Water
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Cost Recovery for Water Schemes to Developing Urban Communities: A Comparison of Different Approaches in the Umgeni Water Planning Area

Derek Hazelton and Simphiwe Kondlo

WRC No. 521/1/98

COST RECOVERY FOR WATER SCHEMES TO DEVELOPING URBAN COMMUNITIES:

A Comparison of Different Approaches in the Umgeni Water Planning Area

by

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REPORT TO THE

WATER RESEARCH COMMISSION

by

UMGENI WATER

and

DIVISION OF WATER, ENVIRONMENT AND

FORESTRY TECHNOLOGY, CSIR

WRC Report No: 521/1/98
ISBN No: 1 86845 432 0

EXECUTIVE SUMMARY

INTRODUCTION

Poor cost recovery from water supply schemes in developing areas is often quoted as being one of the major stumbling blocks to the longer term sustainability of these systems. It is also said to limit the capacity of organisations to increase service coverage. Indeed the White Paper on Water Supply and Sanitation Policy (DWAF 1994) states "many of the homeland administrations either did not or could not ensure that operating and maintenance costs were paid by consumers and soon found that their **entire budgets** were consumed in maintaining the existing very low levels of services. The result is that a small portion of the population enjoys free services whilst the majority has no services ..... It is not the Government who is paying for their free services but the unserved".

In addition fledgling community management structures established to manage a community water supply system cannot hope to survive without a sound financial base and proven methods of cost recovery. Water losses in poorly managed systems can be considerable and when such losses occur they make economic viability even more difficult.

Hence the project on cost recovery was undertaken to assess what can be done practically to ensure the economic viability of water supply schemes to Developing Urban Communities. The research was carried out with Communities obtaining there water from Umgeni Water reticulated schemes in the urban fringe around Pietermaritzburg or close to the Pietermaritzburg/Durban Motorway.

AIMS OF THE PROJECT

To study the acceptability and applicability:-

* of the existing methods of cost recovery used by Umgeni Water and
* of two new techniques

for water supplies to Developing Urban Communities, because acceptable and applicable cost recovery techniques are necessary to achieve the longer term sustainability of these schemes.

NOTE: Acceptability was to be understood as meaning acceptable to the Bulk Water Supplier, to Community Members and to their Water Committees.

Applicability was to be understood as meaning those methods which ensure the economic viability of water supply schemes to Developing Urban Communities and especially Community Managed water supply schemes. Apart from the collection of water charges, the control of UAW is required for economic viability. Hence the assessment of achievable UAW was also to be studied.

MAJOR FINDINGS

The research was carried out under the auspices of Umgeni Water. Between the time that the research proposal was written to when research started Umgeni Water's methods of cost recovery had altered considerably. Consequently the project proposal does not mention metered household connections but by June 1993 when evaluation of the different methods was just starting such connections comprised 88% of all invoices being issued by Umgeni Water and accounted for 71% of the value of invoices issued for schemes associated with Developing Communities where Umgeni Water is directly involved in cost recovery. Umgeni Water and the Service Users considered such connections to be acceptable and applicable throughout the Umgeni Water urban supply area whilst concurrently having negative perceptions concerning other methods of cost recovery. To them therefore the question posed by the aims of the project had already been answered through the introduction of metered household connections.

However the work carried out during the project indicates that, because of poverty and the low per capita water consumption encountered once water is metered and paid for (refer chapter 3), it will not be possible to recover full costs from water schemes supplying Developing Communities when individual household connections are used exclusively. The average cost of supplying water to these communities, excluding capital redemption charges for the reticulation pipework, was R5-63/kℓ in 1996 and R1-29/kℓ was recovered from the customers (refer chapter 7). As about 10 million South Africans live in these communities the project team felt that the necessary cross-subsidisation to sustain this level of funding would not be acceptable in terms of National affordability and thus planners would have to facilitate the implementation of multi-levels of service schemes. Water charges should be based on the total true cost of delivery, the only exception being the non-repayment of capital where grant finance has been obtained for the construction of basic minimum levels of service. Thereafter individual households should be allowed choose the level they want.

Umgeni Water recovers about 90% of all invoiced amounts from customers with household connections including households owning metered shared standpipes. This is done against a background of a high quality of service, the existence of active water committees in all the communities and Umgeni Water branch offices in many of them. In a few cases Umgeni has also had success in recovering invoiced amounts from metered community standpipes and schemes controlled by village water committees (refer chapter 4). Because of the need for greater community control, challenges facing Umgeni Water and the industry generally include: further capacity building and the handing over of control to Local Government and Village Committees within a framework of ongoing monitoring, auditing and support; more resources being used to implement cost recovery from basic and intermediate levels of service and greater openness with respect to implementing innovative methods of cost recovery and innovative administration systems (refer chapters 2, 8 and 9). Umgeni Water is aware of these challenges and will be devoting more resources to them in future.

The two new methods of cost recovery studied during the project were:-

* distributed storage regulating units, and

* community coupon water dispensers.

Consumer acceptability of both new methods of cost recovery was high. With respect to the distributed storage regulating units Umgeni Water was concerned about how to set the fixed monthly tariff since the unit fixes MAXIMUM consumption rather than ACTUAL consumption. With respect to the community coupon water dispensers Umgeni Water initially expressed the opinion that they preferred privately operated metered public standpipes as they are cheaper to install and maintain and there are no coupons to distribute. However towards the end of the project it transpired that cost recovery from the privately operated standpipes may be problematic due to the fact that Umgeni Water is often unable to cut off the water at a shared standpipe when the private operator does not pay the account. Overall therefore distributed storage units are promising as an acceptable intermediate level of service for individual households and there is a need for community dispensers although the unit tested was not sufficiently reliable to fill the need (refer chapter 5).

The project team's investigations into unaccounted for water (UAW) have produced a universal diagram for characterising acceptable UAW levels on water schemes generally (refer chapter 6). Despite the fact that the diagram suggests lower levels of UAW on many schemes having low water usages per connection than is suggested by International norms, UAW % figures for such schemes are still appreciably higher than for schemes with a water usage of 30 kℓ/mth (refer chapter 6).

CONCLUSIONS AND RECOMMENDATIONS FOR IMPLEMENTATION AND FURTHER RESEARCH

Communities will pay for the water they consume provided:

* the pricing is equitable,
* the level of service is adequate and reliable, and
* the authority of the water supply board/committee is accepted.

To developing urban communities:-

* equitable pricing means paying the same price per kilolitre of water consumed as other consumers with the same level of service and paying less per kilolitre of water consumed as the level of service drops
* adequate does not have an absolute definition but its meaning is influenced by expectations which in turn are influenced by the degree of community participation during the development of the water supply scheme and the early days of its operation
* reliable means the operation and maintenance of the scheme is effective
* assuming equitable pricing and effective operation are in place acceptance of authority is secured through a mixture of the service users seeing that the scheme was implemented and is being operated equitably and realising that water will be disconnected if iblls are not paid.

Within the parameters set out above Umgeni Water recovers about 90% of all invoiced amounts from customers in Developing Urban Communities when house connection or yard taps are installed.

For lower levels of service it appears that equitable pricing structures, as defined above have generally not been used. In addition, with the majority of cost recovery methods used for these lower levels of service, disconnections have not been possible. For both the above reasons high levels of cost recovery for such levels of service have been more problematic.

Therefore, alternative methods of cost recovery need to be evaluated and pursued with much more vigour than was possible in the environment within which this project was carried out. The purpose of such a vigorous evaluation would be to ascertain if it is possible to attain high levels of cost recovery with less conventional methods of water supply and cost recovery whilst at the same checking their potential for significantly reducing management costs. Chapters 8 and 9 of this report give some tentative suggestions of how this might be carried out.

Progressing from what has been learned during the execution of the WRC project the CSIR currently implementing a cost recovery study on a range of unconventional devices and support systems as recommended in the previous paragraph on behalf of the Directorate Water Services Operations of the Department of Water Affairs and Forestry, South Africa, with sponsorship from the British Government Department of International Development. The study is being implemented in three parts:

* a literature survey of the socio-economic environment in which community water supply schemes are managed, including southern African case studies;

* a desk survey of available water metering/vending devices and the administrative support structures necessary to use them; and

* an evaluation of devices and support structures already installed in South Africa.

Parts 1 and 2 of the study are complete. The findings have been published in a booklet titled *Implementing prepayment water metering systems* (DWAF 1997). Part 3 has just commenced. An interim report on findings is planned for the first quarter of 1999.

REFERENCES

DWAF (1994) *Water supply and sanitation policy white paper.* Government White Paper, Republic of South Africa, CAPE TOWN. November 1994, pp. 23.

DWAF (1997) *Implementing prepayment water metering systems.* Department of Water Affairs and Forestry, Directorate Water Services Operations, Private Bag X313, PRETORIA, 0001. October 1997, pp. 69.

ACKNOWLEDGEMENTS

The research in this report emanated from a project funded mainly by the Water Research Commission and partially by Umgeni Water, and entitled:

"Cost recovery for water schemes to developing urban communities - a comparison of different approaches in the Umgeni Water planning area".

The Steering Committee responsible for the project consisted of the following persons:

Mr HC Chapman	Water Research Commission (Chairperson)
Mr D Huyser	Water Research Commission (Committee Secretary)
Mr H Maaren	Water Research Commission
Mr JL Rivett-Carnac	Appropriate Technology Information
Mr DG Hazelton	CSIR
Mr I Pearson	CSIR
Mr B Jackson	Development Bank of South Africa
Mr I Palmer	Palmer Development Group
Mr JE Zagt	Port Natal Joint Services Board
Mr S Kondlo	Umgeni Water
Mr I Ngwenya	Umgeni Water
Mr A Wilson	Umgeni Water

The authors express their sincere thanks to the Water Research Commission and Umgeni Water for funding the project on which this report is based.

We also thank our colleagues, the Water Research Commission's project Steering Committee, community members and members of other organisations who spent valuable time giving us information or discussing aspects of the study with us. The opinions expressed are however the authors and not necessarily those of the participating organisations.

COST RECOVERY FOR WATER SCHEMES TO DEVELOPING URBAN COMMUNITIES

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ABBREVIATIONS

Apr	April
Aug	August
Avgs	averages
c	cents
conn	connection
CSIR	Council for Scientific and Industrial Research, South Africa
CWS&S	community water supply and sanitation
Dec	December
DWAF	Department of Water Affairs and Forestry, South Africa
Excl	excluding
Feb	February
hr	hour
HSL	household subsistence level
Jan	January
Jul	July
Jun	June
kℓ	kilo-litre
km	kilo-metre
kPa	kilo-Pascal
ℓ	litre
Mar	March
Mℓ	Mega-litre (10^6 litres)
mth	month
m^3	cubic metres
Nov	November
Oct	October
O&M	operation and maintenance
PDL	poverty datum level
R	Rand
Sep	September
SS	sample size
UAW	unaccounted-for water
VAT	value added tax
WRC	Water Research Commission, South Africa
%	percent

1.1 TITLE OF STUDY

Water scheme cost recovery: a comparison of 4 different approaches to cost recovery for water supplies in developing urban communities.

1.2 ORIGINAL AIMS

The primary aims of this study were to determine the acceptability and applicability of different cost recovery techniques for water supplies to informal urban communities. The four techniques were:

* water kiosks (as already practised in Inanda, near Durban);

* flat rate community run system (a number of which are practised in the Umgeni Water area of responsibility);

* restricted flow distributed storage (to be installed for this study); and

* coupon operated water dispensers (to be installed for this study).

Thus the latter two systems were to be installed and evaluated together with the existing systems in the fringe urban areas surrounding Durban. The evaluation would assess not only the physical performance of the different systems, but more particularly: the acceptability of the systems to the user institutions and communities, the factors relevant to their applicability in different types of communities, and the economic viability of the systems as a whole.

Hence the overall aims of the study were as follows:

* assess the viability of two new water supply cost recovery systems in an informal urban environment;

* obtain economic information on different cost recovery approaches;

* ascertain what approaches to cost recovery result in an acceptable and sustainable community managed water supply system;

* adopt the findings of this study to the technologies for and approaches to water supply in the urban areas of Natal, and if applicable, elsewhere in South Africa; and ensure the economic viability of the water supply systems to urban fringe areas.

1.3 REVISED AIMS

At the first meeting of the working group responsible for implementing the study Umgeni Water reported that flat rate community run systems had been discontinued and had been replaced by;

* metered shared standpipe; and
* individual house metered connections.

Umgeni also reported that it is responsible for seven bulk supplies to developing urban communities where it has no responsibility for internal cost recovery.

There is thus: one cost recovery technique that was used by Umgeni Water but has since been abandoned, three current techniques and two alternative techniques to be introduced as part of this project.

The list of techniques to be studied in terms of the aims was thus modified to read:

* water kiosks (as already practised in Inanda, near Durban);
* metered shared standpipes (privately operated);
* individual household metered connections;
* distributed storage flow regulated units; and
* community coupon operated water dispensers.

The two remaining techniques:

* flat rate community run system (a number of which were practised in the Umgeni Water area of responsibility) and
* bulk water supply systems (operated by community water committees)

would not be ignored. A historical survey would be carried out to ascertain why the first technique was abandoned and the second would be examined to ascertain at what stage in a communities development a bulk water supply system can be considered.

1.4 JUSTIFICATION

Poor cost recovery from water supply schemes in developing areas is often quoted as being one of the major stumbling blocks to the longer term sustainability of these systems. It is also said to limit the capacity of organisations to increase service coverage. Indeed the Department of Water Affairs and Forestry Water Supply and Sanitation Policy White Paper (DWAF 1994 p. 23) states "many of the homeland administrations either did not or could not ensure that operating and maintenance costs were paid by consumers and soon found that their **entire budgets** (emphasis added) were consumed in maintaining the existing very low levels of services. The result is that a small portion of the population enjoys free services whilst the majority has no services......It is not the Government who is paying for their free services but the unserved".

In addition fledgling community management structures established to manage a community water supply system cannot hope to survive without a sound financial base and proven methods of cost recovery. Water losses in poorly managed systems can be considerable and when such losses occur they make economic viability even more difficult.

Hence the project on cost recovery to assess what can be done practically to ensure the economic viability of water supply schemes to Developing Urban Communities. The research was carried out with Communities obtaining there water from Umgeni Water reticulated schemes in the urban fringe around Pietermaritzburg or close to the Pietermaritzburg/Durban Motorway.

It was realised from the outset that the use of technology without the correct community approach has little chance of success. Hence an important consideration of this project was to establish which approaches to community participation with respect to cost recovery are likely to ensure optimum success with each particular system.

2.1 GENERAL

The literature highlights different levels of community participation and control throughout water supply scheme project implementation and claims that the higher the level of community participation throughout the project implementation cycle the greater the likelihood of sustainability.

Other literature stresses that, whilst such participation is usually an essential condition for success it is by no means a sufficient condition. Capacity building and the existence of democratic structures being singled out as the most important additional criteria.

Other subjects covered are increased costs due to increased levels of supply, affordability (usually community wise rather than nationally), equitability of the cost recovery system, other advantages and disadvantages of different cost recovery systems, water wastage and lastly tariff structures.

2.2 OPERATION AND MAINTENANCE COSTS

The literature is sadly lacking in details of actual costs of operating and maintaining community water supply schemes. In addition, some authors warn that true costs are generally appreciably higher than reported costs.

The literature generally discourages direct involvement by statutory bodies in maintenance work and describes such involvement as ineffective and costly. Again communities should operate, monitor, care for and manage their own schemes but leave all major maintenance work to local properly trained professionals. The contribution of statutory bodies is then limited to facilitating an enabling environment and being a mediator between communities, maintenance companies and material suppliers. Regrettably, no references could be found advising on how a shortage of funds should be managed.

2.3 COST RECOVERY

There is no longer disagreement as to whether developing communities in general should pay for water (and other services) but there is still little agreement on whether such communities can be self sufficient even when only operating and maintenance costs are considered. People value something they have to pay for more than free goods; it reduces wastage; ownership and a sense of caring for the installation can only be transferred to a community when the community accepts a central role in paying the operating and maintenance costs the literature proclaims.

There is also general agreement that once a minimum level of service has been provided the charges for higher levels of service should be related to the real costs of supplying the water but again not necessarily covering the full cost when minimum levels of consumption are being discussed.

The literature is however very inconsistent with respect to estimating different communities ability to pay for these costs in full. A study carried out by the Netherlands Economic Institute (van Wilgenburg 1991 p. 20 and 21) reports that rural communities in Burkina Faso (hardly a rich country) not only pays for all operation and maintenance but also sets aside reserves for the replacement or extension of village water supply schemes. On the other hand another study done about the same time in the Netherlands (Besselink 1992 p. 25) reports that generally maintenance costs exceed the financial capacity of villagers. An earlier World Bank report seeks additional evidence of practical community-level cost recovery and management mechanisms but a follow-up volume published at the same time as the Netherlands studies discusses technology issues only.

3.1 INTRODUCTION

This study covers a group of developing urban communities who obtain their water from schemes reticulated and managed by Umgeni Water. The communities comprise 21 750 households (148 000 people) who consume approximately 0,2% of the total water sold by Umgeni Water. In the Umgeni Water area as a whole in excess of 28% of water is delivered to such communities. The quantity of water delivered to developing urban communities throughout South Africa is not known. However, what is known is that about 25% of the total population of South Africa, some 10 000 000 people, live in developing urban communities on the boarders of the Metropolitan areas and the larger Platteland towns (Wilson et al 1989 p.24 and DBSA 1991 p.1). In 1975 41% of households in this category had an income of less than R 125-00 per month (Wilson et al p.25). Since 1975 there has been stark increases in the inequality among Black African (and White) households. Refer figure 3.1 It can therefore be anticipated that the income of this 41% of household has deteriorated further, mainly through rising unemployment, whilst, on the other hand, the more wealthy households have benefitted from the erosion of apartheid.

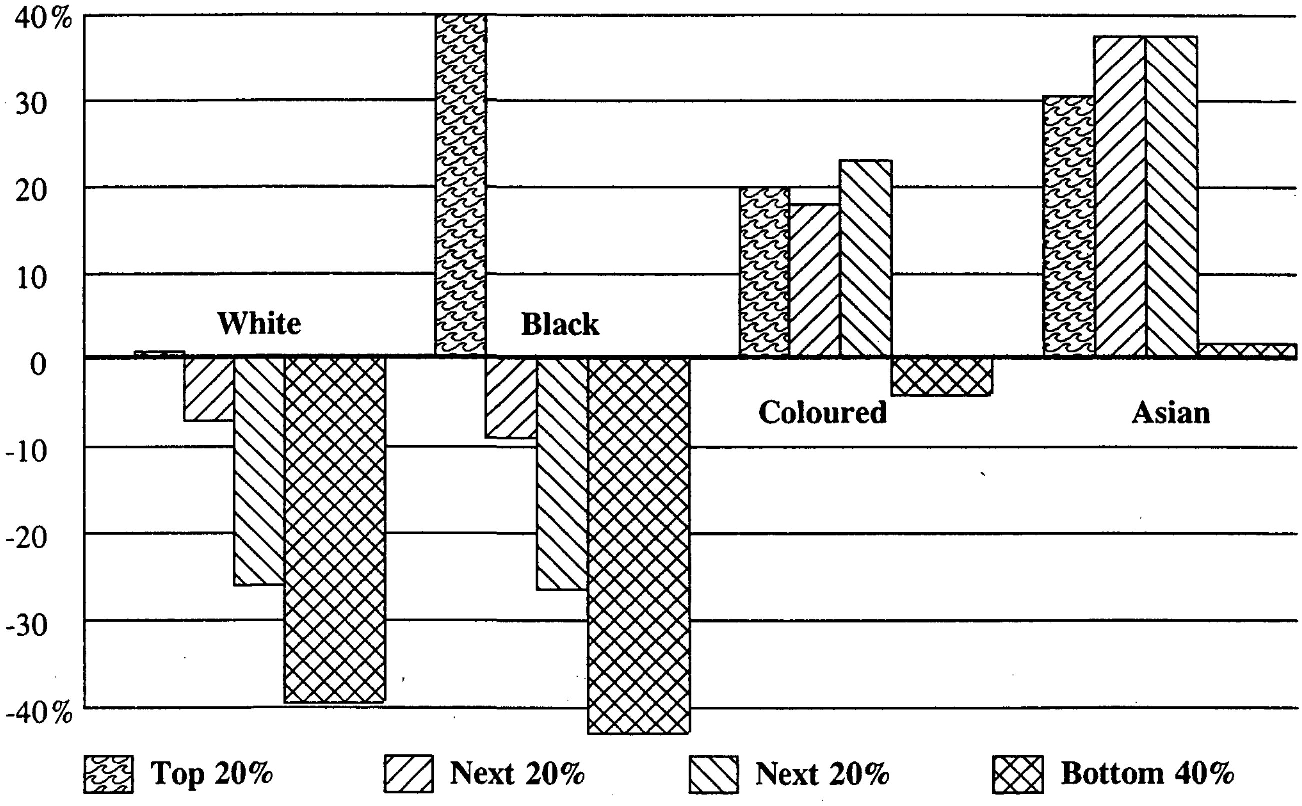


Figure 1: Percent Change in Real Household Incomes (after Adjusting for Inflation) between 1975 and 1991 (McGrath 1994 p:19)

3.2 THE CHARACTER OF DEVELOPING URBAN COMMUNITIES IN THE UMGENI WATER PLANNING AREA

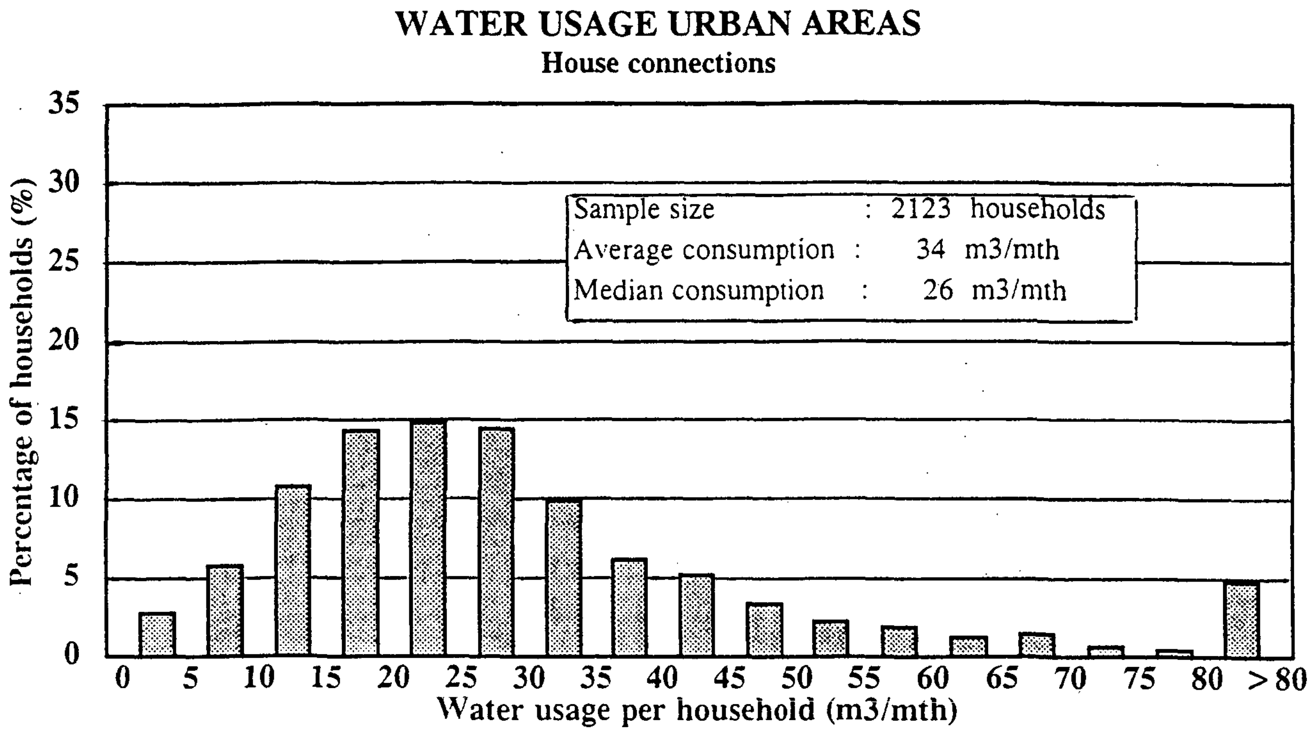
In the Umgeni Water planning area the pervasiveness of poverty within developing urban communities is confirmed in a 1993 document on living standards in the Durban region. The document reports that in Ntuzuma, a large part of which contains informal settlements, between 47 and 58% of households fall below the Household Subsistence Level (HSL) whilst even in Umlazi, a largely formally settled area, it quotes figures of between 34 and 45% falling below the same category (Cobbledick et al 1993 p.40). The HSL is the household equivalent of the per capita Poverty Datum Level (PDL) and allows for a minimum expenditure for providing food, clothing, cooking, lighting, rent, washing and transport but no expenditure for health care, education or household equipment replacement (Brijlal 1994 p.13).

3.3 WATER CONSUMPTION IN THE STUDY AREA CONTRASTED WITH WATER CONSUMPTION IN ESTABLISHED URBAN COMMUNITIES

The pattern of water consumption by households in the study area who have house or yard connections and who pay for their water reflects the general levels of poverty in developing urban communities. Details of the water usage for the study area which comprises developing urban communities and for a range of established urban communities also in the Umgeni Water area is given in figure 3.2. Note, assuming 5 persons per household, less than 5kℓ/mth per household corresponds to less than 30ℓ/day per person. If the study areas households had water borne sanitation we expect the majority of these households would use between 2 and 4kℓ/mth additional water whilst the majority of established urban households reported on probably use between 4 and 8kℓ/mth to flush their toilets.

3.4 CHAPTER SUMMARY

In summary therefore this paper discusses cost recovery from water schemes to developing urban communities in South Africa. Ten million people live in these communities: approximately half of which live below the Poverty Datum Level (PDL) whilst a small minority have quite a high standard of living. Once households in such communities have to pay for water, even those households with house or yard connections use, on average, about 1/3 the water used by households living in established urban communities. The combination of poverty and low water consumption calls for substantially increased effectiveness in the use of moneys recovered to ensure that these moneys cover the total cost of water delivered to the communities without materially increasing the price.



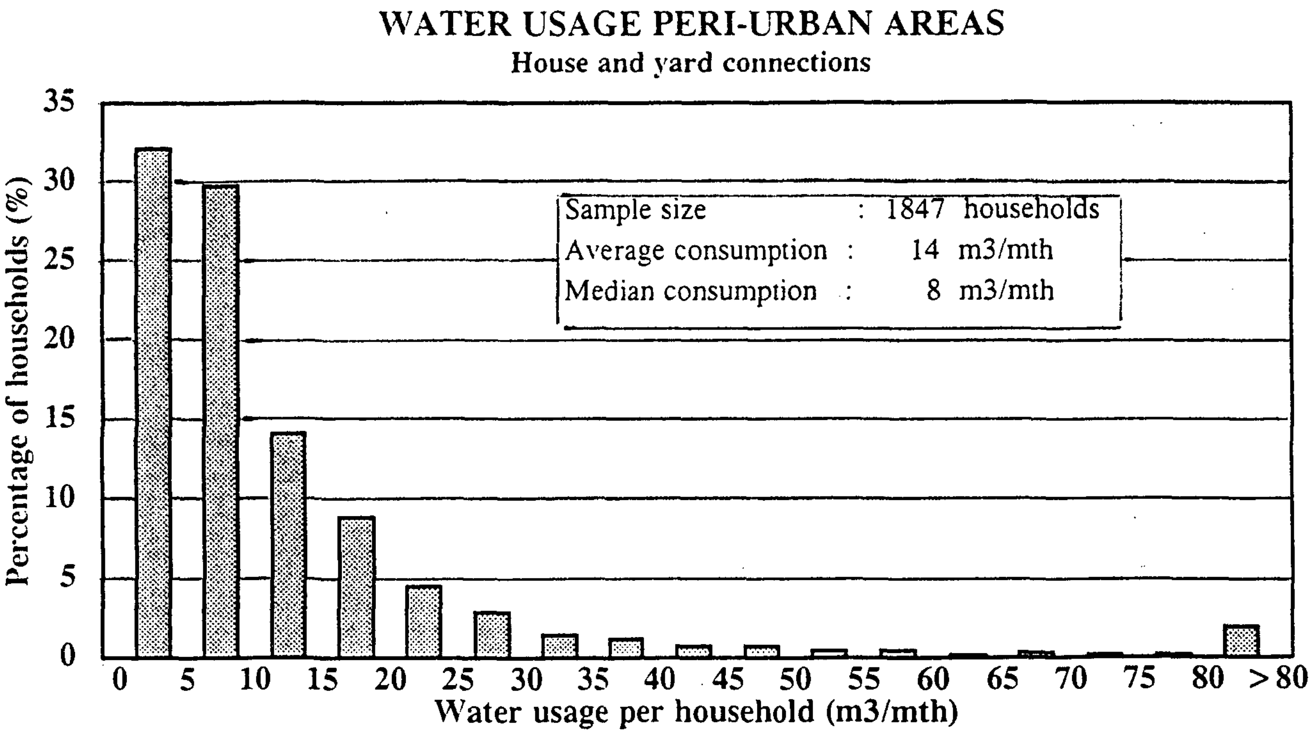


Figure 3.2: Details of household water usage for house and yard connection in the study area, which comprises developing urban communities, contrasted with household water usage for a range of established urban communities also in the Umgeni water area.

4.1 INTRODUCTION

Umgeni Water became actively involved in reticulating potable water to developing urban communities in their area of supply during the drought which began in 1981. Table 4.1 "Analysis of Umgeni Water Debtors June 1994" gives a clear indication of the current importance of different categories of clients with respect to account values and numbers of accounts as well as indicating the current situation with respect to Umgeni Water's general success with respect to cost recovery.

The first column gives a short description of the account type. The first group of accounts all relate to water supplies delivered exclusively to developing communities. The second group relates to bulk supplies in which some of the water is delivered to developing communities and some to established communities. The third or last group relates to water supplies delivered exclusively to established communities and/or first world account holders. The first group, water supplies to developing communities can be further sub-divided into three groups:

* supplies where Umgeni Water accepts responsibility for the operation, maintenance and management of the distribution system and therefore interacts with all the individual customers in the area including households with individual private connections, metered standpipes operators, individuals operating water kiosks and individual institutions such as schools and churches;
* supplies to village level Water Committees where Umgeni Water has no direct contact with individual customers but has accepted responsibility for institutional capacity building and general skills training so the Water Committees can carry out their responsibilities as village level water service providers; and
* bulk supplies where Umgeni Water has no responsibilities for distribution and no contact with village level committees or with individual customers.

The second set of columns examines Umgeni Water's current months debt. (Total current months debt equals the total current months invoiced amount.) This indicates that in excess of 28% of Umgeni Water's income is derived from water delivered to developing communities. However all but 0,23% of this debt was with major institutions such as the KwaZulu Government Service and the Edendale Complex Town Manager. Thus whilst developing communities are a major client, Umgeni Water is only responsible for recovering costs directly from customers representing 0,23% of their total turnover. Thus through using 1,0% of the income from the other 99,77% of their sales Umgeni Water is able to cross subsidize these customers to the tune of R4,34/kℓ as indicated in table 7.3.

The third set of columns illustrates that whilst the value of accounts for which Umgeni Water is responsible for recovering costs directly from customers residing in developing communities is small these accounts do represent over 95% of all accounts related to water sales.

Table 4.1: Analysis of Umgeni Water debtors for a typical month in 1994

(All the accounts included in this analysis have been in existence for at least 13 months)

Account Type	Total current months debt R-c	Percent of total current debt		Number of accounts	Percent of total number of accounts		Average account value R-c	Median account value R-c	Total outstanding debt R-c	Debt ratio Tot/Cur
		Indiv %	Cum %		Indiv %	Cum %				
Dev Communities										
Pvt Connection	23 629,99	0,09	0,09	1151	88,13	88,13	20,53	11,29	77 782,22	3,29
Metered Standpipes	10 487,35	0,04	0,13	36	2,75	90,88	291,32	139,82	85 811,92	8.18
Water Kiosks	173,55	0,00	0,13	4	0,31	91,19	43,39	39,13	260,75	1,50
Individual Inst	2 496,48	0,01	0,14	48	3,67	94,65	52,01	15,05	15 942,95	6,39
Water Committee	23 939,96	0,09	0,23	7	0,54	95,43	3 419,99	2 223,00	200 276,84	8,37
Bulk Inst	7 640 256,44	28,41	28,64	16	1,23	96,63	477 516,03	394 091,15	17 957 604,42	2,35
Sub Total DevC	**7 700 983,77**	**28,64**	**28.64**	**1262**	**96,63**	**96,63**	**6 102,21**	-	**18 337 679,10**	**2,38**
Mixed Communities										
Bulk Inst	10 255 730,32	38,14	38,14	2	0,15	0,15	5 127 865,16	5 127 865,16	13 929 915,09	1,36
Sub Total MixedC	**10 255 730,32**	**38,14**	**38,14**	**2**	**0,15**	**0,15**	**5 127 865,16**	-	**13 929 915,09**	**1,36**
Est Communities										
Pvt Connection	3 410,78	0,01	0,01	19	1,46	1,46	179,51	48,91	6 050,87	1,77
Individual Inst	261 342,66	0,97	0,98	9	0,69	2,15	29 038,07	2 521,68	693 184,24	2,65
Bulk Inst	8 667 077,85	32,23	33,22	14	1,07	3,22	619 076,99	52 733,79	9 790 421,50	1,13
Sub-Total EstC	**8 931 831,29**	**33,22**	**33,22**	**42**	**3,22**	**3,22**	**212 662,65**	-	**10 489 656,61**	**1,17**
Totals										
Umgeni Sup DevC	60 508,51	0,23	0,23	1246	95,40	95,40	48,56	12,54	380 074,68	6,28
Umgeni Water	26 888 545,38	100,00	100,00	1306	100,00	100,00	20 572,72	-	42 757 250,80	1,59

The last sets of columns relate to the average and median value of individual account types and the outstanding debts associated with them. Important items to note from these columns are the low average account values for the private connections and the individual institution connections associated with developing communities and the even lower corresponding median values. These low account values have been one of the many criteria which has made the administration of schemes delivering water to developing communities difficult and which has resulted in Umgeni Water trying various methods of cost recovery and community participation to overcome these difficulties.

With respect to the debt ratio the figures reflect the situation immediately after the current months invoices have been generated but before they have been despatched. Thus the overall total to current debt ratio of 1,59 shows good control of debtors by Umgeni. With respect to water supplies specifically to developing communities the figure of 2,38 for the major institutions needs to be watched carefully. Comments on the debt ratio for the smaller accounts associated with developing communities are discussed later in this chapter under the individual sections examining each of the current methods of cost recovery used by Umgeni Water.

4.2 THE BROADER AIMS OF COST RECOVERY

As the words imply, the central aim of cost recovery is to ensure that water supply authorities recover all the costs they incur in supplying water to their customers. These costs include repayment of capital costs and all operating and maintenance costs.

However there are other broader aims and these broader aims rank high in Umgeni Water's insistance on implementing cost recovery for the community water schemes they manage despite the fact that currently, as reflected in table 7,3, only 23% of the total operating and maintenance costs are being recovered from these schemes.

Broader cost recovery aims include:

* stopping excessive water usage and wastage,
* encouraging an ethos of paying for services generally,
* helping people appreciate that whilst water is a free gift of god/nature the supply of high quality water close to peoples homes in peri-urban areas is relatively costly,
* giving customers a sense of ownership and responsibility for the water supply in their area,
* discouraging distortions in investment policy through customers making excessive demands for a certain level of service whilst, at the same time, water authorities may be discouraged from making the required investment even where payment by

the customer is not a problem because of the effect of such investment on the authorities bottom line, and

* when full cost recovery is not equitably achieveable, minimising the subsidy necessary to achieve sustainability.

To maximise the benefits of including these broader aims requires new cost recovery techniques, longterm commitment, sensitivity and capacity building.

4.3 PRESENT "UMGENI WATER" METHODS OF COST RECOVERY

The present methods of cost recovery being used by Umgeni Water, including those being phased out, and comments on their acceptability and applicability follow:

4.3.1 Flat Rate Standpipes (Hlapo 1996)

This type of standpipe was first installed in a few communities like Ntshongweni and Geogedale during the advent of drought which was followed by the 1982 cholera epidemic. The standpipes were situated along the roads in public places. Unlife many community operated schemes throughout South Africa water was available 24 hours per day 7 days a week from these unattended flat rate standpipes. The responsibility for collecting the fixed "flat rate" monthly charge from customers was given to the tribal authorities controlling the different areas. Payment was made by community members at the magistrates court and the magistrate was then responsible for paying Umgeni Water.

The system worked smoothly for sometime but broke down in the mid-eighties when violence started and customers were also discouraged from paying by a culture of non-payment being preached.

When the violence subsided towards the end of the eighties, Umgeni Water started negotiations with the affected communities to pay for water services and for their improvement. Through these negotiations Water Committees were elected by community members and these committees were charged with the collection of the flat rate charges.

Soon it became apparent that the flat rate was unpopular and that it was regarded as unfair by some custumers because those furthest away pay the same flat rate as customers living next to the unit who, as well as not having to carry the water as far, generally use more water. At the same time it was also difficult for Umgeni Water to know whether the money collected was sufficient for the water used as these standpipes were not metered. Vandalisation of such standpipes was quite common.

For the above reasons this form of cost recovery was discontinued by Umgeni Water and these stand pipes were converted into metered community standpipes and water kiosks. These methods of cost recovery will be discussed next.

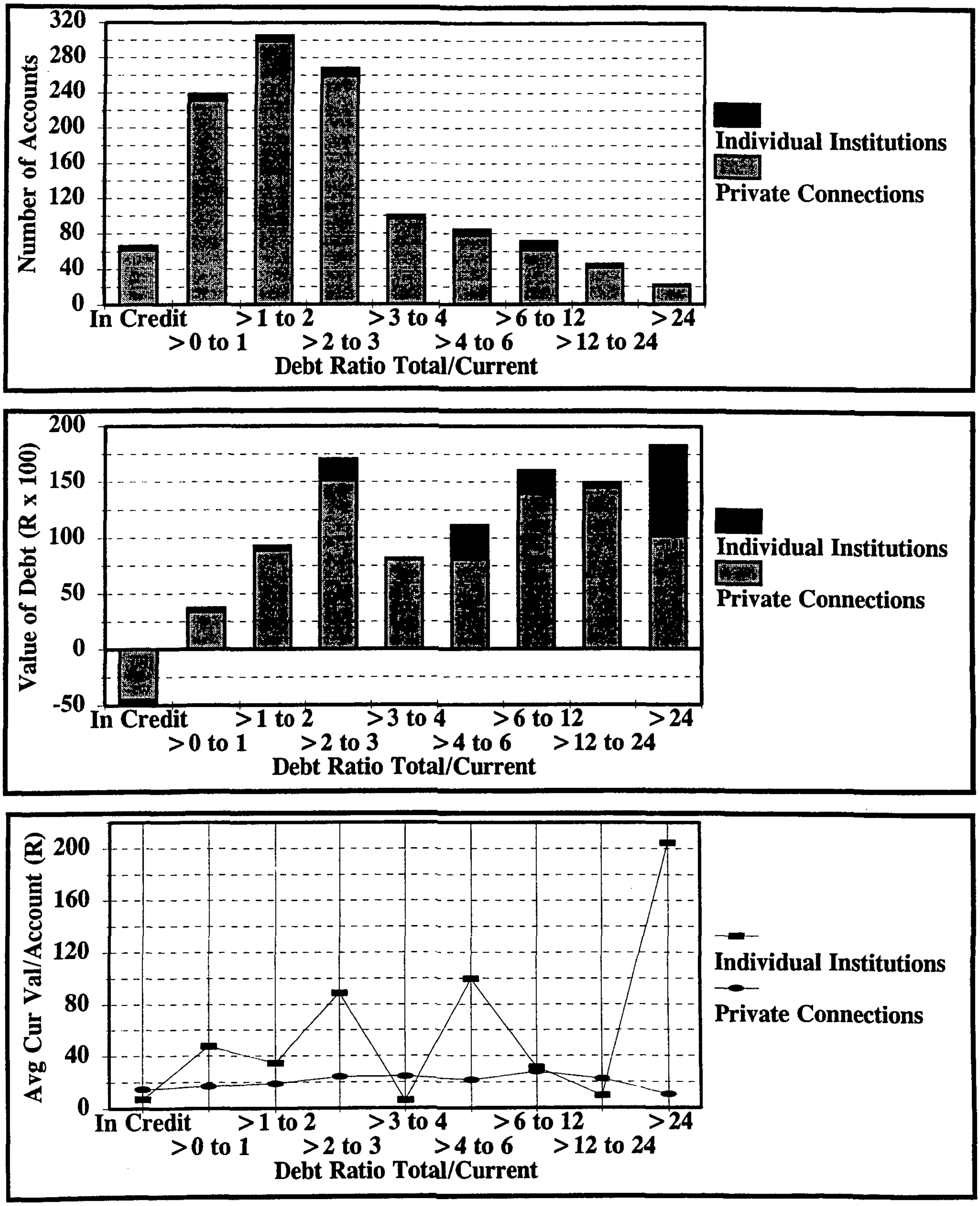


Figure 4.1: Frequency and value distribution of debt ratios for private connections and individual institutions for developing community customers supplied by Umgeni Water

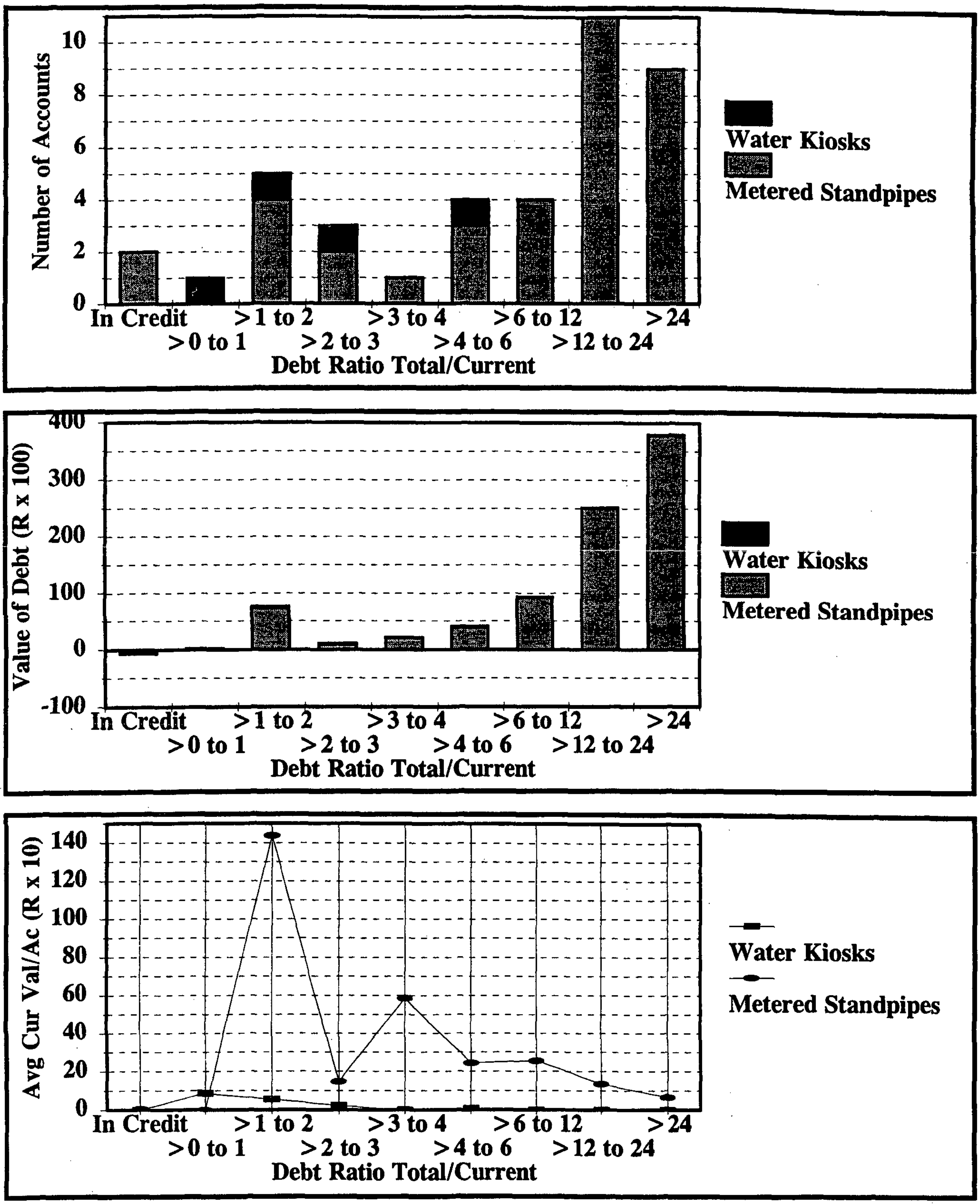


Figure 4.2: Frequency and value distribution of debt ratios for metered standpipes and water kiosks for developing communities supplied by Umgeni Water

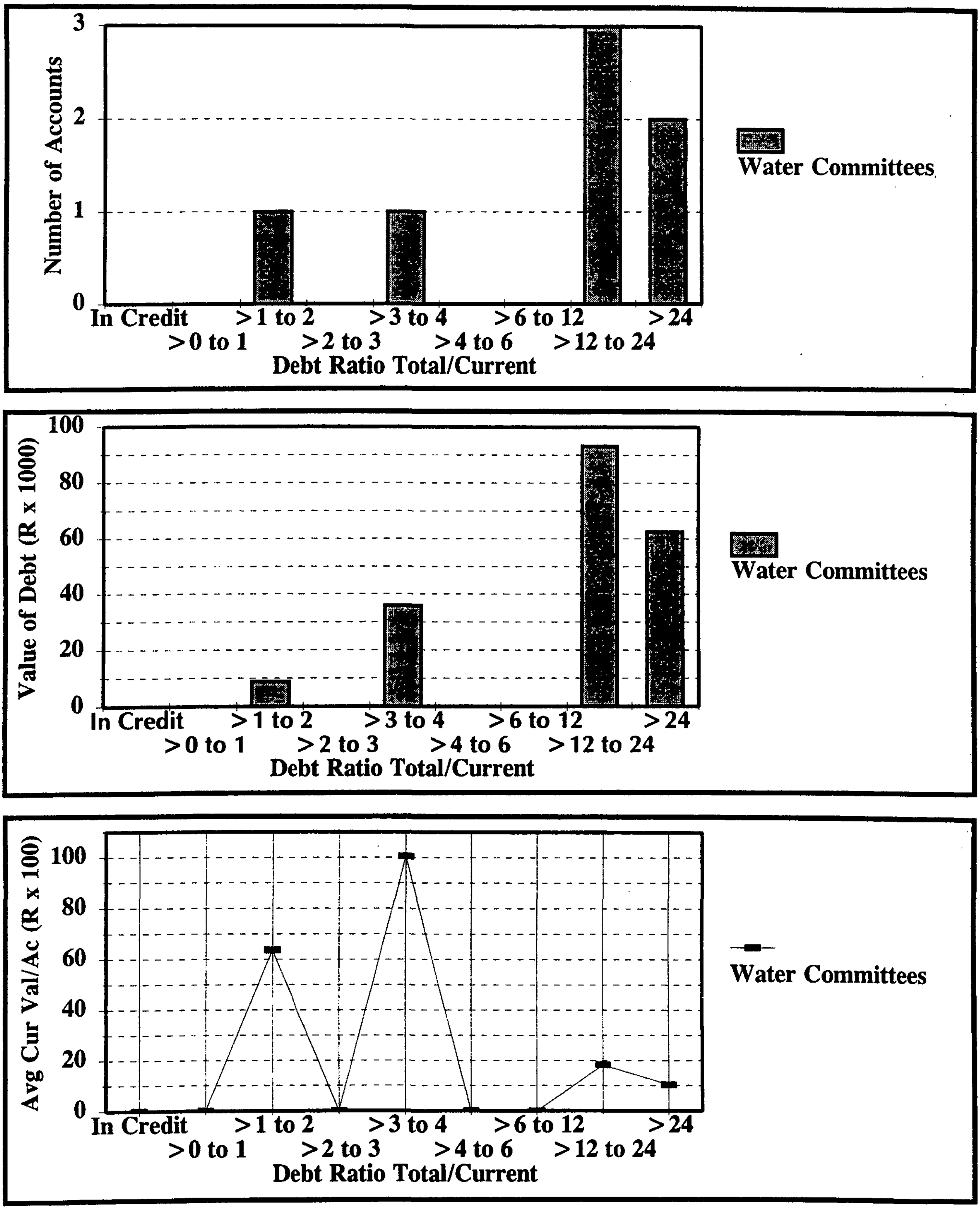


Figure 4.3: Frequency and value distribution of debt ratios for village water committees representing developing communities supplied by Umgeni Water

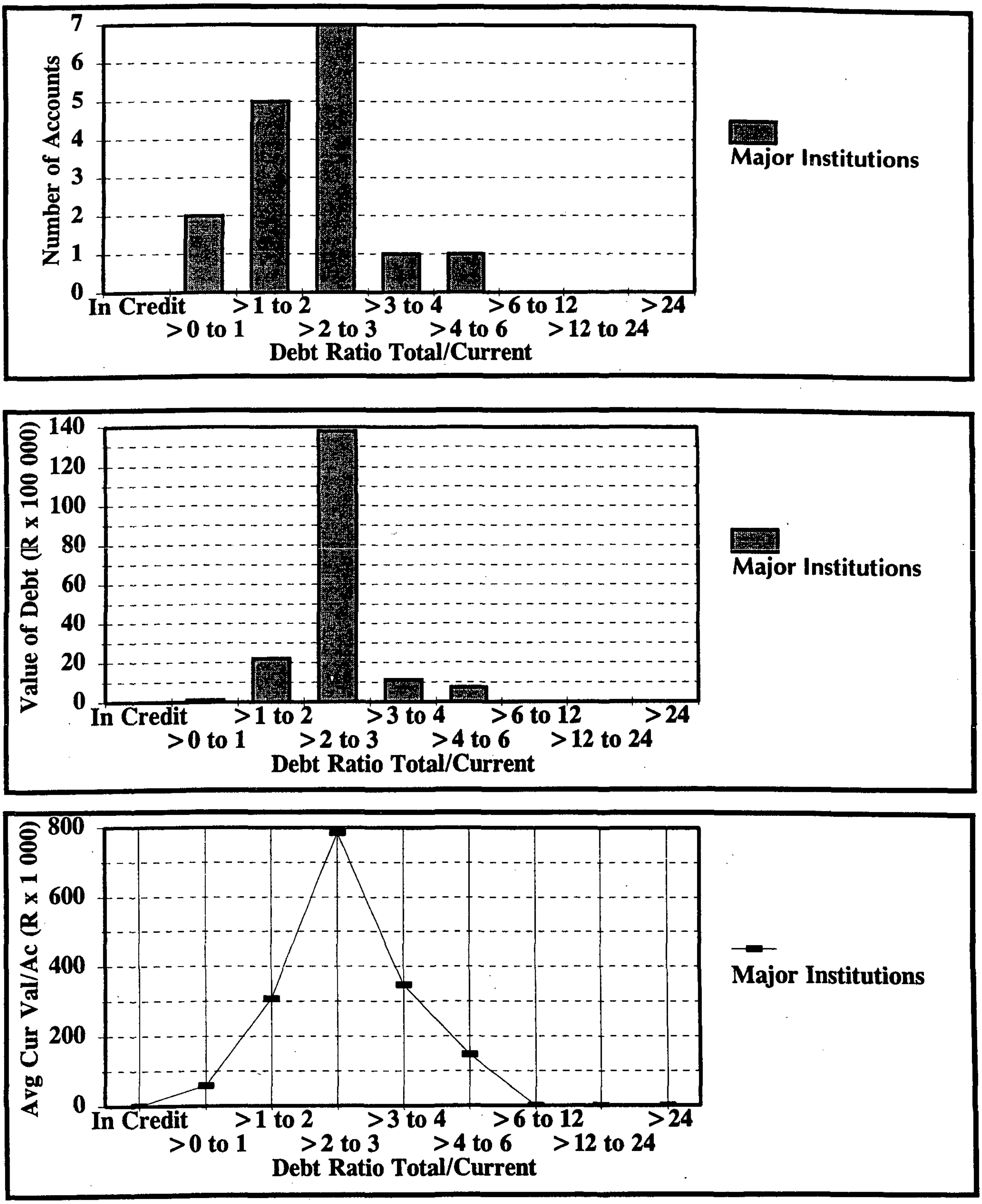


Figure 4.4: Frequency and value distribution of debt ratios for major institutional bulk buyer representing developing communities supplied by Umgeni Water

4.3.2 Metered Community Standpipes and Water Kiosks (Hlapo 1996)

With metered community standpipes the overall control is the responsibility of the Community Water Committee and it is the Committee's responsibility to collect the money from any person they identify to run the standpipe in their name.

For the water kiosk system a water shop is created at a standpipe. The community through its Water Committee identifies a local entrepreneur who is allocated a kiosk. This entrepreneur is responsible for the collection of money for water sold and for the payment of accounts to Umgeni Water. The tariff paid at the kiosk is set with Umgeni Water's advice with the aim of making whole exercise worthwhile for the entrepreneur whilst keeping the price within what the customers will accept.

The disadvantage with these systems is that to be economically viable they should be positioned in such a way that the number of households using each standpipe or water kiosk is large enough to enable the attendant to earn sufficient income without charging the customers too high a tariff for the water. However the population density of the peri-urban communities served by Umgeni Water are generally low. As a result people would have to walk too far if the standpipes or kiosks were spaced in this manner. With the densely populated areas associated with the informal settlements close to the larger cities these systems would be more viable except that they also have a low acceptance by customers because of the limited and often irregular opening hours. Official opening hours for water kiosks is from 06:00hrs to 08:00 hrs and from 16:00hrs to 18:00hrs seven days per week. Many Water Committees used the same opening hours for their community standpipes. Because of low acceptance these systems become prone to vandalism in unstable communities. Therefore no more are being constructed by Umgeni Water and they are gradually being phased out.

Figure 4.2 clearly shows the lack of service provided by the 4 remaining kiosks as well as showing the relatively good payment history of the entreprenurs in charge of them. Figure 4.2 also shows the good service and payment situation in relation to four of the metered standpipes (that is the four with a debt ratio of > 1 to 2) suggesting that in the correct environment such systems can work well. However the general picture is unacceptable with large debt ratios and low volumes of water sales. Would the picture be any different if Umgeni Water had not put so much faith in extending the number of private connections? Yes to an extent, but it should also be remembered that the move to private individual household connections was due in part to the problems already being encountered with metered community standpipes. On the other hand we now know more about the costs and problems associated with private connections and thus the need for various levels of service. Metered community standpipes may therefore have to be revisited with more commitment to capacity building, with ongoing monitoring and support, and with newer cost recovery methods such as community coupon dispensers similar to the unit described in the next chapter of this report. The placement of metered community standpipes off public streets in household yards, with the agreement of the resident household, could also be considered.

4.3.3 **Metered Shared Standpipes** (Hlapo 1996)

This model relates to an intermediate level of service between a metered community standpipe and a private connection. The main difference between a shared standpipe and a community standpipe is that shared standpipes are in the name of individuals who control them and are fully responsible for them whereas community standpipes are usually in the name of a Water Committee which controls them and is responsible for them. Shared standpipes are situated in the responsible persons yard rather than in a public place. The shared standpipe system is based on the idea that the individual responsible will be known to the families that obtain water from his/her standpipe and that these families will know each other. Although similar to community standpipes, shared standpipes are generally placed closer together with fewer customers per per standpipe. The responsible individual keeps a list of all the families that obtain water from his/her standpipe. The idea is that as families get enough money to get their own private connections they will do so and thus eventually leave the shared standpipe as the private connection of the person responsible for it, since it is placed in his/her yard. Community Water Committees often help in identifying suitable individuals to own shared standpipes but, like water kiosks, the owner is always responsible for managing it and paying the bills.

Shared standpipes are operated in two ways. The standpipe owner can either sell water at a profit or divide the bill equally amongst the households that get water from his/her standpipe. When water is sold at a profit each household pays according to its water usage and generally this appears to work well subject to the comments made below. When households agree to share the bill equally problems often arise if the bill is larger than expected as households with fewer dependents start complaining that they are cross-subsidising those with larger families. However whatever decision is taken, it is taken by the standpipe owner and the householders getting their water from that standpipe without either the Water Committee or Umgeni Water influencing them.

Early information from Umgeni Water indicated that these standpipes were working well with a high level of acceptability and applicability. Where household connections were not installed, it was suggested that such standpipes would be the order of the day as they would replace both community standpipes and water kiosks. It was also intimated that they would do away with the need for the introduction of community coupon dispensers.

However further investigations have indicated that this may not be the case. Some Umgeni Water officials believe that outstanding debts from these standpipes are high and that Umgeni Water is having difficulty in cutting off the supplies since in most cases customers claim they have paid for their water. There have also been occasional reports of a customer insisting on being given water without paying. If standpipe owners are not paying their debts there must also be some questions with respect to the service they are giving. Are the opening hours significantly better than with the water kiosks? Do they ever try to charge an unreasonably high price for the water they are selling? It is difficult to prove the success or otherwise of shared standpipes because they are not registered separately and therefore appear as private connections in Umgeni Water's analysis of debtors. In the meantime Umgeni Water is encouraging Water Committees to be more careful in identifying prospective shared standpipe owners. Also two new schemes, Kwandengezi and Nwabi (a temporary scheme) where funds did not allow for private connections will be made up almost entirely of shared standpipes and Umgeni Water will monitor them closely to get a better understanding of this method of water supply and any cost recovery problems which may arise.

4.3.4 Private Individual Household Metered Connections

The meters are read monthly. Invoices are sent to each individual household by Umgeni Water.

Initially there were problems with new consumers refusing to pay the minimum rate bill before they had consumed any water. This occurred because originally once a meter was installed Umgeni Water started billing the owner before he had connected any supply to it. Owners regarded this as unfair and often refused to pay. Now negotiations between Umgeni Water and the owner are more carefully conducted, meters are installed nearer the property owners boundary fence and a few months grace is allowed to give the owner time to take water onto his property.

Since then payments for water usage by owners of individual household connections has been acceptable to Umgeni Water although from figure 4.1 we can see the situation is not perfect. It has been reported that consumers with individual household connections are proud of receiving their accounts each month and when they don't pay it is because of an acute shortage of cash. This can happen through owners of such connections selling water to neighbours and then spending the money. Athene Gerber of the Coastal Region has reported that when the consumption from household connections increases from between, say, 4 to 7 kℓ/mth to between 7 to 14 kℓ/mth this is a warning sign that bills may not be paid. On enquiry it transpired that on these occasions nobody in the household had any work and household members purposely sold water just to get some income hoping that at least one household member would get work before the bill had to be paid. These are the circumstances in which Umgeni Water is reporting in excess of 80% recovery overall despite their dissatisfaction with other methods of cost recovery.

Umgeni Water has no doubt about the willingness of customers to make every effort to pay for the high level of service achieved with private connections on schemes where Umgeni Water has been involved in the reticulation of water to the community and to date actual recovery levels for household connections have probably been in excess of 90% long term. However there are indications that the cost of cost recovery for these connections is high and table 7.3 of this report shows that full operating and maintenance costs are not recovered from any of Umgeni Water's community schemes. Therefore for private connections there is no money available with current tariffs to pay for the redemption of capital as required by Government policy (DWAF 1994 p. 19: Government will only subsidise the cost of construction of basic minimum services) without some form of cross-subsidisation.

Although Figure 4.1 indicates that 73% of customers (877 out of 1199) pay their accounts within 90 days (and Umgeni Water estimates that eventual write-offs with respect to private connections are under 10% of the revenue collected) it also indicates that there are a significant number of customers from whom obtaining payment is problematic. Some of these are customers whose bills were above average and have now reduced their consumption to pay off their debt whilst others are those whose water has already been cut off and are therefore currently being billed the R5,70/mth minimum charge. As suggested in the last section problematic customers may also include some owners of shared standpipes.

In June 1993 only about 10% of households for a representative selection of communities had household connections even when schemes without any household connections are disregarded. Would a 90% level of recovery still be achieved if all household had such connections. Therefore, despite the very high level of acceptability of metered household connections by community members, is it wise to accept metered household connections as the most appropriate option for developing urban community water supplies when costs are so high and there is no assurance that the current high level of recovery can be sustained at a higher level of coverage even with current water tariffs?

4.3.5 Community Operated Water Supply Systems

Such community or local government operated water supply schemes are the long-term aim of Umgeni Water. For such schemes a locally elected Water Committee is responsible for the governance and thus for organising the management of the reticulated pipework, the collection of revenue from community members and the payment of the bulk water delivered by Umgeni Water.

Schemes operated is this way are QadiNyuswa, Lower Ngcolosi, Mpolweni (2 accounts), Inqunqulu, Embo and Mseleku. These schemes are also owned by the communities since they were built by them with assistance from NGO's. Umgeni Water only became involved when the communities experienced difficulties and asked it to assist. Table 4.1 indicates that the total value of the current months account for these 7 schemes is just under twenty four thousand rand and that the total to current debt ratio for these accounts averaged 8,37 in June 1994. Whilst this ratio is poor and not significantly different from the ratio for metered shared standpipes reference to the detailed source file and figure 4.3 indicate that the ratios for two of them, QadiNyuswa and Ngcolosi, which account for 68% of the current debt are 1,39 and 3,57 respectively. These two communities do sometimes seek advice from Umgeni Water to solve their maintenance problems but otherwise have maintained a high degree of self-reliance and consistently maintain a surplus with which to pay for their bulk water supplies indicating close on full financial self-sufficiency .

The acceptability to the consumers of the manner in which these schemes are operated and cost recovery is implemented is unknown but the consistent existence of an operating surplus would indicate a satisfactory level of approval in two of them and confirms the claims in the literature that the higher the level of community participation the greater the possibility of sustainability. Two out of seven schemes is not a particularly good record but it should be seen against the figures in table 7.3 indicating the degree of subsidisation required by the schemes managed directly by Umgeni Water.

4.3.6 Community Water Supply Systems Operated by Major Institutions

Figure 4.4 completes the picture by indicating the frequency and value distribution of debt ratios for water supply systems operated by major institutions. Whilst this figure says nothing about the moneys collected from the end users or the total subsidy per kℓ paid from other sources required to sustain these systems it does highlight the unacceptability of the other profiles particularly with reference to the "value of debt" distribution and indicates the sort of profile required to keep any water service provider in business. Figure 4.4 can therefore be used for setting final targets that are to be achieved over time with adequate capacity building, ongoing monitoring and support, appropriate levels of service and the best cost recovery methods.

5.1 INTRODUCTION

Two new methods of cost recovery were studied in the course of the project. These methods were:-

* distributed storage regulating units, and
* community coupon water dispensers

The results obtained from studying these methods of cost recovery are discussed below.

5.2 THE DISTRIBUTED STORAGE REGULATING UNITS

5.2.1 Principle of operation

Each household is supplied with a 200 ℓ storage tank fitted with a simple fixed head orifice which allows a definite MAXIMUM water usage per month. The fixed head orifice comprises a small rectangular tank fitted in the top of the storage tank (refer figure 5.1). The inlet to this small tank is fitted with a float valve connected to the main water reticulation system. The small tank's only outlet is a small orifice screwed into its end wall close to the bottom. Thus, regardless of the main reticulation system pressure, the float valve allows water into the small tank at the same rate as water flows out through the orifice into the 200 ℓ storage tank. As indicated in table 5.1 the size of orifice dictates the inflow rate and hence the allowable households consumption level. The orifice can be replaced easily after removing the sealed lid of the 200 ℓ storage tank. This allows the householder to ask his/her water service provider to alter the allowable monthly water consumption at short notice.

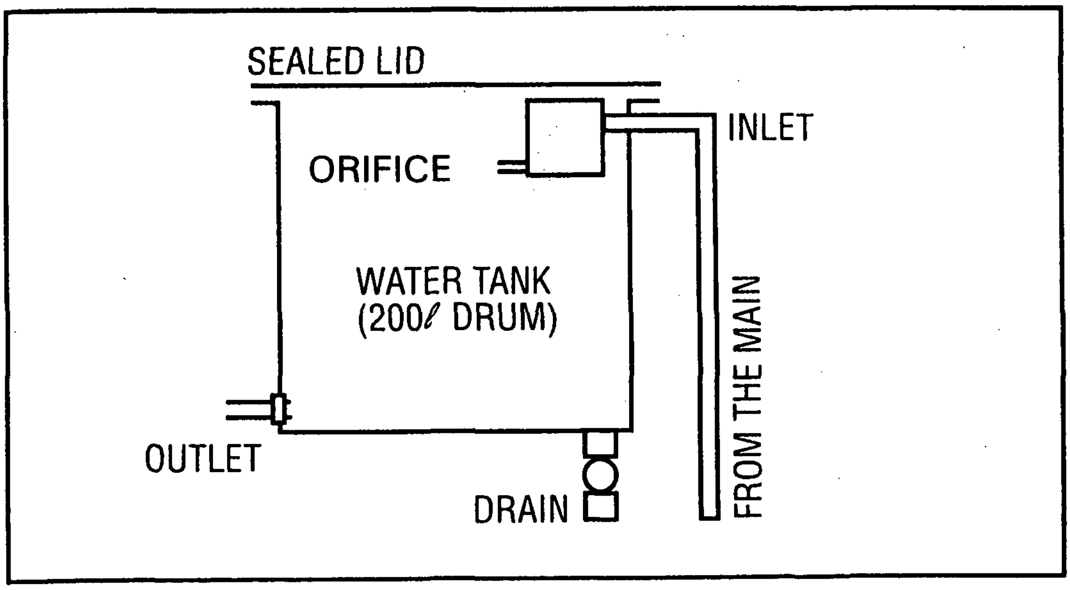


Figure 5.1: 200 ℓ storage tank fitted with a regulating orifice

The units have been designed for low to medium demand supplies. Demands of up to 500 ℓ/day (15 kℓ/mth) can be handled regardless of the skewness of the daily demand curve. As the demand rises from 500 to 750 ℓ/day (15,0 to 22,5 ℓ/mth) the maximum daily demand that a unit can handle is effected by the skewness of the daily demand curve. Figure 5.2 shows the effects of the skewness of the daily water demand curves on the quantity of water stored in the unit at any given time.

Figure 5.2 plot 1 reflects a demand of 500 ℓ/day with the unit fitted with an orifice just capable of supplying the full demand at a steady rate of 21 ℓ/hr. Between 5 and 8 in the morning the demand curve is shown as being extremely steep with the maximum demand in a single hour being 6 times the average daily demand; that is with 125ℓ being consumed by the household between 6 and 7. But despite the fact that the orifice, as depicted, is only just capable of supplying the full demand at the average daily demand rate the unit does not run out of water.

Figure 5.2 plot 2 reflects a similar situation. The demand and the supply orifice again match but the demand is 50% greater at a rate of 750 ℓ/day. At this higher demand a unit with a storage capacity of 200 ℓ is capable of handling a maximum to average demand of 3 to 1, but not much more. Hence the opening statement that the unit has been designed for low to medium demand household supplies.

It should be noted that whilst in both the graphical examples the orifice size matches the total daily demand exactly, in practice the orifice selected should be sized to cater for approximately 1,20 times the household's average daily demand.

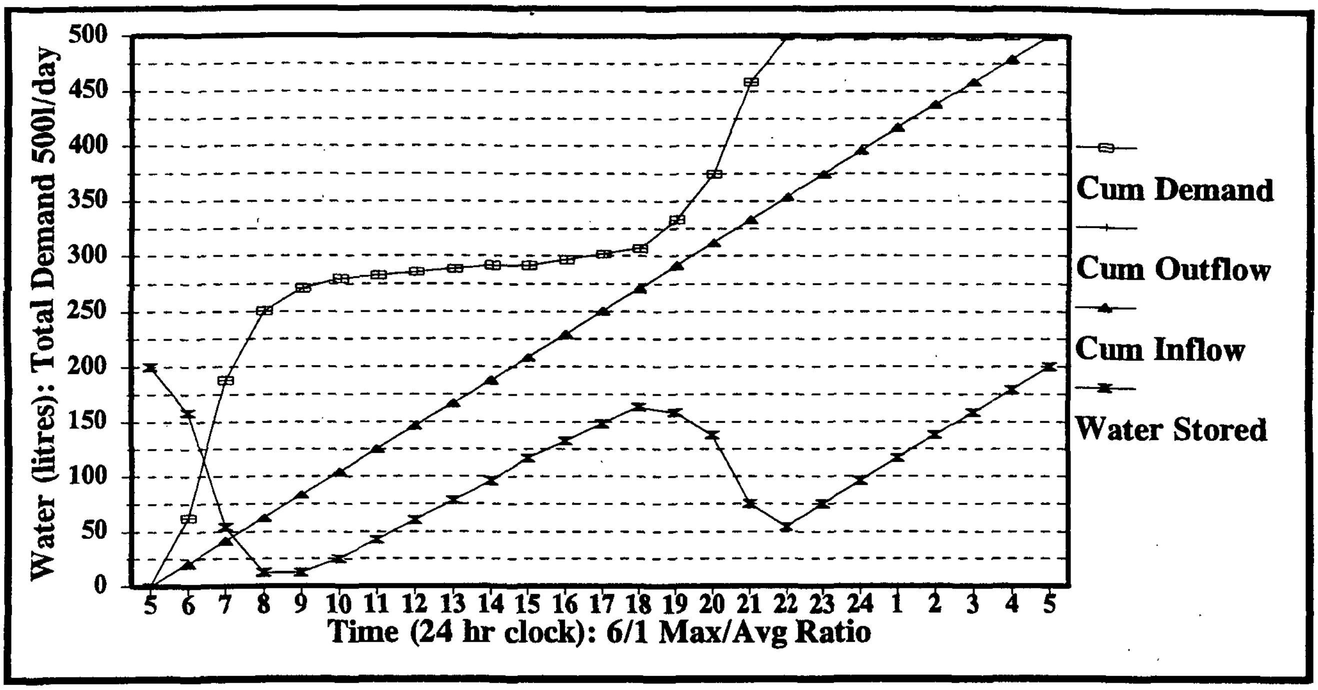
5.2.2 Advantages of distributed storage units to the customer

Having a more reliable water supply because of the buffer storage capacity and because of a lower peak demand in the system as a whole.

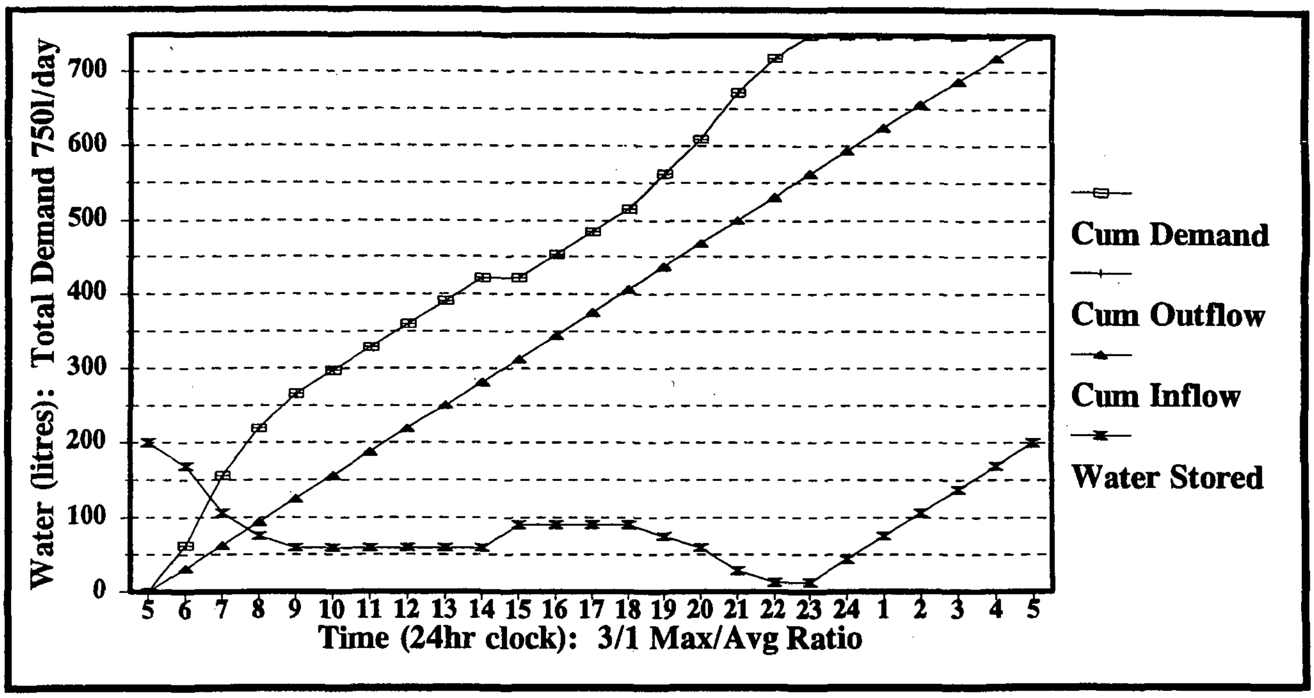
Because of the advantages to the water service provider, having the possibility of obtaining water at a cheaper rate.

Because of the regulating device, having the possibility of paying a fixed amount each month for water used.

Any water losses or taps left running beyond the unit will not cause surprise high water bills but only a temporary shortage of water until the unit fills partially again. This shortage in turn will be a timeous reminder to the customer that water is being wasted on the property and should result in an overall water saving.



Plot 1: Daily demand and cumulative inflow 500 ℓ: unit can supply a 6/1 max to avg demand ratio



Plot 2: Daily demand and cumulative inflow 750 ℓ: unit can supply a 3/1 max to avg demand ratio

Figure 5.2: The effect of tank capacity and demand skewness on the maximum daily demand which can be supplied by a distributed storage regulating tank (to be read in conjunction with the last four paragraphs of section 5.2.1)

5.2.3 Disadvantages to the customer

The possibility of the water demand not being fully catered for during big gatherings such as a wedding or a funeral. As described in section 5.2.1, it is not difficult to remove and refit the orifice. Thus before such a gathering it would be practical for the water service provider to remove the orifice for, say, 2 or 3 days and charge the consumer a fee for removing and replacing the orifice and for the use of an additional quantity of water.

When paying the fixed amount per month, the customer may be concerned that his bill is being based on his maximum possible consumption rather than his actual consumption.

It is not possible to put a pressure hose on the outlet to wash a car or to water a point in a garden higher than the point at which the unit is installed.

5.2.4 Advantages to the water service provider

The use of distributed storage units has the potential to reduce both the capital and general operating costs of new schemes by producing a smoother daily demand curve. Umgeni Water's 1995 installed cost for a household metered connection was R853-00. The corresponding cost for a distributed storage unit was R554-00.

As well as being used for new installations distributed storage flow regulators can also be used with advantage to upgrade existing installations which are able to supply a community's maximum daily water demand but are unable to supply water at its peak hourly demand rate.

However for developing urban communities the greatest potential savings are probably to be realised by doing away with individual water meters, the reading thereof and the billing of individual consumers. Bills are not required since consumers pay a fixed monthly charge based on the size of orifice installed in their unit. For community managed schemes the bookkeeping associated with fixed monthly payments is much easier than the bookkeeping associated with monthly meter readings. (Refer also to chapter 9)

5.2.5 Possible disadvantages to the water service provider

Maximum possible reduction in the capital costs when designing a system exclusively for use with distributed storage units may limit the systems fire fighting capabilities

Although a well designed reticulation system for use with distributed storage units will operate at lower overall working pressures and therefore help to reduce water losses when leaks do occur it may be more difficult to trace them by the low night flow method for example.

If a consumer insists on a water meter being installed with a distributed storage unit that meter will have to be installed downstream of the unit if accurate readings are to be registered. Table 5.1 shows typical incoming flow rates to distributed storage units. When combined with the notes on domestic water meters contained in appendix "A" this table serves to warn water service providers of the danger of the likely under registering that can take place if water meters are installed on the inlets to distributed storage units.

Table 5.1: Typical incoming flow rates to distributed storage units

Orifice Size	Household's Consumption Level	Maximum Inflow Rate	Maximum Inflow Rate	Final Inflow Rate
mm	ℓ/day	ℓ/day	ℓ/hour	ℓ/hour
1,5	135	171	7	0 - 7
2,0	240	304	13	0 - 13
2,5	380	474	20	0 - 20
3,0	545	683	28	0 - 28
3,5	745	930	39	0 - 39

The final inflow rate refers to any period of time during which the unit is filling and the orifice is submerged. The differential head across the orifice during this period can range anywhere between zero and 140 mm depending on what level the water in the unit is at between being completely full and the orifice being just un-submerged.

5.2.6 Installation

When used with yard taps the unit is installed on a small plinth at the site chosen for the yard tap. Refer figure 5.3 which depicts how the test units were installed.

When used with house connections the units should be installed with the bottom of the tank at ceiling level either in/on the roof or on a separate stand outside the house.

5.2.7 Possible developments

Having a larger storage tank to cater for demands in excess of 750 ℓ/day, especially if consumers wish to use one tank to supply a number of households. Currently more than one tank can be connected in series when more storage capacity is required. A flow regulator sized for the higher demand is then fitted in the first tank and the other tank(s) are used for storage only.

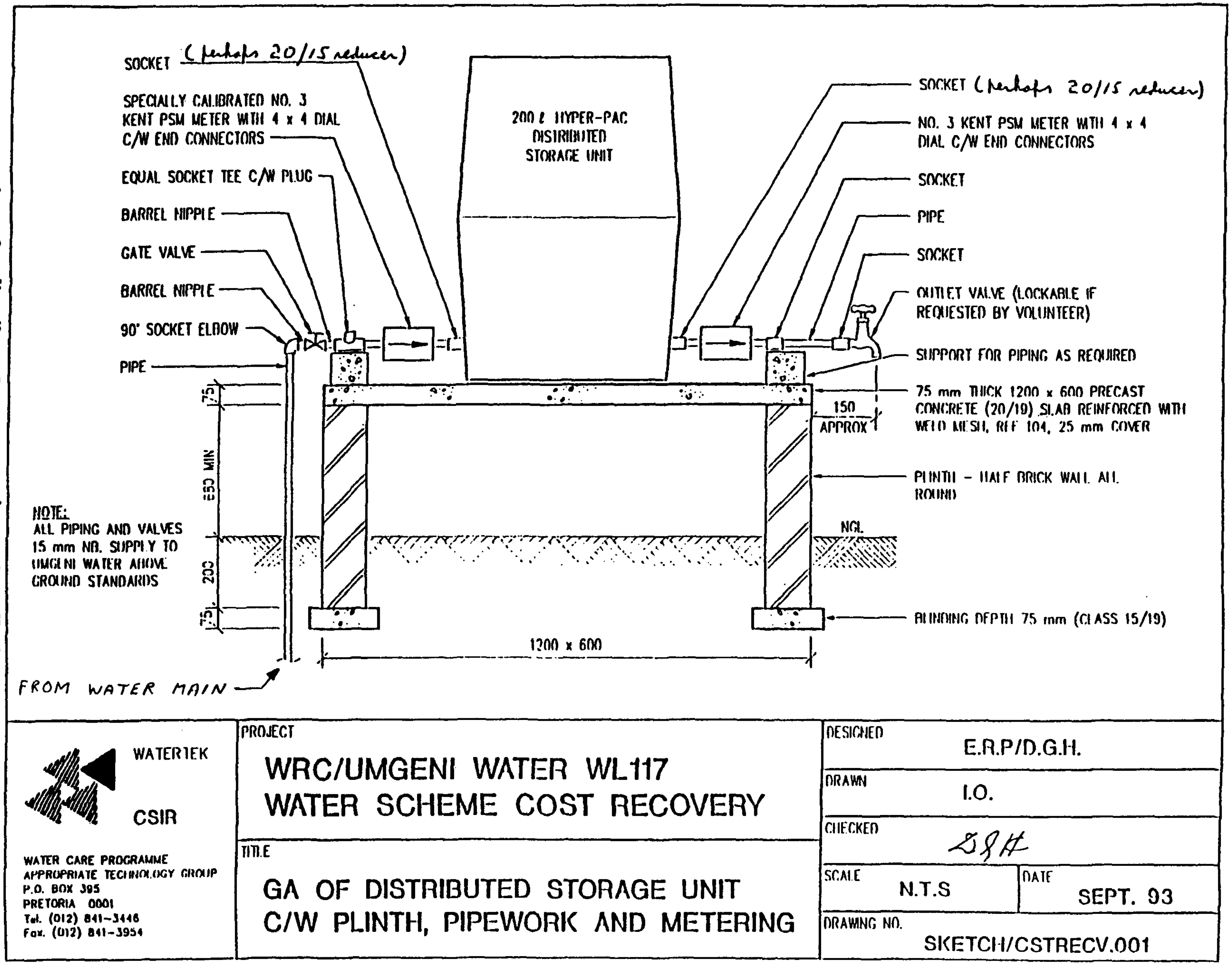


Figure 5.3: Drawing of a distributed storage unit <u>test</u> installation

5.2.8 Tariff charges

Using a tariff of R3,00 /kℓ the resulting fixed monthly charge to consumers with a distributed storage unit would be as shown in table 5.2, dependent on the size of orifice fitted to the unit.

Table 5.2: Relationship between orifice size and a consumer's monthly tariff
(Based on a tariff of R3,00/kℓ and the household's assumed consumption level rather than the maximum possible inflow rate for the unit)

Orifice Size	Maximum Inflow Rate	Household's Consumption Level	Water Tariff per Month
mm	ℓ/day	ℓ/day	R - c
1,5	171	135	12,00
2,0	304	240	22,00
2,5	474	380	34,00
3,0	683	545	50,00
3,5	930	745	68,00

Note the tariff has been calculated using the household's assumed average daily water consumption level rather than the maximum possible inflow. If the tariff were calculated using the maximum possible inflow 25% would have to be added to the monthly tariffs recorded in table 5.2.

5.2.9 Test installations

A total of ten test units were installed. They were all installed at households who already had yard taps and they were installed as an additional water source in the household's yard rather than as a substitute installation. Figure 5.3 is a drawing of how the test units were installed. Commercially installed units would not have the pressure test point tee on the inlet nor either of the test flow meters. Four were installed in Sweetwaters situated just beyond the Pietermaritzburg suburb of Blackridge, five in KwaXimba to the North of Cato Ridge on the road to Nagle Dam and one in Ezitendeni near Hammersdale.

5.2.10 Consumer acceptability

All households responded positively to the units installed. They spoke about liking the fact that water leaves the units at a steady rate no matter what time they are turned on. The yard taps may have a low pressure at peak demand times and at others splash all over the place as soon as they are turned on.

Two households queried the temperature of the water leaving the unit indicating that a white lid and perhaps even a white tank would be preferred. Durban Water and Waste have however reported that a white tank can cause algae growth in the tank due to the penetration of ultra-violet light. They recommend tanks be fitted with a more opaque lining or moulded with a silver pigment which still leaves the tanks cool but prevents the ultra-violet light penetration (Stevens 1996). The old yard taps are still valued by some households as a means of watering vegetable gardens with a hose

After the ten test units had been installed neighbours also requested that units be installed on their properties, again indicating a high degree of acceptance.

On another 1992/93 old Lebowa Government controlled CSIR project in the Eastern Transvaal 2 000 distributed storage units were to have been installed on a community water supply upgrading scheme. The installation of the units was discussed with a representative group of household heads before installation commenced. About 100 units were installed and enthusiastically accepted by the households concerned. Subsequently the youth of the dense settlement complained that the Government was installing a device not seen anywhere in the Developed Urban areas of South Africa and that it was therefore, irrespective of it merits, totally unacceptable to them. Despite the strong objections of their seniors and the householders who already had the units the scheme in that form had to be abandoned.

Until distributed storage are well-known and accepted as a common method of water supply in South Africa, wider consultation and the installation of a few demonstration units is recommended before implementing a full scale project.

The question of the acceptability, to consumers, of a fixed monthly tariff was not addressed adequately during the project. The general idea was seen as attractive but a few of the households did register suspicion and asked why they should pay for their water on the basis of the maximum amount they could consume rather than their actual consumption. They wanted confirmation that the installation of the units would result in their paying lower bills rather than higher ones. Because of the lower pressure and no splashing they were also convinced that their actual consumption would be less rather than higher than before.

5.2.11 Water service provider acceptability

Umgeni Water showed little interest in the concept at the beginning of the project. Later interest grew but was tempered by the technical evaluation reported in 5.2.13.

Umgeni Water's lack of interest at the beginning of the project may well have been influenced by the CSIR Project Leader's tendency to think in terms of one scheme with all metered yard taps and another with all distributed storage units. Mixed schemes, with a variety of options available to the consumer depending on his/her level of consumption and ability to pay, would now seem the most applicable option and the most acceptable to all parties.

5.2.12 General Applicability

Figure 5.4 shows the orifice size which would be required by the households of Fredville, Georgedale, Ntshongweni, Sankontshe, Sweetwaters and KwaXimba who in June 1994 had private connections with an established demand for a period of at least six months. The figure after the community names represent the sample size. The total sample size was 1847 households.

Section 5.2.1 explains the effects of a high maximum demand on the unit whilst section 5.2.8 indicates the daily water consumptions which can be catered for by different orifice sizes. Thus regardless of the skewness of the households demand curve the standard 200 ℓ unit is suitable for orifice sizes up to and including 3 mm whilst provided the household maximum demand ratio does not exceed 3 to 1 the same unit is suitable for use with a 3,5 mm orifice. For higher demands which require an orifice size larger than 3,5 mm a larger storage unit would be required or alternatively two of the standard units would have to be installed in series.

This means that the standard unit is suitable without qualification for nearly 80% of households with private connections in these communities and that a further 8% could use a standard unit provided the skewness of their demand does not exceed 3 to 1. The remaining 12% of households would require a non standard installation.

The Water Supply and Sanitation Policy White Paper published in Cape Town in November 1994 defines 6 criteria which must be satisfied before a person can be said to have access to a basic water supply. The first of these is quantity and under this heading it states: "25 litres per person per day is considered to be the minimum required for direct consumption, for the preparation of food and for personal hygiene". It is not considered to be adequate for a full, healthy and productive life which is why it is considered a minimum basic service provision. If one assume an average of 7 persons per household the minimum supply which should be considered is 7 x 25 = 175 ℓ/day.

To achieve this basic service provision requires the installation of a distributed storage unit with a 2,0 mm orifice, whilst double the figure, 50 litres per person per day, can be supplied by a unit fitted with a 2,5 mm orifice and three times the figure, 75 litres per person per day, by a unit fitted with a 3 mm orifice: all demands which are ideally suitable for supplying with standard distributed storage units. Sadly, 22% of the households in the communities analysed had demands below the minimum basic service provision defined in the White Paper.

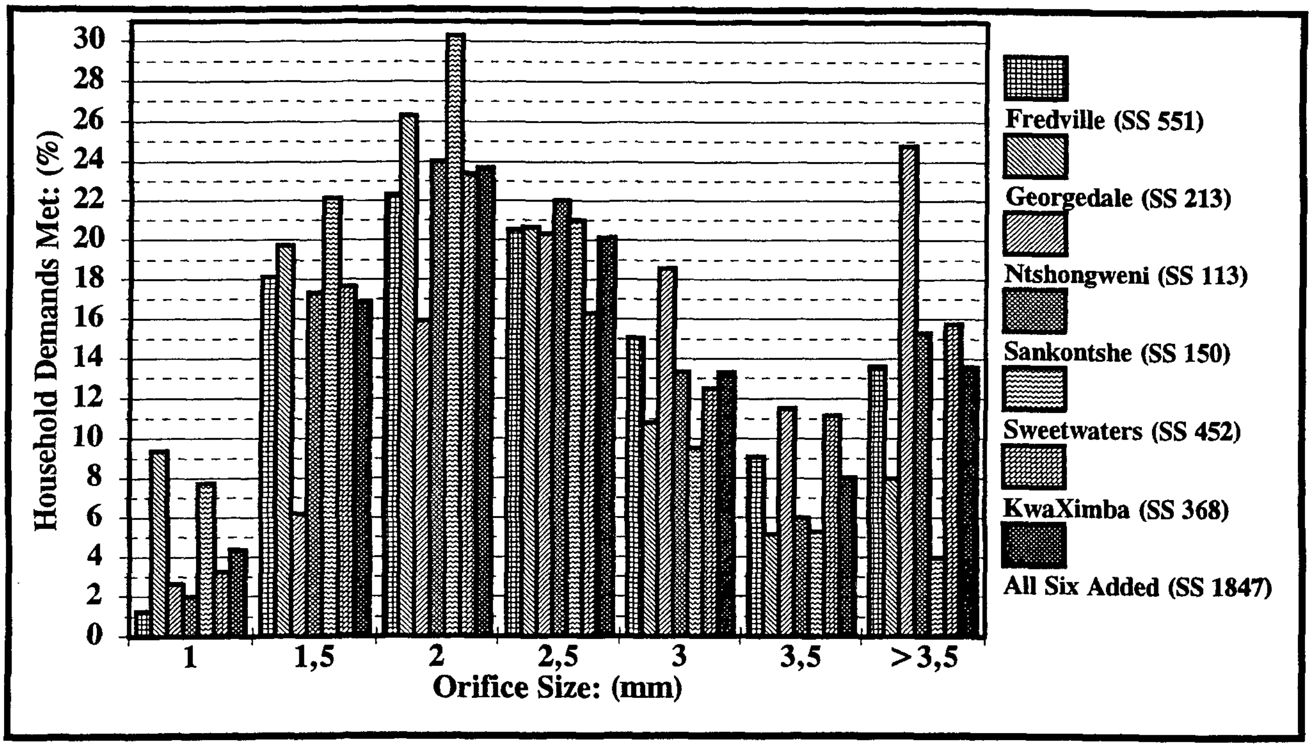


Chart 1: Orifice size which would satisfy the water demands of different households in different villages

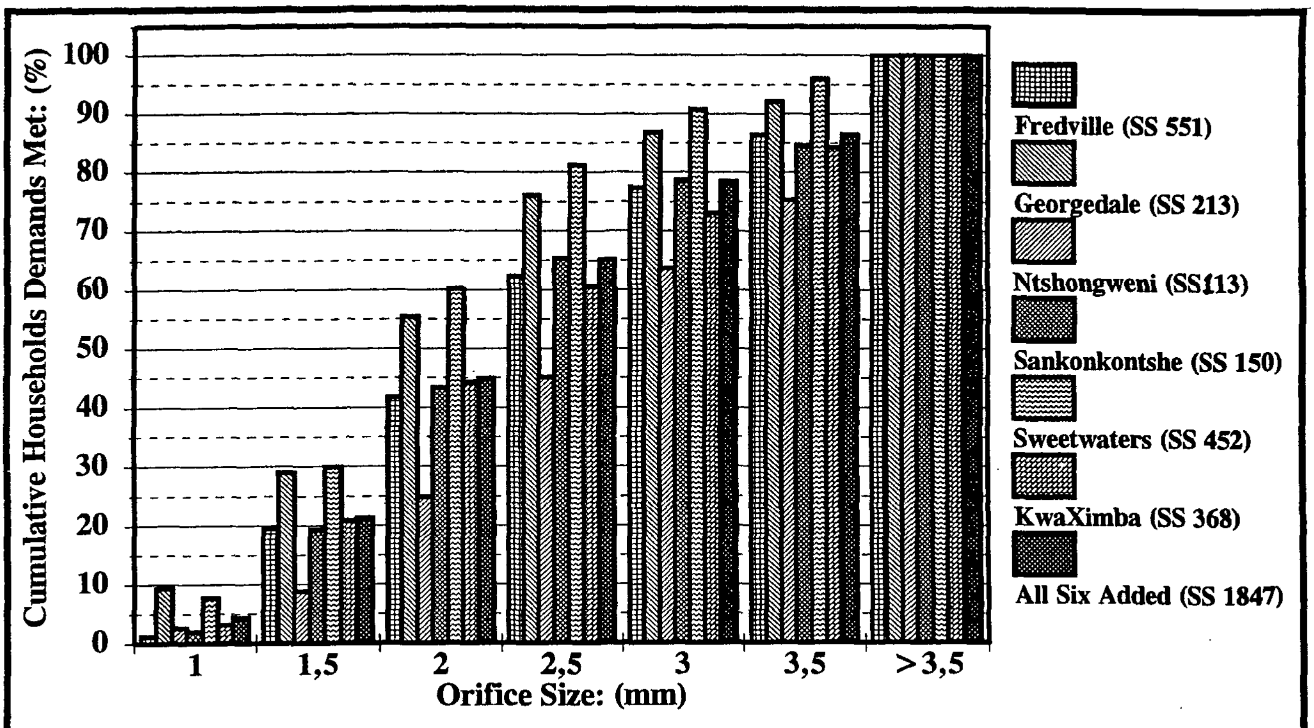


Chart 2: Cumulative demands which would be satisfied by different orifice sizes in the same villages

Figure 5.4: The general applicability of distributed storage units in six villages in the Umgeni Water supply area (to be read in conjunction with the section 5.2.12)

5.2.13 Technical evaluation of the units installed

When the lid was removed from a unit, for inspections purposes, for example, the inner small tank housing the float valve and the orifice sometimes fell into the 200 ℓ tank. Whilst this is not a critical issue, it may have contributed to the failures of the clamped piping reported in what follows.

The internal piping of the units, as installed, was clamped on to the internal fittings. The clamp is designed for a maximum working pressure of 1 000 kPa. There were no problems with the clamped piping on 8 out of the 10 units. The clamped piping on one of the units which was operating at a pressure of 800 kPa during the day came apart at one of the clamped joints during the night within a month of being installed. This piping was re-assembled and gave no further trouble. The remaining unit had been in operation six months when the internal piping came apart, also during the night. After re-clamping the pressure was checked during the day and measured 1 200 kPa, 20% above the maximum working pressure. After the re-clamped piping came apart a second time after two and a half months the test on this unit was terminated by the CSIR.

After approximately 9 months the float valves on the units, which are designed for a maximum working pressure of 2 000 kPa, were not sealing tightly. Although the water loss was minimal, the result was a wetness around the lid and around the base of the unit on top of the plinth. The area around the plinths was hardly affected. However on three of the units the wetness around the lid attracted insects, mainly cockroaches. There was no indication that the insects got inside the units.

The valve supplier, Mr Deryck Brooks of "Aqua-Brooks", Roosevelt Park, Gauteng, was approached in connection with the leakage. He confirmed that the valves as supplied incorporated two changes from earlier models. The seat valve seat had been altered from a knife edge to an inverted "U" with a 3 mm radius to prevent the valve seat being damaged in areas of frequent freeze and thaw conditions. In addition the seal material had been changed from natural rubber to Santoprene because of problems in sourcing natural rubber sheeting of consistent thickness. With the 3 mm radius inverted "U" valve seat the thickness of the seal material became more critical. They subsequently found that the Santoprene developed a compression set in excess of 2,5 times that experienced with natural rubber. In our application, the permanent setting of the Santoprene rubber was made worse by the fact that the valves were continuously sealing at the same point due to the low flow through them. The valves are designed to allow the seal to rotate but this only happens close to the fully open position.

The Santoprene seals were then changed for natural rubber seals and after a further 12 months no further leakage was reported. In the meantime "Aqua-brooks" have changed the valve seat to an inverted "U" with a 0,5 mm radius which is still tolerant to freeze and thaw conditions but allows for easier sealing. Also having tested EPDM seals and found that, because of a similar compression set as was experienced with Santoprene, the valves "showed signs of weeping after six months" "Aqua-brooks" have reverted to using natural rubber seals once again after instituting controls to ensure the thickness is to specification. It is anticipated that the current design of valve will be suitable for the distributed storage units.

During installation, the standard plug valves supplied with the units were changed to standard globe valve units. Two reports were received of the seal on globe valves not lifting when a valve was opened because of the low head on the valve. For complete reliability only valves without a lifting seal should be used.

The manufacturer of the distributed storage units used for this project has gone into liquidation. The new CSIR franchiser has made a number of small improvements to the unit. Internal piping is screwed rather than clamped. The small inner tank housing the float valve and the orifice is fitted in a manner that prevents it falling into the 200 ℓ tank even when the lid is off yet, if required to examine the float valve or the orifice, it can be removed easily. The lid seals more hygienically. The newly designed lid has been specifically designed to prevent insects from entering the unit. The new manufacturer has also manufactured units with a white tank and a white lid as favoured by two of the volunteer households, however also refer section 5.2.10.

To keep insects away from the unit altogether it may still be worthwhile designing a screened overflow for the units which would carry any overflow water away beyond the top of the plinth. Apart from this suggestion of an overflow, the currently manufactured distributed storage unit design seems well suited for its intended use.

5.3 THE COMMUNITY COUPON WATER DISPENSERS

5.3.1 Principle of operation

The community coupon operated water dispenser comprises a tank inside which there is a second small tank with a capacity of 24 ℓ. This 24 ℓ tank is filled through a simple float operated valve. A second float indicates when the unit is full. Once the 24 ℓ tank is full the consumer releases this water by placing a coupon in a chute and pushing down on a lever mounted on the outer tank. As the water is released the coupon drops into a padlocked collector box which can be removed from the back of the unit.

In the meantime the float valve re-opens to re-fill the inner tank. Thus the cycle may be repeated as long as the dispenser is connected to a water supply.

5.3.2 Advantages of the unit

The justification for designing the unit was to replace the current water kiosk system by a unit which is open 24 hours per day and does not require an attendant.

Coupon operated dispensers are less likely to be vandalised for the contents of the collecting box than coin operated dispensers.

5.3.3 Disadvantages of the unit

Unless a large number of units are installed, the average distance a customer has to travel to fetch water is likely to be further than when privately operated metered shared standpipes are installed.

The units dispense the 24 ℓ very quickly. However it does take approximately 3 minutes to fill the unit through the float valve. This is partially because as currently designed, with the float valve in the main dispensing unit rather than in a third pilot container which only fills when the 24 ℓ container is full, the final filling through the float valve is slow. At periods of peak water usage this filling period will cause longer queuing times.

As currently manufactured from stainless steel the installed cost of community coupon dispensers is approximately R 2 100-00. Each coupon costs an additional 40 c to manufacture. Therefore the loss of coupons whilst being circulated could add significantly to the operating costs.

5.3.4 Technical evaluation

Only one test unit was installed for the study. It was installed in a private yard of a householder who operated a metered shared standpipe. Two mechanical problems manifested themselves with the unit: it sometimes damaged the brass tokens so that they could not be recycled and clever customers managed to obtain more than one inner tank full of water using only one coupon. A mark II unit was installed within 3 months which ably solved these two problems. Everyone including the clever customers were smiling until a more serious problem manifested itself: if a customer was in a hurry or because of queuing clients decided not to wait until the 24 ℓ container was completely full and helped himself to water over a short range at approximately 20 ℓ the unit did not reset itself. The result: when the next clients came to fetch water their coupons were accepted by the unit but when the lever was pushed down no water came out. Before the standpipe owners life was threatened or the unit was vandalised it was removed and design of a mark III commenced.

Two mark III units have been built. They are simpler than the mark I and mark II units having fewer moving parts to fail. However in the mark I and the mark II units the moving parts were all small whilst in the mark III unit it is the 24 l container which tips and resets itself. During works testing it operated well but the rocking movement as the empty container returns to reset itself is quite fierce. Evans 1992 p. 28 does warn about the "great sensitivity of coin-operated taps to breakdown and interference" The mark III units have not been field tested because of a shortage of funds.

5.3.5 Acceptability

As far as can be judged from the limited experience gained from a single unit, acceptance by both the customers and the unit operator was high. Umgeni Water prefers privately operated metered shared standpipes since they are cheaper to install and maintain and there are no coupons to distribute. Umgeni's experience of shared standpipes is however limited and their effectiveness needs to be monitored further. Refer also section 4.3.3.

6.1 INTRODUCTION

Non revenue producing or unaccounted-for water (UAW) can be caused by:

* leakage from the system,
* overflowing reservoirs,
* pipeline bursts,
* the flushing of pipelines,
* free water usage by local authorities,
* under registration of water meters,
* non payment of accounts,
* not reading or under reading of water meters,
* under billing due to accounting errors or incorrect book entries,
* new authorised connections never being entered in the billing system, and
* unauthorised connections and usage

Leakages from the system, overflowing reservoirs and pipeline bursts cause real water losses. Leakage losses can be from the pipes themselves, or from pipe joints and fittings or from the reservoirs. These losses usually occur underground and, even when significant, they can go undetected for months or even years. Overflowing reservoirs and pipe bursts can be seen and therefore the severity of losses from these sources largely depend on the co-operation of consumers and on the overall efficiency of the responsible caretaking and maintenance management structures in noticing wastage and in dealing with it.

The flushing of pipelines, free water usage by local authorities and the under registration of water meters can all be controlled by the reticulation managing authority. However, flushing and free water usage cannot be controlled without metering this water and the under registration of water meters cannot be controlled without planned maintenance and periodic checking.

Non payment, under billing, unauthorised connections and unauthorised water usage all relate to practices which are regarded as criminal in well ordered democratic societies. However in the past, and even today, water reticulation management and revenue collection from developing communities have been, and still are, poorly practised. Thus neither the owners of unauthorised connections nor their neighbours consider these connections to be illegal. As a result there is an urgent need to set up local civil service type structures, answerable to democratically elected water committees or local government, to manage local water supply schemes and reticulation. Thereafter, once these local structures have the support of the communities they are serving, the unauthorised connections should be regularised without further delay.

The setting up of effective local structures requires an enabling environment supported by the higher tiers of the government and the civil service. This support requires a more widespread belief in the feasibility and practical value of local democratic governance and management than is currently visible, and a significant shift in the allocation of resources, including quality human resources, time and money, for capacity building and training. "Training is one of the factors which will determine whether or not the objectives of the Government . . . . will succeed in the implementation of the Reconstruction and Development Programme. . . . . Although training is not cheap, the costs of project failure are far greater" (DWAF 1994, p. 17).

6.2 WHY CONTROL IS ESSENTIAL

6.2.1 Background comments

Control of unaccounted-for water is essential for satisfactory cost recovery, for the sustainability of water supply authorities and for keeping the long term price of water low.

Water leakage from a system is equivalent to a retail green-grocer buying too much stock and throwing the excess away before it has even been put on the shelves for sale. Unauthorised connections are equivalent to pilferage and under-registering meters to ringing up too little money on the till. All these are examples of trading practices which if not controlled stringently will put the trader out of business.

Some unaccounted-for water is supplied to every distribution system. In 1992, 225 local authorities in South Africa reported water distribution losses of approximately 200 000 Mℓ (Official SA Municipal Yearbook 1993). Actual unaccounted-for water supplied by local authorities is several times this figure. If the 200 000 Mℓ is valued at R1-50/kℓ, the cost of the reported distribution losses to the local authorities was R300 million.

6.2.2 Keeping the long term price of water low

When unaccounted-for water is allowed to rise the demand on existing schemes exceeds capacity earlier than it should. This necessitates additional capital investment at an earlier date. Because of inflation this increases the average cost of water delivered. In addition it often means exploiting more difficult water resources further away from the demand which pushes up the average cost of water even more. Hence the reason for stating in the first paragraph of section 6.2.1 that the control of unaccounted-for water is essential for keeping the long term price of water low.

6.3 UNACCOUNTED-FOR WATER IS HIGHER FOR DEVELOPING URBAN COMMUNITIES THAN FOR ESTABLISHED URBAN COMMUNITIES

Regardless of whether the bulk water is supplied by one authority and reticulated by another or the bulk water is supplied and reticulated by the same authority, additional revenue has to be raised from the end user to cover the supply, treatment and reticulation of the unaccounted-for water.

In the case of water schemes supplying developing urban communities the unaccounted-for water is intrinsically a higher percentage of the bulk water supplied than is the case for schemes supplying established urban communities. This is because of the lower average demand per connection. In chapter 3 it was reported that the average household water consumption for a typical established urban area is $34m^3$/mth whereas for developing urban communities in the Umgeni planning area the average household consumption for families with house and yard connections is only $14m^3$/mth. Authorities responsible for schemes associated with established urban communities are well satisfied provided unaccounted-for water losses do not exceed 10% of the bulk water received. As the average consumption from such schemes is 2,4 times that of schemes supplying Umgeni's developing urban communities it is to be expected that non revenue water losses from these latter schemes will be about 24%. This hypothesis is well born out by the analysis of four of Umgeni's better run schemes reported in section 6.6 below.

As will be demonstrated in section 6.7.2, having more shared connections is one way of reducing unaccounted-for water in developing urban communities through bringing back the demand per connection to a level similar to that of established urban communities. More shared connections will however also reduce the total water used by a community.

6.4 DESIGNING, CONSTRUCTING AND COMMISSIONING SCHEMES

It is often assumed that rigorous quality control for the design, construction and commissioning of schemes supplying developing urban communities is unnecessary because of the low water demand from such schemes. But control of non revenue water starts with these phases of a project. Therefore material specifications should be for materials that will last. Where applicable, consideration should be given to preventing excessive pressures in pumping mains by boosting rather than generating all the head at one base station. Similarly, for gravity mains intermediate reservoirs or pressure reducing valves should be considered. Quality control should continue during construction and finish with a 48 hour pressure test during commissioning. Partially because such quality controls are generally not carried out, losses, excluding unauthorised connection losses, of approximately 50% are common on schemes supplying developing urban communities.

6.5 ONGOING MONITORING OF SCHEMES

Ongoing monitoring should also be carried out by monthly water balances and by checking night flows and patrolling the pipelines for leaks and unauthorised connections regularly. Acoustic techniques can be used for locating non visible leaks. Apart from the pipelines themselves and their outlet connections, all pressure reducing valves and water meters should be maintained at a high level.

6.6 WATER LOSSES IN UMGENI WATER SCHEMES TO DEVELOPING URBAN COMMUNITIES

6.6.1 Introduction

As early as 1982/83 Umgeni Water has been involved in the construction and management of reticulated potable water supply schemes to rural and peri-urban communities in its area of supply. The schemes, all gravity standpipe schemes off Umgeni Water's potable bulk water pipelines, were installed after requests for assistance were received from community leaders through local magistrates. By the end of 1990, 14 rural and peri-urban were complete and in operation.

During this period, more attention was directed to establishing suitable cost recovery methods, with very little focus on UAW. As the number of schemes increased and some of the existing schemes reached capacity it became imperative for Umgeni Water to pay closer attention to better water supply management and to controlling UAW. In addition, the recent extension to Umgeni Water's area of jurisdiction has resulted in an increase in the number of developing rural and urban communities that need to be supplied by Umgeni Water. This has also contributed to more focus being given to dealing with additional challenges that other water distributors are familiar with.

Thus, as these water distributers will know, control of UAW entails the continual repetition of a series of simple, logical processes and tasks to obtain increasingly accurate detailed data in order to facilitate decision making on more efficient measures of control. In achieving this objective Umgeni Water has embarked on a program that emphasizes high standards of data capturing and record keeping. Central to this program is the use of a customised management information system, linked to an efficient billing system, to process data for the provision of crucial information for decision making at all management levels.

Leakage control is a responsibility that Umgeni Water shares with its customers. Water Committees are responsible for regular inspection and the monitoring of the system, carrying out minor repairs and reporting the need for maintenance work that cannot be handled at Water Committee level. Umgeni Water's team of reticulation supervisors provide ongoing technical support to Water Committees. The team supervises the installation of new connections and meter reading, and co-ordinate major maintenance jobs and meter repairs.

Universal metering has been fully adopted because of its benefits in monitoring consumption trends that are useful for efficient planning. Use of district metering and telemetry are regarded as the core of the metering strategy for UAW control. There is ongoing education within the company to keep abreast with the latest technology in leak detection and pressure management, with the purpose of evaluating and adopting any aspects that can adequately answer problems that are encountered in the field.

The benefits of a UAW loss control program can only be quantified partially in terms of the value of water saved. Other benefits from such a program are not easily quantifiable in number of rands saved, but are nonetheless real and advantageous to the water authorities. The rapid rising cost of water makes it imperative that utilities demonstrate to the public their commitment to efficiency and conservation. If a utility does what it can to conserve water, customers will be more cooperative in other water conservation programs, many of which require individual effort.

A leak-detection and repair program can reduce the damage that leaking water mains and bursts cause to public and private property. The detailed knowledge gained of potential and existing problems can, through preventative maintenance or replacement, reduce emergency situations and thereby improve productivity. The acquisition and keeping of accurate data is vital for proper planning and implementation of a UAW control program. The knowledge gained by local Water Committees about the condition and operation of valves, meters and other devices in the course of a UAW control program results in the more efficient operation of their water schemes.

Before embarking on any form of active UAW loss control one has to consider the extent to which it is economically and more broadly justified. Thus having checked the extent of UAW and the total cost of UAW, management has to set realistic targets for UAW control. This could be a reduction in UAW from say 12 to 4 kℓ/conn.mth. Costs of UAW control vary greatly depending on: labour costs in the particular area, equipment costs and the initial condition of the system. The initiation of an active UAW control programme can be expected to show a considerable positive return on investment but, as the program is developed and UAW levels are reduced, the results of further effort become less rewarding. The law of diminishing returns applies and thus it is advisable to repeat the cost/benefit analysis at regular intervals using updated expense projections to ensure that any increased efforts are justified. At the same time care must be taken continue the ongoing monitoring of schemes to ensure that UAW levels remain low and do not revert to the levels existing before the control programme was initiated.

6.6.2 Assessment of unaccounted-for water levels within developing urban community schemes supplied by Umgeni Water

In this study four schemes were chosen for an investigation of the levels of unaccounted-for water. Table 6.1 gives a brief profile of the four schemes analysed. As can be seen from the number of people served per connection, there are a large number of yard connections in both Phayiphini and Sankontshe whilst in Ntshongweni and Table Mountain the majority of people are still served by public or privately controlled shared standpipes. Water usage per capita is low for all four schemes but is especially low for Table Mountain.

The water balances for each scheme for each month for the 12 month period June 1994 to May 1995 have been compiled and analysed. The figures for unaccounted-for water were calculated as the difference between total inflow and total metered consumption.

Table 6.1: Profile of the four schemes analysed

Scheme name	Metered usage kl/day	Number of connections	Estimated population served	No. of persons served per connection	Metered usage l/cap.day
Ntshongweni	123	179	11000	61	11
Phayiphini	135	637	7000	11	19
Sankontshe	136	246	5000	20	27
Table Mountain	52	195	18000	92	3

Table 6.2: Umgeni Water: Ntshongweni community monthly water balances 1994/95

Month	Length of retic. km	No of connections	Inflow kl/mth	Metered usage kl/mth	UAW kl/mth	UAW %	UAW per km kl/mth	UAW per connection kl/mth
Jun	12	179	4525	3500	1025	22.7	85.4	5.73
Jul	12	179	4005	3400	605	15.1	50.4	3.38
Aug	12	179	3992	3744	248	6.2	20.7	1.39
Sep	12	179	4399	2495	1904	43.3	158.7	10.64
Oct	12	179	4232	3079	1153	27.2	96.1	6.44
Nov	12	179	5105	4346	759	14.9	63.3	4.24
Dec	12	179	5250	4169	1081	20.6	90.1	6.04
Jan	12	179	5080	4481	599	11.8	49.9	3.35
Feb	12	179	4845	4060	785	16.2	65.4	4.39
Mar	12	179	4562	3639	923	20.2	76.9	5.16
Apr	12	179	4278	3515	763	17.8	63.6	4.26
May	12	179	5388	4527	861	16.0	71.8	4.81

Table 6.3: Umgeni Water: Phayiphini community monthly water balances 1994/95

Month	Length of retic. km	No of connections	Inflow kl/mth	Metered usage kl/mth	UAW kl/mth	UAW %	UAW per km kl/mth	UAW per connection kl/mth
Jun	19	637	3330	2045	1285	38.6	67.6	2.02
Jul	19	637	7030	4303	2727	38.8	143.5	4.28
Aug	19	637	5750	3569	2181	37.9	114.8	3.42
Sep	19	637	4480	3356	1124	25.1	59.2	1.76
Oct	19	637	7310	4256	3054	41.8	160.7	4.79
Nov	19	637	5790	4033	1757	30.3	92.5	2.76
Dec	19	637	4670	4530	140	3.0	7.4	0.22
Jan	19	637	5860	5601	259	4.4	13.6	0.41
Feb	19	637	5760	4831	929	16.1	48.9	1.46
Mar	19	637	6160	4151	2009	32.6	105.7	3.15
Apr	19	637	6510	4175	2335	35.9	122.9	3.67
May	19	637	7140	4705	2435	34.1	128.2	3.82

Table 6.4: Umgeni Water: Sankontshe community monthly water balances 1994/95

Month	Length of retic. km	No of connections	Inflow kl/mth	Metered usage kl/mth	UAW kl/mth	UAW %	UAW per km kl/mth	UAW per connection kl/mth
Jun	6.75	246	6158	4399	1759	28.6	260.6	7.15
Jul	6.75	246	4667	2717	1950	41.8	288.9	7.93
Aug	6.75	246	6461	6038	423	6.5	62.7	1.72
Sep	6.75	246	5128	5033	95	1.9	14.1	0.39
Oct	6.75	246	5203	3749	1454	27.9	215.4	5.91
Nov	6.75	246	4749	3137	1612	33.9	238.8	6.55
Dec	6.75	246	5486	3946	1540	28.1	228.1	6.26
Jan	6.75	246	6596	4188	2408	36.5	356.7	9.79
Feb	6.75	246	6764	5643	1121	16.6	166.1	4.56
Mar	6.75	246	7430	4709	2721	36.6	403.1	11.06
Apr	6.75	246	6958	2467	4491	64.5	665.3	18.26
May	6.75	246	6859	3492	3367	49.1	498.8	13.69

The determination of the correct figure for unaccounted-for water was not easy because frequently, even in fully metered systems like the Umgeni Water systems, un-metered water is used for construction related work and the flushing of pipelines. This volume of water, though put to legitimate use, is not quantified, and is therefore added to the general unaccounted-for water. The high losses for Sankontshe in April and May 1995 (refer Table 6.4 and Figures 6.1 to 6.3 may have been due to such un-metered usage. Another problem in determining the net level of unaccounted-for water was the availability of reliable data that could be readily used with a fair amount of confidence.

Table 6.5: Umgeni Water: Table Mountain community monthly water balances 1994/95

Month	Length of retic. km	No of connections	Inflow kl/mth	Metered usage kl/mth	UAW kl/mth	UAW %	UAW per km kl/mth	UAW per connection kl/mth
Jun	27	195	1950	1323	627	32.2	23.2	3.22
Jul	27	195	1630	1023	607	37.2	22.5	3.11
Aug	27	195	2312	1861	451	19.5	16.7	2.31
Sep	27	195	2041	1645	396	19.4	14.7	2.03
Oct	27	195	2143	1511	632	29.5	23.4	3.24
Nov	27	195	2093	1569	524	25.0	19.4	2.69
Dec	27	195	2253	1617	636	28.2	23.6	3.26
Jan	27	195	1853	1394	459	24.8	17.0	2.35
Feb	27	195	2711	1962	749	27.6	27.7	3.84
Mar	27	195	2650	2022	628	23.7	23.3	3.22
Apr	27	195	1650	1261	389	23.6	14.4	1.99
May	27	195	2230	1642	588	26.4	21.8	3.02

Table 6.6: Umgeni Water: Average tables 6.2 to 6.5 monthly water balances 1994/95

Month	Length of retic. km	No of connections	Inflow kl/mth	Metered usage kl/mth	UAW kl/mth	UAW %	UAW per km kl/mth	UAW per connection kl/mth
Jun	64.75	1257	15963	11267	4696	29.4	72.5	3.74
Jul	64.75	1257	17332	11443	5889	34.0	90.9	4.68
Aug	64.75	1257	18515	15212	3303	17.8	51.0	2.63
Sep	64.75	1257	16048	12529	3519	21.9	54.3	2.80
Oct	64.75	1257	18888	12595	6293	33.3	97.2	5.01
Nov	64.75	1257	17737	13085	4652	26.2	71.8	3.70
Dec	64.75	1257	17659	14262	3397	19.2	52.5	2.70
Jan	64.75	1257	19389	15664	3725	19.2	57.5	2.96
Feb	64.75	1257	20080	16496	3584	17.8	55.4	2.85
Mar	64.75	1257	20802	14521	6281	30.2	97.0	5.00
Apr	64.75	1257	19396	11418	7978	41.1	123.2	6.35
May	64.75	1257	21617	14366	7251	33.5	112.0	5.77

Tables 6.2 and 6.6 and Figures 6.1 to 6.3 contain the full results of the analysis. These results give a good overview of the general levels of unaccounted-for water to be expected from well operated and maintained schemes serving developing urban communities. There are however large variations in unaccounted water and even water used from month to month. These variations are probably partially due to different meters being read on different days of the same month and even the same meters being read on different days on different months. As a result of these monthly variations, this analysis does not reveal which of the three common methods of expressing unaccounted-for water (UAW%, UAW per km or UAW per connection) is best suited for expressing the severity of water losses. In section 6.7 therefore further analysis of yearly unaccounted-for water, averaged for the calculation of monthly losses, is undertaken for a number of schemes to investigate this aspect specifically.

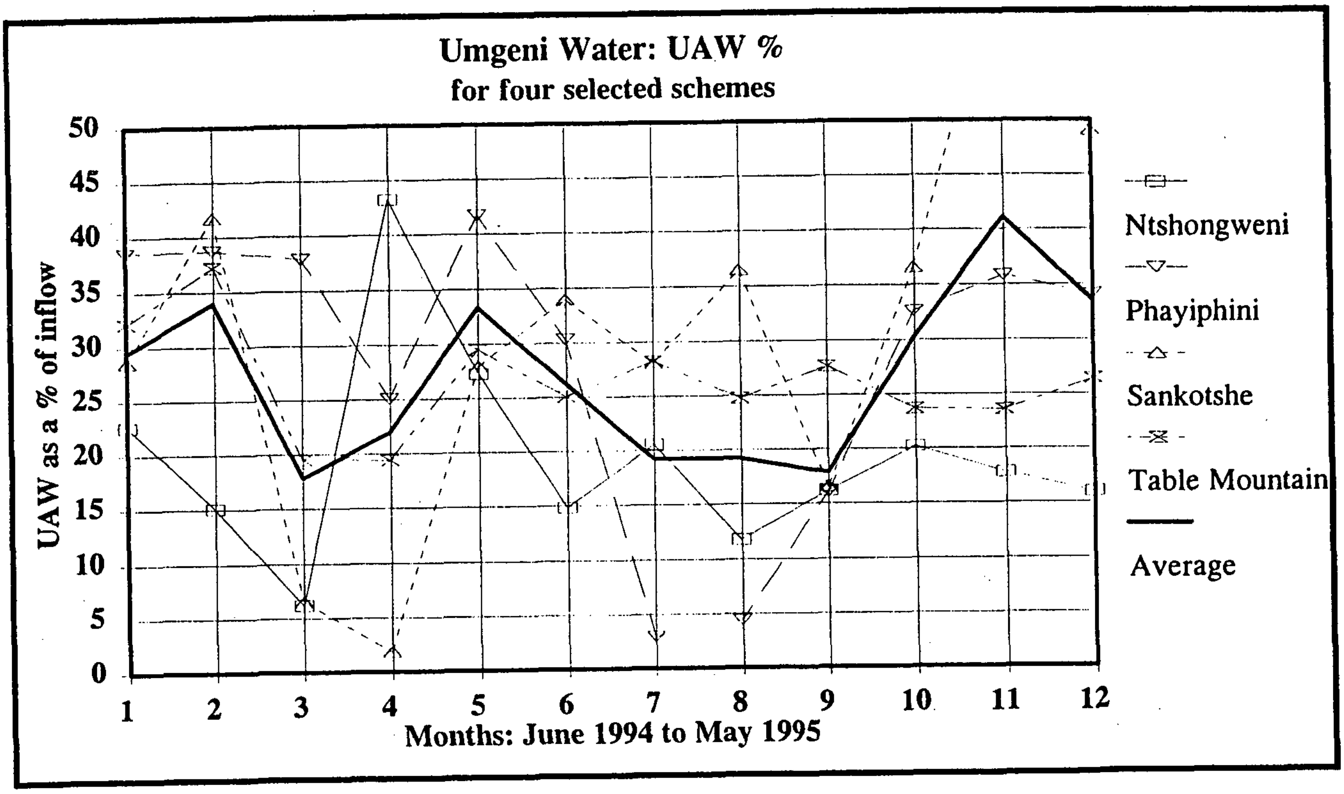


Figure 6.1: Levels of UAW % for four Umgeni Water peri-urban schemes

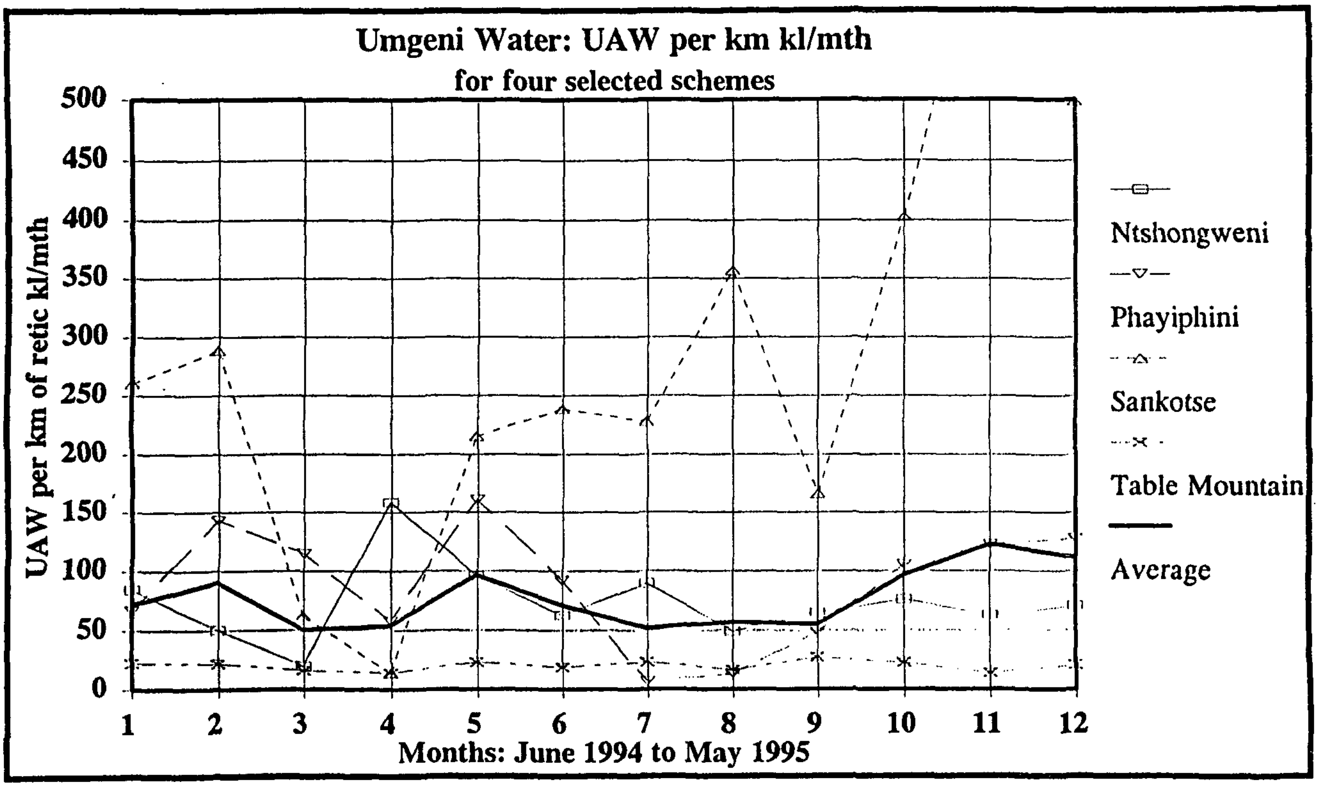


Figure 6.2: Levels of UAW per km for four Umgeni Water peri-urban schemes

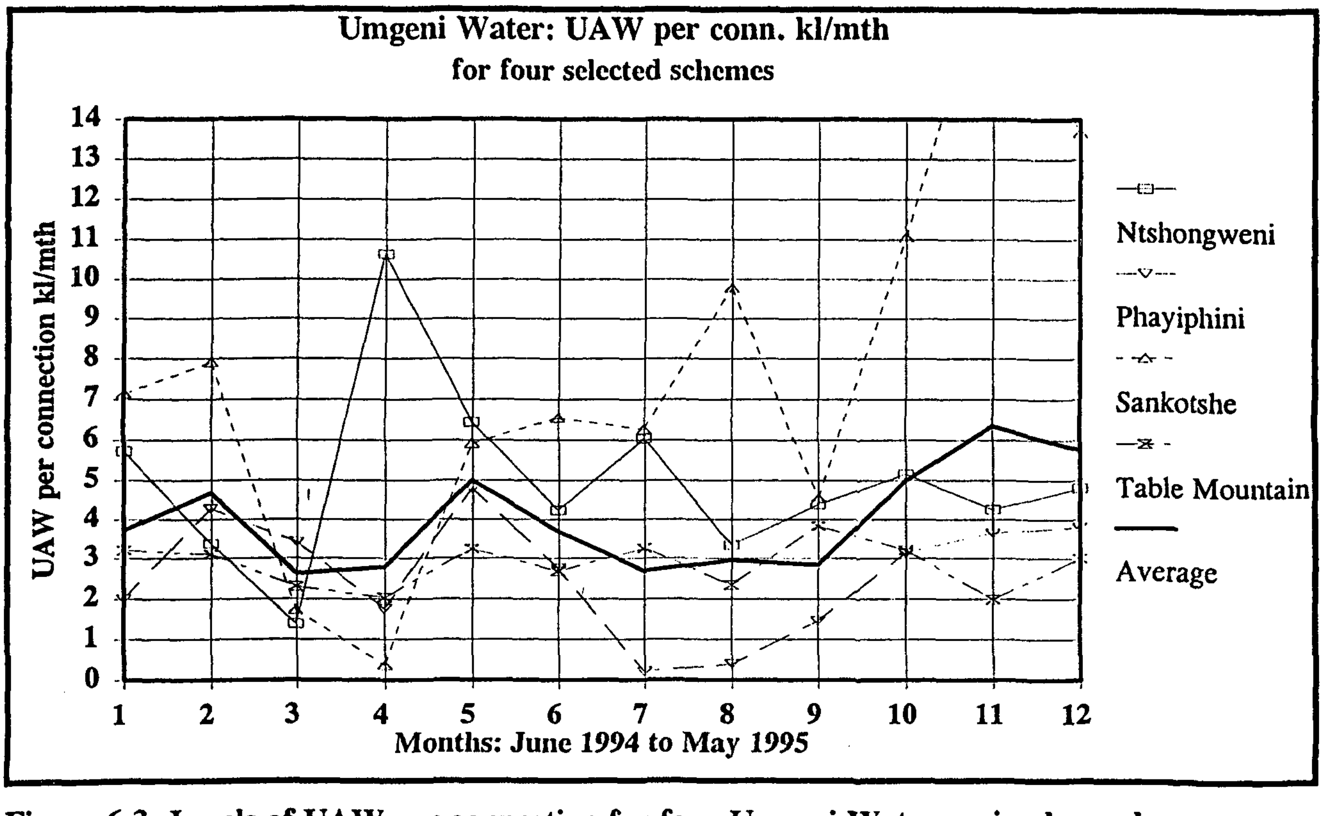


Figure 6.3: Levels of UAW per connection for four Umgeni Water peri-urban schemes

6.7 CHOOSING UNITS IN WHICH TO EXPRESS THE SEVERITY OF UNACCOUNTED-FOR WATER

6.7.1 Norms

The causes of unaccounted-for water are summarised in section 6.1 above. High levels of unaccounted-for water are caused by poor quality control during the implementation of a scheme and ongoing poor operating and maintenance management. But some unaccounted-for water is a reality in every distribution system. Common sense would suggest that these inherent losses will be a function of pipeline length and the number of connections and will be largely independent of levels of water usage although some small increase could be expected at lower levels of water consumption due to increased water pressures in the system.

In the developed world pipeline length has generally been taken as the most important factor contributing to unavoidable losses and an internationally accepted norm for such losses in urban areas is 500 to 700 kℓ/km.mth. Assuming 80 connections per km and an average water usage of 35 kℓ/mth this norm converts to a loss of 15 to 20% which general agrees with the figures quoted for established communities in South Africa although it may be a little on the high side for well maintained schemes. (The figure of 500 to 700 kℓ/km.mth is equivalent to 685 to 959 ℓ/km.hr.)

In section 6.7.3 the factors contributing to inherent UAW levels over a wide variety of water schemes in South Africa is examined. From this examination it is concluded that, at least for newer installations, water losses per pipeline length are negligible, that is approximately equal to zero kℓ/km.mth. Thus relating UAW to losses per pipeline length for schemes serving developing urban communities is often completely worthless. As far as can be determined, for the wide variety of well maintained local schemes examined UAW is exclusively related to losses per connection. In addition, losses of 3 to 6 kℓ/conn.mth can be adopted as a norm for expressing acceptable UAW levels for a wide variety of schemes to both developing and developed communities. For example, again assuming (80 connections per km and) an average water usage of 35 kℓ/mth per connection, 3 to 6 kℓ/conn.mth converts to a loss of 8 to 15% which is achievable for newer schemes. For a developing community with say (15 connections per km and) an average water usage of 14 kℓ/mth per connection the 3 to 6 kℓ/conn.mth converts to a loss of 18 to 30% which is achievable but only for well designed, constructed, maintained and managed schemes.

Contrary to expectations it was also determined that UAW per connection did tend to decrease for low water usage per connection and increase for larger usages per connection. If this more accurate determination of UAW per connection, depicted in figure 6.7, is used for the above example of a developing community with a usage of 14 kℓ/mth acceptable UAW levels would vary between 3,1 and 4.3 kℓ/conn.mth which converts to a loss of 18 to 24%,thereby giving closer limits to what is likely to be achievable through good design, construction, maintenance and management.

The more accurately determined acceptable losses per connection, depicted in figure 6.7, become 4.1 to 5.3 kℓ/mth for the water scheme serving a typical developed urban community with 80 connections per km and a water usage of 35 kℓ/mth per connection. This converts to losses of 328 to 424 kℓ/km.mth. Therefore using the internationally accepted norm of 500 to 700 kℓ/km.mth for acceptable total UAW, it can be concluded, tentatively, that acceptable losses per km due purely to the leakage from the reticulation pipework of **old schemes,** excluding connections, is 172 (500-328) to 276 (700-424) kℓ/km.mth.

6.7.2 UAW levels for nine local water schemes compared

Table 6.7 and figure 6.4 illustrate the UAW levels from seven Umgeni Water schemes delivering water to developing peri-urban communities plus from two other schemes with appreciably higher levels of usage per connection but contrasting numbers of connections per km of reticulation pipework. All the monthly figures tabled are averages taken over a period of several months: June 1994 to May 1995 for the Umgeni Schemes; July 1993 to June 1994 for Pinetown and December 1996 to May 1997 for Modderspruit. The first non Umgeni Water reticulated scheme is the whole area supplied by the old Pinetown Water before its incorporation into Durban Water and Waste. The consumption figure is 70kl/mth per connection because, although 85% of the customers are domestic users, the remaining 15% of customers comprise industrial and other institutional users who consume more than 50% of the total water supplied. Modderspruit, in North West Province, only supplies domestic water. It is a new scheme to basic RDP standards with on average a total of 42 households collecting water from each connection point. Hence the high usage per connection point and the low number of connections per km of reticulation pipework. Part of the water used from this latter scheme has been estimated.

6.7.3 Analysing the UAW levels of the nine local water schemes to choose the best indicators of the condition of water schemes generally

In analysing the UAW of the nine local schemes illustrated in Table 6.7 and Figure 6.4 it should be kept in mind that these nine schemes are widely representative of South Africa as a whole in respect of average water used per connection and number of connections per km **but they are not representative of South Africa in respect of UAW levels.** In fact the nine schemes have been specifically selected to reflect UAW from a wide range of well designed, constructed, maintained and managed schemes with low UAW levels and, with the exception of Sankontshe for the months of April and May 1995, refer Table 6.4, the analysis below confirms that selection was successful.

The three common indicators of UAW, UAW %, UAW per km of pipeline and UAW per connection, have all been examined as a function of both number of connections per km and water usage per connection, the two major variables encountered when examining local water supply schemes. Referring to figure 6.5 it can be seen that the main tool used for the examination of the schemes was linear regression analysis and that 6 plots have been drawn.

Table 6.7: Monthly water balances for nine local schemes

Scheme name	Inflow kl/mth	Usage kl/mth	UAW kl/mth	Usage per connection kl/mth	Connec-tions per km	UAW %	UAW per km kl/mth	UAW per connection kl/mth	Relative UAW %	Relative UAW per km	Relative UAW per connection
Modderspriut	4314	3984	330	83.00	6.5	7.65	44.6	6.88	1.00	2.16	2.60
Table Mountain	2126	1569	557	8.05	7.2	26.20	20.6	2.86	3.42	1.00	1.08
Ntshongweni	4638	3746	892	20.93	14.9	19.23	74.3	4.98	2.51	3.60	1.88
KwaXimba	11411	8170	3241	9.12	20.2	28.40	73.2	3.62	3.71	3.55	1.37
Phayiphini	5816	4130	1686	6.48	33.5	28.99	88.7	2.65	3.79	4.30	1.00
Sankontshe	6038	4127	1911	16.78	36.4	31.65	283.1	7.77	4.14	13.72	2.93
Fredville	10250	7021	3229	8.31	38.1	31.50	145.5	3.82	4.12	7.05	1.44
Georgedale	7560	5927	1633	13.44	59.6	21.60	220.7	3.70	2.82	10.70	1.40
Pinetown	1953387	1794450	158937	70.00	81.1	8.14	503.0	6.20	1.06	24.38	2.34

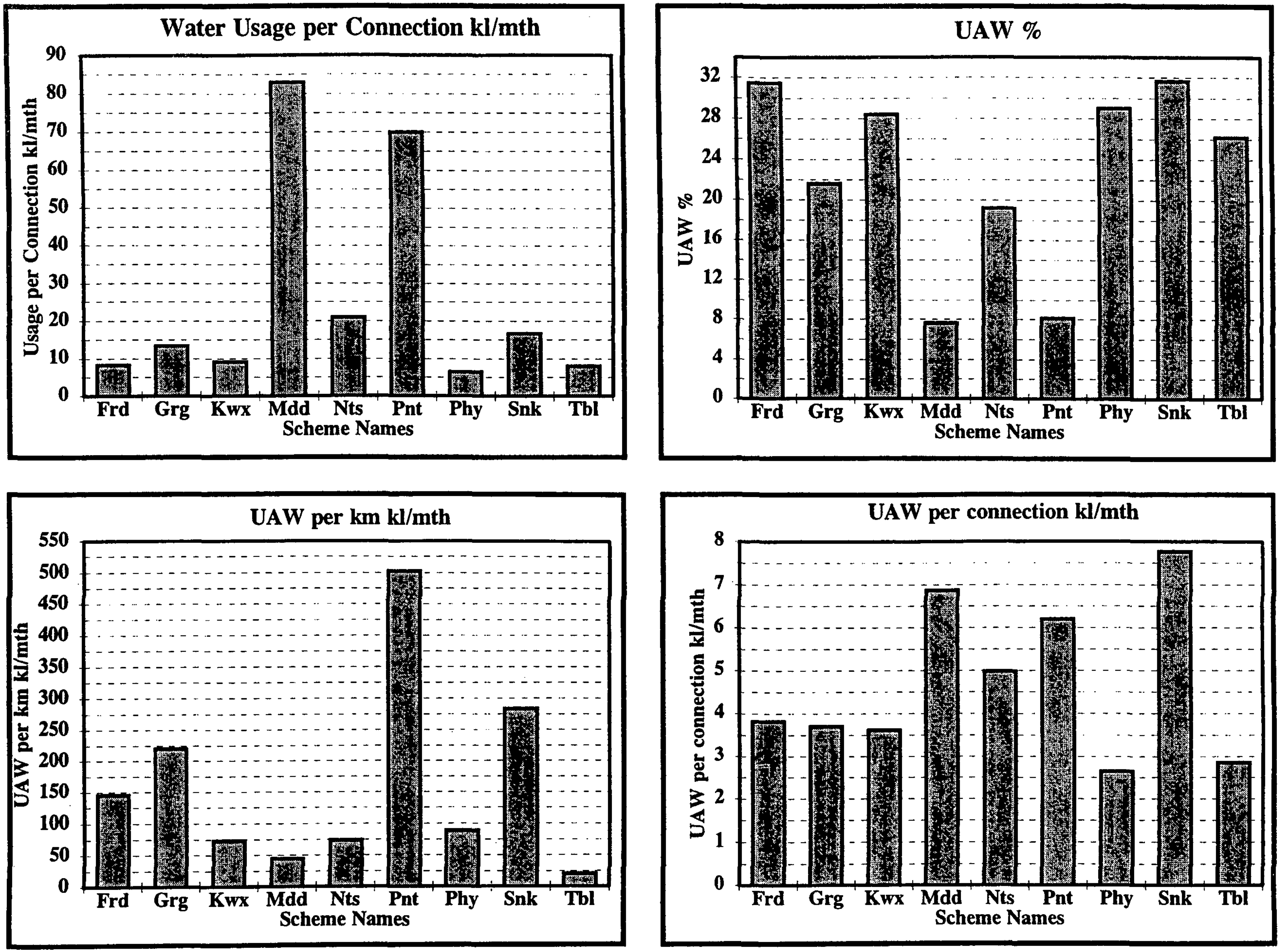


Figure 6.4: Water usage and UAW characteristics for nine local water schemes

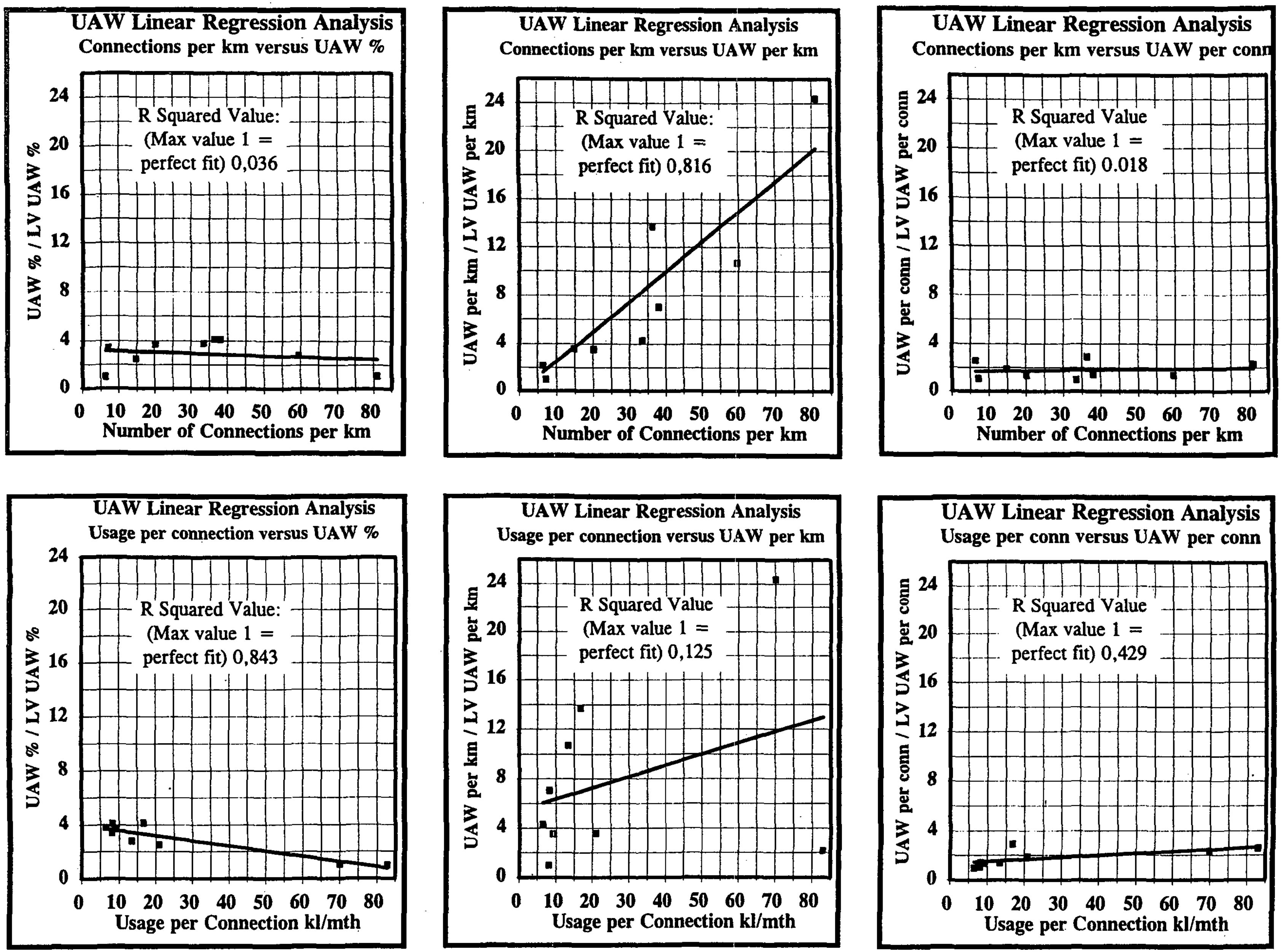


Figure 6.5: UAW linear regression analysis for nine local water schemes

The ratio of least to greatest number of connections per km and the ratio of least to greatest water usage per connection were purposely selected to cover as wide a range as practical. It also happened that the ratios were very similar, 12,5 and 12,4 respectively. Because of this identical ratio actual figures were used for the x-axis for plotting all 6 regression analysis carried out. In contrast, the ratios of least to greatest UAW %, UAW per km and UAW per connection varied significantly. For the y-axis it was therefore decided to use the ratios of the actual figures to the least value (LV) figures for each of these three variables instead of the actual values. The same range of values, 0 to 26, has also been used for the y-axis of the 6 plots so that readers can get a better feel of the relative significance of the slopes of the lines drawn.

Of the 6 plots 3 can be discarded immediately since the low values of the "R Squared Value" of the fit of the points indicates that there is no significance in the relationship. These plots are UAW % as a function of the number of connections per km, UAW per connection as a function of the number of connections per km and the UAW per km as a function of water usage per connection. These plots will therefore not be discussed further.

The plot of UAW % as a function of water usage per connection looks promising at first sight but note the following. The variation of actual percentages is roughly 10 to 30%. The inflow for Pinetown is 76 kℓ/mth per connection. Thus for Pinetown the percentage variation represents an actual loss of between 7,6 and 22,8 kℓ/mth per connection compared with the norm of 3 to 6kℓ/mth which can already be seen as a possibility by looking at Table 6.7. For no water usage per connection the line is predicting a UAW % of just over 40% when in reality the answer must be 100%. Above a water usage of 80kℓ/mth per connection the UAW % becomes negative, an impossibility. Thus use of this plot would be limited to points within the range drawn. However, the comment about Table 6.7 above already indicates that one of the other two plots may be more useful. It was therefore decided to examine the other two plots further. Redrawing the plot with UAW % expressed as a % of water usage rather than as a % of total water used was decided against because of the near universal acceptance of the term UAW % to mean % of total water inflow.

The plot of UAW per km as a function of the number of connections per km also looks very promising at first sight but note the following. For zero connections per km the UAW per km is zero. Thus this plot clearly indicates that the losses per km from reticulation pipework excluding connections is zero. In fact when this "best" plot was first drawn without using zero/zero as a fixed point it crossed the y-axis at UAW/LV UAW equal to -1,2. Therefore with the losses per km of pipeline length being zero it would still give a very wrong impression to use UAW per km of pipeline as the norm for measuring total UAW regardless of the good fit of the plot line. Also really disappointing are the observations that can be made from Table 6.7. There the UAW varies between 20,6 and 503 kℓ/km.mth. That is there is a ratio of more than 24/1 between the lowest and highest value. Therefore despite the common practice throughout the developed world of using around 500 to 700 kℓ/km.mth as a norm for expressing an acceptable level of UAW for urban communities in South Africa a suitable meaningful range cannot be found because of the wide range of figures obtained from schemes purposely selected as being "acceptable". It is also worth noting that in 5 of the 9 schemes chosen for examination the water usage plus UAW, that is the total water inflow, is less than the developed world's acceptable norm for UAW alone! The international developed world's norm for urban areas is therefore irrelevant in the examination of acceptable standards for UAW for water schemes supplying the developing peri-urban communities in South Africa and elsewhere.

The plot of UAW per connection as a function of water usage per connection looks disappointing because the "R Squared Value" of the fit of the points is low although still significant. However a n examination of Table 6.7 reveals that the variation of actual UAW per connection is 3 to 6 kℓ/mth. This is a meaningful figure to use as a norm provided the low "R Squared Value" does not indicate that UAW per connection could vary larger unpredictable amounts particularly outside the limits of the range drawn. Also note that using 3 to 6 kℓ/mth as a norm for UAW per connection translates to a UAW of 100% for zero water usage per connection, 18 to 30% for an average water usage per connection of 14 kℓ/mth, 8 to 15% for an average water usage per connection of 35 kℓ/mth and only approaches zero % for exceeding large average water usages per connection.

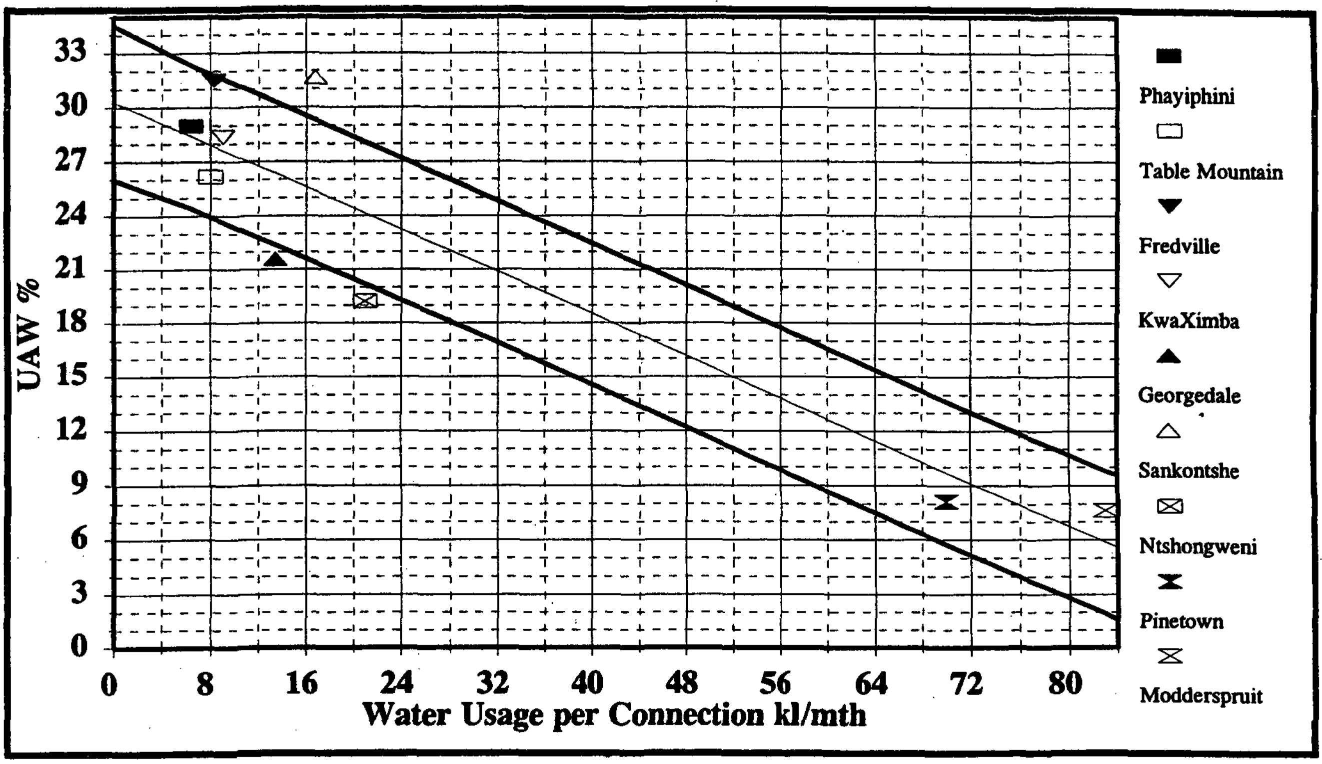


Figure 6.6: UAW % as a function of usage per connection for nine local schemes

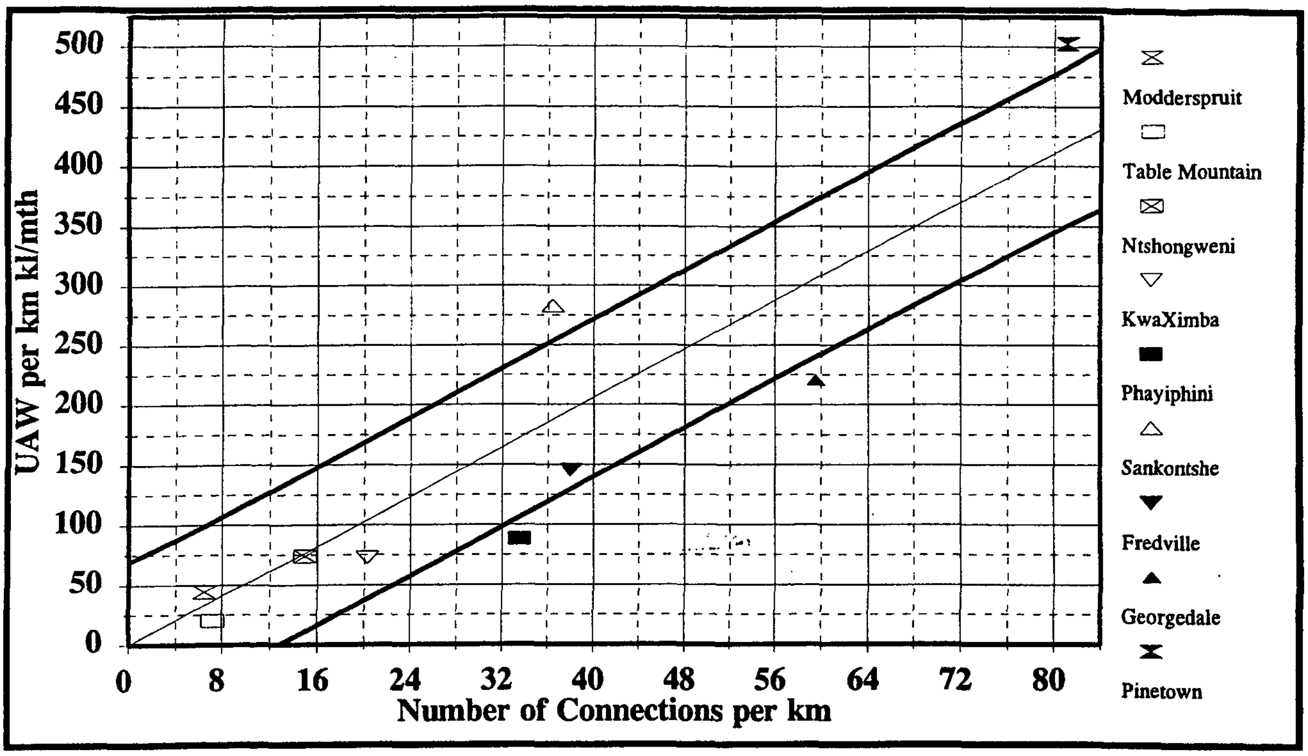


Figure 6.7: UAW per km as a function of number of connections per km for nine local schemes

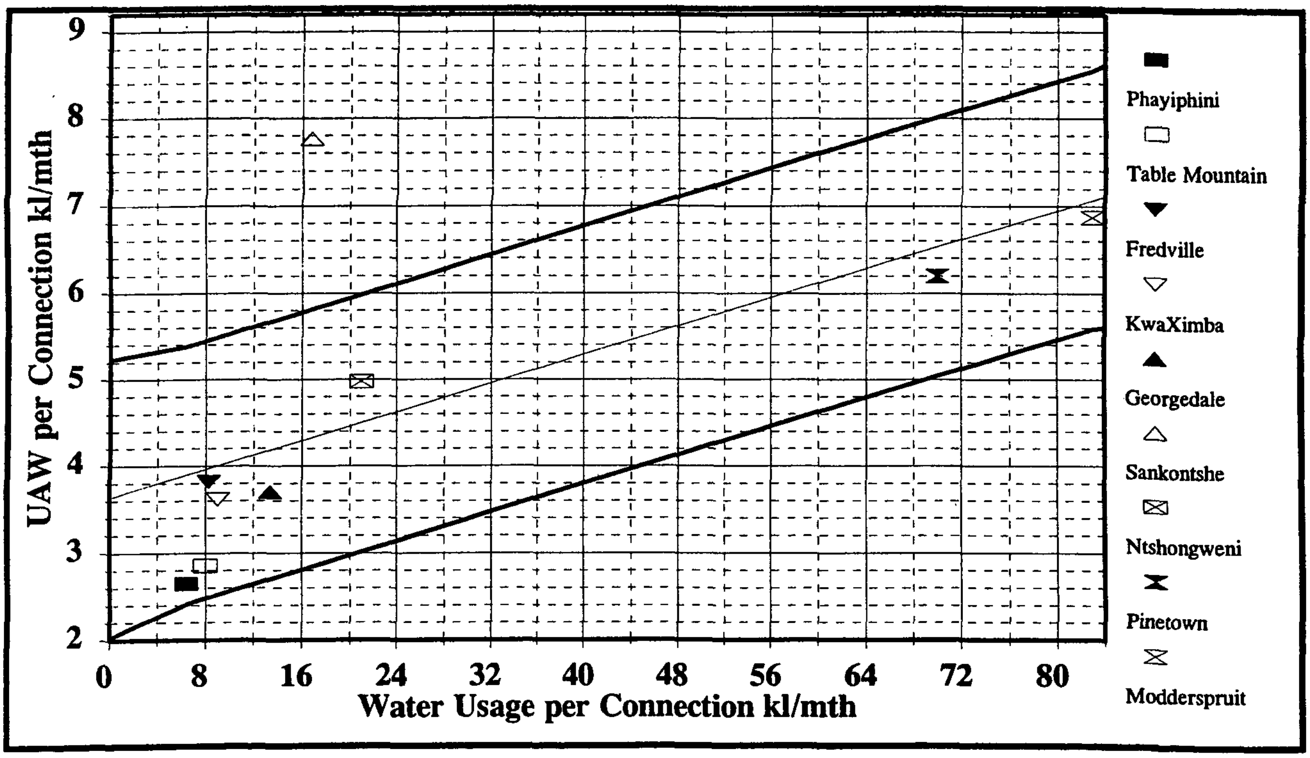


Figure 6.8: UAW per connection as a function of usage per connection for nine local schemes

Because none of the plots yielded completely satisfactory results, plots of the trend lines for UAW % versus water usage per connection, UAW per connection versus number of connections per km and UAW per connection versus water usage per connection were redrawn showing actual UAW levels rather than UAW/LV UAW levels. Also added to these plots were lines showing one standard error deviation for the UAW levels. In extending the plots towards no connections per km and no water usage per connection the slopes were adjusted by one standard error of the slope coefficient. These plots are shown in Figures 6.6 to 6.8. Sankontshe's plot is the only UAW level that is consistently shown outside the norm of one standard error deviation for all three plots and, more interestingly, it is only in the UAW per connection versus water usage per connection plot that it is shown to be clearly outside the norm. But it is known that for the months of April and May 1995, refer Table 6.4, the UAW levels for Sankontshe were high. Therefore this highlighting of the higher UAW level reflects what is required of a good norm. All that remained was to redraw the plot of UAW per connection versus water usage per connection for a third time but now leaving out the scheme which did not truly fit the criteria of only selecting schemes with known UAW levels. The result is shown in Figure 6.9. The "R Squared Value" for this plot excluding Sankontshe is 0.884. Thus the low "R Squared Value" has been overcome and UAW per connection can be recommended without hesitation as the main norm for checking the acceptability of the UAW of a full range of water schemes serving both developing peri-urban and developed urban communities.

6.8 CONCLUSIONS

Nine schemes reflecting UAW from a wide range of well designed, constructed, maintained and managed schemes with low UAW levels were examined. From the examination of these schemes it has been demonstrated that international UAW norms, which are generally based on losses per km of pipeline for schemes serving established urban communities, are worthless in deciding acceptable levels of UAW for schemes supplying developing peri-urban communities. The total inflow to five of the nine local South African schemes examined in detail was less than 500 kℓ/km.mth whilst 700 kℓ/km.mth is the generally acceptable upper limit for UAW according to international norms! The unsuitability of these international norms in deciding acceptable UAW levels for schemes supplying developing peri-urban communities is primarily due to the, on average, fewer number of connections per km of reticulation pipework. An additional contributing factor is that the international norms have been developed using older schemes than those examined in this study.

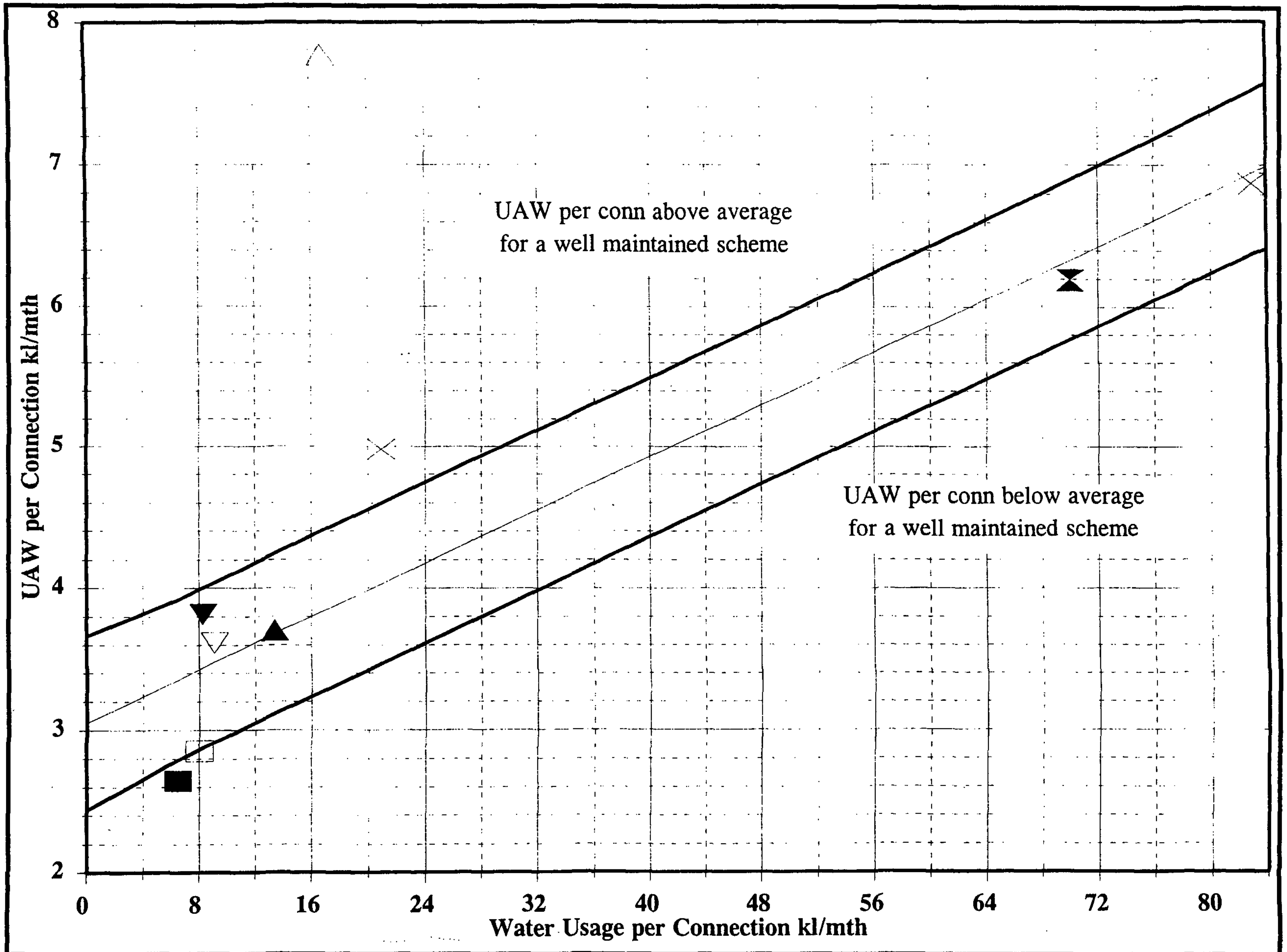


Figure 6.9: Acceptability of UAW per connection as a function of water usage per connection

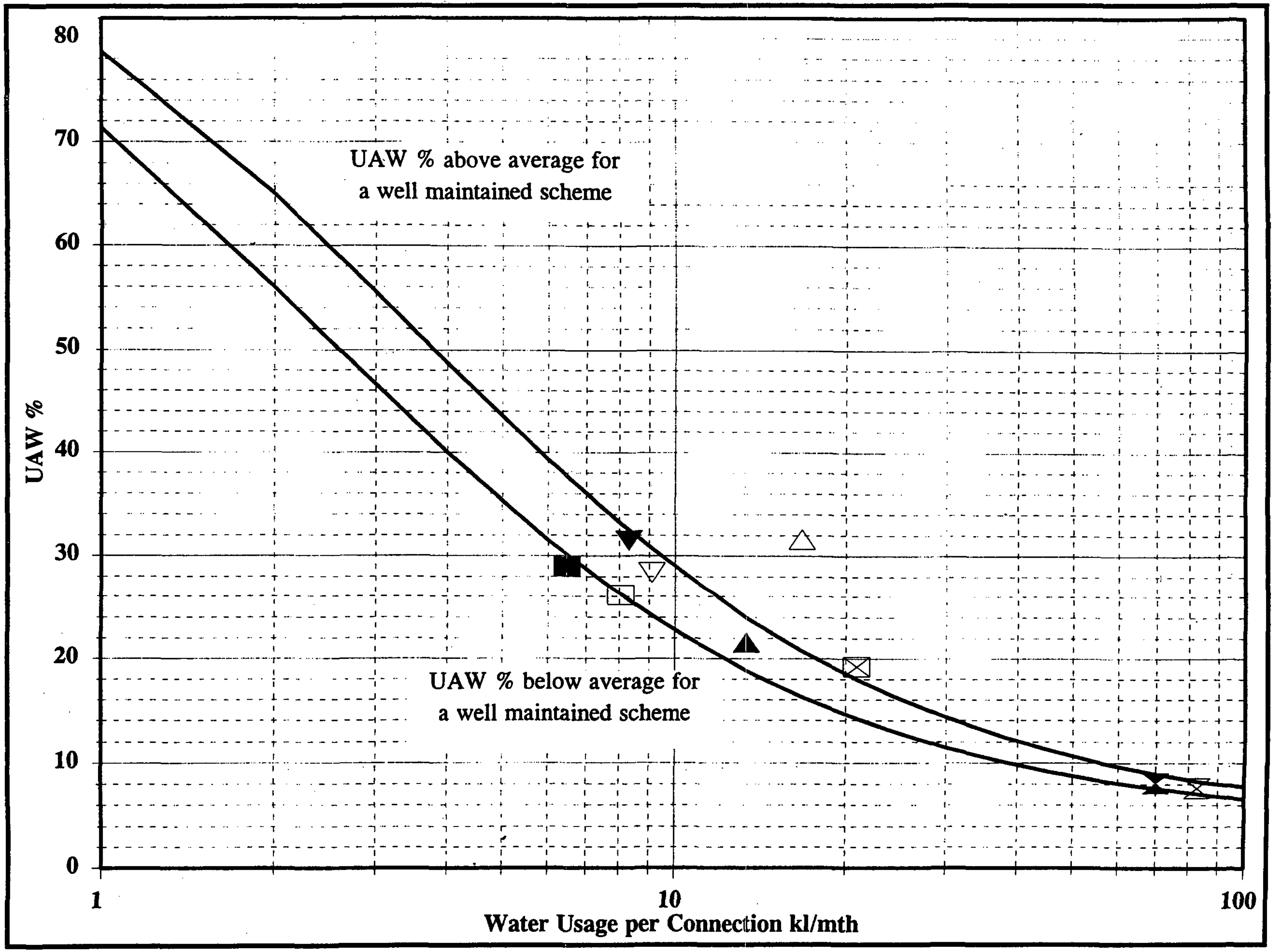


Figure 6.10: Acceptability of UAW % as a function of water usage per connection (Note plot generated from figure 6.9)

For the schemes examined, the water leakage from the pipelines was essentially zero but losses could be closely correlated with the number of connections on the scheme. Through further examination of the nine schemes it has been established that for general work a figure of 3 to 6 kℓ/conn.mth can be used as a norm for checking the acceptability of the UAW for a full range of water schemes for both developing peri-urban and developed urban. Contrary to expectations it was also determined that UAW per connection did tend to decrease for low water usage per connection and increase for larger usages per connection. Thus a more accurate assessment of the acceptability of a UAW level can be obtained by referring to Figure 6.9 which is a plot of acceptable UAW levels per connection as a function of water usage per connection.

Conversion of the acceptable UAW per connection levels illustrated in Figure 6.9 into UAW % levels as illustrated in Figure 6.10 clearly confirms that as water usage per connection becomes less, as occurs in schemes with a high percentage of yard taps delivering water to developing peri-urban communities, achievable UAW % levels rise steeply despite the assumed reduction in the actual amount of UAW per connection.

It has already been stated that the water leakage from the pipelines of the nine schemes examined was essentially zero. Figure 6.9 has therefore also been used in conjunction with the international norms to propose 172 to 276 kℓ/km.mth as a tentative acceptable additional loss due purely to the leakage from pipelines associated with older schemes known to have additional losses of this nature.

Observing a high UAW level in a section of a scheme discloses nothing about the source or the cause of the problem. Ongoing broader monitoring of schemes is therefore essential to an understanding of the causes of UAW and to UAW control. Such ongoing monitoring together with periodic reassessments of total situation are required to establish correct UAW targets in terms of achieving the best returns on resources allocated to UAW management programmes.

7.1 CLASSIFYING WATER SCHEME OPERATING AND MAINTENANCE COSTS

The cost of operating water schemes can be subdivided into three classes of costs:

a) costs which vary roughly proportional to the quantity of water delivered,

b) costs which are fixed and mainly depend on the design capacity of the scheme, and lastly

c) costs which are unaffected by the capacity of the scheme or the quantity of water delivered but are roughly proportional to the number of connections installed.

Type a) costs include: bulk water costs and the cost of internal reticulation boosting not included in the bulk tariff. Type b) costs include: redeeming capital and/or building up a capital works replacement fund, and main reticulation maintenance costs including any additional maintenance costs due to vandalism and thefts. In the case of Umgeni Water peri-urban schemes type c) costs include: costs associated with meter reading, computer billing, general accounting and administration, carrying out disconnections, security arrangements where applicable, community branch accounting offices and officers, maintenance of meters and connections, and unaccounted for water.

Table 7.1: The effect of water consumption levels on the cost recovery charges required to ensure economic viability assuming billing and institutional arrangements are similar.

Cost centres	Typical water costs at a demand of 34 kl/mth per off-take.		Typical water costs at a demand of 14 kl/mth per off-take.	
	R/kl	%	R/kl	%
a) Bulk water costs	1,45	56	1,45	39
b) Redemption/capital fund	0,36	14	0,54	15
Maintenance	0,21	8	0,31	8
c) cost of cost recovery (R14-00 per connection)	0,41	16	1,00	27
UAW (R5-44 per connection)	0,16	6	0,39	11
TOTALS	R2,59	100%	R3,69	100%

7.2 THE EFFECT OF LOWER WATER CONSUMPTION LEVELS ON THE ECONOMIC VIABILITY OF WATER SUPPLY SCHEMES

Assuming schemes for developing urban communities are designed with a 50% higher initial spare capacity factor than used for established urban schemes to allow for a higher percentage growth in sales and that average sales per connection are 14 and 34 kℓ/mth respectively for the developing urban and urban schemes, table 7.1 represents typical charges required to ensure economic viability of two schemes in the same area. These charges are based on 1993/94 costs applicable to Pinetown Water before its incorporation into Durban Water and Waste. In table 7.1 no allowances have been made for additional costs such as vandalism, thefts, additional disconnection costs, or higher unaccounted for water due to unauthorised connections or poor maintenance. The result indicates that householders in developing urban communities with individual yard connections would be required to pay 42% more per kℓ for their water than urban communities assuming full cost recovery is implemented and that conventional methods of billing and payment are used. At a tariff of R3,69/kℓ the cost of 14 kℓ is R51,66.

7.3 COSTS FOR AND INCOME FROM UMGENI WATER SCHEMES TO DEVELOPING URBAN COMMUNITIES

Table 7.2 shows the average monthly operation and maintenance costs for a number of Umgeni Water schemes supplying developing urban communities as supplied by Umgeni Water's Finance and Administration Department. The Umgeni Water costs reflect lower administration charges and higher maintenance charges than the costs shown in Table 7.1 but overall the charges are similar. With respect to administration charges, a typical break down of the items specifically related to the monthly costs of administering cost recovery for Umgeni Water Community Schemes is shown in table 7.4.

Table 7.3 repeats the total operation and maintenance costs for the same schemes and compares these total costs with the income received. This income represents between 80 and 90% of the billed amount over the same period. Thus even with 100% recovery of the billed amount the gross income would be less than 29% of the total O & M costs. This low percentage in turn reflects the need for high tariffs when water usage per connection is very low. The average water usage per connection for the ten schemes recorded in Tables 7.2 and 7.3, including shared connections, is only 8,57 kℓ/mth. Significantly less than the average 14 kℓ/mth usage reflected for the sample used to plot figure 3.2 and to calculate the estimated break-even tariff shown in table 7.1. As well as reducing the revenue collected this reduction in demand per connection explains the majority of the increase in total O & M costs from R3,69 kℓ/mth in table 7.1 to R5,63 kℓ/mth in table 7.3.

Table 7.2: Average monthly operation and maintenance costs during the period June 1994 to May 1995 for ten Umgeni Water schemes supplying developing urban communities

Scheme name	Bulk water sold R/mth	UAW R/mth	Admin-istration R/mth	Operating R/mth	Main-tenance R/mth	Total costs R/mth
Fredville	10 180	4 682	6 497	346	19 798	41 503
Georgedale	8 594	2 368	2 531	210	5 680	19 383
Groutville	2 162	3 563	6 164	616	8 275	20 780
KwaXimba	11 847	4 698	7 123	3 229	26 787	53 684
Manyavu	1 119	984	1 286	240	46	3 675
Ndwedwe	3 534	897	3 173	85	6 100	13 789
Ntshongweni	5 432	1 293	1 391	331	4 851	13 298
Phayiphini	5 989	2 445	6 189	5 324	10 291	30 238
Sankontshe	5 984	2 771	594	86	5 227	14 662
Table Mountain	2 275	808	3 774	936	2 838	10 631
Sub-totals	57 116	24 509	38 722	11 403	89 893	221 643
% of Total	26	11	17	5	41	100
Avg. R/conn.	12,43	5,33	8,43	2,48	19,56	48,23

Table 7.3: A comparison between the average monthly operation and maintenance costs and the income excl VAT during the period June 1994 to May 1995 for ten Umgeni Water schemes supplying developing urban communities

Scheme name	Water used kl/mth	No. of conn.	Total O&M costs			Gross income			Subsidy	
			R/mth	R/kl	R/conn	R/mth	R/kl	R/conn	R/kl	R/conn
Fredville	7 021	845	41 503	5,91	49,12	7 996	1,14	9,46	4,77	39,66
Georgedale	5 927	441	19 383	3,27	43,95	10 571	1,78	23,97	1,49	19,98
Groutville	1 491	780	20 780	13,94	26,64	2 811	1,89	3,60	12,05	23,02
KwaXimba	8 170	896	53 684	6,57	59,92	10 065	1,23	11,23	5,34	48,69
Manyavu	772	212	3 675	4,76	17,33	780	1,01	3,68	3,75	13,65
Ndwedwe	2 437	165	13 789	5,66	83,57	3 770	1,55	22,85	4,11	60,90
Ntshongweni	3 746	179	13 298	3,55	74,29	3 372	0,90	18,84	2,65	55,45
Phayiphini	4 130	637	30 238	7,32	47,47	5 785	1,40	9,08	5,92	38,39
Sankontshe	4 127	246	14 662	3,55	59,60	3 951	0,96	16,06	2,59	43,54
Table Mountain	1 569	195	10 631	6,78	54,52	1 687	1,08	8,65	5,70	45,87
Totals & Avgs	39 390	4 596	221 643	5,63	48,23	50788	1,29	11,05	4,34	37,18
Used/conn & %	8,57 kl/mth		100%			23%			77%	

Table 7.4: Monthly costs of administering cost recovery for Umgeni Water community schemes

Activity	Costs per month Rand
Meter reading	1,30
Accounting and administration services by Umgeni Water	2,80
Billing	0,90
Administration by community branch office	2,50
Total	**R 7,50/mth**

7.4 MANAGING LOW WATER CONSUMPTION LEVELS

There are a number of ways of managing these higher costs. These ways include the following.

7.4.1 Subsidisation

Subsidise operation and maintenance to developing urban communities because subsidisation can be justified on the basis of health gains and of a more equal tariff for all. (Why should the poor pay higher tariffs, after all it is partially due to the unjust policies of the past that the poorer sections of our society live together in isolated communities. Also the water supplies to some of the richer communities are currently being subsidised by large industrial consumers.) Using scheme life cycle costing and assuming a steady growth in sales over the years the subsidy will be temporary in nature. In peri-urban areas there is evidence which suggests that individual yard taps are the minimum acceptable level of service. As a result meaningful cost recovery from lower levels of service is problematic. Contra arguments are: if services are priced correctly the demand for yard connections will decline. Also there are 10 million people living in peri-urban communities. Assuming 6 persons per household the total cost of the subsidy in the early years will be in the order of (10÷6) x (3,69-2,59) x 14 x 12 = R300 million per annum. With such a subsidy to developing urban communities the likelihood of the gap in service level between rural communities and developing urban communities widening is high.

7.4.2 Introduce a fixed monthly charge per connection

Throughout South Africa introduce a fixed monthly charge of R20-00 to R40-00 per month per connection. This will encourage the use of shared standpipes through households being able to share this fixed cost to reduce their total water bills. If cost recovery is a problem from the shared standpipes, consider using coupon operated dispensers or any other suitable form of prepayment system at the standpipes. Such prepayment systems will increase the capital cost of schemes but, if well implemented, such prepayment systems will also reduce the administration costs. A precedent for introducing a fixed charge as a portion of the monthly bill can be found in a contract drawn up between Queenstown Municipality and a private company to manage the municipalities water supplies. The contracting company is paid a fixed sum plus a rate per kℓ of water consumed.

7.4.3 Innovative metering and billing methods

Consider less conventional metering and billing methods, such as card type prepayment meters or a fixed monthly payment system linked to the distributed storage units discussed in this study, to reduce cost recovery costs.

7.4.4 Decentralised management systems

Build local institutional capacity and more decentralised management systems to reduce total operation and maintenance costs. Umgeni Water is committed to placing more emphasis on this aspect in future. It acknowledges that for this option to succeed additional formal training, beyond that received during the construction phase of project implementation, will be required. The training will include village level structures as well as broader structures such as local government. Operation and maintenance can be divided into four main components: a) day to day operation, caretaking and cost recovery; b) unaccounted for water control; c) major maintenance and repair work and d) capital redemption and/or capital fund for hardware replacement. A good understanding of the institutional structures and the financial resources required for each of these components of operation and maintenance is also necessary to implement such institutional decentralisation successfully.

7.4.5 Conclusions

Achieving economic viability of water schemes supplying developing urban communities probably requires a combination of all the ideas discussed above and other ideas we have not thought of. In implementing these ideas, especially those around recovering the true cost of individual household connections and encouraging a greater use of privately operated metered shared standpipes, it is essential that alternatives are discussed fully with the communities concerned before embarking on implementation. Finally, individuals in authority will still have to make some of the ultimate decisions but if the people being served know that they have been heard and that their views have been taken into account the likelihood of successful implementation will increase substantially and absolute failures will be rare. As professional engineers and researchers we know that whilst technology plays an essential role in the water supply arena it is more often organisational and human failures which determine the relative success or failure of any policy or project. Despite this, the current lack of emphasis being placed on community participation, capacity building and training suggests that we have not taken these issues to heart.

7.5 A NOTE ON LIFE-LINE AND SLIDING SCALE TARIFFS

Both these concepts are endorsed by the Water Supply and Sanitation Policy White Paper (DWAF 1994, p. 24).

With respect to the life-line tariff it is important to remember that the concept primarily exists to **subsidise minimum levels of service** to the poorest communities and other isolated poor communities where the cost of water delivery is high. Thus subsiding the first 25 ℓ per capita per day indiscriminately to ensure additional households can have yard taps now is contrary to the concept envisaged in the White Paper. The challenge of "some for all rather than all for some" should have top priority. On the other hand some form of individual household connection is generally a desirable minimum standard of service. Thus customers who are able to afford such a level of service and are willing to pay the full cost should receive it.

Sliding scale tariffs may be a useful means of generating some additional funds for cross-subsidising poor communities. This would be particularly true where water costs are low because the infrastructure was installed long ago and the sliding scale tariff is also being used to introduce more uniform tariffs in a district. However even for affluent households higher water prices will curb consumption. Figure 7.1 examines the effects of price elasticity on the demand for water and on the resultant income where the percent change in demand = the percent change in price multiplied by the price elasticity. Since elasticity itself is not constant but dependent on the initial price level, the demand at which the price increase is applied and the relative affluence of the customers; figure 7.1 only illustrates the way in which the total revenue can fall if the price is raised excessively without predicting when this will happen. Therefore sliding tariff scales should be seen **primarily** as a demand regulator and not as a provider of additional revenue. However as schemes close to large populations become fully utilised demand regulation can be used to supply additional households with reasonably priced bulk water. The high water consumers can still have additional water if they are prepared to pay the full marginal cost of such provision and the Department of Water Affairs and Forestry is prepared to make it available.

Note figure 7.1 also illustrates the manner in which demand and total revenue can fall off sharply when meaningful cost recovery is introduced in developing urban areas for the first time or when the price is suddenly increased substantially. The fall off in demand

and revenue will be even sharper if customers have an alternative source of supply.

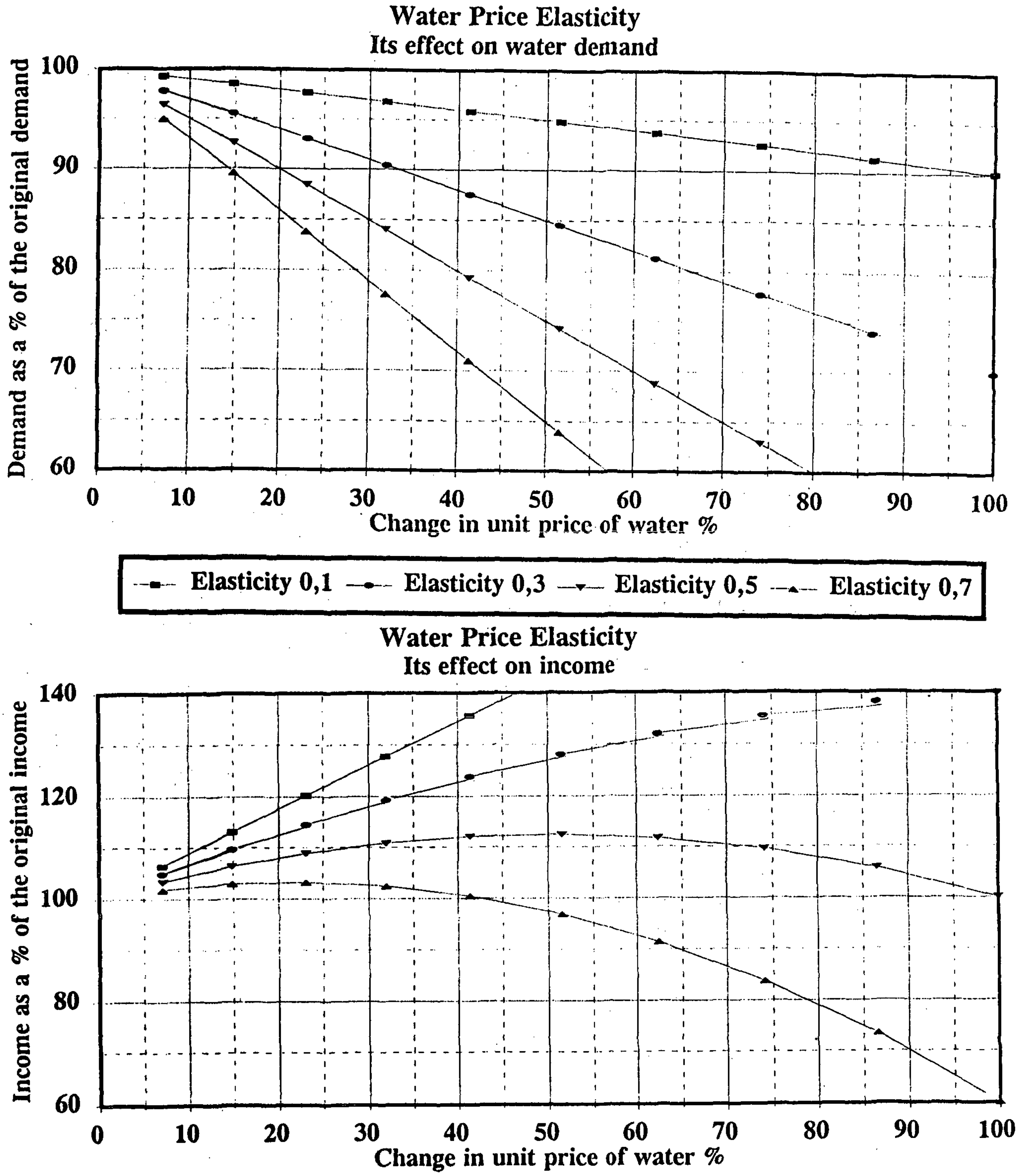


Figure 7.1: The effects of price elasticity on the demand for water and on the resultant income

8.1 ARRANGEMENTS FOR THE SCHEMES ANALYSED

As reported in chapter 4, Umgeni Water currently takes major responsibility for cost recovery from and the management of the schemes analysed in this report. Through this arrangement and through continuous consultation with the communities concerned Umgeni Water achieves levels of cost recovery in excess of 90% in relation to the invoiced amounts for individual household metered connections. It hopes to achieve similar results for privately operated metered shared standpipes but the installations of such standpipes is too recent to report on a proven track record.

The schemes are managed centrally from Umgeni Water's Head Office and two Regional Offices.	In addition there are community branch offices where accounts can be paid. These offices are staffed by community members who report to local water committee although their salaries are currently funded by Umgeni Water.

Figure 8.1: The institutional arrangements which currently apply to the schemes analysed in this report

As a result of low levels of water consumption day to day operating and maintenance costs are currently not always recovered from these schemes. This is particularly true for individual household connections. The result appears to encourage distortions in investment policy through consumers making excessive demands for this level of service. Currently Umgeni Water is not discouraged from making the required investment as it believes sales will increase with time and because the schemes being discussed only consume 0,2% of the total water sold by the utility.

The centralised management of these schemes as practised by Umgeni Water does partially embrace the core social contract principles of the Government's RDP vision through its involvement and support of community structures. The core RDP principles include developing human resources, democratising the state and society, and supporting small and micro enterprises. Yet Umgeni Water acknowledges that additional capacity building and training which would enable local structures to take full responsibility for schemes would enhance its accomplishments with respect to these aspects of the RDP vision.

8.2 UMGENI WATER'S PLANS FOR FUTURE ARRANGEMENTS

Therefore despite its current success relative to other organisations, Umgeni Water is committed to extending its RDP thrust and to redressing the imbalances of the past by helping to build representative local institutions and to train local community members in developing urban areas generally but especially in those areas which cannot be amalgamated with existing established urban communities. It plans to build these institutions for governance. It also plans to train these institutions' civil servants to a level where they have the capacity to deliver and maintain services through their own management and implementation skills and through their employing, where necessary, additional expertise in the form of consultants and local contractors just like their established urban counterparts do.

These efforts will not be sustainable unless the majority of Government, para-statal and private sector organisations working with developing urban communities are committed to these same goals.

8.3 AN INTRODUCTION TO PLANNING INSTITUTIONAL ARRANGEMENTS FOR THE WATER SECTOR

Very broadly there are a number of **tasks** that must be carried out to provide water to communities. These tasks include:

capital works,	operation,	caretaking,	maintenance,
financial aspects,	information management,	standards,	resource management,
capacity building,	water quality control,	prioritising,	auditing.

There are also a number of **players** available to carry out these tasks. These players include:

communities,	ward level forums,	local government,	water boards,	DWAF,
NGO's	provincial government,	district councils,	the private sector.	

All these players have roles in the team which needs to be assembled to ensure sustainable delivery of water supplies to all.

8.4 BROAD PRINCIPLES TO KEEP IN MIND WHEN PLANNING INSTITUTIONAL ARRANGEMENTS

Before looking at who should carry out which tasks and discussing within what institutional framework the tasks should be carried out, a few broad principles that should be kept in mind when planning water for all are recorded below.

* For small schemes and reticulation pipework, construction takes less than a year to complete. O&M continues for more than 25 years. Therefore such schemes should be built in the best way to facilitate their ongoing management and care.
* Governance and management should be decentralised as much as is practical.

* Work should be carried out in a manner which creates an environment of good communication, trust and mutual empowerment. Many thrusts should be integrated.

* Our country needs good leadership which inspires, motivates and stimulates rather than a leadership which dominates.

* Communities must pay O&M costs and replacement costs. Therefore they should have freedom of choice to decide how much responsibility should remain within the community.

* As intimated earlier, the basic wisdom and ethos of the RDP Discussion Document White Paper and the Water Supply and Sanitation Policy White Paper provide an excellent framework for much general decision making: for example, meet basic needs whilst developing human resources, democratising the state and society, and supporting small enterprises.

* Until a comprehensive National information management system is operative, major decisions will have to be made under conditions of poor information. Therefore when in doubt consider an adequately resourced pilot study before making a universal decision.

* Local government is essential for a healthy democracy. Therefore it is important that all persons working in the water sector help to create an environment which helps local government to grow and reach maturity.

* The strides being made by all those involved to expand services into areas of need is impressive. However, is sufficient emphasis is being placed on empowerment for sustainability?

8.5 WHO SHOULD CARRY OUT WHICH TASKS?

With the above introductory comments and broad principles in mind, the following tentative proposals are made with respect to who should carry out which tasks in the water supply sector.

With adequate capacity building and training at the level of small communities, stand alone schemes and the reticulation pipework for villages supplied with water from larger schemes are best managed and cared for by **the communities** themselves. Management covers cost recovery, bookkeeping and financial reporting. Caretaking covers operation, day-to-day care and routine monitoring of the facility. Remembering that it is the community itself which is going to pay for these services we would expect that as the size of communities grows the situation would gradually change from work being done part time on a voluntary basis, to part time for a nominal payment, to full time for higher payments. For the smaller communities it makes sense to train additional personnel to reduce the workload on individuals who are being paid very little and to minimise the disruptive effects of people leaving the community. Being in full control of and participating in the construction of the capital works paves the way for more meaningful sustainable self reliance.

At the top end of the scale, say a village of 10 000 inhabitants who will pay between R10 000 and maybe up to R20 000 per month for their water, it is likely that communities will prefer an outside agency to manage and care for their water supplies. In this situation on balance **local government** is probably best suited to the task. This is despite local government having to cater for services across a wide spectrum whilst water boards are specialist institutions. In these cases there is an urgent need to strengthen local government and even encourage its sub-division down to **ward level**.

Local Water or Development Committee	The democratically elected committee appoints local community members to operate the scheme, care for it and implement cost recovery.
Ward Development Forum	Operates as a 'stokvel' for the management of maintenance funds from a number of communities. Is responsible for procuring spares and employing maintenance personnel from the private sector.
Local Government	Acts as the trustee for the management of loan finances and/or the building up of a capital fund for hardware replacement and upgrading. Local Government implements capital works with the assistance of consultants and contractors committed to labour intensive construction where practical.

Figure 8.2: Institutional arrangements for the operation and maintenance of water supplies within small developing urban communities which cannot be integrated with established urban communities. (The authors believe that these arrangements are consistent with current feasible solutions and the Government's RDP vision.)

For these larger communities capital works can probably also be best handled by local government assisted by **professional consultants and contractors.** At all levels of construction the practicality of labour intensive construction should never be overlooked.

Preventative maintenance and major repairs are a special case in that timeous spares procurement, the expertise required to effect the work and often the level of payment are all beyond the scope of individual communities. This work is probably best carried out by the **private sector,** ideally by small enterprises although the servicing agents of larger businesses should not be ruled out. Ward level forums operating like stokvels are probably best suited in the short to medium term to handle the payments and spares procurement.

Bulk schemes are best undertaken and operated by **water boards** whilst the private sector retains responsibility for much of the detailed design, construction and major maintenance work. If water boards limit their responsibilities to bulk schemes they can objectively determine cross subsidisation levels, which may be required for some time to cover a portion of the maintenance and replacement costs for the hardware associated with supplies in the poorest areas.

DWAF has wide ongoing responsibilities in respect of financing, an information management system, standards, resource management, capacity building, water quality control, prioritising and auditing. Delegating work to lower tiers and to the private sector needs to be encouraged whilst DWAF remains the ultimate custodians of these areas. Encouraged by the very real needs for additional capacity building and training and by short term self interest, we all tend to err in thinking that implementation is best carried out at levels higher than the optimum.

8.6 THE ORGANISATION AND EMPOWERMENT OF STRUCTURES

This section tackles the most difficult question of HOW structures, especially structures up to local government level, are to be organised and empowered through capacity building, training and changing attitudes.

Community water committees are already an established tradition in South Africa. Other community committees and ward forums are becoming more common in rural areas. The need for such committees and forums to support and augment local government will remain for many years. In paragraph 8.5 it is even suggested that for small communities water committees will always be best placed to operate and care for local community water supplies.

Many other functions are best carried out at ward level but formal local government at this level is a long way off not only because of capacity but because of the cost of paying for adequate full time staffing.

There is, therefore, an urgent need for all organisations involved in basic needs provision to make provision for the empowerment of community committees, ward forums and local government to serve not only the water and sanitation sectors but also other basic need sectors that would benefit from the existence of decentralised structures. The recent legislation relating to the establishment of statutory water committees whilst welcome is too complex and a more simple way must be found to enable government to channel funds through local structures. Community committees should continue to be formed by universal adult suffrage. Ward level forums may operate best by community committees selecting members to attend forum meetings.

In the longterm community committees and ward forums will be supported by local government structures although allowance must be made in the short term for them to be supported by other structures where necessary. Therefore the resources made available for capacity building and training for structures at all levels from community committees to local government need to be expanded significantly. Apart from making more resources available it will also be necessary to evaluate and upgrade existing training courses.

We all speak of the different levels of players involved in ensuring the delivery of water supplies. This tends to lead to the dominating or patronising type of leadership so prevalent in the past. A lack of meaningful cost recovery was another reason for these relationships. As a result there is often a need for a fundamental change in the relationship between the players. What the White Paper states in relation to women and development can be extended to include all stakeholders, "any policy or project which does not ensure their full and active engagement at all levels is bound to meet with failure or only partial success". Putting it another way, even engineers know that whilst technology does play an important role in the water supply arena it is more often organisational and human failures which determine the relative success or failure of any policy or project.

To change these thoughts into action the emphasis must be on supporting and serving the next layer down: they are the **clients**. This can only be done through people being given the proper example, training and tools to carry out their tasks competently. Thereafter there is a continuing need for planning, target setting, motivating, monitoring, corrective action, accountability and transparency. All these tasks apply to operation, maintenance and cost recovery as well as capital investment. Their implementation can only be achieved through good communication and regular reporting up and down. Competent extension officers at local government similar to DWAF's Organisational Development Officers and Umgeni Water's Community Liaison Officers will be required to facilitate this communication and reporting. Surprise auditing will still be required to further discourage and catch corrupt individuals and groups.

In the longterm local government will be a very important role player in sustaining water supplies. It is therefore critical that planning and establishing local government begins now. Capacity building and training at community and ward levels will prepare human resources for service and excellence in local government. Building from the bottom up creates strength.

9.1 INTRODUCTION

The Masakhane Campaign has largely failed because face-to-face consultation with communities has not taken place. "Masakhane does not mean people must just pay without improvement on service delivery", is the cry from the grass roots (Ambert 1995 p.8). Thus Umgeni Water's example and experience could lead the way to significant improvements but if followed too blindly could also lead to long delays until services are upgraded to considerably higher levels and to continuing large subsidies. Hence the proposals which follow.

Along with all the current investment to expand coverage, what is required is a national strategy devoted to stimulating and enhancing the capacity of communities and other local structures to manage their own water schemes. The strategy must be backed by :

* human resources with the appropriate educational ability to transfer management, conflict resolution, financial, and technical skills to decentralised structures,
* adequate funding,
* a broad flexible working methodology including frequent cross communication between implementing groups, and
* rewards for and/or recognition of above average achievements.

Currently DWAF's Organisational Development Officers appear to have insufficient support to spearhead such a strategy. The Umgeni Water's Community Liaison Officers position is more favourable but communities still do not get sufficient ongoing support after a new scheme has been completed. Indications are that money invested in capacity building, so that water schemes supplying developing urban communities can be managed efficiently by the communities themselves or by their local authorities and thereby rely less on subsidies, offers significant longterm benefits and returns (Forster 1994 p. 62, 83 and 89). Therefore more effort should be made Nationally to ensure this capacity building takes place.

9.2 WORKING WITH LOCAL STRUCTURES TO INTRODUCE COST RECOVERY

As indicated above, the process of introducing cost recovery should be closely linked with the establishment of local democratically elected water committees. Women and youth should be well represented among the office bearers of these committees. After local committees have been elected DWAF or the local Water Board should continue to empower them by holding joint meetings to develop a working plan for evaluating and rectifying any problems with the existing service and for implementing cost recovery as soon as practical. Do not be over influenced by the detailed experiences described in this report. Evidence suggests that the administration of cost recovery has proven to be most effective when decentralised, developed by the community itself and tailored to meet local conditions. In all cases, however, management efficiency is vital for success. Hence the need for capacity building and training.

To introduce effective cost recovery, that is cost recovery which ensures the longterm economic viability of the scheme and its managing institution, certain basic items of information must be gathered and understood. These basic items are listed below. The order in which the items are listed is not significant and data collection should rather follow the interests of the community.

1. Are there any major problems with the reliability of supply or with the level of service?
2. Are there any indications of high water losses from the scheme because of it being in poor condition?
3. What are the goals of introducing cost recovery and what costs are to be recovered?
4. What institutional arrangements are to be set up to operate and manage the water scheme?
5. Are any costs being recovered currently and what are peoples attitude towards increased costs or the introduction of cost recovery?
6. How many households/persons obtain water from the scheme and what are the affordability characteristics of the different households and the community as a whole?
7. How do different households abstract water from the scheme?

Figure 9.1: Questions which must be answered before cost recovery is introduced

9.3 PROBLEMS WITH THE RELIABILITY OF SUPPLY OR WITH THE LEVEL OF SERVICE

If there are any major problems with the reliability of supply these problems must be investigated as a matter of urgency. Collection of the remaining information can continue with circumspection but no additional cost recovery should not be introduced until major problems are solved. Reliability problems centred round the scheme not being able to handle the demand because of unauthorised connections is a special case. If it is difficult to upgrade the scheme or if affordability is likely to be an issue thought should be given to negotiating a reduction in demand or at lest in the peak demand. The latter can be implemented by means of the distributed storage units described in chapter 5 of this report. Introducing cost recovery is also likely to reduce the demand dramatically.

If a community or some residents within a community express dissatisfaction with the level of service every effort should still be made to introduce cost recovery commensurate with the existing level of service. At the same time the questions of willingness to pay for a higher level of service, affordability and the practicality of upgrading the level of service should be attended to. If the existing level of service is below the basic level defined in the Water and Sanitation White Paper (DWAF 1994 pp.15-16) additional efforts should be made to ensure that an upgrading proposal is submitted to the relevant authority so that it is prioritised. Where affordability varies within a community more effort should be made in future to accommodate the demand for different levels of service by different consumers. This will mean mixing grant and loan capital when implementing the scheme. Once the upgrading proposal is complete the households demanding the higher level of service must be encouraged to prove there willingness to pay for the higher level of service by putting aside a fixed amount per month as an upfront payment once implementation commences.

9.4 HIGH WATER LOSSES

If there are indications of high water losses from the scheme because of it being in poor condition these losses should be estimated. If there are any bulk water supply meters or reservoirs on the scheme the losses can be estimated from night flows. Next what the losses are likely to cost the community after cost recovery is introduced can be estimated as can the losses contribution to problems of a scheme not being able to handle the demand. Lastly negotiations and decisions have to be taken with respect to what is done about the situation.

* Must repairs proceed as a matter of urgency?
* What are the causes of the high water losses?
* What are the repairs likely to cost? Who will pay for them?
* Could the poor condition of scheme cause the water to get contaminated and thus become a health hazard? (This is only likely to happen if the scheme is operated in a manner which causes negative pressures in the pipework and the water is delivered to the consumers without being disinfected by a technique which retains a residual active component. Negative pressures are caused in scheme by excessive demand and by operating a scheme for two discreet periods during the day, one in the morning and one during the afternoon. Note: other scheme conditions not associated with high water losses may also be a potential heath hazard. A dirty reservoir is just one example of a potential health hazard.)
* If the parties agree that repairs are not to be carried out immediately is the bulk water supply authority for the area willing to consider some form of compensation to the community for the costs it would otherwise incur because of the water losses? If such compensation is being considered has the community agreed to put aside some money each month for future maintenance work.

9.5 WHAT COSTS ARE TO BE RECOVERED AND WITHIN WHAT INSTITUTIONAL ARRANGEMENTS?

Before a community implements cost recovery it must first estimate the costs to be recovered. We strongly recommend that all the costs discussed in chapter 7 (namely: bulk water costs, general operating costs, maintenance costs, costs of cost recovery, the costs of unaccounted for water and the cost of building up a capital fund for replacing major items as they wear out) are considered. Thereafter the community should be encouraged to budget for each of these costs. The community must also decide within what broad institutional arrangements the costs are to be recovered (refer chapter 8). We anticipate that, especially for communities with a population of less than 10 000 inhabitants, retaining much of the responsibility within the community will encourage transparency and contain the management costs.

6 WHO IS GOING TO PAY AND HOW MUCH ARE THEY GOING TO PAY?

Having estimated the costs which have to be recovered it is necessary to plan how these costs will be recovered. Encouraging the community to undertake a house by house census recording the name of the head of each household who will be responsible for paying water is a good way to start (Forster 1994 p. 58). When doing this it is always beneficial to collect a little additional information such as the number of persons in each household and a general overview of the economic circumstances of the community. Figure 9.2 represents a typical census form which could be used for such an exercise. If there are different levels of service within the community it will also be necessary for the community to carry out a house by house survey of how households obtain and use water. Figure 9.3 depicts a possible form for carrying out such a survey but consideration should be given to modifying it to suit local conditions. Figure 9.6 gives an indication of likely water consumptions from different sources by different classes of users.

Equipped with the costs to be recovered and these surveys a first estimate of how much each household is to pay for their water can be drawn up. If water usage is very low and the cost of water per kℓ used is high it may be possible for the community to negotiate with the supply authority to allow a discount on the bulk water costs. This could be done by the authority agreeing to absorb the costs of assumed water losses. Figure 6.1 could be used as the basis for this discount. If there are few metered connections on the scheme, it will be essential for the water committee to agree overall estimated usages with each household so that at the end of each month all agreed costs are recovered. If bulk water supply authorities can agree to a fixed monthly charge for, say, a 12 month period it would help such communities with their budgets and with simplifying their method of revenue collection. Longer term charges will of course still depend on the communities overall usage.

Community Name: . . . . **Date: Day/Month/Year:** . . . .

No	Household Head Full Names Mr/Mrs First Middle Last	Pensioners	Unemploy-ed work seekers	People in paid employment	Self employed	Informally employed	Migrant Workers	Mothers not counted earlier	Children	Total
	Totals from previous page:									
1										
2										
3										
4										
5										
6										
7										
8										
9										
0										
1										
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Figure 9.2: Community water supply and sanitation: Household by household census

Community Name: . . . . **Date: Day/Month/Year:** . . . .

No	Household Head Full Names Mr/Mrs First Middle Last	Descriptive Group(s) (Table 9.1)	Plain Yard Taps	Threaded Yard Taps	Basin Taps in House	Other Taps in House	Low Flush Toilets	Full Flush Toilets	Overall Estimated Usage	Water Metered Yes/No
	Totals from previous page	N/A								
1										
2										
3										
4										
5										
6										
7										
8										
9										
0										
1										
2										
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7										
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9										
0										
	Totals to next page:	N/A								

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Figure 9.3: CWS&S: Household by household level of service and water usage survey

In general fixed monthly charges are much easier for communities to control and manage. This is clearly confirmed by examining figures 9.4 and 9.5 which indicated the types of records which must be kept to control fixed and variable charges respectively.

Table 9.1: Household domestic water demands related to access and income category

Group	General description of conditions	Typical demands kℓ/mth
1	<u>Subsistence level income</u> Access very difficult: Steep and distance more the 200m or flattish and distance more than 500m.	1 - 2
2	Access moderately difficult: Steep and distance less than 200m or flattish and distance between 200m and 500m.	2 - 4
3	Access adequate: Flattish and distance less than 200m.	3 - 5
4	<u>Low level income</u> Plain yard tap: No provision for a hose-pipe connection.	4 - 9
5	Threaded yard tap: Provision exists for a hose-pipe connection.	7 - 16
6	<u>Low to middle level income</u> A tap in the house plus and, say, a plain or threaded yard tap. Total demand	 6 - 12 4 - 8 10 - 20
7	<u>Middle level income</u> One or two house taps, a low flush toilet and, say, a plain or threaded yard tap. Total demand	 12 - 18 2 - 4 4 - 8 18 - 30
8	<u>Middle to high level income</u> Two or more house taps, a high flush toilet, a bath or shower and, one or two plain or threaded yard taps. Total demand	 14 - 20 4 - 8 10 - 15 15 - 25 43 - 68
9	<u>High level income</u> Three or more house taps, one or more high flush toilets, one or more baths or showers, and extensive watered gardens. Total demand	 18 - 25 6 - 10 15 - 25 25 - 40 64 -100

(Adapted from van Schalkwyk 1996. Tables 1 and 2, pp. 43 and 71)

Community Name: .... **Year: 19 ....**

AC No	HOUSEHOLD HEAD FULL NAMES MR/MRS FIRST MIDDLE LAST	MNTH CHRG	OWE JAN	PAYMENTS DURING MONTH												YEAR TOTALS
				JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
TOTALS FROM PREVIOUS PAGE			A													
			B													
YR TOTAL		A	TOTAL PAYMENTS													
		B	TOTAL CHRG LIVE ACS													
		C	RECOVERY %													

WORKINGS: DONE BY: Signed: .... NAME: .... Date: 19 .... / .... / ....

NOTES:

A/B X 100 = C CHECKED BY: Signed: .... NAME: .... Date: 19 .... / .... / ....

OWE JAN this year: **Calc from last year's figures:** for each family =
MNTH CHRG x no of mnths Ac is open + OWE JAN - YEAR TOTAL

This year: Page ...... of ...... pages

Figure 9.4: Cost recovery form type 1: Fixed monthly charge: Record of payments received

Community Name: .... **Year: 19** .... **Month:** ....

		A	B	C	D	E	F	G
AC No	HOUSEHOLD HEAD FULL NAMES MR/MRS FIRST MIDDLE LAST	MONEY OWING begin. of month	WATER SALES previous month	SUB-TOTAL	PAYMENTS during month	ADJUSTMENTS + or -	MONEY OWING end of month	AGEING RATIO
	TOTALS FROM PREVIOUS PAGE							
PAGE TOTALS	F							

WORKINGS: A + B = C DONE BY: Signed: .... NAME: .... Date: 19 .... / .... / ....

C - D + (-)E = F

F / B* = G CHECKED BY: Signed: .... NAME: .... Date: 19 .... / .... / ....

*If the Sales Figure is unusual or zero (0) use a typical Sales Figure for this Household for calculating this RATIO

This month: Page ...... of ...... pages

Figure 9.5: Cost recovery form type 2: Metered connections: Record of payments received

COST RECOVERY FOR WATER SCHEMES TO DEVELOPING URBAN COMMUNITIES

10.1 THE LITERATURE SURVEY

The literature survey stressed the need for community participation and control, and the need for implementing cost recovery to cover costs. Information on costs and the successful application cost recovery were however sadly lacking. Other important reasons for implementing cost recovery such as stopping excessive water usage and wastage, discouraging distortions in investment policy were rarely mentioned.

10.2 THE CHARACTER OF DEVELOPING URBAN COMMUNITIES AND HOW THIS AFFECTS THE PLANNING OF WATER SERVICES

About 10 million South Africans live in developing urban communities. Approximately half live below the Poverty Datum Level (PDL) whilst a small minority have quite a high standard of living. Based on the Umgeni Water supply area where only about 10% of households have household connections and Umgeni Water has recently started encouraging residents to share their water supply with neighbours, once water is being paid for, even those with household connections only use, on average, about 1/3 the water used by households living in established urban communities. The large number of people falling into this category, their economic standing and low water usage all suggest that planners should facilitate the implementation of multi-levels of service schemes for these communities. Water charges should be based on the total true cost of delivery the only exception being the non-repayment of capital where grant finance has been obtained for the construction of basic minimum levels of service. Thereafter individual households should be allowed choose the level they want.

10.3 UMGENI WATER COST RECOVERY ACHIEVEMENTS AND CHALLENGES

Umgeni Water recovers about 90% of all invoiced amounts from customers with household connections including those households owning metered shared standpipes (refer 4.3.3). Roughly 17% of these customers do have debts outstanding in excess of 90 days which indicates the additional effort required to achieve the 90% recovery. This recovery is only achieved against a background of a high quality of service, the existence of active water committees in all the communities and Umgeni Water branch offices in many of them.

In a few cases Umgeni Water has also had success in recovering invoiced amounts from metered community standpipes and schemes controlled by village water committees.

In view of the comments on community control and the need for multi-level of service schemes in 10.1 and 2 above challenges facing Umgeni Water incluse:

* further capacity building and the handing over of control to Local Government and

to Village Water Committees within a framework of ongoing monitoring, auditing and support,

* more resources being used to implement and recover costs from basic and intermediate levels of service, and
* greater openness with respect to implementing innovative methods of cost recovery and innovative administration systems.

Umgeni Water is aware of these challenges and will be devoting more resources to them in future.

10.4 THE TWO NEW METHODS OF COST RECOVERY

Distributed storage regulating units are very promising as an acceptable cost effective means of implementing an immediate level of service for individual households with a water demand of up to 500 or 750 ℓ/day, especially households living in small communities and in larger ones which do not have a computerised administrative system. They are likely to be used more as customers are charged the total true costs associated with individual household yard taps. However the lack of familiarity of such units in South Africa suggests the need for a few pilot installations in an environment of clear institutional and community support may be necessary to endorse their acceptability and cost effectiveness.

Reliable reasonably priced water dispensers will make public and privately shared standpipes a much more acceptable and cost effective basic minimum and intermediate level of service. Despite the lack of reliability of the unit tested, this project confirmed the need for such a product. The advent of electronic water dispensers, or prepaid meters as they are commonly called, has overtaken this study to a degree because for communities with more than 100 households such units are likely to be more cost effective. However for small communities a reliable mechanical unit would prove more cost effective because electronic units cannot operate without some form of computerised administrative support system.

10.5 UNACCOUNTED-FOR WATER (UAW)

The control of UAW is essential for the sustainability of water service providers. This project demonstrated that current International Norms of acceptable levels of UAW, which are normally based on losses per km of pipeline, are not applicable in deciding acceptable levels of UAW for schemes supplying developing urban communities. The levels these norms give are too high and in five of the nine South African schemes examined these levels exceeded the total water, used plus UAW, being delivered to the communities!

In place of the International Norms, for well maintained schemes, this study proposes the use of an universal diagram based on UAW being a straight line function of water usage per connection. Although the diagram predicts that acceptable UAW per connection will rise from 3,5 to 7 kℓ/mth when corresponding average water usage rates rise from 10 to 88 kℓ/mth, the corresponding UAW percentage figures are 26% and 7,4% respectively (refer figures 6.9 and 6.10). If usage per connection drops to 5 kℓ/mth the acceptable UAW figure drops a little further to 3,28 kℓ/mth but the percentage figure, which affects water service providers operating margins most, rises to a whopping 40%.

At the beginning of this section it was reported that International Norms resulted in higher acceptable UAW levels. This is mainly water schemes serving developing urban communities generally have fewer connections per km but it is also partially because the nine schemes analysed have no measurable losses associated exclusively with the length of the pipelines as distinct from losses associated with connections. Thus whilst the universal diagram can be used for making judgements on the combined condition/management status of schemes there are likely to be schemes where achieving UAW figures in line with the universal diagram will not be practical without replacing most of the infrastructure. However for the majority of schemes it is expected that reducing losses to the acceptable levels proposed in this report can be achieved by tracking down unmetered/unauthorised connections, making sure all the existing meters are read and perhaps upgrading/replacing some of them. This expectation is based on the findings from the schemes analysed as well as on the fact that most water schemes for developing communities are relatively new and because more emphasis has been placed to date on building sound new schemes rather than the proper management of existing ones.

In conjunction with International Norms a tentative acceptable additional loss of 172 to 276 kℓ/km is proposed to cater for the leakage from older schemes **known to have additional pipeline losses.**

Observing a high UAW level in a section of a scheme discloses nothing about the source or cause of the problem. Ongoing broader monitoring of schemes is essential for an understanding of the causes of UAW and to UAW control. Such ongoing monitoring together with periodic reassessments of the situation are required to establish correct UAW targets.

10.6 THE CHALLENGE OF ECONOMIC VIABILITY

Theoretical considerations indicate that schemes where the water usage per access point is low will require higher tariffs to achieve sustainability than schemes with an average demand per access point. Examination of ten Umgeni Water schemes which supply water to developing urban communities confirms the theoretical considerations. Average total costs, excluding any capital redemption charges for the reticulation component of the infrastructure, for the ten schemes was R5-63/kℓ in 1996.

Umgeni Water realises that to achieve economic viability from such schemes requires a combination of initiatives including more decentralised management with village level control, innovative multi-level supply schemes with innovative metering, cost recovery and administrative support systems, and some continued cross-subsidisation. The introduction of more decentralised management will require extensive capacity building and ongoing monitoring, auditing and support. The innovative cost recovery systems will probably have to include the introduction of a fixed monthly charge of between R20-00 and R40-00 per month per access point throughout South Africa. Despite arguments on the possible health benefits of subsidising high level water services to developing urban communities emphasising such a solution is discouraged on the grounds of National affordability when rural communities are included. Sliding scale tariffs could be introduced as a possible means of generating some additional funds from high volume water consumers but because of likely price elasticity factors such tariffs are seen **primarily** as a demand regulator rather than as a provider of additional revenue.

Further conclusions and recommendations with respect to the best institutional arrangements to achieve economic viability are contained in chapter 8.

10.7 INTRODUCING COST RECOVERY FOR EXISTING SCHEMES

Along with the current investment programme to expand coverage there is an urgent need to start an equally well resourced National strategy to enhance the capacity of communities and other local structures to manage small water schemes and the distribution portions of regional schemes, and to introduce meaningful cost recovery. As well as strengthening institutional arrangements, before cost recovery is introduced for existing schemes it may also be necessary to increase the quality of service and it will be necessary to draw up a budget of what costs are to be recovered and from whom. This planning must be done within a framework of consultation and negotiation between the prospective customers and the fledging water service provider because households will only pay for water when they accept:

* the level of service as being adequate and reliable,
* the price of the water delivered as being equitable, and
* the authority of the water service provider as being sound.

For residents of developing urban communities:

* adequate does not have an absolute definition but its meaning is influenced by expectations which in turn are influenced by the degree of community participation in negotiating the charges for the different levels of service,
* reliable means the operation and maintenance of the scheme is effective,
* equitable pricing means paying the same price per kℓ of water used as other

customers with the same level of service and paying less per kℓ of water used as the level of service drops, and

* assuming equitable pricing and effective operation are in place acceptance of the water service provider's authority is secured through a mixture of the customers respecting the integrity of the institution and realising that water will be disconnected if bills are not paid.

Chapter 9 contains additional guidance on the right questions that need to be answered before introducing cost recovery and on how to obtain answers which will facilitate solving any problem answers which are encountered.

This study does not supply any easy answers for achieving full cost recovery from water schemes supplying developing urban communities. We do however believe it will assist all stakeholders involved in implementing such strategies to plan better for long-term sustainability. Since communities and their environment vary from district to district, decisions will continue to be made under conditions of incomplete and even poor information. It is therefore important to adopt an attitude of flexibility and patience whilst remaining focused on the broad aim of ensuring the long-term sustainability and economic viability of such schemes.

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APPENDIX "A": NOTES ON DOMESTIC WATER METERS (Bailey 1995)

The smallest water meters currently available in South Africa are designed for flow rates from about 25 ℓ/hr to approximately 3 000 ℓ/hr. Below approximately 4 ℓ/hr they do not register any flow and generally under-register for flows up to 25 ℓ/hr. The under-registering at these low flows is significantly higher for inferential turbine meters than for semi-positive displacement type meters. Table A.1 below sets out the results of a set of tests carried out on a random sample of new meters.

Table A.1: Results of a set of tests carried out by Kent Measurements (Pty) Ltd in their laboratory on a random sample of new meters to check their accuracy at low flows.

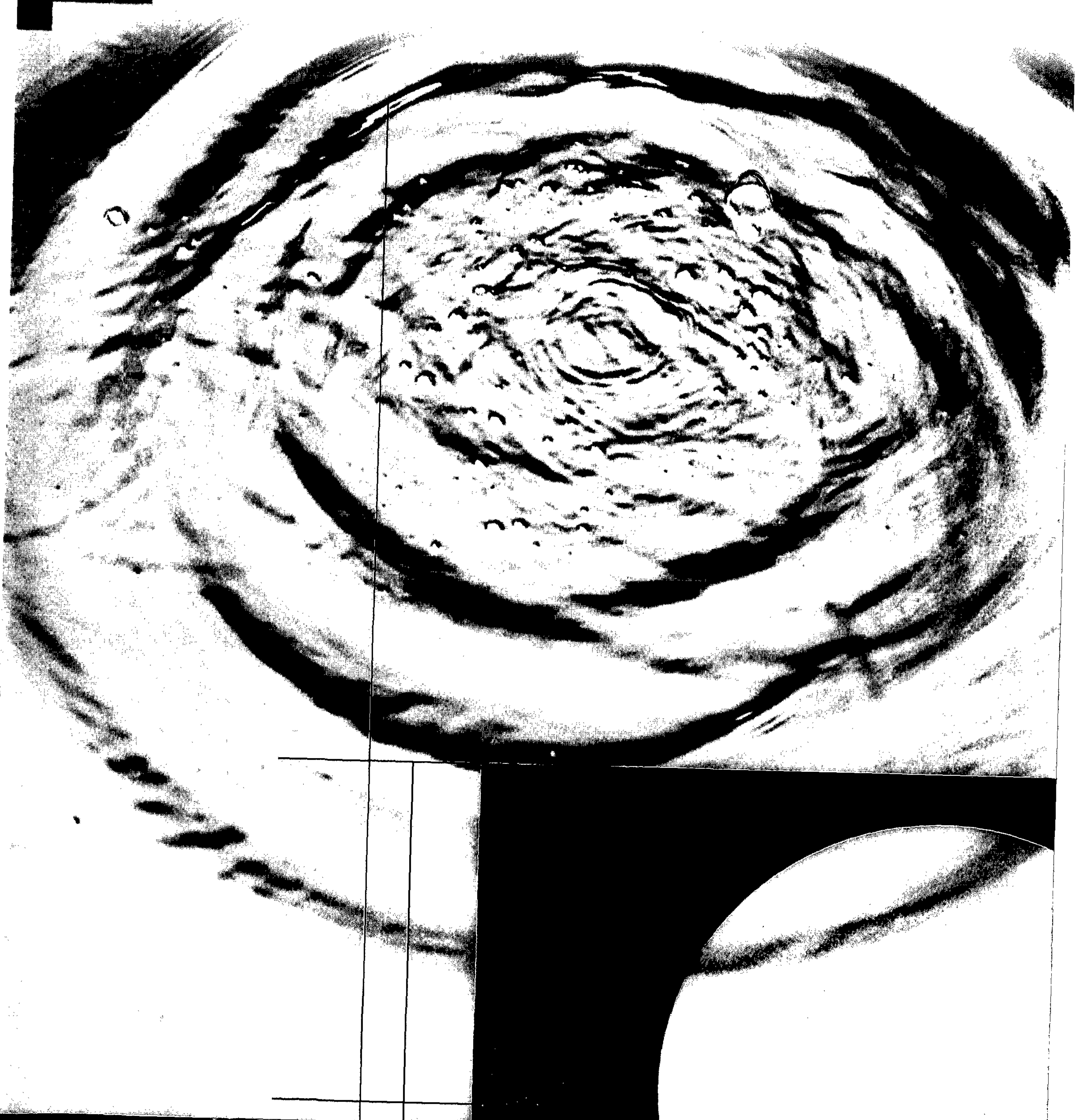
Semi-Positive Displacement Meters					
Sample 1			Sample 2		
Flowrate ℓ/hr	Vol. Recorded in 10 ℓ test	Error %	Flowrate ℓ/hr	Vol. Recorded in 10 ℓ test	Error %
6,3	9,54	-4,6	7,0	9,39	-6,1
11,0	9,96	-0,4	9,7	9,63	-3,7
12,0	10,00	0,0	12,0	9,76	-2,4
15,0	10,08	+0,8	15,0	9,84	-1,6
20,0	10,10	+1,0	21,0	9,92	-0,8
25,0	10,14	+1,4	26,0	10,00	0,0

Inferential Turbine Meters					
Sample 1			Sample 2		
Flowrate ℓ/hr	Vol. Recorded in 10 ℓ test	Error %	Flowrate ℓ/hr	Vol. Recorded in 10 ℓ test	Error %
7,3	6,4	-36,0	7,1	6,80	-32,0
10,0	8,65	-13,5	10,0	8,34	-16,6
13,0	9,38	-6,2	13,0	9,16	-8,4
16,0	9,75	-2,5	15,0	9,60	-4,0
20,0	10,02	+0,2	20,0	9,95	-0,5
26,0	10,13	+1,3	24,0	10,13	+1,3

(All results were recorded using a 10 litre calibrated cylinder for verification. Percentage error = {error ÷ 10} x 100. For example for sample 1 at a flow rate of 6,3 ℓ/hr registered a volume of 9,54 ℓ when the 10 litre calibrated cylinder was full. Therefore error = 9,54 - 10 = -0,46 and the percentage error = {0,46 ÷ 10} x 100 = -4,6 %.)

Both inferential turbine meters and semi-positive displacement meters are covered by the Trade Metrology Act applicable to Domestic Water Meters as amended and published in the Government Gazette No. 8351 27 August 1982. They must flow full to give accurate measurements. Ideally they should have a small back pressure (say +0,5 m H_2O gauge) on them to ensure that no cavitation takes place. With respect to the maximum pressure drop allowed across a flow meter, this is covered by the act but losses through the semi-positive displacement type tend to be marginally higher. During the distributed storage unit field tests semi-positive displacement type meters were placed at the outlets of the units just upstream of the outlet valves. They operated satisfactorily without cavitating and without causing any noticeable restriction on the outflow.

Both types of meter are uni-directional but whilst the turbine type must be installed with its flow-axis horizontal, the semi-positive displacement type may be installed with it flow-axis in any direction. If the water is likely to be in anyway turbid or gritty the turbine type is likely to give the better service. If either type of meter is taken out of service to check its condition or to install it in another position it is advisable to keep it full of water. If not any dissolved solids in the water may precipitate out in the meter and reduce the flow reading until they become redissolved or worn away.



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