MUNICIPAL WATER SUPPLY AGENCIES

D. Hazelton & H. Buckle

Guideline
6 of 9

Building Awareness and Overcoming Obstacles to Water Demand Management

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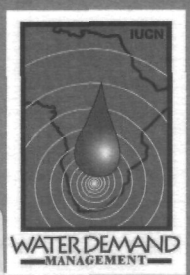

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3. **Bulk Suppliers of Potable Water**
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Preface

The IUCN-RoSA (World Conservation Union-Region of Southern Africa office) managed a Water Demand Management (WDM) programme between 1997 and 2002 to study WDM practices and applications within the SADC member states. These studies indicated the urgent need for improved water resource and supply management in much of the region and the broad potential of WDM to be an important tool in achieving this aim.

Currently, IUCN-RoSA is committed to sharing the knowledge gathered in the studies to promote the adoption of sound WDM practices as a method of accelerating effective water resource and supply management throughout the region. These guidelines on Building Awareness of and Overcoming Obstacles to Water Demand Management are a part of IUCN-RoSA's WDM-sharing initiative. They have been written by a multi-disciplinary team assembled from several countries in the SADC region.

The guidelines comprise 9 separate booklets, aimed at all the people who can influence WDM outcomes or who should be responsible for actively promoting or implementing WDM, within different water management, supply, and user sectors. Since every water user and water resource or supply stakeholder can improve the quality of life for him/herself or others, by ensuring WDM plays an important role in his/her planning and actions related to water management and usage, one or more of these booklets has been written with you in mind. The titles are listed on the inside of the back cover. Check the titles, see which apply to your situation, and obtain copies. They will help you to do your job better.

In these guidelines, WDM includes all actions that improve the efficiency and equity of water use. Efficient water usage includes using water in a manner that minimises pollution. Thus, WDM is not about getting poor people with insufficient water to use less, but about all users using water wisely so that everyone has sufficient. In this context, WDM is seen as an integral part of Water Resource Management (WRM) and Water Supply Management (WSM).

When implemented effectively, WDM will:

- Reduce water supply costs per unit volume, whilst assisting to create more financially sound water supply institutions, through:
  - Postponing the development of new sources;
  - Reducing water wastage; and
  - Equitably reducing unpaid water bills.
- Ensure the delivery of sufficient water to meet the reasonable demands of all users, for domestic and productive water, at a reasonable cost in both water abundant and scarce areas, while assuring ecological sustainability, or, in the few situations where this is not practical, maximising equity and minimising deprivation;
- Improve the assurance of supply through ensuring that the demand does not exceed the yield of the source;
- Prepare users and supply institutions to manage with less water as scarcity arises, through population increase, general development or climate change; and
- Prevent ongoing serious water pollution.

By definition, WDM, on balance, always produces positive outcomes. However, effective implementation requires:

- A good knowledge of current demands and usages;
- Planning and resources to introduce behavioural change within well-managed time frames; and
- Communication with other stakeholders upstream and downstream of your place in the water supply/usage chain.

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Abbreviations and acronyms

CRC	Cost rebate/surcharge charge
GIS	Geographic information system
IWRM	Integrated water resource management
JMP	Joint monitoring programme
LA	Local authority
M&E	Monitoring and evaluation
MWSA	Municipal water supply agency
MIS	Management information system
PRV	Pressure reducing valve
RBT	Rising block tariff
RW	Rand Water, South Africa
WCM	Water cycle management
WDM	Water demand management
WSP	Water services provider
UAW	Unaccounted-for water

Introduction

1.1 Target readership

This Guideline primarily targets municipal water supply agencies (MWSA's) in southern Africa. A secondary target readership group are the users of water supplied by these agencies. The agencies and role players involved with municipal water supply may include:

a) Suppliers of bulk raw and treated water

This readership requires an understanding of the WDM issues affecting municipalities, and of the ways in which they can use the available policies, legislation, regulatory frameworks, and directives to assist them with the implementation of WDM.

Suppliers of bulk treated water need to be encouraged to move from a perspective of supply management and augmentation towards one of demand management. The result of this shift in perspective will be that WDM is perceived not as an abstract theory but as an important valid alternative to implementing new water supply schemes, and as a means of helping to ensure affordable water supplies both currently and in the long term.

WDM includes the management of all classes of water sources, including surface water, groundwater, and recycled water. In Windhoek, the municipality uses a mathematical model of the local aquifer to manage abstraction whilst the government, through the Department of Water Affairs (DWA), has a database of the dams and boreholes throughout the country. This bulk supplier regulates the water usage from the dams and abstraction from the boreholes, especially from the artesian area in the southeast of the country. This teamwork between the Windhoek's bulk water supplier and the Windhoek MWSA in implementing WDM contributes to the exemplary integrated water resource management (IWRM) that is practised to the benefit of all in Namibia.

b) Municipal councillors

Councillors are a municipality's leaders and decision makers. Although they frequently accept guidance from their municipal officials, councillors decide how and where money is spent. It is therefore imperative that they understand and appreciate the value of WDM, and are aware of the best means of applying it to the advantage of their consumers and constituents. It is also important that they recognise that when WDM is implemented, water that would otherwise be lost becomes available for other uses.

c) MWSA managers

MWSA managers, as leaders of official structures, are in a position to drive the implementation of WDM. In order to champion WDM both within the MWSA and at higher institutional levels, they should know how it can be implemented, and be aware of the pitfalls of not implementing it properly.

d) Operational staff

Staff, at the operational level in MWSA's, require an understanding of the actions necessary for WDM to be implemented. They need to be aware of the potential for service delivery improvements that can result from the implementation of WDM.

e) MWSA's customers

MWSA's have a duty to raise their customers' awareness of the benefits of WDM using regular information campaigns. These campaigns should explain how the price of water can be kept affordable through the implementation of WDM and include information on wise water usage.

1.2 Why should MWSA's implement WDM?

The primary objectives of WDM in this sector are to:

- Make the best use of the water available;
- Improve equity;

Table 1: Incentives for the implementation of WDM

Social incentives	• If system losses are reduced, more water may be available for use. • Better service can be delivered due to reduced water losses. • MWSA's are seen as providing good customer service that can lead to a rise in levels of payment for services; • WDM awareness is raised amongst consumers; and • MWSA's contribute towards maintaining affordable water tariffs.
Financial incentives	• More efficient water consumption contributes to reducing government expenditure on capital-intensive schemes such as dam construction. • WDM can initially result in reduced water sales, but if effectively managed it will simultaneously lead to lower bulk water costs and a higher income from larger customers through improved affordability, and better service delivery. • WDM leads to a reduction in unpaid-for water losses and unaccounted-for water (UAW) through leak detection and repairs to the water supply network, and on private premises. • Financial ring-fencing of water supply and sanitation services retains revenue within the control of these departments. This revenue is then available for improving maintenance programmes and service delivery, and even for expanding services. • Short-term WDM measures enable MWSA's to overcome drought periods without resorting to expensive augmentation projects, or the application of inequitable restrictions or punitive tariff structures. • Implementing WDM measures, such as reduced distribution system losses through improved maintenance, leads to more effective operation and efficiency in the delivery of water services, and strengthens a MWSA's finances. • Consumers benefit directly by changing their behaviour through receiving lower water bills.
Environmental	• Efficient water use through WDM safeguards water resources for current economic growth and for future generations. • WDM promotes sustainable use of water resources by introducing water-efficient practices. • Implementing WDM is seen as effective and efficient and can be marketed as being 'green'. • Pollution levels in water resources drop when MWSA's apply tariffs that reflect the true cost of treating the effluent from individual industrial water users. • Artificial recharge of underground aquifers with water from surface sources leads to a saving in evaporation losses.

- Keep water affordable; and
- Provide a better service to consumers.

These objectives can be achieved through the use of a range of incentives (See Table 1).

1.3 Guideline purpose

This Guideline is intended to assist MWSA's to understand the financial, efficiency, and equity benefits of broadly based WDM and its potential for helping to ensure long-term water security.

The Guideline:

- Raises awareness and provides a knowledge base that can be used by bulk potable water suppliers and MWSA's to motivate the implementation of WDM by their own institutions and all other water users;
- Identifies opportunities of where WDM can be implemented to improve water usage and equity; and
- Identifies appropriate and feasible WDM options for MWSA's.

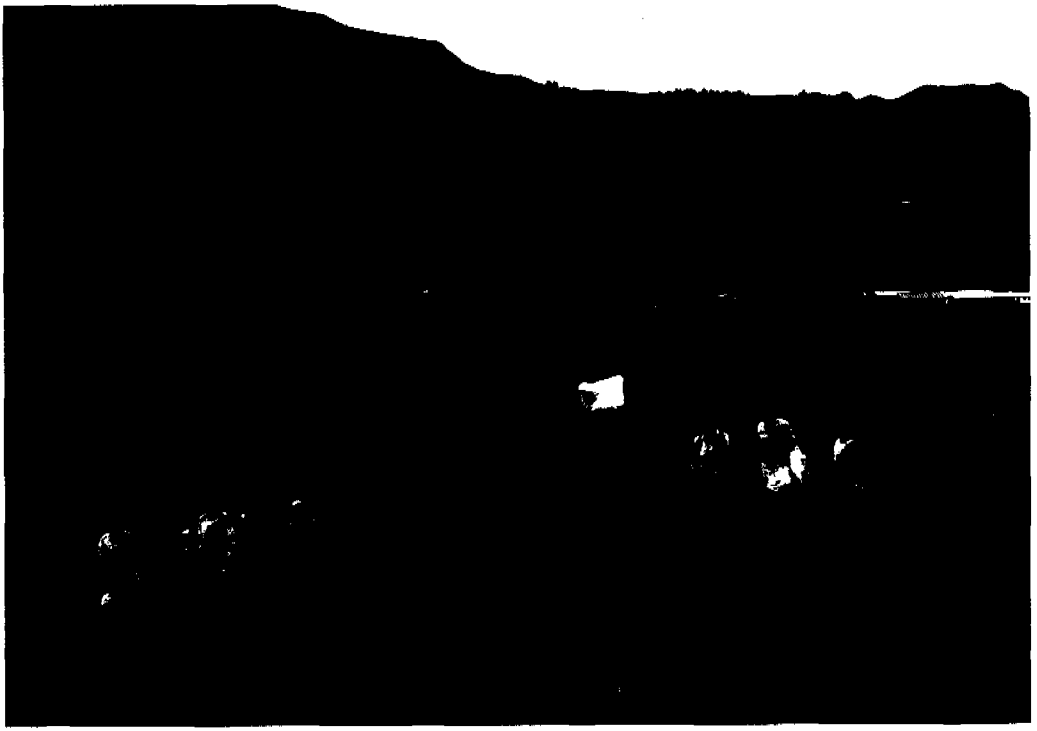
1.4 Guideline content and limitation

This Guideline describes:

- Why and how WDM should be implemented;
- How UAW can be detected and reduced;
- How tariffs can be set so as to support the achievement of certain efficient and equitable WDM goals;
- How municipal water regulations can support WDM; and
- How town planning can support WDM.

Examples are provided of WDM programmes for MWSA's, together with a stepwise WDM implementation procedure.

It must be emphasised that this Guideline is not a detailed WDM implementation manual. It is rather *a guide* to assist MWSA's in building awareness and in overcoming the obstacles to the implementation of WDM in southern Africa. The information contained in this Guideline needs to be adapted to specific situations.



Box 1: How WDM is not even considered after a water delivery crisis

In 1998, huge areas of Zimbabwe's capital Harare ran out of water in the middle of a heat wave. The City Council merely commented that its pumping capacity was no longer capable of providing enough water for the City. By October 14 several schools in the capital had been forced to close because of water shortages. (Worldwater and Environmental Engineering 1998)

Despite these dramatic events, the city made no attempt to create awareness of the advantages of WDM and how it could be used to prevent future supply failures cost effectively.

1.5 Limitations to independent implementation

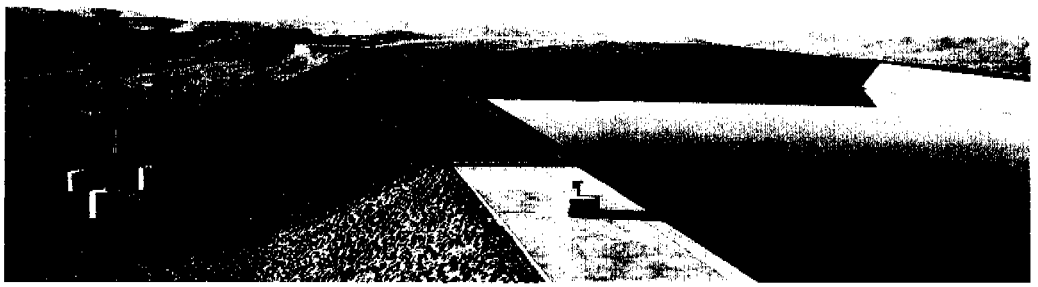
MWSA's can implement many WDM measures on their own. However, there are other measures where MWSA's are constrained due to corrective action being partially or wholly outside an MWSA's control.

Box 2 details the constraints to WDM implementation by MWSA's.

To overcome the constraints in the implementation of WDM that lie outside their control, MWSA's need to integrate their strategies with those of bulk water suppliers, the Government, and other role players in the sector.

Box 2: Constraints in WDM implementation, and ownership of corrective action or implementation decisions

Constraint	Owner of decision
Threat of additional augmentation and associated costs	Others
Low levels of payment – no enforcement	MWSA
Rising debt of municipalities	MWSA
Declining municipal capacity	MWSA
Lack of integration in planning and between role players	Whole sector
Little or no information on unaccounted-for water (UAW)	MWSA
Lack of public awareness and education	MWSA
Political interference in the running of affairs by officials	MWSA and others
No proper decision making or lack thereof	MWSA
Demarcation of boundaries of municipalities	Others
No information on consumption and trends of consumption	MWSA
Maintenance budget cuts	MWSA
No WDM strategy	Whole sector
Reduced revenue due to lower water sales	MWSA
Outdated water supply network plans	MWSA
No WDM champion	MWSA
Not enough understanding of WDM and related issues	MWSA
Very little information available on the social and economic status of the residents	MWSA
Financial accounting systems that make it impossible to determine the LA's water income and expenditure	MWSA
Substandard maintenance on water reticulation of Government institutions	Others



2.1 Introduction

Historically MWSA's have been associated with the retail distribution of water of drinking quality for domestic and industrial purposes in the towns and cities of the SADC region. In smaller towns, MWSA's have also been responsible for bulk supplies and the treatment of raw water. This guideline focuses on retail distribution. Members of MWSA's that have bulk water responsibilities should refer to the relevant guideline or guidelines in this series, the titles of which are given on the inside back cover of this guideline.

In the SADC region, in colonial and apartheid times, the quality of service delivered to industry and to rich households and commercial areas by these MWSA's was high, although little attention was given to ensuring affordable prices, to managing water demand or, in the majority of cases, to extending a water supply service, above the most basic level, to poor households.

These agencies operated as a separate department within broader municipal structures, but shared many functions such as financial management, meter reading, billing, transport and human resources administration and development with other departments in the same municipalities. The sharing of resources had both positive and negative outcomes. The more common negative outcomes include income and expenditure not being allocated accurately or transparently, and, except for applying WDM to customers in times of drought, very little or no efforts being made to manage water demand. However, provided the possible shortcomings are recognised and consciously overcome, well-thought-out sharing can be beneficial, especially for smaller municipalities, and changes should not be made for the sake of change, despite the popularity and advantages for large urban municipalities of registering separate municipality-owned corporate MWSA's. All MWSA's need to be regulated by an external body, but the more independence an MWSA has with respect to day-to-day management, the more important regulation becomes in ensuring that the MWSA is implementing national and municipal policies and regulations.

Regrettably, even where completely self-contained water services entities have been set up, there is often little or no cooperation or communication between the utility's water management engineers and the utilities' metering reading and credit control departments. On the other hand, municipal customers appreciate it when municipal services bills are consolidated after informative details are presented, and they only have a single billing/credit control department to interact with.

Today, in towns and cities, water utilities are being given added responsibilities with respect to their central position in the hydrological cycle. Having delivered water of suitable quality to clients, they are increasingly responsible for collecting domestic and industrial wastewater and often for its treatment and for pollution control.

But, overall, the greatest challenge facing MWSA's is extending affordable quality services to all, whilst maintaining a sound financial status. Especially when it is remembered that the WHO-UNICEF Joint Monitoring Programme (JMP) rightly includes adequate *usage of*, as well as *access to*, services and facilities by each household in its definition for achieving the water and sanitation goals, it will be realised that managing WDM at both the utility and the customer unit level will play an important role in the effective management of MSWAs.

In the meantime, in more and more rural areas, responsibility for domestic water supplies and sanitation is being decentralised from regional government departments, or the

regional branches of national government departments, to local government MWSA's. This policy has improved the coverage and quality of service delivery to many communities, but by no means all. Rather, benefits are only clearly evident in areas where there are proper higher-level regulatory institutions that audit and support the municipal MWSA's, and where the MWSA's themselves still enthusiastically support community management structures, rather than setting out to build their own local top down service delivery 'empires' at the expense of community empowerment, and a demand responsive approach to delivery. An integral part of this whole approach is for all parties, from overseas donors through national governments to local regulators, to ensure that an equal and sufficient emphasis and priority, and corresponding human and financial resources, are devoted to both extending coverage and operating and maintaining existing schemes.

The management of water supplies for irrigation, livestock watering and other rural uses is also being decentralised right down to the community level, but is being kept completely separate from the management of domestic/industrial supplies by MWSA's. In keeping with this separation of management functions, the management organisations are popularly known as water user associations (WUA), rather than community-based organisations (CBOs).

Regardless of the exact situation in any particular region, this separation of domestic/industrial water supplies from agricultural water supplies should be gradually overcome and the management of all water supplies should integrated into the scope of MWSAs' responsibilities, with the pre-condition that national policy adopt and local MWSA's implement a strong community empowerment strategy.

Community management of stand-alone water supply schemes is already being widely and successfully practised in the rural areas of the SADC region. It can be gainfully extended to the distribution portion of larger rural schemes by dividing such schemes into a number of smaller schemes. But the distribution portions of urban schemes offer the greatest unexploited potential for community management.

2.2 Water usage and approaches to demand management in municipalities

After water for irrigation, municipalities are the largest consumers of water in the SADC region. Municipal water supply systems are generally more complex than irrigation schemes and, as a result, they also have a high potential for beneficially implementing WDM. Such implementation should start with the effective management of the distribution system itself to reduce leakage losses, other unaccounted-for water and customer wastage encouraged by *poor credit control.*

Leakage losses on poorly managed schemes often include losses on customers' properties through leaking taps and faulty toilet cisterns. Therefore, as strict credit control is being introduced, MWSA's need to make customers aware of such losses and how they can be repaired. Before implementing strict credit control, more and more MWSA's are carrying out a once-off survey of private properties in poor areas and fixing any leaks they find free of charge. This action is to be recommended, but, at the same time, the sustainability of results needs to be questioned if the MSWAs do not make best use of the fixing of leaks for educational purposes.

Apart from the once-off survey and fixing of leaks on private property, there needs to be ongoing monitoring of household meters to

detect increasing consumption that may be caused by on-property leakage and a periodic monitoring of minimum night-flows in isolatable zones to pick up increasing general leakage losses. This monitoring needs to be followed up by appropriate awareness creation and appropriate corrective action.

If the construction of the infrastructure has been properly planned, credit control will not deprive poor customers of their right to an adequate quantity of water to cover all their basic needs. Rather tariffs will have been designed to ensure that rich customers cross-subsidise poor customers, without the rich customers using high volumes of water. Where few rich customers are being supplied from the scheme, external subsidies will have been agreed to and made available from national taxes or overseas donor grants.

Allowing other demands to increase unchecked merely because customers are paying for water is bad business in most municipal areas because local water sources get used up, and more expensive sources have to be developed to satisfy demands, some of which have been caused by customers being poorly informed. Conventional businesses would not develop such resources because they understand the poor return they are likely to obtain on the capital employed. For MWSA's, this is not a valid reason on its own for the non-expansion of services, but they do need to understand fully the long-term results of looking at supply-side solutions to apparent water demands without considering demand management alternatives. Customers with high water demands also need to be kept fully informed about future water costs and alternative demand management options, so that they can help influence MWSA and bulk water suppliers' investment decisions in an informed manner.

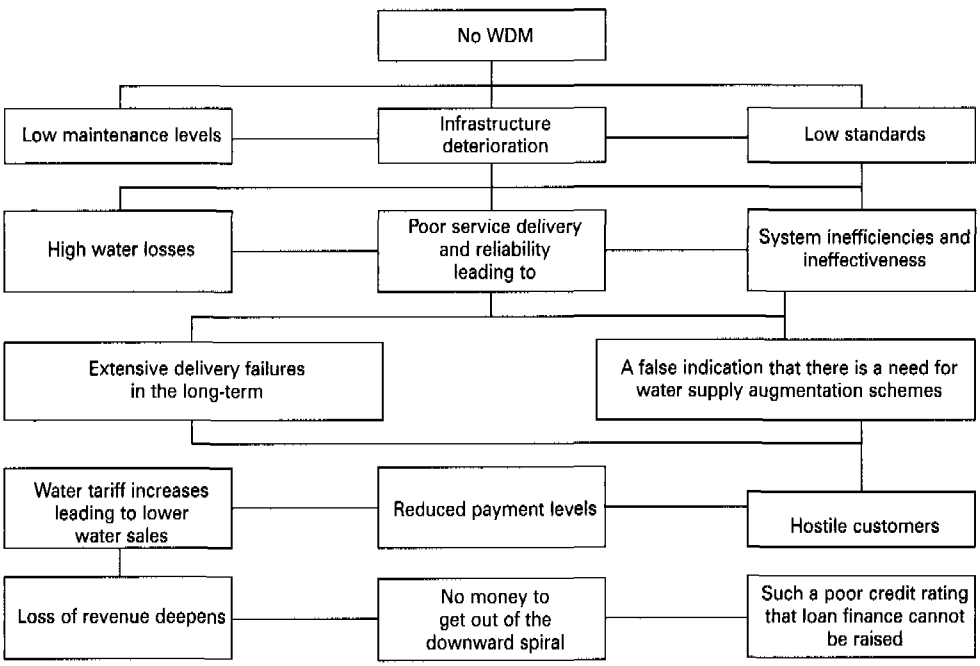
For existing customers, greater emphasis should be placed on such options, as the demand for water approaches the capacity of the current supply schemes. For domestic customers, commercial customers such as office blocks, hotels and shopping malls, and institutional customers such as schools,

retrofitting water-saving devices, and water-wise gardening, need to be encouraged, while wasteful water usage practices like hosing down paved areas with a hose and cleaning cars in a similar manner need to be discouraged, if not made illegal.

For industrial customers, and some institutional customers such as hospitals, a wider range of WDM choices exist and the Guideline in this series for *users of industrial and process water* should be consulted for more information.

Most industries in municipal areas have their effluents treated by the MWSA in their area of operation. It is important that MWSA's charge industries the full costs of treating such effluents, because these charges are an important incentive to industry to use water efficiently, to keep effluent charges low. For any industry responsible for treating its own effluent, it is equally important that the quality of the final effluent leaving site complies with all pollution control laws and regulations and that the responsible government agency audits the compliance. Retrofitting water-saving devices is often costly, especially when industrial consumers are being considered. It is therefore good practice for municipal by-laws to insist that high-quality efficient water-saving devices and practices be used for all new developments. In some instances where existing developed areas are being redeveloped using higher densities MWSA's may need to consider special arrangements, including high-quality dry or other on-site sanitation options, to obviate the need to replace the existing water and sanitation infrastructure to increase its capacity.

Figure 1: Flow diagram of the downward spiral in sustainability service delivery



Another sound practice when planning new wastewater treatment plants is to check the possibility of keeping the domestic industrial wastewaters separate. In this way the MWSA can prepare for the time when it is cost effective to reclaim domestic wastewater and treat it to potable water standard for recycling through the MWSA's standard potable water distribution system. Treating industrial wastewaters to potable standard is generally not economic. Hence there is a need to separate the wastewater collection and treatment systems, if any wastewater is to be recycled in the potable system, rather than through a separate system for watering sports fields, for example. By 1999 nearly 20% of Windhoek's potable water supply was reclaimed domestic wastewater. Apart from the environmental advantages of not exploiting a new resource, it is claimed that the cost of the recycled water is less than 10% of augmenting the supply from the cheapest new source 700km to the north of the city.

2.3 The results of ignoring WDM in municipal water supply

Within the framework indicated in box 2, MWSA's are responsible for implementing WDM measures that affect the supply of water to domestic consumers, industry, government institutions and commerce. Ignoring this responsibility will inevitably lead to a downward spiral of unsustainable delivery, as illustrated in Box 3 and Figure 1.

Box 3: Results of non-implementation of WDM in a municipal environment

No WDM leads to:

- Low maintenance levels
- Low standards
- Infrastructure deterioration
- High water losses
- System inefficiencies and ineffectiveness
- Poor service delivery and reliability to extensive delivery failures in the long term
- A false indication that there is a need for water supply augmentation schemes
- Hostile customers
- Reduced payment levels
- Water tariff increases leading to lower water sales
- The loss of revenue deepens
- No money to get out of the downward spiral
- Such a poor credit rating that loan finance cannot be raised

Figure 1 indicates that the management of water services becomes very difficult if WDM is not implemented over a long period.

A radical change in management style and interim additional external funding is normally required to break the downward spiral if it is allowed to continue to the bottom right hand corner of figure 1 (DfID 2000).

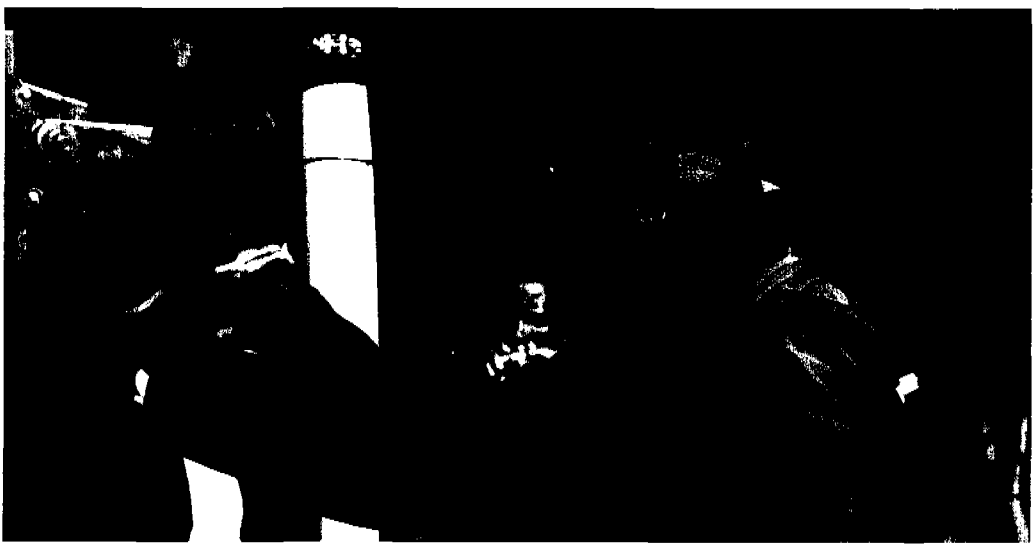
Provided a clear business plan including costs, a programme indicating key tasks and dates, and future cost recovery methodologies is developed to show how the institutional capacity and management style of the MWSA are to be transformed, and what infrastructure is to be refurbished, overseas donors are often willing to provide interim grant funding to cover the cost of implementing such a turn-around project in areas serving poor households.

National governments in the middle-income SADC countries are often also willing to provide similar financial assistance.

2.4 Benefits of adopting WDM in municipal water supply

On the other hand through adopting WDM the following benefits accrue:

- Environmental
  - Through less groundwater and surface water being abstracted from a country's water resources; and
  - Through sound pollution control being implemented; both of which promote greater biodiversity and productivity in ecosystems.
- Economic
  - Through bulk water costing less both because of lower water bulk tariffs achieved through lower infrastructure development costs and because of less non-revenue producing water being purchased;
  - Through reduced water distribution costs achieved through less costly infrastructure, and lower water pumping costs;
  - Through reduced wastewater treatment costs achieved through lower volumes of less diluted effluent water being collected from customers; and finally
  - Through improved revenue collection achieved because of improved *affordability* because of lower costs and improved willingness to pay achieved through better quality services.
- Quality of service
  - Through customers receiving water at a more constant pressure achieved through the demand of 'up stream' customers being controlled so as not to deprive 'downstream' customers of water during peak demand periods and through improved pressure control; and
  - Through fewer supply failures caused by pipe bursts.
- Improved equity
  - All the previous benefits make the expansion of water services to the unserved and inadequately served possible.



3.1 WDM enabling strategies

It is essential for national governments to lead the initiatives so that WDM becomes a core objective for all water and wastewater sector stakeholders: regulators, service suppliers and water users. As discussed in the companion *Guideline for policy makers, legislators and regulators,* successful WDM begins with water ministries and departments developing WDM policies, legislation and implementation strategies in a participatory manner. Thereafter the regional offices of the national departments of water affairs or their catchment management agents should monitor and evaluate WDM implementation and intervene in a supportive or regulatory manner as appropriate.

MWSA's should be familiar with all national WDM initiatives and the contents of the IUCN companion *Guideline for policy makers*. Thereafter, there should be frequent formal and informal interactions between all MWSA's and the regional agents of national water departments to ensure the progressive ongoing successful implementation of WDM.

Finally, it is recommended that all national policies include a compulsory regulation that new water resources are not to be developed whilst WDM is the preferred option in terms of integrated financial, environmental and long-term planning considerations.

3.2 Basic WDM techniques

After ensuring that all poor households have access to, and use, adequate amounts of water to cover health and hygiene requirements, the most basic responsibility of MWSA's is to monitor and manage all non-revenue-producing water by managing:

- *Distribution system leakage losses;*
- UAW including water used by the MWSA itself and other government institutions seen to be associated with it; and
- Credit control.

It is very easy to observe which MWSA's are taking these basic WDM options seriously by observing how they report on income and expenditure. Table 2 illustrates the different approaches. The two sets of figures are for the

Table 2: Typical SADC region MWSA recurrent income expenditure statements

Standard income expenditure statement	Currency units x 000	WDM transparent income and expenditure statement	Currency units x 000
Gross profit		**Potential gross profit**	
Total revenue	384 680	Total billed revenue	499 200
Cost of bulk water	283 930	Cost of accounted for bulk water	211 890
Gross profit	**100 750**	**Potential gross profit**	**287 310**
(Note: These operating costs include unscheduled repairs and disconnection/ reconnection costs. This variation in approach also accounts for the difference in the quoted gross profit figures)		Non-value added costs	
		Cost of unaccounted-for water	72 040
		Billed less actual revenue	114 520
		Unscheduled repairs	6 230
		Disconnection/reconnection costs	890
		Gross profit	**93 630**
Typical operating costs		**Typical value added costs**	
Sum operating costs	123 680	Sum value added costs	116 560
Trading surplus/deficit	**-22 930**	**Trading surplus/deficit**	**-22 930**

same MWSA: it is just the details given that are different. The first set is clouded in mystery: the second set, based on non-value added and value added cost centres, is WDM transparent. The figures reflect the situation in an area where bulk raw water is expensive but the percentage UAW and non-payment levels are typical of the SADC region as a whole.

MWSA's should set up a transparent income and expenditure statement for their utility and then examine how their financial situation would improve if UAW and non-payment of bills by customers were reduced to acceptable levels. Remember that if the high non-payment levels are in poor areas the result of stricter credit control will be lower water sales.

For many MWSA's the implementation of basic WDM will move the utility from an unsustainable future to a sustainable financially strong one, in which adequate expenditure is budgeted each year on preventative maintenance. If this is not the case, check if any controllable non-value added costs are high and plan to reduce them. Otherwise, in addition to basic WDM implementation, tariffs will need to be reviewed to create a sustainable MWSA.

3.3 Promoting WDM among customers

MWSA's also have a responsibility to promote WDM among all its customers by encouraging them:

- To use water wisely; and
- To detect and repair all leaks on their property.

In poor areas, ensuring that customers detect and repair all leaks on their property is an ongoing component of credit control, since if such leaks are not repaired these customers will be unable to pay their bills. Otherwise, the responsibility of promoting WDM among other customers is always important, but only becomes a top priority as the demand for water approaches the capacity of the current bulk supply or distribution infrastructure, or as the

flow of effluent approaches the capacity of existing wastewater infrastructure.

3.4 Second-tier WDM options

As potable bulk water costs increase, water recycling or reuse becomes a viable option. Apart from industrial customers recycling water within their own plants, there are three *different classes of water recycling that can be* implemented by MWSA's:

- Supplying industry with reclaimed effluents as make-up water in place of potable water where an industry can use such water safely and cost effectively;
- Using reclaimed effluents for other non-potable services such as watering ornamental parks and gardens, and playing fields; and
- Reclaiming and treating effluent to potable water standards, and blending it with standard potable water supplies.

With respect to the last option, it is generally only safe to reclaim domestic wastewater for treating to potable water standards. Therefore such an option has to be planned years in advance by separating the collection and treatment of domestic and industrial wastewaters.

WDM options for MWSA's

4.1 Introduction

As indicated in section 3 there are a number of options for implementing WDM available to MWSA's. This section will examine these in more detail using the same main groups and sub-groups as before:

- National and local policy and legislation
  - Regulations
  - Penalties
  - Incentives
- Basic WDM techniques
  - Reducing system leakage losses
  - Managing UAW
  - Implementing credit control
- Promoting WDM amongst customers
  - Starting with government institutions
  - Repairing leaks on customers' property
  - Using water wisely
- Second-tier WDM options
  - Maximising the conjunctive use of surface and ground water
  - Supplying industry with reclaimed effluent
  - Using reclaimed effluent for other non-potable services
  - Reclaiming and treating effluent to potable water standards

4.2 National and local policy and legislation

SADC MWSA's should understand, and implement, all the sound policy and legislation related to WDM promulgated at national level in their respective countries.

The following sub-sections examine how MWSA's can make good use of such policy and legislation. National policy and legislation can be, and often is, augmented by local by-laws where advantageous.

4.2.1 Regulations

4.2.1.1 Planning, monitoring and evaluation

An MWSA cannot implement WDM without measuring its performance. A central part of the regulations in many SADC countries requires MWSA's to report on their performance regularly. If these reports are not produced, or indicate poor performance, some countries have legislation that allows higher levels of government to intervene temporarily to bring the defaulting MWSA's back on track with respect to effective service delivery and financial sustainability.

Good regulations will require MWSA's to develop a plan with respect to how they are going to improve service delivery, and the financial state of their agency over the next 3 to 5 years, so that they have ongoing targets against which to monitor and evaluate their performance. A small team, ideally full-time employees of the MWSA, should be responsible for facilitating the drawing up of the services plan and drafting the final outcome. The thinking, and negotiation between stakeholders in drawing up the plan, is as important as the final outcome. Descriptive passages should describe, for example, how the MWSA plans to improve its own management arrangements, equity with respect to serving poor households, and WDM.

The multi-year tables, starting with the last year for which records are available, should include forecasts and plans with respect to:

- Number of people living in the area;
- Future levels of service, incorporating the water services MDGs;
- Water usage profiles for the different levels of service;
- MWSA and customer water wastage;
- Non-domestic demands;
- Total MWSA water demand and effluent return flow forecasts;

- The condition of infrastructure;
- Payment levels for different levels of service;
- Tariffs for different levels of services, categories of customers and consumption amounts;
- Cost of accounted-for bulk water;
- Other costs, showing non-value added and value added costs separately as illustrated in table 2;
- Income planning to indicate how much is to be raised from different sources; and
- Overall financial planning with respect to both recurrent and capital spending.

Tables should include key performance indicators (KPIs). To build up expertise in selecting and designing KPIs, MWSA's are advised to consult the Water and Sanitation International Benchmarking Network (IBNET) website <www.ib-net.org/index.asp>. The website is funded by the World Bank and DfID and maintained by a consultancy, called the Water Research Centre (WRCplc), based in the UK.

Experience shows that without customer cooperation, improving efficiency is extremely difficult. Thus, MWSA's need to be customer-orientated at all times, and plan to improve their efficiency through a gradual accelerating iterative process.

Even if national regulations do not require MWSA's to produce a multi-year water services delivery plan, it is always useful for them to do so, since it makes the following tasks easier:

- General communications with stakeholders;
- Planning to overcome the constraints preventing the MWSA from attaining its objectives;
- Setting medium-term targets;
- Motivating higher tiers of government and overseas donors to assist the MWSA in overcoming institutional capacity, human skills and financial resource constraints;
- The production of annual business plans and budgets;
- The monitoring and evaluation of the performance of individual utility managers; and
- Fulfiling reporting requirements in terms of national policy, legislation and regulations.

National regulations usually require MWSA's to report comprehensively to higher tiers of Government on:

- Their progress in attaining the MDGs with respect to water services delivery;
- How they spent funds obtained from external sources;
- WDM; and
- Future water demand forecasts.

MWSA's should also use these regulations to improve communications and information flow within their own organisations and with their customers.

4.2.1.2 Registration of persons designing, managing and installing water services

Countries often try to guarantee the quality of work performed in the water sector by only allowing registered persons to carry out certain work associated with water services. Registration in turn depends on successfully completing recognised education or training courses or an apprenticeship, followed by a minimum amount of supervised practical experience.

Infrastructure and institutional design work is often reserved for registered professional engineers but often such registration is based on very broad criteria. MWSA's employing such staff or contracting out work to consultants need to enquire further about the engineers' understanding and attitude towards designing, installing and maintaining infrastructure for all the components of sustainability: social,

institutional, hardware, financial, and resource. In relation to this Guideline, it is important to note that each of these sustainability components requires WDM to be taken into account.

Unfortunately, as well as reserving certain work for professional engineers, national policies often regulate the fees paid to these engineers on the basis of allowing them to claim a percentage of the cost of installed infrastructure. This encourages consultants to remain biased in their work towards solving perceived water shortage problems by exploiting more resources in a capital intensive way, rather than by managing existing infrastructure and promoting solutions that minimise the present net value of total project cycle costs. Ideally national policies need to be reformed, but in the meantime MWSA's can often pay consultants for their work on moderate hourly rates combined with a bonus based on the future:

- Reduced non-value added costs (refer table 2); and/or
- Reduced volumes of accounted for non-recycled bulk water; and/or
- Improved income from customers with high value properties and/or high volume water usage.

The registration of persons involved in the ongoing operation and maintenance of existing water and wastewater treatment, water delivery and wastewater collection infrastructure is often more focused than the registration of persons involved in design work, and MWSA's can make direct use of such requirements to improve their operational efficiency.

Plumbers are a third class of persons in the water sector requiring registration. Their registration is very important because they do

work on private property for households, who cannot issue comprehensive specifications for the work to be done or supervise its implementation. MWSA's should facilitate the rigorous registration of plumbers in their area of supply. If such registration is not compulsory, plans for all new and upgraded water installations need to be submitted to and passed by the MWSA before any work is carried out and thereafter the completed work needs to be passed by an inspector.

In addition to managing water and wastewater in its area of jurisdiction, each MWSA, through by-laws, needs to have full control over:

- Persons effecting a connection or disconnection to any of their water supply or wastewater collection systems; and
- Persons accessing water from any source other than the MWSA's system of supply and discharging wastewater within their area of supply.

4.2.1.3 Standards and norms

National policy may also include compulsory standards and norms to:

- Improve the quality of service to customers; and
- Ensure efficient water delivery by MWSA's and usage by their customers.

4.2.1.3.1 Improving the quality of service to customers

It is essential that all countries give adequate consideration to quality of service. In addition, all the SADC countries committed themselves, in terms of the water supply MDG adopted in the year 2000, to halving the number of persons without access to adequate domestic water in 1990 by 2015. Apart from stating that the water quality shall comply with WHO standards, the WHO/UNICEF JMP has defined an adequate supply, in terms of the MDG, as *"the availability of at least 20 litres per person per day from a source within one kilometre of the user's dwelling"*. However another WHO publication (Howard and Bartam, 2003) clearly indicates that such a level of access is insufficient to overcome *high levels of health concern*. This WHO paper, combined with Inocencio et al 1999, indicates that to *sustain good health* people require a basic knowledge of how to use water effectively for healthcare, and to have access to and use at least 34 or 54 litres of safe water per person per day, depending on whether they have access to dry or waterborne sanitation facilities. Such access and usage depends on having a reliable affordable source within a return trip collection time of not more than about four minutes. Both figures assume minimal water wastage, and the 55 litres per person per day assumes efficient toilet flushing technology and no water recycling between services. It also needs to be noted that the figures do not allow for any additional water:

- For caring for sick members of a household, or
- For productive use.

Howard and Bartram 2003 also report that having access to some productive water may be critical to poor households avoiding extreme poverty, and can, therefore, have a considerable influence on human health.

Thus the real equity challenge to MWSA's and international donors in the SADC region is even greater than defined by the MDG JMP. Besides MWSA's having schemes with mixed service levels, many SADC countries have tried to improve equity to some extent by including factors beyond the JMP minimum in their national policies. Such policies include:

- Zimbabwe: maximum number of persons per water point, 50;
- Madagascar: maximum time for return trip to collect water, 15 minutes;
- South Africa: maximum distance to source,

200m; minimum flow rate, 10litres per minute; maximum cumulative outage time, 7 days per year; and free access for poor households, 6kℓ per month.

Such improvements to national policies need to be introduced and implemented sustainably as a matter of urgency.

4.2.1.3.2 Ensuring efficient water delivery by MWSA's

MWSA's need to manage water supplies effectively to ensure efficient delivery without unnecessary UAW. Governments can help ensure that this is done by promulgating regulations that define minimum management requirements.

4.2.1.3.3 Ensuring efficient water usage by MWSA's customers

Apart from ensuring that they deliver water efficiently, MWSA's that are in earnest about WDM will also ensure that their customers, whether they be domestic, commercial or industrial, use water wisely, through awareness-raising and public education, backed by suitable by-laws, if no suitable national regulations have been promulgated. Box 4 contains abstracts from the Municipality of Windhoek's water supply regulations pertaining to *the prevention of undue water consumption* (Windhoek 1996).

Box 4: Abstracts from Municipality of Windhoek water supply regulations

Prevention of undue water consumption

26 Waste of water

(1) No owner or occupier of any premises shall permit on such premises:

(a) The purposeless or wasteful discharge of water from any water installation and/or water main;

(b) The use of maladjusted or defective water installations; or

(c) An overflow of water to persist.

(2) An owner or occupier shall after written notice by the Engineer, and within a period specified in the notice, repair or replace any part of the water installation on the premises of the consumer which is in such a state of disrepair that, in the opinion of the Engineer, it is causing or is likely to cause an occurrence mentioned in sub-regulation (1).

(3) If an owner fails to comply with a notice referred to in sub-regulation (2), the Engineer may, without prior notice, take such measures as the Engineer may deem fit and recover the cost incidental thereto from the owner.

(4) A consumer shall ensure that any equipment or plant connected to the water installation on the premises of the consumer uses water in an efficient manner.

(5) The Engineer may by written notice to any consumer prohibit such consumer from using any specific equipment in a water installation if, in the opinion of the Engineer, its use of water is inefficient, and any such equipment shall not be returned to use until its efficiency has been restored and a written application to do so has been approved by the Engineer.

(6) Any person who contravenes any of the provisions of sub-regulation (1) or (4) or fails to comply with a notice

referred to in sub-regulation (2) or (5) shall be guilty of an offense.

27 Use of water as heat exchange medium.

(1) No person shall allow water, used as a heat-exchange medium in any equipment or plant and supplied from a water installation, to run continuously to waste except for maintaining a required level of total dissolved solids in a re-circulating plant.

(2) Any person who contravenes sub-regulation (1) shall be guilty of an offense.

28 Hot water distribution systems

(1) A pipe conveying hot water directly from a fixed water heater, or from the point of draw-off from a hot-water circulating system, to a terminal fitting shall not be capable of containing more than 4 litres of water.

(2) A central hot-water system shall be of the circulating type, and the circulating pipes shall be insulated with material which –

(a) Has a co-efficient of thermal conductivity of not more than 0,04 watt per metre degree Celsius; and

(b) Is capable of maintaining the temperature at its external surface under normal operating conditions at not more than 6 degrees Celsius above the ambient temperature.

(3) The electrical heating element of a fixed water heater having a capacity of more than 500 litres shall be installed in such a manner that it can be removed without loss of water from the heater.

(4) An owner of any premises shall ensure that an overflow pipe or heat expansion pipe from any water heater forming part of the water installation on such premises is installed in such a position and in such a manner that any discharge of water therefrom will be readily visible and will not directly enter into a sewer or storm water system.

4.2.2 Penalties

4.2.2.1 Pollution prevention and control

Serious pollution prevention is an essential component of IWRM, as in a worst-case scenario MWSA's will not be able to deliver water of the required quality to their customers if the quality of water resources is allowed to deteriorate beyond certain limits. In addition, this pollution can occur upstream of the area over which any particular MWSA has authority. It is therefore essential that national legislation exists and is monitored to prevent such occurrences. Monitoring is normally the responsibility of the regional offices of national departments or of CMAs, but much of this work can often be delegated to MWSA's.

All pollution prevention and control should be firmly based on the polluter pays principle. In cases of serious pollution senior personnel should be held responsible and receive jail sentences, as fines merely get passed on to the offending organisation's customers.

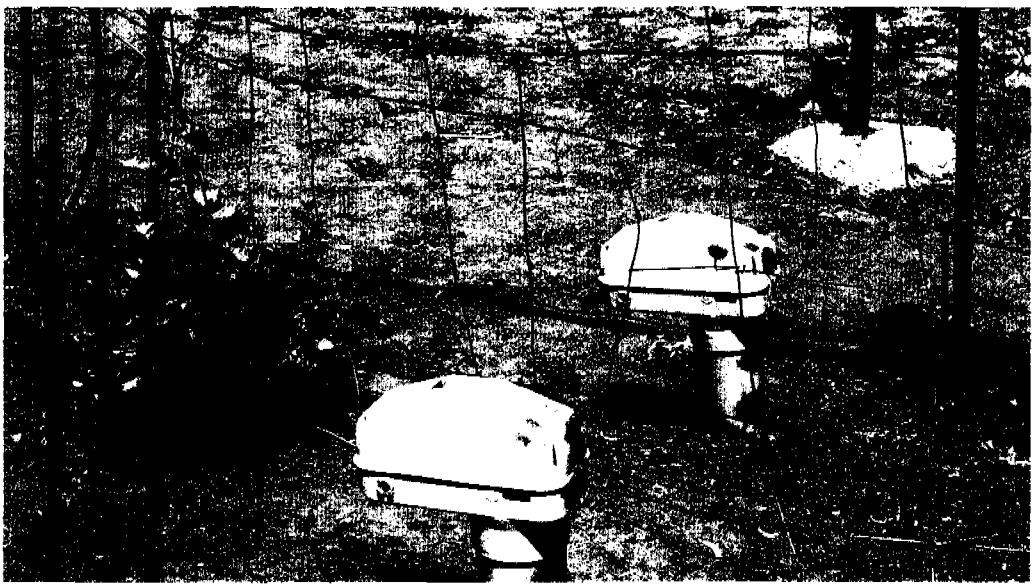
Not all pollution is harmful as ecosystems have a certain self-cleaning capacity, but as industrialisation and population densities increase the risk to the environment increases. Stricter and more formalised control become necessary to encourage organisations involved in activities that may pollute surface water

and/or groundwater resources, or discharging wastewater, to act in the most beneficial manner for society as a whole. One outcome of such an approach is likely to be the gradual introduction of waste discharge charges (DWAF 2003). This is likely to mean that MWSA's will be charged for water leaving wastewater treatment plants that is not re-used in a manner that reduces the water demand. Thus, as well as penalising MWSA's that do not treat their waste waters to a high standard, such charges will also penalise MWSA's and their customers that do not implement extensive WDM practices.

4.2.2.2 WDM in times of drought

Contrary to what is required for long-term planning, during periods when there is sufficient water, MWSA's tend to focus their customer-related WDM efforts on encouraging poor households who have difficulty in paying for water to reduce consumption, while placing little or no pressure on more affluent households, some of whom use water copiously, especially for watering their gardens, to reduce their consumption. In times of drought, however, it is common for suppliers of bulk water to impose substantial penalties for high water usage. MWSA's then implement an awareness campaign, and impose garden watering and other restrictions to reduce the water demand of affluent households. In addition, they pass on the penalties imposed by the bulk suppliers to customers who continue to consume above average amounts of water.

These actions are generally successful in reducing demand sufficiently to prevent bulk water sources from failing. The penalties also bring in additional income to the bulk suppliers. It is recommended that such income be placed in a special fund and given back to MWSA's at a later date to implement pilot projects promoting the benefits of WDM. Rand Water, in Gauteng, South Africa, set up such a fund during the 1992 – 93 drought. Subsequently they funded



numerous pilot projects with the aim of demonstrating examples of best practice, in particular aspects of WDM. A variety of these projects were targeted at leakage reduction in MWSA reticulation systems and at retrofitting old inefficient water endpoint fittings on household and institutional properties with modern efficient ones. The majority of these projects were a resounding success, in the shortterm at least, achieving water delivery reductions averaging 25%. The results, including recommendations for better community and stakeholder involvement to achieve more sustainable outcomes, have been recorded in a booklet (Rand Water, 2002).

When the penalties are withdrawn after the drought is over, it is common for customers to continue to use water more sparingly. MSWAs should use this period to design tariffs that allow them to recover the same costs without depending on customers resuming their previous high levels of water consumption.

4.2.3 Incentives

4.2.3.1 Achieving the MDG water services goals

Every MWSA has close to an absolute responsibility to meet the MDG water services goals. Despite this, the reality is that many MWSA's in the SADC region do not know with acceptable accuracy how many households in their area are without an adequate water supply, and whether or not the number is increasing with time. In addition, they have no plans to meet the MDG goals.

In these circumstances, is it any wonder that overseas donors have been slow in making additional funds available? But, at the 8th plenary session of the UN held from 6 to 8 September 2000, the heads of all the world's governments committed themselves to achieving the MDGs through shared responsibility and solidarity. Their final declaration even places emphasis on *meeting the special needs of Africa* (UN 2000). Thus, MWSA's who have drawn up community driven plans to achieve sound water supply goals, covering the basic domestic and productive water requirements of poor households, and have not already been guaranteed funding, need to ensure that they are partnered with a funding agency without any further delays.

The reluctance of many MWSA's in the past to become dynamically involved in extending services to the poor is not unexpected given the narrow focus of national and overseas funding grant policies, which were typically expressed as follows: ***'The basic policy is that services should be self-financing at a local and regional level. The only exception to this rule is that, where poor communities are not able to afford basic services, the cost of construction of basic minimum domestic services may be subsidised, but not the operating, maintenance or replacement costs'*** (Emphasis in the original. Paraphrased from South Africa's 1994 *Water Supply and Sanitation Policy White Paper*. DWAF, 1994). Many poor communities succeeding in operating and managing stand-alone handpump, reticulated surface water gravity, and engine and motor driven shared standpipe borehole schemes in line with this policy, but long-term maintenance was a problem, as was getting the communities to pay the MWSA for support services. In similar poor areas, schemes making use of outsourced bulk water, that has to be paid for, tended to fail from day one. Where credit control was tight only about 50% of potential users made use of schemes employing fixed monthly charges (Hodgkin el al, 1994). On similar schemes flat-rate volumetric tariffs resulted in minimal water usage, whilst increasing block rate tariffs and/or poor credit control improved usage but not income (DWAF

2000b). Today the need for operational subsidies is receiving cautious consideration, and MWSA's and CBOs need to be involved in developing national policies in this regard.

In donor countries and for privatised utilities in South America (Foster et al 2000) national governments tend to compensate MWSA's in full for any water they supply to customers at subsidised rates. In the SADC region it will probably be necessary, owing to the high demand for limited government and donor funds, to develop a compromise policy, in which MWSA's will only be compensated for the gap between their need for revenue and their ability to raise that revenue from customers (Reschovsky & Schroeder 2001). With such a policy, high volume domestic and, perhaps, industrial water users would cross-subsidise low volume users, while simultaneously helping to achieve the equity objective of WDM, by increasing the water usage of poor customers through a managed process, and motivating high volume users to manage their demand wisely.

Other important criteria that need to be considered in designing and implementing subsidies include:

- Some simply form of targeting;
- A strategy that ensures, with time, an increasing percentage of poor households will receive subsidies covering intermediate levels of service;
- A realistic definition of peoples' basic needs, depending on the circumstances in which they are living; eg: with or without water-borne sanitation; with or without a need for water for productive uses;
- An allocation based on per person usage rather than on per household usage;
- A strategy that ensures payments to MWSA's are based on actual services delivered to poor households, and that the subsidy levels act as a mild incentive for gradually increasing the level of regulated supplies delivered to individual households; and
- A strategy that ensures the payment system acts as an incentive to MWSA's and all their customers to implement sound WDM.

All MWSA's in areas where services need to be extended to the unserved should have a special projects team to evaluate the current situation, to

assist communities to become thoroughly involved in the planning of their new upgraded supplies, to arrange external assistance as needed, to coordinate work in their area of supply and to make sure projects are not delayed due to the late acquiring of external funding. The most effective and efficient services exist in areas where communities have been comprehensively empowered to take as much responsibility themselves as they can assimilate, and the MWSA's continue to provide ongoing monitoring and support, as necessary, after the schemes have been commissioned (Hodgkin et al 1994). The distribution services portion of urban supplies offers the greatest unexploited potential for community management (Brooks 2002).

Even the most basic infrastructure needs to be designed to facilitate long-term monitoring, overall management, WDM, and operation and maintenance. This is currently not being done. For example, many handpump installations are now designed to make maintenance easier, but long-term monitoring, overall management and WDM needs are still generally ignored, in that operating staff cannot check the level of the water in the borehole while the pump is still installed. As implementation continues, the quality of materials and workmanship also needs to be controlled, and full pressure testing included as an integral part of commissioning. Otherwise sustainability and WDM will be compromised for technical reasons.

4.2.3.2 Refurbishing existing infrastructure

Reports have also confirmed that many MWSA's do not provide an effective efficient service to their existing customers. Without a change in the overall management of such MWSA's, they will be unable to extend services to new areas in a sustainable manner. Such MWSA's should examine the reasons for their poor performance and make a firm commitment and plan to transform their organisation, while at the same time striking a balance and planning projects for improved equity. If managed correctly, quality of service improvements and equity improvements will take place concurrently in parallel steps. However, supply-side projects implemented to overcome current failings in WDM implementation should be firmly ruled out and prohibited, in terms of both national legislation and MWSA's own policies.

The DfID publication *Addressing the Water Crisis* (DfID 2000) describes clearly how services deteriorate and become unsustainable. It also reports that although poor management is the root cause of such problems, the downward spiral of poor service delivery can normally only be broken by the injection of external funds which are required for both institutional change management and refurbishing infrastructure. In all but the richest MWSA's this means funding from national or overseas donor sources.

4.2.3.3 Human resource development

Poor financial resources for the operation and maintenance of water supply infrastructure is frequently a major cause of the poor state of services delivery in many MWSA's, which in turn is caused by inadequate cost recovery from rich customers, over capitalisation in some poor areas, and a lack of subsidies to MWSA's, with a high percentage of services being delivered to poor households. But, even with the necessary finances MWSA's will not perform well unless they continuously upgrade the skills of their human resources. National governments and donors need to promulgate incentives to encourage service utilities to do this.

Many universities in the SADC region have excellent short duration post-graduate courses, presented in English, covering many aspects of WDM and IWRM, to which MWSA's should consider sending key staff members. More courses of a more practical nature for field staff are still required.

4.2.3.4 Bulk water tariffs

This Guideline comments widely on the structuring of domestic tariffs to create equity and to support WDM. In urban areas with high water demands, it is time to consider extending some of these ideas to bulk water tariffs based on the services delivered by MWSA's rather than relying on total population figures or on poverty levels. The aims of variable bulk tariffs should be to encourage equity and to curtail extravagant usage particularly by households. WDM related to industry can probably be implemented through wastewater tariffs (refer 4.2.2.1).

4.3 Basic WDM techniques

4.3.1 Reducing system leakage losses

(Refer to SANS Code of Practice 10306:1999 *The Management of Potable Water in Distribution Systems* for additional information on how to reduce system leakage losses and to manage UAW.)

System leakage losses are that portion of UAW that leaks or escapes from a distribution system without performing any planned useful function. These physical losses are distinguished or separated from other aspects of UAW by carrying out minimum night-flow tests. Such tests give an overall estimation of the combined leakage losses from the distribution system and the water delivery attachments on customers' property. These billed losses, which still represent water wastage, can be estimated separately, for high level of service areas, by checking the matching minimum sewage night-flows, preferably at the same time and when it is not raining so that any storm water entering the sewage system does not interfere with the results.

Measuring such losses needs to be carried out in zones comprising a maximum of 2 000 residential stands, or the rough equivalent of mixed or non-residential stands. Areas with high losses should then be prioritised to plan leakage loss reduction interventions. (Refer WRC 2002a and WRC 2002b reports for additional information on what constitutes a high leakage loss.)

The following sub-sections examine some of the techniques used to reduce leakage losses.

4.3.1.1 Pressure management

(Refer to WRC report on *The Potential Savings from Pressure Management in Potable Water Distribution Systems* (WRC 2001) for additional information.)

The pressure in reticulation systems rises at night when the demand for water from the system is low. This causes increased leakage rates on the reticulation pipework, on pump and valve seals and at customers' premises.

The latter leakage is usually worst in poor areas where households can least afford to pay for this wasted water. High pressures also cause additional pipe failures, which increase the leakage even further. High pressures in reticulation systems also affect consumers' endpoint fittings, shortening the lifetime of fittings such as taps, toilet inlet valves and the heat expansion valves of hot water cylinders.

This results in increased costs to customers, due to the failure of these fittings over a shorter time than would normally be expected, and may even lead to damage to property caused by sudden failures and the resultant high loss from fittings.

Pressure management is a method of keeping the pressure throughout a reticulation system closer to the lower ideal required pressure at all times regardless of the demand for water. Frequently, apart from the wasted water saved, pressure management is often very attractive from a narrow financial viewpoint, with the money invested being recovered in less than a year while from a broader

Box 5: Khayelitsha Pressure Management Project – Cape Town Metro

Project objective: To improve the level of service to the Khayelitsha community by reducing excessive water pressure to lower internal plumbing leakage.

Area description: Khayelitsha has 70 000 stands with night water pressures from 600 to 800kPa. The area was characterised by very high internal water leakage losses on customers' private property, with 80% sewage return flows.

Solution: It was possible to control the pressure to the whole of the township using just two pressure reducing valve (PRV) installations; one on a 1 065mm diameter pipeline and the other on a 450mm diameter pipeline. The residents were fully involved in deciding that the project be implemented.

Results:

- Total investment cost R2,5 million
- Water savings of 9 million kℓ per year from 22 to 13 million kℓ per year
- Money savings of R27 million per year, being reduced bulk water supply costs, resulting in a payback period of 1,1 months.

IWRM viewpoint projects with a payback period of 4 to 6 years may still be worthwhile. Box 5 and table 3 give details of a completed pressure management project in the Cape Town area and of proposed projects in the Johannesburg area.

4.3.1.2 Leakage control

The most rudimentary form of leakage reduction is called passive leakage control. It involves dealing with leaks and burst that are reported to the MWSA by its staff, contractors and members of the public. It is inadequate for controlling leakage to effective levels, but is vitally important from a public relations viewpoint. How can an MWSA expect its customers to repair leaks on their own property promptly, and poor households to pay their bills if they see water running down the street and/or seeping out from meter boxes, etc? Rather encourage staff, meter readers and customers to report leaks and other 'unusual' occurrences that could relate to unauthorised connections or meters being bypassed.

To control leakage effectively requires active leakage control, in addition to the enthusiastic passive leakage control. Active leakage control comprises the series of steps that an MWSA implements aggressively to reduce water losses in a methodical way. The technical steps include:

- **Preparation:** ensuring the reticulation can be divided up into isolatable sections called zones that have bulk meters for measuring all water entering and leaving the zone as well as all water usage.
- **Minimum night-flow measurements:** to prioritise active leakage control activities and to detect increases in leakage rates.
- **Detection and location using techniques such as:** visual inspection, gas injection followed by 'sniffer' detection, step testing, pipe location, sounding, leak noise correlation (LNC) combined with fast fourier transformation, moisture determination ground penetrating radar (GPR).
- **Remedial action:** excavation, and replacement and repair.
- **Calibration:** to solve problems of conflicting detection and remedial action results caused, for example, by leaking

Table 3: Estimated potential of pressure management: *Johannesburg northern supply area*

Zone name	Cost of pressure control installation (Rand)	Reduction in inflow (m^3/year)	Cost savings (Rand/year)	Payback period (months)
Emmarentia West	25 015	49 175	78 680	4
Emmarentia East	31 238	45 389	72 622	5
Victory Park	31 238	10 912	17 459	21
Linden	31 238	126 927	203 083	2
Noordgesig	31 238	47 407	75 851	5
Albertville	31 238	25 960	41 536	9
Montgomery Park	31 238	44 466	71 146	5
Roosevelt Park East	36 653	42 836	68 538	6
Waterval North	31 238	17 346	27 754	14
Risidale	31 238	45 523	72 837	5
Total	**311 572**	**455 941**	**729 506**	**5**

(Source: Adapted from McKenzie 2001)

isolating valves, inaccurate metering, or incorrect basic information with respect to the position and number of isolating valves and meters.

- **System design and overall condition checks**: when remedial action only results in temporary leakage reduction.
- **Further remedial action** comprising general refurbishment and the replacement of poorly selected pipe materials and/or fittings.

When implementing active leakage control do not forget to check reservoirs for leakage and their inlet control valves for leakage or failure of the control mechanism.

Table 4 gives a brief description of two leak repair projects.

4.3.2 Managing UAW

4.3.2.1 Introduction

Apart from leakage losses, water distribution systems are also inflicted with apparent losses that have to be managed to avoid MWSA's suffering serious financial difficulties and additional water wastage. These apparent losses cannot be measured directly. Instead UAW water is measured, which can be loosely defined as the total losses in a system (excluding losses on customers' properties) which comprise leakage losses plus apparent losses. Figure 2 reflects this definition graphically.

This is a loose definition because the apparent losses associated with water usage that is neither metered nor regulated cannot be estimated accurately. Thus to encourage MWSA's to meter, or at least regulate all water usage,

Table 4: Brief details of two leak repair projects conducted in South Africa

Location	Cost	Title	Results	Duration
Johannesburg City Business District (CBD)	R750 000 (U$ 125 000)	To investigate a variety of leak detection methods and select the most suitable for use in the CBD areas	The best approach for undertaking a leak detection exercise is to use a combination of techniques. Some methods like sounding, GPR, step testing, Aqualogs etc are better suited for an initial sweep while methods like LNC and ground microphones can be used to pinpoint specific leaks	not available
Thlabane water loss management project	R1,1 million (U$ 183 000)	To reduce and manage water losses through various WDM interventions,	The total minimum night-flow was reduced by 11,2 m^3/hr through the repair of approximately 11 mains leaks. This represents a yearly saving of 100 000 m^3. The repair of leaks on customers' properties was outside the scope of the project	± 6 years

Figure 2: What happens to the water entering an MWSA system

(Source: adapted from WRC 2002b)

Gross total water entering an MWSA system	Accounted-for water		Adjust ±	Change in volume of water in storage
			Revenue water	Billed metered paid-for wise usage
				Billed unmetered paid-for wise usage
				Billed metered paid-for wasteful usage
				Billed unmetered paid-for wasteful usage
			Non-revenue water	Billed metered unpaid-for usage
				Billed unmetered unpaid-for usage
				Unbilled or highly subsidised metered or regulated usage by poor households
				Unbilled unmetered unregulated authorised usage
	Apparent losses	UAW		Customer and/or bulk meter reading inaccuracies
				Customer and/or bulk metering inaccuracies
				Calibration errors other than metering inaccuracies
				Inaccurate estimates of unmetered water usage
				Unauthorised usage
	Leakage losses			Leakage on distribution mains
				Leakage and overflows at reservoirs
				Leakage at customer take-off points

SANS 10306 defines UAW as: *The difference between the measured volume of water put into the supply and distribution system and the total volume of water measured to authorised consumers whose fixed property address appears on the official list of the water services authority*. The IUCN supports the concept of MWSA's metering or regulating all water usage, and recording the addresses of all customers with individual connections for which they are personally responsible. However, for this Guideline the loose definition reflected in figure 2 will be used throughout to encourage MWSA's who have not yet managed to meter all usage to estimate and bill all water usage in access of the basic needs of poor households. This section will first examine how UAW is calculated, and specify values of UAW that reflect good water management, before going on to describe how to manage apparent water losses.

4.3.2.2 Calculation of UAW is calculated by carrying out a water balance.

Firstly the gross total volume of water entering the system is measured over a period of time, usually a month, using the bulk meters. Adjust individual meter readings for varying time periods or known errors. Readings of the volume of water stored in any distribution

storage reservoirs are also taken at the beginning and end of the period. The net total volume of water entering the system for usage is then calculated by adjusting the gross total volume of water entering the system by the change in volume of water in storage: add total volume of water taken out of storage or subtract total volume of water added to storage.

Thereafter the total volume of all accounted-for water usage is measured with meters or estimated over approximately the same period as was used to calculate the gross total volume of water entering the system. Each individual volume of water measured with meters is adjusted to correspond with the period over which the gross total volume of water for usage was measured. To report meaningful results it is essential that the estimates of unmetered-water be treated honestly. Regulated basic needs usage may be estimated by using the maximum regulated volume as the actual amount. The billed volumes can be entered as the actual usage for billed unmetered connections. Low estimated volumes, thought to be under the true usage, need to be entered for unbilled unmetered unregulated authorised usage.

The UAW is then equal to the net total volume of water entering the system for usage, less the total volume of all accounted for water usage. The UAW figure can be refined by installing temporary water meters at all suspected major unmetered accounted-for-water usage points, for approximately one month. The times need not correspond, and further small adjustments can made to these measurements at the time the water balance is being carried out.

The overall UAW for each major region supplied with water by an MWSA needs to be calculated on a monthly basis and moving 12-month trends need to be monitored and evaluated on the same basis. The UAW figure should also be calculated on a monthly basis for each of the zones set up for minimum night flow readings (refer section 4.3.1) as a help in deciding where to prioritise both leakage loss and apparent loss reduction interventions, remembering that apparent losses equal UAW less leakage losses on the MWSA's system. Any leakage losses on the premises of customers have to be subtracted from the leakage losses obtained from the minimum night-flow tests, to estimate the leakage losses from the MWSA's own system.

Carrying out UAW calculations, producing trend lines and prioritising water loss reduction interventions, as well as performing all other WDM and water management functions, are made much easier for MWSA's if they use an effective Management Information System (MIS).

4.3.2.3 Management information systems

For further information on management information systems refer to the IUCN sponsored report *Management Information Systems* (Gumbo et al 2002).

An effective management information system (MIS) can be beneficially used to manage each of the water supply, loss, and usage components depicted in figure 2 and all other major issues associated with good MWSA management. It is very difficult for an MWSA with more than 100 meters installed to manage their utility without a PC with a simple spreadsheet programme and text programme installed. It is equally difficult for an MWSA with more than about 1 000 meters installed to manage their utility without a PC with a reasonably comprehensive MIS installed. The main components of a typical integrated MIS are shown in figure 3. MWSA's should consider their needs carefully and issue an enquiry document to select a contractor that will modify an existing MIS, install it, commission it by entering base

data under the guidance of the MWSA, produce reports, and train the MWSA's staff thoroughly in using the system.

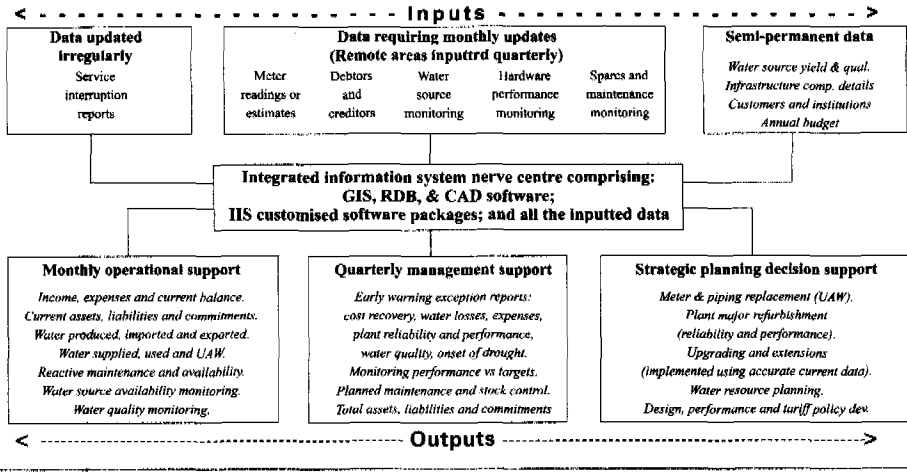
MWSA's with less financial resources should seek suppliers that are prepared to sell their information system a few modules at a time. In this way the MWSA can gain some management improvements at low cost, and gradually introduce a more complex system using the savings already earned through the initial installation. It should also be noted that a comprehensive effective MIS could be used that does not include any geographic information system (GIS) modules. Possibly, an even better approach would be for MWSA's to collectively persuade national regulators with or without overseas funding to engage a specialist to slowly develop a uniform but flexible information management system for use by all MWSA's in a country. To date, no SADC country has developed a uniform system for nationwide use.

However, in 1995, Botswana placed an order for a comprehensive uniform MIS in each of 17 large villages spread throughout the country with a total population of 295 000 people. Three years later, in one of the first villages targeted for inclusion in the management system upgrading:

- Average UAW figures had fallen from over 50% to between 20 and 25%;
- A 40% increase in water billed had been achieved; while
- A 20% reduction in the total demand for water was observed as customers adjusted their consumption in response to accurate billing.

Figure 3: The main components of a typical integrated MIS

(Source: Hazelton and Harris 1999)



4.3.2.4 Acceptable levels of UAW

All water distribution systems show evidence of some UAW. The question is, what level of UAW should be regard as acceptable?

In 1997, UAW tests were carried out on nine well designed, constructed, maintained and managed schemes in South Africa, reflecting a wide range of

connections per km (between 7 and 81) average consumption levels per connection (between 6 and 83kℓ/mth) (Hazelton & Kondlo 1998). From examining the results of these tests, it can be stated that international UAW norms, which are generally based on losses per km of pipeline, need to be treated with caution. The total volume of water entering 5 of the 9 schemes was less than 500 kℓ/mth per km of pipeline, while 700 kℓ/mth per km of pipeline is generally regarded as an acceptable upper limit for UAW according to international norms! The unsuitability of the international norms in deciding acceptable UAW levels is probably due to the, on average, fewer number of connections per km of pipework in South Africa and the fact that the international norms have been developed using older schemes than those examined in the South African study. In the case of the latter schemes, the average age of the pipework varied from three years to about ten years on the largest scheme.

Figure 4: Acceptability of UAW/connection as a function of water usage per connection

(Source: Hazelton and Kondlo 1998)

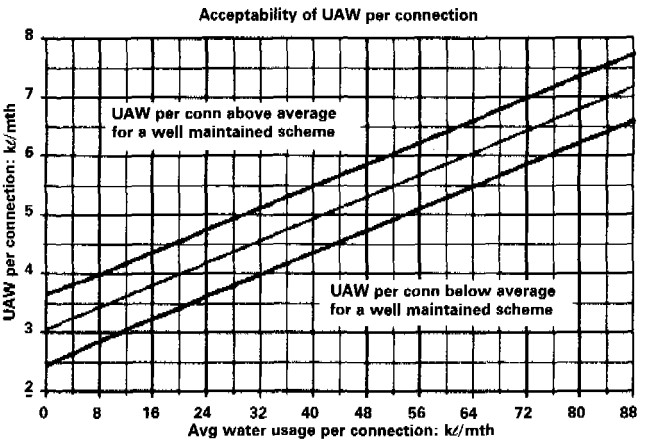
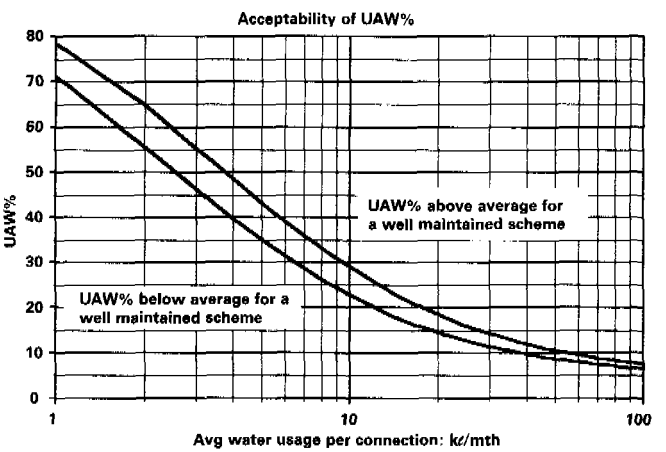


Figure 5: Acceptability of UAW% as a function of water usage per connection

(Source: Hazelton and Kondlo 1998)



As already indicated, the average age of the schemes tested was low. As a result, the leakage from the main pipelines can be expected to be close to zero. Thus, referring back to the international norm, an additional loss of between 172 and 276kℓ/mth per km of pipeline is tentatively proposed as an acceptable additional loss due purely to leakage losses from

pipelines associated with older scheme, known to have losses of this nature.

Observing a high level of UAW discloses nothing about the source or cause of the problem. On going broader monitoring of schemes is therefore essential to an understanding of the causes of UAW and to UAW control.

4.3.2.5 Managing the apparent losses component of UAW

As with leakage control, managing the apparent losses component of UAW requires active commitment by an MWSA's management.

This management starts by calculating the MWSA's level of UAW, and estimating the apparent losses, as described in sub-section 4.3.2.2. Thereafter the procedure differs from managing leakage losses in that there are no specific technical procedures to locate the exact position or causes of the apparent losses.
As can be seen from figure 2, there are 5 possible causes of apparent losses:

- Calibration errors;
- Meter reading inaccuracies;
- Inaccurate estimates of unmetered water usage;
- Unauthorised usage; and
- Metering inaccuracies.

The first task is to consider logically, zone by zone, which causes are likely to be causing the high apparent losses. Thereafter, having a good rapport with made-aware customers, staff, and contractors carrying out ongoing services, is also of great help.

4.3.2.5.1 Meter reading inaccuracies

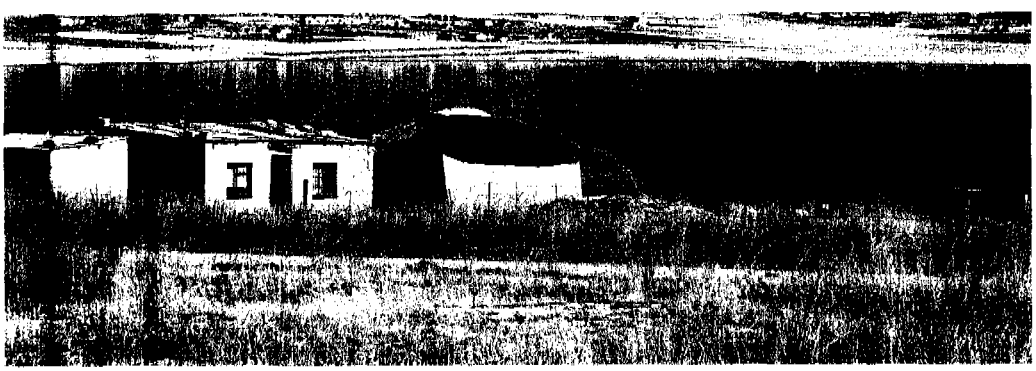
Meter reading inaccuracies can often be discovered by water usage figures varying inordinately from month to month, but some spot checks need to be carried to detect meter readers that fill in figures without actually reading the meters or who under-read intentionally to lower customer charges.

4.3.2.5.2 Inaccurate estimates of unmetered water usage

When whole zones are unmetered, suspected inaccurate estimates can usually be discovered by combining readings of zone bulk meters and minimum night-flow tests. However, without installing meters or regulating the supply, significant improvements in WDM or cost recovery are usually impractical.

4.3.2.5.3 Unauthorised usage

Widespread unauthorised usage, with or without



poor credit control, can cause chaos with an MWSA's quality of service to customers furthest away from the water source when upstream 'customers' use water irresponsibly. In such circumstances it will also cause chaos with an MWSA's overall WDM efforts, and with its financial position. In 1996, South Africa was teeming with such crises, and it is unclear how many MWSA's have overcome them.

Situations of this type develop when MWSA's install low levels of service where mixed levels of service ought to have been installed. When not observed earlier, many of these connections are discovered during leakage control interventions, since the connections themselves are often poorly installed and leak at the off-take point or leak noise correlation equipment may even pick up the noise of the water passing through the unauthorised connection. Such connections need to be authorised in an unrushed orderly assertive manner without undue delay, by installing meters, or regulating the supply, and making good any poor workmanship. Households with unauthorised connections should be encouraged to declare them during a reasonable amnesty period, after which by-laws need to allow for fines to be levied for households found with illegal connections.

Other unauthorised connections occur through households interfering with their connection by, for example, installing by-passes around their meters, or by turning the meter around and allowing the water to pass through it in the reverse direction for a part of each metering period. They also occur through households reconnecting MWSA disconnected supplies. All types of tampering can be discovered by the MWSA observing a definite reduction in demand while there is no evidence of the meter having jammed, or through meter readers being vigilant and observing disturbed earth near a meter or the seal between the top of a meter and inlet pipe being broken.

The former type of tampering usually occurs when poor customers sense that insufficient provision has been made by the MWSA, with or without assistance from higher tiers of government, to ensure that they can access sufficient water to cover their basic needs. Such provision would be made through an indigent policy and/or a lifeline tariff for basic quantities of water. On the one hand it is very difficult to lower a household's level of service. On the other it is important for customers to understand that tampering with an MWSA's property is a serious offense. The action therefore should be two-fold, assuming the household has a valid argument. One, the MWSA, supported by higher tiers of government and overseas donors, should investigate what has to be done to ensure that each existing household with individual connections nationwide can use sufficient water to *sustain good health*, as described in sub-section 4.2.1.3.1, without any of them getting into debt due to affordability constraints, and thereafter make every effort to implement such a 'right to water' policy. Two, the tampering needs to be reversed; a modest fine, to be paid in instalments if necessary, levied to cover all the costs of reversing the tampering; and the household having to sign a form acknowledging that a second offense will mean the loss of the individual connection for a period of, say, 12 months.

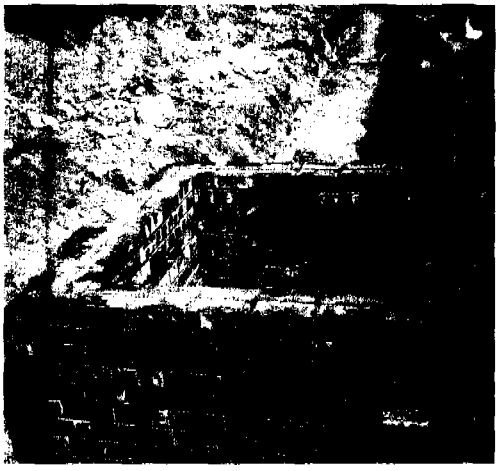
Traditionally, the latter type of tampering usually occurs because of customers being disconnected for not paying accounts. However, through implementing the policy described in the previous paragraph, such disconnections should not take place in future. Rather than disconnecting customers with unpaid accounts, the volume of water delivered to such customers, who have difficulty in

managing their own usage, should be limited to their basic needs by technical means.

Lastly, unauthorised usage can occur because, although authorised plumbers using the correct procedures install all connections, the particulars of some new customers are never entered in the billing register, while the particulars of other customers that had been entered are later 'lost'.

4.3.2.5.4 Disconnections

The previous subsection aims to ensure that disconnections are minimised. However, it is recognised that occasionally MWSA's will have to disconnect individual household connections. In such cases, formal arrangements need to be made, with the MWSA's involvement, to ensure that the disconnected household has access to an adequate water supply in terms of the country's own definition of an adequate water supply, even if such a supply is arranged through a yard tap on a neighbour's property. In addition the actual disconnection needs to be implemented according to a strict code of conduct, possibly incorporated into MWSA's Customer Charter. Refer ESB 2002, for ideas and guidance.



4.3.2.5.5 Metering inaccuracies

Domestic metering inaccuracies occur because domestic units stop working due to the water passing through them containing solid particles that may comprise only a few grains of fine grit. Semi-positive displacement units installed without an upstream strainer, as distinct from turbine meters, are more likely to stop working in this way. Such particles can be due to poor or no treatment of the water supplied, incomplete flushing out of pipework after repair work, or pieces of rust or corrosion protection material travelling down pipework after having become dislodged. Zero-consumption figures need to be checked for this possibility and tampering with the installation.

Other factors need to be taken into account to ensure meters measure the correct volume of water passing through them. These factors include:

- Using only high-quality meters from a reputable manufacturer, manufactured to a reputable national standard guaranteeing the required accuracy and complying with all national legislation;
- Installing them in accordance with the manufacturer's instructions and relevant national standards;
- Ensuring the distribution system is designed and maintained so that the meters are always installed in positions where only water, and never air, passes through them;
- Where meters are installed in areas that allow water to enter the system from either side, installing metering that is capable of measuring and reporting on the volume of water passing in each direction or, alternatively, where it does not affect the system design, installing a back-flow preventer to stop the possibility of reverse flow occurring;

- Ensuring they are correctly sized for the flows being measured; and
- Having a strict meter replacement programme.

4.3.3 Credit control

4.3.3.1 Introduction

Credit control is an essential component of implementing WDM management and ensuring the financial wellbeing of MWSA's and every MWSA needs by-laws covering credit control and debt collection. However, implementing these by-laws will cause high health risks to poor customers and be a nightmare for the MWSA's staff, unless the MWSA also has a Customer Charter covering, but not limited to, its care of indigent households and tariff-setting policies. This section will, therefore, discuss these policies first before discussing credit control and debt collection.

4.3.3.2 Indigent policy

None of the SADC countries have a comprehensive system of social security and for the majority of them funding such a system from their own resources would not be possible. This means that, as well as ensuring that the necessary infrastructure for services delivery is well built, managed and maintained, MWSA's need to ensure that poor households who have access to water use enough to cater for their basic needs.

After 1994 most MWSA's in South Africa introduced a policy whereby very poor households could apply for a free basic water allowance. The system had two major shortcomings:

- The criteria used to define which households were eligible were too narrow; and
- Many eligible households, especially from remote areas, did not apply.

Thus where MWSA's introduced effective credit control many poor households did not even use sufficient water, from a safe source, to look after their basic health and hygiene needs. A major contributory cause of the cholera outbreak in KwaZulu-Natal in August 2000, which developed into the most serious epidemic yet experienced in South Africa, was the introduction and strict application of water charges.

In July 2001 the South African government introduced a policy to make free water available to all households that used less than 6kℓ of water per month. The policy therefore allows all households, rich and poor alike, access to the free basic allowance as long as they limit their water usage to 6kℓ or less per month. All households, rich and poor alike, who use more than 6kℓ per month have to pay for any additional usage. Higher tariffs per kℓ are charged as usage increases, using a rising block system.

The self-targeting policy has definitely been an improvement on the old indigent policy, and where it has been applied in areas without waterborne sanitation it has generally worked well. However, not surprisingly in view of the minimum water usage requirements to sustain a household's good health described in clause 4.2.1.3.1, in areas with waterborne sanitation, households comprising more than four persons have found that the 6kℓ allowance is too low. A number of the MWSA's, with a high percentage of rich customers, are therefore considering increasing the free basic allowance to 10 or 12kℓ/mth per household while retaining the self-targeting policy.

Ensuring that poor households use sufficient water, while managing it effectively, is fully supported by this Guideline, but MWSA's need to plan honestly and carefully how they will achieve this. Details are not available of the

water usage and payment profiles of the customers of the MWSA's considering increasing the free basic allowance, but rough estimates suggest that, even assuming usage profiles remain unchanged, such a policy will not be sustainable in the long term, without charging all high volume users excessive tariffs.

MWSA's, therefore, need to do a careful analysis of anticipated changes in water usage profiles, income and costs, and how sensitive these costs and income changes are to different usage profiles, to decide the best way forward. Recommendations include changing the allowance to a per person basis, introducing targeting and considering a modified tariff structure. Merely increasing the free allowance will not get rid of the discrimination against large households and will cost the MWSA much needed revenue. Targeting could be based on a household quality of life characteristic correlating well with the adult equivalent income per person of households. With respect to this targeting, exclusionary errors should be regarded more seriously than a few inclusionary errors. In addition, excluded households who are having difficulty in paying their water bills and any households who have special needs, and, as a result, need a higher free water allowance, should be able to submit a special application to the MWSA for consideration.

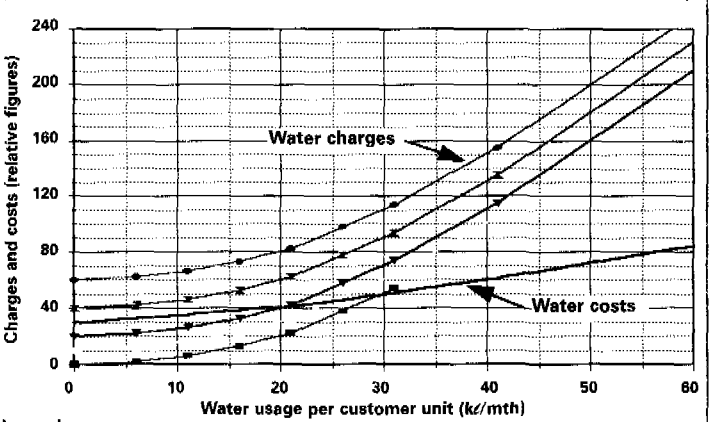
In urban areas, it is recommended that subsidies for other municipal services be calculated in a similar manner. These subsidies should then be grouped together to encourage and empower customers to consciously manage their usage of services by deciding how much of the subsidy to allocate to each service. Thus by only using electricity for lighting and other low consumption appliances like radios, a poor household could possibly use a little more water without having to pay for it. They would of course have to pay for an alternative energy source, but the choice would be theirs.

4.3.3.3 Tariff design

The comments in the previous sub-section indicate that new thinking is required to design tariffs that help MWSA's to deliver water affordably to poor households, without obtaining financial assistance externally, to achieve long-term sustainability, when the revenue raising

Figure 6: Tariff design to balance the requirements for equity, cost recovery and WDM

(Source: Combination of ideas from Sohail 2004 and Hazelton 2002c)



capacity available from their own customers is high enough to make such assistance unnecessary. In addition, through the over-enthusiastic use of rising block domestic tariffs and high non-domestic tariffs, many MWSA's have become over dependent on high-volume usage customers to remain financially sustainable. As a result, these MWSA's are only striving to get poor paying customers to manage their demand and reduce usage, while they become concerned when they detect prompt-paying high volume customers decreasing their usage of their own accord. Such a strategy may be successful within the narrow core objectives of some MWSA's in the medium term, but once the demand exceeds the capacity of the existing bulk water source and infrastructure, their delivery costs will increase unnecessarily.

Figure 6 represents a system that may be used as a basis for overcoming the above concerns. The lowest 'water charges' graph represents the resultant total charges billed to customers for different monthly consumption amounts, based on traditional rising block tariffs (RBTs) or equivalent cost rebate/surcharge charges (Hazelton 2004c). This is the traditional SADC means of keeping the charges per household low, for low volume users, and high, for high volumes users, thus encouraging customers to use adequate volumes of water for health reasons, whilst discouraging excessive usage. In practice, it has been found that the results are very imperfect because it does not take a household's income into account directly, in that regardless of a household's income, the same volumetric tariffs and resultant total charges apply. As a result, poor households, especially poor large households, still use too little water to care for their basic needs including health, whilst the MWSA's income from customers is not maximised.

To produce the additional 'water charges' and additional income for the MWSA from non-poor households, different fixed 'solidarity charges' have been added to the traditional RBTs, on the graphs in figure 6, depending on a household's income. As obtaining each household's income is notoriously difficult, in practice another poverty/wealth indicator correlating approximately with a household's income, such as property rateable values, or 'desirability' of a residential area adjusted for stand size, would be used. To ensure some form of objectivity in the use of such an indicator, overall household incomes profiles need to be compared with property rateable value profiles. For example if only 4% of households have adult equivalent per person incomes of more than US$10 per day, only those households with property rateable values in the top 4% should be charged the top 'solidarity charge'. The idea of a 'solidarity charge' is loosely based on the concept of multiple volumetric tariffs described in Sohail 2004 and used in Georgetown, the capital of Guyana, which allows the MWSA to charge different tariffs to customers depending on their poverty/wealth status.

Figure 6 does not take family size into account. To do this, as is strongly recommended in sub-section 4.3.3.2, in a practical manner, the traditional RBT graph could still allocate the first 6kℓ per household free of charge because the 'solidarity charge' will ensure that all households other than special application cases, as described in sub-section 4.3.3.2, with an adult equivalent per person incomes of more than US$2 per day, will pay for water no matter how little they use. Then assuming the free basic amount, as the system is being introduced in its first year, is based on a free allowance of 40 litres per person per day for all households with waterborne sanitation, all households

comprising more than 5 persons would be entitled to submit a standard application to have their basic free allowance increased. The result would be an automatic allocation of a free basic allowance of 7,2 kℓ/mth to households with 6 persons, 8,4 kℓ/mth to households with 7 persons etc. The allowance would be valid for periods of 12 months with a two-month grace period. Thus every 12 months such families would have to restate the actual number of persons in their household.

4.3.3.4 Credit control

After ensuring that it has an effective Customer Charter, supported by service delivery by-laws and agreements, that aim, amongst other objectives, to help maintain uninterrupted basic services delivery to all households, MWSA's still need these to be augmented by credit control and debt collection by-laws. Again these by-laws need to be drafted and implemented keeping certain aims in mind, such as: treating all customers equally, maintaining low credit levels, helping customers with arrears to repay at a manageable rate, and helping to keep the MWSA's and perhaps the municipality financially strong for the benefit of all current and future customers. These aims include the more generic aims of *effectiveness* and *cost-effectiveness,* defined by Colton 1994 as follows:

- Effectiveness: Is the given credit and *collection practice necessary, as well as productive*, in controlling credit and (non italics added) *in generating payments* of outstanding revenue?
- *Cost effectiveness: Is a given credit and collection practice efficient, as well as cost-beneficial, resulting in greater* credit reduction and (non italics added) *revenue collection than expenses? Moreover is a particular practice the most efficient means of collection vis-a-vis available alternatives?*

Effectiveness and cost effectiveness can, to a certain degree, be written into by-laws and achieved by the correct motivation of implementation staff, but through monitoring and evaluating their credit control and debt collection activities, MWSA's can take corrective action to improve performance with time. In addition, as with all other MWSA activities, excellence will not be achieved without the sharing of information with other MWSA's and utilities on an ongoing basis for benchmarking purposes.

Returning to the earlier more specific aims: treating all customers equally can be facilitated by stating in the by-laws, wherever practical, what the MWSA will do, rather than what it may do. Another important issue is ensuring that deposits for credits accounts are set equal to the average value of charges to each customer over the same fixed period of time for all customers. The habit of collecting higher deposits from customers after they have had difficulty in paying their accounts should not be allowed. Pre-payment customers, of course, should not be charged any deposit. Poor customers need equal access to paying arrears over an extended period of time and should not be penalised for being bad payers.

Maintaining low credit levels should be a core aim of any credit control by-laws. To achieve this requires MWSA's to issue final demand notices early and follow up zero action by the customer by regulating the water supply to the customer so that he/she only has access to the free basic service. If the regulation is done by any category of trickle feed flow controller, the MWSA's intervention needs to include a water storage tank preferably roof mounted if not already a component of the customer's existing supply. As costs decrease, customers and MWSA's will probably favour regulating previously unregulated full

pressure services by installing an electronic controller which limits the volume of water used over fixed 24 hour periods to the desired quantity. Follow-up actions, allowed to a customer after receiving a final demand, to preclude the MWSA from regulating the supply should include: paying the bill, lodging an objection to the bill and arranging to pay arrears in instalments. Objections and applications to pay arrears in instalments need to be processed punctually within a time period stated in the regulations to keep credit levels low. Keeping credit levels low should include the aim of making it unnecessary for MWSA's to take any truly harsh actions against customers. If a customer responds to a final demand by submitting an application for special treatment due to indigence this should protect that customer from legal action but not preclude the MWSA from regulating the water supply to the free basic amount.

Although controversial, the concept of municipalities issuing consolidated bills and regulating services delivery to customers for failing to pay their rates or for solid waste collection, should not be disregarded unreservedly.

4.4 Promoting WDM amongst customers

4.4.1 Introduction

MWVAs should always aim to ensure that, as far as practical, all water usage relates to the three shaded areas indicated in figure 2. That is:

- All water usage should be measured or regulated;
- All water usage, with the exception of water used by schools in poor areas and by poor households to cover basic needs, should be paid for; and
- All water usage should relate to efficiently carried out activities for a good purpose.

This section relates to how this should be promoted by MWVAs in all their interactions with their customers.

4.4.2 Starting with government institutions

4.4.2.1 General

It is vitally important that all government institutions show true leadership through good example. This leadership needs to start with the MWSA itself, both with respect to how well it manages its own water usage and how well it creates awareness in other government institutions, by treating them like it should treat other customers in terms of measuring water usage, billing them, and implementing strict credit control and debt collection.

Government institutions comprise institutions associated with all tiers of government, municipal, regional and national, and may include, but are not limited to:

- The MWSA itself
- Parks and recreation
- Fire department
- Produce markets and abattoirs
- Schools and other educational centres
- Hospitals.

Apart from being responsible for having efficiently designed and operated water and wastewater works, offices, workshops and machinery and transport depots, MWSA's use water operationally for flushing-out potable water pipework after pipe-bursts. This flushing-out needs to be done generously, for both health reasons and the protection of domestic water meters, but it also needs to be done in a controlled manner. In addition, the total quantity of water used during each repair, through draining the section and then flushing it, needs to be measured using a relevant zonal bulk meter.

The habit of flushing potable mains is sometimes extended to clearing sewer blockages. For normal blockages, caused by what has been put in the sewers, clearing is best done using rods. In cases where the prime cause of the blockage is tree roots growing through cracks in the sewer pipes, to be effective, the clearing needs to be done using a special machine, so that it does not block again after a short time, due to the prime cause not being removed. Using potable water to unblock sewers is not recommended, but if it is so used, it ought to be used sparingly, the quantity ought to be measured, and high-pressure hoses, which can damage sewer pipes, should never be used.

There are certain water usage practices that are always bad, and should even be declared illegal in either national legislation or municipal by-laws. These include:

- The watering of parks, recreation areas, or gardens when the sun is high, thus causing high evaporation losses;
- Automatic self-flushing urinals;
- Washing motor vehicles and other similar objects with a hose; and
- Washing down paved areas with a hose except in areas where such the hosing is required for health-related reasons and the paved area is designed so that the water is collected and recycled or reused elsewhere at an industrial site.

MWVAs and other government institutions should never be found guilty of such bad practices. A good example comes from Windhoek, Namibia, where the state horticulturist has laid out indigenous gardens around the Bank of Namibia and the Supreme Court buildings, with outstanding results in raising awareness, and encouraging domestic users to follow suit, which thus contributes to WDM in the region.

Large unauthorised usage water losses can occur through the illegal use of water at fire hydrants. Unless fire hydrants are fitted with combination-type meters, and the meters are

read regularly or fitted with remote water usage display sensors, it is very difficult to locate such illegal usage unless the unauthorised connection happens to be discovered soon after installation while the fire hydrants are being inspected on a regular basis to ensure each one is kept in good working order. Of course, in poor areas without individual household connections, including crowded informal settlements where fire risks that endanger both life and property are high, installing fire hydrants and shared standpipes next to each other, using the same off-take point fitted with combination meters, may well be the preferred option.

4.4.2.2 Schools and public awareness creation

Schools are very special places with respect to creating an awareness of the importance of WDM as an environmental, economic and equity subject. If children understand the benefits of and necessities for WDM measures, they will convey the message to their parents, whose attention the MWSA may not be able to win through its own efforts alone when implementing a WDM awareness strategy.

Schools education in WDM is a key issue in many parts of the world, and an enormous amount of material is already available to assist MWSA's in setting up and implementing a schools education campaign. In some countries, water supply institutions and other relevant government departments work together to design an education campaign that forms part of the official syllabus in the schools.

The following should be considered when developing a schools training programme:

- Site visits to a water treatment works and a sewage treatment works;
- Interesting and challenging educational material relating to home, community, district, country, regional, continental and world water issues;
- Undertaking projects such as: a water audit in the school, painting competitions, essays on using water efficiently and wisely, but selecting them carefully depending on the year of study that the learners are in; and
- Obtaining free posters, booklets and pamphlets on WDM.

Where required, implementing school retrofitting projects can be carried out, involving the retrofitting of school changing rooms and toilets, using low flow shower heads and taps, and dual flush toilets, etc. Such measures are normally implemented in parallel with a water audit project to monitor the savings achieved and to create awareness for efficient water use throughout the school. It has been found that the water consumption in some schools can be reduced by more than 50% where automatic flushing toilets are replaced by toilets with user activated flushing mechanisms (Hazelton 2003).

In section 4.4.1 the idea of schools in poor areas not being charged for water, provided they manage their water usage to use no more than is required to cover the learners' and educators' basic needs, was referred to. The reason is that schools are an important place for learning everyday life skills, and are even a source of help to parents that received a poor education, through their learning of new skills from their children. It is therefore recommended that schools in poor areas be made to reflect the home environment through being included in the MWSA's programme to deliver a basic amount of water to poor households free. Subject to refinement from local experience, eight litres per user per day could be used to define the free basic needs amount for schools with waterborne sanitation (Hazelton 2003). Learners could then be actively involved in managing the schools

water usage to ensure that it is regularly very close to, but below, the free basic amount.

4.4.3 Repairing leaks on customers' property

As stated in section 26 of the Municipality of Windhoek's water supply regulations, quoted in box 4 of this Guideline, customers are the persons primarily responsible for ensuring that leaks do not occur on their property. It is important that MWSA's make their customers aware of this, and of the fact that wastage of this nature is not acceptable.

However, MWSA's also need to acknowledge how seriously they regard such leakage by helping customers to be aware of leakage and facilitating repairs. Section 2.2 reports on MWSA's fixing leaks on customers' properties in poor areas on a once-off basis, before implementing credit control, and discusses ways in which they can help to ensure that such leakages do not return. Ideally customers should be fully responsible for leakage on their property, but perhaps the way of managing such leakage should be closer to that of well-managed MWSA's in the past, before household metering was introduced, when customers were charged a fixed amount each month regardless of the quantity of water they used (or wasted). In those days, customers were responsible for letting their MWSA know when any leakage occurred or was suspected on their property, regardless of the source, and the MWSA came within two working days to repair leaks and within 36 hours to repair bursts, free of charge.

In 2005, MWSA's could consider facilitating repairs in a similar way. Customers could contact their MWSA, who would have the leak repaired. Thereafter, the MWVA would invoice the customer an amount equal to, say, one month's water charges, calculated from the average bill over the three months prior to the leak being reported and repaired. Customers could be allowed to pay the repair bill over 12 months on request. In considering such an option MWSA's would have to consider equity, effectiveness and cost effectiveness (refer sub-section 4.3.3.4). Such repairs may have to exclude the replacement of major expensive items, such as a failed hot water geyser, unless the customer agrees to pay the full actual costs incurred by the MWSA.

Where a customer does not contact their MWSA, and monitoring indicates that leakage is suspected, the MWSA still needs the authority, through its by-laws, to enter the customer's private property, without prior notice, to repair, replace or, in extreme cases, just to isolate and remove, the leaking fitting or pipework, as per the financial conditions set out in the previous paragraph.

In poor areas, where customers made use of this repair service, MWSA's could consider training meter readers to carry out leakage repairs to cold-water taps and toilet cistern fittings, at least.

The granting of rebates for excessive water 'usage' under any circumstances, including 'usage' due to leakages or pipe bursts on a customer's property, is not recommended.

4.4.4 Ensuring customers use water wisely

4.4.4.1 Introduction

In the last ten years many MWSA's have made great efforts to reduce the water wastage of poor households because of non-payment. Because non-payment is the driving force behind these efforts, some of these same MWSA's have ignored the health benefits of water and have wrongly also tried to reduce the efficient beneficial water usage of these households, whilst paying little or no attention

to encouraging good water management by affluent customers that use water extravagantly.

Does your MWSA in fact believe that it would be foolish to do or say anything that may reduce the income stream from affluent paying customers? In the short term, such an outlook may make sense, if the MWSA is only considering its own narrow financial position, and bulk water tariffs do not include strict WDM incentives (refer 4.2.3.4). But, even in the short term, figure 6 indicates how the income stream from affluent customers can be kept constant or even increased as they use less water. In addition, any MWSA whose client base is growing or which is obtaining its bulk water from a source where there is a growing demand for water or is planning to ensure that all customers use sufficient water for all their basic needs, such a belief is likely to cause those same MWSA's additional serious financial challenges in the medium term, as new resources are developed injudiciously and have to be paid for.

For these reasons, and for reasons related to care of the environment, this section concentrates on MWSA's more affluent domestic customers. However, awareness creation, and strict standards in relation to ensuring that only water efficient infrastructure is installed on customers' properties, need to be implemented comprehensively.

It should also be noted that the inclusion of unregulated subsidised or free water as a benefit to people living in company houses can impact negatively to a serious degree on the efforts of MWSA's to encourage such households to use water wisely. Box 6 illustrates the impact of such a benefit at the Selebi-Phikwe Mine in Botswana.

Box 6: The impact of unregulated water subsidies on household water usage

At Selebi-Phikwe Mine in Botswana, a household with an income of P3 000 per month and not receiving any water subsidy will consume on average 22kℓ of water per month. However, water consumption for a household with the same income with access to an unregulated water subsidy will consume on average 63kℓ per month, an increase of 286%. It is surprising that the mine offers such an incentive that encourages wastage of water whilst at the time the company is actively involved in re-using and recycling water in its mining operations.

(Source: Arntzen et al 1999) 4.4.4.1

4.4.4.2 Awareness creation

4.4.4.2.1 Customer service centres

Customer WDM implementation starts with good customer relations and awareness creation. Thus, as a foundation, MWSA's need to have a well-publicised, efficient, accessible, and friendly service centre, where customers can phone or visit, at any time, to obtain information, report a leak or lodge a complaint. To achieve the desired results these centres must be fully functional and staffed by competent caring personnel, as they provide the most important human interface between an MWSA and the public. If customers are unable to contact their MWSA, or receive a poor response when they do, the public's respect for and levels of co-operation with the MWSA are likely to deteriorate.

However, these attributes are not enough in themselves. A customer service centre can only be effective if it is integrated into the rest of the MWSA's organisation, so that the organisation responds to the interaction between the customer and the centre, and, as a result, achieves

excellence in day-to-day customer care and services delivery. A wonderful facade with an empty shell behind it is worthless in the long term. The bottom line is that customer service centres are there to ensure that customers know their just and equitable rights with respect to fair treatment and quality services delivery, and that they will be aware that these rights are met by courtesy, timely responsive feedback from the service centre and the visible external results of the timely action taken by the MWSA.

Of course, MWSA's should have their own internal proactive systems for achieving quality services delivery. Thus service centres exist as a back-up, so that an MWSA can learn about any shortcomings in these systems from a customer's point of view, and to give customers an effective means of interacting with an MWSA on the rare occasions that existing systems have not been implemented in accordance with institutional or national standards.

If a service centre, together with the back-up supplied by an MWSA's less visible human resources, provide customer care and excellent service delivery, improved levels of payment can be expected. When levels of payment rise, customers will implement WDM themselves and the incidence of illegal connections can also be expected to fall, as consumers are more likely to report them to the MWSA.

4.4.4.2.2 Access to information

It is important that any information provided to customers is relevant to their actual, rather than perceived needs. Often MWSA's supply information that is not useful to their customers, which ends up turning them against WDM, instead of getting them involved personally as promoters of wise water usage.

Apart from the availability of information from service centres, MWSA's can distribute brief newsletters with their monthly accounts covering recent frequently asked questions which, if earlier general awareness creation was successful, will include WDM. Windhoek MWSA does this. An MWSA's billing system can also be used to give each customer a graphical record of their last 12 to 24 months' water usage as well as including a water management tip of the month and where additional information on WDM can be obtained. Box 7 reproduces a customer's bill issued by the Hermanus MWSA, in the Western Cape province of South Africa.

4.4.4.2.3 Awareness campaigns

Apart from making information available at information centres and through newsletters or informative billing, MWSA's also need to conduct imaginative awareness campaigns preferably in the languages used by the particular customers whose attention it is hoped to attract.

Awareness campaigns involve the presentation of information to customers on key issues where behavioural change is considered necessary, or key points of a more integrated programme being implemented by an MWSA, which the MWSA needs to highlight and gain acceptance from its customers. In fact, customer awareness creation is best done when an MWSA is already doing work in an area to improve WDM. In these circumstances, it can use the opportunity to get their customers involved also. The MWSA can carry out these awareness campaigns on their own or adapt or join campaigns being organised by bulk water suppliers or higher tiers of government.

The advantage of the former is the ability of the MWSA to focus on the key issues affecting it, whilst the advantage of working closely with bulk suppliers or higher tiers of government is to tap into material that has already been developed for a wider public at a reduced cost.

Figure 7: Example of an informative water bill

(Source: Hermanus Municipality, South Africa)

GREATER/GROTER HERMANUS WATER
PO Box/Posbus 20 Hermanus 7200

Understand your water account/Verstaan u waterrekening

Account No / Rekening Nr	0035168007	Date of Account / Datum van Rekening	03/05/1997	Date of Reading / Lesingsdatum	06/05/1997
Name/Naam	GP LE ROUX			Erf Area	
Property Address / Eiendoms Adres	SELKIRK STREET 45			Erf Nr	

Meter No / Meter Nr	Present Reading / Huidige Lesing	Previous Reading / Vorige Lesing	Consumption / Verbruik	Days / Dae	kl/Day / kl/Dag
30369	5,088	5,061	27	30	0,90

Consumption (kl) / Verbruik (kl)	Cost / Koste	Assurance of Supply / Versekering van Lewering	VAT / BTW	Total / Totaal
27	R 38,00	R 40,00	14%	R 38,92

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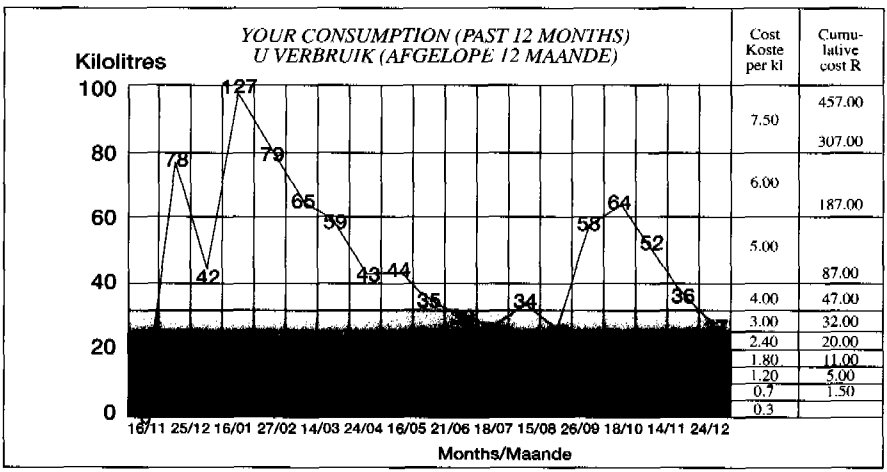
INSULATE YOUR HOT WATER CYLINDER AND HOT WATER PIPES THIS WINTER TO SAVE WATER AND ELECTRICITY. HOTLINE 70 11 11

ISOLEER U WARMWATER-SILINDER EN WARMWATER PYPE HIERDIE WINTER OM WATER EN KRAG TE BESPAAR. NAVRAE 70 11 11



A joint venture between the National Water Conservation Campaign of the Department of Water Affairs and Forestry and the Greater Hermanus Municipality.

'n Gesamentlike onderneming tussen die Departement van Waterwese en Bosbou se Nasionale Waterbewaringsveldtog en die Groter Hermanus Munisipaliteit.

The best campaigns are often driven by a champion employed by an MWSA, who obtains advice and assistance from these other stakeholders. The successful Hermanus WDM initiative carried out in the Western Cape province of South Africa was organised on such a basis.

Other activities that MWSA's can organise or take part in to create an awareness of WDM issues include:

- **National Water Week** in which government officials, and well-known celebrities, undertake activities, which are heavily publicised to create awareness for WDM issues;
- **Competitions** in which customers are encouraged to participate in some activity that highlights the value of WDM. For example, there may be a competition to develop a new water conservation slogan for the water supplier, or to demonstrate how much water can be saved in a house hold over a period of several months etc;
- **Articles or advertisements** in newspapers and popular magazines highlighting some aspect of WDM;
- **Water-Wise posters** displayed at garden centres for effective garden watering and how to minimise irrigation requirements;
- **Pamphlets** and/or leaflets on how to save water and use it more effectively, sent to customers with their water and electricity bills;
- **Stickers** on how to save water displayed in hotel bathrooms, and public toilets at airports, railway stations, government buildings, etc; and
- **Sponsorship** of appropriate events where WDM is promoted. For example, the MWSA may sponsor sporting events such as road races, golf tournaments, and football matches.

4.4.4.2.4 Industrial and commercial customers

In making information available to customers and in organising awareness campaigns, MWSA's should not forget to include the special interests of industry and commercial customers.

4.4.4.3 Information to be disseminated

4.4.4.3.1 General

Much information dissemination needs to start out by making four things clear. It needs to:

- Specify whose attention is the MWSA seeking attract;
- Let these customers know why they are important;
- Specify what behaviour change is being sought; and
- Specify why the change is essential, and the benefits to the customers concerned.

After these introductory comments, customers need to know how they can achieve the results required.

Assuming the changes being sought relate to the more efficient use of water or to pollution control, there is a considerable amount of material available from organisations both in Africa and overseas. It usually just needs adapting to ensure it is appropriate to local conditions. For most MWSA's with low UAW figures, more than 50% of the bulk water entering their system is delivered to domestic customers. Even for the other MWSA's, domestic customers are invariably the most important group of customers with respect to water usage. For most domestic customers in the SADC region, the majority of water is used in the home but for affluent domestic customers, more water is often used in the garden.

This sub-section will therefore briefly discuss

the information required by this group to manage their water better under the headings water-wise homes and water-wise gardening.

4.4.4.3.2 Water-wise homes

Water awareness in this field can focus on general behaviour change or on technology choice. Both should be considered but generally be separated, with the latter being stressed more in posters at hardware shops etc. Box 8 gives examples of the type of information that should be included to encourage behaviour change.

A third type of awareness creation links behaviour and technology by describing how to maintain infrastructure in good working order so that there are no leaks on customers' property (refer section 4.4.3). Such awareness creation would include pamphlets on:

- How to repair leaking taps by replacing the washer;
- How to repair or replace a toilet cistern inlet valve and/or the washer on a cistern outlet; and
- How to use a water meter to detect an invisible leak.

Other example of water-wise behaviour inside the home include:

- Brushing teeth using a mug not a

Box 8: How to become a water-wise family in the home

(Source: Camp 1997 quoted by Earthlife)

Usage by a family of 4 persons	Non water-wise family: usage per day	Percent of total usage	Water-wise family: usage per day	Percent of total usage
Bath	2 baths at a depth of 150 mm = 180 litres	28%	1 bath at a depth of 100 mm = 60 litres	20%
Shower	2 showers at 7,5 litres/min, for 5 mins each = 75 litres	12%	3 showers at 6 litres/min, for 4 mins each (taps off whilst soaping) = 70 litres	23%
Wash-basin	Water used freely = 30 litres	5%	Water used carefully = 20 litres	6%
Toilet	16 uses at 12 litres per flush = 190 litres	30%	Volume of flush reduced and short flush when appropriate = 51 litres	17%
Clothes washing by machine	5 uses per week = 90 litres	14%	3 uses per week = 54 litres	18%
Dish washing	Sink filled each time = 40 litres	6%	Water used sparingly = 20 litres	6%
Other washing by hand	Floors, windows, etc. = 20 litres	3%	Floors, windows, etc. = 15 litres	5%
Cooking and drinking	= 15 litres	2%	= 15 litres	5%
Total water used	640 litres per day		305 litres per day	52% savings

running tap; and
- Rinsing vegetables in a bowl not under a running tap or in the basin.

National policy should include compulsory regulations describing such issues as ensuring that the outlet of a pressure geyser's safety

Box 9: Issues related to water-wise gardening

Garden design: Gardens should be designed around indigenous plants, vegetables, and lawn grasses which are drought resistant and grow well when relying on rainfall without any additional watering.

Caring for the soil: Composting, mulching, reduces water losses due to evaporation by up to 70%. It also prevents excessive runoff from natural rainfall. Caring for the soil is thus very effective for reducing the need for any additional watering.

Watering times and duration: Watering should be restricted to the morning and evening. Evaporation is highest between the hours of 10am and 4pm, when watering should be avoided if possible. Water each area thoroughly to encourage plants to grow deep roots by allowing the water to penetrate deeply into the soil. Less frequent thorough applications are more effective than several smaller ones.

Hand watering: Hand watering makes it easier to use rainwater collected off a roof, and grey water, for gardening. However, users of grey water need to be warned that water used for washing babies' nappies is classified as black water and is as dangerous from a heath point of view as using untreated water straight from the toilet. Secondly, not all soaps or detergents are eco-friendly and many can damage your plants. Thirdly, fatty grey water can gradually block the pores of soils, especially clayey soils so that they do not drain properly, which is detrimental to some plants. Lastly, for Windhoek MWSA, even using grey water inefficiently for gardening is not encouraged, since domestic grey water is a valuable asset to the municipality, as it is treated to drinking water standard and recycled in the potable water supply system.

Hand watering can of course also be done using a hose connected to the MWSA system. If the water supply to the property is not pressure controlled, the hose should have its own pressure control device and a trigger-operated nozzle to minimise wastage.

Other watering methods: After hand watering, drip irrigation is the most efficient method of watering all parts of a garden except lawns. The next most efficient method is using fixed arc pop-up nozzles that spray a fine mist. So that such systems are not used when the soil is wet or it is actually raining, they should be switched on manually (and, perhaps, switched off automatically to prevent over watering because of forgetfulness). Alternatively, they can be set to operate completely automatically with a clock-timer 'supervised' by a moisture-activated controller. Conventional sprinklers are not very efficient because one cannot target the area to be watered.

(Sources: Rand Water undated, and Windhoek 1996)

expansion valve is visible, and some guidelines concerning water-wise fittings, technology and practices. But regardless of the details of national policy, MWSA's should have by-laws (refer 4.2.1.3.3 and box 4)

4.4.4.3.3 Water wise gardening

Water wise use related to the garden includes all outdoor activities. It is thus important for MWSA's to remember to make people aware that they should not use a hose to wash a car. Likewise, paved areas should always be swept with a broom and not hosed down. Finally there are swimming pools. These should always be kept covered when not in use to stop evaporation losses and for safety. Harvested rainwater rather than tap water can also be used to fill and top up swimming pools.

There are many issues related to water wise gardening and gardens. Box 9 provides notes on a few important issues.

4.4.4.3.4 Using town planning as a WDM tool

Large gardens tend to encourage high domestic water usage. Thus by approving and promoting smaller plots/erven, and the subdivision of larger ones, municipalities can help implement WDM. Box 10 briefly describes what one municipality is doing. Especially when large plots/erven are being subdivided, MWSA's need to be careful that integrated planning is properly carried out because although total water per customer is likely to drop, total water usage may still rise, and sewerage flows are almost certain to rise significantly, unless strict regulations exist with respect to the exclusive use of water-saving devices in the construction of such homes. General drainage also needs to be considered. Can the particular area handle higher peak run-off flows and will this be of any benefit in augmenting the MWSA's bulk water source? If not, regulations preventing additional paving, which encourages high run-off, may need to be strictly implemented. The overall socio-economic advantages of well-planned densification projects/programmes are high. Therefore, the above comments are made to ensure proper integrated planning, not to discourage such projects and programmes.

Box 10: Example of the role of town planning in WDM

In Windhoek, the capital of Namibia, the Council has allowed the erection of two dwellings on one erf. This densification of housing makes for a more efficient water supply system, and leaves smaller areas for gardening, leading to a reduction in domestic water use.

Large-scale townhouse developments are also being built. These developments typically allow only a small area for garden development and tend to lead to lower per capita water consumption.

4.5 Second-tier WDM options

4.5.1 Introduction

As cities grow, their demand for water grows until local easily exploitable resources can no longer meet the demand. When this happens bulk water costs rise considerably, until WDM options that were not economically viable in the past become essential tools in minimising cost increases. However, under these circumstances of growing demand, none of the options previously described in this Guideline should be overlooked while attention is additionally focused on second tier options, a few of which are described below in this section.

4.5.2 Maximising the conjunctive use of surface and ground waters

Many MWSA's, which obtain large quantities of water from surface water schemes, make no use of groundwater, and allow individual industries, institutions and households close to unregulated use of such water. As water becomes scarcer, due to growing demand, more of these MWSA's need to considers how best to make use of groundwater. Strategies for its use would involve various forms of conjunctive use designed to reduce total water delivery costs, whilst improving the surety of supply. The strategies could include:

- Largely keeping groundwater in reserve for use during drought periods, to increase the effective assured yield of existing surface water schemes;
- Depending on its quality, using groundwater to augment an MWSA's potable water supplies, or to augment non potable services only, on a more regular basis;
- Introducing artificial groundwater recharge to increase the total amount of water available by reducing the amount of evaporation from surface water storage.

Net present worth costing techniques could be used for decision making, whilst checking the results for sensitivity to errors in the basic hydro-geological data being used.

As for all groundwater usage, care needs to be taken to ensure its exploitation does not encroach on existing stand-alone community water supply schemes within or outside the MWSA's area of supply. Negotiations may also need to take place with other existing users, or an application may need to be made to the local/national licensing/regulating authority. Long-term monitoring is also essential to ensure that overexploitation does not cause environmental damage or the quality of the water to deteriorate.

4.5.3 Supplying industry with reclaimed effluent

Many industries involve processes and services that require considerable quantities of water, but do not require this water to have been treated to drinking water standards. MWSA's need therefore to develop a good relationship with industries with high water demands to seek out opportunities for supplying them with reclaimed effluent rather than drinking water.

As the demand for water rises in an MWSA's area of supply, it can become cheaper to supply such industries with reclaimed effluent at a cheaper tariff than they are currently being charged, than to augment supplies from a new source to meet the total demand.

4.5.4 Using reclaimed effluent for other non-potable services

Apart from industry, there are other potential users of reclaimed effluent including: municipal watering of decorative parks and roadway plants; various municipal and private sports venues and parks used for informal sport; and community vegetable gardens.

When considering the use of reclaimed effluents in this way, MWSA's need to ensure that all heath aspects are addressed.

In the case of watering decorative parks and roadway plants with reclaimed effluent, the only major health hazard that needs to be addressed carefully is the danger that water from the dedicated pipelines and delivery points could be used for potable purposes, for example through poor households making illegal connections.

In accordance with the multiple barrier principle, before the introduction of reclaimed effluent for such purposes, an in-depth awareness campaign should be implemented with ongoing smaller follow-up campaigns, the *outlets should be clearly and permanently* marked, and locked when not in use, and municipal staff who understand that the water is not potable should be present whilst watering is taking place.

For all sports venues, similar precautions would need to be taken, with the added proviso that the possibility of players with cuts being exposed to the water would need to be taken into consideration when defining the quality of the water being delivered. For community vegetable gardens even stricter water quality standards would have to be implemented, without lowering the other precautions significantly.

4.5.5 Reclaiming and treating effluent to potable water standards

Implementing this strategy needs careful forward strategic planning to separate dangerous industrial wastes from other wastes before treatment. Windhoek's MWSA, now a world leader in WDM, *did this some time ago with strict regulations as to* where industries with even suspect wastes may be located, and are now reaping the reward. Despite its arid surroundings, Windhoek still has sufficient water, without the importation of bulk water from distant catchments and without having any energy intensive distillation plant to produce *additional water.*

Although this situation will probably not last for ever, the city has a much larger customer base now to share the cost of expensive augmentation whenever it is required, without threatening further economic growth.

Another possible source of 'effluent' is storm water drains that do not discharge into the MWSA's source of bulk water. If such water is being considered the source needs to be examined and monitored carefully because, although the quality of the water may normally be reasonably good, overflowing blocked sewers and accidents can result in serious short-term degradation.

Planning would also have to include an Environmental Impact Analysis (EIA) since on the one hand the exploitation of storm water drains, as a supplementary water source, could improve the quality of water in local streams as polluted water is removed, whilst, on the other hand, it *could remove vital 'reserve' flows needed to* protect aquatic ecosystems.

5.1 Introduction

This section focuses on how MWSA's should develop WDM programmes in relation to existing infrastructure and customers. It does not deal with the question of improving equity for customers and potentials customers who are currently poorly served due to a lack of infrastructure. The guideline, as a whole, does deal with this issue, and municipal councillors and MWSA managers must ensure that, if not already in place, appropriate MWSA programmes are also developed to cater for the equity aspect of WDM, keeping in mind the need to plan for ongoing WDM once the infrastructure is in place.

For further information on setting up an MWSA WDM programme for existing infrastructure, refer annexures N and O of the SANS code of practice 10306 (1999). The management of potable water in distribution systems and the Krugmann and Mwasambili IUCN analytical paper, *The institutional requirements for WDM in southern Africa* (2003).

In order for a WDM strategy to be implemented by an MWSA, a number of steps need to be followed. The seven steps outlined in table 5

Table 5: Steps in the setting-up and maintenance of a WDM programme

Step	Action	By whom
1	Assessment report	MWSA with additional information from the bulk supplier or, preferably, from a more broadly based Water Services Forum
2	Broad implementation planning report	MWSA with some consultation with top management, possible funders, large customers and customer groups, if such groups exist
3	Organisational arrangements	MWSA
4	WDM awareness campaign	MWSA with help from media specialists
5	Target setting and required implementation programme to manage	
5a	Leakage losses/minimum night flows	MWSA and customers
5b	Pollution control	MWSA and industrial water users
5c	Additional UAW and unpaid bills	MWSA and customers
5d	Wise-water usage by paying customers	High usage customers, with active motivation and help from the MWSA and input from a more widely based Water Services Forum
6	Implementation to achieve previously set targets	MWSA and/or customers, as appropriate, generally with advise and/or help from MWSA
7	Monitoring and evaluating all outcomes	MWSA
8	Ongoing WDM maintenance programme, including a focus to manage the growth in demand	MWSA and customers with additional information from the bulk supplier, and from a more broadly based Water Services Forum

provide a framework within which to develop such a programme. The detailed programme implementation will depend very much on the findings or results of implementing the previous step. In addition, the implementation of some steps needs to commence before all the previous steps are complete. For example, the monitoring and evaluation will start during the *Assessment* step and should continue indefinitely. For other steps, there may be sound customer-relations or financial reasons for proceeding more cautiously. Keeping this limitation in mind, the rest of this section discusses each of these steps in more detail.

The section only discusses the approach. Actual WDM options should be chosen and implemented through re-reading the previous sections of this Guideline and through referring to the additional resource materials recommended towards the end of the Guideline.

From the outset, it is essential to plan in a holistic and integrated manner. This will mean documenting each step clearly and ensuring that all stakeholders are aware of the portions of the documentation that relate to themselves. It can also be useful, whilst keeping customers well informed about plans and progress in their area, to give them an understanding of how their area compares with other areas. Outstanding co-operation by a particular area can be rewarded by holding a braai during the report-back meeting. Although the use of consultants and outside specialists can be beneficial, it is essential that the MWSA be in overall control of the programme and that it builds up its own capacity through the involvement of these external resources.

5.2 Assessment report

The central objective of the assessment should be to get an overall understanding of what aspects of the MWSA's operations are in need of WDM implementation to enable it to perform its core functions effectively in a sustainable manner. To do this it needs to be financially sound and be able to supply the reasonable demands of all existing and potential customers at an affordable and competitive average tariff.

Competitiveness is measured by benchmarking against other MWSA's.

The six basic WDM-related occurrences that can impair the effective performance of an MWSA are:

- UAW comprising leakage and apparent losses;
- Customers not paying their bills or not managing their usage in terms of an equitable poor household's policy;
- Some customers using excess water and thus depriving other customers of a reliable 24 hour service;
- Poor wastewater management impacting negatively on the quality of return flows to water courses;
- The MWSA's total water demand (Is it receiving more water from its sources of supply than the sources can safely supply in the longterm?);
- The MWSA's growth in demand (Is the demand increasing at a rate which indicates it will soon rise to a level that cannot be delivered from existing sources?).

The assessment needs to cover these six basic aspects of the MWSA's business. Where its supply area has already been divided into districts, sub-districts and zones, a table recording the first four aspects at zone level together with sub-district and district subtotals should be drawn up, before finally reporting on the overall situation for all six aspects. UAW is made up of:

- Leakage from the distribution system;

- Additional UAW caused, for example, by connections for which no records exist;
- Non-functioning and inaccurately functioning meters; and
- Customers by-passing or tampering with their meters.

There can also be leakage on customers' properties downstream, which in poor areas can contribute to customers not paying their bill because of affordability problems.

Minimum water-supply night-flow figures can give a good estimate of the combined leakage losses from the MWSA's distribution system and customers' properties. Minimum wastewater night-flow figures give an indication of leakage losses on customers' properties. Thus, depending on where meters have been installed, it may be possible during the assessment to estimate the individual components of the UAW as well as checking if there are serious leakage losses on customers' properties.

The overall approach in carrying out the assessment and writing the report should be to obtain as much information as practical in all areas where any of the six basic WDM-related occurrences indicate that they are impairing, or will in the near future impair, the effective performance of the MWSA, without causing any material delays in moving to step 2 and without spending any significant amount of capital in modifying the infrastructure in any way.

5.3 Broad implementation planning report

Once the assessment is complete, a small team needs to draw up a broad implementation planning report to overcome all the MWSA's WDM shortcomings, in order of criticality. The objectives of the planning report will be to motivate implementation and obtain funding. The motivation needs to be carefully considered. It needs to bring awareness to all stakeholders, and to positively motivate them. Stakeholders will include the MWSA's board members, local politicians, possible funders, staff members, and the MWSA's customers. All need to support the reports contents. If not, as frequently happens, approval will be obtained from the higher tiers and funding will be obtained, but implementation will become an ordeal because of a lack of support from operational staff and customers. These latter two shortcomings can cause lengthy time delays and severe cost overruns.

Table 6: Section headings for a typical WDM implementation planning report

Chapter	Title
-	Executive summary
-	Table of contents
1	Main points from the assessment report
2	Objectives of the plan (including initial and long-term target setting and the financial and other benefits that will result)
3	Organisational arrangements for implementation
4	Implementation methodology
5	Costs (including payback period)
6	Time framework

The implementation recommendations will differ significantly from MWSA to MWSA and will depend on the findings contained in the *Assessment report.*

Table 6 indicates the sections of a typical WDM implementation planning report. In drawing up the planning report, it is advisable to estimate costs carefully and not to leave anything out. In addition be methodical and thorough about setting targets and timeframes. This warning relates directly to the question of ensuring full support from operational staff and customers, before implementing a WDM programme, which may initially appear to benefit top management almost exclusively, and/or to discriminate unfairly against some customers. Time is needed for awareness creation, discussions, and broad consensus development, and for allowing customers to choose between options. WDM implementation is brought about through significant behaviour change, which always takes time if it is to be done whilst deepening democracy and cooperation, rather than engendering resistance and alienation. Technology is a great help in facilitating that change but it cannot bring it about.

It is sometimes advantageous to include options in the report so that managers and funders, and not just customers, are given choices. Before this is done in any detail, it is sometimes worthwhile trying to assess whether these high-level decision makers would prefer a concise simple report with no options, or a slightly longer more complex report with options.

5.4 Organisational arrangements

All MWSA's need a WDM champion in a broadly based managerial position with a high degree of authority. This champion will be responsible for the WDM programme. In large MWSA's the job is likely to be a full-time one, in which case it is usually better for the function to be a cross-cutting services function, rather than a line management one. The WDM programme manager can then also be responsible for setting standards for other line managers, such as the New Works, Maintenance, Billing and Customer Care Departments, and for ensuring that the whole organisation understands the assessment report, and supports the broad WDM implementation planning report. Thereafter, it is usually advantage if the WDM programme is managed through these existing line departments, rather than through a new parallel structure, so as to encourage integrated teamwork and to make ongoing maintenance of the programme easier. Confer rewards for exceptional performance and include all staff members who have genuinely contributed to the outcome, regardless of which department they work for.

5.5 WDM awareness campaign

The awareness campaign needs to go beyond generalities and reflect the particularities of the situation in the MWSA that is planning to implement the WDM programme. Therefore, the awareness campaigns need to cover the following items:

- Why the WDM programme is necessary:
  - The consequences of no action
  - The advantages and challenges of implementation
- What the MWSA will be doing itself with respect to managing leakage losses;
- Broadly what the MWSA will be expecting from different sets of customers;
- In areas where affordability is an issue, how the MWSA will assist customers to become water-wise users to reduce their bills and, if they so wish, to manage their usage within the MWSA's poor households relief policy; and

- What different service levels and payment options will be offered to new customers, and customers in areas that will be upgraded to improve equity, together with the corresponding charges.

Again, a good awareness campaign can work wonders in terms of preparing customers for implementing WDM, and it is often helpful to involve specialist organisations in preparing and implementing such a campaign. However, the MWSA must be deeply involved in the preparation of the campaign, agree with its content, and truly develop a caring serving people-first attitude towards all its customers. If this is not done, no matter how good the awareness campaign is, customers will become antagonised once implementation of the programme begins, when they experience a gulf between the awareness campaign and the MWSA's actions.

The awareness campaign will also need to include meetings where customers can interact with the MWSA's staff members and discuss the programme. In the long term, customers need to be allowed to question the targets set for the MWSA itself, and to become involved in the target setting related to their own behaviour.

However, be aware: it is dangerous to try and set firm usage and credit control targets for customers based on estimates in the assessment report, before the MWSA and each customer has a full understanding of their own water demand, and of the components of the UAW in their zone. These will be obtained in the initial phases of implementation when leakage losses related to the distribution system and to customers are being brought under control.

Generally, if any significant changes are being made to how customers are to be charged for water usage, there needs to be a transition period, of up to twelve months, during which customers will not have to pay higher bills just because, for example, their water is being metered. To date, MWSA's have been very unimaginative with respect to how arrears will be dealt with; even for customers who immediately use less water than their previously deemed consumption once a meter has been installed.

Where households have previously had full pressure unregulated on-site connections, it is recommended that this be allowed to continue for up to twelve months after the WDM programme has been implemented, provided the customer's consumption is gradually being reduced to what they can afford. Special by-laws need to be promulgated, giving such customers temporary rights during the commissioning of the WDM programme. No customer who already has an unregulated on-site connection should be forced to change to a regulated connection (Hazelton 2002a), but should always be offered such a connection as an alternative to being cut off completely.

It is accepted that MWSA's require the right to disconnect on-site water connections when customers tamper with the system for the purpose of committing fraud, or do not make every effort to manage their water usage to an equitable basic amount when they have affordability problems. However, cutoffs and the lowering of existing levels of service should always be regarded as a last resort when customers do use only a basic amount of water; and, in all cases where cut-offs are implemented, regardless of the reason, the MSWA still has a duty to ensure that these customers can obtain an adequate supply within a reasonable distance.

Starting with section 2.3, and continuing, in particular, with sections 3.2 (refer table 2), and 4.3.3 (including figure 6), this Guideline has

extensive ideas to help MWSA's face the challenges of serving poor customers better and sustainably from existing schemes (and of raising funds to achieve and surpass the water services MDGs). Improved equity must always be a core objective of WDM.

5.6 Target setting

Table 5, step 5, sets out four WDM-related targets that need to be set, and suggests that they ought to be attended to in the order in which they are listed. This recommendation is made on the assumption that the MWSA's urgent reasons for requiring a WDM programme for existing schemes relate to poor financial performance and the need for pollution control. If, however, the assessment report indicates that other WDM occurrences, related to total demand and growth in demand, as listed in that section, are major problems, less stringent attention may have to given to the four WDM targets listed in table 5 in the short term, whilst all the six WDM-related targets listed in section 5.2 are dealt with concurrently as an emergency intervention until the MWSA's supply dams are full.

5.6.1 Minimum night flows

Minimum night flows relate to leakage losses associated with both the distribution system and customers' properties. Section 4 indicates how such losses can be reduced. Reference should be made to that section, plus the further reading list, to select the technical options to reduce these leakages and to learn more about target setting. In a guideline the two important things to recommend are:

- It has become standard practice when implementing a WDM programme for the MSWA to carry out once-off repairs to reduce customer property leakages in poor areas to a negligible figure.
- It is essential that MWSA's set high standards in terms of reducing leakage losses from their own distribution system.

Despite it being standard practice for MWSA's to carry out once-off repairs to reduce customer leakage losses, little is known about the sustainability of such initiatives. However to encourage sustainability the plumbers carrying out this work need to explain to households:

- What they have done;
- How households can do many of the simple maintenance jobs themselves;
- Where to buy maintenance tools and spares; and most importantly
- How simple checks for leakage can be carried out on metered connections.

5.6.2 Pollution control

Again, MWSA's or their related wastewater utilities need to lead by example. Therefore, targets need to be set in relation to improving or maintaining the quality of the water in the local watercourses. By-laws, inspections and the imposition of fines or jail sentences in cases of flagrant abuse of the environment are needed to implement pollution control.

5.6.3 Additional non-revenue-producing water

In the context of a hierarchy of WDM targets, additional non-revenue-producing water refers to the additional UAW described in section 5.2 plus the loss of revenue caused by customers not paying bills that they have received.

Throughout the SADC region high additional non-managed, non-revenue-producing water is commonplace, and, as indicated in section 2.3, it is leading to a continuing downward spiral away from quality service delivery in the areas where this ineffective management is not being systematically corrected. Where non-payment has become a pattern for an extended period,

customer water management has invariably also suffered seriously. Thus, on the one hand, a marked change in behaviour by MWSA staff is required, in addition to the change already achieved to manage leakage losses, so that all customers receive correct bills. On the other hand a marked change in behaviour by the MWSA's customers is required, so that they reduce their water usage whilst simultaneously starting to pay any equitable charges they receive for this reduced usage. It is thus a great motivator for an MWSA to have the success and example of having reduced its own leakage losses before focusing systematically on reducing additional non-revenue-producing water.

This is when the awareness campaign needs to be strengthened, to make clear both the MWSA's wish and drive to serve its customers well, and the necessity of reducing non-managed, non-revenue-producing water, to enable this to happen. The more awareness achieved and the more trust developed (or distrust overcome), the more likely that demand will fall before billing and follow-up credit-control have improved, thus making it easier for customers to afford equitable bills when they start receiving them. Even if this should not happen, improved monitoring illustrating that UAW and total demand have already fallen due to significantly reduced leakage will help to get customers and MWSA's working together as a team. Regardless of setbacks:

Persevere in confidence but remain flexible.

- If customers say they accept the MWSA's objectives, but suggest an alternative way of achieving them, consider the alternative sympathetically and if it is at all practical, agreed to try it, **on the strict understanding** that one of the MWSA's original proposals will be reverted to in the case of failure.
- Continue to listen to customers' fears and negotiate modifications to programme details.
- Do not rush, even if the programme has to be revised.

Targets should be less negotiable, but always listen to customers' fears and consider what can be done about them through constructive changes to national, local or MWSA policy. Possible outcomes include:

- More explaining, convincing and/or motivating of customers is necessary.
- The reply for now is 'no' but we will discuss your fears with higher authorities.
- In exceptional cases, it may be correct to adjust targets.
- Improved basic needs allocations based on per capita rather than per house-hold allocations.

When feeling despondent, remember that Windhoek, Bulawayo, Mogale City and Hermanus have all succeeded previously.

5.6.4 Wise-water usage by paying customers

All the previous WDM measures need to be implemented as soon as practical throughout the MWSA's area of services delivery, although in a structured, non-rushed manner. Encouraging paying domestic, institutional, commercial, and industrial customers to manage their water usage more wisely than has been urged in the previous three sub-sections will depend on the situation with respect to the last three basic WDM-related occurrences that can impair the effective performance of an MWSA, as listed in section 5.2.

The main objective of ensuring that paying customers use water wisely is to prevent the development of new water resources in a non-optimal manner, taking all water uses, both consumptive and non-consumptive, into

consideration. A secondary objective is to prevent wasteful investment in distribution infrastructure for short-term gain whilst countries and MWSA's also need to be more attentive to calls for greater equity in terms of levels of supply and adequate basic needs water allocations to poor households.

These objectives should not be interpreted narrowly within the confines of the MWSA's supply area, but should take into account integrated water resource management for the whole catchment, and even adjacent catchments where there may be a valid shortage of water resources.

These issues should be catered for through a Water Services Forum facilitated by a more broadly-based institution such as a Catchment Management Agency, a district branch of a National Water Authority or a bulk water supplier. If such organisations do not exist in an area, a group of MWSA's can set up their own forum, and rotate the venue and chairperson to achieve broader participation. Regardless of who facilitates the management of a Water Services Forum, sound national Water Resource Policy is required to ensure that it functions smoothly and effectively.

Thereafter, individual MWSA's need to keep all their customers fully informed of the deliberations that take place at the Forum, so that together they can set and monitor targets for medium- and long-term water usage by all groups of customers.

5.7 Implementation to achieve previously set targets

The key to successful programme implementation, assuming that the preparation and post implementation steps are carried out competently, is to ensure continuity in moving vertically from the implementation of one step to the next logical one, whilst simultaneously moving horizontally from one zone to the next.

There will thus be a continuous movement in both the vertical and horizontal direction until all the urgent targets have been met, in all the MWSA's zones. Table 7 illustrates the required vertical movement.

5.8 Monitoring and evaluating all outcomes

As each step is being implemented in each zone it needs to be monitored and evaluated, and

Table 7: Vertical implementation movement

Zone 1 (Refer table 5 for definitions of targets)	
Set target 5a	Set target 5b
Implement chosen WDM options to achieve target 5a	
Demonstrate through M&E that target 5a is close to being achieved	Implement chosen WDM options to achieve target 5b
Set target 5c	
Implement chosen WDM options to achieve target 5c	Demonstrate through M&E that target 5c is close to being achieved
Demonstrate through M&E that target 5c is close to being achieved	
Check required programme for the implementation of target 5d and plan immediate implementation or implementation as part of the low-key continuing maintenance programme	
Institute ongoing maintenance programme, including a focus to manage the growth in demand	

corrective action taken if necessary. During this process, an information management system should be set up to facilitate the management of the ongoing WDM maintenance programme described in section 5.9.

5.9 Continuing WDM maintenance programme

As the implementation of the initial WDM programme is completed step by step and zone by zone an ongoing maintenance programme needs to be set up, so that the achievements attained are sustained indefinitely.

The ongoing programme also needs to include a focus to manage the growth in demand as per the objectives set out in sub-section 5.6.4. The existence of this ongoing programme should also make it easier to implement any newly promulgated WDM or pollution control policy or regulations.

5.10 Case study: Water supply in Windhoek

Windhoek's combined WDM and WSM programme is one of the most successful in the world. With the cooperation of all stakeholders, despite the shortage of accessible water resources, it ensures the sustainable delivery of sufficient water in the city so that normal institutional, commercial, and industrial growth is not curtailed. Until poorly planned over-concentrated growth causes congestion and uneven development in a country, such availability should be a core objective of any integrated WDM programme.

In fact, WDM champions should never become so enthusiastic that they are stifling the normal orderly growth of a town or medium sized city by discouraging all new investment in Water Resource and Water Supply Management. Such a state may have been reached in

Box 11: Highlights of the combined WDM and WSM programme implemented in Windhoek

Method of saving	Volume saved in 1998 (Mm^3)	Value of Annual Savings ($ Million*)	Expected Savings in 2005 (Mm^3 average)	Value of Annual Savings ($ Million)
Water Demand Management	5,24*	16,6 O&M 3,5	12,6	38,8 O&M 8,1
Water Reclamation **	2,6	1,7	7,5	5,0
Dual Pipe System	1,1	2,0	1,7	2,7
Artificial Groundwater Recharge	0	0	2,0	3,8

* Values are calculated according to bulk supply cost in 1998.

** A large percentage of this volume evaporates, because of storage in open reservoirs, real benefits will only be realised with underground storage

Bulawayo, Zimbabwe? That is why this Guideline ends with boxes 11 and 12, which illustrate the highlights of Windhoek's combined WDM and WSM programme.

Programmes such as Windhoek's have clearly visible results in terms of an MWSA's improved financial strength and a reduced demand for water. Figures 7 and 8 show the reduced demand for water in two MWSA's where a WDM programme was implemented. Figure 7 reflects the results of Mogale City's programme. This programme only involved basic WDM options and was primarily implemented to improve the financial position of the MWSA.

Figure 8 reflects the results of eThekwini MWSA's programme. Apart from basic WDM options, this programme included the construction of an effluent reclamation plant to supply industries with recycled water. By supplying industry with recycled water the urgent need to construct additional bulk water supply and storage facilities, which would have increased water supply costs of water, has fallen away and given eThekwini time to introduce other WDM options to maintain the total demand for water at current levels, despite population growth and increased water usage by the poorest households.

Box 12: Vulnerability of municipalities in drought situations

The municipality of Windhoek made a loss of N$10,2 million as a result of revenue instability caused by the 1996 drought. There is a backlog in service provision in the informal settlement areas while approximately 10% of the poorest residents benefited very little from the existing rising block tariff due to very low water consumption

A reduction in water consumption through the use of WDM on a day-to-day basis in Windhoek has reduced the vulnerability of the city to drought. The drop of yearly consumption from 20Mm^3 in 1994 to just over 16Mm^3 in 1997 illustrates this point. Pricing, combined with various non-market mechanisms and direct interventions, e.g. advertising campaigns, media involvement in awareness campaigns in schools and community development programmes, decrees etc. have kept water demand in Windhoek at 1990 levels despite a 43% increase in the population over the same period

(Source: van der Merwe 1999)

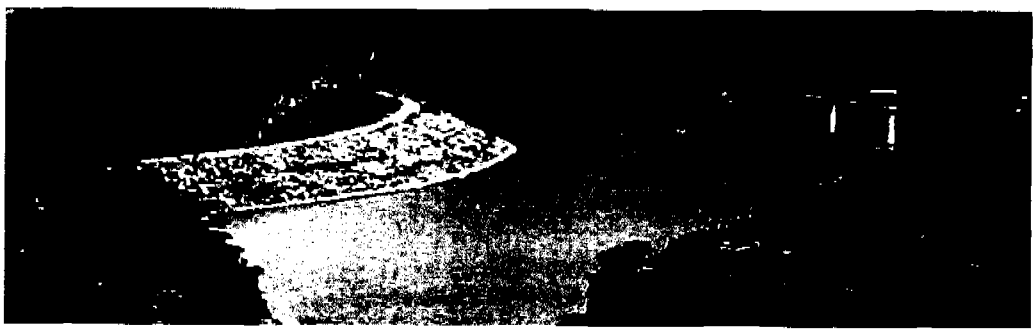


Figure 7: Water delivered to Kagiso, kℓ/mth, from April 1990 to October 2001

(Source: Unpublished Mogale City, July 2001 to June 2002 water sector business business plan, compiled by Michael Rabe, Deputy Director, Water)

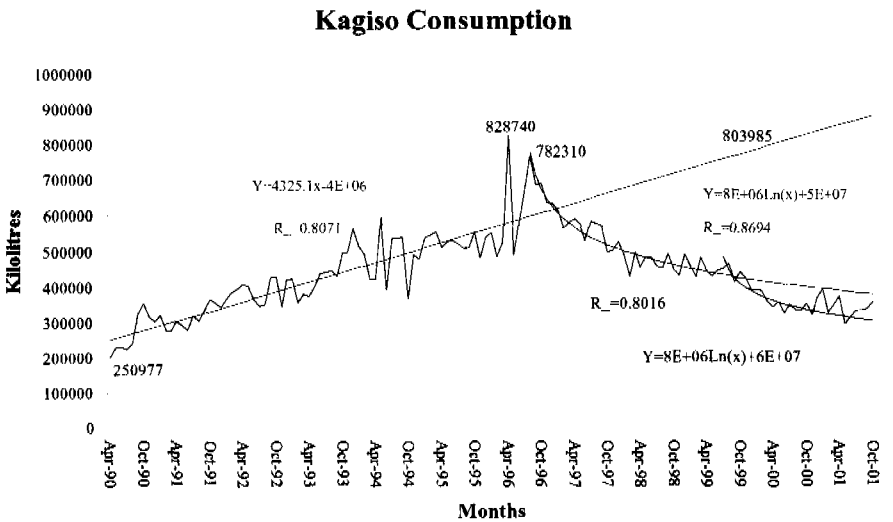
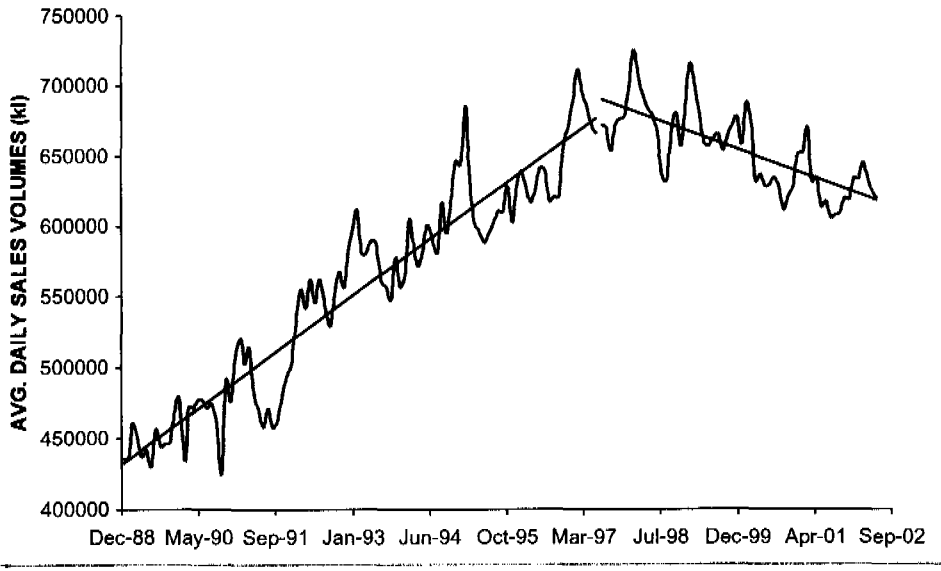


Figure 8: Water demand in eThekwini 1999 to 2002

(Source: Unpublished internal eThekwini Metropolitan Municipality report)



6.1 Further reading not included in the bibliography

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Development of a framework for the economic evaluation of water conservation/water demand management measures with specific application to decision-making in Cape Town	Hugo van Zyl, Anthony Leiman	2001	RSA
Leakage reduction projects undertaken by RW	R S McKenzie et al	2002	RSA
Water Demand Management in Practice	J S Buckle for UN Habitat	2002	RSA
Environmentally sound water management	Edited by N C Thanh and Asit Biswas	1993	Generic
Alternative solutions for water supply and sanitation in *areas with limited financial resources*	Lyonnaise Des Eaux	1998	International
Toward sustainable management of water resources	I Serageldin	1994	International
Water Resources Management	K William Easter et al	1994	International
A guide to water saving in South Africa	S Camp	None	RSA/generic
A Legal framework to pollution mangagement in the Durban Metropolitan area	Durban metro services and Deloitte and Touche	2000	RSA
Gudelines for setting water tariffs	WRC Palmer	2000	RSA
Estimation of the residential price elasticity of demand for water by means of a contingent valuation approach	WRC Veck and Bill	2000	RSA
Sanitation Services model manual	WRC Palmer Development group	1998	RSA
Water Supply Services model manual	WRC Palmer Development group	1998	RSA
Background and overview of management of community water and sanitation training programmes for local government training programme	WRC	2000	RSA
Namibia's Water A decision makers' Guide	Edited by Piet Heyns et al	1998	Namibia
Water in Namibia A resource package to develop awareness of water	Vivienne Ward	1994	Namibia
National survey documents on benchmarking different industries	WRC consultants	1986	RSA
Wise water management – a demand management manual for utilities	Edited by Stuart White	1998	Australia
Conserving and valuing water is our priority The learners handbook	RW youth education program	1999	RSA
The development of procedures for the control of UAW in water distribution systems and for the reduction of water loss	WRC	1997	RSA
UAW – Guidelines for the formulation of a policy and implementation of practical methods for the control thereof	WRC de Vallier	1997	RSA
Namibia water resources review – key issues paper	Team Leader	1999	Namibia
Evaluating Urban water conservation programs: A procedures manual	Planning and Management Consultants, Ltd	1993	USA
Sink or swim: Water and the Namibian environment	D du Toit	1995	Namibia

6.2 Website links

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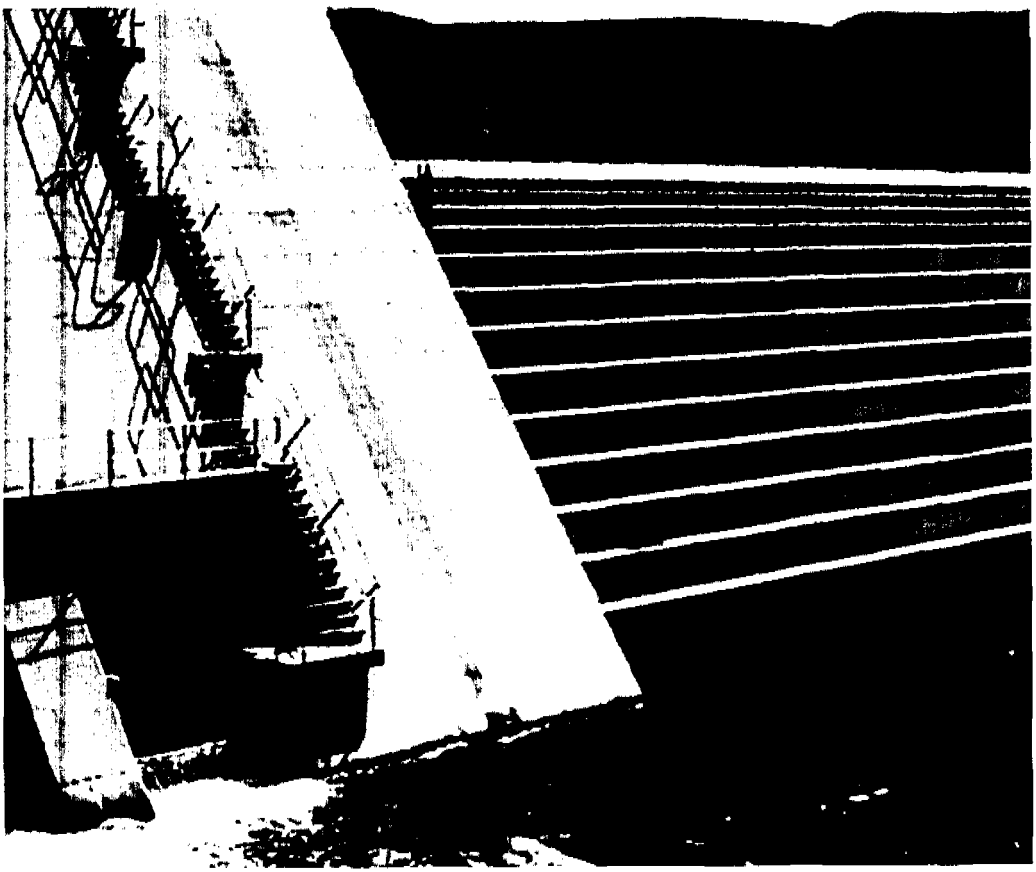
- www.unesco.org/water
- www.awwa.org
- www.savewater.co.za/
- www.irn.org
- www.wateronline.com
- http://web.mit.edu/urbanupgrading/waterandsanitation/home.html
- http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/index.html (Climate prediction centre – El Nino watch)
- http://sea-river.com/eau/aqua05_2_gb.php (UN state of the world's water)
- www.un-urbanwater.net (The site of the Water for African Cities program of UN-Habitat)

A search on a reputable search engine, such as Yahoo.com or Google.com, with the phrase "Water Demand Management" or other more focused search request will direct the searcher to find a host of sites, many of which will be useful or extremely useful.



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