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Water for Asian Cities Programme

Water Demand Management Strategy and Implementation Plan for INDORE

The Energy and Resources Institute

Water Resource Planning and Conservation

Government of Madhya Pradesh

ADB

UN-HABITAT

Water for Asian Cities Programme

Water Demand Management Strategy and Implementation Plan for INDORE

Part – I

Technical Aspects

Part – II

Financial, Institutional and Policy Reforms

The Energy and Resources Institute
Water Resource Planning and Conservation
Government of Madhya Pradesh
ADB
UN-HABITAT

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UN-HABITAT owes a great deal to Water Resources Planning and Conservation (WRP), South Africa in commissioning this Project and the support provided by The Energy Resources Institute (TERI). UN-HABITAT would like to acknowledge the contribution of Indore Municipal Corporation, the Public Health Engineering Department and all other concerned Organisations for their innovative inputs into the Project.

Message

Jayant Kumar Malaiya
Minister
Urban Administration & Development
Housing & Environment
Government of Madhya Pradash

UN-HABITAT under the Water for Asian Cities Programme in India is working in Bhopal, Gwalior, Indore and Jabalpur in support of the ADB financed Urban Water Supply and Environmental Improvement Project of Government of Madhya Paradesh for the improvement and expansion of urban water supply, sewerage and sanitation, water drainage and solid waste management in these cities. All four cities, have substantial population presently living in slums having difficulties in accessing both water and sanitation facilities.

UN-HABITAT has undertaken the Water Balance study in the four cities which revealed that the Non-Revenue Water (NRW) is between 33 and 60% in Bhopal, Gwalior, Jabalpur and Indore. The reduction of NRW can lead to availability of surplus water for the population in the slums, which are presently not having sufficient access to piped water supply.

I am pleased to learn that UN-HABITAT has developed a strategy and action plan on Water Demand Management (WDM) jointly with Urban Water Supply and Environmental Improvement (UWSEI) Project, Madhya Pradesh which proposes technical, financial and institutional measures to reduce NRW.

I hope that the implementation of the strategy and action plan will help the local bodies in improving the water supply condition of the four project cities and attainment of the Millennium Development Goals.

J.K. Malaiya

Jayant Kumar Malaiya

Preface

The most important source of water for the city of Indore is the Narmada Water Supply Project which involves pumping water some 70 kms from Narmada River. The estimated water availability for the city is of the order of 199.5 MLD at maximum and 171 MLD at minimum to serve over 1.5 million population. A significant fraction of the water is also supplemented by ground water through tube wells. The actual situation is much less with estimated per capita availability of around 84 lpcd at maximum and 72 lpcd at minimum. The water supply in the city is unsatisfactory on account of high losses and inefficiencies in the system.

The growth of urban population, estimated at 4% to 5% per annum, and the rapid urbanisation has significant influence on water demand and exerting pressures on the available water sources, leading to over exploitation of groundwater resources. Around 68 per cent of city's population receives water between one or two hours every alternative day, while the other areas augment supplies by water tankers. Many residents use their own tube wells. Non-revenue water is estimated at around 30 per cent. Absence of data on leakages and the reliability of the available basic data on operational aspects of water supply has been the major concern in arriving at water balance audit. The water supply problem in the city of Indore is attributed more to the lack of infrastructure and current management practices rather than lack of water availability.

UN-HABITAT in partnership with Water Resource Planning and Conservation (WRP), South Africa, commissioned the Project to develop a Water Demand Management Strategy and Implementation Plan for the city of Indore to provide useful directions to several other initiatives already being facilitated as well as strengthen the capacities of The Energy Resources Institute (TERI), India, for associating in such projects. WRP has prepared the technical aspects of the Water Demand Management and Implementation Plan, while the financial, institutional and policy reforms have been developed by TERI.

The Publication presents a comprehensive reforms package by developing Water Demand Management strategy and implementation plan for the city of Indore involving institutional, financial and technical issues in water supply and is aimed at the efficiency improvements in the management and utilization of water. The focus is mainly on the water balancing systems, developing information-base on GIS platform, capacity building and approaches for reducing unaccounted-for water, for an efficient and effective distribution of available water supply. The strategy and the implementation framework illustrated in the publication would not only enhance awareness but also provide the basis for formulating effective Water Demand Management policies.

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Water Demand Management Strategy and Implementation Plan for INDORE

Part – I

Technical Aspects

Contents

Abbreviations

ADB	Asian Development Bank
AZP	Average Zone Point
CAD	Computer Aided Design
DMA	District Metered Area
GIS	Global Information System
ILI	Infrastructure Leakage Index
IUDMP	Integrated Urban Development in Madhya Pradesh
IMC	Indore Municipal Corporation
IWA	International Water Association
kl	Kilo Litre/ Cubic meter
km	Kilo Meter
MIS	Management Information System
MNF	Minimum Night Flow
Ml/d	Mega Litre per day (1 Mega Litre = 1000 Kilo Litre)
m^3	cubic meter/ Kilo Litre
NRW	Non Revenue Water
PRV	Pressure Reducing Valve
Rs.	Rupees
UAW	Unaccounted-for Water
WC	Water Conservation
WDM	Water Demand Management

Note:

Rs. 1 crore: Rs. 10 million

Rs. 1 million: Rs. 10 lakhs

Rs. 10 lakhs: Rs. 1,00,000

Executive Summary

Introduction

The UN-HABITAT has embarked on an investigation to develop a Water Demand Management strategy for the city of Indore that will hopefully provide useful support and direction to several other initiatives being supported and facilitated by other organisations including the World Bank and Asian Development Bank. The strategy proposed in this document should be considered as a draft strategy which will require the support and "buy-in" of both the water utility as well as the different funding organisations involved in the upgrading of the Indore water supply. For this reason, the WDM strategy has been restricted to key focus areas which are essential to the efficient management of any water supply system.

Where possible, specific actions have been suggested which will help to improve the situation and must be implemented at some stage if any meaningful progress is to be achieved. It must be noted, however, that without major augmentation and very significant investment in the water supply infrastructure, the possibility of providing a 24-hour supply throughout the City of Indore is unlikely to be achieved in the near future and unrealistic expectations in this regard should not be raised.

The WDM Strategy suggested for the City of Indore is considered to be both practical and methodical, concentrating on key essential issues rather than the "nice-to-have's" which are often included for areas with continuous supply.

Due to the fact that the water supply to Indore is unlikely to be augmented before 2010, it is not practical to suggest certain measures until such time as the new supply is available. For this reason, the proposed WDM strategy has been split into short term actions and longer term actions. The short-term actions should be considered as a matter of urgency to be implemented as soon as possible and certainly within the next 5 years while the long-term actions are of a lower priority (although still important) and should be implemented over a 10 to 20 year time frame.

Addressing the problems in the Indore water supply system will take many years and is unlikely to be completed within less than 20 years. The actual progress will depend upon the commitment of the governing institutions as well as the availability of the funds required to complete the work.

Water Demand Management Strategy

A summary of the aspects covered in the WDM Strategy is provided in **Table 1**.

Table 1: Summary of Water Demand Management Strategy

Item	Short Term Recommendations	Long Term Recommendations
District Metered Areas (DMA)	After recommendations were made by WRP (in 2005) regarding sectorising the supply network in Indore the IMC has started with a process to split Indore in 12 large zones (DMA's). (March 2006). Once the new Narmada Pipeline has been constructed it is recommended to identify one or two smaller pilot DMA's (between 2000 and 5000 connections) where the supply could possibly be sustained for longer periods (i.e. over 12 hr /day). These pilot DMA's could then be used to test several of the WDM recommendations on a smaller scale before applying it to the whole city area.	In the long term, the whole of Indore should be sectorised into DMAs of between 2000 and 5000 properties. The practicality of this should be investigated for each area separately and should be checked with Engineers from the IMC.
Bulk Metering	Bulk meters should be installed on inlets and outlets of all water purification works. 7 Meters in total. (See **Appendix A** for schematic drawing on proposed meter locations). Approximately 11 meters should be installed at selected positions on the trunk mains as shown in **Appendix A**. The suggested location of these bulk meters are shown but must be confirmed by the Engineers from the IMC. The inlets to the initial 12 management zones should be metered. (These zones were identified by IMC). These meters should preferably be placed upstream of the zonal valves that are closed on a daily basis to distribute the water – to ensure that the meter will always be filled with water.	It is recommended that bulk meters be installed on the outlets of all elevated water tanks as well as at the entrance to all zone-metered areas – the details of which must first be clarified with the IMC Engineers. This task is likely to take place over a 10-year period. It should be taken into account that water meters will not be accurate if water supply is not sustained (i.e. air in pipelines). The metering should, therefore, be prioritised to meter the positions with constant supply.
Bulk Revenue Meters	It is recommended that the meters for the top 10 consumers are replaced as soon as possible with reliable meters capable of being logged. The top 50 consumers in Indore should be metered and billed accordingly based on the meter readings. (Consumers that was previously un-metered). This should also include metering some of the larger government buildings to show that IMC is also monitoring the water supply to their own buildings. A bulk meter should be installed at the point where the water tankers are filled each day.	It is recommended that all bulk revenue meters are replaced and a proper billing system is established to streamline the billing system. Standards for meter installations and calibration procedures should be developed by/for the water utility to ensure that all revenue meter installations are of an acceptable quality and of similar design.

Item	Short Term Recommendations	Long Term Recommendations
Domestic Consumer Meters	It is recommended that two or three pilot areas are identified where domestic meters can be installed. Areas with approximately 50 to 100 properties will be ideal for this exercise since the cost of the meters and installations will be relatively small. Such metering will enable the water utility to evaluate the value of domestic metering at a small scale before committing to full scale domestic metering which may or may not be successful in Indore. The domestic metering "Pilot Projects" will have a 2nd use in that they will help to establish the daily or monthly water use per connection or per capita – one of the key uncertainties in the current estimation of water demands in the system.	No recommendations on the long-term implementation of domestic meters can be made at this stage. Ideally every connection should be metered. In the case of Indore, however, it has yet to be shown that full scale connection metering is feasible and the results from the pilot studies should be assessed before approving such a large investment.
Monitoring UAW	Once the first phase of bulk meters are installed the process of monitoring should commence. The bulk meters should be logged and analysed where possible. Unfortunately the minimum night flows can only be determined once meters are installed on the outlets of the water towers.	It is recommended that the level of leakage in all discrete zones be analysed annually using standard techniques (e.g. analyses of minimum night flows etc) as and when such zones are established and the appropriate bulk management meters installed.
Water Audit	The data used to calculate the Infrastructure Leakage Index (ILI) should be verified and updated where necessary by the Engineers of IMC. The calculated ILI for Indore was 400 which is one of highest in the world. It might be that with more accurate data the ILI would come down to a more realistic value. See **Appendix H** for details	It is recommended that the water balance/audit be continuously updated to incorporate the latest and most accurate data. Two electronic copies of the software have been provided to IMC for this purpose.
Pressure Management	It is recommended that the water pressure be monitored at selected points in the distribution system to establish the daily pressure profiles experienced in the system. It may be possible to consider some form of pressure management at certain points in the system but this cannot be established until some accurate pressure information has been collected. Once pressure information is available it might be considered to reduce pressures in selected positions only during night time.	No long term recommendations can be made with regard to pressure management at this time.

Item	Short Term Recommendations	Long Term Recommendations
Mains Replacement	It is recommended that a single policy regarding mains replacement be developed for the City of Indore in which a target percentage of mains replacement per year should be provided. This would involve using GIS coverage for the full Indore area and highlighting all pipes of different ages, materials, conditions and number of bursts. The most critical sections of pipe could then be identified and prioritised for replacement.	It is recommended that the value of the water supply system is assessed and that 2% per annum is allocated to maintenance and repair from which the mains replacement programme can be funded.
Active and Passive Leakage Control	After the initial visit of WRP to Indore (2005) the IMC has started with a process to identify and fix visual leaks in the distribution system. It is recommended that IMC take this initiative further and that full time leak detection teams be established. It is recommended that personnel be trained in the art of leak detection and repair and that a leakage control team (or teams) be established within the water utility. It is recommended that the whole distri-bution system is surveyed using normal simple sounding techniques. (Sounding can only be undertaken during times of water supply). The visible leaks on the Narmada pipeline should be repaired. Guidelines to repair leaking pipelines under pressure are provided in **Appendix B**. These guidelines should be evaluated and used on the discretion of the engineers from the IMC.	A full-time active leakage control team (or teams) should be established to carry out sounding at regular intervals – (annually if possible).
Planned Maintenance	It is recommended a valve audit be undertaken for all valves in the system. They should be inspected carefully, numbered and described properly – i.e. type of valve, size, approximate age, and condition. Any leaking valves should be rated according to the level of leakage so that repairs can be properly prioritised to ensure that the major leaks are repaired first after which the smaller leaks can be repaired. All butterfly valves being used on a daily basis to control the flow of water from one area to another should be checked to ensure that they are water-tight and replaced if necessary with high quality gate valves which are more appropriate for such applications.	It is recommended that all components of the water distribution system are examined and a long term asset management plan is developed in which the planned maintenance of the water supply system will be an integral component.

Item	Short Term Recommendations	Long Term Recommendations
Education and Public Involvement	The effectiveness of the "Indraroot" cell as a public awareness instrument should be investigated. The aim should be to improve the programme continuously. All consumers should know the phone number to report leaks. This can be achieved through a variety of measures such as providing calendars to all registered consumers with the necessary contact numbers. A schools water saving campaign should be implemented whereby all scholars are informed of the water situation in Indore and how the available water in the home and school can be used efficiently.	The possibility of incorporating water conservation in the school curricula should be considered – the Queensland model (Australia) is possibly the best case study in this regard and can be duplicated in Indore if given political and local government support.
Illegal Use of Water	It is recommended that the water utility develop a sound policy for addressing the issue of illegal connections which is fully supported by top management and politicians. The utility should undertake a full scale exercise to identify and remove all illegal connections – replacing them with legal connections if appropriate.	All illegal connections should be eliminated from the system.
GIS System	TERI has developed a draft GIS system for Indore (as used in the 2-day WDM workshop in Indore – March 2006) based on the available CAD information. It is recommended that IMC should use this draft system as a starting point and that it should be continually updated, corrected and improved. Prepare plan books for operations staff.	Collect plan books on an annual basis and make necessary changes on the electronic system; and Obtain regular updates of cadastral information and make necessary changes to GIS system.
Capacity Building	A 2-day training programme on various WDM initiatives has been presented by WRP and TERI to delegates of IMC in March 2006. A WDM unit should be established within the water utility and further detailed training provided to the personnel. A leakage detection team should be trained in the art of leak detection and repair of leaks. A meter management team should be established and trained in the use, installation and repair of water meters.	All training requirements should be identified and co-ordinated by water utility staff.

Item	Short Term Recommendations	Long Term Recommendations
	A GIS team should be established to capture and manage the GIS coverages for the entire water supply network. Appropriate training on GIS may be required. Training on the operation and maintenance of purification and sewage treatment facilities should be provided where necessary.	
Pilot Projects	It is recommended that several pilot projects are undertaken to test the use of domestic meters. Ideally each pilot project should use at least 100 (Number) meters and several such projects can be undertaken to assess the reliability of different meters as well as to assess the per capita use for different levels of service. A pilot project should be undertaken to assess the potential for providing 24-hour supply. Once again a small area should be identified which is discrete and supplied from a single supply pipe – which in turn should also be metered. The area should be supplied with water continuously until such time as the water being supplied into the area stabilises. The minimum night flow can then be determined and the true level of leakage and/or wastage can be assessed. This information is very important when considering the possibility of providing continuous supply. This area can then be used to test various other WDM measures such as leakage detection and even pressure management if the pressures are sufficient.	All pilot projects whether successful or failures should be properly documented for future reference. In the case of successful projects where savings were achieved, they should be revisited after 3 years to determine if the initial savings achieved were sustainable or temporary.
Legislation	Local bye-laws are required to encourage water use efficiency in the home and at commercial properties within Indore. Penalties should be imposed for deliberate water wastage. The bye-laws must be enforced with vigour.	Provincial or national legislation is required to back-up the local legislation and must be promoted at a national level.
Water Harvesting	It is recommended that the effort on water harvesting is maintained and that the campaign be widened to cover other aspects of water saving within the same facility.	The implementation of rain water harvesting tanks for general consumers should be investigated. A commendable project has been undertaken in Sri-Lanka where the local communities were trained to build their own concrete rainwater harvesting tanks.

Item	Short Term Recommendations	Long Term Recommendations
Sewage Reuse	It is recommended that a scoping exercise be undertaken to assess the possibilities for sewage re-use in Indore. This study should investigate the scope for both industrial use as well as agricultural use. With regard to agriculture, it appears that various crops can be considered including cotton and sugar cane amongst others. On the industrial side, many industries might use treated sewage which can be very cost effective compared with water being pumped from the Narmada River.	A sewage reuse project should be implemented.
Retrofit Internal Plumbing	Undertake visual leak surveys in all municipal buildings, schools, police stations etc. Repair all leaks identified in these buildings and remove wasteful devices (e.g. Tip Tray Urinals). Implement a continuous leak survey and repair programme in all public buildings.	Investigate the potential for household retrofitting projects as a pilot project.

1 Introduction

1.1 Purpose of this Report

This Report has been commissioned by UN-HABITAT to provide an overview of the water supply situation in Indore. In view of the proposed new water augmentation scheme to supply more water to Indore through a new $200 million pipeline, it was considered appropriate to undertake an independent assessment of the water supply to Indore as well as a review of all water demand management activities being undertaken in the supply area.

This Report is based on a relatively short investigation of the Indore water supply system undertaken in July 2005 and is therefore limited to a broad status assessment which is supported by general recommendations. It was never intended to provide detailed recommendations with specific designs since such work is part of the larger augmentation study and completely outside the scope of work facilitated by UN-HABITAT.

The Report provides an overview of the current water supply situation in Indore with specific reference to areas where water is being lost or wasted through leakage or inefficient practices. Having identified many of the key problems, various suggestions/recommendations are made which in turn form the basis for a new Water Conservation Strategy.

1.2 Project Area

The city of Indore is situated in the Madhya Pradesh region of India and is known as the industrial and commercial capital of the region (See **Figure 1** for locality map). Some of the key characteristics of the city can be summarised as:

- Average annual rainfall = 900 mm
- Length of mains = ±1400 km
- Number of connections:
  - House : 136 730 – 155 889
  - Commercial : 1024 – 1253
  - Industrial : 1320 – 1354
  - Community Standposts : 7263
  - Illegal : between 20 000 and 40 000
- Population = ±1.66 million (2002)
- Service Reservoirs = 34 (Number) with storage capacity 76 Ml
- Area = 214.1 km^2

Figure 1: Locality Map of Indore, Madhya Pradesh

The bulk water is supplied from four sources and the approximate volumes provided from each source are shown in **Table 2**. Based on these volumes, allowing for approximately 30% losses, the per capita water availability should be between 72 and 84 litres /day. However, Indore currently experiences severe water shortages with the result that it is not possible to provide continuous water supply and most areas only receive water for less than 1 hour every 2nd day.

Table 2: Details of water sources available to Indore

Source	Approx. Daily Supply (Ml/day)	
	Minimum	Maximum
Narmada Water Supply Project	140	150
Yashwant Sagar Tank on Gambhir River	18	27
Municipal Tubewells (2,000 approx)	13	18
Bilawali Tank	0	4.5
Water available (ML/day)	**171**	**199.5**
Theoretical per capita water availability based on 30% losses (1.66 million people)	**72 litres/day**	**84 litres/day**

It should be noted that the above figures are approximate values based on numerous assumptions. They do, however, highlight the key elements of the water supply situation in Indore and provide a rough indication of the existing water available to the city. As can be seen from the figures, the most important source of water is the Narmada Water Supply Project, which involves pumping water some 70 km from the Narmada river through a head in excess of 550 m to the city. This scheme has been in operation for many years and a new pipeline is currently being considered which will provide a further 360 Ml/day. The proposed new scheme will cost approximately $200 million to complete and will only be commissioned sometime after 2010. Until the new scheme is operational, the city of Indore will have to survive using the existing sources which will continue to be stretched due to the rapidly increasing urban population which has been estimated to grow at between 4% and 5% per annum.

The current mode of operation for the Indore water supply is one of crisis management where the water supply personnel allocate the available water on a complex system of scheduling which involves using numerous elevated storage tanks as well as some direct mains supply. In general 68% of the population receives water between 1 and 2 hours every alternate day, while a fleet of water tankers are used to augment supplies to other areas receiving insufficient supply. Many residents also use their own private tubewells (boreholes) which provide water at different levels of reliability and quality.

1.3 Water Demand Mamagement Strategy

It is in the context of severe water shortages and limited resources that UN-HABITAT has embarked on an investigation to develop a Water Demand Management strategy for the city of Indore that will hopefully provide useful direction to several other initiatives being facilitated by other organisations including the World Bank and Asian Development Bank. The strategy proposed in this document should be considered as a draft strategy which will require the support and "buy-in" of both the water utility as well as the different funding organisations involved in the upgrading of the Indore water supply. For this reason, the WDM strategy has been restricted to key focus areas which are essential to the efficient management of any water supply system.

Where possible, specific actions have been suggested which will help to improve the situation and must be implemented at some stage if any meaningful progress is to be achieved. It must be noted, however, that without major augmentation and very significant investment in the water supply infrastructure, the possibility of providing a 24-hour supply throughout the City of Indore is unlikely to be achieved in the near future and expectations in this regard should not be raised.

The WDM Strategy suggested for the City of Indore is considered to be both practical and methodical, concentrating on key essential issues rather than the "nice-to-have's" which are often included for areas with full pressure continuous supply.

Due to the fact that the water supply to Indore is unlikely to be augmented before 2010, it is not practical to suggest certain measures until such time as the new supply is available. For this reason, the proposed WDM strategy has been split into short term actions and longer term actions. The short-term actions should be considered as a matter of urgency to be implemented as soon as possible and certainly within the next 5 years while the long-term actions are of a lower priority (although still important) and should be implemented over a 10 to 20 year time frame.

Addressing the problems in the Indore water supply system will take many years and is unlikely to be completed within less than 20 years. The actual progress will depend upon the commitment of the governing institutions as well as the availability of the funds required to complete the work.

1.4. Methodology

The following aspects formed part of the proposed Water Demand Strategy for Indore:

- District Meter Areas (DMAs);
- Bulk Management Meters;
- Bulk Revenue Meters;
- Domestic Consumer Meters;
- Monitoring of Unaccounted-for Water in each Zone;
- Water Audit;
- Pressure Management;
- Mains Replacement Programme;
- Active and Passive Leakage Control;
- Planned Maintenance;
- General Education and Public Involvement;
- Payment for Water and Illegal Use;
- GIS System;
- Capacity Building;
- Pilot Projects;
- Legislation;
- Water Harvesting;
- Sewage Re-use;
- Retrofit Internal Plumbing.

Each of these aspects is discussed in further detail in the remainder of this report. In addition, useful practical procedures on a range of practical WDM subjects were included in the Appendices of this Report.

2 Water Demand Management Strategy

2.1 District Metered Areas (DMAs)

Discreet management zones (areas) are a pre-requisite for efficient management of any distribution system. It enables the operational staff to monitor and manage the water usage and losses for each separate zone. The international norm for the size of zone (according to the code of practise of various countries) is between 2,000 and 4,000 properties. However, at this stage no minimum or maximum size of zone will be specified for Indore as this will vary from area to area.

The procedure of implementing District Metered Areas (DMAs) is described below.

Sectorisation: Short Term

- After recommendations were made by WRP (in 2005) regarding sectorising the supply network in Indore the IMC has started with a process to split Indore in 12 zones (DMAs). (March 2006). Details of these 12 zones were not available at the time of finalising this report.
- Once the new Narmada Pipeline has been constructed it recommended to identify one or two smaller pilot DMAs (between 2,000 and 5,000 connections) where the supply could possibly be sustained for longer periods (i.e. over 12 hr /day). These pilot DMAs could then be used to test several of the WDM recommendations on a smaller scale before applying it to the whole city area. (Discussed in further detail in **Section 2.15**). Areas with higher than average water loss should also be identified and sectorised as a matter of priority.
- Perform zone discreteness tests through site inspections and logging. Sectorisation plays a key role of water demand management and it is imperative that the operation staff understand the system boundaries and operation. A discreet zone can be described as a zone where all zone cross connections are closed or metered.
- Identify, service and mark all zone valves for all zones. Zone valves are defined as closed valves on cross boundary connections. If zone valves do not seal properly, they should be replaced. All zone valves should be checked on a monthly basis to ensure zone discreteness and only authorised senior operation staff should be allowed to operate zone valves.
- The exact position of all zone valves and other boundary valves should be captured on a GIS system for reference.

Sectorisation: Long Term

- Ideally in the long term, the whole of Indore should be sectorised into DMAs of between 2,000 and 5,000 properties. The practicality of this should be investigated for each area separately and should be checked with Engineers of IMC.

2.2 Bulk Management Meters

Proper bulk metering is essential for efficient management and water balance calculations in a water distribution system. In Indore there are currently no bulk management meters. Recommendations for a procedure to address bulk metering in the short and long term are described in this section.

Information on the characteristics of mechanical, electromagnetic and ultrasonic meters are provided further on in this section while some detailed guidelines for design of the pipework and chambers for mechanical meters are provided in **Appendix C** for reference purposes. It should be noted that the team responsible for the installation of any meters should develop its own standards in line with the current Indian legislation in this regard. The details have been provided to assist with the development of such standards.

Bulk Management Meters: Short Term

- Bulk meters should be installed on inlets and outlets of all water purification works. (Details below). The losses at purification works usually represent a significant portion of the overall water losses and, therefore, it is important to measure both the inlets and outlets. Due to the relatively large pipes involved and because it will cause problems if the supply is interrupted for any time, it is likely that ultrasonic meters will be the most practical solution. These meters can be installed permanently on the outside of the pipe without having to shut down the pipeline. (See **Appendix A** for schematic drawing on meter location).
- Meters should be installed at selected positions on the trunk mains as shown on **Appendix A** (Details Below). The suggested location of these bulk meters are shown but must be confirmed by the Engineers of the IMC. For large pipes it is also likely that ultrasonic meters will be the most practical solution.
- It was mentioned previously that the IMC is currently sectorising Indore in 12 management zones. It is also recommended to meter the inlet to each of these zones. These meters should preferably be placed upstream of the zonal valves that are closed to distribute the water – to ensure that the meter will always be filled with water.
- A bulk meter reading programme should be implemented to record and evaluate bulk meter readings and to undertake a water balance per zone on a monthly basis. Any anomalies in meter readings or in the water balance should be investigated and remedial action implement if required.
- A bulk meter repair programme should be implemented whereby broken meters can be repaired within seven days. For most mechanical meters this is a fairly simple exercise since the internal mechanism can usually be replaced without replacing the meter body. For magnetic and ultrasonic meters the process is normally more complicated as the electronics of the meters must be checked and repaired if necessary – a process that can often take many weeks if not months.

The details of the meter installations are described further in detail below.

Meters at Water Purification Plants

The inlets and outlets of the water purification works should be metered as summarised in **Table 3**.

Table 3: Suggested meters on inlets and outlets of water purification plants

No.	Purification Works	Installed Capacity Ml/d	Production Ml/d	Pipe Size Inlet mm	Pipe Size Outlet mm	Meters Required
1	Narmada	185	172 to 185	1200 and 600	1200	3
2	Deodharan (Yashwant Sagar)	40	18 to 27	700	2 X 650	3
3	Bilawali Tank	9	0 to 4.5	Unknown	Unknown	1
					Total	**7**

Note: 1) The Narmada and Deodharan purification works require meters on the inlets and outlets of the purification works.

2) The volume of water supplied from the Bilawali Tank is low and according to the IUDMP reports the pressure filter units are not operational and, therefore, it is recommended to install only one meter on the outlet of Bilawali Tank.

3) The capacity of purification works were obtained from the IUDMP Report for Indore. The pipe diameters were obtained from a presentation by IMC. All information must be verified on site.

Bulk Management Meters: Short Term

The bulk supply of water in Indore should be metered as shown in **Appendix A**. The suggested location of these bulk meters are shown but should be confirmed by the Engineers of the IMC.

Table 4: Proposed bulk management meters

No.	Trunk Main	Description	Pipe Size mm	Meters Required
1	Trunk Main #2	Trunk Main from Jalud	1200	3
2	Dewas Line	Trunk Main to Dewas Town	520	1
3	Trunk Main # 3	Trunk Main #3 to Hawa Bunglow Tank	620	1
4	Trunk Main #1	Trunk Main #1 to Annapurna Tank	900	1
5	Trunk Main #1	Trunk Main #1 to RAJ Mohalla Tank	750	1
6	Inlet to zones	Inlet to 12 zones. (According to IMC 12 zones are currently implemented – March 06)	Various sizes	Guess 12
7	Main Sumpwells	Sumpwells with supply greater than 1 Ml/day.	Various sizes	Guess 4
			Total	**23**

Note: The pipe diameters were obtained from a presentation by IMC and should be verified on site.

Bulk Meters: Long term

- It is recommended that bulk meters be installed on the outlets of all elevated water tanks as well as at the entrance to all zone-metered areas – the details of which must first be clarified with IMC Engineers. (The IUDMP technical report for Indore indicates that 71 bulk meters will be required on feeder mains). The number of zone metered areas that can be established will be dictated by the availability of funding. It will not be possible to complete this task over the short-term and is likely to take place over a 10-year period.
- It should be taken into account that water meters will not be accurate if water supply is not sustained (i.e. air in pipelines). The metering should, therefore, be prioritised to meter the positions with constant supply.

Additional Meter Information

The characteristics of different type meters are shown in **Table 5** and the schematic layouts of suggested meter installations are shown in **Figure 2.** Cost calculations for meters in South Africa indicate that mechanical meters are more cost effective up to meter diameters of 300 mm. From 350 mm diameter and over, magnetic or ultrasonic meters should be considered as they are often

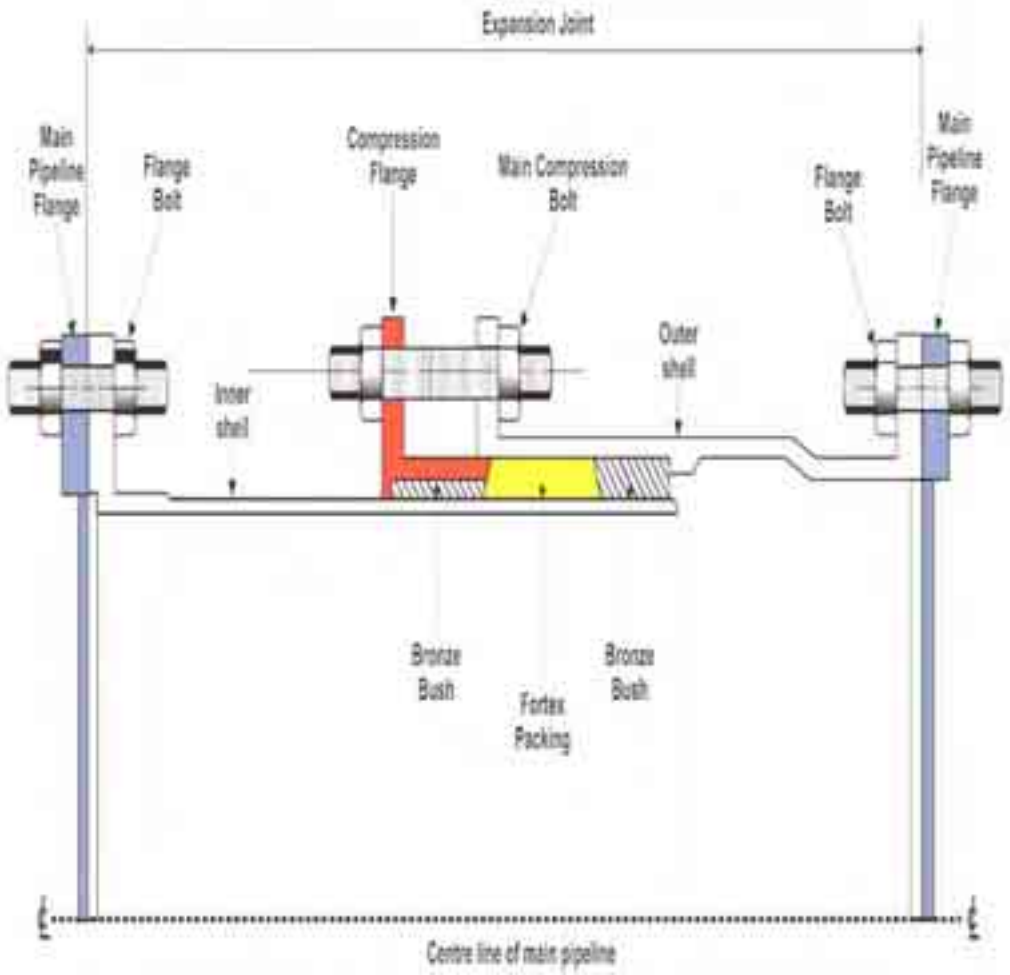


Figure 2: Schematic layouts of typical meter installations

more cost effective for the larger sizes. The local consultant should verify which meters are the most cost effective and reliable in India as this may be different from South Africa. The issue of power supply as well as back-up support must be considered when selecting the most appropriate meter. A copy of a typical spreadsheet used to assess the most cost effective meter is shown in **Appendix E.** A typical design drawing for a mechanical meter installation is shown in **Appendix G**.

Table 5: Meter Characteristics

Characteristic	Mechanical Meter	Electromagnetic Meter	Ultrasonic
Straight pipe requirement	Typically 3 pipe diameters before meter, no abrupt restrictions after meter, can vary for different meters	Typically 5 pipe diameter before mete r, 3 pipe diameters after meter, can vary for different meters	Usually longer straight length required, than other types of meters
Power supply	No power supply required, unless connected to telemetry system	Power supply required.	Power supply required.
Uninterruptible Power Supply Box required?	No	Yes	Yes
Sizes (may vary for different suppliers)	40 mm to 800 mm	25 mm to 1200 mm	All sizes
Pressure loss	Low pressure loss	Zero pressure loss	Zero pressure loss
Accuracy	Very good	Very good	Very good
Will accuracy be affected by air in the pipeline?	Yes	Yes	Yes
Is a strainer required?	Yes	No	No
Are Isolating Valves required?	Yes	No	No
Is cutting of pipe required?	Yes	Yes. Except if a probe meter is installed. However, probe meters installed on site will usually not give the same accuracy as a full bore meter.	Not always. An external meter can be installed on the outside of the pipe.
Flow totalling	Cannot separate totalling and logging of forward and reverse flow	Separate totalling and logging of forward and reverse flow	Separate totalling and logging of forward and reverse flow
Level of skill required to fix meter.	Low skill	High skill	High Skill
Is water interrupted for repair work on meter?	Yes	Usually Not	Usually Not
Telemetry connection	Can be connected. Converter and power required.	Can be connected. No converter required, power already available.	Can be connected. No converter required, power already available.
Level of skill required to log meter	Low to Medium skill	Medium to High Skill	Medium to High Skill
Lightning	Very small chance of getting damaged by lighting	Can be damaged by lightning	Can be damaged by lightning
Photo (will vary for different suppliers)			

2.3 Bulk Revenue Meters

A list of 59 bulk consumers was obtained from IMC. These consumers pay monthly water charges based on their meter readings. The details of the top 10 (of the 59) consumers are summarised in **Table 6.** The top 10 consumers represent approximately 94% of the total volume billed for metered bulk consumers. Examination of several of the bulk meters suggests that there is no consistency between the type or make of the meter and it seems that a different system has been used for each consumer. (see **Figure 3** and **4**) It is very difficult to establish the accuracy of the metered readings although it is claimed that many of the different types of meters are checked regularly. It appears that there is no system for meter replacement and in many cases the meters have never been checked or replaced since they were installed – some are in excess of 10 years old.

Table 6: List of top 10 bulk water consumers in Indore

No	Name of consumer	Size of connection inch	Average monthly supply kl/month	Tariff Rupee per kl	Year of connection
1	M.E.S Mhow	20	318500	10	1978
2	Mhow Cant Board	12	75116	10	1979
3	Sarpanch, Gram Panchayat, Kodaria	3	29180	10	1992
4	CAT, Indore	8	21850	10	1990
5	Western Railway, Mhow	8	18324	10	1978
6	Adresh Guru Nanak Griha Nirman Sanstha, Niranjanpur, Indore	6	15900	10	2001
7	C.M.O. Rao	4	8950	10	1979
8	Rajiv Aawas Vihar Yojna No.114 IDA, Indore	16	7500	10	2002
9	M.Y. Hospital, Indore	6	5125	10	1995
10	Maa Vihar Colony, Indore	2	4860	10	2001
	Total		**505305**		

Figure 3: Typical Bulk Consumer Meters in Indore

Figure 4: Typical Bulk Consumer Meters in Indore

Recommendations for a procedure to address bulk revenue meters in the short and long term are described in this section.

Bulk Revenue Meters: Short Term

- It is recommended that the meters for the top 10 consumers (that are currently metered) are replaced as soon as possible with reliable meters capable of being logged using standard logging equipment. For the military base at Mhow it might even be worthwhile installing two meters in series to ensure accurate meter readings.
- As a next step, the top 50 consumers in Indore should be metered and billed accordingly – based on the meter readings. (Consumers that was previously un-metered). This should also include metering some of the larger government buildings to show that IMC is also monitoring the water supply to their own buildings.
- A bulk meter should be installed at the point where the water tankers are filled each day. (see **Figure 5**) There is currently no meter at this point and the current assumption of 7 Ml/day can then be confirmed or revised as appropriate.
- The water utility should preferably standardise on one (or maximum of two) makes of meters e.g. Elster Kent , Sensus, Panametrics etc. It is important that the meters are sized properly for the customer and that they are installed properly by following the recommended installation procedures regarding length of straight pipe, strainers, isolating valves etc. (**Appendix G** for typical mechanical meter design drawing)
- All new meters should be maintained properly and the supplier should be selected to ensure that spare parts are readily available and the quality of the meters is high. It should be remembered that the cost of the meter is often only a small component of the overall cost of a meter installation and it is not always appropriate to select the cheapest. Consumer meters can be compared with cash registers and it is imperative that these meters are well maintained and checked for accuracy.

Figure 5: Water Tanker Filling Point in Indore

Bulk Revenue Meters: Long Term

- It is recommended that all bulk revenue meters are replaced and a proper billing system is established to streamline the billing system.
- Standards for meter installations and calibration procedures should be developed by/for the water utility to ensure that all revenue meter installations are of a certain quality.

2.4 Domestic Consumer Meters

There are no domestic consumer meters in the Indore water supply system. All accounts sent to individual domestic consumers are therefore based on a flat rate tariff. This form of billing often results in very high wastage and/or leakage at the consumer level since there is no financial incentive to save water. Flat rate tariffs should therefore be discouraged if possible and replaced eventually by a step-tariff which is based on genuine metered consumption. It appears, however, that domestic metering has been implemented in several parts of India with varying degrees of success. While such metering would normally be the ideal solution to customer leakage control it may be premature to propose full domestic metering in the city of Indore due to the expense involved with installing, servicing and reading the meters. A more cautious approach has therefore been proposed after which a decision regarding full domestic metering can be taken.

Figure 6: Typical Domestic Consumer Meter Installations in South Africa

Domestic Meters: Short Term

- It is recommended two or three pilot areas are identified where domestic meters can be installed. Areas with approximately 50 to 100 properties would be ideal for this exercise since the cost of the meters and installation will be relatively small. Such metering will enable the water utility to evaluate the value of domestic metering at a small scale before committing to full scale domestic metering which may or may not be successful in Indore. Due to the warm climate in Indore it may be considered to install above ground meters in Indore which is cheaper than the conventional method of putting a meter below ground in a meter box. (See **Figure 6** for typical examples). In colder climates the consumer meters burst if the temperature falls below zero and, therefore, the meter box is required to shield the meter from the elements.

- The water utility may also wish to trial different makes of domestic meters to assess their reliability and suitability for use in Indore. There are many makes of domestic meter and it is important to ensure that the meters used in any large scale project are reliable and suitable for the area. (A list of various meter suppliers in India was provided in the IUDMP Technical Report Volume 6).

- Pre-paid metering should also be considered as one of the options for a pilot project. With pre-paid metering consumers can only use the volume of water they have paid for in advance. Normally this type of metering serves as an incentive for consumers to use less water. Examples of typical pre-paid meters are shown in **Figure 7**.

- The domestic metering "Pilot Projects" will have a 2nd use in that they will help to establish the daily or monthly water use per connection or per capita – one of the key uncertainties in the current estimation of water demands in the system. It is only through such case studies that the water utility can establish realistic estimates of current and future water demands which in turn influence the overall water balance of the system.

It should be noted that with any type of domestic metering it is crucial to get the acceptance of the consumers before installation of the actual meters.

Domestic Meters: Long Term

- No recommendations on the long-term implementation of domestic meters can be made at this stage. Ideally it is normally recommended that every connection be metered including all fire-fighting and municipal connections etc. In the case of Indore, however, it has yet to be shown that full scale connection metering is feasible and the results from the pilot studies should be assessed before approving such large investment.

It should be noted that some detailed information on a procedure which can be used to check the accuracy of domestic meters is included in **Appendix F** for reference purposes.

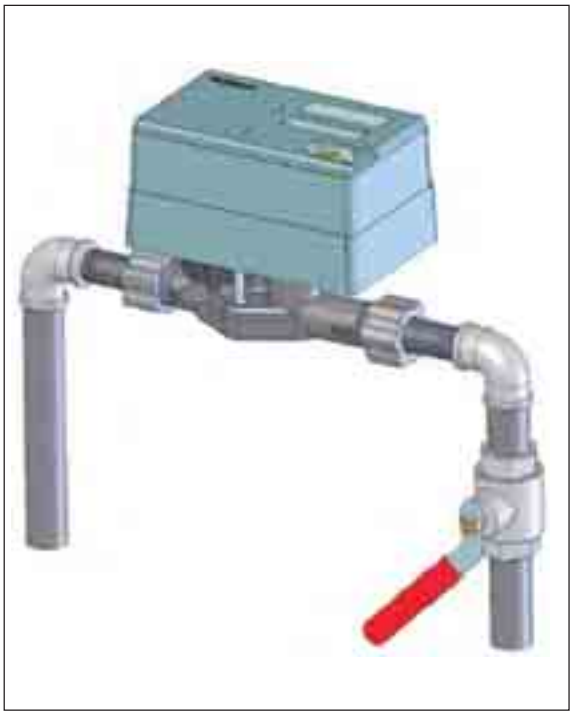


Figure 7: Typical Pre-paid Domestic Meters

2.5. Monitoring of Unaccounted-for water in each zone

Monitoring of unaccounted-for water can be achieved at two different levels namely through the logging of minimum night-flows and the analysis of the various management meter readings. In Indore the scope for this monitoring will be limited to the number of bulk meters installed. Electronic copies of software programmes (including the manuals) to undertake the calculations will be provided as part of this report to the IMC.

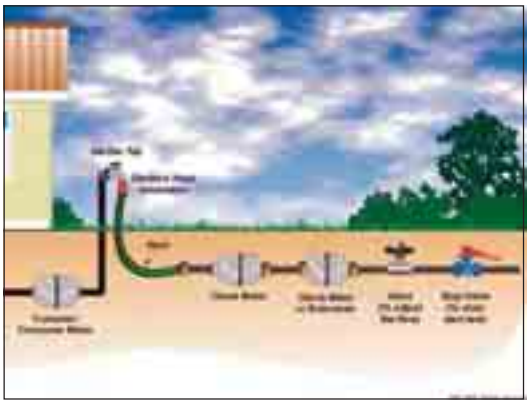
Recommendation: Short Term

- Once the first phase of bulk meters are installed the process of monitoring should commence. The bulk meters should be logged and analysed where possible. Unfortunately the minimum night flows can only be determined once meters are installed on the outlets of the Water Towers. Additional information on the analysis of logging results can be found in the SANFLOW manual [*Reference*].

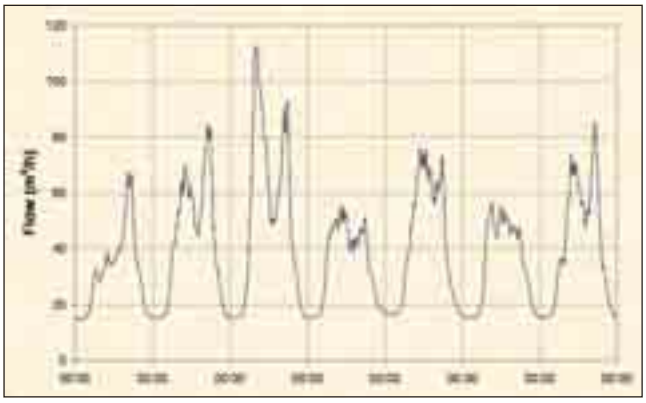
Recommendation: Long Term

- It is recommended that the level of leakage in all discrete zones be analysed annually using standard techniques (e.g. analyses of minimum night flows etc) as and when such zones are established and the appropriate bulk management meters installed (**Figure 8**). This should become a standard technique employed by the utility to control leakage.

The term Unaccounted-for-water (UFW) should be replaced with the internationally accepted term Non-revenue Water (NRW) since this latter term is less ambiguous and cannot be easily manipulated.



(a)



(b)

Figure 8: (a) Logging of bulk Meters; (b) Analysis of logging results

2.6 Water Audit

A preliminary International Water Association (IWA) water balance/audit was undertaken for Indore using the AQUALIBRE software supplied with this report (See **Water Audit Report for Indore** or **Appendix H**). The calculated Infrastructure Leakage Index (ILI) for Indore is approximately 400 which indicate severe leakage problems. The ILI value is used to benchmark leakage in different countries. A low ILI indicates low leakage and a high ILI indicate high leakage. Current findings in other countries indicates the following average ILI values (South Africa = 6, USA = 6, UK = 3, Australia = 2).

Recommendation: Short Term

- The data used to calculate the ILI should be verified and updated where necessary by the Engineers of IMC. The calculated ILI for Indore was 400 which is one of highest in the world. It might be that with more accurate data the ILI would come down to a more realistic value.
- It should be noted that the ILI calculation is very sensitive to the time the system is pressurised. If the time pressurised is 1hr /day the ILI is approximately 400, but if the ILI is 6 hr/day the ILI is approximately 80. The time the system is pressurised should be investigated in more detail through the pressure loggings throughout the system. It might be that low laying areas receive water for much longer periods than 1 hour per day.
- A paper on the accuracy limitations of the Infrastructure Leakage Index (ILI) with specific relation to developing countries is provided in **Appendix I**.

Recommendation: Long Term

- It is recommended that the water balance/audit be continuously updated to incorporate the latest and most accurate data. Two electronic copies of the Aqualibre software used for the water audit have been provided by WRP to IMC for this purpose. (March 2006).

2.7 Pressure Management

Pressure management can be used to control customer demand and reduce leakage in water supply systems. Under certain circumstances it is the most cost-effective form of leakage control that can be implemented. In the case of the Indore water supply system, however, it is not considered appropriate at this time since few if any parts of the system receive continuous pressure (let alone high pressure), and the scope for pressure management is therefore very limited.

Recommendation: Short Term

- It is recommended that the water pressure be monitored (logging of pressures) at selected points in the distribution system to establish the daily pressure profiles experienced in the system. It may be possible to consider some form of pressure management at certain points in the system but this cannot be established until some accurate pressure information has been collected. A simple method to test water pressures is included in **Appendix F**.
- Once pressure information is available it might be considered to reduce pressures in selected positions only during night time. Additional information on pressure management can be found in the PRESMAC manual [*Reference*].

Recommendation: Long Term

No long term recommendations can be made with regard to pressure management at this time.

2.8 Mains replacement programme

Mains replacement is often the most expensive measure that can be undertaken to reduce leakage and is usually only undertaken as a last resort. It is therefore important that any mains replacement is properly co-ordinated and motivated to avoid wasting the limited funds available to improve the system. Mains replacement is normally based on the frequency of bursts occurring from a specific length of pipe and it is, therefore, important to record the frequency of bursts for each main section of pipe in the system. It should be noted that most water supply systems are designed to last up to 50 years which in turn suggests an annual replacement of 2% of the total asset value. Very few water utilities worldwide allocate 2% per year to the maintenance with the result that many systems, including the Indore system are gradually deteriorating.

Recommendation: Short Term

- It is recommended that a single policy regarding mains replacement be developed for the City of Indore in which a target percentage of mains replacement per year should be provided. This would involve using GIS coverage for the full Indore area and highlighting all pipes of different ages, materials and conditions. The most critical sections of pipe could then be identified and prioritised for replacement. The number of bursts per pipe section can also be indicated on the GIS system.

Recommendation: Long Term

- It is recommended that the value of the water supply system is assessed and that 2% per annum is allocated to maintenance and repair from which the mains replacement programme can be funded.

2.9 Active and passive leakage control

Passive leakage as the name suggests is a passive or reactive approach to leakage control whereby a water utility will send out a leak repair team only when a leak is reported to the utility by a member of the public. Active leakage control is a pro-active approach whereby water utility personnel, armed with leak detection equipment, actively search for unreported leaks in the water distribution system (**Figure 9**).

There is an existing communication system called the "Indraroot" cell that was established by the IMC to monitor and coordinate all water related matters including leak reporting. This forms part of Passive leakage control. Passive leakage control will always be required whether or not active leakage control is undertaken and requires an efficient telephone answering system supported by quick and efficient repair teams.

Active leakage control involves manually checking the water supply system in order to identify any unreported leaks. In the case of Indore, it is understood that only recently (2005/2006) the IMC has started with some form of active leakage control – where a number of visible leaks in the distribution system has been identified and fixed.

Figure 9: Active Leakage Control in other areas in India

Recommendation: Short Term

- After the initial visit of WRP to Indore (2005) the IMC has started with a process to identify and fix visual leaks in the distribution system. It is recommended that IMC take this initiative further and that full time leak detection teams be established.
- It is recommended that personnel be trained in the art of leak detection and repair.
- It is recommended that the whole distribution system is surveyed using normal simple sounding techniques. This exercise can be coupled to the valve audit (as proposed in **Section 2.10**) since both activities can be undertaken simultaneously. It should be noted that active leakage control can only be undertaken during periods of pressurised supply.
- The visible leaks on the Narmada pipeline should be repaired (**Figure 10**). Guidelines to repair leaking pipelines under pressure are provided in **Appendix B**. These guidelines should be evaluated and used on the discretion of the engineers of IMC. The engineers of IMC have struggled in the past to repair these leaks because the supply of water cannot be interrupted.

Recommendation: Long Term

- It is recommended that the systems used for passive leakage control be improved and linked to a GIS including a database suitable for recording details of all reported leaks etc. In addition, a full-time active leakage control team (or teams) should be established to carry out sounding at regular intervals (annually if possible).
- The effectiveness of the "Indraroot" cell as part of passive leakage control should be evaluated.

Figure 10: Visible leaks on 1200 mm Trunk Main from Narmada

2.10 Planned Maintenance

It appears that relatively little planned maintenance takes place in the City of Indore and as a result many of the valves are in poor condition. All valves have a limited life and without regular maintenance they will deteriorate quickly causing leakage and water loss.

In the City of Indore, at least 50% of the valves inspected were leaking to some degree. It was indicated by water utility personnel that many of the valves used on a daily basis to control the flow of water into the various areas do not provide a proper seal. This can result in greater wastage and is generally a major problem in cases where butterfly valves are being used on a daily basis to control the flow of water from one area into another. Butterfly valves are renowned for not sealing if opened and closed frequently since they are not designed for daily use.

Recommendation: Short Term

- It is recommended a valve audit be undertaken for all valves in the system. They should be inspected carefully, numbered and described properly – i.e. type of valve, size, approximate age, and condition. Any leaking valves should be rated according to the level of leakage so that repairs can be properly prioritised to ensure that the major leaks are repaired first after which the smaller leaks can be repaired. (**Figure 11**).
- The Yeshwant Sagar pumpstation appears to require repair work to some of the electrical systems although this will require further investigation by a specialist mechanical engineer. (**Figure 12**).
- All butterfly valves being used on a daily basis to control the flow of water from one area to another should be checked to ensure that they are water-tight and replaced if necessary with high quality gate valves which are more appropriate for such applications.

Recommendation: Long Term

- It is recommended that all components of the water distribution system are examined and a long term asset management plan is developed in which the planned maintenance of the water supply system will be an integral component.

Figure 11: Typical Leaking Valves throughout Indore

Figure 12: Photos of the electrical system from Yeshwant Sagar Pumpstation

2.11 General education and public involvement

Education and the involvement of the general consumer is an important aspect of any WDM strategy. Water is already being supplied on an intermittent basis and the situation can only deteriorate further over the next 5 years as the population of Indore increases at the projected 4% to 5% annually. The augmentation scheme is unlikely to be commissioned before 2010 and it is therefore essential that actions are taken to help manage the current resources properly. In this regard it is important that the consumers are informed how they can save water in the home and they should be encouraged to inform the water utility whenever they see leakage or wastage.

It was previously mentioned that the IMC has established an "Indraroot cell" (**Figure 13**) which helps to create public awareness through various initiatives including exhibitions, documentaries and pamphlets which are distributed throughout the city.

Figure 13: "Indraroot" communication cell in Indore

Recommendation: Short Term

- The effectiveness of the "Indraroot" cell as a public awareness instrument should be investigated. The aim should be to improve the programme continuously.
- All consumers should know the phone number to report leaks. This can be achieved through a variety of measures such as providing calendars to all registered consumers with the necessary contact numbers.
- A schools water saving campaign should be implemented whereby all scholars are informed of the water situation in Indore and how the available water in the home and school can be used efficiently.

Recommendation: Long Term

- The possibility of incorporating water conservation in the school curricula should be considered – the Queensland model (Australia) is possibly the best case study in this regard and can be duplicated in Indore if given political and local government support.

2.12 Payment for water and illegal use

It is estimated by the water utility personnel that there are approximately 20,000 to 40,000 illegal connections in the Indore area of supply although this estimate is not based on any proper investigation. Others suggest that the figure may be much higher and in reality nobody knows the true extent of the problem. It is often not politically acceptable to simply remove illegal connections and in most cities the approach of legalising such connections is preferable. It should be noted that illegal connections are often made with sub-standard fittings with the result that they leak badly and more water is often lost through the leakage than is used by the resident using the illegal

connection. When legalising such connections it is therefore important to make a proper connection using proper fittings and in this manner, the consumer is added to the billing data base and the leaking connection is replaced with a proper connection. Political support is required to address illegal connections and the water utility must develop a proper strategy to this issue which is fully sanctioned by the politicians. Without such support the process of removing illegal connections may flounder.

Recommendation: Short Term

- It is recommended that the water utility develop a sound policy for addressing the issue of illegal connections which is fully supported by top management and politicians.
- The utility should undertake a full scale exercise to identify and remove all illegal connections – replacing them with legal connections if appropriate.
- Legislation and appropriate bye-laws should be in place to facilitate the process.

Recommendation: Long Term

- All illegal connections should be eliminated from the system.

2.13 GIS system

The consultant TERI has developed a draft GIS system for Indore (as used in the 2-day WDM workshop in Indore). The information used should be verified and should only be used a starting point to build a comprehensive GIS system for the city. The type of information that can be added to the GIS includes:

- Cadastral information (properties and numbers, suburbs and names, roads and names, land use);
- Contours;
- Customer information (Name, address, historical consumption data);
- Pipeline information (pipes, control valves, zone valves, storage structures).

Once the basic GIS system is in place, it can be upgraded to incorporate valve and meter management programmes, maintenance programmes, other services such as electricity, sewer, stormwater, communications, etc.

Recommendation: Short Term

- The consultant TERI has developed a draft GIS system for Indore (as used in the 2 day WDM workshop in Indore) based on the available CAD information. It is recommended that IMC should use this draft system as a starting point and it should be continually updated, corrected and improved;
- Prepare plan books for operations staff.

Recommendation: Long Term

- Collect plan books on an annual basis and make necessary changes on the electronic system; and
- Obtain regular updates of cadastral information and make necessary changes to GIS system.

2.14 Capacity Building

There is a general lack of capacity within the water utility with regard to WDM and water use efficiency. In addition there is little capacity with regard to metering, maintenance, GIS and various other issues required to run a water utility efficiently. For this reason it is necessary to provide support and training in various key areas. Such training should be properly managed and co-ordinated to gain maximum benefit and sufficient funds should be available to enable the water utility to undertake their core business in a proper manner.

Recommendation: Short Term

- A 2-day training programme on WDM has been presented by WRP and TERI to delegates of IMC and Bhopal, Jabalapur, Gwalior in March 2006. (see **Figure 14**).
- A WDM unit should be established within the water utility and further detailed training provided to the personnel.
- A leakage detection team should be trained in the art of leak detection and repair of leaks.
- A meter management team should be established and trained in the use, installation and repair of water meters. (see **Figure 14** for training on meter repair).
- A GIS team should be established to manage the GIS system for the entire water supply network. Appropriate training on GIS may be required.
- Training on the operation and maintenance of purification and sewage treatment facilities should be provided where necessary.

Recommendation: Long Term

- All training requirements should be identified and co-ordinated by water utility staff.

Figure 14: WDM Training Programmes for Municipal Corporation personnel

2.15 Pilot Projects

Before embarking on any large scale projects to improve a water reticulation network it is often appropriate to undertake a small scale project or Pilot Project to assess whether or not the proposed procedures are viable. Pilot projects are extremely useful and can often provide information that may save a water utility investing heavily in something that will not function properly in a specific environment. Pilot projects can be used to improve virtually any aspect of a water utility's business

ranging from metering to leak location to tariff structures. While some recommendations are made with regard to possible pilot projects, the list is far from complete and the water utility management should add to the list or delete items as appropriate.

Recommendation: Short Term

- It is recommended that several pilot projects are undertaken to test the use of domestic meters. Ideally each pilot project should use at least 100 (Number) meters and several such projects can be undertaken to assess the reliability of different meters as well as to assess the per capita use for different levels of service.
- A pilot project should be undertaken to assess the potential for providing 24-hour supply. Once again a small area should be identified which is discrete and supplied from a single supply pipe – which in turn should also be metered. The area should be supplied with water continuously until such time as the water being supplied into the area stabilises. The minimum night flow can then be determined and the level of leakage and/or wastage can be assessed. This information is very important when considering the possibility of providing continuous supply. This area can then be used to test various other WDM measures such as leakage detection and even pressure management if the pressures are sufficient.

Recommendation: Long Term

- All pilot projects whether successful or failures should be properly documented for future reference. In the case of successful projects where savings were achieved, they should be revisited after 3 years to determine if the initial savings achieved were sustainable or temporary.

2.16 Legislation

Legislation is required to support the process of WDM and encourage the use of water use efficiency in the City of Indore. Such legislation can be in the form of regional laws or local bye-laws. Such legislation also requires full support from the municipal managers as well as all politicians if it is to be implemented successfully. There should be both incentives for adopting water efficient practices as well as penalties for wasting water. The water supply situation in Indore is very poor and the situation will almost certainly worsen if appropriate and decisive action is not taken immediately. Proper legislation is therefore important to facilitate water use efficiency in the City of Indore. It should be noted that the assessment undertaken through the UN-HABITAT was relatively short and there was little opportunity to collect or study the local Bye-laws and national legislation covering water use efficiency. The recommendations made in this regard are therefore relatively coarse and should be considered in this light.

Recommendation: Short Term

- Local bye-laws are required to encourage water use efficiency in the home and at commercial properties within Indore. Penalties should be imposed for deliberate water wastage.
- The bye-laws must be enforced with vigour. (In South Africa the Department of Water and Forestry has recently established an investigative unit with the specific aim to investigate water misuse.)

Recommendation: Long Term

- Provincial or national legislation is required to back-up the local legislation and must be promoted at a national level.

2.17 Water Harvesting

Considerable effort has been spent promoting and implementing the harvesting of rainwater from roof tops in order to recharge the groundwater throughout Indore. The success of the efforts is commendable and while the results are difficult to quantify, the publicity accompanying the efforts has created a greater awareness for water conservation throughout the Indore supply area. See **Figure 15** for photos of the rain water harvesting programme.

Figure 15: Rain Water Harvesting Project in Indore

Recommendation: Short Term

- It is recommended that the effort on water harvesting is maintained and that the campaign be widened to cover other aspects of water saving within the home since many structures are already in place to facilitate such efforts.

Recommendation: Long Term

- The implementation of rain water harvesting tanks for general consumers should be investigated. A commendable project has been undertaken in Sri-Lanka where the local communities were trained to build their own concrete rainwater harvesting tanks. The quality of the rainwater should also be much better than the current quality of the piped water if the storage period is not excessive.

2.18 Sewage Reuse

It is estimated that it cost between 7 and 15 Rupees / kl to supply treated water to Indore and that the cost of treating the sewage to a level suitable for discharge into the local stream is approximately 1 Rupee per kl of water. Furthermore it is estimated that the annual sewage treated in Indore will increase to more than 90 Ml/day soon after the new transfer scheme is commissioned. Clearly the volume of sewage is likely to increase significantly and the possibility of increasing the capacity of the sewage treatment works is a distinct possibility.

The scope for re-use of treated sewage is becoming a key issue in most large cities in the world and Indore will be no exception. The scope for using treated sewage for either industrial or agricultural purposes is enormous and should not be overlooked. To date it appears that little, if any, attention has been given to this issue.

Recommendation: Short Term

- It is recommended that a scoping exercise be undertaken to assess the possibilities for sewage re-use in Indore. This study should investigate the scope for both industrial use as well as agricultural use. With regard to agriculture, it appears that various crops can be considered including cotton and sugar cane amongst others. On the industrial side, many industries might use treated sewage which can be very cost effective compared with water being pumped from the Narmada River.
- The possibility of groundwater contamination, especially in areas where tube wells are used, should be taken into account when assessing sewage re-use.

Recommendation: Long Term

- A sewage reuse project should be implemented

2.19 Retrofit Internal Plumbing

Retrofitting is the repair and or replacement of various household fittings that can attribute to high water loss or usage. General retrofitting of leaking plumbing fittings are usually more successful in public buildings and schools than in private homes. In this regard the main focus of this task should be addressed at reducing the consumption and losses at public buildings. More information on different types of retrofitting and retrofitting pilot projects can be obtained in the publication by UN-HABITAT: Leakage Reduction Projects undertaken by Rand Water [*Reference*].

Recommendation: Short Term

- Undertake visual leak surveys in all municipal buildings, schools, police stations etc.
- Repair all leaks identified in these buildings and remove wasteful devices (e.g. Tip Tray Urinals).
- Implement a continuous leak survey and fixing programme in all public buildings.

Recommendation: Long Term

- Investigate the potential for household retrofitting projects as a pilot project.

References

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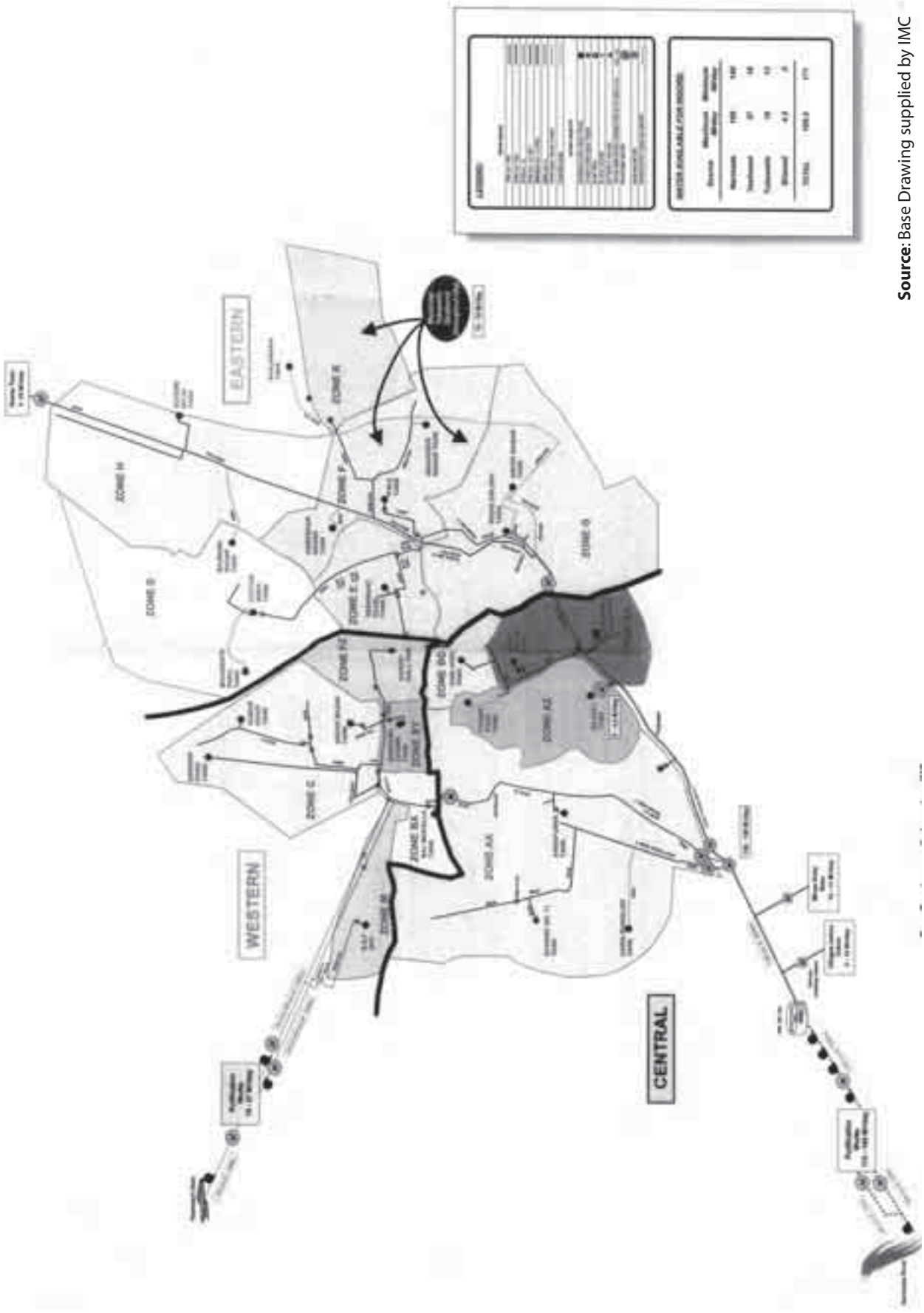
Appendix A

Schematic Layout of Bulk Water Supply, Indore



Source: Base Drawing supplied by IMC

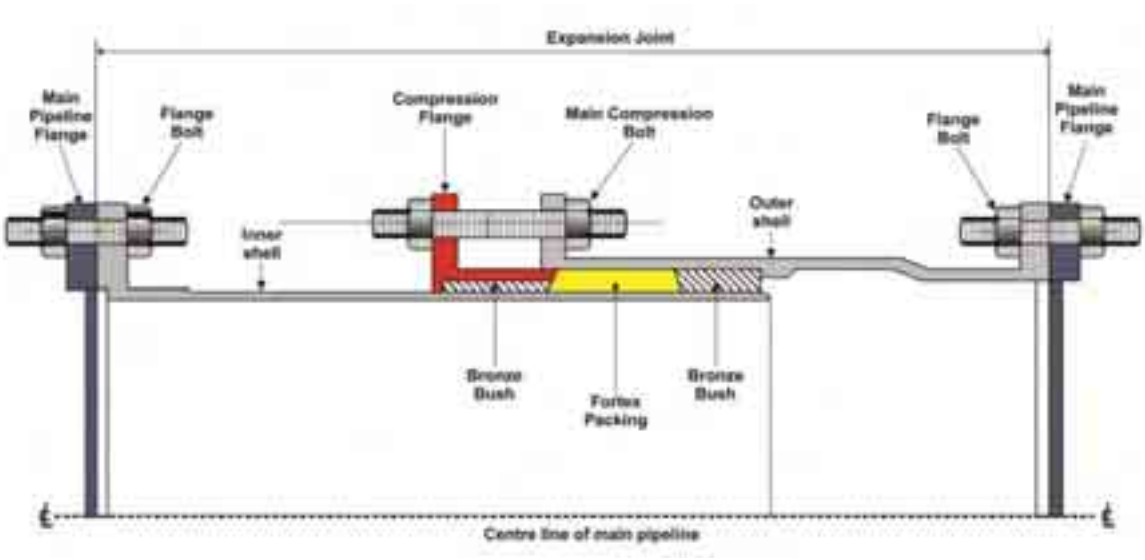
Appendix B

Repair Leaking Pipelines without Disturbing the Pipeline

There are a large number of the expansion joints that are leaking on the main pipeline from the Narmada River to Indore and significant quantities of water are being lost which could otherwise be used to provide a better supply to Indore. (See **Figure B-1** for typical leaking joints). The pipeline is a critical element in the water supply to Indore and cannot be taken out of service while repairs are made.

Figure B-1: One of the leaking joints on the Narmada Pipeline

It should be noted that the type of expansion joint used on the Narmada pipeline as shown in **Figure B-2** can sometimes be serviced by tightening the flange bolts which in turn will compress the packing into the joint and this reduce any leakage. Obviously this will be the cheapest and quickest option to repair the leaking joints. It is not known if this has already been attempted by the water utility and this should be checked before proceeding with the other suggested processes.



Elevation: not to scale

Figure B-2: Expansion Joint Detail

1. Repair by injecting epoxy sealant

Various options of repairing the pipeline have been examined and after considerable discussion it was agreed that one specific repair method offers the most appropriate solution. The proposed method involves injecting an epoxy sealant into the fortex packing (See **Figure B-2**) around the leak while the system remains pressurised as can be seen in **Figure B-3**.

The following pictures were taken from the web site **www.coltonline.com**.

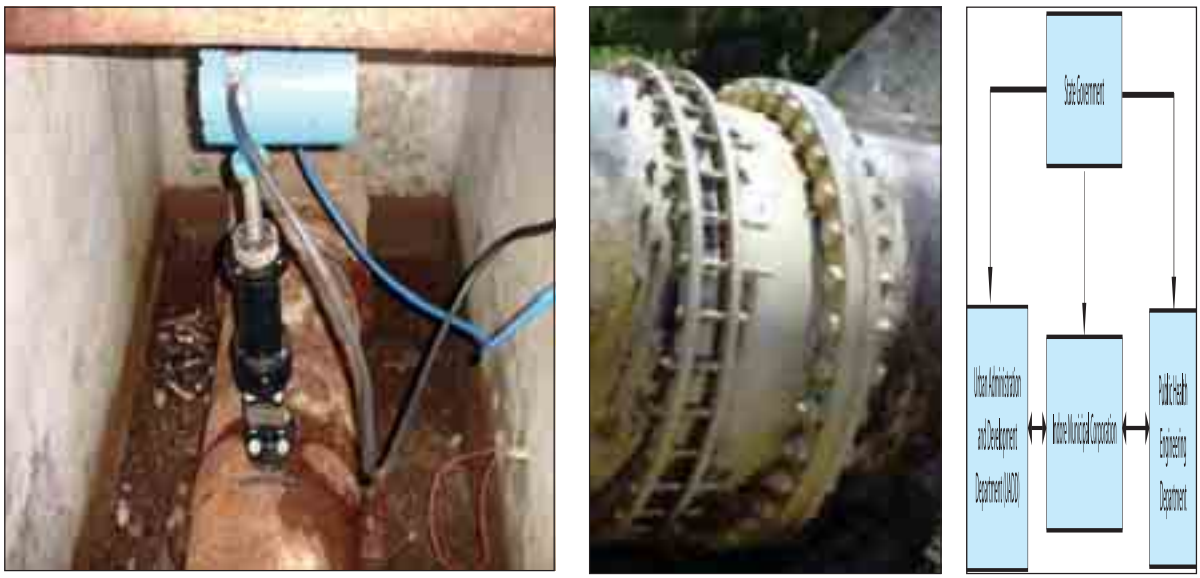


Figure B-3: Repair of leaking expansion joint (Source: Coltonline website)

The leaking pipe joints on the Narmada Pipeline (**Figure B-2**) are virtually identical to those depicted on the Coltonline website and it appears that this method would be ideally suited to repair the leaks on the Narmada pipeline. Care must, however, be taken to ensure that the drilling and injection is undertaken at the correct position on the joint to avoid aggravating the problem.

2. Repair with a custom made shell

While the drilling and injection option is considered to be the most appropriate approach to repairing the Narmada Pipeline, an alternative approach involves the use of a watertight sleeve which is placed over the whole expansion joint. The leaking joint is basically encapsulated with a custom-made steel shell that is sealed on to the pipeline with a compression type joint. The system is described as follows:

- The shell is delivered on site in two halves;
- The two halves are fitted together over the leaking joint and can be fitted together through welding or any other suitable method. The valve at the bottom of the shell should be kept open so that the water can drain out during assembly to avoid pressure building up within the joint during construction.
- The complete shell is then sealed onto the pipeline with a custom made joint which should incorporate a flexible coupling to allow some movement through expansion and contraction of the pipeline.
- The valve at the bottom of the shell is closed at the end of construction making the leak watertight.

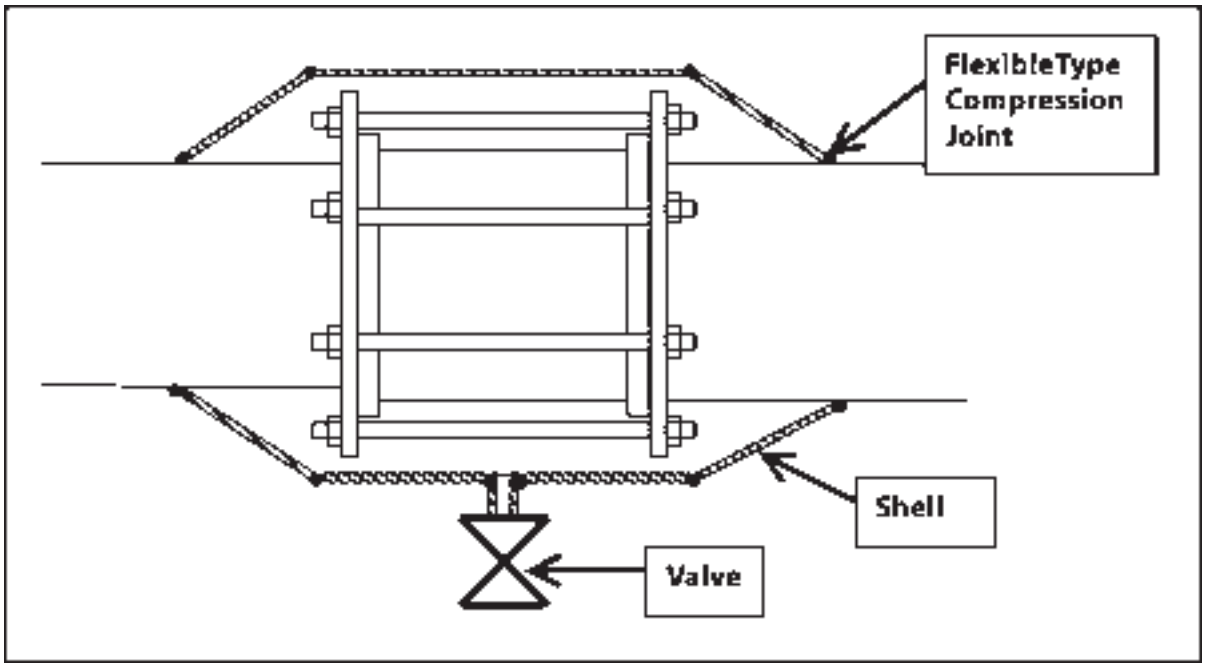


Figure B-3: Custom Sleeve that can be fitted over leaking joint

Although this method will work to repair the leaks on the Narmada Pipeline it will require skilled boilermakers to make the shell and compression type joints, as it is unlikely that such joints can be obtained "off the shelf".

Appendix C

Sizing and Design of New Meter Installation

1. Sizing of Meters

Information on different types of meters (i.e. mechanical, electromagnetic and ultrasonic) was provided in **Section 2.2** of the main report. Once a decision is taken on the type of meter to be used, the meter must be properly sized. The sizing of water meters can be undertaken using software or sizing sheets supplied by most meter suppliers. The input parameters for sizing include maximum and minimum flow rates, which can be obtained through the use of a temporary clamp-on ultrasonic meter that is installed on the outside of the pipe as shown in **Figure C-1**. After the initial logging the temporary meter is removed and the sizing is undertaken for the permanent meter installation.

Figure C-1: Initial logging of flows with temporary clamp-on ultrasonic meters on large and small diameter pipes

The typical sizing table for SENSUS WPD mechanical meters (one of the large meter companies – formerly Meinecke from Germany) are provided in **Table C-1** to provide an indication of the flow ranges per meter size. The flow values indicated can be summarised as follows:

- **Qmax: Maximum Peak Flow Short Time.** This is the absolute maximum flow that should be allowed through the meter. Qmax for a once in life time over 24 hours or Qmax X 1.2 for once in a life time over 5 minutes.
- **Qn: Continuous Flow**. Qn is the maximum flow rate at which the meter can run for an unlimited time. The meter should ideally be sized that the actual maximum flows be lower than Qn. The meter accuracy will be (± 2%).
- **Qt: Transitional Flow.** The meter should be sized that actual minimum flows are higher than Qt. The meter accuracy will be (± 2%). The meter should be sized to operate between Qn and Qt.
- **Qmin: Minimum Flow**. This is the absolute minimum flow that should be allowed through the meter. The meter accuracy will be (± 5%).

Table C-1: Sizing Table for SENSUS WPD mechanical meters

Meter (mm)	Qmax m^3/hr	Qn m^3/hr	Qt m^3/hr	Qmin m^3/hr
40	60	40	0.8	0.3
50	90	50	0.7	0.3
80	200	120	0.8	0.5
100	300	230	1.8	0.8
125	350	250	2	1
150	600	450	4	1.8
200	1200	800	6	4
250	1600	1250	11	6
300	2000	1400	15	12

It should be noted that meters are usually designed to measure accurately at flow velocities that are higher than in normal pipelines. For this reason it is usually necessary to reduce the pipe diameter before the meter to ensure higher flow velocities through the meter. For example on a 200 mm diameter pipeline it would typically require a 150 mm meter and not a 200 mm meter as often used by many water utilities.

2. Design of mechanical meter installation

Once the meter make and size has been established, the meter installation can be designed. The following issues should be considered when designing the pipework for a mechanical meter installation:

- Most meters require a straight length of pipe before and after the meter to ensure accuracy of flow measurement. These requirements should be obtained from the meter manufacturer and vary from one meter to another.
- A strainer should be installed upstream of the mechanical meter to trap any debris in the line and thereby protect the meter mechanism which is easily damaged.
- Isolating valves should be installed upstream and downstream of the meter to facilitate regular maintenance and/or repair. These valves can be excluded if existing operational valves are located in the vicinity of the new installation.
- If air in the pipeline is of concern (as is the case in Indore) an air valve should be installed upstream of the meter. Meters are designed to measure water flow and will be in-accurate if there is air in the pipeline. Software developed by the air valve manufacturers should be used be used to size the air valves.
- A dismantling joint (i.e. Viking Johnson Coupling or similar – see **Appendix G**) should be provided in the installation to enable easier removal of fittings during maintenance.

A typical design drawing for a mechanical meter is shown in **Appendix G.**

It is normal practice to house meters and associated fittings in a brick or concrete chamber depending on the site conditions. The following issues should be considered when designing the chamber:

- Working space should be allowed underneath the pipework to allow for easy maintenance of fittings (i.e. remove bolts etc). The working space should also be sufficient to easily remove the sieve of the strainer. For Y-type strainers this will require lowering the sieve from the strainer body. The clearance required to remove the sieve can be obtained from the strainer manufacturers.
- The overall inside height of the chamber should be sufficient for an average person to stand up while performing maintenance work. A guideline for the inside height is 1.8 m to 2.2 m with an inside width of between 1.4 m and 1.6 m.
- The pipework should be anchored in the walls of the chamber.
- The pipework should be supported with brick or concrete plinths underneath all fittings.
- Air ventilators should be provided if possible to reduce condensation.
- Where possible, the roof of the chamber should be 300 mm to 500 mm above the natural ground level. If the top of the chamber is level to the natural ground the chamber can easily be covered with mud during heavy rainstorms. Where traffic safety is of concern the top of the chamber should, however, be flush with the road or sidewalk and designed to minimise ingress of rain.
- Provision should be made for a sump in the floor of the chamber, below one of the manhole covers, to allow for collection of water when pumping water out of the chamber with a submersible pump.
- If security is of concern a lockable manhole cover should be provided to prevent unauthorized access to the chamber.

A few photographs showing the process of installing a new meter installation are shown in **Figure C-2 to Figure C-4**.

(a) **(b)**

Figure C-2: (a) Exposed pipe with temporary supports;
(b) Cutting into asbestos cement pipes

(a) **(b)**

Figure C-3: (a) Installing new pipework and fittings;
(b) New pipework completed with concrete floor in place

(a) **(b)**

Figure C-4: (a) Brickwork completed with anchor block visible;
(b) Completed chamber with lockable manhole cover

Appendix D

Consumer Meter Test Procedure

Appendix D provides a summary of a useful test procedure that can be used to test consumer water meters to evaluate whether or not they are reliable and the likely error associated with meter under-registration.

A sample of properties is selected for the meter tests. Field report sheets are then prepared including spaces for address, meter type and before and after test readings. The consumers whose meters are to be tested should be notified in advance. At the same time as the notifications are sent, the meters should be visually inspected. It should be confirmed that the meter visibly stops when no water is being used. This is also a useful indication if there are any leaks are on the premises and if so, the leaks should be repaired before the meter accuracy test is undertaken. If the leak can not be repaired, the particular consumer meter should not be included in the test, since the test is only effective if the meter comes to a complete stop when no water is being used.

Three tests each for slow, medium and fast flow rates should be carried out (in total nine tests per meter). At least two of the three tests at each flow rate should yield consistent results; otherwise the tests should be repeated. The following table provides details of the various flow rates.

Table D-1: Flow rates used when testing domestic meter

Meter size	Flow Rate		
	Slow	Medium	Fast
15 mm	66 – 56	450 -550	1500 – 1600
20 mm	110 – 130	900 – 1100	2300 - 2700

The theory of the test is based on measuring volumetric flow with meters that are known to be accurate. A meter testing kit is constructed that consists of either two check meters connected in series(as shown in **Figure D-1** and **Figure D-2**), or a check meter and a rotometer connected in series.

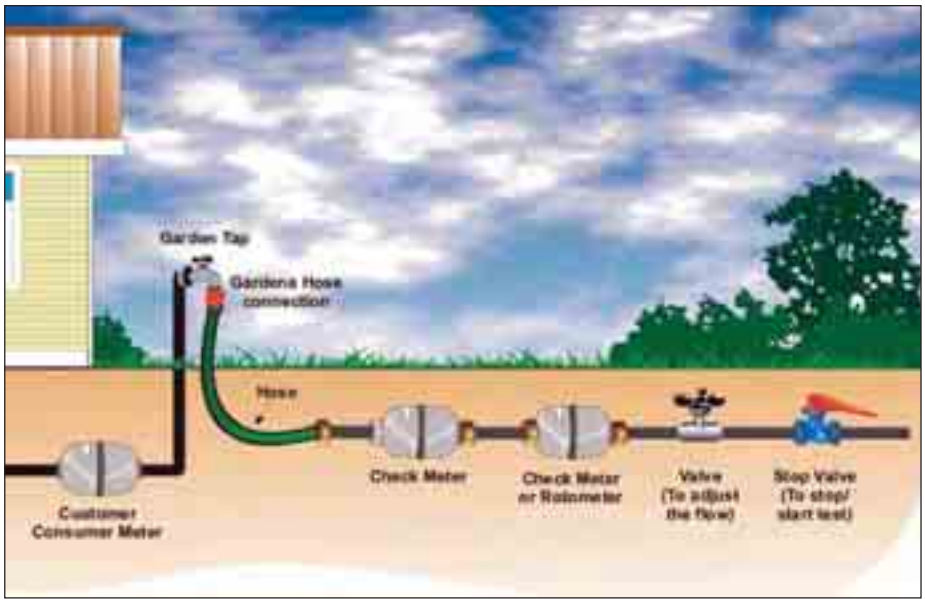


Figure D-1: Graphical presentation of test apparatus

Figure D-2: Photos of test apparatus used in South Africa.
Class "C" meters were used for the check meters.

The test procedure is as follows:

- The apparatus is connected to a garden tap. The occupants of the house should be informed that they should not flush toilets or use any water for the duration of the test.
- The tap is opened and the flow rate is regulated in one of two ways. 1) If the apparatus has a rotometer the flow rate can be read directly; 2) If not, a stop watch should be used along with the check meter in order to get the correct flow rate. The adjusting valve is throttled to achieve the desired flow rate as indicated in **Table D-1**. Once the desired flow rate has been achieved the stop valve is closed completely without moving the adjusting valve. This will ensure that that adjusting valve stays at the same percentage opening for all the tests.
- The reading on the check meters are recorded as well as the reading on the consumer meter on the premises. The stop valve is then opened to allow a quantity of water to flow through the meters. This quantity can be either be a litre if the consumer meter is able to record to litres (3 decimal points), in which case one whole revolution of the third decimal point should take place. If the meters have only two decimal points the volume passing through the meter would then be 10 litres, in this case one whole revolution of the second decimal point should take place. The following table represents the approximate time that the tests should take at the various flow rates and different volumes for a 15 mm meter. It is recommended that approximately 10 litres be used (rather than 1 litre) for the fast flow rate since 2.32 seconds as required to pass 1 litre of water through the meters is a very short time period.

Table D-2: Approximate times for meter tests

Volume	Slow	Medium	Fast
1 litre	1 minute	7.2 sec	2.32 sec
10 litres	10 minutes	72.3 sec	23.2 sec

- Once the required volume has passed through the meter, the stop valve should be closed quickly. The readings on all meters are then recorded. If the apparatus consists of two check meters, these should be checked against each other and the average of the two values used in the calculation.
- The results are then analysed using the following equation. The equation is used to calculate the % error at the slow, medium and fast flow rates. If the % error is positive, it indicates that the meter overestimates the flow (very unusual) and a negative error indicates an underestimate of the flow which is the normal situation.

$$\text{Error (\%)} = \frac{V_{\text{in situ}} - V_{\text{check}}}{V_{\text{check}}} \times 100$$

Where:

$\mathbf{V_{in\ situ}}$ = Volume through consumer meter

$\mathbf{V_{check}}$ = Average volume through check meters.

Error (%) = The percentage error of the consumer meter.

Appendix E

Meter Cost Estimates

Meter Cost Estimates (Rupees)

The costs quoted were obtained from South Africa in July 2004 and should serve as an indication only. (Exchange rate of South African Rand vs. Indian Rupee: 1 Rand = 8 Rupees)

All costs should be verified and checked with local manufacturers, suppliers and contractors in India.

Mechanical meter installations (One directional)*

Installation	Description	100mm	150mm	200mm	250mm	300mm	400mm	500mm	Quantity (Nos.)
	Reduce from pipe (mm)	150	225, 250, 200	300	350	400, 500	600	700	
Reducers	Size (mm) to (mm)	150x100mm	250x150mm	300x200mm	350x250mm	400x300mm	600x400mm	700x500mm	
	Value in Rs.	1,760	3,408	5,704	11,616	18,296	41,584	56,000	2
VJ Coupling	Value in Rs.	2,728	3,176	4,144	6,120	6,304	8,704	16,000	3
Valves	RSV waterworks (in Rs.)	16,592	25,952	40,248	78,328	98,976	178,576	331,112	1
	Non-Return (in Rs.)	18,568	32,176	48,432	82,976	105,608	195,984	240,000	1
	Strainer (in Rs.)	12,336	27,400	40,000	58,432	127,056	200,000	240,000	1
Spool piece	Length (m)	0.6	0.9	1.2	1.5	1.8	2.4	3.0	
	Mild steel (in Rs.)	1,600	1,912	3,360	4,488	5,352	6,728	11,216	
Meter	Sensus WPD (in Rs.)	19,600	34,240	38,080	63,120	79,680	148,640	194,000	1
Labour, Installation	(in Rs.)	80,000	100,000	120,000	144,000	184,000	216,000	240,000	
Total (in Rs.)		**159,760**	**237,833**	**314,632**	**475,180**	**660,458**	**1,064,627**	**1,438,760**	
Total (A) (in Rs.)		**159,760**	**237,833**	**314,632**	**475,180**	**660,458**	**1,064,627**	**1,438,760**	

* No lightning protection and cables required

Magnetic flow meter installations (One or two directional)

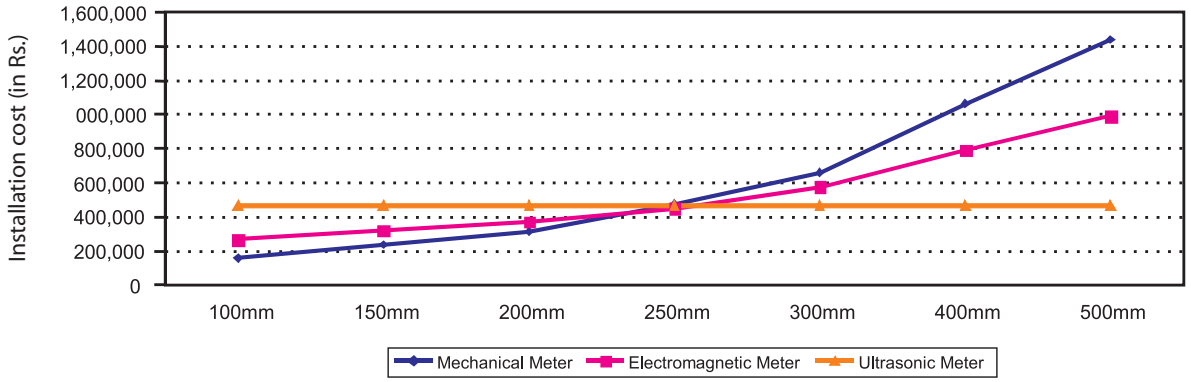
Item	Description	100mm	150mm	200mm	250mm	300mm	400mm	500mm	Quantity (Nos.)
	Reduce from pipe (mm)	150	225, 250, 200	300	350	400, 500	600	700	
Reducers	Size (mm) to (mm)	150x100mm	250x150mm	300x200mm	350x250mm	400x300mm	600x400mm	700x500mm	
	Value in Rs.	1,760	3,408	5,704	11,616	18,296	41,584	56,000	2
VJ Coupling	Value in Rs.	2,728	3,176	4,144	6,120	6,304	8,704	16,000	3
Spool piece	Length (m)	1.0	1.5	2.0	2.5	3.0	4.0	5.0	
	Mild steel (in Rs.)	1,600	1,912	3,360	4,488	5,352	6,728	11,216	
Meter	Meimag 3100W	112,808	131,848	147,232	170,240	226,288	335,016	424,096	1
	Remote Kit (in Rs.)	8,400	8,400	8,400	8,400	8,400	8,400	8,400	1
Accessories	Cables etc (in Rs.)	16,000	16,000	16,000	16,000	16,000	16,000	16,000	1
Lightning protection	(in Rs.)	15,000	15,000	15,000	15,000	15,000	15,000	15,000	1
Labour, Installation	(in Rs.)	104,000	130,000	156,000	187,200	239,200	280,800	312,000	
Total (in Rs.)		**269,512**	**320,460**	**373,192**	**449,652**	**576,448**	**791,408**	**991,576**	
Total (B) (in)		**269,512**	**320,460**	**373,192**	**449,652**	**576,448**	**791,408**	**991,576**	

Remarks: 1. No valves or strainers required.
2. The cost to get electricity on site was not included.

Ultrasonic flow meter. Installed on outside of pipe (One or two directional)

Item	Description	100mm	150mm	200mm	250mm	300mm	400mm	500mm	Quantity (Nos.)
Meter	Panametrics Df868 (in Rs.)	385,256	385,256	385,256	385,256	385,256	385,256	385,256	1
	Enclosure Box (in Rs.)	30,000	30,000	30,000	30,000	30,000	30,000	30,000	1
Accessories	Cables etc (in Rs.)	8,000	8,000	8,000	8,000	8,000	8,000	8,000	1
Lightning protection	(in Rs.)	15,000	15,000	15,000	15,000	15,000	15,000	15,000	1
Labour, Installation	(in Rs.)	30,000	30,000	30,000	30,000	30,000	30,000	30,000	
Total (in Rs.)		**468,256**	**468,256**	**468,256**	**468,256**	**468,256**	**468,256**	**468,256**	
Total (C) (in Rs.)		**468,256**	**468,256**	**468,256**	**468,256**	**468,256**	**468,256**	**468,256**	

Remarks: 1. No valves or strainers required.
2. The cost to get electricity on site was not included.



Appendix F

Simple Method to Measure Water Pressures

Appendix F provides a summary of a useful procedure to measure pressures at garden taps.

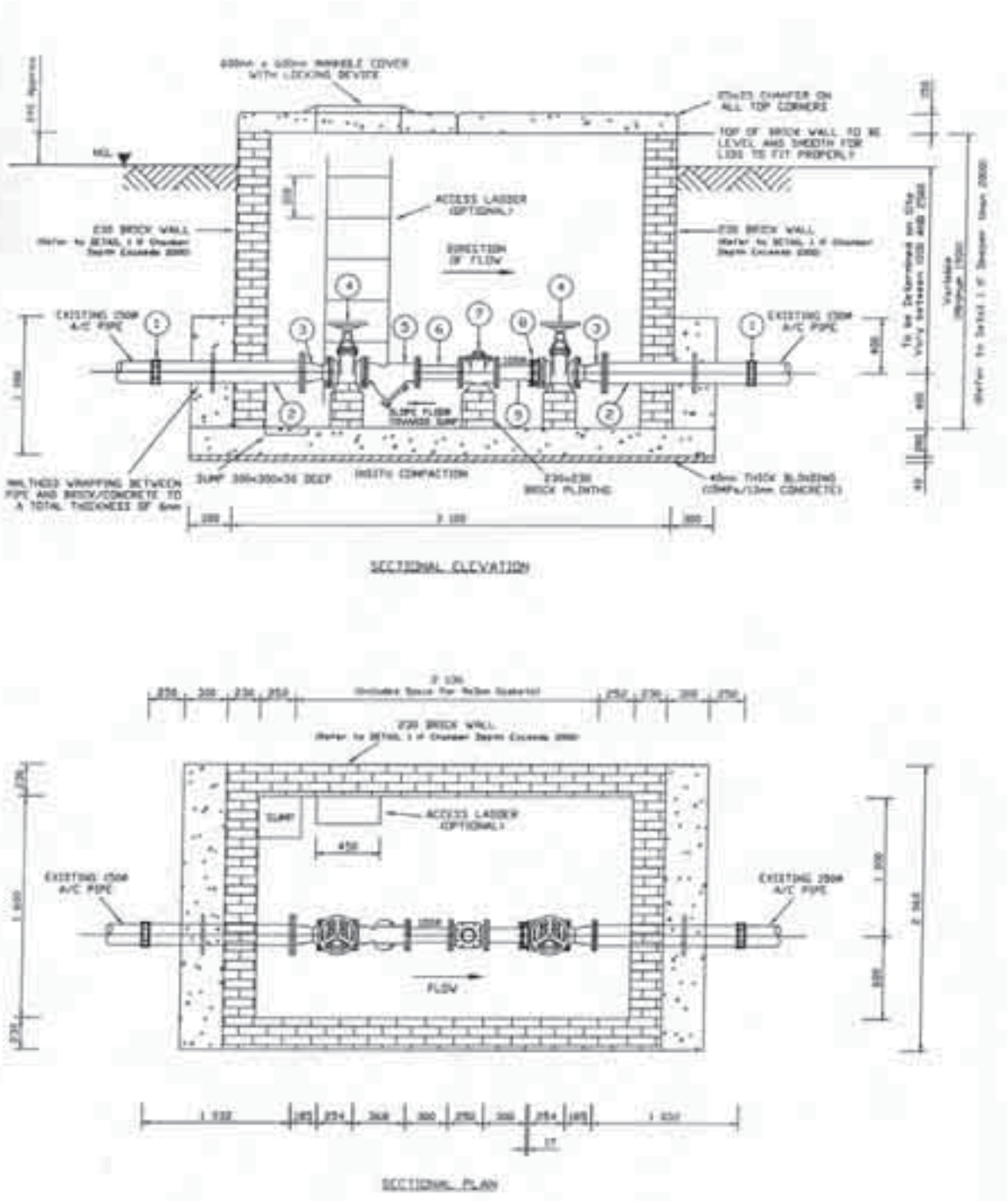
This is an easy low cost method that can be used to gain an understanding of the operating pressures in a water distribution system. Information on the pressures in a specific area can greatly assist the engineers to decide which WDM intervention, if any, should be implemented.

The test apparatus is made up of a standard pressure gauge, garden tap connection and galvanised pipe fittings. The pressure gauge can be obtained from any control valve supplier and the garden tap connection/pipe fittings can be obtained from most hardware stores. Photographs of a typical pressure test apparatus are shown in **Figure F-1**.

Figure F-1: Photos of a typical pressure test apparatus

Appendix G

Design Drawing for 100 mm Diameter Mechanical Meter Installation

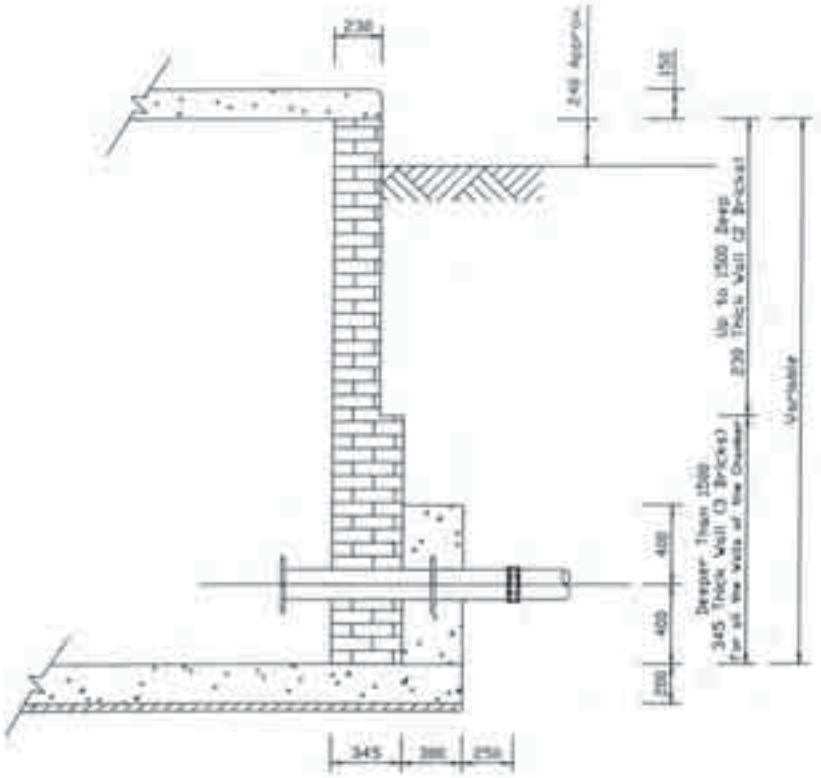


SCHEDULE OF FITTINGS

1) 150mm VIKING JOHNSON OR SIMILAR STEPPED COUPLING A/C TO STEEL (x2)
2) 150mm STEEL PIPE WITH PUDDLE FLANGE, PLAIN END ONE SIDE, FLANGED OTHER SIDE, IF 230mm BRICK WALL L = 1032mm (x2), IF 345mm BRICK WALL L = 1147mm (x2)
3) 150-100 STEEL REDUCER, FLANGES AS SHOWN WITH WELDNECK FLANGE ONE SIDE, L = 185mm (x2)
4) 100mm CAST IRON GATE VALVE WITH HANDWHEEL, RSV CLOCKWISE CLOSING, L = 254mm (x2)
5) 100mm CAST IRON 'Y' TYPE STRAINER, FLANGED, L = 368mm (x2)
6) 100mm STEEL PIPE, FLANGED BOTH SIDES, L = 308mm (x1)
7) 100mm SENSUS WPD WATER METER WITH 1m³/1m³PULSE REGISTER, L = 250mm (x1)
8) 100mm VIKING JOHNSON FLANGE ADAPTOR (x1)
9) 100mm STEEL PIPE, FLANGED ONE SIDE, PLAIN END OTHER SIDE, L = 300mm (x2)

NOTES

A) ALL STEEL FITTINGS AND PIPES TO BE COATED AND LINED WITH FUSION BONDED EPOXY 250 MICRON OR HOT DIPPED GALVANISED
B) STEEL FITTINGS AND PIPES IN CONTACT WITH SOIL SHALL BE ADDITIONALLY PROTECTED WITH THE CORRECT DENSO SYSTEM
C) ALL DIMENSIONS TO BE CHECKED ON SITE BY THE CONTRACTOR BEFORE CONSTRUCTION STARTS
D) ALL FLANGES DRILLED TO SABS 1123 TABLE 1600/3
E) ALL VALVES AND FITTINGS PN16
F) ALL STEEL COMPONENTS (NUTS, BOLTS, ACCESS LADDER) TO BE HOT DIPPED GALVANISED
G) DRAWING TO BE READ IN CONJUNCTION WITH SPECIFICATIONS
H) DIMENSIONS OF FABRICATED FITTINGS ARE BASED ON BUTT-WELD STANDARDS, IE. TEES, BENDS, REDUCERS AND WELD-NECK FLANGES
I) STRAINERS ARE SET AT 30° AWAY FROM WALL (IE. ONE BOLT HOLE ROTATION)
J) FOR CHAMBERS WHERE TOTAL DEPTH EXCEEDS 2000mm REFER TO DETAIL 1
K) THE GATE VALVES AND METER SHOULD BE SUPPORTED WITH 230x230 BRICK PLINTH



DETAIL 1
(FOR CHAMBERS WHERE TOTAL DEPTH EXCEEDS 2000)

0 10 20 30 40 50 60 70 80 90 100
100mm ON ORIGINAL PLAN AT SCALE 1:1

//KHARA HAIS MUNICIPALITY
BULK METER INSTALLATIONS

PIPEWORK DETAILS
150mm - 100mm

MARCH 2005

P0133 / UPT-002 / 00

Appendix H

Preliminary Water Balance Calculations for Indore

Data Used for Water Balance

The data used in the water balance were obtained from reports and personal conversations with the staff of IMC (See **Table H.1** for summary). Assumptions were also made in cases where no reliable information could be obtained. All data should therefore be verified and updated where necessary by the Engineers of IMC. (Latest data were received from IMC on 2006/3/30).

Table H.1: Summary of data used in the Water Balance for Indore

Item	Value or assumption used in Water Balance
Number of legal connections	155,889 Domestic Connections 1253 Commercial Connections 1026 Industrial Connections - (92 "Other" connections were also indicated – for the purpose of this exercise they were added to the Industrial connections.) Therefore: Total Industrial connections: 1118 **158,260 Total Billed Connections** **7263 Community Standposts** **165,523 Total Legal Connections**
Number of illegal connections	Varies between 20,000 and 40,000
Average operating pressure when system is pressurised	Varies between 3 m and 15 m.
Time the system is pressurised	45 min/day
Length of mains	1,400 km (Some sources indicate 1,200 km)
Length of bulk supply mains	Narmada – 70 km length @ 25 m pressure Yashwant – 21 km length @ 25 m pressure
Total System Input (m^3 /year)	Narmada – 180,000 X 365 = 65,700,000 m^3/yr Yashwant – 20,000 X 365 = 7,300,000 m^3/yr Bilawali – 0 m^3/yr Tubewells – Tubewells were not included in the analysis. The supply from tubewells was not taken into account and also not the demand on tubewells. This was done because of the uncertainty of the tubewell data. **Total – 73,000,000 m^3/yr**
Billed Metered Consumption (m^3 /year)	59 Bulk Consumers (8.2 MLD/day) 8.2 X 365 = 2,998,128 m^3/yr Bulk consumers includes Mhow Army Base

Item	Value or assumption used in Water Balance
Billed Unmetered Consumption (m^3 /yr)	Legal domestic Connections (155,889) = 100 MLD (Obtained from IMC) This calculates to approximately 19 kl/month/connection This appears to be very high for properties that receive water at only 7m of pressure, 45 min a day and sometimes only every second day. This should be verified through installation and measurement of a few domestic meters. A more realistic estimate will probably be 70 MLD. (13 kl/month/connection) = 70 MLD X 365 = 25,550,000 m^3/yr Commercial Connections (1253) = 25 MLD (Obtained from IMC) = 25 MLD X 365 = 9,125,000 m^3/yr Industrial Connections and Others (1026 + 92) = 15 MLD (Obtained from IMC) = 15 MLD X 365 = 5,475,000 m^3/yr Dewas Town 1,825,000 m^3/yr (Obtained from IMC)
Unbilled Metered (m^3 /year)	0 m^3/yr
Unbilled Unmetered Consumption (m^3 /yr)	Water Tankers 8.75 MLD for 3 months 1 MLD for other 9 months Average: Approximately 3 MLD = 3 X 365 = 1,095,000 m^3/yr 7263 Public Standposts @ 25 litre/person/day, @ 7 person/household, @ 10 households/standposts 7263 X 25 X 7 X 10 X 365 /1000 = 4,639,241 m^3/yr The standposts (additional 7000) from tubewells were excluded because the input volume from tubewells were also excluded previously.
Unauthorised Consumption (m^3 /yr)	Illegal Connections (20,000 to 40,000) Estimated to be between 10 MLD and 20 MLD = 10 X 365 = 3,650,000 m^3/yr
Cost Factors	Water Production cost = 12.5 Rupees/ m^3 Average Water Sales cost = 15 Rupees/ m^3 Annual Running cost of system = 850,000,000 Rupees

Aqualibre Water Balance Model

System Data

Water Undertaking Details

Water Undertaking	Indore Municipal Corporation	
Address		
City	State	Zip
Tel	Fax	e-mail
Contact Person		

System Pressure		
Average System Pressuremeters	10.00	30
Percentage Time Pressurised	4.17	30

Customer Meters		Error %
Total Customer Meters		

Mains	Kilometers	Error %
Total Trunk Mains	90.0	8.1
Total Distribution Mains	1,400.0	10.0
Total Mains	1,490	9.4

Connections and Properties		Error %
Total Number of Units	165,582	9.5
Total Connections	165,582	9.5
Total Properties	165,582	9.5

Aqualibre Water Balance Model

Name of Water Undertaking	Indore Municipal Corporation
Supply Area:	001
Period of Record:	January 2004 to December 2004 (365 days)
Water Balance Units:	cubic meters

Primary Water Balance

System Input: Own Sources	73,000,000	9.1
From Narmada River 180 MLD	65,700,000	10.0
From Yashwant Sagar 20 MLD	7,300,000	10.0
Exclude Tubewells (0)		
Bilawali Tank (0)		
System Input: Imported Sources		
No other imported sources		
Total System Input	73,000,000	9.1
Billed Metered Consumption: Domestic Consumers		
Billed Metered Consumption: Non-Domestic Consumers	2,998,128	10.0
59 Bulk Users	2,998,128	10.0
Total Billed Metered	2,998,128	10.0
Billed Unmetered Consumption: Domestic Consumers	25,550,000	30.0
From 155,889 flat tariff connections 100 MLD	25,550,000	30.0
Billed Unmetered Consumption: Non-Domestic Consumers	16,425,000	13.1
Export to Dewas town	1,825,000	20.0
Commercial 25 MLD	9,125,000	20.0
Industrial 15 MLD	5,475,000	20.0
Total Billed Unmetered Consumption	41,975,000	19.0

Unbilled Metered Consumption		
There are no unbilled metered connections (0)		
Unbilled Unmetered Consumption: Domestic Consumers	5,734,241	16.6
Water tanker 1 MLD (9 months) 8.8 MLD (3 months)	1,095,000	20.0
7263 Public Standposts 25 l/c/p (7 person/house) (10 hours)	4,639,241	20.0
Customer Metering Inaccuracies and Data Handling Errors	333,125.33	10.0
Total Metering Errors	333,125.33	10.0
Data Handling Errors		
Unauthorised Use	3,650,000	30.0
20,000 – 40,000 Illegal Connections 10 MLD	3,650,000	30.0
Losses from Storage Facilities		
Storage Facility Losses		
Losses by Volume		

Aqualibre Water Balance Model

Primary Water Balance Summary

	Cubic meters	Error %
Billed Authorised Consumption	**44,973,128**	**17.7**
Billed Metered Consumption	2,998,128	10.0
Billed Unmetered Consumption	41,975,000	19.0
Unbilled Authorised Consumption	**5,734,241**	**16.6**
Unbilled Metered Consumption		
Unbilled Unmetered Consumption	5,734,241	16.6
Apparent Losses	**3,983,125.33**	**27.5**
Unauthorised Use	3,650,000	30.0
Consumption Meter Error	333,125.33	10.0
Total System Input	73,000,000	9.1
Water Losses	22,292,631	46.7
Apparent Losses	3,983,125.33	27.5
Real Losses	18,309,505.67	57.2
Bulk Storage Leakage and Overflow		
Revenue Water	44,973,128	17.7
Non-Revenue Water	28,026,872	37.3

Aqualibre Water Balance Model

Performance Indicators

Base Data Used in Calculations	Value	Error%	Lower Estimate	Upper Estimate
Averager pipe length from street edge to meter	10.00	0	10.0	10.0
Length of trunk mains	90.0	8.1	83	97
Length of distribution mains	1,400.0	10.0	1,260	1,540
No. of Service Connections	165,582	9.5	149,852	181,312
Connection Density (distribution mains)	118.27	13.8	101.96	134.59
Average System Pressure	10.00	20	20.0	30.0
Average Trunk Pressure	25.00	20	7.0	13.0
Percentage time pressurised – System	4.17	30	2.9	5.4
Percentage time pressurised – Trunk Mains	100	0	100.0	100.0
Number of Accounts	165,582	9.5	149,925	181,239

Unavoidable Annual Real Losses	m^3/day	Error %
On Trunk Mains	41	21.6
On Distribution Mains	11	12.6
On service connections to street boundary	55	31.9
On service connections to street edge to meter	17	31.9
Total unavoidable real losses	124	42.8

Cost of Running the System	Rupee/m^3	Rupees
Real Loss Cost :12.5000	Apparent Loss Cost :14.0000	System Cost : 850,000,000

Performance Indicators	Best Estimate	Lower Estimate	Upper Estimate
Non Revenue Water Basic (IWA Level 1, Fi37)			
Percentage of System Input by Volume	38.4	20.1	56.7
Non Revenue Water Basic (IWA Level 1, Fi38)	42.93	22.5	63.4
Percentage of System Input by Value			
Real Losses Basic (IWA Level 1, Op24)			
l/connection/day when pressurised	7,245.1	2,515.2	11,975.1
l/km mains /day	856,902.6	296,836.9	1,416,968.2
Real Losses Intermediate			
l/connection/day/m pressure when pressurised	724.5	203.5	1,245.6
l/km mains/day/m pressure	85,690.3	24,065.7	147,314.8
Real Losses Detailed (IWA Level 3, Op25)			
Infrastructure Leakage Index	403.44	115.18	691.69

Appendix I

Paper on Accuracy Limitations of the Infrastructure Leakage Index (ILI)

Accuracy Limitations of the ILI – Is it an Appropriate Indicator for Developing Countries?

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Keywords: ILI, accuracy limitations, developing countries

Introduction

Since the level of water losses from potable water distribution system is one of the key efficiency issues, it would be expected that reliable performance indicators are used for benchmarking, international performance comparison or target setting. Unfortunately this is not the case in most parts of the world and utility managers and consultants around the world as well as the International Financing Institutions still continue to express water losses as % of System Input Volume.

The serious problems of using % of system input as a key PI have been highlighted in many conferences around the world. (e.g.Liemberger, 2002) and there is general consensus that this indicator should not be used for comparison or target setting purposes.

Experienced practitioners consider the Infrastructure Leakage Index (ILI, Recommended by IWA and AWWA) as the most appropriate performance indicator for real losses (physical losses). In many cases, however, poor data quality as well as low operating pressures, particularly in developing countries, are often cited as motivation for not using the ILI in which case the % of system input tends to re-appear.

Brief description of the ILI

The ILI is effectively an indicator of how well a distribution network is being managed and maintained at the current operating pressure. It is the ratio of Current Annual Volume of Real Losses (CARL) to Unavailable Annual Real Losses (UARL).

$$ILI = CARL / UARL$$

Being a ratio, the ILI has no units and thus facilitates comparisons between countries that use different measurement units (U.S. metric or imperial). But, what are unavoidable losses and how are they calculated? Leakage management practitioners around the world are well aware that Real Losses will always exist – even in new and well managed systems. It is simply a question of how high these unavoidable losses will be.

The complex initial components of the UARL formula were converted to a 'user friendly' pressure-dependent format for practical use:

$$UARL\ (liters/day) = (18 \times Lm + 0.8 \times Nc + 25 \times Lp) \times P$$

where Lm = mains length (km); Nc = number of service connections, Lp = total length of private pipe, property boundary to customer meter (km); P = average pressure (m).

Is the ILI well known and widely used?

The answers unfortunately is NO. The authors are most certain that a minority of utility managers and consultants (presumably a single digit percentage) around the world have heard of the ILI or using it regularly. However, significant promotional efforts have been made:

- in Australia, the WSAA is publishing the ILI of their members on an annual basis.
- in New Zealand it was introduced in 2001 and is currently being used by many water utilities throughout the country.
- in South Africa the ILI is well accepted and used by many utilities. It is soon to be implemented as the key PI for assessing water losses by the regulator throughout the country.
- in Italy, by the "water loss user group".
- in North America, by the AWWA water loss control committee.

by members of the IWA water loss task force (WLTF) in their working environment.

One of the key challenges to the WLTF is to develop a strategy of how best to introduce the ILI to utility managers and consultants around the world.

Part of the problem is that people are simply not aware of the ILI – and the other part of the problem is the limited understanding and acceptance of the ILI. In this regard, may practitioners prefer not to use the ILI for one or other of the following reasons:

- the accuracy of the UARL formula is questionable;
- data required to calculate UARL are not available;
- nobody uses and understands the ILI – it is basically not accepted in the industry;
- the ILI is not needed – the classical performance indicators (like real losses per km mains per day) are sufficient.

In addition to the above there are another two reasons why the ILI is sometimes not used:

- 10% water losses always sound acceptable and low – while the ILI in many cases highlights that the true leakage performance is far from satisfactory.
- Warnings from the Water Losses Task force that the ILI must not be used for systems with less than 25 m average pressure or less than 5,000 connections.

Initial applicability limitations for the ILI

The equation used for calculating Unavoidable Annual Real Losses (UARL) (Lambert et al 1999), is based on components of Real Losses originally calculated at 50 meters pressure, then corrected for pressure, assuming a linear pressure: leakage rate relationship for large systems with mixed pipe materials.

Practical limitations placed on applying the UARL formula were, originally, that systems should not have less than 5,000 service connections, not less than 20 connections/km of mains, and not less

than 25 meters of pressure. Following recent research, the lower limits for number of service connections is now 3,000 and the lower limit on density connections has been removed.

The lower limit of 25 meters for pressure was introduced to avoid significant errors from extrapolating the assumption of a linear pressure: leakage relationship to systems with 100% flexible pipes at low pressure, where the N1 exponent would be close to 1.5 (note: Leakage varies with Pressure^{N1}).

Advanced pressure reduction is becoming an increasingly popular technique to reduce both leakage and burst frequencies and in some cases utility managers try to maintain system pressures to avoid the average pressures exceeding 25 metres. To compound the problem, most of water distribution networks in the developing world do not even enjoy continuous supply – and pressures of more than 10 or 15 metres tend to be the exception and not the rule.

Should such utilities be discouraged from using the ILI ?

General ILI accuracy considerations

The accuracy of the ILI depends less on the accuracy of the (empirical) UARL formula but on the accuracy of:

- annual volume of real losses
- average pressure
- distribution network data

The following example demonstrates the accuracy problem of a system with a low level of leakage:

- System input volume: 45 million m^3/year (+/- 1%, this is already considered a very good accuracy).
- Real Losses: 4.1 million m^3/year (but since the amount is small the accuracy is only +/-11%, using the statistical 95% confidence limits methodology).
- Length of mains: 2000 km, number of connections: 200,000 (both +/- 1%).
- Average length of private supply pipe 5 m (+/- 20%).
- Average pressure 40 m (+/- 5%).

The ILI was calculated to be 1.27 – but the 95% confidence limits are 1.12 and 1.43. This means that with 95% confidence it can be assumed that the ILI of this system is between 1.12 and 1.43 – although the assumed data quality of this example is truly excellent.

If the system input of this example is changed to 70 million m^3 (leaving everything else unchanged) and therefore the real losses increase by 30 million m^3/year to 34.1 million m^3, the ILI would be between 9.9 and 11.2 (best estimate: 10.6).

The first example would mean an ILI accuracy of +/- 12%, the second one +/- 6%. Adding this to the accuracy limitation of the UARL formula (at 40 m pressure up to +/- 10%) it is obvious that the ILI's overall accuracy will not be less than 15% but could be considerably more.

Another problem is the accuracy of the average pressure since this is normally not calculated by water utilities and is often estimated based on a few pressure measurement (if any). It is certainly unusual for the accuracy of the system wide average pressure to be better than +/- 10%. Furthermore, increasing average pressure is a simple way in which utility managers can "improve" their ILI.

Taking the previous example and reducing average pressure by 10% (from 40 to 44 m), the corresponding ILI's would be reduced to between 1.0 and 1.3 or 9.0 and 10.2 respectively.

Showing too many decimal places sends a misleading signal of the ILI's accuracy and the authors therefore recommend the following:

- don't show decimal places for ILIs > 10.
- use only one decimal place for ILI's below 10.
- in a more comprehensive analysis, always calculate and report the potential ILI bandwidth.

The accuracy issue must be taken into account if the ILI is used for regulatory purposes.

Data availability and quality in developing countries

When introducing the ILI in the developing world, most utilities initially face the following problems:

- no reliable information on the true network length. Maps (if any) often show only a fraction of the existing network (result: UARL underestimated → ILI overestimated)
- number of service connections is not known – number of customers is used instead (number of customers will in most cases be higher than the number of connections, result:UARL overestimated →ILI underestimated)
- neither pressure data not pressure loggers available. Estimated average pressure usually too high ("wishful thinking"!) (result: UARL overestimated → ILI underestimated)
- high level of apparent losses (difficult to estimate) and therefore unreliable and inaccurate volume of real losses.

The following three examples are from cities in Vietnam, Indonesia and Sri Lanka. In all three cases substantial field work (flow and pressure measurements) and comprehensive data collection and analysis were undertaken. Water balances and performance indicators, including accuracy estimations, were undertaken using the Aqualibre™ Water Balance Software.

Table 1: Annual volumes and system characteristics of three cities in developing countries

	Vietnam		Indonesia		Sri Lanka	
		+/-		+/-		+/-
System Input Volume [m³/a]	365,440,000	2%	20,415,203	1%	10,263,867	2%
Authorised Consumption	214,830,000	0.3%	12,247,970	0.0%	5,626,176	0.3%
Billed Consumption	213,730,000	0.0%	12,235,450	0.0%	5,589,676	0.0%
NRW	151,710,000	4.9%	8,179,753	3.5%	4,674,191	4.4%
Water Losses	150,610,000	4.9%	8,167,233	3.5%	4,637,691	4.4%
Apparent Losses	17,040,000`	9.9%	1,397,676	13.5%	547,573	4.8%
Real Losses	133,570,000	5.7%	6,769,557	5.1%	4,090,118	5.0%
Length of mains [km]	2,647	5.0%	756	2.8%	421	1.7%
Number of Connections	426,000	0.7%	45,280	1.7%	25,229	1.9%
Average length of private pipe [m]	0		5	20.0%	5	25.0%
Total length of private pipe [km]	0		226		126	
Supply Time [%/day]	99%	10.0%	95%	3.0%	86%	10.0%
Preassure [m]	12	10.0%	11	10.0%	11	15.0%

Table 2: Real loss performance indicators

	Vietnam	Indonesia	Sri Lanka
l/conn./day	**866**	**430**	**519**
min	766	403	460
max	966	457	577
l/conn./d/m preassure	**72**	**38**	**48**
min	60	34	39
max	84	43	57
ILI	**79**	**31**	**39**
min	67	24	32
max	91	37	47

Simulating the scenario of an overestimated number of service connections (by using the number of customers) the number of connections was reduced by 20% and the changed real loss performance indicators can be seen in Table 3.

Table 3: Real loss performance indicators after number of connections has been reduced by 20%

	Vietnam	Indonesia	Sri Lanka
l/conn./day	**1083**	**430**	**519**
min	958	403	460
max	1208	457	577
l/conn./d/m preassure	**90**	**36**	**48**
max	60	32	39
min	84	41	57
ILI	**96**	**36**	**46**
min	80	32	38
max	111	41	55

Going a step further and assuming that the drawings were incomplete and increasing the length of mains by 20%, the ILI would of course change (see Table 4):

Table 4: Real loss performance indicators after increasing length of mains by 20%

	Vietnam	Indonesia	Sri Lanka
ILI	**93**	**34**	**44**
min	79	20	36
max	108	39	55

Average pressure in all three systems is well below 15 m (11 - 12 m) and therefore the question: how wrong are the calculated ILI values?

Thornton and Lambert (2005) suggest a use of a pressure correction factor in the UARL formula that would in this case be in the order of 0.6 (since most but not all leaks are on flexible pipes). Consequently the "true" ILI values would be significantly (60%) higher. In the Vietnamese situation, the ILI would increase from between 67 and 111 to between 112 and 160. The issue to be resolved is whether it is necessary or not to introduce a new parameter to the ILI and if the adjusted ILI estimates

are more reliable and meaningful than the original values. The answer to this question is highly debatable and the authors tend to favour the original unadjusted values on the grounds that a new parameter may simply confuse a methodology that has yet to be universally accepted and the impact of the adjustment is not particularly important once the ILI's are already so high. It is after all considered to be a relative indicator which is used to highlight whether a system has a serious leakage problem or not. A system with an ILI of 30 will be regarded as having a serious leakage problem as will a system with a value of 130. It is, however, important to understand the ILI values in low pressure situations tend to err on the low side and can often be up to 60% higher – depending on the material mix of mains and service connections.

How meaningful are ILI values of distribution networks in developing countries?

The present approach of expressing water losses as "Non-Revenue Water" in terms of percentage of system input volume often significantly underestimates the true extent of the leakage problem in developing countries and tends to penalise systems with lower consumption. This can be clearly seen from the previous examples:

- Vietnam 42% (ILI = 79)
- Indonesia 40% (ILI = 31)
- Sri Lanka 46% (ILI = 39)

As can be seen the % losses do not reflect the huge difference in leakage performance between the Vietnam system and the remaining two systems.

It is therefore the view of the authors that despite the accuracy limitations described above, the ILI is still the best indicator to quickly describe the level of real losses of a system. Many utility managers and consultants, however, remain reluctant to switch from the "prehistoric" % UfW or % NRW to the ILI (both in the developed and the developing world). To help address this issue, a simple look-up table based on the ILI was suggested by Liemberger (2005). This allows a first simple assessment using liters per connection per day in combination with the approximate average pressure. This table has meanwhile been included in the new water loss reduction training modules of the World Bank Institute (WBI, the capacity building arm of Worked Bank Group).

Technical Performance Category		ILI	Liters/connection/day (when the system is pressurised) at an average pressure of:				
			10 m	20 m	30 m	40 m	50 m
Developed Countries	A	1-2		<50	<75	<100	<125
	B	2-4		50-100	75-150	100-200	125-250
	C	4-8		100-200	150-300	200-400	250-500
	D	>8		>200	>300	>400	>500
Developing Countries	A	1-4	<50	<100	<150	<200	<250
	B	4-8	50-100	100-200	150-300	200-400	250-500
	C	8-16	100-200	200-400	300-600	400-800	500-1000
	D	>16	>200	>400	>600	>800	>1000

Figure 1: Proposed use of ILI as PI in developed and developing countries (Liemberger, 2005)

As can be seen from the figure, different ILI ranges have been provided for developing and developed countries. The proposal attempts to classify the leakage levels within the Water Utilities into four categories based on the ILI value as follows:

Category A: Further loss reduction may be uneconomic unless there are shortages; careful analysis needed to identity cost effective improvement

Category B: Potential for marked improvements; consider pressure management; better active leakage control practices, and better network maintenance

Category C: Poor leakage record; tolerable only if water is plentiful and cheap; even then, analyze level and nature of leakage and intensify leakage reduction efforts

Category D: Horrendously inefficient use of resources; leakage reduction programme imperative and high priority

Since the vast majority of water utilities in the developing world will have ILI values exceeding the upper limit of the table (16), reducing real losses to below 16 will be the starting point. As soon as utilities start to introduce active leakage control, carry out flow and pressure measurements, and improve overall data quality the bandwidth of the ILI will dramatically be reduced. Often leakage reduction will also lead to an improved supply situation and pressure increases that will make the calculation of the UARL formula more accurate.

Conclusions

The ILI has, in recent years, proved to be a very useful performance indicator when Benchmarking leakage in water distribution systems.

Although various limits on the use of the ILI have been proposed by it's original developer to safeguard the soundness of the results, the author have found that it can still provide a useful indication of high leakage even when used outside the normally accepted limits. It is certainly also a most suitable indicator for water utilities in developing countries and it is now understood that "true" ILI's of low pressure system will always be higher than the calculated figures. This suggests that the leakage problem in developing countries is even more serious than previously anticipated.

There have been various suggestions on how the ILI can be improved by refining certain coefficients or adding new terms in the underlying equations. While further research should never be discouraged, the authors do not feel that modifications are necessary at this time. There is a danger that modifying the equations before the basic approach has been universally accepted will undermine much of the confidence that has been gradually created over the past five years. It took a tremendous effort from the original developers of the ILI together with its numerous proponents around the world to get the ILI officially endorsed by the IWA and it is unlikely that this can be repeated with a modified formula. Changes in the UARL formula will certainly disrupt and even confuse users around the world that are not so familiar with concept and methodology. The present UARL formula has been published in papers and books around the world and it will take many years to spread new information. It may not be the interest of the industry to create a new UARL formula as this is likely to lead to at least two versions being in use at the same time – clearly a difficult and contentious issue that will no doubt draw considerable debate.

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Water Demand Management Strategy and Implementation Plan for INDORE

Part-II

Financial, Institutional and Policy Reforms

Contents

Note:

Rs. 1 crore: Rs. 10 million
Rs. 1 million: Rs. 10 lakhs
Rs. 10 lakhs: Rs. 1,00,000

Tables

Figures

Boxes

List of Abbreviations

ADB	Asian Development Bank
BWSSB	Bangalore Water Supply and Sewerage Board
CWRPS	Central Water and Power Research Station
CMWSSB	Chennai Metropolitan Water Supply and Sewerage
CAGR	Compounded Annual Growth Rate
CII	Confederation of Indian Industry
CPI	Consumer Price Index
DMA	District Metered Areas
GIS	Geographical Information System
IIM	Indian Institute of Management
IMC	Indore Municipal Corporation
ILI	Infrastructure Leakage Index
IWA	International Water Association
KUIDFC	Karnataka Urban Infrastructure Development Finance
MAPCOST	Madhya Pradesh Council for Science and Technology
MDG	Millennium Development Goal
ML	Million Litres
NMC	Nagpur Municipal Corporation
NRW	Non-Revenue Water
NGO	Non-Governmental Organisaton
OHT	Over Head Tanks
PSC	Pre Stressed Concrete
PHED	Public Health and Engineering Department
RPA	Receipt and Payment Account
RRL	Regional Research Laboratories
RWA	Resident Welfare Association
SGSITS	Shri G.S Institute of Technology of Science
MPSEB	Madhya Pradesh State Electricity Board
SWOT	Strength, Weakness, Opportunity, and Threat
ULB	Urban Local Bodies
VMC	Vishakhapatnam Municipal Corporation
WDM	Water Demand Management
WAC	Water for Asian Cities Programme
WRP	Water Resource Planning and Conservation
WTP	Water Treatment Plant
HUDCO	Housing and Urban Development Corporation Ltd.

1 Introduction

Over the past decade sustainable access to water supply has emerged as one of the most critical development challenges facing the developing world. Scarcity of water resources coupled with inequitable distribution and inefficient use and distribution of water have led to a situation wherein a large percentage of the population in urban centres across the country have no access to safe drinking water and at the same time huge quantities of water is wasted through leakages and pilferages. Water Demand Management (WDM) which essentially encourages improvements in water distribution and use rather than augmentation of supplies has over the years emerged as an alternative approach to securing access to water supply for everyone on a sustainable basis.

In the above context, TERI in partnership with UN-HABITAT and Water Resource Planning and Conservation (WRP), South Africa has undertaken a project to conduct a rapid assessment of the water supply services in Bhopal, Gwalior and Jabalpur so as to develop a Water Demand Management strategy and implementation plan for these cities. For Indore, as assessment of the financial, institutional and policy reforms was made and strategies have been proposed by TERI. The project is also aimed at building capacities for mainstreaming WDM principles in water supply planning at different organisational levels in these Municipal Corporations.

The project is supported under the Water for Asian Cities (WAC) programme, a collaborative initiative between United Nations Human Settlements Programme (UN-HABITAT), Asian Development Bank (ADB) and Governments of Asia. The WAC program supports Capacity Building, Mobilizing political will, enhancing Human Resources, Water Education, and Pro-poor investments in Water and Sanitation sector aimed at meeting the Millennium Development Goal (MDG).

1.1 Objectives of the Report

This Report has been prepared to build upon the WDM strategy prepared by WRP, South Africa by providing insights into the financial and institutional aspects of Water Supply operations in Indore and provide recommendations for reforms in the city in terms of improvements in financial management and institutional/policy framework.

1.2 Scope of the Report

This Report basically aims at a rapid assessment of the existing financial management systems in Indore Municipal Corporation:

- Identification of key issues and problems by a SWOT matrix analysis of institutional players.
- Suggesting institutional reforms such as capacity building, performance monitoring and involvement of private sector etc.
- Suggesting an institutional mechanism for integrated water resource planning.
- Studying the existing tariff structure including billing, pricing, and recovery structure and suggesting measures for financial sustainability.

1.3 Partners and Stakeholders

The project is being executed under the overall guidance of UN-HABITAT and WRP. The following partners and stakeholders have been involved in the different stages of the project for the collection of information, its analysis, and capacity building:

1. Indore Municipal Corporation (IMC).
2. Public Health and Engineering Department (PHED).
3. Bulk Consumers: MES, Railways etc.
4. Irrigation Department.
5. Project Monitoring Unit and Project Implementing Agency, Madhya Pradesh Urban Water supply and Environmental Improvement Project (MPUWSEIP).
6. Project Management Consultants (Louis Berger) and Design and Supervision Consultants (Shah Consultants) for MPUWSEIP.

Besides these, other partners in the project include Shri G.S. Institute of Technology of Science (SGSITS), Indore who have supported the capacity building exercise of municipal officials. Other stakeholders like the Health Department, Central Ground Water Board, Electricity Department, Meteorological Department, and Population and Census Department, etc. have been approached for inputs and feedback on the proposed WDM strategy and the implementation plan.

2 Financial Assessment and Recommendations for the Waterworks Department, Indore Municipal Corporation

2.1 Background

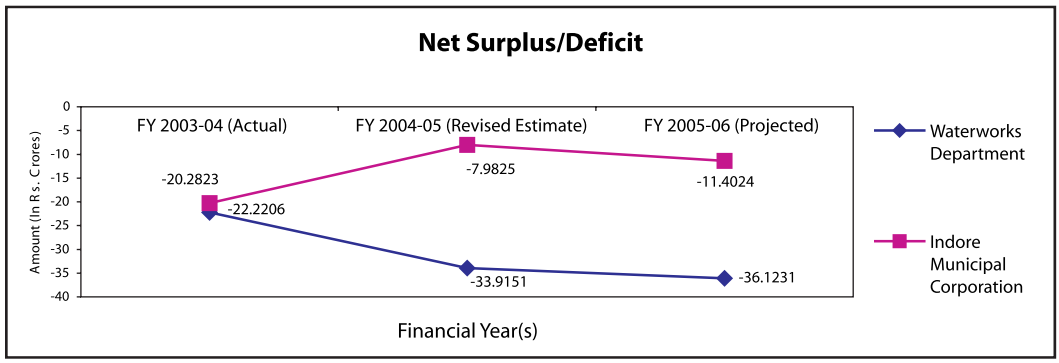
Till the enactment of 74th Constitutional Amendment in 1995, the Public Health and Engineering Department (PHED) operated and maintained all water projects and schemes within the municipal limits of Indore city. Subsequently, the responsibility for management of water supply and sewerage system was transferred to the Indore Municipal Corporation (IMC), with PHED giving the financial and administrative sanction for all projects. However, the salary of employees under the Narmada Water Supply Project is borne by the PHED and is allocated to the IMC as annual administrative grants. Additionally, the planning, design and construction of water schemes continues to be the responsibility of PHED. As highlighted for municipal corporations in other project cities, the institutional arrangement between the IMC and the PHED needs to be clarified for the sake of financial and operational transparency.

At the municipal level, IMC has adopted several measures aimed at introducing prudent financial management and budgeting. In this direction, the Corporation initiated the double entry accrual system of accounting in FY 1999-2000, while simultaneously computerizing its budgeting activities. These initiatives were supplemented by measures to improve billing & collection from existing revenue sources, rationalization of service charges, increased user-charge recovery, cost savings in operations and initiation of public-private partnerships. All these initiatives led to a significant increase in municipal revenues, as is evident from the fact that during the first six years of programme implementation (1997-2003), the own source revenue generation[1] of IMC more than tripled from Rs. 19.49 crores to Rs. 63.51 crores. The stakeholder interactions also suggested that subsequent to improvements in data recording and management, the total number of connections has increased from 70,000 in 1999-00 to 1,52,000 presently.

In FY 2001-02, the corporation successfully issued a Rs. 38 million municipal bond to private institutional investors. The proceeds of this bond issuance were intended to enable capital improvements in roads, water and sanitation schemes with active community participation. One of the noteworthy features of the current accounting practices is the segregation of revenue & capital receipts and expenditures for various departments (including Waterworks), as well as the amounts accruing to the current and previous financial years.

In actual income terms, the share of Waterworks Department in total revenue receipts of the Municipal Corporation (Property Tax, Water Charges, License Fees, Show Tax, Advertisement Tax & Fees, Shop Rent etc.) has been in the range of 16-18%. On the other hand, the share/proportion of revenue expenditure of Waterworks Department to the total municipal expenses has been in the range of 30-35%. This reflects the negative contribution of the Waterworks Department to the overall municipal finances. Our interaction with IMC officials confirmed that deficit from water supply operations is generally offset with other charges & taxes. The Figure on the following page compares the net surplus/deficit of the Waterworks Department vis-à-vis the Municipal Corporation.

[1] Strengthening the Revenue Base of Indore Municipal Corporation, Indo-US FIRE Project, December 2002



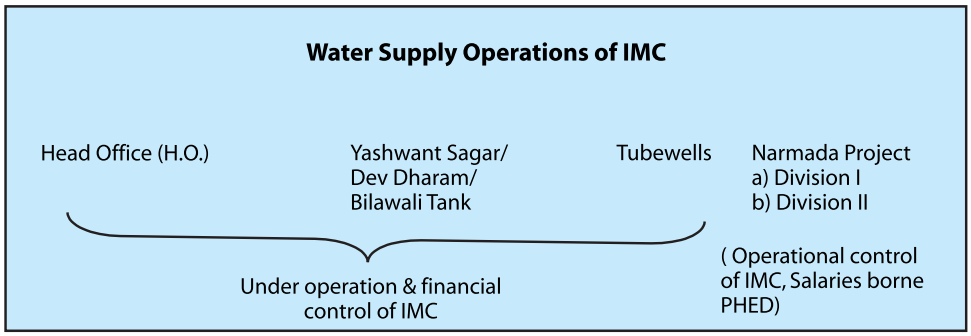
It can be observed from the above figure that the Waterworks Department contributes substantially to the total Municipal Corporation deficit. Moreover, this deficit is projected to deteriorate in the future, leading to higher extent of cross-subsidization by other services (property, license & show tax etc.) in favour of water service provision. Clearly, the precarious financial position of water supply operations needs to be alleviated not only by improving the revenue base & collection methodology, but also by introducing efficient expenditure-side management strategies.

The analysis in subsequent sections is based on the actual figures for Waterworks Department in FY 2002-03 & 2003-04 and revised estimates for FY 2004-05 and FY 2005-06. The department-wise revenue and expenditure break-up for the earlier financial years is not available, and, therefore the current report is constrained to that extent. Further, the water tariff schedule, which was last revised in FY 1997-98, has been considered for analyzing the Municipal Corporation's existing tariff structure and methodology.

For assessing the financial health of the Municipal Corporation's water supply operations, this chapter has been organized into two distinct parts. The first part presents an analysis of the existing financial (Income-Expenditure) position of the Waterworks Department. In the second part, a broad assessment of the current tariff structure is presented and analysed.

2.2 Analysis of Income-Expenditure Statement

The revenue and capital receipts and expenditure of IMC's water supply operations typically comprise of amounts accruing to the Head Office (H.O.) and to the various supply sources i.e. River Narmada, Yashwant Sagar/Bilawali Tank and tubewells. Additionally, the IMC reports all charges relating to new connections, disconnections, regularization and water harvesting under a separate 'Revenue Department'. This Department was basically formed to strengthen and centralize the Municipal Corporation's revenue billing & collection efforts. Therefore, in the following analysis, income & expenditure from water supply operations have been computed by aggregating relevant accounting heads under the Revenue Department, Waterworks H.O., Narmada Project, Yashwant Sagar/Bilawali/ Dev Dharam Tanks and Tubewells. The current functional set-up of water operations of IMC is summarized in the box below:



a. Revenue Account

Revenue Receipts: In municipal finance parlance, these receipts are primarily classified into tax and non-tax revenues. While the tax revenues include own-generated resources & shared taxes, the non-tax based revenues are derived from user charges, governmental grants and income from municipal properties. For IMC, the revenue receipts from water supply operations are projected to increase from Rs. 30.80 crores in FY 2002-03 to Rs. 59.74 crores in FY 2005-06, representing a CAGR of 24.71%. However, for the audited information available, there was actually a decline in revenue receipts to Rs. 26.32 crores in FY 2003-04. This was contributed by a decrease in revenue earning of both, the Head Office and the Narmada Project. The consolidated revenue and capital receipts of water supply operations of IMC are highlighted in the Table 2.1.

Table 2.1 Revenue Receipts Statement of the Water Department, Indore Municipal Corporation

Revenue Receipts					(Rs. in Lakhs)
S.No.	Item	2002-03 Actual	2003-04 Actual	2004-05 Revised Estimate	2005-06 Projected
Waterworks Department H.O.					
1	License Fees (Plumber)	0.11	0.00	5.00	5.00
2	Miscellaneous Receipts	–	0.33	0.01	0.01
3	Demand for Water Tanker	3.33	0.55	7.50	5.00
Sub-Total: Waterworks Department H.O.		**3.44**	**0.88**	**12.51**	**10.01**
Revenue Department					
1	Water Charges	512.21	789.28	1100.00	1150.00
2	Water Harvesting Charge with Building Permission	22.04	–	–	–
3	Application Fee for new Water Connection	0.02	0.03	0.50	0.50
4	New Water Connection Charges	180.72	151.25	150.00	160.00
5	Name Transfer Fee for Water Connection	0.00	0.13	1.00	1.00
6	Regularization of Water Connection	0.00	0.27	200.00	200.00
7	Income from Road Repair	1.35	0.88	25.00	15.00
8	Water Disconnection Charges	0.00	1.62	1.00	1.00
9	Grant from Government for solution of Water Problem	10.00	–	–	–
10	Receipts from previous year	449.77	216.95	2050.00	2100
Sub-Total: Revenue Department		**1176.11**	**1160.41**	**3527.50**	**3627.50**
Tubewell Department		**0.00**	**0.32**	**1.00**	**1.00**

Narmada Project					
1	Grant from the Government for Maintenance of Narmada Project	203.83	131.30	350.00	400.00
2	Miscellaneous Receipts	1230.17	0.29	10.00	10.00
3	Receipts from PHED for Salary & Allowances		890.00	900.00	900.00
4	Income from Water Charges (Narmada)	426.00	448.45	600.00	600.00
5	Revenue Receipts from previous year	40.50	0.00	425.00	425.00
Sub-Total: Narmada Project		**1900.50**	**1470.04**	**2285.00**	**2335.00**
Total Revenue Receipts: Water Supply Operations (Rs. in Lakhs)		**3080.05**	**2631.65**	**5826.01**	**5973.51**
Total Revenue Receipts (Rs. in Crores)		**30.80**	**26.32**	**58.26**	**59.74**

Revenue Expenditure: Broadly consists of allocations made under functions such as Wages and Salaries, Operating expenses, Repair & Maintenance (R&M) and Debt servicing. The revenue expenditure incurred by IMC for water provision is projected to increase from Rs. 53.01 crores in FY 2002-03 to Rs. 78.30 crores in FY 2005-06, which represents a CAGR of 13.89%. However, in actual/ audited revenue expense terms, there was a decrease to Rs. 45.27 crores in FY 2003-04. This decline can be largely attributed to the lower expenditure on the Narmada Project (especially Division II that monitors the project distribution system) during FY 2003-04.

Table 2.2 Revenue Expense Statement of the Water Department, Indore Municipal Corporation

Revenue Expenditure					(In Rs. Lakhs)
S. No.	**Item**	**2002-03**	**2003-04**	**2004-05**	**2005-06**
		Actual	**Actual**	**Revised Estimate**	**Projected**
Waterworks Department – H.O.					
1	Maintenance of Public Tap	0.92	0.00	1.00	1.00
2	Platform Construction for Tap	3.42	0.00	5.00	5.00
3	Emergency Water Problem	160.13	115.01	120.00	120.00
4	Maintenance of Overhead Tanks	41.41	0.94	2.00	2.00
5	Maintenance of Sirpur and Mundi Talaab	0.00	0.09	1.00	1.00
6	Maintenance of Ponds/Tanks	0.10	0.03	0.50	0.50
7	Chemicals – Alum	41.57	2.90	12.00	15.00
8	Chemicals – Chlorine	13.15	3.98	6.00	10.00
9	Chemicals – Bleaching & Others	13.58	0.57	3.00	3.00
10	Water Tanker Hire Charges	120.00	144.44	160.00	175.00

11	Identification of Recharging Acquifier Zone	–	0.37	2.00	50.00
12	Water Recharging in Tubewells (Corporation)	0.00	4.95	5.00	5.00
13	Water Recharging Expenditure – Corp. Buildings	8.78	1.83	5.00	5.00
14	Water Recharging Expenditure – Gardens	8.31	3.11	8.00	15.00
15	Water Recharging Expenditure – Government Buildings	3.33	1.78	5.00	5.00
16	Water Recharging Expenditure – School Buildings	5.36	3.05	5.00	5.00
17	Water Recharging Expenses – Public Places	0.00	3.47	5.00	5.00
18	School Going Students: Jalood Tourding (Food & Bus)	–	0.00	10.00	2.00
19	Water Recharging Expenditure – Other Places	0.00	0.00	5.00	5.00
20	Salaries & Allowances	–	428.40	317.01	347.24
21	Travelling Expenses	–	0.00	0.25	0.25
22	Expenditure on Temporary Exployees (Contract Basis)	–	5.19	2.00	2.00
23	Maintenance of Typewriters/Photocopeirs	–	0.03	0.15	0.50
24	Maintenance of RCC Syphon	–	0.00	12.00	5.00
25	Maintenance of Boat at Crossing	0.11	0.22	4.00	2.00
28	Maintenance of Impelor	1.50	0.45	1.50	3.00
29	Maintenance of Transformer	7.27	1.23	2.00	2.00
30	Maintenance of Water Lorry	0.00	1.81	2.50	2.50
31	Construction of Bilawali Filter Plant	0.00	0.00	5.00	5.00
32	Purchase of Valves	0.00	1.20	5.00	6.00
33	Expenditure of Ashray Nidhi Grant	–	46.98	10.00	50.00
34	Rent of Railway Pipeline	–	0.07	0.20	0.50
35	Stationery and Printing	–	0.15	3.00	3.00
36	Postage Expenditure	–	0.00	0.10	0.10
37	Miscellaneous Expenditure	–	3.15	5.00	5.00
38	Maintenance of Fire Fighting Equipment	–	0.00	0.05	0.05
39	Expenditure on Survey and Drawing	–	0.00	0.50	0.50
40	Fee for Renewal of Narmada Scheme Pumping	–	0.00	0.20	0.20
41	Publicity for Water Recharging	0.26	0.96	1.00	5.00
42	Exhibition and Social Works	–	1.00	1.00	1.00
43	Expenditure on Seminars and Workshops	–	0.00	1.00	1.00
44	Revenue Expenditure in previous years	82.45	0.00	0.00	0.00
	Sub–Total: Waterworks Department H.O.	**875.73**	**862.24**	**853.96**	**991.34**

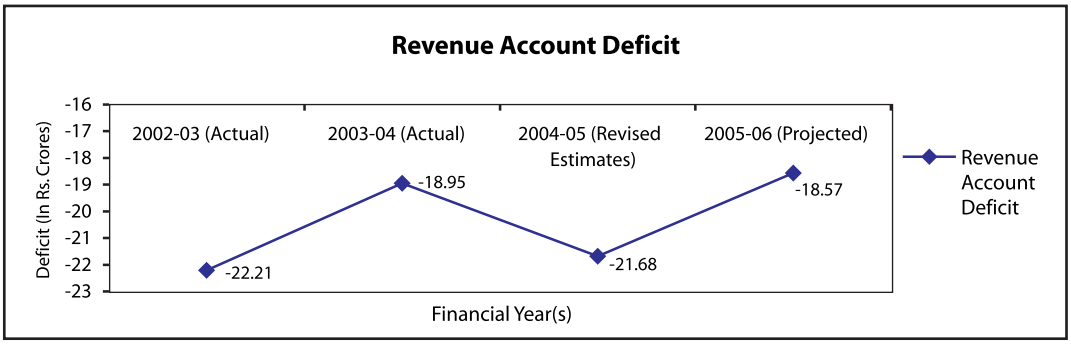
Yeshwant Sagar/Dev Dharam/Bilawali					
1	Gradation of Rao/Bilawali Channel	–	0.00	5.00	7.00
2	Salaries & Allowances	–	0.00	127.38	122.87
3	Travelling Expenses	–	0.00	0.25	0.25
4	Expenditure on new Temp. Employees (Contract Basis)	–	0.73	5.00	2.00
5	Maintenance of Building	–	0.00	2.00	2.00
6	Maintenance of Machinery at Dev Dharam	0.74	0.00	8.00	8.00
7	Expenditure at Devdhar Filter Plant	4.05	0.12	10.00	10.00
8	Maintenance of Pumping at Yashwant Sagar	1.77	0.14	25.00	25.00
9	Maintenance of Bilawali and Limbodi Talaab	0.00	0.47	5.00	5.00
10	Maintenance of Bilawali Filter Plant	0.00	0.48	0.50	0.50
11	New Works at Dev Dharam Filter Plant	0.00	0.27	5.00	5.00
12	New Construction Work at Yeshwant Sagar	0.00	1.17	15.00	15.00
13	Purchase of Impelor	0.00	0.10	9.50	9.50
14	Postage Expenditure	–	0.00	0.10	0.10
15	Miscellaneous Expenses	–	0.00	1.00	1.00
16	Fee for Renewal of Licence of Foolkalaria Pumping	0.04	0.00	0.05	0.05
17	Fee for Renewal of Licence of Devdharam Filter Plant	0.01	0.68	0.02	0.02
	Sub–Total: Yashwant Sagar/Dev Dharam/ Bilawali	**143.05**	**4.16**	**218.80**	**213.29**
Narmada Project					
Narmada Project – Division I					
1	Maintenace of City Main Roads	–	0.00	25.00	20.00
2	Salaries & Allowances	–	400.00	400.00	400.00
3	Travelling Expenses	–	0.00	5.00	5.00
4	Maintenance of Vehicles	–	8.22	28.00	15.00
5	Maintenance of Intactwell	–	0.00	5.00	5.00
6	Maintenance of Building	–	1.53	18.00	15.00
7	Chemicals and Other Goods	–	54.32	108.00	70.00
8	Maintenance of Transformers	–	0.00	20.00	25.00
9	Maintenance of Laboratory Equiment	–	0.12	6.00	2.00
10	Maintenance of Plant & Machinery Intakewell	21.59	31.13	42.00	45.00
11	Maintenance of Plant & Machinery of Pumphouse No. 2	31.89	42.61	42.00	45.00

12	Maintenance of Plant & Machinery of Pumphouse No. 3	30.63	23.38	42.00	45.00
13	Maintenance of Plant & Machinery of Pumphouse No. 4	22.00	15.14	42.00	45.00
14	Maintenance of Plant & Machinery of Pumphouse No. 5	33.84	21.42	42.00	45.00
15	Maintenance of Electrical Equipment	49.53	35.80	40.00	35.00
16	Maintenance of Water Purification Plant	36.41	18.18	18.00	25.00
17	Maintenance of Spare Parts	0.00	0.00	24.00	24.00
18	Maintenance of Pipeline of Pumphouse No.1	19.65	0.57	1.50	1.50
19	Maintenance of Telephone & Wireless	11.57	1.12	18.00	18.00
20	Maintenance of Employee Quarters	–	11.89	20.00	10.00
21	Spare Parts & Consumables	–	0.00	50.00	30.00
22	Maintenance of Intakewell Bridge & Pumphouse	0.28	0.49	4.00	4.00
23	Maintenance of Retaining Wall	0.00	0.00	5.00	0.01
24	Maintenance of Clear Water Pump	0.00	0.00	40.00	60.00
25	Maintenance of Boundary Wall	0.00	0.00	9.00	5.00
26	Maintenance of Panels & Cables	0.00	0.00	16.00	10.00
27	Maintenance of Pipeline B.P. Tank	30.00	8.51	12.00	8.00
28	Spares for Raw Water Pump	35.30	51.51	110.00	75.00
29	Spares for Clear Water Pump	–	0.00	0.00	40.00
30	Tools for T&P Machinery	–	0.00	15.00	10.00
31	Purchase of Batteries	–	0.00	6.72	9.00
32	Purchase of Valves	–	0.28	20.00	10.00
33	Purchase of Capacitors	–	1.70	5.00	5.00
34	Stationery & Printing	–	0.00	5.00	2.00
35	Postage Expenditure	–	0.26	1.20	1.00
36	Miscellaneous Expenses	–	18.79	10.00	12.00
37	Maintenance of Fire Fighting Equipment	–	0.00	3.00	3.00
38	Vehicles Hire Charges	–	0.00	0.00	5.00
39	Fee for Renewal of Narmada Scheme Pumping	0.15	0.00	0.30	0.30
40	Regrouping of Account Heads	–	0.00	20.00	0.00
	Sub–Total: Narmada Project I	**894.62**	**746.97**	**1278.72**	**1184.81**

Narmada Project – Division II					
1	Maintenance of Overhead Tanks	–	79.80	60.00	75.00
2	Expenditure on Survey	–	1.00	1.00	2.00
3	Salaries & Allowances	–	490.00	500.00	500.00
4	Travelling Expenses	–	0.00	1.00	1.00
5	Maintenance of Furniture/Fixtures	–	1.99	5.00	2.00
6	Maintenance of Vehicles	–	11.78	18.00	15.00
7	Chemicals & Other Goods	–	19.41	25.00	25.00
8	Maintenance of Transformers	–	0.00	6.00	5.00
9	Maintenance of Electricity Sub–Station	–	0.00	4.00	5.00
10	Maintenance of Roads	–	11.68	10.00	15.00
11	Maintenance of Laboratory Equipment	–	14.41	15.00	15.00
12	Emergency Repairs	–	29.01	35.00	40.00
13	Maintenance of Office Equipment	–	2.00	4.00	4.00
14	Maintenance of B.P.Tank	–	2.95	12.00	10.00
15	Maintenance of Telephone & Wireless	–	3.68	18.00	18.00
16	Maintenance of Employee Quarters	–	9.93	8.00	10.00
17	Spare Parts & Consumables	–	24.33	30.00	30.00
18	Maintenance of Office Building	–	4.00	4.00	5.00
19	Maintenance of Store Building	–	1.99	2.00	3.00
20	Maintenance of Guest House	–	2.98	3.00	3.00
21	Maintenance of Rao Sumpwell	–	1.45	3.00	3.00
22	Maintenance of City Distribution Pipeline	–	74.84	90.00	100.00
23	Maintenance of Main Trunk Pipeline	–	59.98	75.00	90.00
24	Maintenance of Small Bridges	–	3.00	5.00	5.00
25	Maintenance of Main Trunk	–	24.97	30.00	40.00
26	Electricity Expenses – Office	–	19.07	25.00	25.00
27	Electricity Expenses – Guest House	–	0.00	5.00	5.00
28	Electricity Expenses – Others	–	4.91	3.00	3.00
29	Purchase of Valves	–	24.79	30.00	50.00
30	Purchase of Electrical Equipments	–	4.87	6.00	8.00
31	Purchase of Water Meters	0.99	0.00	2.00	10.00
32	Change of Old Pipelines	99.55	99.93	100.00	125.00
33	Interest on HUDCO loan for Overhead Tank	113.83	303.17	220.00	140.00
34	Interest on Army loan	0.00	10.64	11.00	11.00
35	Interest on loan	0.00	0.00	0.00	50.00

36	Interest on HUDCO loan for New Overhead Tank	0.00	0.00	40.00	50.00
37	Stationery & Printing	–	4.95	8.00	8.00
38	Postage Expenditure	–	0.03	1.00	1.00
39	Telephone Expenditure	–	6.24	12.00	12.00
40	Miscellaneous Expenses	–	9.99	10.00	8.00
41	Tender Release Expenditure	–	2.00	5.00	5.00
42	Electricity Expenditure	–	1308.00	3470.00	3400.00
43	Vehicles Hire Charges	–	3.74	8.00	5.00
44	Expenditure on Seminar & Workshop	–	0.00	1.00	2.00
45	Guarantee Fee	–	0.00	20.00	12.00
46	Regrouping of Account Heads	–	5.97	9.00	0.00
47	Revenue Expenditure in previous year	521.78	0.00	290.00	60.02
	Sub–Total: Narmada Project II	**3188.03**	**2683.48**	**5240.00**	**5011.02**
	Grand Total – Narmada Project	**4082.65**	**3430.45**	**6518.72**	**6195.83**
Tubewells					
1	Maintenance of Wells, Cleaning & Covering	17.49	4.90	5.00	5.00
2	Maintenance of Handpump	12.21	5.98	11.00	12.00
3	Expenditure on Survey	–	0.00	2.00	2.00
4	Conduction of Survey of Private Tubewells	–	0.21	1.00	1.00
5	Salaries & Allowances	–	0.00	39.19	66.53
6	Travelling Expenses	–	0.00	0.25	0.25
7	Maintenance of Furniture/Fixtures	–	0.10	1.00	1.00
8	Maintenance of Tubewells	148.16	121.97	150.00	150.00
9	Maintenance of Electrical Fittings and Open Well Pump	2.78	1.80	2.00	5.00
10	Maintenance of Fire Hydrant	0.00	4.28	5.00	5.00
11	Expenditure on Rewinding of Tubewell Pump	0.00	50.80	80.00	90.00
12	Cleaning of Tubewell Pump	0.00	36.02	90.00	80.00
13	Cleaning of Wells	0.00	4.42	10.00	6.00
14	Stationery & Printing	–	0.00	1.00	1.00
15	Postage Expenditure	–	0.00	0.10	0.10
16	Miscellaneous Expenses	–	0.14	5.00	5.00
	Sub–Total: Tubewells	**199.68**	**230.62**	**402.54**	**429.88**
	Total Revenue Expenditure – Waterworks Department (Rs. in Lakhs)	**5301.11**	**4527.47**	**7994.02**	**7830.34**
	Total Revenue Expenditure – Waterworks Department (Rs. in Crores)	**53.01**	**45.28**	**79.94**	**78.30**

The amount of revenue surplus/deficit generated by a Municipal Corporation is indicative of the Corporation's ability to not only fund capital expenditure, but also enhance its operating efficiency. In this context, it is imperative to track the movement of revenue account surplus/deficit of water supply operations of IMC. The trend from FY 2002-03 to FY 2005-06 is highlighted below:



It is clear from above that the revenue expenditure of IMC's water supply operations have been consistently higher than its receipts, thereby resulting in a persistent revenue account deficit over the last few years. While the deficit decreased by 14.64% in FY 2003-04, it is expected to revert to its FY 2002-03 level in FY 2004-05. The deficit is projected to be Rs. 18.57 crore in FY 2005-06.

b. Capital Account

In the context of an Urban Local Body (ULB), the importance of having a stable stream of capital receipts as well as their deployment towards prudent capital expenditure can hardly be undermined.

Another facet of capital account worth examining is the consistency/stability of capital expenditure over the years as well as its proportion to the total waterworks expenditure. The trend of capital receipts and expenditure for water operations of IMC are highlighted below:

- ***Capital Receipts:*** IMC prepared its first balance sheet in FY 1999-00. The capital receipts for water operations of the Municipal Corporation primarily consist of grants from the Government and loans from financial institutions, especially for the Narmada Project. The trend of capital receipts is presented as at Table 2.3.

  It can be readily observed from Table 2.3 that capital receipts are expected to show an up-trend, primarily based on higher loans from financial institutions. This trend obviously implies a higher interest liability for the Municipal Corporation in the future. For sake of better financial management, the Waterworks Department needs to regularly assess not only its debt profile with reference to the source, tenure, interest rates and repayment arrangements of major loans, but also survey alternative financing means for capital expenditure works.

- ***Capital Expenditure:*** Capital Expenditure is primarily undertaken by ULBs to augment infrastructure and improve quality & reliability of water supply. The level of capital expenditure and means to finance the same are critical inputs in determination of tariffs. The proper treatment of Capital Expenditure is exacerbated by the fact that new projects aimed at augmenting water supply infrastructure are generally long-term and require investments spread over a number of years. In the recent years, IMC has introduced certain level of consistency in classification of expenses (recurring/non-recurring and capital) and in attributing them to various departments & accounting heads. In its accounts statement, the Municipal Corporation broadly classifies capital payments under fixed assets and loan repayments. Accordingly, the capital expenditure schedule

of IMC's water supply operations have been prepared to reflect expenses both on, fixed assets for the Head Office (H.O), Yashwant Sagar/Dev Dharam, Narmada Project and Tubewells and the loan repayments mainly to Housing and Urban Development Corporation Ltd. (HUDCO). The trend of capital expenditure is presented in the Table 2.4.

Table 2.3 Capital Receipts for Water Operations, Indore Municipal Corporation

Capital Receipts					(In Rs. Lakhs)
S. No.	**Item**	**2002-03**	**2003-04**	**2004-05**	**2005-06**
		Actual	**Actual**	**Revised Estimate**	**Projected**
Narmada Project – Division I					
1	Grant from government for Chandan Nagar Water Tank	–	0.00	0.00	60.00
2	Receipt from IDA for Chandan Nagar Water Tank	–	0.00	0.00	51.00
3	Grant from government for construction of tanks	–	0.00	0.00	400.00
	Sub-Total		**0.00**	**0.00**	**511.00**
Narmada Project – Division II					
1	Loan from HUDCO for Water Tank (Old Scheme – Part II)	–	284.00	200.00	0.01
2	Loan for Water Tank – Khatiwala Tank	–	0.00	160.00	50.00
3	Loan for Water Tank – Sukliya	–	0.00	160.00	50.00
4	Loan for Water Tank - Bada Ganpati	–	0.00	100.00	100.00
5	Loan for Water Tank – Nanda Nagar	–	0.00	60.00	0.01
6	Loan for Water Tank – Chandan Nagar	–	0.00	85.00	130.00
7	Loan for Water Tank – Sch. No. 54/74	–	0.00	100.00	100.00
8	Loan for Water Tank – Chhatribagh	–	0.00	100.00	125.00
9	Loan for other Tanks	–	0.00	0.00	0.01
10	Loan received from ADB	–	0.00	0.00	0.01
	Sub-Total		**284.00**	**965.00**	**555.04**
	Waterworks Department H.O.				
	Receipt for construction of Water Tank in colonies	–	**3.39**	**5.00**	**5.00**
Total Capital Receipts – Waterworks & Narmada Project (Rs. in Lakhs)			**287.39**	**970.00**	**1071.04**
Total Capital Receipts (Rs. in Crores)		–	**2.87**	**9.70**	**10.71**

Table 2.4 Capital Expenditure for Water Operations, Indore Municipal Corporation

Capital Expenditure					(Rs. in Lakhs)
S. No.	**Item**	**2002-03**	**2003-04**	**2004-05**	**2005-06**
Fixed Assets and Loan Repayment		**Actual**	**Actual**	**Revised Estimate**	**Projected**
Waterworks Department H.O. (Fixed Assets)					
a.	New Water Pipelines	447.44	162.75	200.00	150.00
b.	New Pipeline at new colonies	0.00	0.00	100.00	75.00
c.	Expenditure on Water Supply Pipeline Network at zone	–	0.00	0.00	345.00
d.	Expenditure on Water Supply Pipeline Work at Zone	–	0.00	0.00	120.00
e.	Purchase of Pumps for Clean Well	–	0.00	1.00	1.00
f.	Purchase of Office Equipment	–	0.00	0.50	0.50
g.	Expenses from MPs Fund	0.00	0.00	25.00	25.00
h.	Expenses from MLA Fund	0.00	0.00	20.00	20.00
Waterworks Department H.O.		**447.44**	**162.75**	**346.50**	**736.50**
Yashwant Sagar/Dev Dhar (Fixed Assets)					
a.	Construction of Store Room at Devsharam	–	0.00	5.00	9.00
b.	Enhancement of Water Storage Capacity	–	0.00	50.00	0.01
c.	Puchase of Pumpset	–	18.16	40.00	20.00
d.	Purchase of NAV at Devdharam	–	0.00	0.00	4.00
Yeshwant Sagar/Dev Dhar		**–**	**18.16**	**95.00**	**33.01**
Sub-Total (Waterworks Department H.O+ Yashwant Sagar/Dev Dharam)		**–**	**180.91**	**441.5**	**769.51**
Narmada Project (Fixed Assets)					
Division I		–	0.00	135.00	98.00
Division II		–	160.89	1365.00	1717.00
Sub–Total: Narmada Project		**–**	**160.89**	**1500.00**	**1815.00**
Tubewells (Fixed Assets)					
a.	New Tubewells & Machines	53.25	107.68	100.00	50.00
b.	Purchase of G.I Pipes for new Tubewells	–	0.00	0.00	40.00
c.	Purchase of Pumpsets for Jansahyog Tubewell	–	0.00	0.00	50.00
d.	Purchase of Pumpsets	0.00	6.96	100.00	50.00
e.	Purchase of Furniture	–	0.11	1.00	1.00
f.	Purchase of Office Equipment	–	0.00	1.00	1.00
g.	Expenses from MPs Fund	0.00	0.00	25.00	25.00
h.	Expenses from MLA Fund	0.00	0.00	25.00	25.00
Sub-Total: Tubewells		–	**114.75**	**252.00**	**242.00**

Schedule of Loan Repayment					
a.	Repayment of HUDCO Loan (Old Tanks)	109.83	146.44	146.50	146.50
b.	Repayment of HUDCO Loan (Tanks Part 2)	–	0.00	0.00	50.00
c.	Repayment of Army Loan	21.86	10.64	23.00	11.00
d.	Repayment of Loan – Sukhlia Water Tank	–	0.00	0.00	50.00
e.	Repayment of Loan – Khatiwala Water Tank	–	0.00	0.00	50.00
f.	Repayment of Loan – Chatribagh Water Tank	–	0.00	0.00	25.00
g.	Repayment of ADB Loan	–	0.00	0.00	0.01
Total Loan Repayment		**131.69**	**157.08**	**169.50**	**332.51**
Total Capital Expenditure (Rs. in Lakhs)		**–**	**613.63**	**2193.50**	**2826.52**
Total Capital Expenditure (Rs. in Crores)		**–**	**6.14**	**21.94**	**28.26**

It can be observed from Table 2.4 that capital expenditure is projected to increase substantially from Rs. 6.14 crores in FY 2003-04 to Rs. 28.26 crores in FY 2005-06. While the actual and the projected figures for any local body may vary to a large extent, the above trend does indicate the positive intention of IMC to increase its capital spending on water works.

The extent of capital receipts over expenditure reflects the level of capital account surplus. However, a capital surplus arising solely from cutback in capital expenditure and for funding revenue deficits is considered an imprudent financial practice. Another important parameter, which could indicate the prudence of expenditure management at IMC, is the contribution of capital expenditure to the total water supply expenditure.

Table 2.5 Assessment of Capital Expenditure & Capital Account Deficit

Item Head	FY 2003-04	FY 2004-05	FY 2005-06
	Actual	Revised	Projected Estimates
Capital Expenditure (Rs. in Crores)	6.14	21.94	28.27
Capital Account Deficit (Rs. in Crores)	-3.26	-12.24	-17.55
% age Contribution of Capital Expenditure to Total Expenditure	12%	22%	27%

The Table 2.5 reflects that IMC's increasing capital deficit on water operations is linked to its projected increase in capital expenditure. Additionally, the contribution of capital expenditure to the total Waterworks expenditure is also projected to increase substantially from the FY 2003-04 levels. However, as these parameters are based on the revised/projected estimates, they may or may be realised in actuality and hence should be viewed cautiously.

Based on the revenue and capital account performance, the annual loss levels of the Waterworks Department are presented at Table 2.6.

It is clear from Table 2.6 that the annual loss level of IMC's water supply operation is projected to increase substantially over the next few years, thereby negatively impacting the Municipal Corporation's overall fiscal position. While the Municipal Corporation has introduced several steps towards improving financial sustainability, measures on tariff rationalization and improvement of

the collection coverage, billing and enforcement need to be further hastened. However, before we discuss these aspects in greater detail, presented below is the component-wise analysis of revenue receipts and expenditure statement of IMC's water operations.

Table 2.6 Annual Surplus/Loss Level of Water Operations, Indore Municipal Corporation

Item Head	FY 2003-04 (Actual)	FY 2004-05 (Revised Estimates)	FY 2005-06 (Projected)
Revenue Account Deficit (Rs. in Crores)	-18.95	-21.68	-18.57
Capital Account Deficit (Rs. in Crores)	-3.26	-12.24	-17.55
Annual Surplus/Loss (Rs. in Crores)	-22.21	-33.96	-36.12

2.2.1 Analysis of the Revenue Receipts Statement

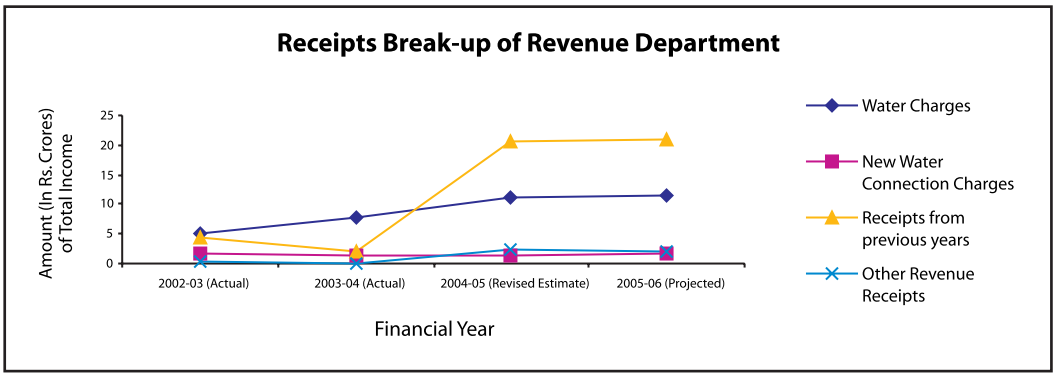
As highlighted earlier, the revenue receipts of IMC's water operations have been categorized under various departments such as Revenue, Waterworks H.O., Narmada Project, Yashwant Sagar/Bilawali/ Dev Dharam and Tubewells. The underlying trend for each of these Departments is detailed below:

- **Waterworks H.O.:** Revenue accounting under Waterworks H.O primarily consists of License fee (Plumber), Miscellaneous receipts and Demand for water tanker. While revenue from license fee of plumbers is primarily a one-time registration fee, the demand for water tankers reflects the charges levied for supply of water through tankers (Rs. 300/- for 600 liters, Rs. 500/- for 1400 liters and no charge for slum area supply). On the other hand, miscellaneous receipts cover revenue from sources such as sale of forms for tender & water registration. The revenue receipts of Waterworks H.O. are expected to increase from Rs. 0.88 crores in FY 2003-04 to Rs. 12.51 crores in FY 2004-05 and Rs. 10.01 crores in FY 2005-06. This increase is based on the expected increase in revenue from water tankers. However, there seems to be no apparent reason for IMC to project such a substantial increase in revenue receipts from the tankers.

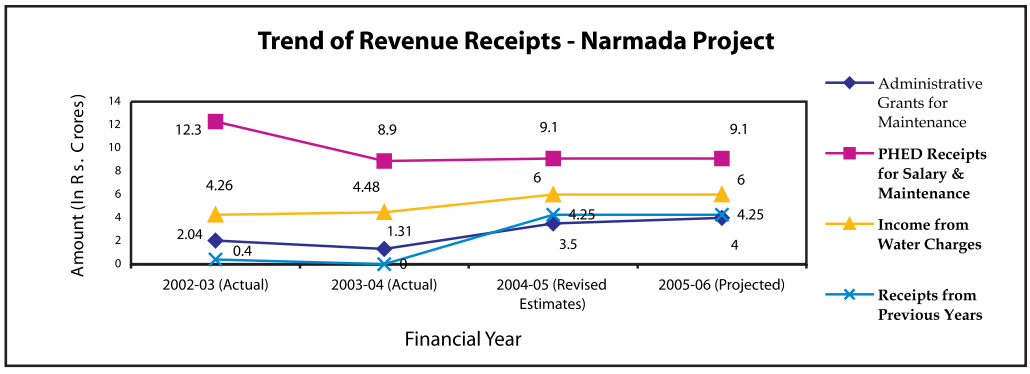
- **Revenue Department:** As stated earlier, the Revenue Department was formed in the year 2002 to bring all billing & collection activities of the Municipal Corporation under one department. Subsequently, the Department was reorganized into two new sub-departments on the basis of its assessment and recovery functions. Efforts were simultaneously undertaken to decentralize collections by introducing recovery counters at the zonal level as well as by forming special property & water bill collection teams with pre-specified targets. The IMC also authorized its zonal officers to disconnect water connection of the defaulters.

  The Revenue Department primarily reports its water related receipts under three heads viz. Water charges, new water connection charges and receipts from previous years. Revenue collection from water charges is projected to increase from Rs. 5.12 crores in FY 2002-03 to Rs. 11.50 crores in FY 2005-06, representing a CAGR of 30.94%. This upswing in the water charge recovery indicates the benefits reaped on account of IMC's improved bill collection and enforcement efforts. On the other hand, receipts from new connections are projected to decline marginally from Rs. 1.81 crores in FY 2002-03 to Rs. 1.60 crores in FY 2005-06. According to a FIRE-D Report, IMC is able to bill for only two-thirds of its water supplied, the rest being illegal connections. There is therefore ample of opportunity for legalization of existing illegal consumers, which indicates the possibility of earning higher revenues from new connections.

Furthermore, as IMC follows the accrual system of accounting, it regularly reports the revenue receipts from previous years. These receipts are projected to increase substantially from Rs. 4.50 crores in FY 2002-03 to Rs. 21.00 crores in FY 2005-06, indicating a CAGR of 67.1%. The break-up of revenue receipts by originating source for the Revenue Department is presented below:

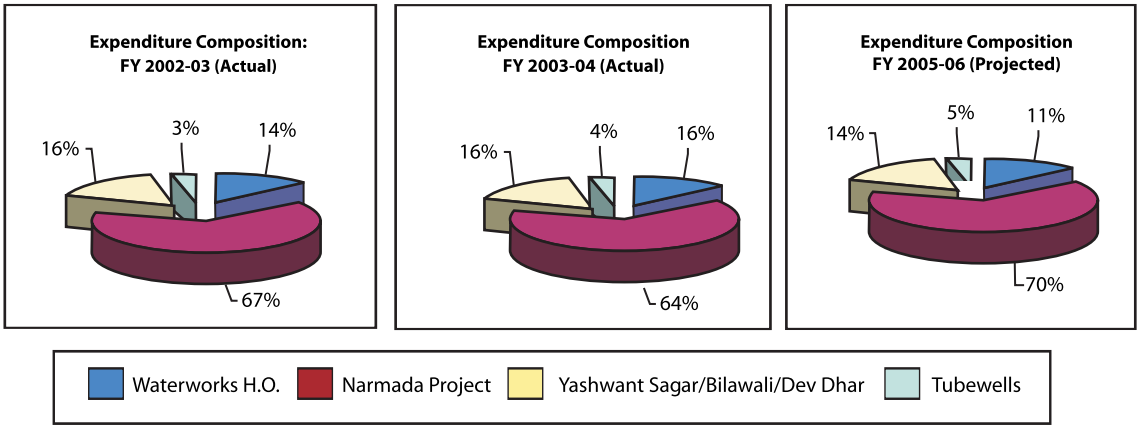


- **Narmada Project:** Of the total water supply of 189.0 million liters per day to the Indore city, Narmada Project contributes as much as 75.0%, making it the largest source of water (Narmada Jalpradaya Yojana, Indore). As Narmada River flows about 70 km away from the main city, this project also services about 59 bulk consumers (including Military Headquarters at Mhow, Dewas and several villages) along its water transmission pipeline. An analysis of revenue receipt sources of Narmada Project reveals that a major portion (70-75%) is currently derived from administrative grants from the Government/PHED for maintenance and staff salary. Further, about 22–30% of the total receipts of Naramda Project are from own sources i.e. water charge levy. On an aggregate, the revenue receipts from Narmada Project are expected to increase from Rs. 19.0 crores in FY 2002-03 to Rs. 23.35 crores in FY 2005-06, reflecting a CAGR of 7.10%. However, in FY 2003-04, the actual revenue from this project declined to Rs. 14.70 crores. The segregation of revenue receipts by originating source for the Narmada Project is presented as follows:



2.2.2 Analysis of the Revenue Expenditure Statement

IMC's Revenue Expenditure on water supply is reported under four broad heads viz. Waterworks Department H.O., Yashwant Sagar/Dev Dharam/Bilawali Tank sources, Narmada Project (Division I & II) and Tubewells. It is worth mentioning that as part of its accounting system reforms, the revenue expenditure schedule was made more exhaustive to reflect even minor expense heads. The graphs show the composition of total revenue expenditure for each of the above-mentioned heads during FY 2002-03 & FY 2003-04, FY 2004-05 (Revised Estimates) and FY 2005-06 (Projected).



- **Waterworks H.O.**: The major expense sources of Waterworks H.O. include salaries & allowance, water tanker hire charges, expenditure on emergency water problem and maintenance of water distribution mains. As the department-wise break-up of revenue expenses for FY 2002-03 is not available, it is not possible to comment on the trend in actual terms. However, expenditure on account of salaries is projected to decline from Rs. 4.28 crores in FY 2003-04 to Rs. 3.47 crores in FY 2005-06, which is a part of the expenditure control drive initiated by the Municipal Corporation.

- **Narmada Project**: As with the Waterworks H.O., the major component of revenue expenses for the Narmada Project (Division I & II) is salaries & wages to the staff (25.94% of total). This component is entirely borne by the PHED as annual administrative grants. Other important expense components include the purchase of chemicals, maintenance of plant, machinery, pipelines & overhead tanks, electricity expenses and interest payment on HUDCO loan. Most importantly, the electricity expenditure incurred by Division II is projected to register a massive increase from Rs. 13.08 crores in FY 2003-04 to Rs. 34.02 crores in FY 2005-06, which shows a CAGR of 61.22%. However, it is not clear from the financial statements whether or not the Municipal Corporation is paying for its electricity consumption and the amount outstanding on this account. IMC also needs to consider pump/energy efficiency improvements, which could potentially reduce the annual expenditure on power in the future. Our interaction with IMC officials revealed that the Government of Madhya Pradesh is directly making payments to Madhya Pradesh State Electricity Board (MPSEB) for a bulk of electricity consumed by the Narmada Project. Further, the IMC has taken a Rs. 500 crore loan from the Asian Development Bank to pay for electricity charges.

- Apart from Waterworks H.O. and Narmada Project, there are two other revenue expense items viz. Tubewells and Yaswant Sagar/Bilawali/Dev Dharam Tanks. Together, they account for 6–8% of the total revenue expenditure of water operations of IMC. However, under both these heads, the salary & wage expenditure is not being accounted properly.

2.2.3 Inconsistencies and Data Gaps in Financial Statements

- Expenditure on salaries & wages is not being accounted in a proper manner, especially for the Tubewell and expense on Yashwant Sagar/Dev Dharam/Bilawali Tanks. Additionally, there exists no separate accounting to reflect own- revenue generation and receipts from the Government as administrative grants.

- As highlighted earlier, there are four departments within the IMC that deal in various aspects of water supply & delivery i.e. Waterworks H.O., Revenue Department, Tubewells & Narmada Project. While this functional demarcation enables better service orientation & delivery, it potentially shields the proper estimation of profit/loss level solely accruing water provision. In other words, the existing functional division hinders the financial assessment of each department as a 'Profit Centre'.

- No reporting is being currently done on revenues received by the Municipal Corporation from each consumer category i.e. Domestic, Industrial, Commercial and Bulk.
- There are no clear estimates of annual collection efficiency. Municipal Corporation officials estimate the current collection efficiency to be about 50%. However, a more accurate figure for this measure is essential, as it would enable the Municipal Corporation to target improved collection levels on a yearly basis.
- The Waterworks Department apparently does not have a policy on bad debts. There exists limited recorded data on bad debts even for the past few years.

2.3 Current Water Tariff Structure & Collection Efficiency

IMC supplies water to consumers within the Corporation limits through approximately 1,46,355 water connections. Our field visit revealed that a majority of these connections consist of un-metered domestic water connections from which a monthly fixed charge of Rs. 60/- is being collected.

The water user charges of IMC are mentioned in its tariff schedule (effective 1997-98). The Municipal Corporation has broadly classified its water supply consumers as follows:

1. Domestic/Residential.
2. Commercial establishments such as hotels, restaurants, beauty parlours, cinema theatres, nursing homes etc.
3. Industry.

There exist 59 bulk consumers across all categories for whom tariff rates have been specified in accordance to the ferrule size (i.e. diameter of supply pipe).

For all these categories, the Municipal Corporation charges a fixed service charge, levied on a quarterly basis. This amount is determined for each category based on the ferrule size characteristics. The existing water tariff schedule is shown at Table 2.7:

Table 2.7 Existing Tariff Schedule

Applicable Water Charges				
S.No.	**Connection Size**	**Residential**	**Commercial**	**Industrial**
1	½"	60	150	300
2	¾"	120	300	600
3	1.0"	240	700	1200
4	1.5"	480	1200	2400
5	2.0"	960	2400	4800
6	3.0"	1920	4800	9600
7	4.0"	3840	9600	19200
8	6.0"	7680	19200	–
9	8.0"	0	0	0
10	10.0"	0	0	0
	Metered Charges	(Rs./Kilo Liters)	Bulk	
	Domestic	2	10	
	Commercial	10.0-50.0	11	
	Industrial	22	22	

Source: Proposed Tax, Charges, Rent and Rate Guidelines of IMC (FY 2005-06)

Apart from charging fixed rates for water supply, the Municipal Corporation also charges for provision of specific services such as opening new account, road cutting and legalization of connection. The applicable rate for these services is presented below:

Table 2.8 Charges for New Water Connection

S. No.	Type of Connection	Charges (in Rs.)
1	1/2"	2500
2	3/4"	3750
3	1"	5000
4	1-1/2"	15000
5	2"	20000
6	3"	30000
7	4"	45000
8	6"	90000
Road Cutting Charges		
Type of Road		**Charge per m^3**
Temporary Road		40
Metal Road		75
Damar		150
Cement Concrete Road		142
Black Stone Paving		200
Red Stone Paving & Service Lane Repair		175
Hot Mix Paver		600

Table 2.9 Illegal to legal conversion charges – Domestic Connections

(in Rs.)

S. No.	Connection Type	Negotiation Charge	Non-Refundable, One-year extra payment
1	½″	3220	No
2	¾″	3750	1440
3	1"	5000	2880
4	1-1/2"	15000	5760
5	2"	18000	11520
6	3"	30000	23040
7	4"	50000	46080
8	6"	1000000	92160
9	8"	–	–
For people residing in Jhuggis, legalization of illegal water connections			1/4 of the applicable water charges

In addition to above, the schedule offers concessions for water provision to backward areas, low-cost housing, and slum areas, and to the handicapped consumers.

Collection Efficiency

Collection Efficiency primarily indicates the percentage of the billed amount that is collected through water charges. Based on total number of connections, the expected revenue from water charges works out to be Rs. 11.90 crores. However, the actual amount of revenue receipts from water charges was Rs. 5.12 crores in FY 2002-03 and Rs. 7.89 crores in FY 2003-04, indicating an overall collection efficiency of 43.03% and 66.30% respectively. Obviously, higher collection from water charges would increase the revenues, thereby reducing overall loss levels. Our field visit revealed that the collection efforts were not being rigorously pursued at the Municipal Corporation end.

2.4 Key Recommendations

- **Tariff Rationalization**[2] : Currently IMC follows a method of charging flat rates for water supply, primarily because there is no metering at the consumer end. This methodology is inherently based on two assumptions. These are:
  - It takes approximately the same amount to service each customer, irrespective of the water amount supplied and the time of supply.
  - The Waterworks Department is able to recover all costs, irrespective of the consumption level.

As these two assumptions generally do not hold true, this methodology of charging flat tariffs for water supply leads to inefficiencies as well as defies economic logic. A flat tariff not only encourages indiscriminate and illegal water usage, but also acts as a disincentive for consumers to conserve water.

An alternative to the current tariff structure is the 'two part' tariff structure. Such a tariff design typically includes a consumption/ volumetric rate in addition to the fixed water charge. The former is primarily a variable charge that recovers costs based on usage. The two-part tariff design is beneficial over current structure as it encourages conservation, recovers costs of holding unused capacity for peak demand and reflects tariff efficiencies for servicing various customer categories. International literature on water tariff reform suggests that the following factors determine the structure of two-part tariff:

- Level of metering (total, partial or no metering).
- Extent of cross-subsidization between consumer classes.
- Number of customers and disproportionate customer structures (e.g. numerous high volume users or high proportion of small volume users).
- Fluctuations in demand patterns during different times of the year.
- Age of the system that determines the level of operating & capital cost requirements.
- Existing rules and water tariff structure.

[2] Due to lack of information on category-wise annual revenue receipts & expenditure, the current analysis presents only a broad recommendation on tariff rationalization. This is because an implementation plan requires detailed break-up of income-expenditure items, which is lacking in the current context.

To operationalise the two-part tariff structure, the Waterworks Department needs to develop appropriate information and monitoring systems that collect and report the following financial details:

- Allowable costs and cost allocation procedure.
- Profit, return on investment and return on assets i.e. the Department is allowed a mark-up or return over its economic costs.
- Tariff setting procedures.

It should also be noted that two-part tariff structures are most suited for metered systems. Field visits by our project team have shown that currently there is only limited or no metering in the Domestic/Residential categories.

It should be noted that any water tariff rationalization exercise should take into consideration the following points:

- Consumer categories that are not being charged for the water supplied, for example, places of worship need to gradually start paying for the same. If the State Government wants to provide free water to these consumers, they need to provide subsidy to the Municipal Corporation for the same.
- Tariff rationalization should include some collection efficiency improvement measures for e.g. rebate/discounts on early payment and penalty of delayed payment.
- Continuation of lifeline slab for "poorest of poor" domestic consumers keeping in view their capacity to pay.
- While the correct extent of cross subsidy is difficult to ascertain due to lack of data, our interaction with IMC officials revealed that there certainly exists a high level of subsidy in favour of the residential consumers. In most ULBs across India, the bulk and industrial consumers cross-subsidise the consumption of domestic, worship places and public standpost categories. This cross subsidy needs to be gradually reduced, as all categories should ideally pay on the basis of the service consumed.
- Apart from adopting cost-coverage principles for tariff rationalization, two other operational parameters need to be considered by the Municipal Corporation. These are:

  a. Cost-containment: The Municipal Corporation should make all efforts to reduce operational wastage and improve cost-effectiveness. For a piped water system, measures such as minimizing non-revenue water (including water unaccounted for and all other water not paid for) and maximizing efficiency of billing and collection can significantly reduce the cost structure of Waterworks Department.

  b. Liquidity-maintenance: The Municipal Corporation needs to also maintain adequate cash on hand to meet expenses for construction, debt servicing and O&M.

- Data required for tariff rationalisation & financial assessment needs to be collected in an unambiguous and easily interpretable manner. This would enable the Waterworks Department to not only assess its current financial performance regularly but also undertake corrective measures as and when required. Based on information availability, the various financial ratios that could be reviewed by the Municipal Corporation are listed below:

  a. Rate of return: Ratio of income to average net fixed assets in operation.

  b. Operating ratio: Ratio of operating expenses to operating income.

c. Current ratio: Ratio of current assets to current liabilities

d. Debt equity Ratio: Ratio of long-term debt to equity

e. Debt service Ratio: Ratio of internal cash generation to total debt service

f. Self-financing ratio: Ratio of net internal cash generation less debt service to capital expenditure.

- **Prudent Financial Management & Planning**: As a first step towards financial sustainability, the Waterworks Department could tap additional revenue sources either by increasing user fees & charges/tariff rationalization, by ensuring maximum coverage & collection or by introducing new taxes & charges. While the IMC has already tapped external funding such as municipal bonds, more efforts need to be made in this direction.

  On the expenditure front, possibilities of savings through efficiency improvements should be vigorously explored. In this context, adequate emphasis needs to be laid on setting & prioritisation of various expenditure items, as well as on justifying the geographic benefit of service provision. The Waterworks Department also needs to make provision for increases in expenditure on account of inflation, prior service commitments and uncommitted proposals for service expansion. Additionally, for effective planning and control of municipal expenditure, the Department could adopt the following measures:

  a. Municipal Action Plans: Action planning at the municipal level has been widely implemented by ULBs in Brazil. This system is implemented in a phased manner i.e. from the level of strategic objectives to a medium term financial & programme plan, to an annual work programme and budget; and finally to a quarterly implementation plan.

  b. Performance Indicators: The annual expenditure performance of Waterworks Department could be assessed in terms of such indicators as cost-to-output ratio.

  c. Quarterly Rolling Plan: Short-term quarterly plans could be implemented for ensuring continuity and more effective expenditure planning.

- **Inventory & Materials Management**: Like all other ULBs, the Indore Municipal Corporation (IMC) holds a significant amount of fixed assets. However, it has been observed that very few ULBs are currently exploiting the real commercial benefit of these properties to generate non-tax revenues. This is because of the following reasons:

  a. Currently, ULBs do not maintain proper records of asset inventories. This obviously constrains implementation of strategy for optimum utilization of resources and sound inventory management principles.

  b. Generally, executives in the production & purchase departments take decisions relating to municipal inventories. However, sound inventory management requires the proactive involvement and participation of finance officials, who would help ensure that key resources are being efficiently monitored and controlled.

It is also necessary to devise methods to arrive at the optimum quantity of inventory based on the average consumption pattern, lead time and economic considerations such as cost of carrying inventory, procurement cost and stock-out cost.

Additionally, the existing tariff structure needs to be rationalized to address cost recovery principles, incentivise metering, improve collection efficiency and provide clarity to tariff design. The existing tariff structure in Chennai, Bangalore and Delhi are given in Annexure 2.1. The Box 2.1 gives the experience in India in the electricity sector in this regard.

Box 2.1 Electricity Tariff Reforms in India

One of the most important demand side management measures in infrastructure service provision is designing an appropriate tariff structure based on cost allocation principles. Since the early 1990s, the power sector in India has been going through a process of reforms and restructuring. Undoubtedly, the most important problem in this sector is irrational tariff structure. Before the setting up of Regulatory Commissions at the state level, the tariffs were being fixed and realised by the State Electricity Boards and Electricity Departments. However, the state governments have constantly interfered in this process so as to provide concessional tariffs to certain sectors – mainly agriculture and domestic consumers. These sectors are generally cross-subsidised by the commercial and industrial sectors and also directly subsidised by the government. At the same time, the SEBs are not adequately subsidized for this loss in revenue and they have been incurring heavy losses. The attempt to make up these losses by raising industrial tariffs has led to increasing migration out of the grid through the captive generation route. As a result, the financial position had been deteriorating every year.

The Electricity Act 2003 notified in June 2003, empowers the SERC's to specify the terms and conditions for the determination of tariff and ensure transparency in the tariff setting process. SERC's have to constitute proper measures to allocate revenue requirement in an economically efficient manner by reducing the extent of cross subsidies. This is primarily achieved by increasing the low-tension (LT) tariff to a greater extent as compared to high-tension (HT) tariff. The Act also provides the guidelines and the procedure to be adopted for the purpose of tariff determination and issuing of tariff order. The draft National Tariff Policy was introduced in March 2005. Till date, 21 states have already issued their first tariff orders aimed at rationalizing tariffs.

A number of commissions have instituted measures to allocate revenue requirement in an economically efficient manner by reducing the extent of cross subsidies. This has primarily been achieved by increasing the LT tariff to a greater extent as compared to the HT tariff. Also, a number of commissions have initiated an increase in the tariff of agricultural consumers despite it being a highly politicized issue. However, in some states including Andhra Pradesh and Maharashtra, the state government decided to continue fee power to agricultural consumers and this led to huge burden on the state's finances. In Andhra Pradesh, there were considerable debates and discussion on the issue and it was finally decided that the subsidy that will be provided to farmers will have to be target properly and criteria for the same were established. There is also a movement towards determination of tariff based on the cost of supply approach. These regulatory reforms have in-turn resulted in a progressive reduction in the differential between average tariff and average cost of supply, as well as a greater orientation to base tariffs on cost allocation principles.

3 Water demand management strategy: Institutional and policy reforms

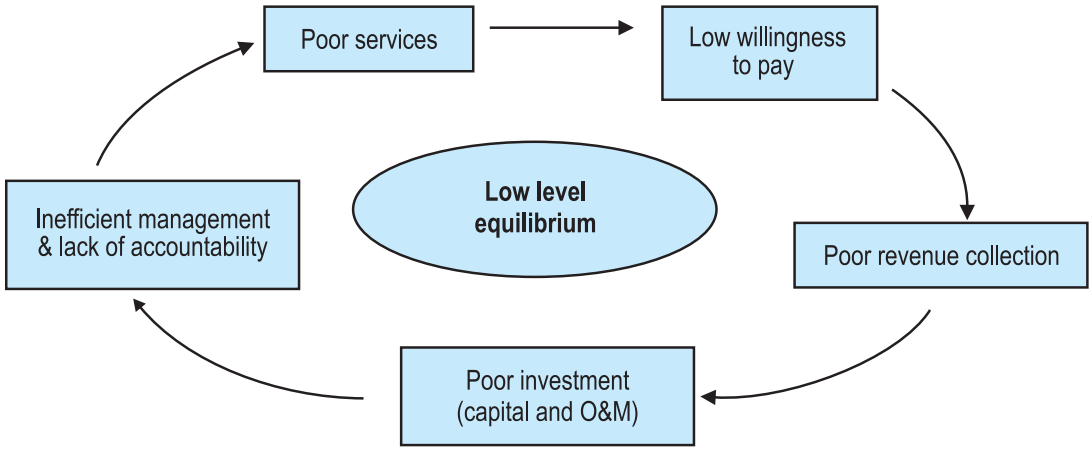
3.1 Introduction

To achieve the targets set out in the Madhya Pradesh Urban Water Supply and Environmental Improvement Project (MPUWSEIP) of improved coverage and transformation to a round-the-clock water supply system with significantly less losses (<15%), sweeping changes would be required in the way the municipal corporations functions today. The institutional structure of the organization needs to be geared up for promoting managerial efficiencies and ensuring a greater level of accountability. It is thus imperative to analyze the institutional issues plaguing IMC and develop a reforms package to address these issues. This chapter tries to analyse the current institutional and legal framework for provision of water supply services in Indore and suggest a strategy for future action. A SWOT (Strength, Weaknesses, Opportunities and Threat) approach has been followed to identify critical issues for IMC. Reform strategies to gear up IMC towards better efficiency are thereafter suggested.

3.1.1 Rationale for reforms

It has been found that official reports tend to give much greater weightage to physical and financial progress rather than the quality, reliability and sustainability of water supply services (TERI 2002a, IRC 2003). Reported statistics usually indicate the population covered and hide important parameters like regularity or duration of supply, financial sustainability of the system, water security and long-term sustainability of the source.

The urban water supply sector in India has traditionally been plagued with high levels of inefficiencies leading to poor service delivery and a high level of losses. The sector is characterised by a low level equilibrium (Figure 3.1) wherein the low level of service and poor accountability of the water utilities leads to a poor willingness to pay among the consumers which on the other hand translates into a financial crunch for the utility making any improvements including day to day O&M very difficult.



Source: Deb 2003

Figure 3.1 Key issues in urban water supply: The vicious circle

Urban Local Bodies (ULBs) suffer from several deficiencies and are yet to respond adequately to emerging challenges posed by the rapidly changing urban scenario. The critical issues are service coverage and quality, per capita water supply, increasing demand for water, inequitable water supply, deficiencies in the treatment of raw water and in the distribution system along with poor revenue collection (Pachauri and Batra 2001). These drawbacks have in many ways resulted in the establishment of informal "*water markets*" where urban poor are the main sufferers and pay more than the affluent for the service.

The solution to water supply is often seen as capacity augmentation, rather than operating the existing capacity more efficiently. This bias in favour of new projects is partly due to the lack of accountability of agencies at both local and state levels and also because of inefficient management of systems goes un-noticed (The World Bank, 1999). Over exploitation of groundwater, degraded watersheds, lower water supply and sanitation service coverage, poor construction and operation & maintenance can be traced to lack of monitoring and control, low tariffs and a lack of revenue to undertake development. High Non-Revenue Water (NRW) and low water accountability result from illegal connections, inadequate metering and meter reading and inadequate billing on one hand and from leakage of water on the other (McIntosh 2003). According to Pachauri & Sridharan (1998), since the low quality of service is the single biggest obstacle to the levy of reasonable user charges, efficient operation will help improve acceptability of higher user charges.

Further over the last decade, the responsibilities and problems to be tackled by the Urban Local Bodies (as managers and service providers) have increased manifold. The 74th CAA has led to decentralization of powers and responsibilities to the Local Bodies. The Constitution thus envisages urban local bodies as being totally responsible for all aspects of development, civic services, and environment in the cities, going far beyond their traditional role. However these institutions as mentioned earlier are still in the process of building their financial capabilities and institutional capacities to address the issues in service delivery. It is a known fact that most municipal corporations in India face problems related to poor financial health, sub optimal service delivery levels, inefficiencies and a general lack of accountability.

This problem has been recognized at the national level and the tenth five-year plan aims to address the problem, as shown in the Box 3.1.

Box 3.1 Organisational Problems on Water and Sanitation

"……the focus should not only be on the investment requirements to augment supplies or install additional systems in sanitation and water supply. Instead, greater attention must be paid to the critical issues of institutional restructuring, managerial improvement, better and more equitable service to citizens who must have a greater degree of participation."

"Institutions dealing with water supply and sanitation have very little autonomy on personnel and financial matters. Information systems necessary for effective management are generally lacking"

Source: Organisational Problems: Tenth Five Year Plan document, Government of India – Chapter 6.2

The Water works department of the Indore Municipal Corporation was also found to be facing this problem. It is thus important to implement a reform package, which would essentially aim at putting in place a policy and institutional framework and thus addressing the root cause of inefficiencies in IMC.

The huge investment requirements for urban infrastructure and the policy directives of the national and state governments also make it necessary for the local bodies to reform their governance and management structures. Annexure 3.1 details some of the reform initiatives being undertaken at the national level, which make it imperative for ULB's to enhance their efficiencies and ensure greater transparency and accountability in their functioning.

3.2 Current legal and institutional framework for provision of water supply services in Indore

Water supply services in all towns of Madhya Pradesh are provided by the Municipal corporations/ municipalities in accordance with the provisions of the Madhya Pradesh Municipal Corporation Act 1956 and the Madhya Pradesh Municipalities Act, 1961. The acts govern the functioning of all ULB's, defining their powers and responsibilities. The composition of the Indore Municipal Corporation has been fully ensured as per the provisions of the Act. The State government has also nominated persons having special knowledge and experience in the municipal affairs recently. Wards committees/ Zonal Committees have also been constituted by Indore Municipal Corporation as a step towards a decentralized approach. Indore Municipal Corporation has been established according to the provisions of the Madhya Pradesh Municipal Corporation Act, 1956.

As per the act, IMC is mandated with provision of water supply services in Indore city and collecting charges/taxes for the same. It is vested with powers to source, treat and distribute drinking water supply in all areas of Indore city.

The specific responsibilities of water works department of IMC are:

- Complete arrangement including operations and maintenance for water source, operation and maintenance of Intake wells, Filter plants, Storage and supply system.
- Operation, maintenance and replacement of main and distribution pipelines.
- Maintenance of public standposts.
- Arrangement for water and supplying it through tankers or other available means at times of shortage.
- Registration of private tap connection and its maintenance.
- Maintenance of Nagar Nigam's private and public water sources, ponds, wells etc.
- Construction and maintenance of drains and sewers including its cleansing.

3.2.1 Institutional Arrangement: IMC

In accordance with the 74th CAA the Indore Municipal Corporation comprises of an elected body supported by the administrative machinery. The elected wing consists of a Mayor and 69 elected councillors (one from each ward). A Mayor-in-Council is also in place according to the provisions of the MP Municipal Corporation Act, 1956 that constitutes of the Mayor and 10 council members chosen from the elected councillors.

The Urban Administration and Development department (UADD) is the nodal department at the state level responsible for providing urban services in all cities and towns. The UADD allocates funds and provides policy directives for provision of urban service. In addition the PHED (Public Health Engineering Department) is mandated with the responsibility of design and execution of water supply

and sewerage schemes, which are to be handed over to ULB's for operation and maintenance. Figure 3.2 gives the institutional arrangements for delivery of water supply services.

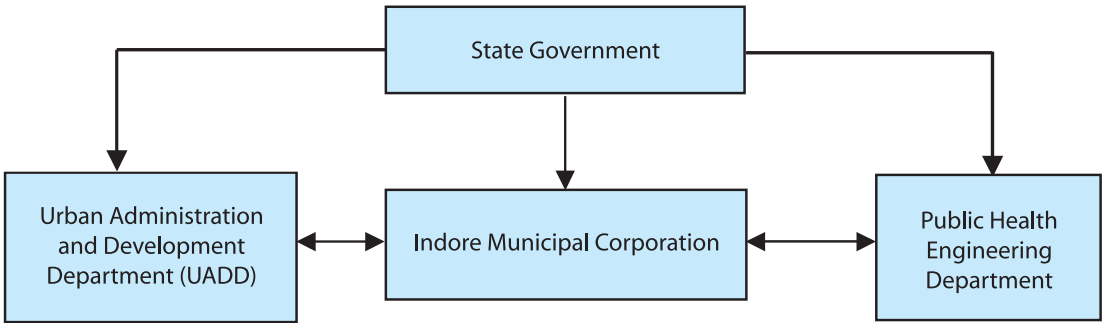


Figure 3.2 Institutional arrangements in Madhya Pradesh for provision of urban water supply

3.2.2 Composition of Indore Municipal Corporation

Elected representatives

The IMC comprises a body of elected representatives called the Council. Since each ward elects one person to the council and Indore is divided into 69 wards, the Council of Indore comprises of 69 members. The Mayor is the chairperson of the council and is elected through direct elections by the citizens of the Municipal Area. A 10 member Mayor-in- Council is also constituted by the Mayor from the members of the Council.

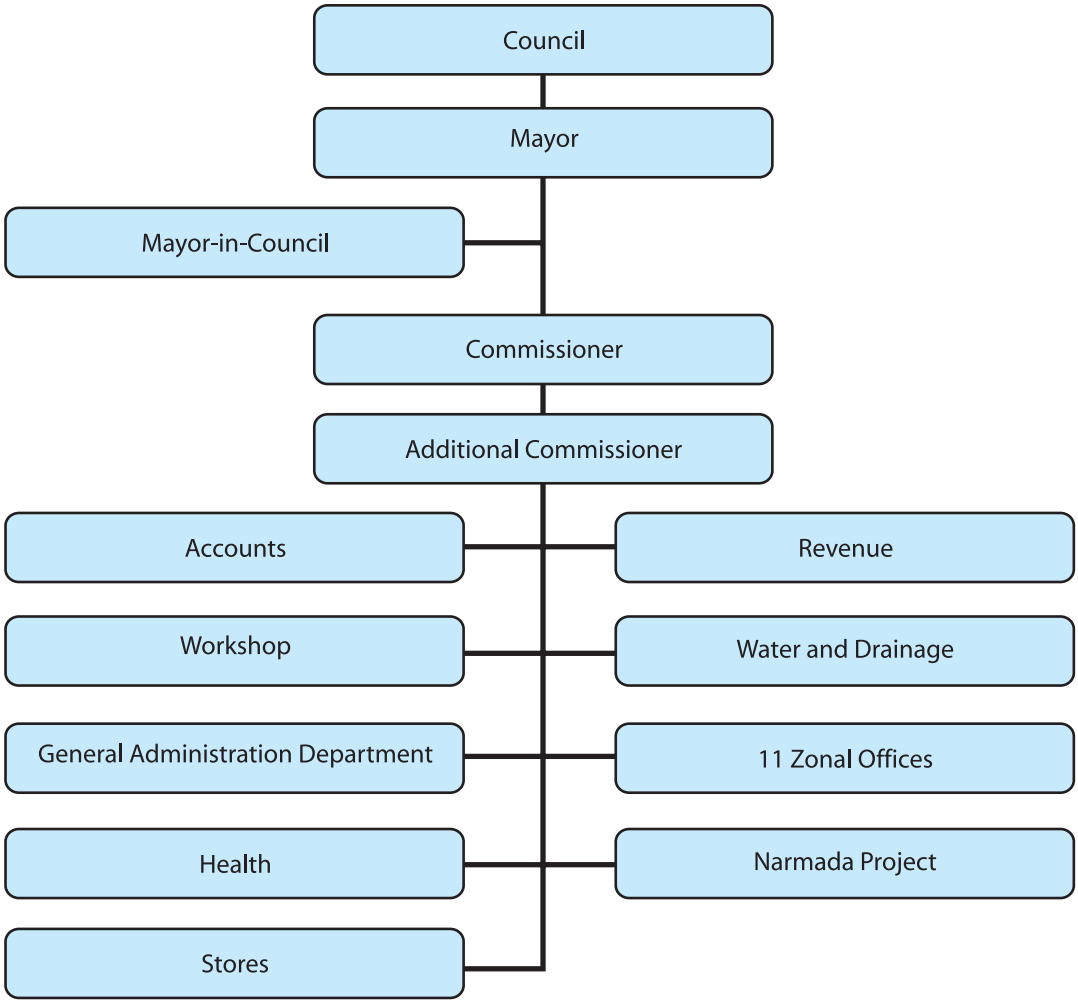


Figure 3.3 Institutional structure of Indore Municipal Corporation

3.2.3 IMC Staff: Water Works Department

The commissioner is the overall in-charge of the water supply operations in Indore Municipal Corporation. The Water Works Department of the Indore Municipal Corporation is headed by a Superintending Engineer on deputation from Public Health Engineering Department (PHED).

He is supported by two Executive Engineers handling independently the two Maintenance Divisions of Mandeleshwar and Indore. Each Executive Engineer is assisted by Sub Engineers responsible for the various sub-divisions within the jurisdiction of the Municipal Corporation. Figure 3.4 gives the institutional structure of the water works department.

The total manpower in the water works department of IMC as per records is 747. In addition, staff from PHED is also deputed for maintenance of bulk supply lines.

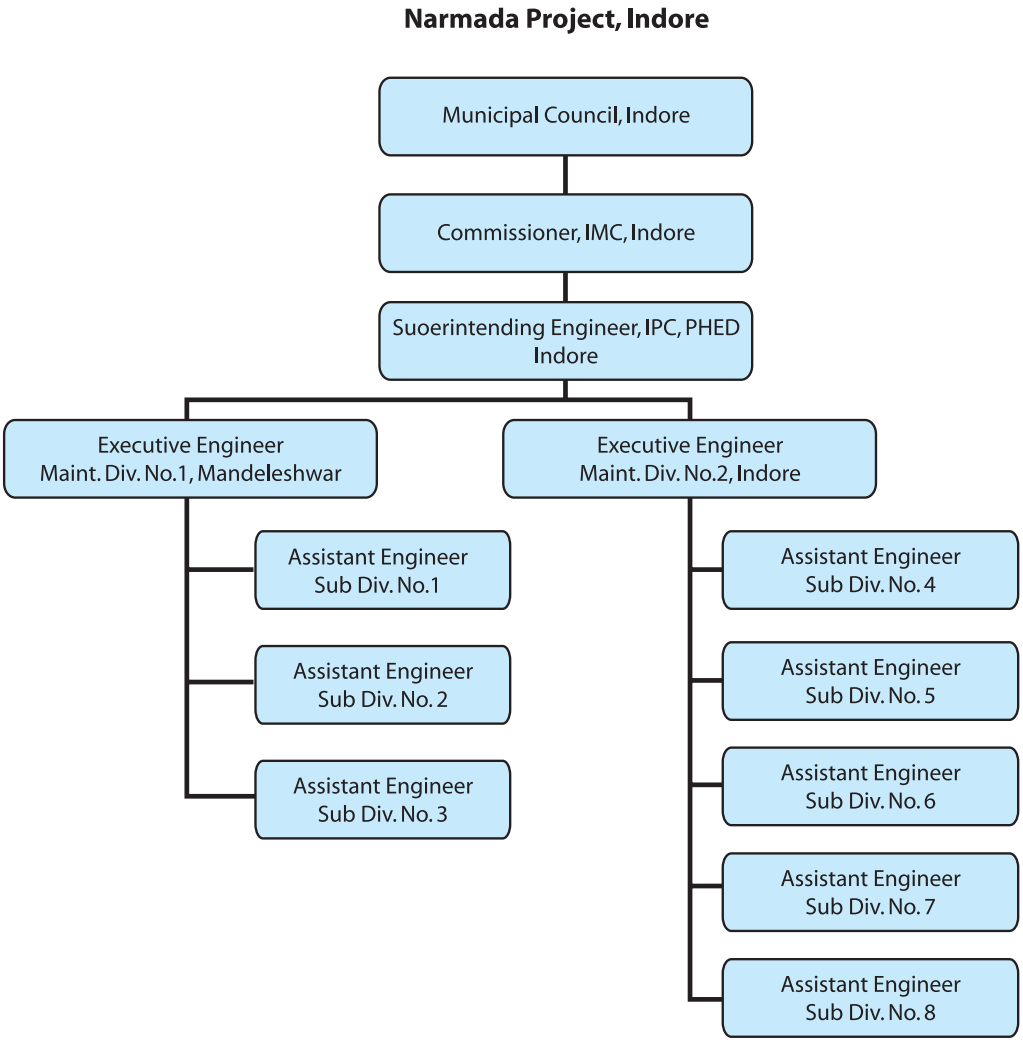


Figure 3.4 Organisational chart for Narmada Water Project, IMC

Indradoot Cell

Indore Municipal Corporation has led the way in establishing an "Indradoot" cell to monitor and coordinate all matters related to water supply including complaints, redressal of their complaints, regularization of illegal connections, launching all drives related to water conservation, public awareness, revenue recovery drive etc. The cell has an interface with Municipal Head quarters, all zonal offices, all OHT's distribution zones for regular communication. It has two dedicated telephone lines and an internet connection.

All types of complaints related to water tax, short water supply, polluted water supply, etc are recorded and action is taken to address them within a prescribed time period. Similarly, all drives for collection of old water tax, survey of leakage detection, search of illegal connections, awareness campaign and all miscellaneous activities are conducted from this office. In addition, this cell also arranges for quality analysis of water samples on consumer request and also monitors the water quality in the distribution system.

A format has been developed to register complaints and proper records are maintained for complaints registered and the actions taken on these complaints.

Efforts are also underway to monitor water leakage and pilferages in different zones. This effort is limited due to the non-metering of connections in the distribution system. However, regular physical monitoring is done by the field staff. A record is also maintained for break downs in major infrastructure such as non supply of electricity, bursting of pumping and gravity mains, leakage from major valves etc. To avoid major break downs, the status of these are kept constantly under surveillance and sufficient inventory is maintained to undertake repairs in minimum possible time. (Source: Report on 'Impact assessment study of Indore water supply scheme').

The creation of this cell is an effort to be lauded. The function of the cell should be expanded from surveillance of major infrastructure to keeping a check on the whole system. It is thus proposed to first enhance the leak detection facilities of the water department, and then to delegate manpower, which looks after only the leak detection, and leak repairing functions.

As the scope and popularity of this cell widens, it is possible at a later stage that the cell may not be able to manage all the functions it is presently carrying out. At such time it may be considered to split this cell to perform specialized functions. Outsourcing certain functions to a private player till further capacities of the IMC are built can also be considered.

3.2.4 Key institutional issues concerning water supply operations in IMC

As is the case with most cities in Madhya Pradesh, IMC is also plagued with issues concerning inefficiencies in service delivery and low consumer satisfaction. Moreover the existing legal and regulatory framework does not allow the corporation to work on commercial principles. It is thus essential to identify the root cause of inefficiencies in terms of the institutional issues and develop a strategy to address the same. It is also a good approach for transition to a commercial orientation of IMC.

3.3 Introduction to SWOT

A SWOT approach is used for identifying the critical issues facing IMC in both the short term and the long term. This section aims at introducing the SWOT concept and identifying the key issues. SWOT is an acronym for Strengths, Weaknesses, Opportunities, and Threats. The SWOT analysis is an extremely useful tool for understanding and decision-making for all sorts of situations in business and organizations.

The SWOT analysis approach seeks to address the concept of strategy formulation from a two fold perspective: from an external appraisal (threats and opportunities in an environment and an internal appraisal (of strengths and weaknesses within the organization). The SWOT analysis template is normally presented as a grid shown in Table 3.1.

Table 3.1 SWOT framework

A strength: resource or capacity effectively	**A weakness**: a limitation, fault or defect in the use can organization organization that will keep it from achieving its objectives
An opportunity: any favourable situation organizations environment	**A threat**: any unfavourable situation in the organizations in the environment that is potentially damaging to its strategy

Due to its many advantages, it is proposed to use it for the purpose of strategy formulation for Indore. A detailed SWOT Analysis has been undertaken at the stakeholder's consultations. The major issues of concern have been identified to guide the discussion and brainstorming for the SWOT analysis.

3.3.1 Key Issues

Key issues have been identified under various broad headings, which require immediate attention.

Lack of policy guidelines for service delivery

Currently water supply services in Indore are provided as per provision of the Madhya Pradesh Municipal Corporation Act, 1956. However there is a lack of policy directive from the state government/ municipal government to promote managerial efficiencies and customer orientation. This further leads to a fragmented approach wherein water supply schemes are designed on an adhoc basis rather than taking a holistic approach for ensuring long term water supply to the city.

Legal framework

As per various previous studies, at present there are inconsistencies in the various laws governing urban planning e.g. municipal law, town and country planning law, district-planning law etc. Further the byelaws for provision of water supply need a thorough revision with clear guidelines on cost recovery and empowering IMC to take punitive action against defaulters.

Organisational structure

There is no clarity on roles and responsibilities on the elected representatives and the reporting relationship between staff and elected representatives.

- The powers of Mayor, Mayor-in-Council and the local body are not defined adequately.
- Further the current institutional structure of the IMC as discussed before includes mainly engineers. All operational and management works, the responsibility of which lies with the Municipal Corporation is done by engineers on deputation from PHED to the IMC. This arrangement needs to be clearly defined in terms of power, roles and responsibility, reporting etc.
- Within the Municipal Corporation itself, there is a clear lack of interdepartmental coordination.
- Overall there is lack of accountability and transparency.
- There is also a complete lack of civil society in the planning and implementation of programs.
- The current institutional structure makes it practically impossible to have customer orientation and improved efficiencies. It is thus imperative to review the existing framework with an objective of having specialised cells for customer grievances, GIS, MIS etc.

Internal Management

One of the weaknesses of the IMC is improper internal procedures and information management including financial management. Further the Planning capacity, human resource development and financial management functions are not adequately developed, as a result of which these are operating inefficiently. Some of the key issues of concerns are:

1. Operational Aspects

   - There is a lack of information on consumption of water in the city, the length of the distribution network, pressure in the pipelines etc. This is due to the fact that all connections (Domestic/ Commercial/Institutional) are unmetered and the available information on the production and supply of water in the city is improperly recorded.
   - The available data also is conflicting in nature and constitutes mainly of poorly recorded estimates, which could prove to be a major hindrance in the efficient planning and management of the department. The data is also inadequate to enable a good financial assessment.
   - Either maps are not available or available as a sketch. This kind of information is highly inadequate for carrying out GIS mapping or further planning work in this sector.

2. Financial Aspects

   The financial data is poorly recorded. Only single digit accounting system for recording of financial information is used which does not clearly indicate the existing situation. Also, there is no monitoring and accounting of the funds allocated/ grants received and their usage. Transfer of funds from one project to the others is a common practice thus making the situation even more chaotic.

3. Infrastructure

   - A large amount of the existing infrastructure for the operations and management of water supply is either out-lived or poorly maintained. Further there is a urgent need to modernize the infrastructure specially for data recording and transmission. There is also no policy in place for ensuring regular upgradation or replacement of old and out-dated infrastructure.
   - Modernization and upgrading of systems and procedures in city management through equipment, skill-enhancement and application, and updating of manuals and codes (e.g. GIS and MIS) have not been carried out to meet the current and emerging challenges.

4. Staff Capability/Motivation

   - The Municipal Corporation itself lacks in technical expertise and the engineering staff of the Municipal Corporation who are on deputation from the PHED also face similar constraints.
   - Besides, most of the work force of the municipal corporation were found woefully unaware/ lacking in modern skills for water management. Further the staff lacks basic public interaction, financial management and social skills.
   - Based on limited interaction with the municipal employees it can be inferred that the motivation levels and job satisfaction is very low due to the following reasons:
     - The poor working condition and multiple pressures from community, department and politicians.
     - There are no incentives for the employees to perform.

– Political intervention in the IMC also reduces the motivation and performance of the employees.

– Employees of PHED on deputation to IMC lack a sense of belongingness as they are estranged from the PHED and IMC treats them as outsiders being paid for by PHED. This eventually results in low motivation for performing their duties.

Public Participation/ Consumer Interface

- One of the major issues facing IMC right now is to improve its civil society interface and emerge as a responsible customer oriented organization.
- Indore Municipal Corporation has done a commendable job in formulating a citizen's charter. The existing citizen charter for water supply clearly outlines the rules and conditions to be followed by the water supply department, defines the procedure for obtaining a new water connection and provides a detailed listing of the water charges applicable within the Municipal Corporation. Besides, it also enables a consumer to see his/her bill online and provides guidelines on how and where to pay the bill. The charter also provides contact information of officers to be contacted for specific grievances.
- No RWAs or NGOs working in the sector of public water supply. There is a pronounced lack of role of the civil society and the urban poor in policy formulation, decision making and implementation of civic plans as the Municipal Corporation has never encouraged the participation of the public in these.
- Water is still considered as a social good and not an economic good. There is a lack of awareness about the economic costs of water. This can be attributed to low awareness among the citizens regarding the costs involved in delivery of water services.
- There is a major communication gap between the IMC and the consumers. The public has a poor image of Indore Municipal Corporation due to poor service delivery. This has increased the misery of the consumers since Municipal water is the only available source of drinking water. This is reported to be reduced with the implementation of the Over Head Tanks Project.
- Previous studies indicate that there is a general willingness to pay for improved water supply mainly as no alternative dependable and safe source of water are available and the consumers have to depend on the Municipal supplies to meet their demand.

3.3.2 Results from SWOT analysis

The key issues that emerged from the exercise on SWOT analysis are listed in Table 3.2.

Table 3.2 Results of the SWOT analysis

Strengths	Weaknesses	Opportunities	Threats
Institutional and Governance			
– Good relations between political, administrative and technical staff – Responsive public	– Un-metered water supply and wastages – Lack of resources rationalization – Outdated water supply bye-laws	– Cooperation of political members – Financial powers are vested in local authorities as a result of decentralization resulting in fast finalization of policies, fast decision making	– Varying political situations and political interference at corporate level for technical discussions – Frequent change in policies – Non-awareness among public regarding water use – Unauthorized connections – Public attitude to defer payments – Multiple agencies in water supply arrangements – Illegal connections – Instability of key post holders
Financial			
– Double entry system in accounting – Camps for collecting revenue	– Low revenue realization of IMC – Insufficient funds for improving system from Government/IMC	– Reforms have helped in financial arrangements – Availability of funds by ADB Project; Sanctioned third phase (UWSEP) water supply scheme for augmentation	– Low revenue realization from public
Technical			
– Adequately trained manpower	– Inadequate pressure in supply – Non-availability of distribution system map – Frequent leakages due to old pipes	– Up gradation of water resources under JNNURM – Financial powers are vested in local authorities as a result of decentralization resulting in fast finalization of policies, fast decision making	– No Master plan
Information Systems			
Computerized billing system developed by IMC recently	No infrastructure for generating operational information such as flow and pressure records	Presence of UN-HABITAT and ADB focusing on reforms	

3.3.3 Recommendations for policy and institutional reforms

Based on the critical issues identified in sections above it is proposed to initiate a comprehensive reform programme for management of water supply to Indore city. The proposed strategies also aim to facilitate the implementation of the Water Demand Management Strategies proposed in the earlier chapters. Short, medium and long-term implementation goals for each of the strategies have been identified to ease the load on the Municipal Corporation for their implementation and also to provide the Municipal Corporation with measurable targets.

The key underlying principles that have been adopted while formulation of the strategies are:

- Promoting a commercial incentive based environment for water supply, based on cost recovery principles while ensuing services to the poor.
- Greater public participation and involvement of public in managing water supply systems.
- Enhanced capacities of the Municipal Corporation to manage the reform programme.
- Reorientation of the utility to have a customer focus facilitating improvements in service delivery.

To achieve the above objective, following reform strategies are proposed.

3.4 Formulation of a vision and policy for provision of water supply services

To achieve the objectives it is recommended that IMC sets out a vision for itself, which should incorporate the principles stated above, and act as a guiding document for the water utility. As of now there is no policy or vision document for provision of water supply services to Indore. As a first step it is thus recommended that a vision be developed for provision of water supply services by involving all stakeholders such as IMC employees, NGO's, academia, RWA's etc. The vision statement should draw upon the existing national and state water polices and urban development plans adopted by the state and national governments and also the expectations of the consumers.

The policy should address issues such as consumer awareness, up gradation of infrastructure, reducing losses/NRW, cost recovery and financial sustainability of operations, improved service delivery and customer satisfaction.

3.4.1 Defining a water services policy and vision for IMC

The present project is instrumental in identifying some of the key issues plaguing the Indore Municipal Corporation. On the basis of this analysis it is proposed that a brainstorming session be conducted to develop a vision for water supply in the city. It is important to involve the stakeholders in the process right from the start.

The current citizen charter of IMC and especially for the water works department is sufficiently elaborate although it can be further strengthened to provide more information about the functioning of the Municipal Corporation which would eventually result in greater transparency in procedures. The charter should also include the vision for Indore Municipal Corporation.

3.4.2 Master plan for water supply

On the basis of the vision document IMC should develop a master plan for provision of water supply services in Indore. It may also draw-up annual plans and short-term plans for a period of five years focusing the areas identified in the policy that need immediate attention. It is important to understand here that such plans are instrumental in the implementation of the water policy and thus should have clearly defined targets. The plans should also outline the approach that should be used for

achieving these targets, the possible constraints as well as suggest methods to overcome these constraints. It would be highly beneficial in the implementation and monitoring of the annual plans if it incorporates an activity schedule on a time scale.

3.5 Performance Measurement (PM)

Though water supply projects are designed as per the government norms there are hardly any performance targets that the municipal corporation adheres to. Further, there is no assessment of the service delivery levels and conformity to norms. There is thus no obligation of the municipal corporation to check if the service levels are achieved on a continuous basis. To achieve the desired efficiency levels, it is thus critical to define operational targets for both physical and financial performance. Performance measurement is a starting point for any such initiative. A properly designed PM system, in conjunction with a supporting MIS (Management Information System), can go a long way in improving the efficiency and effectiveness of the IMC. A simple truth about PM is: 'what gets measured gets done'.

Performance Measurement is a practice that many organizations adopt in order to achieve higher levels of efficiency and greater effectiveness in their operations. It also serves as a tool for strategic decision-making and long-range planning. With increasing pressure on urban local bodies to improve their performance in the provision of civic services, there is a great need to integrate modern management practices into public systems, drawing from the corporate sector. In the context of urban local bodies, PM can be defined as the process of determining how efficiently and effectively the concerned agencies are delivering the services. It provides an assessment of the quality of work the local body is doing and how successful it has been in satisfying community needs and expectations. The most important reasons for measuring performance in urban local bodies are:

– Rationalizing decision-making
– Strengthening accountability
– Greater transparency in the organization

PMS can also assist in the performance appraisal of employees by providing the basis for decisions regarding annual salary increments and promotions or even punitive action against employees whose performance is unsatisfactory. This, in turn, would lead to better governance.

The key elements of a PMS are a PM (performance measurement) framework, a set of performance indicators, a supporting MIS (management information system), and a strategy for performance benchmarking.

3.5.1 Performance measurement framework

Performance measures indicate how much or how well the Corporation is doing. An I-O-E-O framework (Input-Output-Efficiency-Outcome) can be used to measure the performance of a utility against four types of performance measures.

- Input measures indicate the amount of resources used. These indicate the level of effort but are strictly not a measure of performance.
- Output measures indicate the level of services provided or amount of work done. These measure performance in terms of how much, not how well or how efficiently.
- Efficiency measures relate outputs to inputs, or work performed to the resources required to perform it. These indicators are central to PM, but they do not measure the results achieved.

- Outcome measures indicate the degree to which programme objectives are achieved and measure the value of service from the perspective of the end-user.

3.5.2 Performance Indicators

In practice, measuring performance is a complex exercise because, for each selected measure, there should be a practical measurement strategy – an indicator that captures the concept to be measured and is easy to operationalize with the available information. Table 3.3 below gives an example of I-O-E-O indicators.

Table 3.3 Examples of the four types of performance indicators applied to urban water supply service

Type of Measure	Water Supply Service
Input	Installed capacity of water filtration and treatment plants
Output	Average daily clear water production
Efficiency	Total staff per 1000 connections
Outcome	Percentage of population receiving adequate supply

3.6 Management Information system

It has been observed in the Indore Municipal Corporation that important information is usually scattered, non-standardized, and improperly reported. An MIS (management information system) can help public managers achieve greater efficiency and effectiveness, especially when there are resource constraints. It is a tool that can be useful in making all types of decisions – at the operational, strategic, and policy levels.

One of the most critical bottlenecks in implementing the water demand management strategy is the lack of information/ unavailability of authentic information even with the middle/junior management level. Thus it is recommended that as a first step to the reform process IMC should develop a comprehensive MIS that covers all aspects of water management.

An MIS is basically a system for recording and reporting information in a way that promotes efficiency and effectiveness, and facilitates long-term planning and decision-making. Hence, information has to be presented in such a manner that is useful for decision-making instead of remaining just as data, which may not serve the management's needs. Box 3.2 shows an effort in this direction made by the Bangalore Water Supply and Sewerage Board (BWSSB).

Box 3.2 Bangalore Information System On Networks (BISON)

Bangalore Water Supply and Sewerage Board (BWSSB) has recently completed the development of a Geographic Information System (GIS) and computerization of water supply and sewerage networks for 100 sq.km. of its service area in Bangalore. The project was implemented with a funding of 7.8 million Francs from the Government of France. The consultancy services for the Project were provided by SCE (Nantes, France) and IRAM consult (New Delhi, India). After the successful completion of the Phase-1 of the GIS development for the 100 sq.km. pilot zone, the Project has been extended, with additional French assistance of 5 million francs, to cover the full BWSSB service area of 300 sq.km. in Bangalore. BWSSB plans to ultimately implement a GIS based system for about 600 sq.km. covering the total Bangalore Metropolitan area and some other areas.

Source: *Change Management Times*, September 2003 by Abdullah Khan, President, IRAM Consult Intl. Pvt Ltd., New Delhi

An MIS can thus help the municipal corporation to achieve greater efficiency and effectiveness, especially when there are resource constraints. The approach to develop a structured MIS is presented here. The key features of the approach are:

- Information collection and compilation: Data is captured at the operational level viz. Accounts, Finance, Field Units, site offices, etc. in standardized formats. Thus, it constitutes a major part of the short-term strategy proposed for IMC. A key part of the process is to identify the right kind of information required at each level and then develop indicators to capture the required information.
- Information Technology (IT) infrastructure – It forms the backbone of the system and facilitates timely and accurate collection/compilation and analysis of data.
- Performance Measurement: At the middle level and top level, the information is validated, reviewed and corrective action initiated. Performance measurement is undertaken at this level to optimally judge the performance of the Municipal Corporation and its employees.

Short and medium term strategy

As a first step to establishment of a computerized information management system in IMC, it is imperative to undertake a detailed assessment of information requirements for decision-making process. This may be compiled in the form of performance indicators to be used at all levels. Formats for collecting the relevant information to feed into the indicator framework may subsequently be developed along with the frequency of reporting.

Efforts have been made by the Indore Municipal Corporation to tap information related to complaints and their redressal. To this effect, a complaint registering format has also been developed which adequately captures information for an effective and efficient decision making process. Proper records are maintained on breakdowns of important infrastructure such as non supply of electricity, bursting of pumping and gravity mains, leakages from major valves etc. This effort could be extended for other areas as well to prepare a comprehensive Information System.

The information thus collected may broadly be divided into three sets as indicated in the strategy for developing a GIS database:

1. Asset database
2. Operational data
3. Consumer data

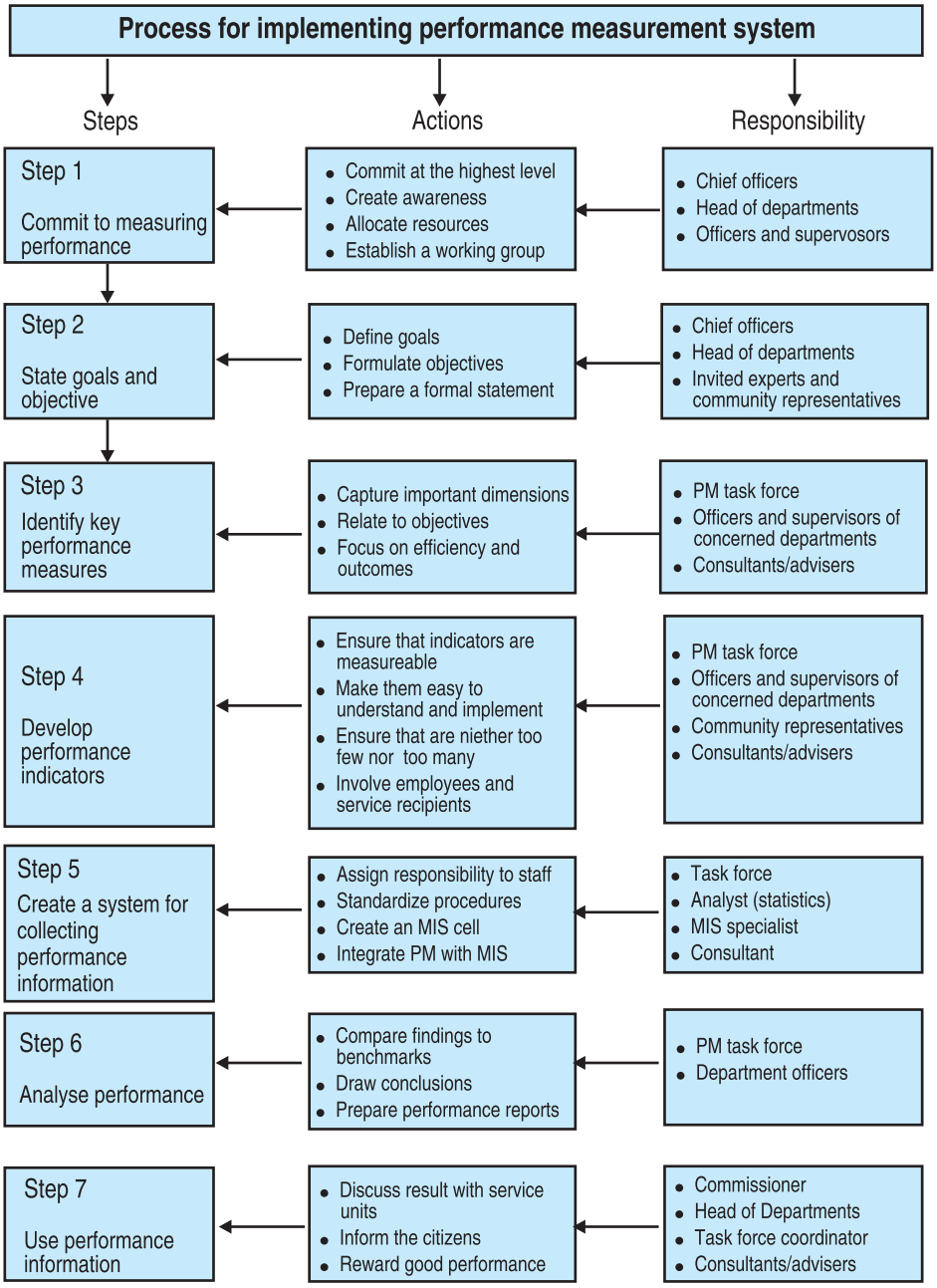
Long term interventions

All departments of IMC should be technologically linked (LAN, WAN etc.) so that communication and flow of information is instant and smooth. All the information can be added in the GIS database in due course. Such exercise shall also help IMC to make an analysis of its performance compared to the targets set by it using national and international benchmarks.

Operationalizing performance measurement

Operationalizing a performance measurement system would essentially involve developing a set of performance indicators to initiate the benchmarking process, developing an MIS to collect the right information and start using the information generated to take corrective action for improving the performance of the utility in both physical and financial terms. Figure 3.5 below gives a broad outline of procedure for operationalizing a PM system.

A TERI publication on "Benchmarking Performance: A manual on performance measurement in urban local bodies" is available and acts a detailed guide for setting up a performance measurement system for any ULB.



PM – Performance Measurement; MIS – Management Information System

Figure 3.5 Implementing PM system

3.7 Capacity building

To effectively implement a comprehensive and integrated water supply reform programme there is a need to build the capacities among the staff of the municipal corporation on the latest tools and approaches to managing a water supply utility in an efficient manner. There is severe need to build capacities of the staff and the officials on key concepts of the WDM strategy, policy, and institutional frameworks to cover issues related to demand forecasting, auditing, commercial management

practices etc. A continuous process of training the professionals on diverse issues is required. This will not only improve their skill set but also motivate the staff.

Some of the specific aspects on which the municipal staff would need training are project formulation and appraisals, financial management, social aspects, GIS, MIS and modern tools for water management such as network modelling, leak detection and SCADA systems. In addition almost the entire staff (supervisory and managerial) needs to be trained on the use of Information technology. Box 3.3 highlights the human resource development efforts undertaken at the Chennai Metro-water which may be used as an example for IMC.

Box 3.3 Human Resource Development, Chennai

Chennai Metro water as a part of Human Resource Development has established a full-fledged staff-training centre as early as 1979 to cater to the growing needs of all categories of employees. Metro water Training Centre has been imparting training to its staff covering all the categories including field workers. For about two decades the orientation was mainly in the direction of improving the operational practices. A reorientation towards managerial aspects was considered necessary and accordingly the staff training activities were restructured.

In-House Training Programme for Metro Water Staff

Employees including technical, administrative, finance and field workers are trained in courses related to Finance, Commerce, Administration, Engineering and Operation. Twenty-eight modules in two categories Technical and Management are offered. New topics such as leakage control, water conservation, water quality, human resource development, project management and financial management have been introduced. Special courses are also offered in Introduction to computers, Implementation of Official Language to familiarise the staff in preparing drafts and letters in Tamil, wireless operations, Proper Maintenance of Files and Records, Contract procedures and Transparency Act, Activity Based Accounts and Budgeting,

Training Program for other Institutions

Exclusive courses are also conducted based on request from various institutions. Training programmed for Science students of Women Christian College, Chennai was conducted in "Water and Sewerage Treatment and Analysis". An "Orientation Course on Execution of Sewerage works" for TWAD Board Engineers and. Tamil Nadu Urban Development Project sponsored Orientation Course For Municipal Engineers was designed and conducted for 249 Municipal Engineers. Government of India (CPHEEO) sponsored refresher courses are conducted every year. Awareness programmes on Rain Water Harvesting are conducted for board staff, NGO's and general public.

The board officers are deputed to attend seminars and training programmes conducted by other organisations in India and abroad. Employees are also encouraged to pursue graduate or postgraduate programmes. As a part of the human resource development, department tests, appreciation and awards, are also extended to achieve increased productivity and efficiency for organisational success. The participants of other public utilities from all over India are participating and getting trained from the level of Assistant / Junior Engineer to Superintending Engineer cadre in these courses.

The topics covered in Metro Water Training Centre are:

1. Sewage Works Supervisors; 2. Care and use of Chlorinators; 3. Corrosion Control; 4. Filter Operations; and 5. Laying of Water mains and Sewer mains.

3.7.1 Implementation plan

Short term

In light of the above and the skill enhancement, it is recommended that a structured approach be developed for capacity building. A separate training cell needs to be created to look into the training needs for the entire water works department of the municipal corporation. The training cell would identify the specific training needs of all employees and develop a training calendar for a year. Specifically targeted training programmes may then be conducted using both internal and external resources. A feedback and evaluation system must also be instituted to monitor the effectiveness of the training programmes.

To enhance the current skill set of functionaries and to enable them perform the envisaged tasks more efficiently, the following measures are recommended:

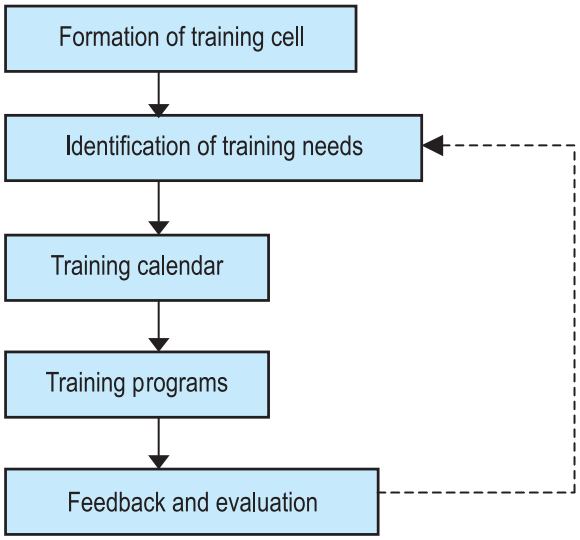


Figure 3.6 Capacity building framework

1. It is recommended that for the purpose of training, the entire staff may be divided into three categories:
    - Operating level: Beldars, foreman, lineman etc.
    - Supervisory level: Junior Engineers
    - Managerial level: Assistant Engineers and above who have overall responsibility for management within their zones.
2. Following training modules are proposed as part of the capacity building programme:
    - Technical
    - Financial management
    - IT (Information Technology)
    - Environment
    - Social
    - Customer services
    - General

A combination of various training tools such as classrooms, case studies, hands on training and cross visits may be employed for each course. The training cell should also work out the training methodology for each program while designing the courses. Specific courses under each module are given in Table 3.4.

Table 3.4 Training Modules

Level → / Module ↓	Operating level	Supervisory level	Managerial level
Policy and Institutional			– Policy and institutional frameworks for delivery of WATSAN services including various forms of PPPs – Principles of financial management including tariff restructuring – Project formulation and appraisal
Technical	– O&M of WTPs and distribution network – Leakage detection and control – Record keeping – Metering	– Overview of water supply – Basics of design – Basics of equipment O&M – Water balance estimation and auditing – Materials management	– Overview of water supply operations – Importance/concepts of WDM – Tendering for technical works – Preparation of DPRs (project formulation and appraisal) – Project planning and control (Use of PERT/CPM)
Financial management	– NA	– Basics of financial management – Accounting systems – Procurement	– Basics of financial management – Accounting system – Budgeting – Principles of tariff restructuring
IT (Information Technology)	– Basics of computers (wherever applicable)	– Basics of computers – MS-Office – Database management	– Basics of computers – MS-Office – Database management including GIS – Modeling tools for distribution optimisation and demand assessment – Management information systems
Environmental management	– Environmental issues related to water supply	– Environmental issues related to water supply – Basic course in environmental assessment	– Environmental issues related to water supply – Basic course in environmental assessment – Techniques/tools for environmental assessment
Social	– Social issues related to water supply	– Social issues related to water supply	– Social issues related to water supply – Rehabilitation of PAP – Techniques for social assessment
Customer services	– Basics of public dealings	– Grievance redressal system – Basics of public dealings	– Grievance redressal system – Basics of public dealings
General	– Safety procedures – Rules/regulations governing JMC	– Safety procedures – Rules/regulations governing JMC – Time management	– Safety procedures – Rules/regulations governing IMC – Time management – Human resources management – Basics of water resource management and issues facing water sector in India

3.8 Regularisation of illegal connections

Non-revenue water in Indore has been estimated to be around 60%. A major part of the non-physical losses are attributed to pilferage/presence of illegal connections across the city. Illegal connections not only result in a loss of revenue to the municipal corporation but also lead to wastage of water, as these consumers do not value the water they use. Further, illegal withdrawal of water is against the basic principles of law and equity. Thus, a strategy for reducing the number of illegal connections needs to be formulated and adopted.

The Nagpur Municipal Corporation has adopted a pragmatic approach to the regularization of illegal connections and a similar approach may be tried for Indore (refer Box 3.4). As part of its efforts to reduce revenue loss, the Bangalore Water Supply and Sewerage Board "regularized" 35,000 unauthorized water connections during the past six years and replaced 1.35 lakh outdated or malfunctioning domestic water meters (refer Box 3.5). *(www.hinduonnet.com)*

3.8.1 Implementation plan

Short term

It is generally not practical to simply disconnect illegal connections and therefore, it is recommended that such connections be legalised by charging a nominal fee. Strategy for reduction in illegal withdrawal would essentially involve development of a policy for regularisation of illegal connections and a strict enforcement of the same. The strategy should aim at regularising maximum number of illegal connections through a simple administrative procedure. A step-by-step approach to regularisation of illegal connections is discussed below:

- Identification of illegal connections: The first step would be to identify and record information on the number of illegal connections, their location and population/households served. A detailed survey may be commissioned for this purpose. One approach could be to outsource this activity to the local plumbers on an incentive based approach. These plumbers would be more aware of the location of such connections. These local plumbers can also convince people about the need for regularization and the scheme offered by IMC.
- Awareness campaign: An awareness campaign must precede any such initiative, which should include the use of both PLA (Participatory learning appraisals) tools and mass media to create awareness among the consumers about the problems stemming from illegal withdrawal of water. The awareness campaign must also involve the local councillors and the RWAs. Incentives, in the form of financial awards and recognition, may be instituted for wards with no illegal connections. This shall encourage the councillors to play an active role in the regularization drive.
- Provision of adequate and safe dirking water: In most cases the community resorts to illegal connections when adequate water supply is not available. It should thus be ensured that all areas with major concentration of illegal connections are provided with adequate water supply through augmentation of the network.
- Regularization of connections: Detailed formats and guidelines should be developed, discussed and disseminated before a regularisation drive is initiated. Connections may be regularised by paying a nominal fees, which may be same, or 1.5 times the charges for a new connection. It is very important that all necessary information is provided to the public regarding the regularisation policy and the procedures should be simple so as to encourage people to regularise connections.
- Setting date for regularization of illegal connections: The entire regularization should be within a specified time frame. After lapse of this date, a strict enforcement campaign should be launched to disconnect all illegal connections or regularize them only after a penalty fees is deposited.

Medium term

In the medium term, a strict enforcement on part of IMC is a must. The users should realize the economic cost of water and start developing a habit to pay for the water consumed by them. The municipal corporation needs to take punitive actions for those indulging in any kind of water theft, on lines similar to the electricity sector. Lessons may be drawn from the electricity sector in this aspect.

3.8.2 Obstacles

Political support and community awareness are key to success of any such drive. Further simple procedures and transparency would ensure that more people come forward for regularization of connections.

Box 3.4 Reducing Unaccounted-for Water: Strategy adopted by Nagpur Municipal Corporation

In early 2001, the water supply situation in Nagpur city was far from satisfactory. NMC(Nagpur Municipal Corporation) was concerned about a very large number of illegal (unauthorized) connections that resulted in substantial loss of revenue to the corporation. Although all water connections in Nagpur city were required to be metered, it was estimated that there were nearly 35000 un-authorized water connections in Nagpur city at that time.

In order to improve the revenue situation NMC declared a time bound scheme for regularization of all illegal water connections in the city. To implement the scheme NMC adopted a pragmatic approach, since water connections (both legal & illegal) were installed through plumbers, NMC decided to involve plumbers in detection of illegal connections and its subsequent transfer into legal.

A security deposit of Rs 5000 was announced for licensed plumbers and the renewal fee was increased from Rs. 25 to Rs. 30. After a protest by plumbers, it was agreed upon that the security deposit would be waived off against an active participation by plumbers towards the drive to detect and regularize illegal connection. A target of finding 35,000 illegal connections was set with an incentive of Rs. 50–100 per illegal connection**.**

The plumbers were organized into small teams, which conducted door-door survey, filled simplified forms and collected charges as laid down by the NMC. Effective arrangements were made, to accept application forms, sanction application, and accept requisite charges. Awareness was disseminated about the drive through media.

About 25,000 (71%) illegal connections were detected and regularized within a period of 4 months. Revenue from water supply of the NMC also had recorded a substantial increase. The quantity of water billed in 1998-99 was 163 MLD, whereas in 2002-03 the quantity billed was 300 MLD, i.e., nearly double.

This initiative has brought the NMC closer to its goal of universal metering in the city. The time-bound regularization scheme received tremendous response due to the simplified procedures and reasonable charges. The citizen's feedback as reported in the media was very positive.

Box 3.5 Legalizing water in slum colonies – Bangalore

The BWSSB (Bangalore Water Supply and Sewerage Board) created a social development unit within the utility to promote legal connections to the piped municipal water supply as part of a much larger water sector reform strategy funded by the Australian Aid Agency (AUSAID). Although the unit was created specifically to drive a donor-funded pilot project in three slums, it has persisted beyond the end of the pilot, expanded its scope to a handful of new slums, started planning for the entire city, and continued to generate great support from the Chairman of the Water Board. These efforts provide an interesting case of how a progressive unit within a reform minded organization can tackle the twin problems of low access levels and illegal connections in slums.

When the social development unit embarked on its first effort to connect slums legally to its piped network, it was clearly operating at the level and mindset of a pilot project. The project had all the requisite nursing required to ensure its success. Three slums were carefully chosen to reflect typical slum characteristics across the city: high density, legal land tenure, and informal land tenure. The aim of the project was always to show that slums can be connected with slum dwellers paying some share of the cost. To this end, several measures were taken to lower the bar and ensure replicability. First, the water board abolished the requirement for proof of formal land tenure. Second, pricing was subsidized through a reduced connection fee, although the volumetric tariff rate applicable citywide was not altered. Third, an institutional structure was developed in which geographically situated sub-district engineers work closely with the head of the newly created social development unit to extend the pipes, ensure water flow, maintain pressure, and carry out water meter readings. Fourth, the board gained bargaining power and leverage with slum dwellers after an amendment to its charter was passed making illegal connections punishable by fine and imprisonment and the board embarked on a controversial regularization drive.

Roughly 1,000 households were connected in the three pilot slums, though it is only a very small proportion so far, the approach will over time be more than a mere policy gesture. The case is thus a good example of how a public sector utility begins to meet its obligations to serve the entire city, including slum dwellers.

3.9 Consumer awareness

One of the key challenges facing IMC is the low level of confidence amongst the consumers regarding the services provided by IMC. It has also been observed that water is considered more as a social good rather than an economic good. Awareness on water conservation is also minimal. Such a scenario leads to water wastages, low willingness to pay and a poor perception of service provider.

Previous studies indicate that a recently implemented project for Over Head Tanks (OHTs) has reduced the consumer complaints about inadequate water supply at reduced pressures in areas covered under this project. This could be built upon by the Municipal Corporation for gaining back the confidence of the consumers. It is, however, necessary to build consumer awareness on water use and conservation. Enhanced consumer awareness shall also help IMC in getting greater co-operation from the consumer and build a better understanding.

Education and the involvement of the general consumer is also an important aspect of any WDM strategy. To tackle the above issues, it is imperative that the reform program includes a component of IEC (Information, Education and Communication), which would motivate users to conserve water. This shall also build awareness on the costs borne by IMC in water treatment and supply to household and hence create a willingness to pay among consumers. It may further be necessary to build a consensus among the various stakeholders on the reform programme that IMC may embark upon. It is thus essential to involve stakeholders such as academia, resident welfare associations, prominent NGO's and independent experts in the project preparation and build consensus on the reform agenda. Media should also be included extensively in such a process of consensus building.

A well-designed IEC campaign should thus be launched which aims at delivering certain key messages to the consumers such as:

- Key issues plaguing water supply services and the need for reforms
- Water stress in the country and the need for conservation
- Rainwater harvesting: Need and approach
- Need to pay for water
- Need for metering and the procedures involved
- Regularization of connections
- Water conservation at household level
- Avoiding water leakages before and after the property line

3.9.1 IEC strategy

The IEC strategy should necessary look at informing various sets of consumers and bringing about a behavioural change towards water demand management. Figure 3.7 gives a framework for an IEC strategy for water demand management.

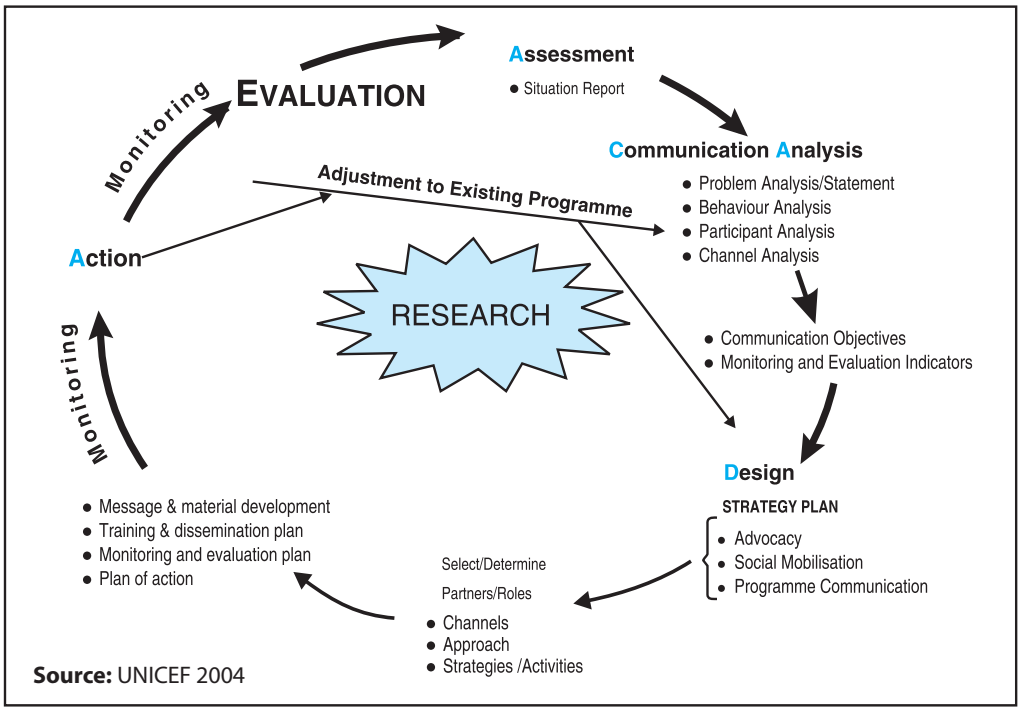


Figure 3.7 Framework for IEC strategy

3.9.2 Approach to IEC campaign

It is suggested that a step-by-step approach to IEC may be followed as given below:

- **Step 1:** Inform and build consensus among the IMC employees on the need for reforms and take feedback.
- **Step 2:** Identify and map various stakeholders such as RWAs, NGOs, academia, researchers, media etc and inform about the programme through workshops/stakeholder consultations.
- **Step 3:** Modify the strategy incorporating the suggestions received in Step 1 and 2 above.
- **Step 4:** Design IEC campaign for general public. It is suggested that a two-pronged approach is adopted for such a campaign involving the use of mass media tools on one hand and a direct interaction with the community groups through involvement of NGOs to inform the community on various aspects of WDM. Exhibitions, documentaries, pamphlets, banners etc may also be developed for IEC. In addition it is also recommended that RWAs and municipal councilors be motivated to act as ambassadors for WDM.
- **Step 5:** Roll out IEC campaign in a phased manner.

3.9.3 Obstacles in implementation

Current levels of awareness on the subject are minimal. This may pose problems in selecting the most appropriate media for dissemination of information. Bringing different stakeholders on a common platform will also be challenging assignment.

3.10 Regulation

It is proposed that in the long run IMC may consider separating the policy formulation, regulatory and service provision functions. An independent regulatory body for setting up of tariffs and ensuring service levels has successfully been used in other infrastructure sectors and it may be worth exploring the possibility of an independent regulator at state level for this purpose. However, detailed feasibility study of any such initiative needs to be carried out. The section below brings out the possible role for a regulator and the key features of the same.

3.10.1 Functions of a regulator

The existing water department is highly monopolistic in nature with no competition from any private player in the sector and has the sole responsibility for providing safe drinking water in the city. In such a circumstance, the regulatory authority is expected to have the following functions. These functions could evolve over the path of transition of the economy from state of control to liberalized competition. Its core functions should include:

- Price control
- Promotion of better operating efficiency
- Service standard specification and monitoring
- Control of externalities
- Maintenance of public good functions
- Ensure asset serviceability over time

- Ensure development of essential infrastructure
- Control over powers to manipulate land values/ land speculation
- Controls over unfair trading practices
- Safety net regulations
- Promote water use efficiency
- Ensure responsiveness to final customer needs

Its advisory role should include providing information to the government and advising the relevant ministry on issues of importance or whenever the regulator's advice is requested.

The role of a regulator is bound to change once the sector, or various segments in the sector, undergoes changes from a monopolistic to a competitive structure. For example, in a competitive market, the tariff setting function of a regulator may become 'light' or be 'forbearing'. Thus, there is a need to delineate the regulator's role given the degree of competitiveness in the sector.

3.10.2 Other salient features

The following principles need to be kept in mind while designing the regulatory framework, to ensure regulatory independence and to balance the interests of various stakeholders:

- Autonomy of the regulator
- Transparency and encouraging stakeholder involvement
- Predictability through well defined criteria for decision making and review of standards
- Flexibility by being open to alternative regulatory tools
- Consultative through consultation with all stakeholders for encouraging commitment and a better understanding of the implications of the proposed action
- Independence through appointing representatives from the private industry and academic or research institutions along with Judge of High Court or Member UPSC in the Selection Committee, setting up of a Regulatory Commission Fund funded by grants/ loans by Govt., levy of fees on the licensees
- Accountability through independent review and assessment of the regulatory body against the specific objectives and an appeal mechanism in relation to the regulatory decisions

Box 3.6 describes the Maharashtra Water Regulatory Commission, which has recently been established and is also the first regulator set-up in the water sector in India. Thus, it can be taken as a model for setting up a water regulator in Madhya Pradesh. It is important to mention here that a regulator is not feasible to be set-up at the city level. It is thus proposed that a detailed survey of the water sector in the State is undertaken before a decision on the type of regulator as well as the exact functions and features of a regulator are defined.

Box 3.6 Setting up of Maharashtra Water Regulatory Commission

Based on the recommendations of the Sukthankar Committee, a Maharashtra Water and Waste Water Regulatory Commission (MWRC) has been established. The key functions of the Maharashtra Water Regulatory Commission (MWRC) would be the following:

- Regulation of the quality of service being provided by local bodies and to be provided by the licensed entities.
- Economic regulation of tariffs to be charged by the service providers (local bodies, CWSEs, other service agencies such as MIDC, MJP, City and Industrial Corporation, and private sector entities).
- Issue and regulation of licenses to the proposed CWSEs, in association with one or more local bodies or other agencies such as the MJP and the MIDC. The MWRC will issue licenses to all new entrants, including private operators, in the sector after following a transparent procedure.
- Coordination with other regulators for environmental regulation, especially related to drinking water quality and wastewater disposal standards.
- Collection and dissemination of sector information to enable the MWRC to establish good regulations and to assist different interest groups, especially consumer councils, to recognize improprieties by the local water supply entities.
- Regulation related to tariff setting are as follows:
  - Tariff setting should ensure a fair charge to customers in relation to services consumed and the commercial viability of the providers.
  - The MWRC should establish mandatory guidelines and principles, such as recovering costs for desired service levels, to help tariffs gradually move toward this goal. It should conduct regular reviews of the tariffs set by local bodies and over time as more information becomes available it should develop yardsticks to measure progress.

3.11 Organizational Restructuring

As discussed in sections above, the Indore Municipal Corporation is responsible for provision of water supply services in Indore in line with the provisions of the Madhya Pradesh Municipal Corporations Act 1956. IMC provides water supply services through the water works department, which is primarily staffed with engineers most of which are on deputation from the Public Health Engineering Department. Further there is ambiguity in the roles of various departments. Following broad recommendations are suggested for consideration by IMC for improved service delivery. Each of these would require brainstorming and stakeholder consultations to develop further.

1. Restructuring of the water works department with clear demarcations for planning, construction, design, distribution O&M and plant O&M.
2. Reorganisation of the institutional structure in parallel with the proposed reorientation of the distribution network into hydraulically discrete zones such that each function is taken care by one engineer.

3. In addition it is important to clearly define roles for each functionary in the demand management strategy and provide adequate training to carry out the desired tasks.
4. Further it is important to build in an incentive scheme for the employees to motivate them to achieve improved efficiency.
5. Certain engineering posts may be re-designated as managerial posts in wake of the responsibility to be assumed by these professionals after the reforms.
6. Creating special cells for functions, which have been neglected till date such as leak detection, consumer grievances and database management.

This has been discussed in detail below:

GIS Cell

The Municipal Corporation has a computer wing. To set up the computer/GIS cell, the services of the computer cell could be used. The computers and the software could be purchased and installed by this wing. Hiring of specialized manpower for preparation and updation of GIS maps needs to be undertaken.

Billing and collection

The function of billing has been outsourced to a private organization on Build-Operate-Own-Transfer agreement basis. This agency has a completely computerized database and bills are distributed in the city on a quarterly basis.

At present, the bill collection functions are being carried out in the zonal offices, head office, Indradoot cell and recovery camps. On a short term basis, it is recommended to let this function be in the hands of private players. To enhance financial recovery, introducing an incentive based approach could be considered.

In the long term though it is suggested that the Municipal Corporation builds up capabilities to integrate the billing and bill collection function under a special cell having the sole responsibility for this function. This cell could either have billing and collection centres in each zonal office or use drop boxes system for the convenience of the public in depositing their bills. Online facilities for bill payment should also be developed.

3.12 Public-Private Partnership Arrangements

Public-Private Partnership (PPP) is widely looked upon as a solution to the failure of publicly owned and managed utilities. It is important, however, to understand that private sector involvement cannot of itself and by itself remove many of the barriers to efficiency, which impedes public sector operations. The scope of private participation to yield performance improvements will partly depend upon the way the Municipal Corporation is functioning presently. Also, the following four interrelated factors play an important role in the achievements made by the private players:

- The form of private involvement (Table 3.5 gives details on the Indian experiences of Public-Private Partnerships and Table 3.6 provides details of different models for PPP).
- The type of private company involved- this includes its technical and managerial competence, the range of its operations etc.

- The post-privatization regulatory regime- this would include all the continuing roles of the public sector and the institutions (contracts, regulatory agencies, laws, market tools etc.) employed to influence, provide incentives for or to directly control private sector behaviour.
- It is however important to note that the involvement of private sector in the water sector is an exceptionally difficult task.

The following characteristics of the water sector make the involvement of the private companies a particularly challenging venture:

- The level of natural monopoly and the lack of substitute products.
- The public and merit goods supplied by the sector.
- The crucial relationship between water infrastructure and urban/economic development.
- The highly capital intensive nature of the sector and the over-whelming presence of sunk costs, which increase private-sector risks.
- The multipurpose and hydraulically interconnected nature of the water resource itself.

For IMC, the privatization of assets is not recommended under the present circumstances. Instead, it is proposed that Private sector should be involved in building the infrastructure and capacity building of the MC. It is also recommended that an incentive based approach should be used for involving the private sector since it would improve the services provided by the private sector party. Feasibility of management contracts/BOOT arrangements for operation and management of water treatment plants and distribution networks may however be explored.

On the basis of this discussion, certain recommendations for private sector involvement are proposed below. It is important to realize that the choice of public-private arrangements would constantly change over time. Thus, no specific long term strategies are proposed. It is however recommended that a detailed study should be undertaken to study and identify the role of private sector in water supply in Indore before taking a decision on the type of partnership that would be suitable in the long run.

Building new infrastructure

Private Sector involvement for building of new infrastructure ranging from construction of pump houses, water treatment plants, expanding the IT infrastructure or GIS mapping etc., should be preferred as the IMC is not equipped to carry out such a task and building capacity for each task is financially not practical.

Management of Services

Involvement of Private Sector for management of services is recommended only in the short and medium run. For this, involvement of the private sector is envisaged in billing, collection and leak detection and repair.

Maintenance of existing infrastructure

It is proposed that contracts could be given out to Private parties for maintenance of pump houses and water treatment plants. Separate contracts could be given out for repairing and replacing of pipelines wherever required, but this should be considered only in the short and medium term.

Table 3.5 Indian experience in Privatisation of Water Supply & Sanitation

Tirupur Water Supply and Sewerage Project	• Implemented through a SPV New Tirupur Area Development Corporation (NTADC) promoted by: – Infrastructure Leasing & Financing Services (IL&FS) – Tirupur Exporters' Association (TEA) – Tamil Nadu Corporation for Industrial Infrastructure Development (TACID) • Estimated Project cost – Rs. 900 Crores at 1998 prices (Rs. 1000 crore at present) – O&M contract to consortium of Mahindra & Mahindra – United Utilities International North West Water +Bechtel – Attained financial closure with 10% stake by LIC & GIC.
Pune Water Supply and Sewerage Project	• Developed by Pune Municipal Corporation at a estimated project cost of Rs. 750 crores ($ 187.5 M) later revised to Rs. 392 Crores with HUDCO assistance – Private Sector Participation envisaged in Construction, Operation and Maintenance, Tariff collection – Financial Participation in addition to HUDCO expected from IL&FS, ICICI, HDFC, IDFC and Bank of Maharashtra – Request for proposal sought – Tie-ups: Anglian Water + Trafalgar House & Shirkes Binnie Black + Veatch & Thames Water + L&T Krugger + Generale Des eaux & Shanska Int. Preussag + Tata Projects Hyundai + Sundram Chemicals Hanjin + Krupp and Zoom Development Group – Political Risk – work re-tendered at RfP level
Bangalore Water Supply Project	• BOOT arrangement for sourcing 500 mld water. – Establishment of two Tertiary Water Treatment Plants (of total 60 mld capacity) with HUDCO assistance – Private Sector (Industries) to undertake laying of feeder mains – envisages provision of 500 mld of water to the city on a BOT basis with estimated project cost is Rs. 800 Crores (US$ 173 M).
Chennai Metro Water	• Out of 119 Sewerage Pumping Stations, Operation & Maintenance of 70 by private sector • Sourcing of water in 7 wells through private sector • Construction of 300 mld Water Treatment Plant by – M/s Hindustan Dorr Oliver Ltd. and O&M by M/s Richardson Cruddas • New Chembarampakkam WTP of 530 mld capacity (over and above the existing 600 mld capacity) – Bid documents for BOT by TCS – HUDCO funding availed
Karnataka Urban Water Supply and Drainage Board (KUWS&DB)	• Management Contract in Distribution and O&M • Towns selected for the initiative are – Mysore – Mangalore – Hubli – Dharwad – Gulbarga
Others	• Private Sector Participation on the anvil in water supply & sanitation – Nagpur – Dewas – Kolhapur – Cochin – Vishakhapatnam – Dharwad – Goa – Alandur

Source: Presentation on Innovative Infrastructure Financing by V Suresh, Director General, Good Governance India and Former Chairman and Managing Director, HUDCO

Table 3.6 International examples of options for private sector participation and allocation of responsibilities

Option	Asset Ownership	Operations & Maintenance	Capital Investment	Commercial Risk	Duration	Examples
Service Contract	Public	Public and Private	Public	Public	1-2 Years	Chile (Santiago) India (Chennai)
Management Contract	Public	Private	Public	Public	3-5 Years	Gaza Trinidad and Tobago
Lease	Public	Private	Public	Shared	8-15 Years	Guinea (17 cities) Poland (Gdansk)
Build- Operate- Transfer	Private (bulk services)	Private	Private	Private	20-30 Years	Malaysia (Johor) Australia (Sydney)
Concession	Public	Private	Private	Private	25-30 Years	Argentina (Buenos Aires) Cote d'Ivoire Philippines (Manila)
Divestiture	Private	Private	Private	Private	Indefinite	England and Wales

Annexures

Annexure 2.1

Existing Tariff Schedules in Chennai, Bangalore and Delhi

Chennai

Category	Qty. of water	Rate/KL (in Rs.)	Minimum rate chargeable (including sewerage charges) (in Rs.)
Domestic			
Residential	upto 10 KL	2.5	50/- per month per dwelling unit
(i) Domestic Residential premises (other than flats or block or line of houses)	11 to 15 KL	10	
	16 to 25 KL	15	
	Above 25 KL	25	
(ii) Flats or houses in a block of flats or line of houses respectively used wholly for residential purposes	upto 10 KL	2.5	50/- per month per flat
	11 to 15 KL	10	
	16 to 25 KL	15	
	Above 25 KL	25	
(iii) Individual flats or houses in a block of flats or line of houses respectively used for other than residential purposes	Partly commercial – Rs. 150/- p.m. per flat		
	Non water intensive – Rs. 400/- p.m. per flat		
	Water intensive – Rs. 650/- p.m. per flat		
	Private hospital – Rs. 800/- p.m. per flat		
	Institutional – Rs. 300/- p.m. per flat		
	Pvt. Educational Instn. – Rs. 400/- p.m. per flat		

B. Commercial	Private hospital – upto 500 KL Rs. 50/KL		Rs. 800/- * (Water Intensive)
	All others upto – 500 KL Rs. 35/KL		Rs. 400/- (Non-water intensive)
	Private hospital – above 500 KL Rs 80/KL for entire quantity		Rs. 800/- *(Water intensive)
	All others – above 500 KL Rs. 60/ KL for entire quantity		Rs. 650/- * (Water intensive)
C. Partly Commercial	Upto 10 KL	Rs. 5	
	11 to 15 KL	Rs. 15	Rs. 150
	above 15 KL	Rs. 25	
			Rs. 400
D. Institutional	1) Pvt. Edn. Institution	Rs. 40.00/KL entire quantity	Rs. 200
	2) Govt. Hospital	Rs. 20.00/KL entire quantity	Rs. 300
	3) All others	Rs. 30.00/KL entire quantity	
E. Municipal bulk supply	Entire consumption	Rs. 15	–
E (I) Municipal bulk supply	Entire consumption	Rs. 7.00 (wherever local bodies met the cost of infrastructure)	–

* Sewerage charges 25% on water supply charges wherever sewer connections are provided.

* Water intensive means premises used fully or partly as theatres, hotels, boarding houses, lodges, clubs, private hospitals, private hostels, kalyanamandapams, clinics with inpatient facility, swimming baths, places for keeping animals, vehicle service stations, nurseries.

i.	Hydrant and public fountains	Rs. 400/- per month including maintenance charges
ii.	Maintenance charges	
F.	1) Mobile water supply to slums	Rs. 4/- per 1000 litres for entire quantity supplied
	2) Maintenance charges for steel tanks	Rs. 200/- per month per tank
G. Casual water supply		
Mobile water supply to customers		
i. Domestic (including hostels of colleges and schools recognised by state/central govt./ govt. Qtrs. etc.)	Rs. 400 per load of 6000 litres/- Rs. 600/- per load of 9000 litres/ Rs. 670/- per load of 10000 litres	
ii. Partly commercial		
a) Domestic purpose	Rs. 400/- per load of 6000 litres/Rs. 600/- per load of 9000 litres/Rs. 670/- per load of 10000 litres	
b) Other than domestic purpose	Rs. 510/- per load of 6000 litres/Rs. 765/- per load of 9000 litres/Rs. 850/- per load of 10000 litres	
iii) Commercial (including private hospital)	Rs. 510/- per load of 6000 litres/Rs. 765/- per load of 9000 litres/Rs. 850/- per load of 10000 litres	

iv) Institutional	
a) Private educational institution including hostels	Rs. 510/- per load of 6000 litres/Rs. 765/- per load of 9000 litres/Rs. 850/- per load of 10000 litres
b) Govt. offices/schools/colleges/hospitals etc.	Rs. 400/- per load of 6000 litres/Rs. 600/- per load of 9000 litres/Rs. 670/- per load of 10000 litres
v.) Water supply at Metro water filling points	
a) Domestic (including govt. schools/colleges/office institutions/ hospitals)	Rs. 400/- per 1000 litres
b) Commercial (including private hospitals/private educational institutions)	Rs. 60/- per 1000 litres
vi.) For the employees of the Chennai Metropolitan Water Supply and Sewerage Board who desires to avail the lorry water supply for their own house hold requirements, the cost will be calculated at actual cost price	Rs. 200/- per load of 6000 litres Rs. 300/- per load of 9000 litres
H. Hire charges for tanks hired out	Rs. 250/- for two days and Rs. 50/- for every additional day

Unmetered consumer tariff	**Water charges/Month (including sewerage charge)**
Category	
A. Residential	
(I) Domestic residential premises (other than flats or block or line of houses)	Rs. 50/- p. m. per dwelling unit
(ii) Flats or houses in a block of flats or line of houses respectively used wholly for residential purposes	Rs. 50/- p. m. per flat
(iii) Individual flats or houses in a block of flats or line of houses respectively used for other than residential purposes	Partly Commercial Rs. 150/- p.m. per flat
	Non water intensive Rs. 400/- p.m. per flat
	Water intensive (all others)
	Rs. 650/- p.m. per flat
	Private Hospital Rs. 800/- p.m. per flat
	Institutional Rs. 300/- pm. per flat
	Pvt. Educational Instn. Rs. 400/- p.m. per flat
B. Commercial	**Water intensive**
	Private Hospital Rs. 800/- p.m All others Rs. 650/- p.m.
	Non water intensive All others Rs. 400/- p.m.
C. Partly Commercial	Rs 150 p. m.
D. Institutional	I) Pvt. Educational Institution – Rs. 400/- p. m.
	ii) Govt. Hospital – Rs. 200/- p. m.
	iii) All others – Rs. 300/- p. m.
E. Public supply tubewell pumps or mark II pumps	Rs. 40/- p. m.

Bangalore

Domestic (filtered water)			
	Category and Consumption (KL)	**Rs/KL**	**Minimum charges (in Rs.)**
I. Domestic (Section 36[1])			
	1) 0 – 8000	6.00	48.00
	2) 8001 – 25000	9.00	201.00
	3) 25001 – 50000	15.00	676.00
	4) 50001 – 75000	30.00	1326.00
	5) 75001 – 100000	36.00	2226.00
	6) 100001 & above	36.00	5826.00
	Sanitary charges for domestic connection	(I) Rs. 15.00 at flat rate for consumption of 0 to 25000 liters	
		(ii) From 25001 to 50000 liters 15% on water supply charges per month	
		(iii) 20% of water supply charges per month against for consumption of above 50000 liters	
II. Non-domestic			
	1) 0 – 10000	36.00	360.00
	2) 10001 – 20000	39.00	390.00
	3) 20001 – 40000	44.00	880.00
	4) 40001 – 60000	51.00	1002.00
	5) 60001 – 100000	57.00	2280.00
	6) 100001 & above	60.00	NA

Industries		Rs. 60.00	
III	Bidadi Industrial Area	Rs. 51.00	
IV	Lorry loads	Rs. 250.00	
V	Swimming pools	Rs. 60.00	
VI	Public taps Section 36 VII	Rs. 3000.00	
Sanitary charges			
I	Domestic connection	Rs. 15/- at flat rate for consumption of 0 to 8000 liters and 8001 to 25000 liters	
		Rs. 15% of water supply charges per month for consumption of above 25000 liters upto 50000 liters	
		Rs. 20% of water charges per month for consumption of above 50000 liters	
II	All non-domestic connection	From 10% to 20% of water charges for month	
III	For premises having water supply and UGD connection but supplementing water supply for tanker/borewells Bidadi Industrial Area		
	a. Domestic and apartment	Rs. 50/- per month per individual house per flat. Revised from Rs. 200 to 300 per month per HP of borewell	
	b. Non-Domestic		
IV	Premises not having water supply connection from BWSSB but having only UGD connection in addition to sanitary charges	Rs. 300/- per month	

V	Hotels having boarding and lodging supplementing water supply by tankers in addition to borewells		
	(I) Non star hotels	Rs. 1000/- per month	
	(ii) 3 star hotels and above	Rs. 3000/- per month	
	(iii) 5 star hotels and above	Rs. 10000/- per month	
VI	For hospitals/nursing homes supplement-ing water supply by tankers in addition to borewell		
	(I) Nursing home & hospitals having 100 beds	Rs. 2500/- per month	
	(ii) Hospitals/nursing homes having more than100 beds	Rs. 5000/- per month	

Delhi

Category I (Domestic)		Category II (Commercial)		Category III (Industrial)	
Consumption (per month)	**Rs. (B) per KL.**	**Consumption (per month)**	**Rs. (B) per KL.**	**Consumption (per month)**	**Rs. (B) per KL.**
Upto 6 KLs	0	Upto 25 KLs	10.00	Upto 25 KLs	15.00
7 – 20 KLs	2.00	Above 25 KLs and upto 50 KLs.	20.00	Above 25 KLs and upto 50 KLs.	25.00
21– 30 KLs	7.00	Above 50 KLs	30.00	Above 50 KLs and upto100 KLs.	35.00
Above 30 KLs	10.00			Above 100 KLs.	50.00

The second part of the tariff is volumetric Water Charges is based on actual consumption and to be calculated as 1.5 B X

Hence, the bill will be calculated as follows :

1. **P= M + 1.5 B X Where, M= Minimum service Charges**

   B= Block tariff rates per KL.

   X= Units consumption in KL.

   P = Total Bill.

   - M =Minimum service charges (Rs.)
   - B= Block tariff rate per KL (Rs./KL.)
   - X= Units consumed in KLs. (Number)

2. 50% of water consumption charges is towards sewerage maintenance.
3. In addition, water cess charges shall continue to be recovered at the previous rate of 2-paise per KL. till revised by the Central Govt./ DJB.
4. Meter Maintenance (Rent) charge @ Rs. 10.00 p.m. in case of DJB supplied water meters after expiry of warranty period.

Annexure 3.1

Rationale for Reforms in urban water supply sector

Investment Requirements

Public expenditure on urban water supply and sanitation accounts for 1.2% to 1.8%(10th Five Year Plan/latest figures) of the total plan investments, and is significantly short of requirements. For example, notwithstanding an aggregate budgetary investment of Rs. 243.41 billion in the urban water and sanitation sector over the successive five year plans investment gaps are large. According to estimates of the Rakesh Mohan Committee total requirement for urban infrastructure development covering backlog, new investments and O&M costs for the next ten years is Rs. 2,50,000 crores (US$ 57 Billion). The ninth Plan proposal identifies only around Rs. 12000 crores. With anticipated growth in Tenth plan providing additional funds of Rs.13,000 crores, the total expected plan outlay comes to Rs. 25,000 Crores (US$ 5.7 Billion) which is one tenth of the project requirements.

A direct consequence of inadequate provision is manifested in sharp deterioration of service levels. Economic and social costs of under-provision of water are also assessed to be extremely high (Mathur,www.fiscalconf.org/papers/mathur.pdf)

To meet the huge requirements of funds for the improving infrastructure the urban local bodies thus need to look at alternate source of funding which may include external donors/banks (World Bank, OECF, ADB , DFID etc) or institutional investors like HUDCO/LIC etc. Further in the long term the municipal corporation may also need to tap funds from the markets by using instruments such as municipal bonds or by tapping funds from commercial banks. As a prerequisite to tapping these extra source of funding it may be necessary for the local bodies to put in place institutional and policy reform initiatives in the form of better governance systems, performance monitoring and improved financial management.

National/State policy directives on reforms in water sector

National Water Policy 2002

India's National Water Policy 2002 has clearly identified the need for improvements in the management of water sector in the country and has identified the need for reorientation of the current institutional structure of the sector in a manner which promotes a multi sectoral, multidisciplinary and a participatory approach while giving special attention to the management/ O&M of water resource schemes (Box 1).

Box 1

With a view to give effect to the planning, development and management of the water resources on a hydrological unit basis, along with a multi sectoral, multi disciplinary and participatory approach as well as integrating quality, quantity and environmental aspects, the existing institutions of various levels under the water resources sector will have to be appropriately reoriented / reorganized and even created wherever necessary. The institutional arrangements should be such that maintenance of water resources is given importance equal or even more than that of new construction.

Source: National Water Policy, Ministry of Water Resources, Government of India

City Challenge Fund

The Ministry of Urban Development, Government of India is encouraging citywide reforms and restructuring so as to ensure that cities are managed efficiently and become creditworthy (to attract private finance) which will enable them to prepare long term plans for infrastructure investments and implement poverty alleviation programmes. For the implementation of these reforms the Ministry of Urban Development has proposed to set up a performance based City Challenge Fund for catalyzing city level economic reform programmes. Access to the fund would be on a competitive basis.

Urban Reform Incentive Fund

The Urban Reform Incentive Fund (URIF) has been created with a corpus of Rs 500 crores per annum as Additional Central Assistance for reform linked incentive to State Government. URIF is a state level incentivization programme. It seeks to incentivize State Governments to follow a certain reform programme decided by the Government of India. The incentive under URIF is provided as 100 per cent Grant to the States and Union Territories entering into a Memorandum of Agreement with the Central Government addressing the first phase reform. The first phase reforms are proposed for a number of areas inclusive of the following:

- Introduction of computerized process of registration.
- Levy of reasonable user charges, with full cost of O&M being collected by the end of the 10th plan period.
- Introduction of a double entry system of accounting.

MoUD Initiatives

MoUD also proposes certain regulatory frameworks, which should be brought into effect in the water supply and sanitation sector. It also proposes to draw up guidelines for Public-Private Partnership to encourage PPP in infrastructure development (Box 2).

Box 2

Regulatory Framework

The participation of the private sector in financing and the delivery of infrastructure at the municipal level, especially in the water and sanitation sector, requires a regulatory framework to protect consumers, apply environmental standards and support the delivery to the poor. As there are a variety of models of regulation from centralized to decentralized systems, guidelines will be developed at the National level to ensure consistency across the country. Appropriate training programmes and capacity support to regulators will also be developed in partnership with the private sector and urban research institutions.

Public-Private Participation Guidelines

Central Government will develop guidelines for involvement of the private sector in infrastructure, which will ensure competitive biding process in a transparent manner. These guidelines will not only protect the consumers but also ensure integrity of the process. This would support municipalities in designing the PPP process on the lines of the BOT Centre in Philippines or the PPP in the Ministry of Finance in South Africa.

Source: Urban Reforms, Ministry of Urban Development, Govt of India

Jawaharlal Nehru National Urban Renewal Mission

The need of the hour in most cities is to introduce and sustain reforms, and improve service delivery efficiencies with a focus on minimizing costs, maximizing revenue, and allocating resources in the most optimal manner, all of which are possible in the existing institutional framework. National Urban Renewal Mission, about to be launched by the government, will be completely "reform driven" with eligible cities having to belong to states that have displayed reforms in terms of repeal of Urban Land (Ceiling) Regulation Act, reform of rent control acts, rationalization of stamp duties to not more than 5% over the next five years, introduction of independent regulators for urban services, levy of reasonable user charges for basic urban services, constitution of Citizen Advisory Groups to guide urban reforms' processes, and e-governance, among others.

The funds allocated under this mission come from a combination of Central Government, State Government and also as loans from Financial Institutions. The release of Central assistance would be linked with implementation reforms. The Mission includes a list of mandatory and optional reforms of which States and Urban Local Bodies (ULBs) are required to implement all mandatory reforms. In addition, States & ULBs are required to implement any five optional reforms in the first year.

A summary of the various national programmes and policies related to urban water supply in India over the years is given in Table 1 below.

Table 1 Various policy instruments/programmes used in the urban water supply sector in India

Year	Policy/Act/Programme	Highlights
1974	Environmental Improvement of Urban Slums (EIUS) Scheme	• The scheme is applicable to notified slums in all urban areas. • Aims at provision of basic amenities like water supply and sanitation. • The EIUS scheme was made as an integral part of the Minimum Needs Programme in 1974.
1979	Integrated Development of Small and Medium Towns (IDSMT)	• The scheme was initiated with a view to augmenting civic services. • Strengthening municipalities through promotion of resource generating schemes. • Reducing migration from rural areas to larger cities by providing sufficient infrastructure facilities, including water supply.
1986	Centrally sponsored Rural Sanitation Programme (CRSP)	• Provide technical and financial assistance to states to implement rural sanitation programmes under the Minimum needs programme.
1986, 1990/91	Urban Basic Services Scheme (UBSS) (1986) / Urban Basic Services for the Poor Programme (UBSP) (1990/91)	• The primary objective was improving the standard of living of urban low-income households, particularly women and children through the provision of sanitation and social services in slum areas. • In 1990/91, the scheme was integrated with the EIUS and came to be known as the Urban Basic Services for the Poor (UBSP) programme.

1991	Rajiv Gandhi National Drinking Water Mission (RGNDWM)	• The Accelerated Rural Water Supply Programme (ARWSP) under the (RGNDWM) assists the States and Union Territories (UTs) to accelerate the pace of coverage of drinking water supply.
1992	73rd and 74th Constitution (Amendment) Acts	• A three-tier system of local governance, through Panchayati Raj Institutions (PRIs) in rural areas and through Urban Local Bodies (ULBs) in urban areas was established. • State legislatures were empowered to entrust local bodies with necessary power and authority to enable them to function as institutions of local self-government. • State Finance Commissions were to be set up to provide for sharing of revenues between State and local bodies. • The urban and rural local bodies are now responsible for Water supply and sanitation.
1993/94	The Accelerated Urban Water Supply Programme (AUWSP)	• The Programme was initiated by the MoUDPA to provide safe and adequate water supply facilities to the entire population of the towns having population less than 20,000 as per 1991 Census. 50% of the finance for the urban water schemes is provided by the Union Government and the rest by the State Government.
1996	National Slum Development Programme (NSDP)	• Additional Central Assistance is being released to States/ Union Territories for the development of urban slums. • Objectives of the programme include provision of adequate and satisfactory water supply, sanitation, shelter upgradation, garbage, and solid waste management in slums. • Focus areas of the NSDP include development of community infrastructure, empowerment of urban poor women and involvement of NGOs and other private institutions in slum development.
2002	Urban Reforms Incentive Fund	• Rs 500 crore to provide reform linked assistance to States on: • Revision of municipal laws in line with model legislation. • Levy of realistic user charges and resource mobilisation by urban local bodies. • Initiation of public private partnership in the provision of civic services.
2002	City Challenge Fund	• Support to mega cities for transitional cost. • Partial cost of developing an economic reform programme and financially viable projects undertaken by the ULBs.
2002	National Water Policy	• Drinking water should be priority in planning and operation of systems. • Maintenance of existing water resources schemes would be paid special attention under these institutional arrangements.

2005	National Urban Renewal Mission	• Participatory approach should be adopted and water user associations and local bodies should be involved in operation, and maintenance to lead to eventual transfer of management to the local bodies/user groups. • Private Sector Participation should be encouraged in planning, development and management to introduce corporate management and improve service efficiency. • A standardised national information system with a network of data banks and data bases, integrating and strengthening the existing Central and State level agencies should be established. • Exploitation of ground water resources should be so regulated as not to exceed the recharging possibilities as also to ensure social equity. • The thrust of this mission is on urban infrastructure and basic services for the poor. This mission plans to cover only 63 cities including 7 mega cities, 28 million plus cities, and 28 other cities over a five year period. The mission proposes an agreement between the states, urban local bodies and the central government to undertake reforms before delineation of funds from NURM to the ULBs.

State Government directives

MP State Water Policy

The Madhya Pradesh state water policy also advocates institutional reforms including better coordination mechanisms and inclusion of demand side perspective in water management along with developing a reliable information system for better management and decision-making.

Box 3

Present information and data network including data of processing capabilities should be improved to make it broader, modern and effective. Emphasis should be given for greater use of Remote Sensing technique. It should be made mandatory for users and regulatory departments to maintain all necessary data for compilation of storage of surface and ground water…..

…..The water resources planning structure which is at present based on water availability should be correlated with demand base of water distribution and necessary institutional reforms be taken.

Source: State Water Policy, Madhya Pradesh, 2003

10th Five Year Plan (Draft)

The State Government has published its own Draft 10th Five-Year Plan 2002-2007 in May 2002. "The Plan recognizes the importance of people in the process of development. It further lays emphasis on "decentralization, greater accountability, and increasing space for direct community action".

MP Municipal Corporation Act 1956 (With amendments)

The Madhya Pradesh Municipal Corporation Act came into existence in 1956. Since then, all Municipal Corporations in the State are governed by this Act. The Act vests the powers for management and maintenance of all water works and the construction and maintenance of new works to the Municipal Corporations across the state. Further, it also directs the Municipal Corporation to find means for providing a sufficient supply of suitable water for public and private purposes.

It further defines the composition of the Municipal Corporation. The State has the provision to nominate persons having special knowledge and experience in the municipal affairs to be a part of the Municipal Corporation. Also, according to the act's mandate, a Mayor-in-council has to be brought in place in the city, which leads the pathway for public participation. Wards Committees/ Zonal Committees also need to be constituted by, as a step towards a decentralized approach.

In lieu of the above policy directives it may be necessary for the Municipal Corporations to undertake reforms aimed at improving the efficiencies and demonstrate that its operations and sustainable even for attracting funding from the government and also the institutional sector/external donors.

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