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A WATER PRICING STUDY

FOR

THE REPUBLIC OF ZAMBIA

VOLUME ONE

September 1983

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NORWEGIAN INSTITUTE FOR WATER RESEARCH

Svein Stene Johansen
Project Manager

PREFACE

The Norwegian Institute for Water Research (NIVA) was in March 1981 engaged by the Norwegian Agency for International Development (NORAD) to undertake a Water Pricing Study for the Western Province of Zambia.

The report including the recommendation for a new water tariff structure for Western Province was presented in October 1981.

The Department of Water Affairs, however, felt that a National Study was required in order to establish a National Water Tariff Structure.

NORAD agreed to finance the extension of the Study and a Contract between NORAD and NIVA was signed in September 1982.

The same Project Team as for Western Province was used. However, the team was extended by one water engineer.

The Project Team consisted of:

Mr. David G. Browne, Agricultural and Water Resources Economist
Mrs. Mette Jørstad, Social Anthropologist
Mr. Torbjørn Damhaug, Water Engineer
Mr. Svein Stene Johansen, Project Manager.

The two latter are permanently employed by NIVA, the two other persons hired as sub-consultants.

The Project Team visited Zambia in August-December 1982 and had discussions with relevant authorities at central, provincial, and local levels. The team also met members of the Department of Water Affairs (DWA) staff as well as many water consumers.

In order to provide data for the main report and NIVA's recommendations to the Zambian Government, socio-economic surveys covering various topics which have a bearing on consumer's ability and willingness to pay were carried out by the economist and the social anthropologist. Both surveys *are based on the same questionnaires and methodology. These surveys were meant to be independent studies at the responsibilities of the authors. The result of the surveys are presented as Appendix I and II to the main report. Technical Findings are presented as Appendix III.*

Svein Stene Johansen
Project Manager

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SUMMARY AND RECOMMENDATIONS

Objective

The objective of this report is to examine DWA's present pricing policy and to recommend an appropriate tariff structure for the 1980's.

Present Rate and Revenue Situation

DWA's water rates have fallen well behind inflation. The rates that were in force when DWA took over the township water supplies from PWD in the early 1970's were not increased until January 1979. That increase failed to make up the ground lost to inflation in the 1970's. Since 1979 rates have not been increased whilst costs have almost doubled. In real terms individual connection rates, at K4-5, are only one third, and communal rates at K1, are only one half, of those of ten years ago. In addition, the authorities are only collecting approximately one third of the revenue expected from the present price structure. This is partly due to a revenue collection failure, councils are only collecting 50% of expected revenue, and partly due to a failure to charge for water on a quantity used basis as intended by the tariff structure. Furthermore, councils are only handing over approximately half of the revenue that they collect. Thus the revenue that DWA is actually receiving only represents one quarter of the revenue expected from the present flat rate method of charging. In fact DWA's income covers under 10% of all its direct and indirect recurrent township water supply expenditure.

DWA's Present Financial Position

As a result of insufficient Treasury funding DWA is facing a financial crisis. The limited capital allocations mean that necessary augmentations are not being made, consumer demands are not being met, and supplies may even be deteriorating. Furthermore, authorised recurrent expenditures are significantly less than DWA's requests and are inadequate. If recurrent financial allocations are not increased, existing assets may not be fully utilised, for example pumping hours may be restricted. In addition, the supplies are likely to deteriorate due to inadequate maintenance.

A Limited Augmentation Strategy

The present capital cost of a new typical township supply/major augmentation is estimated at close to K2 million. However, the consultants found that at some supplies minor investments could significantly increase the quantity, and/or improve the quality, of the water available. In some cases the increase in capacity may still fail to supply today's peak requirements. In others the period for which the investment would allow all demands to be met may be quite short. But the crucial factor is that it would represent an improvement and allow a higher proportion of present and future demand to be satisfied. Furthermore, the total period required for planning and implementing most of these proposals would be very short. The overall average cost is estimated at just over K100,000 per supply.

It is, therefore, contended that when there isn't much money available for water supply development there may be considerable merit in a piecemeal approach. The application of limited development finance for small augmentations could lead to significant improvements at many supplies even though the solution proposed would be sub-optimal in a situation where more resources were available.

Present and Future Costs

The present overall average recurrent cost of a township supply including provincial overhead costs is close to K50,000 per annum, over 60% of which represents staff and labour costs. If a supply is not augmented, or if a limited augmentation is undertaken, this cost will not increase significantly during the 1980's in real terms. However, where major augmentations are undertaken this cost may increase by 70%. Furthermore, while the annual capital costs of a limited augmentation may typically only be K10,000, thus increasing the total annual cost to K60,000, the annual capital costs of a typical major augmentation will increase the total annual cost to well over K250,000.

The overall average unit production cost of water during 1983-8 will be around 30 n/m^3 at supplies where no, or a limited, augmentation is undertaken. However, at supplies where a major augmentation is undertaken the corresponding cost would be 90 n/m³.

Metering

Precise metering decisions will not be able to be made until there is better data available, particularly on the effect that metering has on consumption. Nevertheless, it can be concluded that:-

(1) All major consumers must be metered.

(2) At supplies where the unmetered demand approaches or exceeds capacity, i.e. at most DWA supplies, universal metering is justified. The costs of metering will be justified by either; (a) capital cost savings of major augmentations, provided that the effect of metering is taken into account at the design stage, or (b) permitting existing capacity to meet demands for a longer period in the future and thereby allowing a significant delay in incurring development expenditures. Furthermore, based on a foreign exchange saving analysis metering is even more favourable than it is from a purely financial point of view.

At supplies where there is considerable spare capacity, for example at supplies where major augmentations have recently been completed, metering can only be justified at the moment by variable cost savings. In this case metering should be restricted to major consumers unless variable costs exceed 4 n/m³. Low cost consumers should only be metered if variable costs exceed 10 n/m³.

Since the estimated current variable costs at supplies using electricity average only 4-5 n/m³, low cost consumers should only be metered at supplies where diesel is used and where variable costs may be as much as 20 n/m³.

Although metering is justified by cost analysis, the recommendation to pursue a policy of universal metering must also take a number of other factors into consideration. The most important is the willingness of DWA/councils to charge for water on a quantity used basis and their ability to enforce this pricing method. If this cannot be achieved there is no point in incurring the costs of metering. Secondly, the authorities must have the capacity to handle the technical and administrative burden that will result from universal metering.

It is, therefore, suggested that while universal metering is recommended for most supplies, DWA/councils should only install the number of meters that they can adequately service, both technically and administratively. Since it would be worthwhile to devote resources to building up this capability, it is hoped that donor assistance will be made available in order to achieve this objective.

Wastage

Serious efforts must be made to reduce wastage. Gardening restrictions may have to be introduced and consumers who contravene such regulations must be dealt with severely.

Communal Standpipe Payment

Whilst:-

(i) the consultants are sceptical as to whether water rates can be collected successfully from communal point users other than council employees and council tenants,

(ii) a free communal point policy has social merit, and

(iii) revenue from communal points has a very limited effect on overall revenue, (the consultants estimate that communal point revenue will constitute less than 10% of total revenue); it is proposed that since the majority of senior DWA officials oppose a free policy, efforts should be made to collect revenue:-

A number of possible courses of action were examined. These together with the consultants'conclusions are as follows:-

Possible Course of Action	Conclusion
(1) Lock communal points	Would cause too many problems.
(2) Refuse repairs of a standpipe until arrears are paid	Has merit if the problem of only some consumers paying can be overcome.

Possible Course of Action	Conclusion
(3) Report offenders to heads of department	Insufficient by itself.
(4) Involve the Party	Not a solution.
(5) Mount an education campaign	Necessary, but by itself insufficient.
(6) Deduct government employees rates at source from salaries	Unlikely to work smoothly.
(7) Supervision of standpipes	Full-time supervision would be too expensive but partial supervision has considerable merit and is the consultants' recommended strategy.
(8) Water kiosks	A practical solution that would yield revenue but which requires a political judgement.

Hence DWA should pursue a policy of partial standpipe supervision. But even this optimum policy is not certain to be successful.

Connection Fees

For all consumers other than those living in low cost housing, it is recommended that the connection fee should reflect the full costs of making the connection. Since the cost of a ½" connection is estimated at K250, DWA should increase the fee for medium and high cost housing domestic consumers to this figure. It is also recommended that the present practice,whereby consumers who need a connecting line in excess of 30 metres must pay for the additional pipes, be continued. The minimum rates for larger connections should be increased to K450 and K1350 for 1" and 2" connections respectively. Where actual cost exceeds these figures, the consumer should be charged actual cost. All these connection fees should be increased every 2 years in line with actual cost increases.

However, there is a good case for subsidising the connection fee of low cost housing consumers and it is proposed that the fee for these consumers remains at K100 until the standard fee for other consumers is increased above the currently proposed figure of K250. However, as this subsidy is substantial, low cost consumers requiring pipes in excess of

30 metres should be charged for those additional pipes.

It is also proposed that the above connection fees should be charged whether or not a meter is fitted.

Basis for the Proposed Tariff

The cost of producing water, ignoring the capital costs of major augmentations which DWA could not hope to recover, i.e. the costs of administration, operation and maintenance and of minor augmentations is around 30 n/m³. This means that the cost of water supplied is around 36 n/m³ due to leakage and other losses. However, leakage is only part of the water produced for which DWA will be unable to collect revenue. The consultants estimate that revenue will only be collected for 51% of all water produced. Hence, in order to cover all operation and maintenance and limited augmentation costs, DWA would need to charge 60 n/m³.

For a typical 7 person family living in high/medium cost housing and consuming 250 l.c.d. a rate of 60 n/m³ would represent a monthly rate of about K32. The socio-economic survey showed that only a minority would be willing to pay this figure. For a typical 7 person household living in low cost housing and consuming 100 l.c.d. from their own connection, a rate of 60 n/m³ would represent a monthly rate of about K13 per month, again well above the average willingness to pay.

Hence it is recommended that the major criteria in determining DWA's rates should be consumers' maximum ability and willingness to pay for water. These are summarised below:-

Summary of Average Ability and Willingness to Pay for Water

	Ability to pay (K/month)	Willingness to pay (K/month)
For individual connections:-		
High cost housing	20	25
Medium cost housing	12.5	15
Low cost housing	5	-

	Ability to pay (K/month)	Willingness to pay (K/month)
For communal point access:-		
Low cost housing	3	2
Informal housing	1.75	2.10

Proposed Tariffs

Since it is considered impractical to charge different rates to medium and high cost housing residents, the following rates are proposed as the maximum flat rates that should be levied in providing consumers with the "design criteria" consumption.

High and medium housing cost families	-	K15 per month
Low cost families with own connection	-	K 6 per month
Communal standpipe consumers	-	K 2 per month

These represent rates of approximately 28 n/m³ for house connection consumption and 23.5 n/m³ for communal standpipe consumption.

However, as it is recommended that all major consumers are metered immediately and that universal metering is adopted as soon as DWA develops the necessary technical and administrative capability to handle the problems of metering, the above rates for domestic consumers with their own connections are only applicable prior to widespread metering. The following rates are recommended for metered consumers:-

High and medium cost domestic, institutional, industrial and commercial consumers	K10.50 for the first 35 m³/month and K0.50/m³ for additional consumption
Low cost domestic consumers	K4.00 for the first 20 m³/month, K0.30/m³ for the next 15m³/month, and K0.50/m³ for additional consumption

It is proposed that these rates be charged at all supplies, i.e. that there should be a uniform national pricing policy. However, where supplies are especially unreliable it is proposed that unmetered consumers' monthly rates should be reduced to the minimum rate applicable to metered consumers.

It is very important that these rates are increased in line with costs and inflation. It is therefore proposed that they be increased every second year by the percentage needed to achieve this objective.

The Financial Implications of the Proposed Policy

Even these dramatically increased rates will not enable DWA to cover all its recurrent costs including all allocable overheads, let alone contribute towards capital costs.

It is estimated that, based on the assumption that costs will be increased in line with inflation, revenue will cover the following proportions of costs during the period 1983-8:-

(i) at supplies where no augmentation is implemented, between 40% and 50% of recurrent costs.

(ii) at supplies where a limited augmentation is implemented, between 60% and 70% of recurrent costs, and between 50% and 60% of all costs including annual capital costs.

(iii) at supplies where a major augmentation is implemented, between 40% and 50% of recurrent costs and between 15% and 20% of all costs including annual capital costs.

Hence, whatever augmentation strategy is adopted the proposed rating policy is unlikely to enable DWA to cover much more than 50% of its total recurrent costs of the township water supplies.

However, the new rates will enable DWA to more than cover its short term variable costs, i.e. chemical and energy costs. Although these costs at diesel operated supplies may exceed revenue, at supplies operated with electricity these costs will only represent one quarter of revenue.

Rate Payment Encouragement

At present a major contributory factor to the low level of collection is the fact that consumers who do not pay their bills, notably government institutions, are not disconnected as they should be according to the existing theoretical disconnection policy. Since disconnection is an effective method of enforcing rate payment it is vital that DWA does all it can to ensure that a disconnection policy for non-payment of water rates is strictly enforced. In order to achieve this objective it is proposed that disconnection teams be established. It is also suggested that as an additional deterrent the reconnection fee be increased to K40, K80 and K80 + 10% of outstanding arrears, for low cost domestic, high cost domestic and other consumers respectively. In addition, a system of water rate deposits would have considerable merit in that whenever a consumer has to be disconnected, DWA would be able to recover part, or all, of the outstanding arrears from the deposit. However, it is recommended that such a system should not be introduced until revenue accounting improves.

Responsibility for Township Water Supplies

In the longer term it may be appropriate, within the context of the decentralised programme, for DWA to relinquish control of the township water supplies to the district councils. This would need to be accompanied by the transfer of many DWA staff to the councils. However, schemes should not be handed over until the councils together with the transferred staff, are capable of operating and maintaining the supplies efficiently.

Consequently for the time being, DWA should continue to be responsible for the township water supplies that it currently operates. However, the present arrangement whereby councils collect revenue on behalf of DWA is unsatisfactory in most townships. Councils' clerical efficiency and revenue collection performance is poor; they only remit part of the revenue collected, on average 50%, to DWA; and they fail to provide DWA with the information necessary to enforce a strict disconnection policy. Hence it is recommended that as long as DWA is responsible for financing the operation and maintenance of the township supplies, it should also be responsible for revenue collection. In order to ensure that DWA performs the administrative tasks more efficiently than the councils have been doing, a training programme for its clerical staff is needed. It is therefore proposed that a donor be requested to provide a training officer to establish the necessary programme.

Recommended Pricing Policy for Rural Water Supplies

Rural water supplies must be provided free of charge. Rural consumers have a very limited ability and willingness to pay for water and the policy has considerable social merit. The problems of regular collection would impose a major administrative burden. If the rates were set at a very low level the costs of collection would take a major part, if not all, of the revenue collected. But if higher rates were charged, and in the unlikely event that payment was successfully enforced, the consumers would simply revert to using their traditional sources.

Although a limited willingness to pay for repairs exists it is unlikely that any collection procedure could be successfully adopted on a wide scale.

ABBREVIATIONS

DWA	Department of Water Affairs
PWE	Provincial Water Engineer
IBRD	International Bank for Reconstruction and Development
ZESCO	Zambia Electricity Supply Corporation Limited
CPC	Copperbelt Power Company
UNIP	United National Independence Policy
MP	Member of Parliament
ZNPF	Zambia National Provident Fund
O & M	operation and maintenance
c.w.p	communal water point
i.c.	individual connection
r.w.s	rural water supply
l.c.d.	litres per capita per day
p.a.	per annum
K	kwacha
n	ngwee
NIVA	The Norwegian Institute for Water Research

1. INTRODUCTION

In 1981 the consultants prepared a report "A Water Pricing Study for Western Province, Zambia" for the Zambian Government. Not unnaturally DWA felt unable to implement increased water rates in one province alone. At the same time it was hesitant to request government approval for major pricing changes nationwide when the study was based on only one province. Consequently this study largely represents an extension of that work to the national level.

The major objective remains unchanged, to examine the present pricing policy being followed by DWA and to recommend an appropriate tariff structure for the 1980s. Again while rural supplies are not neglected, major emphasis is on township water supply schemes because they are more important in terms of costs and potential revenue, and because the issues involved are more complex.

As before the study has centered on supplies operated by the client, DWA, but some consideration has also been given to council operated supplies. The main reasons for this were:-

(i) in a national study it is useful to examine the relative costs of supplying water and any differences in the appropriate pricing policy, between the smaller DWA township supplies and the large urban schemes.

(ii) it is hoped that this document will be a useful tool for a wider audience than DWA. For example, for financial secretaries in presenting their case to their councils and the government on politically sensitive issues such as increasing water rates, enforcing disconnections, etc. for which it is usually difficult to obtain permission.

Issues which have a bearing on pricing policy are examined and explained in detail so that the reader can understand the reasoning behind the consultants' recommendations. The client and other authorities will, therefore, be able to determine the merit behind the various recommendations and which proposals are suitable for implementation.

Many of the analyses in this report depend upon a number of subjective assumptions. The consultants, while believing that their assumptions are realistic, make no claim to precision. Hence, in a number of situations the reader may wish to alter certain variables in order to determine the subsequent result. In such cases the consultants have attempted to present their calculations in such a way that new figures can easily be slotted in and the calculations reworked by the reader.

This type of report will usually reflect the views of the officials of the client agency to a major extent. While the consultants are responsible for the views expressed and while their own fieldwork may result in their disagreeing with certain views expressed by DWA and other officials, they will frequently be convinced by the views put forward by persons who have long experience of dealing with the local situation and problems. In fact it can be argued that a major function of consultants, other than bringing their wider experience to bear on a specific country or situation, is to reflect the views of local officials. They can supposedly do so in a more articulate way than junior personnel, and have more time than senior officials to concentrate on a narrow range of issues. It is only to be expected, and certainly hoped that at times DWA officials will feel that they are only reading what they already know.

The consultants found that the basic data situation had not improved since their visit in 1981. This is partly due to the slow provision of a cost accountant by donors, but it is understood that this has now been remedied. The comments in the Western Province report that data was sometimes not available, of doubtful quality, and even contradictory still apply. Consequently the consultants have again had to depend on data with limited reliability. Fortunately no evidence has emerged to suggest that earlier guesstimates were not reasonably sound. Hence, it is believed that they together with the data gathered during the recent fieldwork have produced figures which are perfectly adequate for establishing a sound basis for determining an appropriate water pricing policy for DWA.

2 PRESENT FINANCIAL SITUATION

2.1 Present Water Pricing Policy

At present Government policy is that urban water supplies should be financially viable and should generate sufficient revenue to cover all their costs, including their capital costs. Section 4.6 shows that with significant, but still acceptable increases, the large urban supplies should be able to achieve this goal. However, the smaller township supplies, i.e. the supplies operated by D.W.A. cannot possibly meet this target if large augmentations are undertaken to provide consumers with all their needs. Therefore the present policy for smaller township supplies is that they should cover their operation and maintenance costs. Phrases such as "steps should be taken to increase the revenue so that it meets, at least the direct expenses of operation and maintenance" have appeared in D.W.A. policy statements. The direct expenses usually being listed as (i) staff costs of the direct work force, (ii) electricity, diesel, lubricants and chemicals and (iii) normal maintenance of buildings, machinery and equipment.

At the time of the last rate increase in 1979 it was stated that it was hoped that with the proposed rates, supplies will be run on a "no profit no loss basis". It was indeed just a hope, although it was recognised that "in line with this policy we should identify where and by how much revenues fall short of operation and maintenance costs and the reasons why". Section 2.10 presents an attempt to estimate the relationship between revenue and recurrent costs. Unfortunately, it demonstrates that at present the revenues from township water supplies are failing dismally to cover recurrent costs. The viability of this target in the future is examined later in this report.

2.2 Present D.W.A. Water Rates

The current rates for township water supplies are presented in Table 2.1 overleaf.

Table 2.1

Present and Previous Township Water Rates

Type of Connection	Current Tariff	Previous Tariff
Metered connections	K4 for the first $35m^3$ or part thereof	K3* for the first $32m^3$ or part thereof
	Consumption above $35m^3$/month is 18n per m^3	Consumption above $32m^3$/month was charged at 9-11n per m^3
Unmetered connections	K5 per month	K4* per month
Communal tap	K1/month/family	K0.45/month/family
Connection fee	K100 including one length of pipe	K25 including one length of pipe
Reconnection fee	K5	

* With some variations from town to town.

Usually metered consumers are charged the minimum rate of K4 per month and rarely have to pay for consumption above $35m^3$, i.e. meter readings are usually ignored when consumers are billed. Katete was the only township where the consultants were able to verify that an effort is being made to charge metered consumers on a quantity used basis at $18n/m^3$ for use in excess of $35m^3$. Most consumers without meters are charged the official rate of K5/month.

However, the fieldwork showed that in some towns, for example Serenje and Mumbwa all domestic consumers pay the same amount, either K4 or K5 whether or not they have a meter. Where K4 is charged those without meters are paying K1 less that the official rate and where K5 is charged, those with meters are paying K1 more than the official rate. These modifications to the official rates are in fact more equitable and sensible than the common situation where one unmetered consumer is paying K5, but where another consumer having a meter that has been useless for years is paying K4 simply because he has a meter. Unless metered consumers are charged on a metered consumption basis, there is no reason to differentiate between the two groups of consumers.

Institutions are occasionally billed on a quantity used basis and this can result in bills of several hundred Kwacha per month. But in most townships even these large consumers are charged flat monthly water rates, but the rates that they are charged vary dramatically between townships. In some locations even the largest consumers are only charged the domestic rate of K5 per month. But at the majority of supplies large consumers such as schools, hotels, hospitals and police are charged higher rates. Unfortunately, there is no consistency and the basis for the flat monthly rates often appears to be rather arbitrary. Secondary schools are charged rates of anything from K5 to several hundred Kwacha. In some provinces for example in Western Province, most major consumers are charged from K10-K30 per month but elsewhere for example in Eastern Province, higher rates are levied. Often the higher flat rates in a township are around K50-K60 per month but some institutions which pay on a flat rate basis are charged much higher rates. For example the police camp at Nyimba is charged K249 per month. The secondary school in Mkushi is charged K300 per month.

Those consumers who pay for access to communal taps pay K1 per month but as is discussed in Section 8.1, many consumers do not pay. Government and council employees who have the fee deducted from their salaries form the majority of those who pay. Sometimes communal taps are provided free to consumers since a number of councils, for example Mumbwa, gave up trying to collect rates from communal point consumers several years ago.

All D.W.A. water rates are very low compared to the costs of operating the supplies. This is largely due to two major factors (a) inflation and (b) the political difficulties associated with increasing water rates. The latter means that D.W.A. has not always been able to increase the rates as often, or as by as much, as it would have liked. The present tariffs were first proposed in June 1977, but were not implemented with Government approval until January 1979. In addition, Government did not sanction an increase in the unmetered connection fee to K6. In fact it was probably correct since it would have increased the illogical fee differential between metered and unmetered connections. But this reason was not given, it was simply considered to be too large an increase.

Consequently, D.W.A.'s water rates have been allowed to fall behind D.W.A.'s costs. The extent to which rates have been outstripped is shown in Section 2.3. However, D.W.A. is not the only agency facing the problem of Government reluctance to increase public utility prices. For example ZESCO has faced long delays in obtaining Government approval for any price increases, the approvals may be limited to certain categories of consumers, for example industrial, and their proposed increases are sometimes modified. During a period when only two increases, one of 10% and one of 25% have been permitted, costs have increased by well over 100%.

Permitting rates for public services to get out of line with higher costs resulting from inflation must be seriously examined by Government, and is discussed in Section 10. 2.

A major justification given for the 1979 increases in D.W.A. water rates was "to improve the management of the Township Water Supply System". However this is fallacious reasoning. Rate increases are not directly reflected in DWA's budget since the revenu goes directly to the Ministry of Finance. Furthermore, the rate increase made a very small difference to the subsidy needed by DWA and would have had little, if no effect on the quality of management. The justification for the increase should have been to realign rates with policy, i.e. with marginal costs or whatever. Inflation having caused rates to get out of line with costs, there were serious dangers of mis-allocation and misuse of scarce national resources.

2.3 The Extent to Which D.W.A.'s Water Rates Have Been Outstripped By Costs

Over the last decade the costs of constructing and operating water supplies have increased dramatically while there has been just one minor increase in water rates.

The determination of the actual increase of the cost side of the equation is rather difficult. For example between 1975 and 1980 the cost of fixed capital formation increased by 185.5 percent while the cost of building materials only increased by 97.2 per cent. However, an inspection of all available indices leads the consultants to the following estimates of development costs:-

1975-8	23% p.a.
1979	16% p.a.
post 1979	12% p.a.

However, discussions with consultants who have been working in Zambia over the last few years suggested that the post 1979 figure was a slight under-estimate. In addition the rate of increase in the costs of operating water supplies in the mid 1970's was well below the cost increase in construction. Hence an overall rate of 15 percent per annum will be used for the increase in D.W.A.'s costs for order of magnitude estimates.

The rates which were in force when D.W.A. took over township water supplies in the early 1970's from P.W.D. were not changed until 1.1.79 Inspection of the files and enquiries to long serving D.W.A. personnel failed to reveal when these rates had been introduced. However it was prior to 1973.

Table 2.2 presents water rates prior to and after 1979, together with the consultants' estimates of what water rates would be today if they were similar in real terms to those of 1973 and 1979.

It can be seen that the present rate for unmetered connections would be K9.4/month if D.W.A. was currently charging the same price in real terms as prevailed at the time of the last increase in January 1979. The corresponding current price for metered connections would be K7.5/month for the first $35m^3$/month and $34n/m^3$ for additional consumption. The corresponding price for communal standpipe consumers would be K1.9/month. Hence in real terms, today's prices are well below those of 1979. However, they are even further out of line with those of the early 1970's because the price increase in 1979 only made up a part of the ground lost to inflation during the 1970's. In order to be the same in real terms as the rate of ten years ago, the unmetered connection rate would have to be K16.2/month, i.e. more than three times the present rate. The other corresponding figures are; metered connections K12.1 per month plus $45n/m^3$ for consumption in excess of $35m^3$/month, and communal standpipe users K1.8 per month. Thus all current individual connections rates are, in real terms, only one-third of the 1973 rates. Furthermore, present day rates are even more out of line with those from the time of the previous rate increase up to 1973.

Table 2.2

Comparison of Water Rates in Real Terms

	Water Rate prior to 1979	Water Rate from 1979	Equivalent present day rate Compared to rates in 1973	Equivalent present day rate compared to rates when they were last increased in 1979
Unmetered connections (K/month)	4	5	16.2	9.4
Metered connections (K/month)	3	4	12.1	7.5
- additional use (n/m3)	11	18	45	34
Communal standpipes (K/month)	0.45	1	1.8	1.9

2.4 Present Council Water Rates

Table 2.3 presents the rates charged for water by ten different councils. It can be seen that although price levels differ their rate structures are similar and the current average water rates of council supplies are as follows:

	Minimum Charge	Rate for additional use (K/m^3)
Low Density Housing	K6.00 ($36m^3$)	K0.20
High Density Housing	K2.00 ($20m^3$)	K0.20
Industrial/Commercial	K10.00 ($36m^3$)	K0.25

Where flat rates are levied, they are similar to the minimum charge for metered consumers.

Table 2.3 shows that most councils have increased their rates in the recent past, but that the increases have been rather limited. In general, council rates are somewhat higher than the rates charged by D.W.A. but it should be noted that if D.W.A. implements the proposals of this report (cf. Section 10.5) it will be charging for higher rates than the councils. However, a comparison of D.W.A.'s costs (cf. Chapter 3) with councils' costs (cf. Section 4.2.3) shows that D.W.A. has to contend with higher unit costs of production.

The large councils' pricing policy up to 1975 was to charge lower rates for high consumption. Although this is a rational policy when there is a lot of spare capacity it was no longer appropriate for many urban supplies in Zambia in the 1970's when the demand of many schemes approached or reached the capacity of the supply.

In 1975 the policy was revised so that reasonable fixed rates for every category of consumer were charged for the first 8000 gallons, ($36m^3$) and higher rates were charged for higher consumption. However, the higher rates were, other than for the high density housing category which was charged a very low rate for its basic consumption, only marginally higher than the effective unit rate for the first 8000 gallons. The most important divergence is that Lusaka still charges its largest consumers on a reducing rate/increasing use basis.

A major feature of all these supplies is that despite recent increases rates have been falling in real terms. The overall average increase over the last five years is well under 50%. During this period costs of operation have doubled.

Table 2.3

Council Water Supply Rates

Council	Date of implementation	Low Density Residential: Minimum charge (K/month)	Low Density Residential: Quantity allowed at minimum charge(m^3)	Low Density Residential: Rate for additional use (n/m^3)	High Density Residential⁺: Minimum charge (K/month)	High Density Residential⁺: Quantity allowed at minimum charge(m^3)	High Density Residential⁺: Rate for additional use (n/m^3)	Flat⁺ rate (K/month)	CWP flat rate (K/month)	Non-residential. Usually industrial and commercial: Min charge (K/mth)	Non-residential: Quantity allowed (m^3)	Non-residential: Rate (n/m^3)
Livingstone now	1/3/82	6	40	10	2	25	15			10	25	15
Livingstone previously		4	36	7	1	18	7			6	18	10
Kitwe now	1/7/82	4.6	31	15	3.57	36	15	3.57	1.10	4.6	31	15
Kitwe previously	1/11/81	4	31	13	3.10	36	13	3.10	1.10	4	31	13
Kitwe proposed	during 1983	6.5	32	20	5	30	20	4	3.00	7	28	25
Luanshya now	1/7/82	6.5	36	17	only flat rates			3.5	1.5	8.5	45	18
Luanshya previously	1/1/80	5.5	36	16				3	1.2	7	45	18
Mufulira	1/7/82	8(1)	36	16.5	only flat rates			3.85	-	15	36	20
		4.8	36	16.5				3.50		10	54	20
Kabwe	1/7/82	4	18	11				2.50		15 small commercial 25 industrial	45	11
Chingola now	1/10/81	6.5	36	20	2.8/2.0(2)	18	next 18 m^3 16.7 then 20			10	36	33
Chingola previously	1/5/78	4	36	16.5	2.0/free(2)	18	next 18m^3 11 then 16.5			4	36	16.5
Chipata	1978	6.4	36	20	flat rates			4	2	8	36	30
Kasama	1/12/78	6.4	36	20					1	8	36	31

Cont.

Table 2.3 cont'd

Council Water Supply Rates

Council	Date of implementation	Low Density Residential: Minimum charge (K/month)	Low Density Residential: Quantity allowed at minimum charge(m^3)	Low Density Residential: Rate for additional use (n/m^3)	High Density Residential+: Minimum charge (K/month)	High Density Residential+: Quantity allowed at minimum charge(m^3)	High Density Residential+: Rate for additional use (n/m^3)	Flat+ rate (K/month)	CWP flat rate (K/month)	Non-residential. Usually industrial and commercial: Min charge (K/mth)	Non-residential: Quantity allowed (m^3)	Non-residential: Rate (n/m^3)
Lusaka now	1/5/82	5.5	36	22	1.80	23	25	-	1.35	8.4	36	25**
previously	1/1/81	5	36	20	1.65	23	22			7.6	36	22**
					1.25(CT)							
"	1/1/80	4.5	36	20	1.65	23	18			7.1	36	20**
					1.25(CT)							
"	1/1/76	4	36	18	1.65		18			6.4	36	18**
Ndola now	1/1/82	6	37.5	16	flat rate			4.5	1(3)	6	31.5	19 Ind
Ndola previously		3.6	36	13				3	1	3.6	36	16 Comm 15

\+ In practice flat rates are usually charged in high density areas.

(1) In Mufulira there are some low density consumers (in council or private flats where there is only 1 meter for all flats) on a flat rate of K8/month (previously K4.80).

(2) The latter price is for site and service.

** reduces above 480m^3 to 22n, 20n, 18n, 15n respectively.
above 945m^3 to 20n, 18n, 15n, 13n respectively

(3) 1.50 where there are communal ablution blocks. Squatters 75 ngwee.

2.5 Consumers' Attitude to DWA's Present Rates

According to officers in charge of township water supplies, most consumers consider the present level of water rates perfectly acceptable. The majority would even be prepared to pay considerably increased rates. The amount that they would be prepared to pay is discussed in Chapter 5.

Nevertheless, it was pointed out that objections to current water rates do arise in townships, or local supply areas, where the service is extremely poor and unreliable. In such areas, consumers would like to be metered with a very low minimum monthly usage charge. They believe that they would pay less, but more importantly they would know they were actually receiving the water for which they were paying. At present many of these consumers feel that they are paying for more than they receive.

2.6 Analysis of the Present Price of Water as Implied by the Present Price Structure

(A) Domestic Consumers

The rates of K4 for the first 35n³ and 18n for additional consumption implies an overall rate of approximately 15n per m³.

The flat monthly rate of K5 implies a rate of just under 10n/m³ for a household of 7 persons consuming 250 litres per person per day. Where a flat rate of K4 per month is charged the corresponding implied rate is just under 8n/m³.

It is suggested that the main intention of the present price structure is that most consumers should pay the metered rate, even though this is impossible in practice.

(B) Industrial/Institutional Consumers

Again, although most institutional consumers pay flat rates, the intention was that these consumers should pay 18n/m³ for most of their consumption.

(C) Communal Standpipe Consumers

Based on a daily consumption/wastage of 40 litres per person per day, the current rate of K1 per month per household implies a rate of almost 12n/m³ for a typical family of 7 persons.

(D) Overall

Appendix G suggests that the division of water consumption is likely to be:-

Individual domestic consumers	46%
Institutional/industrial consumers	11%
Communal standpipe consumers	43%

The application of these figures to the implied rates for the respective groups results in an overall implied rate of 14n/m³. In practice, institutions are probably using considerably more water at present than has been projected for the future, due to the fact that they are currently escaping the financial implications of their current levels of usage/wastage. This could increase the overall implied rate by almost 1n/m³. Hence the present pattern of water use implies that 15n should be collected for every m³ of water consumed.

2.7 Current Unit Revenues

Table 2.4 compares the recent average annual revenues with water produced at nine township supplies visited by the consultants.

Table 2.4
Unit Revenue Implications of Collection

	Average water production (m³/day)	Recent average revenue (K/annum)	Unit revenue (n/m³)
Chizela	180	2500	3.8
Kabompo	700	7000	2.7
Kasempa	500	6000	3.3
Luwingu	500	3000	1.6
Mkushi	430	10000	6.3
Mwinilunga	500	12000	6.6
Nyimba	400	15000	10.3
Petauke	800	15000	5.1
Serenje	1200	10000	2.3
Total	5210	80500	4.2

It can be seen that DWA is currently only earning approximately 4-5n per unit of water produced and that there are significant differences between locations. The figures are consistent with those found in the Western Province study (cf. Western Province report Table 4.5), which showed that the unit revenue in that province ranged from 3.3 to 6.8 n/m³. Consequently, the conclusion reached for Western Province, that the authorities are only collecting approximately one third of the revenue intended by the present tariff structure, is valid for other provinces.

2.8 Comparison of Actual and Expected Revenue at DWA Township Supplies

Table 2.6 presents the revenues that should be collected by councils on behalf of DWA if all consumers paid their bills. The revenue due calculations are based on multiplying the estimated numbers of individual connections (cf. Appendix K) by the rates actually charged and adding the theoretical income due from communal standpipe consumers. DWA makes similar annual estimates and some of the figures in Table 2.6 are close to these figures. But where the consultants' own estimates were different, their figures were used. The example of the calculation for Katete which is one of the few supplies where some consumers are charged on a metered basis, is shown in Table 2.5. The figures were all taken from the current water register. It can be seen that the consultants' estimate of K13,116 is, in this case, very similar to DWA's estimate of K12,929.

The revenue collected figures in Table 2.6 represent recent annual averages. Where revenue has been reasonably constant the actual average has been taken but where the figures have been very different, judgement has been applied and a greater weighting given to the 1981 and 1982 revenues.

Most of the average revenues are based on figures taken from cash books etc., and are therefore, reasonably reliable. Nevertheless, there may be inaccuracies in some of the individual figures. However, these would not affect the overall conclusion that can be deduced from Table 2.6, i.e. that councils are actually collecting approximately 50% of expected revenue.

Table 2.5

Current Estimate of Revenue Due from Katete Township Water Supply

		Number of consumers		Monthly revenue (K)
Total domestic metered consumers:-	=	88		
number paying K4 per month	=	65		260
number paying more than K4 per month	=	23	(average bill = K6)	138
Total domestic unmetered consumers paying K5 per month:-	=	26		130
Total number of insitutions:-	=	31		
number paying K4 per month	=	10		40
number paying K5 per month	=	5		25
number paying more than K5 per month	=	16	(total bill = K330)	330
Total number of CWP consumers paying K1 per month	=	170		170
Total monthly revenue				1093
Total annual revenue				= 13116

Table 2.6 also suggests that, although there is a wide range of remittance performance, on average councils are herding over just under 50% of the money that they collect to DWA instead of the 90% which they are supposed to remit.

A comparison of the total estimate of revenue due from the 22 townships listed in Table 2.6 with the actual sums received by DWA suggests that DWA is receiving 22% of the expected revenue. Allowing for a 10% retention by the councils DWA is only receiving just over 24% of the money that it should be receiving.

Table 2.6

Estimated Revenue Due, Collected by Councils, and Remitted to DWA.

Township	Estimate of the revenue due from consumers (K/annum)	Average revenue collection (K/annum)	Average remittance to DWA (K/annum)
Chizela	3000	2400	1200
Kabompo	12000	7000	5400
Kalabo	10000	4000	2300
Kaoma	15000	7000	4500
Kaputa	5000	Nil	Nil
Kasempa	11000	6200	2200
Katete	13000	9800	5200
Kawambwa	16000	6000	4800
Lukulu	6000	2400	1800
Luwingu	8000	2500	300
Mkushi	18000	7000	1500*
Mporokoso	25000	8000	200
Mumbwa	12000	7000	Nil
Mwinilungu	18000	12000	4500
Namushakende	3000	1800	1700
Nchelenge	10000	7000	3500
Nyimba	19000	16000	(
Petauke	31000	15000	(20000 (
Senenga	11000	5000	1900
Serenje	22000	11000	1500
Sesheke	13000	2800	1100
Siavonga	11000	10000	Nil
Total for 22 townships	292000	149900	63600

* Indirect payment - a sum of approximately K6000 paid by the council to ZESCO for electricity for the water supply was the only payment to the council in the last four years.

Table 2.7 shows the percentages of DWA's revenue estimates that were actually received in the period 1978-81 for seven provinces. It can be seen that overall approximately 25%-30% of revenue that should have been received was actually received. The consultants' estimate for 1981, based on data extracted from the DWA files, was that total revenue excluding the Copperbelt institutions could have reached K450,000-K500,000 if all revenue had been collected. However, actual remittances only totalled K150,000, giving a shortfall of K300,000-K350,000, i.e. remittances from councils only equalled 30%-34% of DWA's estimates. This figure is a little higher than, but reasonably consistent with, the consultants' estimates shown above. The last two columns of Table 2.7 show that only 5 of 39 councils for which data was available, remitted high proportions of the amounts due, i.e. only 5 councils collected a high proportion of the amount due from consumers and remitted it to DWA. In contrast 19 of the 39 councils remitted nothing during the year. Table 2.7 also shows that the remittance performance in Northern, Central and Southern Provinces was considerably worse than that in the rest of the country.

DWA have prepared an estimate which shows that councils owe DWA a sum of K2 million for the period 1973-81, i.e. K220,000 per annum. This sum is composed of the two elements;

(i) revenue which councils failed to collect and
(ii) money which councils failed to remit.

Since the figures for the years from 1979, when rates were increased, would, given the same overall revenue performance, be greater than those for the years up to 1978, the annual figure of K220,000 for 1973-81 is reasonably consistent with an annual figure of K300,000 for the 1980's. It suggests that there has been no major change in revenue performance over the last decade, although if anything, there appears to have been a small deterioration.

Table 2.7

Proportion of Estimated Revenue Actually Received by DWA

Province	Percentage of DWA's estimate that DWA received in; 1978	1979	1980	1981	1978-81 overall	Number of supplies	Number of councils which; remitted all/most of the estimated sum due in 1981	remitted nothing in 1981
Eastern	54	28	43	82	52	6	3	2
Western	28	22	55	18	31	7	0	3
Northern	6	13	12	11	11	7	0	3
Central	0	0	0	0	0	3	0	3
Southern	0	0	0	34	8	7	1	5
North Western	25	62	17	38	36	5	1	1
Luapula	44	55	48	19	41	4	0	2
Unweighted average	22	26	25	29	26			
Total						39	5	19

2.9 Collection and Billing Performance in the Urban Supplies

The revenue collection performance at the large urban supplies is reasonably satisfactory. Officers in Kitwe, Luanshya, Ndola and Livingstone estimated that over 80% of the billed sum is actually collected. For example, in 1981 Kitwe collected K2,275,000 from the sale of water compared to an estimate based on the prevailing tariffs suggesting that revenue should have been over K2,800,000. However, the revenue performance from standpipe consumers who do not occupy council houses, notably squatters and site and service residents, is usually extremely poor, often less than 10%. Some officials claim that these people do not represent a serious problem because they only consume a small percentage of total consumption.

Even in large urban areas there is a major revenue failure stemming from under-billing. AESL mentioned the following contributory factors:-

(i) meters not working and under-registration. AESL estimated that, if a consumer in Kitwe or Lusaka was charged at the minimum rate due to a non-functioning meter, on average he was only paying for 33 per cent of his consumption

(ii) poor meter reading performance

(iii) a large number (10-20%) of assessed billings resulting from non-functioning meters and meter reading difficulties

(iv) inaccuracies and omissions occurring in consumer records. In Lusaka many connections were not billed or were listed as unoccupied or under a previous tenant's name. Municipal consumption was often not measured.

(v) although unmetered high density houses have their water charges included in their rent, they only pay for $18m^3$/month which was estimated to represent only 43% of their actual consumption.

This picture suggests that it is not surprising that there is a considerable difference between the total amount of water passing through consumers' meters and the amount billed. Although the above scenario was based on investigations in Kitwe and Lusaka alone it is typical of urban water supplies in Zambia and is responsible for a major loss of revenue.

AESL estimated that overall 66 per cent and 61 per cent of consumption was billed in Lusaka and Kitwe respectively. A detailed study of localised supply areas suggested that the billing loss was generally over 30 per cent and could reach 50 per cent.

Even in the largest most efficient water supply undertakings the billing performance has deteriorated over time. AESL pointed out that in 1963 Lusaka billed 90 per cent of the water produced. But by 1976 only two thirds of the water produced was reaching the consumer and only two thirds of this was being billed, i.e. less than half of water production was being billed. In Kitwe where 85 per cent was reaching the consumer, only 61 per cent of the water delivered to consumers was billed, i.e. again only half of the water produced was being billed.

Hence even at the largest supplies, one third of potential revenue is being lost unnecessarily due to non-operating and buried meters, errors in meter reading and billing, the considerable number of assessments, and unrecorded connections and properties not being billed.

2.10 Comparison of Township Water Supply Income and Expenditure

Despite the fact that the approved estimate for "Maintenance of Township Water Supplies" in 1982 was only K673,200, the consultants' estimate that the actual cost of township water supply operation was approximately K2,000,000. This did not result in a large over-expenditure because large parts of the direct and indirect costs allocable to township water supplies were accounted for under other expenditure headings. This whole question is discussed in Section 3.5.

The current level of remittance to DWA from township supplies is around K150,000. Hence DWA's income covers under 10% of its direct and indirect recurrent township water supply expenditure. Even if all revenue collected by the councils was remitted, it would only cover 15% of all direct and indirect township recurrent expenditure. If all the revenue that should be collected was actually collected, 30% of recurrent expenditures would be covered. Hence in order to cover present recurrent expenditures, water rates would need to be increased by a factor in excess of three, even if 100% revenue collection and remittance was achieved.

The short run variable costs of township supplies, i.e. chemicals, diesel and the variable element of electricity is estimated at K250,000 per annum. Hence DWA's current income is failing to cover its short term variable costs.

2.11 DWA's Financial Situation

2.11.1 Introduction to a Crisis

It could be argued that it doesn't matter to what extent a social service such as a water supply meets financial criteria. However the fieldwork investigations and the responses of PWE's and officers in charge of supplies to the question of what were the worst problems that they face suggested that the lack of available finance has serious implications for the short and longer term futures of the township water supplies. The most common problems were:-

(i) the capacity of the supply falls far below consumer demand
(ii) the pressure is too low to supply certain parts of the township reliably
(iii) the equipment and distribution system is old so that breakdowns and breakages are common
iv) the inability to pay for the necessary recurrent inputs.

The first three points mean that capital expenditures are urgently required at most supplies in order to maintain the present level of service. One PWE reported that if there is not a major fund injection in the near future, the situation will deteriorate. It is a general view that many supplies are being run down and the resulting technical problems mean that operation and maintenance problems are more difficult than they need be.

Hence it is vital that capital funds are made available in the very near future. In Section 12.1 the consultants argue that a more flexible approach than is usually adopted could mean that relatively limited injection of capital funds would lead to a major improvement.

Provincial Water Engineers without exception claimed that the recurrent financial allocations were insufficient for operating and maintaining the township supplies properly. Dovetailing with this complaint, officers in charge of supplies complained that PWE's let debts for items such as electricity mount up, and that provincial headquarters respond slowly to breakdown requirements, the latter of course being a reflection of the lack of transport, spare parts, etc.

Hence the problems of the development fund shortage is exacerbated by the lack of recurrent funds. The result is that planning becomes relatively meaningless and DWA officials have had to become experts in "Management by Crisis".

2.11.2 Development Finance

In recent years the amount of development finance being made available is rather limited and is below current requirements. Table 2.8 summarises the authorised capital expenditures for the period 1980-82.

Table 2.8
Approved DWA Capital Expenditures 1980-82
(K)

Programme	1980	1981	1982
National Water Supplies	3,000,000	1,000,000	500,000
Western Province Water Supplies	800,000	2,000,000	4,240,000
Rural Water Supplies	210,000	300,000	400,000
All others (inc canals, basin plans, hydrology, drilling, etc)	957,000	1,095,000	1,147,000
Total	4,967,000	4,395,000	6,287,000

Hence it can be seen that total expenditure in 1982 is, in real terms, similar to that in 1980. However, this is due almost entirely to the increasing Western Province programme. The rural expenditure has seen a limited increase in real terms but the absolute allocations are small compared to needs if rural water supply provision is deemed to be a high priority activity. The national water supply programme has been cut dramatically and the 1982 allocation only allows expenditure on "bits and pieces". In practice much of the expenditure made under this heading really represents maintenance rather than development and would be more appropriately termed recurrent. The 1982 national water supply allocation can be put in perspective by examining what could be achieved if it was all allocated to making real augmentations or to constructing new schemes. K500,000 would only pay for one major augmentation or for one new supply in a smallish township.

Meanwhile the continuing increases in township populations mean that a high proportion of DWA supplies require major expenditures immediately or in the near future. The development of township water supplies is better than it would appear from consideration of the national water supply programme alone, since two thirds of the expenditure on the Western Province programme is for township water supplies. This expenditure is still increasing in real terms and will result in 8 new supplies/augmentations in the townships of Western Province. However the total current township development programme represents approximately 2-3 new supplies/major augmentations per year at a time when DWA is operating over 50 supplies, virtually all of which require major augmentations in the next few years. The total cost at 1978 prices, of the first development phase only, of 30 schemes examined by consultants, was approximately K25 million which represents approximately K50 million at 1983 prices.

Hence the development expenditure requirement for all DWA schemes in the very near future is probably nearer the upper end of the K50-100 million range. The probability that the desirable level of expenditure during the 1980's will exceed this figure is emphasised by the fact that many of the consultants' first phase designs only met demands up to 1988.

It can be concluded that the financial constraints faced by the Government are resulting in a very slow and insufficient pace of water supply development, i.e. the financial situation in the sector from a capital availability point of view is extremely serious.

The NORAD programme is currently the most important development taking place under DWA and hopes for any improvement must rest largely on aid. At present most of the development funds authorised for water are based on aid and constitute approximately 2 per cent of all capital expenditure. Given all other demands on Government funds one could not expect a significant increase in this percentage without additional outside assistance.

Unless more development funds are allocated to township water supplies consumer demand at an increasing number of supplies will reach the capacity of the supply, unreliability will increase and only part of the demand will be met.

But the situation could be considerably worse if insufficient recurrent finance is provided. Existing assets could deteriorate through lack of maintenance and would not be properly utilised. Insufficient funds for power may mean that the production is restricted below capacity which is itself insufficient. The services provided to the public would then deteriorate at an even faster rate than that at which demand is increasing. Hence in order to make the most of the limited resources within the sector it is more important that recurrent allocations meet requirements than that capital funding allows all demands to be met.

2.11.3 The Serious Recurrent Financial Position

This section demonstrates the seriousness of the insufficient recurrent financial allocations being made for township water supplies. The obvious recommendation is that the government should allocate more finance to DWA's recurrent budget. But since the limited allocation is largely a reflection of the government's overall financial position, such a proposal may be of limited use until world economic factors become more favourable. The consultants therefore go on to examine whether relatively small increases within the township water supply sector could lead to a significant improvement in operation and maintenance.

PWE's make annual budget submissions to the Director of Water Affairs. DWA headquarters examines and often alters those submissions, usually downwards and submits a consolidated request to the Ministry of Agriculture and Water Development which submits the Ministry request to Treasury.

Table 2.9 summarises the DWA's recurrent requests for 1981 and 1982 and approved estimates for 1980, 1981 and 1982.

Table 2.9

Department of Water Affairs Recurrent Requests and Approved Estimates 1981/82

(K)

Expenditure head (all under 89/06)	Approved estimate 1980	DWA request 1981	Approved estimate 1981	DWA request 1982	Approved estimate 1982
1. Personal emoluments	619,800	765,200	731,900	1,056,100	975,200
2.01 General expenses	417,300	1,078,246	626,100	1,364,800	942,800
02 Travelling on duty	227,600	494,670	266,800	413,100	361,100
07 Maintenance of plant and vehicles	35,000	80,000	35,000	190,000	129,200
09 Maintenance of township water supplies	610,000	968,000	540,000	800,000	673,800
10 Maintenance of rural water supplies	210,000	359,000	220,000	400,000	378,100
11 Maintenance of fieldworks	580,000	1,002,000	580,000	1,113,000	1,136,000
All other Heads under 89/06	62,000	200,000	98,600	200,000	100,400
Total	2,761,700	4,947,116	3,098,400	5,537,000	4,696,600

Table 2.9 shows that the Ministry of Finance reduced all DWA's 1982 requests except for fieldworks. Overall the approved estimate represented 84.8 per cent of the amount requested. The reductions were not as great as they were in 1981 when only 62.6 per cent of the amount requested was approved. This was in part due to DWA headquarters reducing the amounts requested to below those estimated as necessary by PWE's, but was in part due to an increase of approximately 30 per cent in the real value of the total approved. The percentages that the approved estimates provided of the requests were as follows:

	1982	(1981)
Personal emoluments (covering all civil servants, i.e middle level and senior staff in headquarters and the provinces)	92.3%	(96%)
General expenses (junior office staff wages, services etc.)	69.1%	(58%)
Travelling on duty	87.4%	(54%)

	1982	(1981)
Maintenance of plant and vehicles	67.9%	(44%)
Maintenance of township water supplies	84.2%	(56%)
Maintenance of rural water supplies	94.5%	(61%)
Maintenance of fieldworks	100.0%	(58%)

In as much as DWA's estimates are mainly based on what they estimate they need, rather than on the assumption that all requests will be reduced, it is clear that DWA is not being granted what it requires to operate efficiently. Nevertheless, the percentage of the requirements granted was far better than in 1981 when many of the approved recurrent estimates were only just over half of the sum required and the shortages were extremely serious. For example, the consultants' Western Province study, pointed out that although vehicles were being maintained in a poor state only 44 per cent of the 1981 request for vehicle operation and maintenance was granted. It was further calculated that if Western Province had received DWA's estimate of its minimum requirement, it would have taken almost 54 per cent of the national approved estimate for the maintenance of plant and vehicles. However, in 1982 the total approved estimate for "Maintenance of Plant and Vehicles" increased by over 250% and the percentage of the request that was approved increased from 44 per cent to 68 per cent.

Similarly, the "Maintenance of Township Water Supplies" approved allocation, as a percentage of its request, increased from 56 per cent to 84 per cent. However, this is far less satisfactory than it might appear due to the actual drop in the approved figure between 1980 and 1981. The 1982 approved estimate was only 10 per cent greater than that approved in 1980. This represents a fall in real terms of approximately one sixth. There are of course, no fewer township supplies to maintain than there were in 1980 when the financial allocation was already insufficient. Hence the recurrent financial situation facing DWA was considerably worse than in 1980 and it is therefore probable that the level of service deteriorated.

2.11.4 The Effect of Financial Stringency on Non Labour Expenditure

Unfortunately these overall figures disguise the fact that although high percentages of requests for the wages and salaries elements are normally granted, the approved percentages of the requests for the other elements are often very low. Table 2.10 presents a breakdown of DWA's recurrent requests and approved estimates for 1982 in salaries/wages and all other costs. It can be seen that most wages/salaries elements are approved at, or close to, the requested amount. Overall wage/salary cost approvals were more than 96 per cent of the requests. However the overall other cost approvals only totalled 66 per cent of the requests, (or 57 per cent depending on whether the rural water supply allocation was K214,000 as in the approved estimated or K21,400 as DWA received). The relevant percentages of the expenditure heads with the greatest direct bearing on the operation and maintenance of township water supplies were 74 per cent for the other cost element of "Maintenance of Township Water Supplies" and 40 per cent for the other cost element of "Maintenance of Plant and Vehicles".

Table 2.10

Breakdown of the Department of Water Affairs 1982 Recurrent Requests and Approved Estimates into Wages and Other Costs

(K/annum)

	Request* 1982	Sub-Totals	Approved estimate 1982	Sub-Totals
1. Personal emoluments	1,056,100	1,056,100	975,200	975,200
2.01 General expenses				
Wages	605,800		605,800	
Other costs	759,000	1,364,800	337,000	942,800
02 Travelling on duty				
Wages	204,600		204,600	
Other costs	208,500	413,500	156,500	361,100
07 Maintenance of plant and vehicles				
Wages	90,000		89,200	
Other costs	100,000	190,000	40,000	129,200
09 Maintenance of township water supplies				
Wages	340,000		332,800	
Other costs	460,000	800,000	341,000	673,800
10 Maintenance of rural water supplies				
Wages	184,000		164,100	
Other costs	216,000	400,000	214,000	378,100
11 Maintenance of fieldworks				
Wages	913,000		903,000	
Other costs	200,000	1,113,000	233,000	1,136,000
All other Heads under 89/06	200,000	200,000	100,400	100,400
Total Wages	3,393,500		3,274,700	
Other costs	2,143,500**		1,421,900**	
		5,537,000		4,696,600

Notes: * Based on data from DWA files since the consultants did not see the official submission

** All costs under "other heads" are treated as containing no wage element although they do include ZNPF contributions

The seriousness of the effects of the recurrent financial position can be seen by examining the monthly releases to the provinces for the non salary/wage elements of the main operational headings. Table 2.11 presents these figures under; Vote 207 maintenance of plant and vehicles, Vote 209 maintenance of township water supplies, Vote 210 maintenance of rural water supplies and Vote 211 maintenance of fieldworks, for November 1982. Although there are minor fund switches between provinces from month to month, the November 1982 figures were typical for the year.

Table 2.11
Recurrent Financial Releases - November 1982
(excluding wage and salary costs)

	Vote 207 Maintenance of plant & vehicles (K)	Vote 209 Maintenance of township water supplies (K)	Vote 210 Maintenance of rural water supplies (K)	Vote 211 Maintenance of field-works (K)
Annual total	40,000	341,000	21,400*	233,000
November release	3,333	28,416	1,783	19,416
Distributed to:				
DWA Headquarters	933	6,000	-	2,500
Development & Planning Section	200	-	-	2,000
Drilling Section	250	-	-	1,500
Lusaka Province	250	2,000	197	1,500
Copperbelt Province	200	2,000	197	1,500
Central Province	100	1,916	197	1,000
Northern Province	250	3,500	197	1,638
Western Province	250	3,500	197	1,638
Eastern Province	250	3,500	197	1,640
North Western Province	250	2,000	197	1,500
Southern Province	200	2,000	197	1,500
Luapula Province	200	2,000	197	1,500

* compared to K214 000 in the approved estimates

It can be seen that a PWE typically has K4,000 per month to cover all costs, excluding wages and salaries, under Votes 207, 209, 210 and 211 combined. A sum of K200-250 per month is clearly insufficient for plant and vehicle maintenance. Since a PWE has an average of six water supplies to operate and maintain a sum of K2,000 per month allows him approximately K350 per supply per month. This sum, which is meant to cover all the operation and maintenance costs, i.e. diesel, electricity, chemicals and maintenance and repair costs often fails to cover 50 per cent of the electricity/diesel costs, is clearly insufficient, and the PWE is faced with a difficult situation. The result of this desperate recurrent financial shortage is that bills do not get paid and it becomes necessary to transfer financial allocations under capital votes, i.e. National Water Supply and Rural Water Supply Votes to operation and maintenance. The money which is intended for improvements is used to keep supplies operating. Since DWA officers are only doing what has to be done the auditors accept the explanations. However, the present situation means that the book accounting/approved estimates only have a limited relationship to reality. It would be more satisfactory to increase the recurrent budget even if this meant reducing the development budget.

Even after some juggling of the accounts has taken place to ensure that the limited capital and recurrent funds are used as usefully as possible:-

(i) a PWE may have only K200-300 per month for spares and a similar sum for petrol. The latter would mean that all travel within a province has to be restricted to 1500 km per month. This can only result in a number of journeys necessary for repairs and/or maintenance having to be delayed or put off altogether. In time this will be reflected in a deterioration in the level of service. Typical quotes from PWE's recorded by the consultants included; "how can we provide a satifactory service if we are not given the necessary funds which we requested," and "our requests for the maintenance of township water supplies are invariably reduced below realistic levels."

(ii) over-expenditure becomes inevitable because PWE's are unable to keep monthly expenditure within their monthly recurrent financial allocations, i.e. unpaid bills mount up. For example at the time of the fieldwork investigations DWA had not directly paid any electricity bills in Central Province, since March 1981. Furthermore, a comparison of DWA's arrears with ZESCO and average monthly electricity bills suggested that at many supplies these arrears represent between one and two years' electricity consumption. Hence it is not surprising to find that ZESCO has occasionally disconnected water supplies. In 1982, Mkushi and Luwingu were cut off after the outstanding bills had reached unacceptable levels and repeated reminders had had no effect. For example after exercising considerable patience ZESCO threatened, on 14 April 1982 to cut off the electricity supply to Mkushi water supply unless payment was made within 7 days. Despite the seriousness of the threat DWA could not find the money to pay the bill and ZESCO finally disconnected in May. Meanwhile DWA is continuing to accumulate debts in most provinces.

2.11.5 The Residual Nature of Crucial Expenditures

Although fuel and spares only account for a small percentage of recurrent expenditure and are more vital for the efficient operation of the water supplies than are many of the workers, efficient operation has been and may continue to be affected by insufficient finance for fuel and spares.

The fact that labour represents a high proportion of total costs and the undesirability of not paying workers on time, means that items such as fuel and spares tend to receive residual finance. Hence even if DWA is bailed out of difficult financial positions by supplementary financial allocations, the sums made available for fuel and spares may still be grossly insufficient. Unpaid workers would represent a greater problem for the Government than limited pumping hours resulting from lack of fuel. Even in the past when overall financial restrictions on DWA were not as severe as they are at present, shortages of recurrent funds have led directly to limitations on the number of pumping hours and on the quantity of water supplied to the consumers in some towns. They are therefore an important contributory factor to the intermittent water supply service and resultant consumer disatifaction and complaints. It is worth considering, and subsequently taking action, on the fact that the variable cost elements of operation are low but they are the items which are most seriously affected by the recurrent financial shortage. In other words, a relatively limited increase in DWA's recurrent budget concentrated in the non labour components could lead to a major improvement in the recurrent financial situation facing PWE and township water supplies. For example, a doubling of the non labour components of Votes 207 and 209 would only require an 8% increase in DWA's recurrent budget but could lead to a significant increase in the efficiency with which DWA is able to operate its most important activity, i.e. township water supplies.

It is only because consumers are usually charged on a flat rate basis that this shortage of recurrent finance does not currently lead directly to a loss of revenue. In the rural areas the lack of recurrent finance is a major cause of handpumps and mechanical pumps not being repaired.

2.11.6 Impossibility of Significant Cost Savings

The potential for achieving cost savings in non labour inputs is non existent. Hence the only possible saving that could be made would be to reduce labour costs by making workers redundant. Some of the present work force are surplus to requirements but a rationalisation, although desirable on financial grounds would pose a major political problem. Furthermore, the saving that could be achieved is limited. On average the officers in charge believe that they could release a total of 1-2 men. The consultants estimate that an average of 3 men per supply could be saved through greater flexibility. Nevertheless, the average saving per supply would only be K4,000 per annum, or under 10 per cent of current costs. Also if a programme of augmentations is undertaken in the middle 1980's the number of staff required will increase significantly. Hence the present over-staffing could then be absorbed.

2.11.7 The Link Between Revenue Collection and Recurrent Financial Allocation

While:-

(i) the current low level of water rates and poor collection performance means that government must subsidise the operation of water supplies and

(ii) the recurrent financial problem means that operation and maintenance expenditure is reduced below the desirable level,

it should be noted that increasing the level of water rates and improving the collection performance may only have a minor effect on the funds available for operation. The links between the revenue collected and the recurrent financial allocations for (i) an individual supply and (ii) the water supply sector are very weak, and possibly non existent. The revenue does not remain with the local DWA's office or even with DWA Headquarters but is channelled into the Ministry of Finance. Hence revenues are not available for local expenditure. Allocations of funds for operation and maintenance from the government's recurrent budget appear to take place without reference to the revenue collected.

Thus the relationship between the need for real subsidy and the frequent lack of funds for operation is extremely blurred. Even if revenue performance of a particular supply were to be satisfactory it could still be allocated insufficient funds for operation. A few officers interviewed in the course of the fieldwork suggested that every supply should be allocated a minimum amount of recurrent finance annually based on its most basic needs and that the supply should be allowed to keep the revenue raised for additional recurrent expenditure. This would result in (i) an incentive for an officer in charge to improve revenue performance and (ii) a minimisation of the deterioration or even an improvement in the level of service provided by supplies where the revenue collection performance was good. However if the rates are increased to the levels proposed by the consultants and collection improved, this could result in larger than necessary financial sums being available for operation and maintenance. Furthermore such a proposal would conflict with government accountancy procedures and could therefore not be endorsed. It is therefore suggested that since an incentive to officers to improve their level of collection is desirable that a major merit of decentralisation could be a more direct link between revenue performance and available expenditure. In the meantime DWA in distributing their annual allocations between schemes should in theory consider revenue performance as one criterion for increased expenditures. However in practice it is probable that, if the critical shortages of recurrent finance continue, DWA management will be unable to use any other yardstick than their present "Management by Crisis" approach.

Nevertheless, it is hoped that improved revenue collection will influence government to increase recurrent allocations for township water supply maintenance. It is therefore suggested that if and when revenue performance improves, DWA produce an information sheet to highlight this trend and use it to persuade the Ministry of Finance to increase real maintenance allocations.

2.11.8 Conclusion

It can therefore be concluded that the present financial position of DWA's township water supplies is extremely serious. Authorised recurrent expenditures are significantly less than DWA's requests and are inadequate. The new NORAD financed water supplies that are currently being planned and implemented in Western Province will increase the resources that are required for operating and maintaining township supplies. They will also increase the financial demands on the Government's recurrent budget. It is therefore, desirable that:-

(a) Government increases the recurrent financial allocations to match requirements.

(b) NORAD and other donors continue their assistance after scheme completion with resources for operation and maintenance.

(c) The amount of revenue from water rates is increased very significantly. As discussed above, under the existing financial system, this would only reduce the recurrent requirement indirectly. Hopefully it will influence Government to provide increased recurrent finance.

It is worth stressing that if recurrent financial allocations are not increased it is likely that existing assets and future capital investments will not be properly utilised and will be partially wasted.

Furthermore, it is important that the Government, while having to place stringent limitations on all its expenditures due to the overall economic situation, appreciates that if a realistic water pricing policy is followed, a shortage of recurrent finance that leads to a limitation on pumping hours may result in a loss of revenue which exceeds the "costs saved".

3. PRESENT AND FUTURE COSTS OF TOWNSHIP WATER SUPPLIES

3.1 Typical Schemes

Since the purpose of this study is to produce a realistic pricing policy for DWA supplies the consultants have based their future cost estimates on "typical" DWA schemes. While it could be argued that it would be more appropriate to tackle the question via a "cross section" of schemes, this approach was found to be impractical. The different consultants produced very different operational costs. Hence future figures for specific schemes would often be subject to vide error, while superficially appearing sound. Typical schemes, based on average unit costs established from the fieldwork, will be better estimates and at the same time will not appear to be anything more than they are, i.e. estimates for the purpose of deriving an optimum pricing policy. Consequently the consultants have categorised DWA supplies into three groups, large, medium and small. Inspection of the Phase I design capacities of consultant's feasibility studies suggests that the suitable grouping would be as follows;

large schemes , those having an end of Phase I demand above 1500 m^3/day
medium schemes, those having an end of Phase I demand between 600 and 1500 m^3/day.
small schemes, those having an end of Phase I demand below 600 m^3/day.

Typical examples of DWA schemes in every category are;

Large; Petauke, Katete, Zambezi, Samfya.
Medium; Namwala, Kalabo, Kaoma, Kasempa, Kawambwa
Small; Chavuma, Lukulu, Namushakende, Chipili, Lubunda

The demand characteristics of three typical schemes, one in every category which will be used in the cost calculations are shown in Table 3.1

Table 3.1
Typical DWA Supplies

Supply Category	Demand in 1988 (m^3/day)	Present demand (m^3/day)	Present capacity prior to augmentation (m^3/day)	Probable capacity with limited augmentation (m^3/day)
Large	2000	1440	900	1350
Medium	1000	920	480	720
Small	350	252	160	240
Overall average	962	693	448	672

It should be noted that these "typical" schemes do not represent any particular township, but they have been constructed to be typical of schemes in their particular category, i.e. the 1988 demands shown in the first column, 2000 m^3, 1000 m^3 and 350 m^3 have been selected as typical of large, medium and small supplies respectively. The present demands shown in column two are 72% of 1988 demands, based on a typical annual increase in demand of 6.7%. The present capacities shown in column three are based on typical current production capabilities. These are often below the original design capacities due to aging pumps etc. The fourth column shows production capabilities that could result from the limited augmentation strategy proposed in Section 12.1.

The consultants discovered during the course of their fieldwork that existing production capability could often be increased around 50% with very limited upgrading expenditure.

The bottom line of Table 3.1 shows what is termed the typical overall average scheme. Its characteristics were calculated on the assumption that 19% of schemes are large supplies, 46% are medium supplies and 35% are small supplies. These precentages represent the proportions of the 38 schemes, for which the consultants have examined the feasibility studies, which fell into the three categories.

3.2 Development Costs

Table 3.2 presents the estimated development costs of 38 township water supplies extracted from feasibility studies/preliminary designs by four different consulting engineers. The first column shows the latest cost figures presented in feasibility study/preliminary design reports. In order to achieve a degree of comparability all these costs must be converted to a common date. Hence all the feasibility study figures have been updated to 1983 values using a 15% annual inflation factor, as suggested in Section 2.3. These 1983 costs are shown in the third column. The fourth column presents the design capacities, and the resulting unit costs of development are shown in the final column.

Although most of the consultants' reports present cost estimates for follow up Phase II investments to meet demand in the 1990s, this report concentrates on Phase I costs for the following reasons;

(a) the prime interest in this report is to establish the appropriate pricing policy for the period from 1983, to the end of the decade,

(b) despite the fact that the unit cost of additional Phase II capacity is generally lower since some of the Phase I scheme components were designed to the end of Phase II, the overall cost per m^3 of Phases I and II combined is not that different from Phase I alone unit costs. For example (i) over the 12 Colquhuon schemes the overall unit cost was 16% lower than the Phase I cost, (ii) over the 11 Lottie schemes the overall cost was 13% lower than the Phase I cost and (iii) in the original Gauff feasibility studies the overall unit cost was actually higher than the Phase I cost.

The average 1983 unit development costs, to the nearest hundred kwacha, derived from the different consultants overall figures are ;

Colquhuon	K1200 /m^3
Østlandskonsult	K1600 /m^3
Gauff	K2200 /m^3
Lottie	K1900 /m^3

Based on these figures a cost of K1900/m^3 is proposed as the best guesstimate for DWA schemes. (Solwezi and Mongu have been omitted from the overall estimates since they are council controlled and are larger than DWA's own schemes.) However this figure disguises the very significant economies of scale which exist. This feature of township water supply in Zambia is best illustrated graphically. Figure 3.1 shows the estimated 1983 unit costs of 11 of the 12 Colquhuon schemes, (only one consultants studies have been used since the between-consultant differences would tend to obscure the picture), plotted against design capacity. The twelfth Colquhuon scheme was the low capacity Mbabala supply for which the unit cost is off the graph. It can be seen that there is a significant correlation between capacity and unit cost. The only scheme which does not adhere to the pattern is Nyimba, circled on the graph. Hence significant ecomonies of scale exist.

Table 3.3 presents the average unit cost figures for the large, medium and small supply categories based on schemes which have been costed or recosted in, or since, 1980. The bottom line of Table 3.3 shows the consultant's best average unit cost guesstimate i.e. large schemes K1300/m^3, medium sized schemes K1800/m^3, and small schemes K3000/m^3. Although these costs have allowed, for all local inflation, they do not include the effects of devaluation which are currently working their way into construction costs. 1983 post devaluation costs will be taken as K1500, K2000 and K3300 for large, medium sized and small schemes respectively. These figures have been applied to the "typical" schemes described in Section 3.1. Table 3.4 shows the resulting development costs.

Table 3.2
Development Costs of Township Water Supplies

Scheme	Feasibility study cost ('000K)	Date of study	Updated 1983 costs ('000K)	Production capacity (m^3/day)	Unit capital cost (K/m^3/day)
Mbabala	972	1978	1955	238	8214
Namwala	555	1978	1116	1304	856
Gwembe	530	1978	1066	575	1854
Zimba	546	1978	1098	1016	1081
Mambova	634	1978	1275	560	2277
Chama	344	1978	692	570	1214
Nyimba	190	1978	382	639	598
Jeremiah	181	1978	364	170	2141
Petauke	954	1978	1919	2018	951
Katete	826	1978	1661	2076	800
Old Mkushi	282	1978	567	309	1835
Mumbwa	519	1978	1044	1582	660
Total Colquhuon	6533		13139	11057	1188
Kalabo	1185	1980	1801	1396	1290
Kaoma	1839	1980	2795	1159	2412
Limulungu	1350	1980	2052	1406	1459
Lukulu	550	1980	836	439	1904
Mongu	3530	1980	5366	4868	1102
Namushakende	571	1980	868	321	2704
Senanga	590	1980	897	935	959
Sesheke	960	1980	1459	1053	1386
Total Østlandskonsult	10575		16074	11577	1388
Total excl. Mongu	7045		10708	6709	1596

cont.

Table 3.2 (cont)

Development Costs of Township Water Supplies

Scheme	Feasibility study cost ('000K)	Date of of study	Updated 1983 cost ('000K)	Production capacity (m^3/day)	Unit capital cost (K/m^3/day)
Solwezi	7680	1982	8832	5409	1633
Kabompo	2955	1982	3398	1625	2091
Kasempa	3985	1982	4583	1137	4030
Mwinilungu	3060	1982	3519	1873	1879
Zambezi	3189	1982	3667	2165	1693
Chizela	346	1979	605	316	1915
Chavuma	535	1979	936	313	2990
Total Gauff	21750		25540	12838	1989
Total excluding Solwezi	14070		16708	7429	2249
Ndola Rural	780	1982	897	215	4172
Samfya	1710	1982	1966	2300	855
Kawambwa	1640	1982	1886	1210	1559
Kaputa	1650	1982	1897	615	3085
Mpulungu	1660	1982	1909	860	2220
Isoka	1450	1982	1667	1030	1618
Total Lottie (1982)	8890		10222	6230	1641
Chipili	433	1978	871	335	2600
Lubunda	803	1978	1615	500	3230
Puta	1516	1978	3049	925	3296
Kambwali	1020	1978	2052	835	2457
Mwense	618	1978	1243	990	1256
Kawambwa	1031	1978	2074	1060	1957
Total Lottie (1978)	5421		10904	4645	2347

Table 3.3
Average Development Costs of Township Water Supplies
(K/m^3 in 1983 prices)

Consultant	Large supplies	Medium supplies	Small supplies
Østlandskonsult	-	1500	2300
Lottie	900*	1800	3600
Gauff	1900	4000*	-
Best guesstimate	1300	1800	3000

* only one scheme involved.

Figure 3.1. Relationship between Production Capacity and Unit Cost.

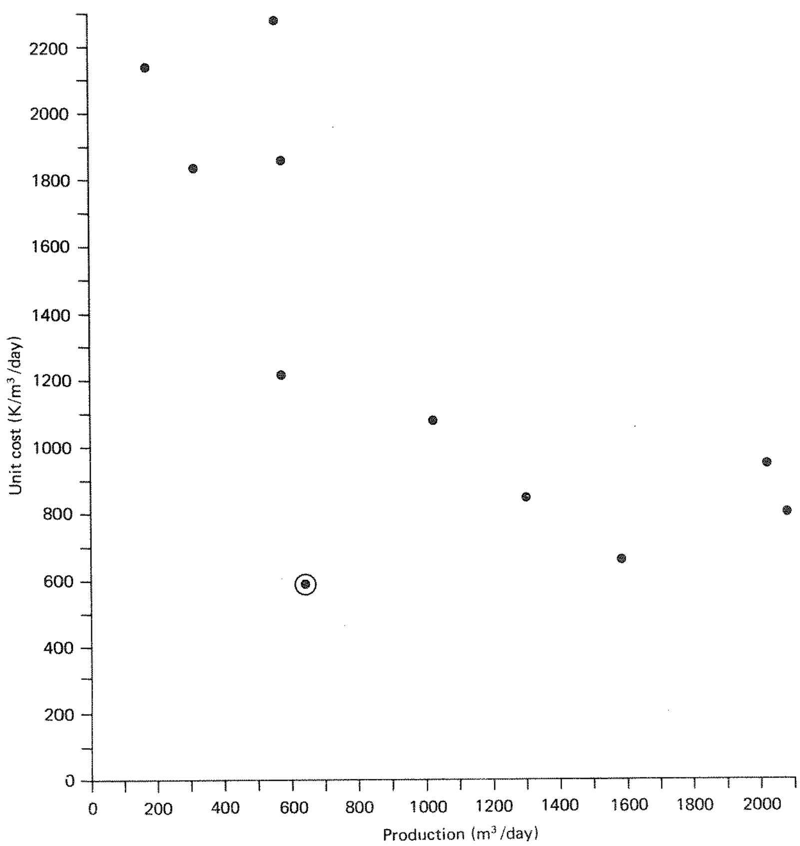

Table 3.4
Capital Costs of the Major Augmentations of Typical Supplies

Supply category	Proposed capacity (m^3/day)	Unit cost (K/m^3/day)	Total cost (K)
Large	2000	1500	3,000,000
Medium	1000	2000	2,000,000
Small	350	3300	1,155,000

3.3 Limited Augmentation Costs

In Section 12.1. the consultants recommend a possible strategy for DWA if capital finance is extremely scarce, that of incurring limited expenditures to maximise the value of present resources by upgrading the most severe existing constraints. A description of the facilities/components that will be upgraded is presented in the Technical Report together with a cost breakdown. A summary of those costs for the "typical" supplies described in Section 3.1 is as follows;

Large supply - K150,000
Medium supply - K120,000
Small supply - K 70,000

These figures represent 5%, 6% and 6.1% respectively of the cost of implementating the full augmentations proposed by the various feasibility studies. Of course the quantity of water supplied will be considerably less, sometimes even failing to meet current demands. On average it is estimated that it should be possible to increase the current production capability of a scheme by 50% by this strategy. This will sometimes mean that a scheme will only be brought up to the original design capacity. However if capital funds are short this approach represents a "better buy" than major augmentations, even though the latter would meet future demands for several years.

3.4 Annual Capital Costs

In calculating the annual capital cost of an investment one must make assumptions about (i) the life of the project and (ii) the appropriate discount rate.

The various components of the water supply schemes have useful lives of between 10 and 30 years. It would be possible to examine every scheme, component by component, applying the component's life in calculating the precise annual capital cost. However, it has been decided to assume an overall project life of 20 years. This is simple and gives an annual capital cost as accurate as one needs for present purposes. It should be borne in mind that the capital costs being used for the current calculations are only approximations. Furthermore a breakdown of the project costs based on the study/design reports shows that on average 15% of the costs are for components having a 10 year life, 25% of the costs are for components having a 20 year life, and 60% of the costs are for components having a project life of 30 years. This results in an overall capital recovery factor which is very similar to the overall 20 year capital recovery factor. Furthermore with projects having lives of at least 20 years, the annual capital cost is not particularly sensitive to the project life assumed.

However the annual capital costs are rather more sensitive to the rate of interest selected. In a purely financial analysis one would simply utilise the terms being charged by the lender. In purely economic analyses one would use the opportunity cost rate. In this study, which examines financial viability and the rates necessary to achieve various financial objectives, one could use the rate being levied on the individual water undertakings. However this would mean using different rates for different supplies depending on the source of the funds. While it may be possible to justify a somewhat higher rate for the very largest urban supplies it would be inappropriate to differentiate between the various township supplies in this way, or to assume that capital costs are zero where a donor finances a capital augmentation with a grant. Hence a rate of 6.5% will be used throughout this report. Rates close to, and the same as, this figure has been used in a number of consultants' water supply reports in Zambia in recent years, although it could be argued that it is a rather arbitrary figure.

However, in this study the main emphasis in determining the water rates that consumers should be asked to pay should be the national interest. Unfortunately the opportunity cost of capital in Zambia is unknown, but the feeling is growing that estimates in developing countries have frequently been over-optimistic and a real rate of 6.5% is suggested to represent a reasonable guesstimate. In the light of current interest rates and the fact that many projects are discounted at much higher rates, 6.5% may seem rather low. However it should be noted that the rate being referred to is the real rate of return and that the entire analysis is being performed in constant 1983 prices.

The annual capital cost estimates in this report ignore the value of existing assets. This is acceptable; (i) from a financial point of view since no capital repayment or interest is being paid, (ii) from a national point of view since the opportunity cost of these assets is low.

The capital recovery factor for projects having a 20 year life and a 6.5% discount rate is .0908. Table 3.5 presents the resulting annual capital costs of typical schemes for both major and limited augmentations.

Table 3.5
Annual Capital Costs of Township Water Supplies.
(K/annum)

Supply category	Major augmentation/ new supply	Limited augmentation
Large	272,400	13620
Medium	181,600	10896
Small	104,874	6356

3.5 Background to Recurrent Costs

3.5.1 The Present Recurrent Cost of Township Water Supplies

This section attempts to estimate DWA's actual recurrent expenditure on township water supplies from the 1982 approved estimates (c.f. Table 2.10)

Senior and middle level officers are civil servants and the cost of their salaries and other benefits is included under expenditure head 1 (under 89/06) personal emoluments. The current annual cost is approximately one million kwacha per annum and the consultants estimate that the average cost is around K80,000 per province, including the costs of housing, ZNPF etc. This means that the average cost per supply is around K13000 when the provincial office costs are allocated to the individual supplies. It is further estimated that something under 50 per cent of all senior/middle level officers' time should be allocated to township water supplies. Hence the township water supply costs of personal emoluments are approximately K6000 per township scheme. Costs of civil servants located at DWA headquarters working on township water supply maintenance are ignored.

The average monthly wage bill of junior office personnel paid under heading 201, general expenses, is estimated at almost K700 per supply. The cost of housing and ZNPF brings the total up to K850, and other expenses plus part of the provincial office costs increase it to K1250 per month i.e. K15000 per annum. The appropriate allocation of this cost between the township water supply and all DWA's other activities is uncertain. A figure of 50 per cent will be assumed, giving an annual cost attributable to a township water supply of K7500 per annum. Since approximately two thirds of the total general expenses costs represent wages and salaries, the non labour component is approximately K2500 per annum per supply.

The percentage of "Travelling on Duty" and "Maintenance of Plant and Vehicles" that should be attributed to township water systems, is also extremely uncertain. A figure of 50 per cent will again be assumed. The total expenditure in 1982 under headings 202 and 207 was just under K500,000. This results in a cost of K5,000 per township water supply with a non labour cost component of approximately 40 per cent i.e. K2,000.

If the percentage attributable to township water supplies was reduced from 50 per cent to 33 per cent the cost per supply would be reduced by approximately K1700 per supply. However based on the total cost estimated below, this would represent a reduction of less than 5 per cent.

The total approved expenditure under "heading 209 Maintenance of Township Water Supplies" was K673,800. However some expenditures which are accounted for under capital votes may actually be incurred for maintaining township water supplies. Hence a figure of K800,000 (the initial request) will be taken. This results in a cost of approximately K16,000 per supply. Since the costs under this heading are divided equally between labour and non labour costs, the costs of both are estimated at K8,000 per supply per annum.

As has been discussed elsewhere in this report a part of the expenditure under headings 210 and 211 is really spent on township water supplies. It is guesstimated that this adds K2000 per supply to the costs of township supplies.

By far the largest single item under "all other heads under 89/06" in Table 2.10 is ZNPF costs. Since approximately 40 per cent of these costs may be attributable to township water supplies, this figure will be applied to the entire item, giving a cost of approximately K1000 per supply.

Table 3.6

Annual Recurrent Costs of a Typical DWA Township Water Supply

Expenditure Heading	Total annual cost (K)	labour cost component (K)	Non labour cost component (K)
1. Personal emoluments	6000	6000	-
2.01 General expenses	7500	5000	2500
2.02 Travelling on duty) 2.07 Maintenance of plant and vehicles)	5000	3000	2000
2.09 Maintenance of township water supplies	16000	8000	8000
2.10 Maintenance of rural water supplies) 2.11 Maintenance of field works)	2000	2000	-
All other heads under 89/06	1000	1000	-
Total	37500	25000	12500

Table 3.6 summarises all the above figures and shows that the 1982 recurrent cost of running a typical township water supply was K37,500, of which K25,000, i.e. 66 per cent represents the cost of labour i.e. wages, salaries and allowances. This figure is slightly below the labour cost figure estimated in Section 3.5.3 of K23,000 per annum since it includes an element of approximately K5,000 which although attributable to township water supplies, is actually incurred at provincial headquarters. Hence the two different calculations of the labour costs attributable to a township water supply within the township/district organisation are K20,000 and K23,000. Given the approximations involved in all the calculations, this level of difference is acceptable. If the average of these two cost estimates attained by the two different approaches is taken, the direct labour expenditure would be K21,500 per annum.Therefore together with the K5000 per supply incurred at provincial headquarters, the total cost of labour would be K26,500 per supply per annum.

There appears to be an inconsistency within the non labour cost element under heading 209. For example the consultants estimate that the average cost of electricity/diesel is over K8000 per annum i.e. more than the total cost of all repairs, electricity, chemicals and other non labour costs calculated from the budget figures. The true total cost of this item is unlikely to be less than K12,000 per annum, though the consultants could not accurately estimate the figure without visiting nearly all DWA supplies.

The apparent difference between the actual costs incurred and the money paid out is probably explained by a combination of: - (a) increasing arrears with ZESCO and (b) an underestimation of the sum accounted for under capital votes which is really expended in operating and maintaining township water supplies. Hence the total 1982 non labour component of the recurrent costs attributable to township water supplies will be increased by K4,000 to K16,500 per annum. Hence the recurrent total cost per DWA township supply in 1982 was K43,000 i.e. K26,500 plus K16,500.

The costs in 1983 will reflect the wage/salary increases granted in January 1983 of up to 17%, and other cost increases related to overall inflation. It will therefore be assumed that all 1983 costs are 15 per cent higher than the 1982 costs. This results in a labour cost of K30,500 and a non labour component cost of K19,000. Hence total cost equals K49,500, say K50,000 per supply per annum, of which over 60 per cent represents the cost of labour.

It is difficult to find figures which support this overall calculation due to the problems of allocating recurrent expenditure between different township supplies. It can be done by officers familiar with the day to day operation of township supplies and the PWE Eastern Province has made his own estimates of the costs of operating water supplies in his province in 1981. These are shown below.

3.5.2 Eastern Province Recurrent Cost Estimate

Table 3.7. presents the PWE's Eastern Province estimates of the costs of operating township water supplies in his province in 1981. Petauke and Nyimba are combined since the officer in charge at Petauke is also responsible for the Nyimba supply.

Table 3.7

Recurrent Costs of Five Supplies in Eastern Province

Township supply	Labour cost component (K/annum)	Other direct costs of operation. Electricity, chemicals, diesel etc. (K/annum)	Total cost (K/annum)	Number of workers
Petauke/Nyimba	18433	27067	45550	7+6
Lundazi	18188	33813	52001	15
Chadiza	9876	2587	12463	7
Chama	11759	25800	37559	8
Average over five supplies	11651	17853	29515	8.6

It can be seen that the average recurrent cost of a township water supply was K29,515. The cost of labour was K11651, while other direct operational costs were K17,853. Updating these 1981 figures to 1983 gives a current total cost of K39,000. The labour and other cost components being K15,400 and K23,600 respectively.

This total cost supports the consultants' overall 1983 recurrent cost figure of K50,000 per supply, because the above figures do not include provincial overhead. The exclusion of this component from the consultants' overall figure would have resulted in a cost of K 44,000 per supply per annum. Hence, the Eastern Province calculations result in a figure that is 89% of the consultants' estimate. This is close, given the present cost data availability situation.

Differences can be seen when the two estimates are divided into (i) labour and (ii) direct operational costs i.e. electricity, fuel, chemicals etc. The Eastern Province direct operational cost figure of K 23,600 is 24% higher than the consultants' figure of approximately K 19,000. The fact that two of the five supplies in the Eastern Province analysis use diesel rather than electricity is largely responsible for this higher figure.

The labour component of K 15,400 in the Eastern Province's analysis is only 62% of the overall estimate of K 24,700, (K21500 updated from 1982 to 1983). This difference is largely explained by the fact that the Eastern Province estimate was based only on staff such as pump operators who are employed directly and full fime for the township supply. The consultants' overall estimate included cost allocations for staff such as the officer in charge, clerks, drivers etc.

Hence, the analysis by the PWE Eastern Province supports the consultants' estimate that the present average recurrent cost of operating a DWA township water supply is around K50,000 per annum.

3.5.3 Direct Approach to Establishing the Present Cost of Township Water Supply Labour

(A) The Problem

It is extremely difficult to determine exactly how many staff DWA employs to work on the township water supplies. The only way to obtain any degree of accuracy at all is to visit the supplies to discuss the level of staffing with the officer in charge. This statement may appear, to those who are not familiar with the problem, to be rather strange in view of the fact that staff lists exist at DWA headquarters and in the provincial offices.

In order to illustrate the situation the example of Mkushi is presented below:

Table 3.8
Mkushi Township Water Supply Staff

Green Ntalasha	Pump Operator
Susiku Mutunda	Pump Operator
Mubiana Sepiso	Pump Operator
Fackson Daka	Pump Operator
Anthony Tundela	Pump hand
Teddy Phiri	Labourer
George Chuni	Labourer
Joster Munenga	Labourer
Abraham Musonda	Labourer

Table 3.8 shows the staff working at Mkushi, under the township water supply according to DWA's provincial records. In practice the number of staff employed is 23. Five of these men one would no expect to find on the Mkushi township water staff list, the engineering assistant/officer in charge because he is a civil servant and hence paid under a different vote, and the three watchmen and stores clerk because they are paid under Sub Vote 001. But it was not obvious why 9 did not equal 18.

The reasons were:

(i) 5 labourers, the works foreman, the bricklayer and the works supervisor were paid under the rural vote.

(ii) one labourer who works at Mkushi is not listed under the Mkushi staff and is on the Serenje paysheet.

This made the total number tally but the confusion did not end there. The Mkushi paysheet showed only 16 persons instead of 18. One of the other two was the man mistakenly recorded on the Serenje staff list but the other one who is correctly listed on the Mkushi staff list is on the Mumbwa paysheet.

The accuracy of the job descriptions on the DWA staff list was equally confusing to someone who simply wanted to know the number of staff in every major functional category. For example according to the officer in charge he had 3 plumbers but there was not a single plumber on the DWA staff list. It transpired that Green Ntalasha, Susiku Mutunda and Mubiano Sepiso who were all listed as pump operators were in fact working as plumbers.

But this meant that according to the staff list only Fackson Daka was left to operate the pumps. However it turned out that George Chuni, Joster Munenga and Abraham Musonda all listed as labourers, actually work as pump attendants.

This brief description, which has omitted certain other inaccuracies, demonstrates that the use of staff lists for assessing the present township water supply staff levels or staffing costs could result in rather dubious figures.

(B) The Present Staffing Position

Table 3.9 presents the staffing position at the time of the consultants' visits in late 1982 at 11 supplies.

Table 3.9

Present Staffing Position

	Mkushi	Mumbwa	Serenje	Katete	Nyimba	Petauke	Chizela	Kabompo	Kasempa	Mwinilungu	Zimba
Engineering Asst.	1	1	1	1	-	1	-	-	-	-	-
WDO	-	1	1	2	-	-	1	1	1	1	1
Supervisor	2	1	-	-	-	-	-	-	-	-	1
Operator/ attendant	4	4	5	8	3	5	2	6	4	4	5
Plumber	3	2	2	3	-	2	-	1	2	2	-
Other artisan	1	-	4	-	-	-	-	1	1	1	-
Labourer	18*	3	5	-	-	-	2	2	4	4	-
Watchman	3	2	2	3	2	3	-	2	-	-	-
Driver	-	-	-	1	-	1	-	-	-	-	-
Office staff	1	1	4	3	-	5	-	4	3	3	1
Total	33	15	24	21	5	17	5	17	15	15	8

* including 10 daily paid workers

(C) Cost of Labour Attributable to Township Water Supplies

Table 3.10 presents the consultants' estimates of the labour cost of 20 township water supplies at the time of their visit in 1982. The cost of every individual worker was calculated by adding the cost of housing and ZNPF contribution to his salary. A part, or all, of this cost was allocated to the township water supply depending on the proportion of the working time spent on the township supply. The figures for the townships below the line in Table 3.10 were based on data in which the consultants have limited confidence, or on figures from PWEs which were not verified locally. It can be seen that the overall average cost of labour attributable to township water supplies in 1982 was K23,000 per supply per annum.

Table 3.10

Estimated 1982 Annual Labour Costs of DWA Township Supplies

Township	Total estimated annual labour cost attributable to the township water supply.(K).
Mkushi	50000*
Mumbwa	30000
Serenje	29000
Katete	35000
Petauke	25000
Nyimba	10000
Chizela	10000
Kabompo	28000
Kasempa	24000
Mwinilungu	24000
Zimba	15000
Chadiza	15000
Chama	19000
Lundazi	27000
Kawambwa	35000
Nchelenge	35000
Kaputa	8000
Luwingu	20000
Mporokoso	24000
Siavonga	2000
Overall average	23000

* high cost is due to the high labour requirement for the slow sand filter.

3.6 Recurrent Costs

3.6.1 Labour

Table 3.11 presents the consultants estimates of the number of staff required at township water supplies; (a) if no augmentation is undertaken and (b) if a major augmentation is undertaken. It is believed that if the limited augmentation strategy is followed no more staff will be required than will be necessary if no augmentation is undertaken.Table 3.11 also shows the estimated annual staff costs based on the average costs per man shown in the first column.

Table 3.11

Township Water Supply Labour Requirement

Staff category	Average cost (K/annum)	Large supply: Without major augmentation	Large supply: With major augmentation	Medium supply: Without major augmentation	Medium supply: With major augmentation	Small supply: Without major augmentation	Small supply: With major augmentation
Engineering Asst.	5700	1	1	-	-	-	-
W.D.O.	4000	1	1	1	1	-	1
Supervisor/foreman	3000	1	2	1	2	1	-
Operator	3000	4	8	3	6	1	2
Plumber	2100	1	2	-	1	-	1
Other artisan	2100	2	3	1	2	-	1
Labourer	1700	4	6	3	3	2	2
Watchman	1800	3	3	2	2	1	2
Driver	2100	1	1	-	1	-	-
Office staff	2000	3	3	2	2	-	1
Total staff		21	30	13	20	5	10
Total cost (K)		42480	67020	26800	46100	11200	22200

Notes for Table 3.11

(i) the average costs include the cost of housing and ZNPF

(ii) the total costs include the following staff costs attributable to the township water supply;

engineering asst. and WDO at a large supply without major augmentation - 40%

engineering asst. and WDO at a large supply with major augmentation - 60%

WDO at a medium supply without major augmentation - 50%

WDO at a medium supply with major augmentation - 75%

WDO at a small suply with major augmentation - 100%

Office staff in all situations - 50%

(iii) the proposed staffing for the without augmentation situation will also apply to a limited augmentation situation.

3.6.2 Energy

(A) Unit Cost Estimate

The consultants have estimated the costs of electricity and diesel at typical DWA supplies on the following basis;

(i) the consultants' theoretical calculations suggest that the average energy requirement per m^3 of water produced and distributed is 0.7 kwh at small supplies and 0.5 kwh at medium and large supplies.

(ii) the cost of electricity at the current tariff applicable to DWA township water supply demands (shown in Table 3.12) is 1.83 n per kwh. Hence the variable electricity costs in 1983 will be taken as 1.3 and 0.9 n per m^3 of water produced at small and larger supplies respectively. Calculations have shown that the fixed energy costs will be similar to the variable energy costs. When a supply is augmented the fixed element will tend to be higher, perhaps equal to 120% of the variable cost. This will fall to less than 100% over the following period. Hence the fixed electricity costs of operating a DWA supply will be taken as 120% of the 1983 variable cost, reducing gradually over the period 1983-88.Hence the average unit cost of electricity per m^3 of water will, assuming an annual increase in water demand of 6.7% p.a., be as follows;

	1983	1988
Small supplies	2.8 n/m^3	2.4 n/m^3
Medium and large supplies	2.0 n/m^3	1.7 n/m^3

(iii) One litre of diesel produces 3.2 kwh of energy. Hence on average 0.22 and 0.16 litres of diesel are required to pump and distribute one m^3 of water at small and larger supplies respectively. The cost of diesel is 70 n/litre and thus the unit cost per m^3 of water pumped and distributed is 15.4 n at small schemes and 11.2 n elsewhere.

Table 3.12

ZESCO Tariff Applicable to DWA Township Water Supplies

Tariff	Maximum demand (kva)	Fixed monthly charge (K)	Maximum demand charge (K per kva per month)	Unit charge (n/kwh)	Sales tax (%)
D.I (a)	300	21.13	3.63	1.63	12.5

(B) Comparison with Actual Costs

Table 3.13 presents data on average water production and energy expenditure from a cross section of DWA supplies. The figures were estimated by officers in charge of supplies and may contain inaccuracies. However the consistency of the electricity costs shows that, overall, they must be reasonable. The electricity estimates were based on bills for the year up to the time of the consultants' visits in late 1982. Since then there has been a 25% increase in the ZESCO tariff and so the figures in Table 3.13 should be increased by 25% to obtain current costs. It can be seen that the unweighted average electricity cost in late 1982 was 4.4 n/m^3 of water produced. Hence the current equivalent is 5.5 n/m^3.

There appears to be a major difference between the consultants' figures and current costs. It is suggested that the major reason for this apparent discrepancy is the low efficiency of aging installed equipment. Therefore when new equipment is installed, efficiency will increase to the consultants' theoretical figures.

Therefore in estimating the costs of electricity for supplies where no augmentations are undertaken, the consultants will use an overall figure of 5.5 n/m^3. But where augmentations are made the theoretical figures will be used.

Where diesel is used and where augmentations are made the theoretical diesel cost figures will be used, but where no augmentation is made costs will be increased by 50% to allow for a lower efficiency.

Table 3.13
Costs of Energy at Township Supplies

Townships using electricity	Reported average water production (m^3/day)	Reported electricity/ diesel bill (K/annum)	Estimated energy cost (n/m^3)
Solwezi	1320	15000	3.1
Kasempa	500	10800	5.9
Mwinilungu	500	8400	4.6
Kabompo	700	15000	5.9
Kasama	5548	50000	2.5
Luwingu	500	10500	5.8
Petauke	800	12000	4.1
Mkushi	432	8400	5.3
Serenje	1200	12000	2.7
Unweighted average			4.4
Townships using diesel			
Chizela	180	6400	9.7
Nyimba	400	25600	17.5

(C) Large Urban Supplies

Large urban supplies enjoy lower unit electricity costs than DWA townships. The consultants have estimated the total unit cost of electricity incurred at three urban supplies in 1981 based on the councils' expenditures on electricity and on the quantities of water produced. The figures are as follows;

Ndola 0.98 n/m^3, Mufulira 1.07 n/m^3 and Kitwe 1.78 n/m^3.

These figures suggest that although there is considerable variation in the power required to pump a cubic metre of water in different locations, a mean urban cost estimate of 1.2 n/m^3 of water produced would be reasonable. The recent electricity price increase would result in a current mean estimate of 1.5 n/m^3. The difference between this figure and the estimate for DWA schemes is largely explained by the lower electricity tariff that is appliable to large urban supplies.

(D) Energy Costs for Typical Schemes

Table 3.14 presents the cost of electricity and diesel for the consultants' typical schemes, based on the unit costs and assumptions described above.

Table 3.14

Annual Energy Costs for Typical Township Water Supplies

	Average water production (m^3/day)		Cost of Electricity: Fixed cost (K/annum)		Cost of Electricity: Variable cost (K/annum)		Cost of diesel (K/annum)	
	1983	1988	1983	1988	1983	1988	1983	1988
Large								
without augmentation	900	900	9855	9855	8212	8212	-	-
with limited augmentation	1350	1350	5322	5322	4435	4435	-	-
with full augmentation	1440	2000	5676	5676	4730	6570	-	-
Medium								
without augmentation	480	480	5256	5256	4380	4380	29434	29434
with limited augmentation	720	720	2838	2838	2365	2365	29434	29434
with full augmentation	720	1000	2838	2838	2365	3285	-	-
Small								
without augmentation	160	160	1752	1752	1460	1460	13490	13490
with limited augmentation	240	240	1366	1366	1139	1139	13490	13490
with full augmentation	252	350	1435	1435	1196	1661	14165	19673

3.6.3 Chemicals

The current (1983) prices of the major chemicals required for water treatment in Zambia are estimated to be as follows;

Calcium hypochlorite	K 9.0 per kg
Aluminium sulphate	K 1.5 per kg
Sodium carbonate	K 2.0 per kg

In the Western Province Study the consultants estimated the cost of calcium hypochlorite at 0.9 ngwee per m^3 of water produced. This was based on a cost of K6 per kg and a dosage of 1.5 grams per m^3 of clear water produced. Hence in most towns where only chlorination was required, the unit cost of all chemicals was 0.9 ngwee per m^3. In one town, Namushakende, where Østlandskonsult recommended a pH adjustment the cost of soda based on a unit cost of K1.7 per kg and a dosage of 7 grams per m^3 was 1.19 ngwee, per m^3 of clear water produced. Thus the total cost was 2.09 ngwee per m^3. Since Namushakende only accounted for 3% of the total water production of the eight towns being studied, the overall unit cost of chemicals was around 0.94 ngwee. Based on 1983 costs this figure would have been 1.4 n/m^3.

However at schemes, where more sophisticated treatment is required, the cost will be higher. For example the cost of chemicals in the KMCK Kitwe Study was 2.4 n/m^3, despite the fact that the consultants of that study used considerably lower unit costs of chemicals. It is estimated that overall cost in the Kitwe study would have been over 5 n/m^3 if 1983 prices had been used.

In Gauff's Chipata Study the cost of chemicals was 3.1 n/m^3, or approximately 4 n/m^3 if the consultants' 1983 costs are used.

Clearly the cost differences result from;-

(i) different requirements of the raw water at different locations and

(ii) different consultants' opinions of the appropriate chemical dosages of similar water.

For the purposes of this study the consultants will only estimate the cost of the normal/most common dosage of a particular chemical. At DWA supplies the normal dosage of calcium hypochlorite will be taken as 1.5 grams per m^3. The cost will therefore be 1.35 n per m^3. This figure therefore represents the minimum cost of chemicals. At more sophisticated urban schemes where chlorination is used both for pre-treatment and disinfection, the cost of chlorination could be double the above figure.

Where alum is required and used throughout the year the average cost is estimated at 3.75 n/m^3 of clear water produced. This is based on a cost of K1.5/kg and a typical application of 25 g/m^3. However at DWA supplies where the application of alum is required, it is often only a seasonal requirement.

Where a pH adjustment is required the average cost is estimated at 1.4 n/m^3. This is based on a sodium carbonate cost of K2/kg and on application of 7 g/m^3. Where other chemicals are needed for example lime and potassium permanganate, the cost will be low, and even at urban supplies is unlikely to exceed 0.5 n/m^3.

Hence, the main chemical costs at DWA supplies, based on normal dosages are estimated to be;

Chlorination (calcium hypochlorite)	= 1.35 n/m^3
Precipitation (aluminium sulphate)	= 3.75 n/m^3
pH adjustment (sodium carbonate)	= 1.2 n/m^3
Other (maximum cost)	= 0.5 n/m^3
Total maximum cost	= 6.8 n/m^3

Hence, it will be assumed that at DWA supplies, the minimum cost of chemicals, i.e. where chlorination suffices, will be 1.35 n/m^3. However assuming that alum will be required for 6 months of the year at two thirds of DWA supplies but that pH adjustment is only required at a few supplies, the overall average cost of chemicals is estimated at 2.7 n/m^3.

Unfortunately it is impossible to check this figure against current DWA operational expenditures since, (i) a chemical cost allocation by scheme does not exist, and (ii) actual application is below desirable levels.

However the consultants have estimated the cost of chemicals incurred at four urban supplies in 1981 based on the councils' expenditures on chemicals and on the quantities of water produced. These calculations are subject to two errors, (a) they equate expenditure during the year with use, and (b) they include sub-optimal applications when chemicals were short, or when attempts were being made to economise. The resultant unit costs are as follows; Luanshya 0.9 n/m^3, Kitwe 1.5 n/m^3, Mufulira 2.3 n/m^3, Ndola 2.4 n/m^3, of water produced.

Bearing in mind the large increases in chemical costs in the last two years these figures suggest that an expenditure of 2.7 n/m^3 at simpler DWA supplies represents the correct order of magnitude. However this level of expenditure will only be incurred if DWA regularly applies the desirable chemical dosages.

The consultants' figure also receives corroboration from Gauff's recent studies in North Western Province. They estimated an average chemical cost of between 2.7 n and 2.8 n per m^3 of water produced.

Table 3.15 presents the consultants estimates of the cost of chemicals at the typical township supplies based on the above cost of 2.7 n/m^3.

Table 3.15

Chemical Costs for Typical Township Water Supplies

	Average water production (m^3/day)		Cost of chemicals (K/annum)	
	1983	1988	1983	1988
Large Supply				
without augmentation	900	900	8870	8870
with limited augmentation	1350	1350	13304	13304
with full augmentation	1440	2000	14191	19710
Medium Supply				
without augmentation	480	480	4730	4730
with limited augmentation	720	720	7096	7096
with full augmentation	720	1000	7096	9855
Small Supply				
without augmentation	160	160	1577	1577
with limited augmentation	240	240	2365	2365
with full augmentation	252	350	2483	3449

3.6.4 Maintenance

The maintenance cost of new augmentations is estimated to be 1% of the construction cost. It is assumed that this will cover the maintenance of those existing facilities which will continue in use after the new augmentations are complete.

At schemes where no augmentation is undertaken it would be inappropriate to estimate the maintenance costs of existing facilities as 1%, or any other fixed percentage of existing assets. It would mean that the maintenance cost estimates for the older supplies, which actually require more maintenance, would be lower than those of newer schemes. Hence the consultants have estimated a lump sum requirement for typical DWA supplies.

Discussions with officers in charge of supplies suggested that direct maintenance expenditure at DWA supplies is averaging K3000-K6000 per annum. However the existing financial constraint sometimes means that expenditure is unduly limited. It is therefore suggested that maintenance expenditure should be in the range K3000-K9000 per scheme. The lump sum requirements for maintaining existing non augmented schemes will be taken as; large supplies K9000 p.a., medium sized supplies K6000 p.a. and small supplies K3000 p.a. Where only limited augmentations are undertaken these figures are assumed to increase to K11,000, K7500, and K4000 respectively.

3.6.5 Transport

Officers in charge of supplies were asked to estimate what transport would be sufficient, (i) for all their work and (ii) for the township water supply alone. Although there was some variation in the answers, the average response which the consultants believe is realistic is that the average DWA office requires one landrover plus a lorry for 20 per cent of the time. For the township water supply alone a landrover for 40 per cent of the time and a lorry occasionally would suffice. It is estimated that for a province the total transport required at present is as follows;

Landrovers = 1 per DWA office + 2 for the provincial office
Lorries = 2

However in the future as augmentations are constructed at existing supplies and as maintenance improves, transport requirements will increase, by an estimated 50%. It is therefore suggested that in costing township water supply transport, 60% of the cost of one landrover plus 20 per cent of the cost of one lorry should be included for the average township. Hence the following figures will be used in the cost estimates of different size township supplies.

	Without augmentation		With augmentation	
	Landrover	Lorry	Landrover	Lorry
Small supply	20%	5%	30%	10%
Medium supply	40%	10%	60%	20%
Large supply	60%	15%	90%	25%

These figures assume that lorries will largely be controlled at the provincial level, and that the part of landrovers' time which is not allocated to township supplies will be used for other activities, for example rural supplies.

The annual costs per vehicle are estimated as follows;

	Landrover	Lorry
Capital costs (K)	25000	50000
Annual capital costs based on an expected three year life (K/annum)	9440	18880
Operational costs (n/Km)	25	50
Distance travelled per annum (km)	20000	25000
Operational costs (K/annum)	5000	12500
Total cost (K/annum)	14440	31380

The transport costs per township water supply, based on the annual costs per vehicle and on the percentages of a landrover and lorry required at a particular catagory of supply, are shown in Table 3.16.

Table 3.16
Annual Transport Costs of Typical Township Supplies

	Annual cost without augmentation (K/annum)			Annual cost with augmentation (K/annum)		
	Landrover	Lorry	Total	Landrover	Lorry	Total
Small supply	2888	1569	4457	4332	3138	7470
Medium supply	5776	3138	8914	8664	6276	14940
Large supply	8664	4707	13371	12996	7845	20841

3.7 Operation and Maintenance Cost

3.7.1 Fixed Costs

For the purpose of this study the costs of maintenance, transport and labour will be considered fixed for a given supply in a given state, i.e. with no, limited or full augmentation. This is not 100% accurate but is a reasonable approximation of the truth for 1983-88, given the proposed approach to maintenance costs and suggested levels of transport and staffing. Furthermore since the basis of the calculations of costs can only be approximate any minor adjustments to transport or maintenance costs with respect to minor increases in annual water production would only be window dressing. Part of the cost of electricity is also a fixed cost for a given water supply.

Table 3.17 brings together the annual fixed costs of township water supplies estimated in Sections 3.6.1, 3.6.2, 3.6.4 and 3.6.5. It should be noted that the cost of provincial overhead, (estimated at approximately K6000 for the average supply) is not included because it gave rise to the question of, if provincial headquarter overhead is added, why isn't national headquarter overhead also included. If provincial overhead alone was included it would increase the fixed costs of supplies having major augmentations by approximately 7% and of other supplies by approximately 13%.

Table 3.17

Annual Fixed Operation and Maintenance Costs

(K/annum)

	Maintenance cost	Transport cost	Fixed energy cost*	Labour cost	Total fixed cost of operation and maintenance for schemes run on; Electricity	Diesel
Large						
without augmentation	9000	13371	9855	42480	74706	**
with limited augmentation	11000	13371	5322	42480	72173	**
with full augmentation	30000	20841	5676	67020	123537	**
Medium						
without augmentation	6000	8914	5256	26800	46970	41714
with limited augmentation	7500	8914	2838	26800	46052	43214
with full augmentation	20000	14940	2838	46100	83878	**
Small						
without augmentation	3000	4457	1752	11200	20409	18657
with limited augmentation	4000	4457	1366	11200	21023	19657
with full augmentation	11550	7470	1435	22200	42655	41220

* assuming use of electricity. If diesel is used fixed energy cost is zero.

** it is extremely unlikely that any large scheme or a fully augmented medium sized scheme would use diesel.

3.7.2 Variable Costs

The only costs that will increase directly with water production are chemicals, diesel and the variable element of electricity costs. Table 3.18 presents the annual variable costs for the "typical" township water supplies for the without, limited and major augmentation alternatives for both electricity and diesel operation. The figures represent the summation of the energy and chemical costs estimated in Sections 3.6.2 and 3.6.3.

Table 3.18
Annual Variable Costs of Typical Township Water Suppplies
(K/annum)

	Using electricity		Using diesel	
	1983	1988	1983	1988
Large Supply				
without augmentation	17082	17082	-	-
with limited augmentation	17739	17739	-	-
with full augmentation	18921	26280	-	-
Medium Supply				
without augmentation	9110	9110	34164	34164
with limited augmentation	9461	9461	36530	36530
with full augmentation	9461	13140	-	-
Small Supply				
without augmentation	3037	3037	15067	15067
with limited augmentation	3504	3504	15855	15855
with full augmentation	3679	5110	16648	23122

3.7.3 Summary

Table 3.19 summarises the total annual costs of operation and maintenance for 1983 and 1988 for the "typical" supplies for the different augmentation and source of energy alternatives.

Table 3.19
Summary of Township Annual Operation and Maintenance Costs
(K/annum)

Large Supply	Using electricity 1983	1988	Using diesel 1983	1988
without augmentation	91788	91788	-	-
with limited augmentation	89912	89912	-	-
with full augmentation	142458	149817	-	-
Medium Supply				
without augmentation	56080	56080	75878	75878
with limited augmentation	55513	55513	79744	79744
with full augmentation	93339	97018	-	-
Small Supply				
without augmentation	23446	23446	33724	33724
with limited augmentation	24527	24527	35512	35512
with full augmentation	46334	47765	57868	64342

Table 3.20 presents an estimate of DWAs total operation and maintenance costs, by cost component for 1983 and 1988 assuming universal use of electricity. The figures are derived by calculating the costs of the "typical overall average" scheme described in Section 3.1 and multiplying the costs by 50.

The total cost will increase by approximately K12,000 p.a. for every small scheme operated by diesel and by approximately K27,000 p.a. for every medium sized scheme operated by diesel.

It can be seen that the total cost is around K2.5 million for the no augmentation and limited augmentation situations. But this increases to K4.3 million (1983) and K4.5 million (1988) for the large augmentation situation.

Hence if DWA was to implement major augmentations at all its supplies it would add approximately K2 million per annum to its recurrent financial requirement.

Table 3.20
Total Operation and Maintenance Cost
(K/annum)

	Variable cost	Maintenance cost	Transport cost	Labour cost	Fixed energy cost	Total operation and maintenance cost
1983-8 no augmentations	425,000	279,000	410,000	1,216,000	245,200	2,572,200
1983-8 limited augmentations	447,400	347,000	410,000	1,216,000	139,800	2,560,200
1983 - full augmentations	461,700	947,100	672,300	2.085,500	144,300	4,310,900
1988 - full augmentations	641,300	947,100	672,300	2,085,500	144,300	4,490,500

Table 3.21 presents the cost components expressed as percentages of the total operation and maintenance costs. The main features are: -

(i) the variable costs only represent between 10% and 18% of all operation and maintenance costs.

(ii) labour is the largest component of the operation and maintenance costs representing between 46% and 48% of total cost.

(iii) transport represents between 15% and 16% of the total operation and maintenance cost.

(iv) maintenance costs increase from 10-13% before, to over 21% after major augmentations are implemented.

Table 3.21
Breakdown of Operation and Maintenance Costs
(expressed as % of total operation and maintenance cost)

	Variable costs (%)	Maintenance cost (%)	Transport cost (%)	Labour cost (%)	Fixed energy cost (%)	Total (%)
1983-8 no augmentation	16.5	10.7	16.0	47.3	9.5	100.0
1983-8 limited augment.	17.5	13.5	16.0	47.5	5.5	100.0
1983 full augmentation	10.7	22.0	15.6	48.4	3.3	100.0
1988 full augmentation	14.3	21.1	15.0	46.4	3.2	100.0

3.8. Total Annual Costs

Tables 3.22 and 3.23 bring together all the annual costs of the township water supplies for 1983 and 1988 respectively for the different supply categories for the no, limited and full augmention situations.

The first columns show the annual capital costs as estimated in Section 3.4.

The second columns show the annual fixed costs of operation and maintenance from Table 3.17.

The third columns show the annual variable costs of operation and maintenance from Table 3.18. The fourth columns show the total annual costs of operation and maintenance i.e. they represent the addition of the second and third columns.

The last columns show the total annual costs i.e. they represent the summation of (a) the first and fourth columns and (b) the third and fifth columns.

The features of the annual costs include: -

(i) the capital cost element of the limited augmentation strategy only represents 16% of all annual costs compared with over 66% in the full augmentation situation.

(ii) variable costs represent under 20% of total annual costs, if electricity is used. In the no, and limited, augmentation situations they average 16% and 15% respectively but with full augmentation they fall, on average, to under 4%.

(iii) the use of diesel increases the variable cost element dramatically to around 45% and 40% of total annual costs in the no, and limited, augmentation situations respectively. With full augmentation of the small supply variable costs represent 10% of total annual costs.

Table 3.22
Annual Cost Summary of Typical Supplies - 1983
(K/annum)

Supply category	Annual capital cost	Annual fixed operation and maintenance cost	Annual variable cost	Annual operation and maintenance cost	Annual fixed cost	Annual total cost
Large (using electricity)						
- no augmentation	-	74706	17082	91788	74706	91788
- limited augmentation	13620	72173	17739	89912	85793	103532
- full augmentation	272400	123537	18921	142458	395937	414858
Medium (using electricity)						
- no augmentation	-	46970	9110	56080	46970	56080
- limited augmentation	10896	46052	9461	55513	56948	66409
- full augmentation	181600	83878	9461	93339	265478	274939
Small (using electricity)						
- no augmentation	-	20409	3037	23446	20409	23446
- limited augmentation	6356	21023	3504	24527	27379	30883
- full augmentation	104874	42655	3679	46334	147529	151208

cont.

(Table 3.22 cont.)

	Annual capital cost	Annual fixed operation and maintenance costs	Annual variable costs	Annual operation and maintenance costs	Annual fixed costs	Annual total costs
Typical overall (using electricity)						
- no augmentation	-	42943	8500	51443	42943	51443
- limited augmentation	9825	42254	8949	51203	52079	61028
- full augmentation	171998	76985	9235	86220	248983	258218
Medium (using diesel)						
- no augmentation	-	41714	34164	75878	41714	75878
- limited augmentation	10896	43214	36530	79744	54110	90640
Small (using diesel)						
- no augmentation	-	18657	15067	33724	18657	33724
- limited augmentation	6356	19657	15855	35512	26013	41868
- full augmentation	104874	41220	16648	57868	146094	162742

Table 3.23
Annual Cost Summary of Typical Supplies - 1988
(K/annum)

Supply category	Annual capital cost	Annual fixed operation cost	Annual Variable cost	Annual operation and maintenance cost	Annual fixed cost	Annual total cost
Large						
- no augmentation	-	74706	17082	91788	74706	91788
- limited augmentation	13620	72173	17739	89912	85793	103532
- full augmentation	272400	123537	26280	149817	395937	422217
Medium (using electricity)						
- no augmentation	-	46970	9110	56080	46970	56080
- limited augmentation	10896	46052	9461	55513	56948	66409
- full augmentation	181600	83878	13140	97018	265478	278618
Small (using electricity)						
- no augmentation	-	20409	3037	23446	20409	23446
- limited augmentation	6365	21023	3504	24527	27379	30883
- full augmentation	104874	42655	5110	47765	147529	152639

cont.

(Table 3.23 cont.)

Typical overall (using electricity)						
- no augmentation	-	42943	8500	51443	42943	51443
- limited augmentation	9825	42254	8949	51203	52079	61028
- full augmentaion	171998	76985	12826	89811	248983	261809
Medium (using diesel)						
- using augmentation	-	41714	34164	75878	41714	75878
- limited augmentation	10896	43214	36530	79744	54110	90640
Small (using diesel)						
- no augmentation	-	18657	15067	33724	18657	33724
- limited augmentation	6356	19657	15855	35512	26013	41868
- full augmentation	104874	41220	23122	64342	146094	169216

3.9 Unit Costs

Table 3.24 presents (a) total and (b) operation and maintenance, unit costs of water produced for 1983 and 1988. It shows these estimated unit costs under the various combinations of;

(i) different supply categories
(ii) different augmentation situations and
(iii) diesel and electricity use.

They have been calculated by dividing (i) the annual total costs and (ii) the annual operation and maintenance costs shown in Tables 3.22 and 3.23 by the annual water demand of "typical" supplies detailed in Section 3.1.

It can be seen that;

(i) without augmentation the unit total cost of water is identical to the operation and maintenance cost, (since no capital costs are involved). Furthermore the unit costs are the same in 1983 and 1988 since no additional water can be produced to meet additional demands. The cost of water falls from 40.1 n/m^3 at small supplies to 27.9 n/m^3 at large supplies when electricity is used. The overall average cost being 31.5 n/m^3 of water produced. The use of diesel increases costs on average by just under 15 n/m^3.

(ii) with limited augmentation the unit total cost of water is slightly higher than the unit operation and maintenance cost of water reflecting the small capital costs involved in the limited augmentation strategy. The total unit cost of water falls from 35.2 n/m^3 at small supplies to 21.0 n/m^3 at large supplies when electricity is used. The overall average cost being 24.9 n/m^3. The corresponding operation and maintenance unit costs are 28.0 n/m^3 at small supplies falling to 18.2 n/m^3 at large supplies with an overall average cost of 20.9 n/m^3.

The use of diesel increases costs on average by just under 11 n/m^3. On average total unit cost is only 80% of the total unit cost in the no augmentation situation and the operation and maintenance unit cost is only 66% of the corresponding cost in the no augmentation situation. These reductions are due to the very significant increases in the quantities of water produced for limited capital costs.

(iii) under full augmentation all costs increase very significantly. The total unit cost in 1983 is 164.4 n/m^3 at small supplies and falls to 78.9 n/m^3 at large supplies with an overall average of 102.1 n/m^3 when electricity is used. As result of increased production at a limited additional cost these costs fall by about 27% by 1988 when the overall average unit cost of water produced is 74.5 n/m^3. The unit operation and maintenance cost of water produced in 1983 at small supplies is 50.4 n/m^3, falling to 27.1 n/m^3 at large schemes with an overall average cost of 34.1 n/m^3. These costs fall by about 25% by 1988 when the overall average operation and maintenance unit cost of water produced is 25.6 n/m^3.

A simplified summary of all this is that the overall average production costs of water are as follows;

No augmentation	32 n/m^3 for both operation and maintenance and total unit costs.
Limited augmentation	21 n/m^3 for operation and maintenance and 25 n/m^3 for total unit cost.
Full augmentation	34 n/m^3 in 1983 falling to 26 n/m^3 by 1988 for operation and maintenance, and 102 n/m^3 in 1983 falling to 75 n/m^3 by 1988 for total unit cost.

Diesel	will add between 9 n and 18 n to the m^3 cost.

Hence it could be said that the overall production cost of water is around 30 n/m^3 provided that (a) only a limited number of the smaller supplies use diesel and (b) the capital costs of major augmentations are excluded. If included they would increase the overall average cost of water produced for the period 1983-8 to around 90 n/m^3 for fully augmented supplies.

Since all the above figures are expressed in terms of water produced, the cubic metre costs of water consumed would be 20% higher to allow for leakage and other losses.

Table 3.24

Unit Costs of Water Produced (n/m^3)

Supply category	Unit total cost of water produced (n/m^3) 1983	1988	Unit operation and maintenance cost of water produced (n/m^3) 1983	1988
Large (using electricity)				
- no augmentation	27.9	27.9	27.9	27.9
- limited augmentation	21.0	21.0	18.2	18.2
- full augmentation	78.9	57.8	27.1	20.5
Medium (using electricity)				
- no augmentation	32.0	32.0	32.0	32.0
- limited augmentation	25.3	25.3	21.2	21.2
- full augmentation	104.6	76.3	35.5	26.6
Small (using electricity)				
- no augmentation	40.1	40.1	40.1	40.1
- limited augmentation	35.2	35.2	28.0	28.0
- full augmentation	164.4	119.5	50.4	37.4
Typical overall (using electricity)				
- no augmentation	31.5	31.5	31.5	31.5
- limited augmentation	24.9	24.9	20.9	20.9
- full augmentation	102.1	74.5	34.1	25.6
Medium (using diesel)				
- no augmentation	43.3	43.3	43.3	43.3
- limited augmentation	34.5	34.5	30.3	30.3
Small (using diesel)				
- no augmentation	57.7	57.7	57.7	57.7
- limited augmentation	47.8	47.8	40.5	40.5
- full augmentation	176.9	132.5	62.9	50.4

3.10 Short Term Variable Costs

The short term variable costs of production, i.e. chemicals, and energy when electricity is used, are as follows; -

All schemes without any augmentation	5.2 n/m^3
Small schemes with either limited or full augmentation	4.0 n/m^3
Medium or large schemes with either limited or full augmentation	3.6 n/m^3

The use of diesel increases these costs dramatically. The short term variable costs of water production when diesel is used are as follows;

	No augmentation	Limited augmentation	Full augmentaion
Small supply	25.8 n/m^3	18.1 n/m^3	18.1 n/m^3
Medium supply	19.5 n/m^3	13.9 n/m^3	-

Hence while the short term variable costs are quite low when electricity is used, the cost of diesel quadruples these costs to an overall average figure close to 20 n/m^3.

Since all the above figures are expressed in terms of water produced, the cubic metre costs of water consumed would be 20% higher to allow for leakage and other losses.

3.11 Foreign Exchange Element of Costs

3.11.1 Development

In order to estimate the foreign exchange component of the development costs of water supplies in Zambia, the consultants examined the figures calculated by other consultants in preparing feasibility studies. At the large urban schemes the mean was usually around 60%. Gauff calculated the foreign exchange components of the seven North Western Province supplies. These are presented in Table 3.25. Since Solwezi is not a DWA operated scheme, the consultants propose to take the Gauff average excluding Solwezi. This is approximately 40%.

3.11.2 Operation and Maintenance

In order to estimate the foreign exchange component of operation and maintenance costs the consultants have assumed that the labour component contains no foreign exchange element and that overall all other operation and maintenance costs contain a 30% foreign exchange element. The latter figure is only a guesstimate, but various calculations making different assumptions, within calculated potential ranges, show that the 30% figure represents the correct order of magnitude.

Since labour represents approximately 47% of all operation and maintenance costs, the overall foreign exchange element of all operation and maintenance costs is approximately 16%. The actual current figure will be below this since the areas of under-expenditure, for example vehicles and chemicals, contain significant foreign exchange components.

3.11.3 Foreign Exchange Element of "Typical" Supplies

The foreign exchange element of the total costs of schemes without augmentation will be identical to that for operation and maintenance, i.e. 16%. However the capital cost element will increase this to just under 20% for schemes with limited augmentations, and to just under 32% for major augmentation supplies.

Table 3.25

Foreign Exchange Components of the Development Costs of Township Water Supplies in North Western Province

Township	Foreign exchange cost expressed as percentage of total development cost (%)
Solwezi	56.7
Kabompo	31.9
Kasempa	34.7
Mwinilungu	51.3
Zambezi	34.3
Chizela	33.1
Chavuma	38.2
Overall Average	44.5

4 LARGER COUNCIL SUPPLIES

4.1 Introduction

This chapter presents the costs and financial positions of large and medium sized council supplies.

4.2 Large Urban Scheme Costs

4.2.1 Annual Expenditure

Table 4.1 presents the annual costs of the largest eight water supplies in Zambia for 1981. The total annual cost ranged from just over K500,000 for the smallest of these schemes to nearly K7 million in Lusaka. The total cost of all eight supplies exceeded K16 million. This figure was more than double DWA's total expenditure in 1981 on all activities, and approximately four times DWA's total expenditure on township water supplies.

The comparison is even more dramatic when only recurrent costs are examined. The total recurrent cost of the eight urban supplies exceeded K11 million, compared to DWA's total approved recurrent budget of just over K3 million, of which approximately half represents the direct and indirect costs of township water supplies operated by DWA. Hence in 1981 DWA's recurrent expenditure on approximately 50 township water supplies was only 15% of the total incurred by the eight largest supplies operated by councils.

4.2.2 Urban Water Supply Cost Breakdown

Table 4.2 shows the cost breakdown figures from Table 4.1 converted into percentages.

The main features are as follows:-

(i) recurrent costs represent approximately two thirds of all costs and capital costs only one third of all costs.

(ii) direct employee costs represent approximately 15% of total costs, i.e. over 22% of recurrent costs.

(iii) establishment expenses which contain a significant indirect labour cost element compose 7% of total cost or just over 10% of total recurrent cost.

(iv) electricity and chemicals combined represent approximately 30% of all costs, i.e. approximately 45% of recurrent costs. Of this just under 25% represents a fixed cost. Hence the variable element represents approximately 23% of total costs, i.e. approximately 35% of recurrent costs.

(v) all other recurrent costs, i.e. excluding labour costs, establishment expenses, chemicals and electricity only represent approximately 16% of total cost, i.e. under 25% of recurrent costs.

Hence in very approximate terms capital cost, fixed recurrent costs and variable recurrent costs respectively represent 33%, 42% and 25% of total cost. Hence in the short term marginal cost is approximately one quarter of total cost.

4.2.3 Average Unit Cost of Urban Water

Table 4.3 on page 93 presents the approximate costs incurred by four of the urban supplies in 1981, together with very approximate water production figures and the resulting unit costs.

Table 4.1

Annual Costs in 1981 of the Large Council Supplies (K/annum)

Cost Category	Kabwe	Chingola	Kitwe	Luanshya	Mufulira	Ndola	Lusaka	Livingstone	Eight town total
Labour Costs									
Wages and salaries	73.100	148.990	331.000	72.160	199.127	421.200	-	99.500	
Other employee costs	16.950	17.140	5.000	-	200	59.350	-	22.910	
Total employee costs	90.050	166.130	336.000	72.160	199.327	480.550	919.575	122.410	2.386.202
Central/departmental establishment expense	131.440	20.000	235.700	22.740	2.500	186.020	497.820	77.460	1.173.680
Other Recurrent Costs									
Electricity	90.000	65.000	480.000	41.000	70.195	395.400	1.080.000	90.000	2.311.595
Chemicals	6.000	46.000	440.000	58.000	147.600	975.000	876.100	60.000	2.608.700
Repair & maintenance of plant and equipment	73.000	47.000	109.200	96.200	67.210	77.200	623.300	19.000	1.112.110
Purchase & repair of meters	10.000	-	31.000	-	-	49.000	138.000	10.000	238.000
Vehicle costs	54.600	21.570	45.500	8,000	28.600	46.000	235.960	7.000	447.230
Purchase of water	-	-	280.000	-	1.000	-	-	-	281.000
Other	18.300	16.220	29.300	59.930	42.860	127.520	250.000 (1)	10.040	554.370
Total recurrent expediture	473.390	381.920	1.986.700	358.030	559.292	2.336.690	4.620.955	395.910	11.112.887
Capital repayment and interest (2)	388.000	308.400	720.600	200.000	204.513	764.000	2.290.150	146.900	5.022.563
Total cost	861.390 (3)	690.320	2.707.300	558.030	763.805	3.100.690	6.911.105	542.810	16.135.450

Notes for Table 4.1

(1) includes an unspecified bad debt provision which does not represent recurrent expenditure.

(2) (a) includes the following contributions to capital outlay:

Kabwe	K 40.000
Chingola	K 8.000
Ndola	K 60.000
Lusaka	K262.000

(b) rate of interest on outstanding loans is generally in the range of 6% - 7.25%.

(3) does not equal the total water undertaking account expenditures shown in Table 4.6 since it excludes a figure of K50.000 for bad debt provision and K235.500 contribution to sewer undertaking.

Table 4.2

Cost Breakdown of the Larger Urban Supplies Expressed in Percentages

Cost Category	Kabwe	Chingola	Kitwe	Luanshya	Mufulira	Ndola	Lusaka	Livingstone	Unweighted average	Weighted average
Labour costs										
Wage & salaries	8.5	21.6	12.2	12.9	26.1	13.6	-	18.3		
Other employee costs	2.0	2.5	0.2	-	-	1.9	-	4.2		
Total employee costs	10.5	24.1	12.4	12.9	26.1	15.5	13.3	22.5	17.2	14.8
Central/departmental establishment expenses	15.3	2.9	8.7	4.1	0.3	6.0	7.2	14.3	7.3	7.3
Other recurrent costs										
Electricity	10.4	9.4	17.7	7.3	9.2	12.8	15.6	16.1	12.4	14.3
Chemicals	0.7	6.7	16.3	10.4	19.3	31.4	12.7	11.1	13.6	16.2
Repairs & maintenance of plant & equipment	8.5	6.8	4.0	17.2	8.8	2.5	9.0	3.5	7.5	6.9
Purchase & repair of meters	1.2	-	1.2	-	-	1.6	2.0	1.8	1.0	1.5
Vehicle costs	6.3	3.1	1.7	1.4	3.8	1.5	3.4	1.3	2.8	2.8
Purchase of water	-	-	10.3	-	0.1	-	-	-	1.3	1.7
Other	2.1	2.3	1.1	10.8	5.6	4.1	3.6	1.8	3.9	3.4
Total recurrent costs	55.0	55.3	73.4	64.1	73.2	75.4	66.8	72.9	67.0	68.9
Capital repayment and interest	45.0	44.7	26.6	35.9	26.8	24.6	33.2	27.1	33.0	31.1

Table 4.3

Average Unit Production Costs of Urban Supplies in 1981

Town	Daily production ('000m³)	Total annual cost ('000K)	Annual recurrent cost ('000K)	Average production cost (n/m³)	Average recurrent production cost (n/m³)
Kitwe	74	2707	1987	10.0	7.3
Luanshya	17	558	358	9.0	5.8
Mufulira	18	764	559	11.6	8.5
Ndola	110	3101	2337	7.7	5.8

It can be seen that the average production cost was 8n to 11n per m³, with a recurrent cost element of between 6n and 8n per m³. Table 4.4 presents the approximate quantities of water supplied to consumers, i.e. production less system losses, together with estimates of the average cubic metre cost of water supplied to consumers.

Table 4.4

Average Unit Costs of Water Supplied to Consumers of Urban Supplies in 1981

Town	Daily quantity supplied ('000m³)	Total annual cost ('000K)	Annual recurrent cost ('000K)	Average cost per unit supplied (n/m³)	Average recurrent cost per unit supplied (n/m³)
Kitwe	63	2707	1987	11.8	8.6
Luanshya	13	558	358	11.8	7.5
Mufulira	15	764	559	14.0	10.2
Ndola	82	3101	2337	10.4	7.8

It can be seen that the average cost of water supplied to consumers was 10n to 14n per m³. The corresponding recurrent cost was between 7.5n and 10n per m³. Assuming a total unit cost increase of 25% over the last two years the current (1983) average cost of water supplied by the urban supplies will be in the range 13n to 18n per m³. The recurrent element will be in the range 10n to 13.5n per m³ and the short term variable cost element will be in the range 4n to 5n per m³.

4.3 Medium Sized Scheme Costs

A breakdown was performed for ten medium sized townships supplies for which councils are responsible, i.e. the 13 schemes which fall into this category but excluding the two supplies actually operated by DWA, and Kalulushi which is so large that it would distort the results due to its water purchases from Kitwe. The summarised figures are shown in Table 4.5.

Table 4.5

Summary Cost Breakdown in 1981 of Ten Medium Sized Township Supplies Operated by Councils

	Cost (K)	Proportion of recurrent cost (%)	Proportion of total cost (%)
Total employee costs i.e. wages, salaries plus all benefits	429.078	41.0	35.6
Electricity	166.031	15.8	13.8
Chemicals	128.786	12.3	10.7
Repairs, maintenance of plant, equipment, meters, etc	208.036	19.9	17.3
All other recurrent costs	115.091	11.0	9.5
Total recurrents costs	1,047.022	100.0	86.9
Capital costs, interest and repayment	158.116	-	13.1
Total	1,205.138	-	100.0

The main features compared to the large urban supply breakdown, are:-

(i) the increased proportion of total cost represented by labour, from about 15% to over 35%.

(ii) the reduced proportion of total cost represented by capital costs, down from over 30% to 13%. This shows the very limited capital investments that have been made at these supplies in recent years.

(iii) the similarity of electricity and chemical costs, i.e. 25% compared to 30%.

The short term variable recurrent costs, and hence marginal costs, which are composed primarily of chemicals and half of the cost of electricity are approximately 18% of total average cost.

The overall unit cost of water cannot be calculated since the consultants did not discover the quantities of water being produced by some of the supplies. In addition, a minor part of some of the cost elements are attributable to non-township water supply activities. However, the overall cost in 1981 is guesstimated to range from 10n/m^3 to as much as 30n/m^3. With the unit recurrent cost ranging from 8n/m^3 to 25n/m^3. The corresponding current 1983 figures are, therefore, in the ranges 13n to 40n/m^3 and 10n to 30n/m^3 for total and recurrent costs respectively.

If these supplies were augmented as and when necessary total unit costs would certainly increase. While the unit recurrent cost may not increase significantly, the unit capital cost element would increase dramatically.

4.4 The Current Financial Position of the Large Urban Supplies

Table 4.6 presents the revised 1981 expenditures and incomes for the largest eight urban water supplies in Zambia. The original estimates are normally revised in the latter half of the year and they will be close to reality.

In all cases, except Livingstone, income other than sale of water was extremely small, 5% or less, with an unweighted average of less than 2%. At five out of the eight largest supplies sale of water covered all water supply expenditure. However at three supplies large deficits were generated. In order to eliminate these it would have been necessary to have increased income and hence water rates, (assuming that the level of collection was not increased), by just over 100% in Kabwe, by just over 50% in Mufulira and by 15% in Kitwe.

Table 4.6

Overall Income and Expenditure of the Larger Urban Water Supplies in 1981

	Income (K/annum)	Expenditure (K/annum)	Surplus/deficit (K/annum)
Kabwe	555,200	1,146,940	- 591,740
Chingola	711,825	690,320	+ 21,505
Kitwe	2,352,000	2,707,300	- 355,300
Luanshya	571,000	558,030	+ 12,970
Mufulira	500,714	763,805	- 263,091
Ndola	3,371,650	3,100,690	+ 270,960
Lusaka	7,131,700	6,911,105	+ 220,595
Livingstone	596,600	542,810	+ 53,790

An examination of income and expenditure figures from 1978 shows that although 1981 was not untypical of recent years,there has been a minor deterioration in the overall financial performance of the water undertakings. For example Mufulira has been in deficit during the whole of that period, and the deficit has been steadily increasing. Luanshya has been in surplus for four out of the five years 1977-81 but the revised 1982 figures show a deficit of K60,000. Kitwe was in surplus during the period 1978-80 but went into deficit in 1981. The general picture is that costs have been increasing continuously, (at an overall average rate of approximately 12% per annum), but income has been relatively constant with sudden jumps when price increases have been implemented.

Overall the picture appears to be reasonably satisfactory with certain exceptions but the above figures do not tell the entire story. Most low cost housing in these towns is owned by the council and the water rates are included in, and collected with, the rent. An internal transfer is then made from a councils' low cost housing account to its water undertaking account. The basis for the transfer varies from one council to another, for example it is sometimes based on bulk meter readings,and sometimes on the total amount due to the water undertaking based on the flat rates charged to low cost housing residents. However, the net result can be that the transfer is larger than is equitable to the low cost housing account. For example the transfer may be made on the basis that all water rates are collected from low cost housing families when in fact all rent, and hence all water revenue, is not collected. Table 4.7 shows the transfers made in 1981,(based on the revised estimates).

Table 4.7

Transfers from Low Cost Housing Accounts to Water Undertaking Accounts in 1981

	Transfer (K/annum)	Percentage of water supply undertaking income derived from the low cost housing account (%)
Kabwe	151,900	27
Chingola	88,000	12
Kitwe	772,000	33
Luanshya	206,000	36
Mufulira	200	-
Ndola	1,400,000	42
Lusaka	644,250	9
Livingstone	195,000	33

It can be seen that at five supplies the transfer from the low cost housing account represents more than 25% of total income.

All councils' low cost housing accounts are in deficit. In the majority of towns the level of subsidisation required is between 20% and 35% of low cost housing expenditure. The unweighted average in the eight largest towns being 28.4%. If the transfer were reduced by the present percentage shortfall on the low cost housing account, the total income of the water undertaking would be reduced by between 7% and 12% in the five towns currently covering their water supply costs. Although this would make a difference to the surplus/deficit situation of the township water supplies, the overall situation would not be dramatically altered. Lusaka would still be in surplus, Chingola and Livingstone would be breaking even, and water rate increases of under 10% would result in a continued surplus in Ndola and Luanshya.

The situation in Mufulira would be unchanged and the proportional increase required in Kabwe would not be large. However the increase required in the rates in Kitwe, for the water supply undertaking to break even, would increase from 15% to 25%.

Most of the larger urban supplies implemented small price increases in July 1982 which were approximately in line with cost increases over 1981. Hence the present situation is similar to that described above, i.e. a picture where some towns are just in surplus but where others have a deficit which represents well under 20% of total income, except in Kabwe and Mufulira. Deficits are still manageable within the overall financial budget but in all towns it is important that rate increases in line with increasing costs are implemented regularly.

4.5 The Future Financial Position of the Large Urban Supplies

4.5.1 Introduction

The present costs and financial positions of the large urban supplies are currently benefitting from the fact that their capital costs, i.e. loan repayments and interest are very low. Capital expenditures in recent years have been very limited so that the outstanding debts which give rise to current annual capital costs are based on construction costs which were low relative to today's costs. However, most of the larger supplies are now needing to be augmented. This may increase future annual capital costs and four examples are presented in Section 4.5.4.

4.5.2 Loans for Water Development

Until recently central government was a prime source of funds for water undertakings wishing to raise funds to finance a water supply augmentation.

However in recent years central government has been unable to finance all the capital developments being planned by water undertakings, who must therefore, obtain funds from other sources. The funds will be channelled to them via central government if the lender is a non-Zambian organisation/agency.

The cost of finance has tended to increase in recent years. For example, most oustanding loans on water supply development are based on rates of 6.5% or below. But currently 8% is a more typical figure. This rate has been charged by ADB for urban water supply development in Ndola, and by the National Provident Fund to local authorities. The ADB loan is based on a five year grace period during which time the interest accumulates, and a 15 year repayment period. The National Provident Fund generally allows a 30 year repayment period.

However ADB loans for sewerage schemes and for smaller water supplies are granted on far more favourable terms. These soft loans are granted at interest rates as low as 0.75%, with longer repayment periods. A number of townships in Southern Province are hoping to finance water supply extensions with these cheap ADB loans. Other agencies are also likely to finance water supplies with extremely soft loans. For example, the cost of German aid finance for Chipata water supply,and possibly for township supplies in North Western Province,will be provided at an interest rate of 2% with a grace period of 10 years followed by a 30 year repayment period.

4.5.3 Unit Development Costs

Table 4.8
Unit Development Costs of Urban Supplies

Water Supply	Planned additional volume (m^3/day)	Estimated cost in 1983 prices (K)	Estimated unit cost in 1983 prices (K/m^3/day)
Kitwe	136.000	24.0	176
Luanshya	11.000	6.0	545
Mufulira	7.200	7.2	1000
Ndola	100.000	40.0	400

Table 4.8 shows the estimated costs of augmentations planned at four urban

water supplies. The figures have been taken from existing feasibility studies, (updated to 1983 prices), which are not strictly comparable. For example, the Ndola figure includes the costs of planned reticulation extensions, but the cost for Kitwe only includes planned treatment, storage and major distribution costs.

However, despite the limitations of the strict accuracy and comparability of the figures in Table 4.8, they do serve to show; (i) that there are very significant economies of scale associated with water supply development in Zambia, and (ii) the unit development costs of the large urban schemes in Zambia are generally far lower than those facing DWA and the smaller councils.

4.5.4 The Future Unit Costs of Four Urban Supplies

(A) KITWE The KMCK Kitwe study estimated that the cost of augmentations required for the Kitwe water supply will cost approximately K21.5 million in 1982 values, i.e. K24 million in 1983 prices.

Based on the typical repayment terms which urban authorities have to face on new loans, this would result in a future annual capital cost of K2.13 million. This together with Kitwe's current annual capital cost of K0.72 million, results in a new total capital cost of K2.85 million per annum, i.e. a quadrupling of the present cost. The feasibility study suggested that the first part of the augmentation would be complete in 1985 and that the remainder would be ready 18 months later. The effect of this expenditure on unit capital costs is shown below:-

	Total water production (m^3/day)	Capital cost (million K/annum)	Unit capital cost (n/m^3)
Present	74.000*	0.72	2.67
1985	154.000**	2.85	5.07
1990	200.000**	2.85	3.90
1992/3	236.000**	2.85	3.30

* total current production including that purchased from the mine.

** as estimated by the KMCK feasibility study.

The above figures are an oversimplication of the future situation, notably the assumption that the feasibility study timetable will be adhered to. However it does illustrate that unit capital costs will increase from their present level. Furthermore while unit costs appear to be falling after 1985, this will not necessarily be the case. Other capital costs may need to be incurred notably for reticulation. Hence a figure of 5 n/m³ is considered to represent a reasonable guesstimate of the unit capital cost in the late 1980's. This increase is very limited. The reason is that the present restricted supply capacity means that the augmentation is projected to result in a dramatic increase in the quantity of water supplied to consumers.

Inspection of the projected operational costs in this feasibility study suggests that unit recurrent costs, after the augmentation has come on stream, will be similar to present costs.

Hence the overall unit cost increase is not expected to be large in Kitwe. Therefore a limited increase in the real level of rates, followed by subsequent increases in line with inflation should allow the Kitwe Water Undertaking to break even.

(B) LUANSHYA Luanshya is planning to increase existing production capacity of approximately 17,000 m³/day to 28,000 m³/day at a cost of approximately K6 million in 1983 prices. This means that from 1985 annual capital costs will be around K730,000 compared to K200,000 today. Assuming a 1985 demand of 19,286 m³/day, (as estimated in an informal report), the unit cost will have increased by a factor of approximately three. Furthermore, assuming that operational costs increase on a pro-rata basis with water production, unit costs may increase from the present estimate of 11n/m³ of water produced to 18 n/m³. Since the expenditure of the Luanshya water undertaking is similar to its income, it may be necessary to increase its water rates by over 50% in real terms if it is to break even during the early years of the new augmentation.

(C) MUFULIRA Mufulira is planning to increase the present capacity of 18.200 m³/day to 41.400 m³/day, by two stages. The first phase, taking production capacity to 25.400 m³/day, will cost approximately K7.2 million in 1983 prices. Consultants' projections suggest this augmentation would be fully utilised very soon. A comparison of the current unit cost with that after the first phase of the augmentation is complete, assuming that costs of operation increase approximately in line with production, is as follows:-

	Present	Future
Production (m^3/day)	18,200	25,400
Annual capital cost (K)	200,000	840,000
Unit capital cost (n/m^3)	3.0	9.1
Unit recurrent cost (n/m^3)	11.2	11.2
Total unit cost (n/m^3)	14.2	20.3

It can be seen that capital cost will increase by a factor of approximately three, and that the overall unit cost of water produced will increase by just under 50%. Hence rates will need to be increased in real terms. Since current revenue at Mufulira is only covering approximately two-thirds of expenditure, Mufulira's rates will have to be increased by over 100% in order for the water undertaking to break even.

(D) NDOLA Ndola is planning to develop Misandu to provide 100 m.l.d additional production, bringing the total production capacity up to 212 m.l.d. It is also hoping to undertake a major augmentation to the reticulation system. The total cost of this planned development in 1983 prices is in very rounded figures K40 million. This would mean that annual capital costs could be around K4.3 million compared to K764,000 today. Assuming a 1986 demand of 164 m.l.d. the unit capital cost will have increased by a factor of almost four to over 7 n/m^3. Furthermore, assuming that operational costs increase on a pro-rata basis with water production, unit production costs may increase from 9.6 n/m^3 to almost 15 n/m^3. Consequently, although the water undertaking is more than covering its costs at present,a real price increase of approaching 50% may be necessary if Ndola is to break even at the time the new augmentations are implemented. Furthermore, one of the conditions of the ADB loan was that water and sewerage should be amalgamated. This may require an additional increase.

4.6 Summary of the Future Rate Requirements at Urban Supplies

While it is stressed that the figures in Section 4.5 are only very rough approximations and while the new developments may not require rate increases until any loan grace periods are over, they do suggest that the major supplies are benefitting from historically low development costs and hence have low loan repayments. They also suggest that any future development will lead to the need to increase rates, in real terms. However, it appears that total costs of production will generally not exceed 20 n/m³, in 1983 prices, after augmentations are implemented. At most supplies a rate increase of 50% plus whatever is required to make up any current deficit plus further increases to match inflation would enable the water undertakings to cover all their costs. This is a more promising situation than that which faces DWA supplies and even medium sized council supplies. One example of the latter, Chipata, is presented in Section 4.8.

4.7 Present Financial Position of Medium Sized Council Water Supply Undertakings

Table 4.9 presents the 1981 income and expenditure of the 13 medium sized council water supply undertakings.

Table 4.9

Expenditure and Income in 1981 of Thirteen Water Undertakings where the Council is Responsible for the Township Water Supply

Township	Expenditure (K/annum)	Income (K/annum)	Percentage by which income needs to be increased in order to match expenditure (%)
Chililabombwe	86152	69851	23
Kalulushi	530329	566340	-
Chipata	198808	197584	1
Mansa	130395	121620	7
Kasama	189672	154518	23
Mbala	88084	40500	118
Mpika	82477	26500	211
Solwezi	145290	119059	22
Choma	206855	33997	508
Kalamo	39925	27700	44
Mazabuka	138819	81500	70
Monze	97369	47000	107
Mongu	81834	92000	-

It can be seen that most councils' water supply undertakings were operating at a loss. In fact the two councils which were managing to cover costs were being indirectly subsidised. Kalulushi was purchasing treated water at a favourable price from Kitwe council and Mongu was paying DWA less than the actual cost for operating and maintaining its supply. Of the 11 other undertakings, nine were making significant losses, requiring income to be increased by 20% or more in order to break even. Of these, four were failing to cover half of their costs.

4.8 Future Financial Situation of Medium Sized Council Water Supply Undertakings

As with the large supplies,the medium sized supplies are benefitting from very low loan repayment costs. Hence major augmentations would certainly increase both annual capital and total costs dramatically. This, added to the present failure to cover current costs, means that large rate increases would be necessary to enable the water undertakings to cover their costs. This section examines one supply, Chipata, for which Gauff recently prepared a detailed feasibility study, to estimate the effects on costs and break even water rates of expensive major augmentations.

The capital cost of the Chipata extension is estimated at around K18,000,000 in 1983 prices. This will provide for an additional treated water production and distribution of 5000 m^3/day. However, the mains and distribution network is designed to match a production capacity of 12,000 m^3/day. Hence it may be guesstimated that the overall average unit cost of treatment and distribution is around K2000/m^3. This is high since it is in line with the consultants' estimates of 1983 unit capital costs, for supplies with capacities of 1000 m^3/day. However even if the capital costs are ignored,the consultants' (Gauff) feasibility study suggests that the increase in recurrent costs alone will need a major increase in the water rates.

Table 4.10 presents the present recurrent costs of the Chipata supply. It can be seen that the present cost of water production is 15.6 n/m^3.

Table 4.10

Present Costs of Water Production in Chipata

Total operation and maintenance costs	=	K250,000
Of which short term variable costs, i.e. primarily electricity and chemicals	=	K 75,000
Total water production capacity	=	4400 m^3
System losses - 25% of production	=	1100 m^3
Available for consumption	=	3300 m^3
Hence the current production costs are:-		
Total cost	=	15.6 n/m^3
Capital cost	=	0.0 n/m^3
Recurrent cost	=	15.6 n/m^3
Short term variable cost	=	4.7 n/m^3

Table 4.11 presents the estimated recurrent costs from the feasibility study for the augmented supply.

Table 4.11

Future Recurrent Costs for Chipata Water Supply

Current costs		=	K250,000
Additional costs:-			
(i)	operational staff	=	K 25,000
(ii)	administration	=	K 10,000
(iii)	maintenance	=	K190,000
(iv)	chemicals and electricity	=	K 34,000 (1983, increasing annually)
Total		=	K509,000 (1983, increasing annually)

Hence the 1983 unit cost of production, given a total estimated production of 6369 m^3/day, would be 21.9 n/m^3, i.e. a 40% increase on pre-augmentation costs even when the capital costs are ignored. Even though these unit costs will, in real terms, decrease during the 1980's as demand increases, the 1988 cost will still be 20% higher in real terms than the pre-augmentation cost. The recurrent cost increase can be brought even more dramatically into focus if the additional recurrent costs of the augmentation are allocated entirely to the demand that would not have been satisfied by the existing supply. The resulting recurrent cost of water from the new scheme in 1983 is 36 n/m^3.

The annual capital cost of the new augmentation is likely to be around K360,000 due to the very soft terms of the German loan. But even this would give a 1983 total production cost of 37.4 n/m^3, i.e. well over double pre-augmentation costs. Hence it will be difficult for Chipata to cover the costs of its augmentation even though it is benefitting from an extremely soft loan. Since the water undertaking is currently just about breaking even, rates would have to be increased by approximately 140%. However if the loan was based on more realistic financial terms, (8% over 30 years) with a resultant total production cost of 90 n/m^3, falling to 74 n/m^3 by 1988, it would be almost impossible for the council's water undertaking to break even. Rates would have to be increased by over 400%.

Although the Chipata augmentation appears to be a high cost development it does fit into the observed pattern whereby as supplies become smaller their financial viability becomes more precarious. The financial situation of the Chipata undertaking appears far more hazardous than those of the major urban supplies.

Consequently DWA, which is unfortunate in the sense that it is only responsible for smallish supplies and therefore incurs higher unit costs, may not be able to meet all its recurrent costs, let alone contribute towards capital costs. Chapter 10 shows the validity of this hypothesis.

5 ABILITY AND WILLINGNESS TO PAY FOR WATER

5.1 Introduction

In formulating an effective water rating policy consideration must be given to the willingness of consumers to pay for a piped water supply. Willingness to pay is a combination of the ability to do so and, of the perceived need for the water that is being sold.

5.2 The Perceived Need for Water

However much people may want water they will be limited by their ability to pay but the perceived need for water in some areas of the world may mean that people are willing to pay a high proportion of their cash income. On the other hand even people with high incomes may believe that their existing natural sources are adequate and will not be willing to pay anything for water.

In most townships in Zambia there are alternative sources of water, but few are comparable with the township supplies. The existence of these other sources, albeit with distance, quality and reliability limitations acts as a constraint on effective demand for DWA water. Nevertheless, there is a genuine willingness to pay for clean communal supplies, especially water piped to the house, which is not reflected in current revenue collection. However, most consumers particularly in rural areas do not perceive that the additional benefits of government provided supplies are worth paying for, other than by token fees.

5.3. Employment

The Western Province study estimated that unemployment in the townships of Western Province was not high. The conclusion was that "the majority of families have at least one member with regular monthly cash income. Even in the poorer areas 35 percent - 50 percent of households have a regular wage earner". The fieldwork in Katete and Mumbwa fully supports this conclusion. Every family in the high service sample had at least one person in regular employment and so had a regular source of income. In the low cost housing areas 88 percent of households had at least one person in full time employment. The figure was 50 percent in the shanty areas, but dropped to 18 percent in the rural areas. Hence, in the low cost township areas very few families do not have a regular source of income from which they could pay water rates.

5.4 Income

5.4.1. Survey Data

The major source is estimating current income levels of existing and potential water supply consumers was the socio-economic survey carried out by the consultants.

The average (mean) family income of the high service sample was approximately K510 per month though the median figure, which represents a better guide, was approximately K 400 per month. The incomes in Mumbwa were somewhat higher than in Katete and the individual township averages were as follows:-

	Mean (K/family/month)	Medium (K/family/month)
Katete	462	350
Mumbwa	559	450
Overall	510	400

The distribution of income of households having their own connection was as follows:-

Number of households monthly earning:-

less than K200	K200 -299	K300 -399	K400 -499	K500 -599	K600 -699	K700 -799	K800 -899	Over K1000
5	11	18	11	6	4	3	3	7

Thus 59% earn between K 200 and K 500 per month. Only 7% earn less than K 200 and 34% earn more than K 500 per month.

An analysis in Mumbwa showed that there is a very significant difference between the income of high service consumers living in high cost housing with a mean of K 937 per month, and of high service consumers living in medium cost housing with a mean of K 378 per month. Furthermore the poorest family in high cost housing had a higher monthly income (K 500) than the mean of those living in medium cost housing. The rounded overall mean and median figures for both townships combined were as follows:

	Mean (K/family/month)	Median K/family/month)
High cost	850	650
Medium cost	350	300

The average (mean) income of low service consumers was found to be approximately K 150 per month in both township low cost housing areas and in the shanty area. However, the median incomes in Katete township and in Mumbwa shanty area, K 100 and K 105 respectively, were less than the median income, K 134, in the formal low cost housing area in Mumbwa. The mean household income of the rural sample was K 60 per month, but the median was only K 30.

The distribution of income of consumers was as follows:-
Number of households monthly earning:-

	Less than K50	K50 -79	K80 -99	K100 -129	K130 -159	K160 -199	K200 -299	K300 -499	Over K500
Low cost township	2	3	6	18	11	6	7	2	0
Shanty	2	5	1	4	1	3	2	2	1
Rural	12*	0	2	0	1	1	2	0	2

*8 earn less than K 10 per month.

It can be seen that

(i) the low cost housing families income follows a normal distribution with a concentration in the K 100-160 range

(ii) the shanty households have a more evenly spread distribution over the entire income range

(iii) rural families can be divided into two main groups, the larger of which (60%) has extremely low incomes.

5.4.2. Comparison of the Survey with Other Income Data

In addition to the income data from the socio-economic survey the consultants also had income data from

(i) the 1974/5 household budget survey (cf. Appendix C)

(ii) the Northern Sector study conducted by Lottie and Associates

(iii) the guesstimates of water supply officers in six provinces (cf. Appendix D).

(iv) the Western Province study.

The following sections compare this other income data with that from the socio-economic survey, and produce income estimates for use in the ability to pay discussion.

5.4.3. Townships

Table 5.1 presents the overall median township household income figures from the survey together with the median figures from other sources.

Table 5.1

Comparison of the Socio-Economic Survey Results of Township Household Income with Other Sources

Household category	Survey median income (K/month)	Household budget updated median (K/month)	Western* province updated median estimates (K/month)	Water supply officers guesstimated median (K/month)
High cost residents	650	) 510	360**	500
Medium cost residents	300	)	272	300
Low cost residents	120	166	151	150
Informal residents	105	94	72	90

*the midpoint figures of the range estimated in the Western Province study fieldwork have been increased by 10% per annum.

**Not a median figure (cf. text)

The updated household budget figure for medium and high cost households cannot be divided into separate medium and high cost categories. The combined figure of K510 is somewhat higher than the consultants survey result of K400. A simple extrapolation of these figures would suggest that updated household budget survey figures for separate high and medium cost categories would produce figures 25 percent higher than those of the consultants' survey. The updated Western province figure for high cost households is not directly comparable since it was simply estimated that high cost households had incomes of K 360 upwards. The water supply officers' average guesstimate of median income for high cost househoulds was 23 percent below the consultants survey figure.

As regards the median income of middle cost resident households there is a high degree of agreement between the different sources at around K 300 per household per month.

The socio-economic survey median income estimate for low cost residents is approximately K 30 per month less than that derived from other sources. These estimate a figure of approximately K 150 which is similar to the consultants' mean estimate. The Northern Sector Study* (which is the only other recent survey which collected income data) estimated that the overall mean of communal standpipe and traditional source consumers living in the townships and nearby villages was K130 - K140.
This is consistent with, but slightly lower than, the consultants' equivalent figure of K 150.

The socio-economic survey's median income estimate for informal residents is approximately K10 higher than two of other estimates and K 30 higher than the Western Province figure. However it is suggested that the figures are not inconsistent. The consultants informal residents data is based on Mumbwa alone which had higher incomes than the other survey areas. Hence a figure K10 above a 'national' figure is not unreasonable. It is also suggested that the argument advanced in section 5.4.5. that there will be greater inter-provincial differences in rural income than in formal township income also applies to shanty area income. If true, this would explain the lower figure for Western Province, an area with lower than average incomes.

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*Revision and Updating of Detailed Designs Rural Townships - Northern Sector Population, Socio-Economic Aspects and Water Demands.

C Lottie and Associati for DWA. May 1982.

Hence the consultants propose that the following figures represent 1982/3 median income figures:

High cost housing residents	- K 650
Medium cost housing residents	- K 300
Low cost housing residents	- K 125
Informal housing residents	- K 100

It can be seen that the greatest reliance has been placed on the consultants' own socio-economic survey results, with very minor modifications suggested by the data from other sources.

5.4.4. Large Urban Areas

The 1974/5 household budget survey is the only source of income data the consultants have for examining whether or not incomes, and hence the ability to pay for water, is higher in the large urban areas than in the smaller townships. The data is presented in Appendix C together with the consultants 1982/3 updated estimate. The overall median income of the large urban areas is K 167 compared to K 149 in the townships. It is believed that non cash income would represent a smaller proportion of income in the urban areas and an overall figure of K 165 is assumed compared to K 140 in townships. The median incomes of the different household categories are squatters K 139, low cost K 167 and high cost over K 1000. Thus the income of the low cost housing residents is similar in large urban areas and in townships. The median urban squatter has an income rather higher than his township equivalent. The major difference is that the median income of high cost housing residents is considerably higher in the urban areas than in the townships.

5.4.5. Rural Areas

Section 5.4.1 showed that the socio-economic survey estimated median rural cash income at K 30 per month. This was well below the estimated mean of K 60 due to the wide disparity of rural incomes. The updated 1982/3 mean and median figures from the 1974/5 rural household budget survey (cf. Appendix C) are K 35 and K 25 respectively. Thus although the mean is somewhat below the survey figure the more important median figure is only slightly lower than that of the survey. This is consistent since the survey area has above average agricultural land.

It is thought that there could be greater differences between provinces in rural incomes than in township incomes, since the largest contributor to the latter is public sector wages and salaries, which are the same nationwide. The rural element of the 1974/5 survey was nationwide but only overall figures were presented. The consultants 1981 study in Western Province, estimated that median cash income was K 12.50 per month. If this figure is updated to the present at an average increase of 10 percent per annum, the current median rural household income in Western Provine would be K 15. Although this is well below the other estimates of K 25 it is not necessarily inconsistent, since it is known that average rural incomes in Western Province are below the national average due to a limited agricultural resource base.

The various data suggest the following conclusion. The current national median rural household cash income is K 25 per month. In the better off areas this may increase to K 30 or above but in the poorer areas the median income may be no more than K 15 per month.

However, in determining rural households' ability to pay for water, median data by itself is insufficient. The socio-economic survey showed that even in a good agricultural area 40 percent of rural families average less than K 10 cash income per month. Comparable figures from the updated household budget survey are difficult to obtain, due to the fact that once one departs from consideration of overall averages, the percentage of income represented by subsistence will vary, generally upwards as total income decreases and downwards as total income increases. However, it is believed that at the lower end of the income spectrum the socio-economic survey results are not untypical of other provinces and the household survey and Western Province figures do not contradict this belief.

5.5. Ability to Pay

Since it is desirable that water rates allow lower income families access to the basic supply service and the majority of consumers with house connections to be able to continue to afford the service, it is important that any water pricing study examines the ability of consumers to pay.

In estimating consumers' ability to pay for water two factors must be considered. Firstly the income of the population and secondly the proportion of this which could be spent on water. Section 5.4 dealt with former.

The proportion of income that consumers can afford to spend on water has no objective answer. It will vary from group to group and it is reasonable to hypothesise that the percentage of income available for piped water decreases as income decreases. This is due to the fact that as a household's income increases there is a marked decrease in total household expenditure as a percentage of its income and in its expenditure in food as a percentage of total expenditure, i.e. there is more money to spare for non essentials such as piped water, (although water is a most vital necessity, piped water is not as basic to life as food and shelter). For example the 1974/5 Zambian household budget survey showed that urban households earning less than K 30 per month, (less than K 90 at 1983 prices), spent over 80% of their income on food. This percentage steadily fell as income increased, so that the wealthiest groups earning over K 500, (K 1500 at 1983 prices), spent less than 20 percent of their income on food. The proportion that a particular group can afford for water will depend on its income, its needs, and the costs of those basic essential needs. Although generalisations are always dangerous, a figure of 5 percent of cash income is often quoted as the acceptable ceiling and this will be adopted in this study as the maximum that consumers should be asked to pay. However, it must not be forgotten that the poorest groups cannot only afford less in absolute terms, but also in percentage terms. Thus although the consultants are basing their ability to pay ceiling percentage on conventional wisdom, they believe that this figure should be reduced for the poorer groups. It is, therefore, proposed that the maximum ability to pay creterion for this study should be 5 percent for median and high cost housing residents and for low cost resident s with their own house connection, 3 percent for low cost residents using communal standpipes and 2½ percent for squatters. It should be recognised that though arbitrary these figures represent sensible yardsticks.

Unfortunately the household budget survey did not record expenditure on water. Either it was included as an element of the rent, was hidden in the small miscellaneous total or was omitted. However, the survey did provide an indicator of ability to pay that is sometimes utilised, namely consumers' expenditure on alcohol and tobacco. The household budget survey showed that almost all income groups spend around 5 percent of their income on these items. Unfortunately it is not known whether the reduction in real incomes since 1974/5 has reduced this percentage, but the 1974/5 data suggests that asking households to pay up to 5 percent of income for water piped to the house is not totally unreasonable, even though most of the income of the lower income groups is spent on basic necessities. However, it is often considered more appropriate for rates to be 1-2 percent of cash income and the implications of 2 percent and 1½ percent and 1 percent for high/medium cost, low cost and informal groups respectively are also considered.

What does x percent of cash income mean? Median income by definition is more representative of a particular group than mean income and it is proposed that, if the choice lay between means and medians, the proposed ability to pay percentage should relate to the median income of any group. However this is still not very satisfactory since 50 percent of the population would be paying more than the intended percentage. On the other hand to take the lowest income in any group would be unrealistic and so a compromise is required. The consultants suggest that the lower inter-quartile figure would be suitable. Their fieldwork and the 1974/5 household budget survey suggest that the lower inter-quartile figure is approximately 70 percent of the median. The following figures are, therefore, proposed as a basis for calculating ability to pay:-

High cost housing residents	K 400
Medium cost housing residents	K 250
Low cost housing residents	K 100
Shanty dwellers	K 70
Rural dwellers	K 10*

*although this is only 33 percent of the rural median income, the fieldwork showed that the lower inter-quartile figure for the rural area was below K 10.

Table 5.2 presents the ability of the different consumer groups to pay for water when the lower inter-quartile figures are combined with the proposed maximum and more desirable ability to pay percentages.

Table 5.2

Ability to Pay for Water

	Lower inter-quartile income (K/month)	Maximum ability to pay percentage	Maximum ability to pay (K/month)	More appropriate ability to pay percentage	More appropriate ability to pay (K/month)
High cost housing residents	400	5 %	20.00	2 %	8.00
Medium cost housing residents	250	5 %	12.50	2 %	5.00
Low cost I housing residents	100	5 %	5.00	2 %	2.00
Low cost II housing residents	100	3 %	3.00	1½%	1.50
Informal housing residents	70	2½%	1.75	1 %	0.70
Rural inhabitants	10	2½%	0.25	1 %	0.10

It can be seen that the "ability to pay" criterion suggests that the appropriate rates for house connections in the medium cost housing areas are lower than in high cost areas. Consequently this report presents some calculations and recommendations based on the premise of higher rates being charged in high cost areas. At the same time it is recognised that DWA may not be able to charge different rates to high and medium cost housing residents, especially where the areas are not clearly defined. The socio-economic survey results, combined with the 5 per cent ability to pay criterion, would mean that the number of existing high service consumers (high and medium cost housing residents) who could afford various levels of rates would be as follows:-

K 10 would be affordable by 93% of existing high service consumers
K 15 " " " " 76% " " " " "
K 20 " " " " 50% " " " " "
K 25 " " " " 34% " " " " "

If a single rate had to be charged to all high and medium cost housing residents the rate recommended above for medium cost, i.e. K12.50, would be appropriate in order to be affordable by most medium cost households. This rate would be affordable by over 85 percent of existing high service consumers. Most of the other 15 percent would probably not be excluded from the service, but would have to pay more than 5 percent of their monthly income.

If the maximum acceptable water rate of 5 percent of cash income for house connections was applied, the present rate of K 4 would be affordable by

50 out of 55 interviewees (91%) resident in the formal low cost housing areas in Katete and Mumbwa. Any rate above K 5 would exclude a significant proportion of low cost housing families. For example, a rate of K6.50 would represent more than 5 percent of the income of 29 (53%) low cost housing families.

The most cursory inspection of the implications of basing water rates on the more desirable "ability to pay" percentages show that this would result in the financial criterion receiving little weight. Table 5.3 demonstrates the resultant cubic metre prices and revenues that would be effectively charged.

Table 5.3

Unit Rates and Revenues Resulting from Adopting the Lower Ability to Pay Criterion

Consumer category	Average family size	Consump -tion per capita based on designs (l/c/d)	Consump -tion per house -hold (m^3/mth)	Rate based on desir- able ability to pay criterion (K)	Result -ant rate (n/m^3)	Result -ant revenue (n/m^3)
High cost housing residents	7	250	52.5	8.00	15.2	12.2
Medium cost housing residents**	7	250	52.5	5.00	9.5	7.6
Low cost I housing residents	7	100	21.0	2.00	9.5	7.6
Low cost II housing residents	7	60	12.6	1.50	11.9	9.5
Informal housing residents	7	40	8.4	0.70	8.3	6.7

** includes high cost housing residents where it is not possible to adopt price discrimination between high and medium cost housing residents.

Since it is unlikely that more than 80 percent of water would be paid for, these rates, other than for high cost housing consumers, would imply revenue of 7.6 ngwee per m^3 of water consumed for medium and low cost I consumers. The corresponding revenue figure for water produced would be 6.5 ngwee. In the consultants' opinion this rate is unacceptable in the long term although it exceeds the effective rate being collected today.

It is clear that the high cost of providing water and the limited ability of consumers to pay will conflict. Hence, it is proposed that in dealing with ability to pay in this report, the maximum abilities to pay proposed above will apply unless otherwise stated.

Table 5.4 presents the resultant unit prices and revenues that would effectively be charged if the maximum ability to pay criterion was adopted.

Table 5.4

Unit Rates and Revenues Resulting from the Adoption of Maximum Ability to Pay Criterion

	Average family size	Consump -tion per capita based on design	Consump -tion per h/hold	Rate based on maximum ability to pay criterion	Resultant rate	Resultant rate
		(l/c/d)	(m^3/mth)	(K/mth)	(n/m^3)	(n/m^3)
High cost housing residents	7	250	52.5	20.00	38.1	30.5
Medium cost housing residents**	7	250	52.5	12.50	23.8	19.0
Low cost I housing residents	7	100	21.0	5.00	23.8	19.0
Low cost II housing residents	7	60	12.6	3.00	23.8	19.0
Informal residents	7	40	8.4	1.75	20.8	16.7

** includes high cost housing residents where it is not possible to adopt price discrimination between high and medium cost housing residents.

It can be seen that utilising the proposed maximum"ability to pay "criterion results in rates of between 20 and 38 n per m^3 and in maximum revenues of between 16n and 30 n per m^3.

5.6 Willingness to Pay

5.6.1. Background

In addressing this question it must be stressed that only a very limited reliability can be placed on the results of any willingness to pay investigations other than on those based on historical payment data in a situation where collection is extremely effective. This does not usually exist and there was no such data available for townships in Zambia. Hence, although care was taken to ensure that the willingness to pay study was as soundly based as possible, the inherent unreliability of such surveys should not be forgotten. The major problems are (i) consumers themselves may not know how much they are willing to pay until they are forced to go without, (ii) their estimation of their willingness to pay may be conditioned by the existing rate structure.

Ideally the survey would have attempted to determine (i) the maximum monthly flat water rate that consumers were prepared to pay and (ii) their maximum willingness to pay for water charged for on a quantity used basis, i.e. the maximum basic charge and maximum rate per cubic metre that they were prepared to pay.

However, in setting up the survey it was obvious that a number of difficulties existed. For example the inability of most consumers to grasp the concept of a cubic metre, meant that there was little point in attempting to determine willingness to pay for water on a quantity used basis. Instead interviewees were requested to state the maximum amount they would be willing to pay monthly for water.

5.6.2. High Service Consumers

In the course of the socio-economic survey the willingness to pay for water was measured by two different methods. Firstly by the direct question of how much would the interviewees be willing to pay monthly for their water. The averages were K 6.65 in Katete and K 5.05 in Mumbwa. No real significance can be placed on the higher figure in Katete since the major finding was that consumers' responses were largely conditioned by the current rates and bills. Womens' average willingness to pay was slightly higher than that of the men interviewed.

80 percent of interviewees stated that they would be willing to pay higher rates than they are paying at present for a better service, usually interpreted as a more reliable supply. 36 percent stated that they would be willing to pay " a lot more". Hence increased reliability would mean that consumers would more readily accept price increases. The consultants believed that the direct willingness to pay question lead to an under-estimation of the real willingness to pay, largely due to interviewees' instant responses being influenced by what they were paying at the time. An alternative approach was therefore adopted which is referred to as the "cut off" point approach. After an interviewee had answered the first direct question the enumerator then asked whether, if the rates were to be fixed at a figure which exceeded his originally stated figure by K 2-3, the interviewee would pay, or would refuse to pay and wait to be disconnected. If the respondent said he would pay,

the question was asked again with the rate further increased. The process was repeated until the interviewee said he would no longer be willing to pay. These responses were translated into willingness to pay and the results are presented in Table 5.5.

Table 5.5
Summary of Willingness to Pay for Water Determined by the "Cut Off Point" Approach

	Katete	Mumbwa
Overall mean	15.37	20.94
Overall median	18.00	18.00
High cost residents mean	23.33	26.00
High cost residents median	25.00	32.00
Medium cost residents mean	13.72	18.83
Medium cost residents median	15.00	16.00
Males mean	14.79	-
Males median	18.00	-
Females mean	16.38	-
Females median	15.00	-

This method of questioning suggested that the overall average willingness to pay is around K 18 per month (average of the Katete and Mumbwa mean values and the median value in both townships). The average willingness to pay of high cost residents is around K 25 per month and of medium cost residents around K 15 per month. The Katete analysis also showed that there is no major difference in the willingness to pay between men and women.

An analysis the survey to determine the appropriate price, if water charged were to be based on flat rates suggested that a monthly fee of K 14 would be appropriate in both Mumbwa and Katete for both high and medium cost areas. This rate would be within the willingness to pay of approximately 80 percent of high service consumers and would lead to an immediate doubling of revenue in both townships. This figure would be paid by almost all high cost residents, but could exclude approximately 25 percent of medium cost residents from the service. However, many of these would only be included if the rate was much lower. Hence unless the financial criterion was to be given little weight the willingness to pay survey suggested that the K 14 figure would still be appropriate for medium cost areas. This is consistent with the ability to pay analysis since, based on the 5 percent criterion, K14 is acceptable for all households earning K 280 or more per month. In the survey 95 percent of high cost residents and 71 percent of medium cost residents earn K 280 or over.

5.6.3. Willingness to Pay for a Low Service Supply

(A) Willingness to Pay for Handpump Supplies.

The willingness of both township and rural consumers to pay for shallow wells and well points is very low. Rural consumers in particular do not usually feel a need for improved supplies whilst nearby traditional sources are available. They are, therefore, not willing to pay anything more that token rates. They appreciate improved supplies, but generally do not feel that the improvement is worth paying for. Hence they tend to prefer their free, traditional, if inferior sources unless the new supplies are also free or virtually so. In all probability there would be widespread resistance to paying monthly rates for wells equipped with handpumps and any attempts to charge consumers regularly would meet with failure. Furthermore, while willingness to contribute towards repair costs does exist, it is rather limited in the rural areas. While 30/37 interviewees in the township areas felt that if they were dependant on a handpump, the community could collect funds for repairs, 50 percent of rural people said that they should only be expected to report the breakdown to "the people concerned". Furthermore it is considered unlikely that, even if there were a real willingness to contribute, any procedures for collection by the operating agency could be successfully implemented.

(B) Willingness to Pay for Communal Standpipes in the Townships.

Within the township areas there is an ability and expressed willingness to pay monthly water rates of around K 2 per month for communal standpipe access. The average response to the direct question of "How much would you be willing to pay for continued standpipe access?" was K1.98 per month. Over 90 percent of formal township residents currently using communal points claimed that they would prefer to pay K 2-3 per month for access rather than use a free well equipped with a handpump. However, the administrative work-load required to collect the rates in view of the real collection problem would stretch DWA/council's resources. The low nationwide level of collection from communal standpipes is most likely due to the fact that consumers are able to "get away" without paying rather than to a basic inability and unwillingness to pay the existing rates.

If Mumbwa shanty is typical of urban shanty areas there is a high willingness to pay for public standpipe access in shanty areas. In Mumbwa 67 percent of interviewees stated figures of K 2 or above, with an average of K2.10 when asked how much they would be willing to pay for public standpipe access. Furthermore 75 percent claimed that they would prefer to pay K 2-3 per month for public standpipe access rather than use a free well equipped with a handpump. Unfortunately the collection problems would be even more difficult to overcome than those in the formal township areas.

(C) Willingness to Pay for Communal Standpipes in the Rural Areas.

Though the willingness of rural consumers to pay for access to communal standpipes is higher than for wells equipped with handpumps, it is still extremely low. In a situation where most consumers were unhappy with their existing supply, almost half of the interviewees were unwilling to pay anything exceeding 50 ngwee/month for public standpipe access. This is partly due to their much lower incomes and ability to pay. Virtually all rural people would prefer a free well, equipped with a handpump, to a public standpipe for which rates would be charged. It is concluded that only a minority of rural households would be willing to pay any realistic rate for the service. In addition the problems of collection would be insurmountable until there is an improvement in administrative efficiency.

5.6.4. Low Service Consumers' Willingness to Pay for a High Service Supply

88 percent of existing communal standpipe consumers claimed that they would like to have their own connection. The average willingness to pay monthly rates was:- Katete township K 4.78/month, Mumbwa formal township, K 5.67/month and Mumbwa shanty K 4.33 per month. Just over 60 percent of all formal township residents and 50 percent of shanty residents claimed that they were willing to pay at least K5. Hence many consumers who do not have their own connection would be willing to pay the current monthly water rate. In addition, as has been discussed above, direct questioning may underestimate the real willingness to pay.

However, if the responsibility for new connections was to be left to the low service consumers it is unlikely that there would be a dramatic increase in the number of new connections because, apart from DWA's limited implementation capacity, the willingness to pay for connections is far below today's connection fee. The average willingness to pay connection fees among consumers prepared to pay K 5/month water rates was only K 30 in the townships and K 18 in the shanty areas. This means that even if the survey underestimated willingness to pay connection fees, the current fee of K 100 would deter nearly all low service consumers from taking up their own connections.

However, it can be argued that this is irrelevant since most low cost housing is owned by the government and councils, who would be responsible for new connections. The survey has shown that the majority of council house tenants would be willing to pay rates of at least K 4-5 per month for water were the councils to provide house connections.

The unlikelihood of a sufficiently effective demand existing in the rural areas to justify piped networks catering for individual connections was verified. The average willingness of 22 rural interviewees to pay for their own connection was K 2.37 per month; only 4/22 (18%) were willing to pay K 5 or more, while 15/22 (68%) were unwilling to pay as much as K 3 per month.

6 METERING

6.1 Introduction

In both theory and practice metering water consumers results in reduced consumption provided that water is charged for on a quantity used basis and revenue collection is reasonably efficient. Nevertheless, it could be argued that, from a national point of view, metering is a waste of resources if real benefits result from the additional non-metered usage. However it is clear that the major part of the extra consumption is wastage.

If consumers are not metered they have no financial incentive to use water economically and to prevent wastage. The idea that water is free can be perpetuated since the marginal cost of using or wasting it is zero. It may also be felt that it is unfair not to meter since one does not distinguish between the high and low users, and the wealthier consumers are likely to be among the higher users; i.e. metering distributes the cost of supplying water equitably. However, the consultants believe that most of the emphasis in Zambia should be placed on wastage prevention. The costs involved could not be justified in order to increase equity especially since the utility of everyone's initial consumption is very high. Hence achieving equity is only a marginal argument in favour of metering.

A policy of wholesale metering involves capital, maintenance and administration costs on which the return when dealing with low income/low use consumers may not justify the cost. It may be better not to meter such consumers but to charge flat monthly rates. Consequently the question of metering is inextricably tied up with the structure of water rates. If a particular category of consumer is to be charged flat water rates there is no point in installing water meters at every connection. Conversely if pricing policy dictates that water rates shall be based on the quantity of water consumed, meters are necessary. However, even if it is intended to charge on the basis of quantity used, i.e. to implement wholesale metering in the long run, it may still be worthwhile delaying the costs involved in metering if there is considerable spare capacity in the system.

Supporters of metering must consider the costs of metering and examine all their own assumptions. For example, although metering will generally lead to consumers being more careful to restrict their usage and to prevent wastage, this will not always be true. For example some employers pay their employees' water bills. Usually the size of the bill does not affect the consumer's income and other perks. Consequently the usage/wastage of consumers who have their bills paid on their behalf is unlikely to be affected by metering unless the unit charges are sufficiently high that employers become more conscious of the size of their employees' water bills.

6.2. Present Policy and Attitudes to Metering

Over the last few years senior officials of the DWA have on more than one occasion stated that it is now Government policy that all individual connections for all categories of consumer should be metered. However, in practice a rather different policy is being followed. In most townships virtually all consumers are charged a fixed monthly rate irrespective of their usage in a given month, although a few large consumers are charged higher fixed rates than the average consumer.

All DWA officers interviewed by the consultants were asked for their view on metering. A striking feature of such discussions was that most personnel have fixed views on the subject which are rarely changed even when faced with a strong argument against their own case. A minority of officers in charge argued that metering is necessary and put forward the standard points in favour, but had no constructive suggestions as to how DWA could cope with the associated problems. The majority felt that DWA should only meter to the extent that it is capable of maintaining them. They believed that it would be realistic to meter only the largest consumers at present.

The consultants would, therefore, like to add a rider to the generalisation that water supply authorities often tend to favour metering since they concentrate their attention on the benefits of metering, i.e. on the costs of not metering. This is that the tendency weakens as the grass roots operational level is approached.

Hence the majority of officers in charge of supplies and in touch with day to day problems felt that water would, in the near future, have to be charged for on a fixed monthly basis, (other than for large consumers). They appreciated that this would lead to much higher consumption that when water is metered. (Their average estimate was that consumption would be 50% higher). But it would not be higher than it is at present and could be reduced by some form of consumption control.

The majority of council personnel support metering. It appears that while the smaller councils believe that metering would result in increased revenues they have given insufficient thought to the full costs involved in metering.

6.3. The Present Level of Metering

It was difficult to estimate the number of connections that are currently metered at DWA operated supplies since the data obtained from different sources often conflicted. However, an overall figure of 65% is believed to be a reasonable approximation. Estimates for selected provinces were Central 50%- ; Eastern 80%+ ; North Western 75%+ and Western 65%. Within individual townships the percentages rarely drop below 33% but in some places for example, Mumbwa, Katete, Petauke and Nyimba it was reported that nearly all individual connections had meters installed.

In the large urben supplies virtually all high cost housing, institutional, commercial and industrial connection are metered. However, some high cost housing consumers are not individually metered, i.e. many who live in flats. In most towns for example Mufulira and Luanshya, very few low cost consumers are metered, but in a few areas notably Kitwe and Lusaka, over 50% of all meters are located in low cost areas.

The consultants estimate that the present number of consumer meters is over 70,000. It is very approximate and depends on considerable extrapolation. The major constituents being Lusaka 22,000, Kitwe 11,000, Ndola 10,000, and other large council (population exceeding 60,000) operated supplies 15,000. DWA operated supplies are estimated to have around 7,000 meters installed. The remainder are at medium sized council operated schemes.

6.4. Number of New Meter Installations in Recent Years

In the period 1979-82 there have been two water meter suppliers operating in Zambia. The consultants had discussions with both companies and as a

result estimate that during the period 1979-82 approximately 15,000 meters were imported into Zambia. This is a very tentative figure and only is useful for order of magnitude requirements. The breakdown of meter sales by size, again very approximately, was: $\frac{1}{2}$" = 65%, $\frac{3}{4}$" = 25% and 1" and above = 10%. Excluding the meters supplied to contractors, which represent about 15% of total imports, the largest 8 towns account for approximately 80% of meter purchases. The other 20% have mostly gone to the medium size supplies for example Chipata, Mazabuka, Kapiri-Moshi where the councils are responsible. The number of meters purchased by DWA has been small.
Section 6.3 showed that there are approximately 70,000 consumer water meters in Zambia. Based on the above level of new meter installations this means that, even if no new consumers were being metered, every existing meter is, on average, being replaced every 20 years. Since some new metered connections are being provided existing meters are currently being replaced at a rate far below once in 20 years. This would probably mean a deterioration in the metering situation even if maintenance was very efficient. As it is, it is ineveitable that the situation is deteriorating and will continue to do so until more money is provided for metering.

6.5. Foreign Exchange Constraint

Foreign exchange represents a major constraint on the availability of meters. The suppliers can usually only import a few hundred meters at a time. Consequently their stocks in Zambia are usually low. Furthermore, water undertakings are unable to acquire additional meters directly from abroad since they have no foreign exchange for the purpose. The greater difficulties involved in obtaining foreign exchange permission for meter purchase, than in obtaining some other imports for water supply operations, suggest that metering is currently not a high government priority within the Ministry of Finance. It is, therefore, suggested that DWA and other operating agencies could use this report to bring the foreign exchange saving potential of metering to the Treasury's notice.

6.6. The Present State of Meters

A large number of meters are not working but the consultants found it difficult to estimate the actual percentage. Many officers in charge did not know how many of their meters were functional. When an officer in charge reported that a majority of the meters were working well, spot checks usually confirmed the consultant's suspicions within minutes that the claim was over-optimistic. This supported an investigation in 1981 in Western Province which showed that specific meters identified in the books as working were obviously not working properly. The number of meters working varies considerably. For example, in Central Province all officers in charge reported that virually all of their meters were not working. In Eastern Province which possibly has the highest percentage of working meters, the PWE estimated a figure of 35% though this figure could be exceeded in certain townships. Consequently, based on the field discussions and limited checks the consultants would be extremely surprised if the percentage of DWA meters that are working exceeds 25%.

Back in 1976 the AESL study*showed that 80-90% of consumers meters were working in the Kitwe and Lusaka townships, though only 50% of the bulk flow meters were working. It is possible that these percentages have dropped in recent years, but the majority of consumers meters are still working and the metering situation at the large urban supplies is considerably better that at DWA supplies. Water supply officers' estimates of the percentage of meters working in the urban areas were usually around 65-75%.

The extent to which meters which are apparently working are registering correctly is unknown, but as the majority, even in the largest towns, have not been checked since installation, it is probable that they are inaccurate and will under-register as a result of the wear on moving parts.

6.7. Present Maintenance

6.7.1. Department of Water Affairs

DWA has no meaningful maintenance system for meters. There is no mechanism for remedial action to be taken when meters stop functioning. Virtually all supplies have no facilities or competence for testing and cleaning meters let alone the spare parts and skill for repairing them. Therefore, it was not surprising to find that most water supply personnel reported that metering creates so much work that the technical problems are greater than they can handle. For example, if consumers fiddle with or break their meters there is nothing DWA can do. The probability of detecting consumer interference is extremely low. Even at the far larger supplies run by DWA, for example Chipata (on behalf of the council) only a few meters are cleaned and tested in a month. The testing is sometimes done on the spot by fixing a new meter

*Zambia Water Wastage Study. Associated Engineering Services Ltd. 1977 beside the old one. There are no repair facilities. At the small supplies there are usually no facilities whatsoever and usally nothing is done to maintain meters. Even cleaning is ignored. When a meter goes wrong the fact may or may not be recorded by a meter reader, but nothing else is done and usually the meter remains unserviceable. Sometimes it may be replaced by a new one if the officer in charge has any meters in stock. The broken meters are sometimes stored, but are never cannabilised to produce a smaller number of serviceable meters. These useless meters are sometimes installed at new connections so that the consumer is "metered".

Consequently there are large numbers of non-serviceable meters, many of which are know to be faulty, but no efforts are made to repair them even though many of them are only clogged with dirt and could be rectified simply be cleaning. Consumers do not report the malfunction for two reasons (i) they know that nothing will be done and (ii) they have no incentive to report it since their water bill will remain unaltered whether their meter is working or not.

6.7.2. Larger Councils

Although the situation at the larger council operated supplies is considerably better and is reflected in a much higher proportion of working meters, it is still unsatisfactory. Most of the urban meter readers are supposed to report faulty meters which are then supposed to be fixed. The substantial number of defective meters shows that the system is not effective. In fact there is rarely any proper systematic checking leading to cleaning and/or repair. Once domestic meters are placed in service they generally receive no further attention unless they cease to operate. Even in the largest towns there is no planned maintenance programme and few repairs are undertaken. Often defective meters, even the more expensive bulk flow meters are replaced and the faulty ones just discarded.

The largest councils generally have the facilities and competence to clean and test meters, but although some claimed to be regularly undertaking these tasks, they usually only do so when a consumer complains that his meter is over-reading. Typically a fee of K5 is charged, which is refunded if the consumer's complaint turns out to be justified. Low reading meters continue in service unchecked, although the average cleaning/testing cost is estimated at well under K10. The largest councils have the facilities to repair meters, but they are underutilised. Ndola reported that although they have the facilities they do not have the competence to repair meters. Kitwe, where two men were specifically trained for the task a few years ago, usually replaces rather than repairs small meters. One major problem reported by a number of councils was the difficulty of obtaining the spare parts from the suppliers. The company, with its very limited foreign exchange allocation for spares, prefers to undertake the repairs itself in order to increase its rather limited turnover. They would, however, be happy to quote for spare parts in foreign currency. One town engineer did not know that the agent had repair facilities. He and other town engineers (development secretaries) prefer to throw away faulty meters and to replace them with new ones rather than repair them. It was even claimed that this course of action is cheaper. This certainly should not be true, and if it is it is a reflection of the current organisation of metering. Another major problem is the lack of transport which limits all meter testing, cleaning and repair activities. It may also delay the replacement of faulty meters even when the council has new ones in stock.

Thus the turnover of meter cleaning, fixing and repair falls well below requirements everywhere. At Kitwe, which is better equipped than most supplies, there are staff specifically trained for the job and a potential handling capacity of 300 meters per month. However, it was reported that only 40-50 meters per month are fixed and tested at the meter repair office with another 30-35 per month being cleaned on the spot. This annual total of approximately 1,000 meters means that on average a meter would be touched less than once in ten years.

6.7.3. Ironies of the Present Situation

There are a number of ironies associated with the present metering situation. Firstly at a time when the general state of meter maintenance is poor, the meter suppliers repair and testing facilities are little used due to a lack of demand. Secondly at a time when finance is scarce, stocks of new meters are although limited, far healthier than the stock of spare parts which could yield a similar level of achievement at far lower cost. For example although DWA has virtually no spare parts, it is possible to find officers in charge of smallish township supplies having considerable numbers of unused meters.

Even Kitwe which currently has over 900 new consumer meters in stock, enough for two years, (250 replacements and 200 new connections are made annually), does not have an equally good stock of spares.

6.8. Meter Reading

At present the larger councils employ meter readers who read meters monthly, but the situation at DWA operated suppliers is more confusing. Lottie reported that consumers' meters are no longer used at the supplies they studied and the consultants found that meters have not been read at any of the DWA supplies in Central Province for several years. In Eastern, Northern, North Western and Western Provinces it was reported that meters are still read monthly but with certain exceptions, for example Katete, meter reading is usually a rather pointless activity since most consumers are charged on a flat rate basis.

Some meters record in metric units and others record in British units. There is still some confusion among the meter reading and clerical staff as to what the number that they write down really means. In addition simple meter reading mistakes are made even when the units are understood. Since the numbers are not used for billing purposes it does not really matter at present.

Meter reading is, of course, more important in the large urban areas where many consumers are charged on a quantity used basis. But these councils are finding that meter readers represent a constraint of efficient billing and revenue maximisation because many are doing their jobs rather sloppily. They sometimes mis-read the meters, keep the meter books carelessly, record their figures illegibly and even provide completely ficticious readings.

6.9. Broken Meter Better Than No Meter?

The view that it is better to have broken meters installed rather than no meter at all was expressed by a few water supply personnel. They argued that a large proportion of the population will not realise that their meter is not working and will, therefore, be more careful not to waste water if they are charged on a theoretical usage than if they are charged a flat rate. The consultants were somewhat sceptical of this argument, but the socio-economic fieldwork supported the hypothesis that many consumers have no idea whether of not their meter is working.

6.10 Current DWA Metering - Conclusion

Consequently the whole metering situation at present is rather futile;

(i) the majority of meters are not working, (ii) even though they are not working properly some meters recording obviously incorrect consumption data are still being read (iii) even when a working meter is read the consumer is not necessarily billed on a quantity used basis, i.e. the readings are often disregarded for billing purposes, (iv) even though meters are currently not fulfilling any function either for billing or for planning, new connections are still being fitted with meters.
The existence of meters also creates a situation of inequality. Consumers with meters are generally charged a flat rate of K4 while consumers without meters are charged a flat rate of K5. Although there is nothing wrong in theory with metered low use consumers paying less than unmetered consumers, under present circumstances when no billing is done on a quantity used basis and faulty meters are not repaired it is unfortunate and naturally upsets unmetered consumers.

6.11 Costs

6.11.1 New Meters

At present there are two suppliers of water meters in Zambia. They quote different but similar prices for a particular size of meter. Table 6.1 shows the approximate average rounded current costs.

Table 6.1
Cost of Water Meters

Meter size	Price
15mm/½" Plastic case	K40
15mm/½" Metal case	K60
20mm/¾" Plastic case	K45
20mm/¾" Metal case	K75
25mm/1" Metal case	K115
50mm/2" Metal case	K350
80mm/3" Metal case	K450
100mm/4" Metal case	K600
150mm/6" Metal case	K800
250mm/10" Metal case	K2000

6.11.2 Meter Repairs and Cleaning

It is very difficult to estimate the cost of repairs by councils or what the cost would be if DWA was given the facilities. Hence the current cost estimate is based on repairs undertaken by the suppliers. They estimate that the cost of spares averaged out over a large number of small, (up to 25mm), meters would be K10 per meter. They charge K13 per hour for labour and based on a service engineer repairing 10 meters per day the labour cost per meter would also be K10. Hence the toal cost = K20 per meter or 33% of the average cost of new consumers' meters.

Where only cleaning is required it is assumed that the labour cost will be similar to that of repairs, i.e. K10 per meter and that no other costs will be involved.

6.11.3 Meter Life

In discussing probable average meter life, the responses of water supply personnel ranged from 2 years to over 10 years. One PWE estimated that if universal metering was adopted in the near future, 40% of the new meters would not be working within 2 years and most meters would not be working after 5 years. However, this represents a confusion/cynicism with the question of meter maintenance. In general both the meter suppliers and water supply personnel experienced with metering felt that the consultants' proposal in the Western Province study that meters have an expected life of eight years and that they will have to be removed for cleaning, testing. adjusting and, where necessary, repair, every two years on average, i.e. three times during their lives, was extremely sound.

A number of interviewees pointed out that plastic cased meters had a much shorter life than metal cased ones owing to their greater propensity to damage; a figure of 4 - 5 years' life was suggested. Hence the consultants will use expected lives and costs associated with metal cased meters.

6.11.4 Overall Unit Cost of Domestic Metering

The average capital costs of purchasing and installing meters for house connections will be as follows:-

15 mm water meter	K60
Fittings and Valves	K30
Meter Manholes or chambers	K15
Labour and other charges	K15
Total capital cost of installation	K120

It is assumed that the meters have an expected life of 8 years and that they will have to be removed for cleaning, testing, adjusting and, where necessary, reconditioning every two years, i.e. 3 times during their lives. Section 6.11.2 suggested that the average cost of cleaning and testing would be K10 and that when repair was necessary the average cost would increase to K20. In calculating the total present value cost of metering it will be assumed that the additonal repair cost will be required at the second inspection, i.e. after 4 years.

The costs of meter reading, based on a meter reader visiting 100 meters per day and costing K1,800 per annum including benefits, is approximately K1 per meter per annum. Meter reading could be reduced to once a quarter for most consumers. In this case the annual cost would be reduced to 25 ngwe.

The additional billing costs of a metered connection compared to an unmetered connection are estimated at K1.25 per annum. Hence the meter reading/ additional billing costs are K2.25 or K1.50 per annum when meters are read monthly and quarterly respectively.

The present value cost of meter purchase, installation and maintenance = K120 + K 31.22 = K151.22 where it is assumed that maintenance takes place at the end of years 2, 4 and 6 and that the discount rate is 6.5%. Consequently the annual cost of meter installation and maintenance, assuming an 8 year life is K24.84. Thus the total annual cost of metering = K24.84 + K2.25 = K27.09, say K27 per annum when meters are read monthly. The overall cost would be reduced by K0.75 if meters were to be read quarterly.

6.12 Pre-Conditions for Metering and Charging for Water on a Quantity used Basis

Whether or not metering is necessary and desirable, DWA's first priority should be the achievement of an efficient billing and collection system. In situations where metering is not worthwhile it will lead to increased revenue. In situations where metering is worthwhile much of the merit of metering disappears without it. Hence, efficient billing and revenue collections is:-

(i) the cheaper method of increasing revenue initially and,
(ii) a necessary pre-condition for universal metering.

If, in future, consumers are to be charged on a quantity consumed basis it is essential,(a) that meter readers are more effective, (b) that meters are kept in good working order and (c) that meters are standardised in metric units to simplify the meter reading process. Hence there is a need for considerable capital expenditure on meters and on maintenance facilities (cf. below). Given the financial and resource allocations that DWA has had for metering in recent years, anything other than highly selective metering would be an unrealistic target, unless government makes special provision for funds for metering or a donor is prepared to provide the necessary assistance (cf. Section 6.19).

6.13 Metering Service

There will be little point in DWA or a council metering most consumers unless it can provide an effective maintenance and repair service for the meters, i.e. metering should only be adopted to the extent that such a service exists. The service section must have the necessary repair facilities, spares and trained manpower competence to be capable of responding quickly to reports of defects, etc. It must be able to:
(i) fit new meters at new connections,
(ii) maintain meters,
(iii) replace faulty and damaged ones.
(iv) repair the faulty/damaged meters,
(v) test meters.

This will require the establishment of a maintenance team solely for cleaning, testing and repairing meters. Even if a real effort is made in the future to maintain meters properly, meter maintenance will continue to represent a major problem which will only be solved if sufficient resources are always devoted to it. It is recommended that during the next few years the available resources are devoted to a central meter maintenance facility, possibly located in Lusaka, where DWA concentrates its meter repairs until the number of meters in a particular province justifies the provision of the necessary facilities at provincial headquarters. Since a skilled man, backed up by support staff, adequate facilities and spare parts should be able to fix 1500 meters per annum, provincial facilities would not be justified for several years.

Meters which were identified locally as being faulty would be removed by a township supply plumber and replaced with one from the local stock. They would then be sent to the central metering facility, and added to the local stock when returned in servicable order. Thus one skilled man would remain at the central facility to deal with this flow of faulty meters. However, it would also be necessary for maintenance team members to periodically visit every supply to inspect, test, clean and replace meters on the spot. Visits every 2 years are recommended.

In developing the maintenance facilities, DWA should request the co-operation of the local meter suppliers. In particular the latter should be able to provide training for meter maintenance/repair personnel at a reasonable cost.

6.14 Requirements of Improved Meter Reading

If the benefits of metering are to be maximised it is important that meter readers are more effective than they are at present. They must read meters accurately. It is unlikely that the calibre of meter readers could be improved in the near future but improved training will improve their performance and reduce mistakes. If it is necessary in the short term to continue to use different types of meters the classification of every meter must be made clear to everyone and the meter readers must be able to recognise the units immediately. They must note all dubious readings and report suspected defective meters for immediate inspection. It is possible that an effective metering system could induce some consumers to tamper with their meters. Meter readers must be alert to this possibolity and report any suspicions so that meters which have been tampered with are fixed immediately and are given higher priority than purely technical meter failures. In this way the guilty consumers will not profit from their misdemeanours.

It is important that both DWA and councils supervise the meter readers effectively. Some councils are already concerned with the problem and intend to improve supervision. This can be done by (i) field checks by supervisors who would take independent sample readings for comparison with the meter reader's figures. This would be followed by suspension of meter readers whose recordings were shown to be rubbish, (ii) office checks on consumption records for identifying inaccuracies especially with respect to major consumers.

However sometimes meter readers are genuinely unable to gain access to a meter, for example due to the presence of a fierce dog. Meter readers should report all cases of inaccessibility immediately. Where entry is a regular occurence the consumer should be informed by post of the date of the next meter reading and requested to take the appropriate measures. If access is still unobtainable the officer in charge of the meter readers should use his judgement as to what he should do. The final sanction, after many months, during which time the bills would be estimated, could be disconnection.

6.15 Special Attention for Major Consumers' Meters

Since a faulty meter could quickly lead to a significant loss of revenue from a large consumer and to considerable wastage, it is important that such meters receive priority. Meter readers must then pay them special attention and report suspicions of faulty readings immediately. Officers in charge (DWA) and supervisors (councils) must also regularly inspect the readings records to identify faults as soon as possible so that they can be rectified immediately. Meter servicing units must relate the priority given to the inspection, maintenance and servicing of a particular meter to the magnitude of consumption from the connection, i.e. give highest priority to the largest consumers. Even if the reading of most meters is reduced to once in three months, major consumers use should still be read monthly.

This special attention should help to reduce the heavy loss of revenue which can, and currently does, result from just a few major consumers' meters being out of order. A.E.S.L. suggested that at the largest supplies, an additional monthly computer print out of the major consumers would be helpful for identifying necessary inspections and repairs as soon as possible. Their study showed that even in Kitwe considerable revenue was being lost unnecessarily, 48 out of the largest 129 consumers' meters were out of order, so that those consumers were only being billed at the minimum rate. In addition, although it was council policy that council water use should be charged for on a quantity used rate, 41 out of 91 non-domestic council meters were not working.

6.16 The Metering Decision

6.16.1 Introduction

It is important that any arguments concerning metering are based on quantitative data rather than on "gut feelings". This may appear to be stating the obvious, but at least one leading consultant has in recent years recommended universal metering on the basis that "the additional cost of metering is normally more than offset by the savings in water consumed". However, there was a total absence of any cost data. In addition the merits of the case for metering were described but the problems were largely ignored. This type of report/paper is, of course, very dangerous especially when what is said is well presented, since non-specialist readers may not appreciate what has been omitted.

Conceptually the decision as to whether or not to meter a group of consumers can be based on a cost benefit analysis, although the problem of quantifying the benefits often means that the final decision relies heavily on judgement.

The costs of metering are (i) the purchase and installation of the meters, (ii) the subsequent costs of maintenance and (iii) the reading and billing costs. In addition the reduction in consumption brought about by metering may reduce the level of benefits achieved. Metering may also result in a loss of head and slightly increase pumping costs. The major benefits of metering are discussed below.

6.16.2 The Reduction in Demand Resulting from Metering

There is very little data available in Zambia on the probable reduction in consumption that metering brings about. However, the consultants' experience suggests that, on average, an unmetered consumer is likely to use twice the quantity of water of an identical metered consumer, who pays for his water on a quantity used basis. However, some consumers, for example communal standpipe consumers, cannot realistically be charged on a quantity used basis. Other consumers who are charged on the quantity used basis, for example those who have their water rates paid by their employers, will not significantly alter their consumption. Furthermore, major consumers should be metered whatever metering approach is adopted for the average consumer. Hence, it is guesstimated that consumption, in a situation where only major consumers are metered, will be 50% higher than where all connections except public standpipes are metered.

6.16.3 Township X

In order to illustrate the various cost savings which result from metering, the consultants "typical overall average" township supply will be utilised and referred to as Township X. It is assumed to have the following characteristics: population = 7,000 persons; number of individual connections = 240, of which 10 are considered major consumers; total demand when all domestic consumers are metered = 700 m^3 per day; and total demand when only major consumers are metered = 1050 m^3 per day. The final figure is based on the assumption discussed above in which failure to meter increases overall consumption by 50%.

6.16.4 Capital Cost Savings on New Schemes/Major Augmentations

If a decision to meter is made prior to the construction of a new supply/ augmentation the designers may be able to save treatment and distribution costs by providing less treatment capacity and smaller diameter pipes if it is believed that metering will significantly reduce consumption.

Unfortunately design consultants do not usually follow through the probable effect that metering or lack of metering will have on consumption. Logically, alternative designs should be prepared based on the estimated production required at the end of the proposed design period, under alternative level of metering assumptions. Of course, time and finance may only permit "back of the envelope calculations", but even these could provide a valuable input to the metering decision. Instead most water scheme designs are based on certain accepted design criteria and often the level of metering, that those criteria assume, is not spelt out. Generally it appears unlikely that already designed schemes would be modified as the result of a metering decision made prior to construction. The quantification of those potential capital cost savings is difficult in the face of little quantified data from actual experience. However, if as the consultants suggested above, lack of metering increases overall demand 50%, universal metering will reduce the required design capacity of the water scheme by 33%. It is estimated that on average this will reduce the capital cost of the new scheme by 15%. Hence in Township X where a new scheme, based on consumption criteria which assume limited metering, would now be expected to cost at least K1,500,000 a cost saving of, at least, K225,000 could be achieved by universal metering. This would pay for metering all the 230 individual house connections up to a unit metering cost almost of K1000 per consumer. Since this figure is several times the cost of metering today, it can be seen that even if the values assumed for the different variable in the above example are altered, the costs of metering can be justified by capital cost savings alone where new schemes are being considered.

Although the above figures represent those of a typical DWA supply there will be considerable variations between schemes. The consultants estimate that based on their annual cost of metering figure of K27 per connection per annum, universal metering would be justified on capital cost savings alone, wherever the marginal cost of a new supply/major augmentation exceeded K370/m^3. This figure will nearly always be exceeded and hence metering would be justified. In addition the metering of all the consumers other than low cost housing residents would be justified whenever the marginal capital cost exceeds K150/m^3.

Even where an existing scheme is only being extended to new supply areas without expenditures being incurred on inceased capacity, it may be possible to justify metering within that part of the town on the basis of cost savings achieved through the use of smaller distribution pipes.

6.16.5 Capital Cost Savings Resulting from Delayed Augmentations

At schemes where present demand, in a situation of no or limited metering, is close to or already exceeds capacity, it is desirable to take measures to ensure that demands are met. The first possibility is to augment the supply at a considerable capital cost. However, widespread metering may represent an alternative if metering reduces demand to below existing capacity. In time even metered demand will exceed capacity, but the delay will represent a cost saving. In economic terms the annual saving would be the opportunity cost of capital applied to the cost of the augmentation.

If the capacity in Township X is less than 700 m^3/day, augmentation is required immediately and metering will result in reduced development costs described in Section 6.16.4. If present capacity is above 1050m^3/day the cost saving will be restricted to the operation cost savings discussed in Section 6.16.6. However, if the present capacity is between 700m^3/day and 1050m^3/day the saving will be a combination of capital cost savings resulting from delayed augmentation, and reduced augmentation costs in the future.

If existing capacity is close to present metered demand the achievable delay will be small, but future capital cost savings will be achieved by the smaller augmentation necessary as described in Section 6.16.4. If existing capacity is similar to present unmetered demand, the main benefit will be a cost saving resulting from delayed augmentation. Hence, if the present capacity in Township X is 1050m^3/day and total demand in increasing at 7% per annum, metering would permit a six year delay in undertaking the augmentation. At an interest rate of 6.5% and a 20 year project life the annual saving on a K 1.5 million augmentation would be approximately K136,000 per annum. This more than covers the cost of metering all individual connections in Township X. It represents approximately 2200% of the annual cost (K27 x 230) of metering all non-major consumers.

If the government were prepared to use the tariff structure to reduce demand, i.e. to charge a very high unit price for water, it would be possible to use metering as a tool to delay the need for augmentations for several years, even where projections based on a lower price for water suggest the need for augmentation in the near future.

6.16.6 Saving of Operational Costs

Metering will achieve a saving in the variable operation costs at all supplies where metered demand is less than the supply capacity, since less water will have to be pumped daily due to reduced wastage and consumption. These variable costs will typically be around 5n/m^3, (cf. Section 3.10). Hence, if in Township X capacity exceeds 1050m^3/day the additional supply of 350 m^3 per day would cost around K6400 per annum or K28 per non existent meter. This cost is similar to the annual cost of metering, and hence metering may or may not be justified on operational savings alone. However, the overall figure of K 28 discuises differences between different consumers. For example the failure to meter an average low cost household is estimated to increase its consumption by 700 litres per day. The annual operational cost of this additional consumption would be approximately K15 per annum. However, the failure to meter an average high cost household is estimated to increase its consumption by 1750 litres per day. The annual operation cost of this additional consumption would be approximately K38 per annum. Hence, it can be seen that the operational cost implications of failing to meter different groups of domestic consumers are very different. However, in a typical township operational costs alone may justify metering all domestic consumers, and they will always justify metering households with well above average additional consumption resulting from a lack of metering.

However, the marginal operational cost of consumption in different townships will vary considerably. Table 6.2 presents the minimum consumption saving figures necessary to justify metering when the annual cost is K27 (cf. Section 6.11.4.).

Table 6.2

Break-Even Consumption Savings Necessary to Justify Metering

Marginal operational cost (n/m3)	1	2	3	4	5	7.5	10
Minimum consumption saving needed to justify the cost of metering (l/d)	7400	3700	2470	1850	1480	990	740

In a given township where the marginal operational cost is known, judgement should be used to decide whether the probable consumption saving shown in Table 6.2 corresponding to that cost is likely to be achieved. Unless marginal cost exceeds $4n/m^3$ it is unlikely that metering could be justified on operational cost savings alone. Nevertheless the decision to meter is almost certainly appropriate for some townships. Where diesel is used, resulting in very high short term variable costs of around $15\text{-}20n/m^3$ (cf. Section 3.10) metering should receive high priority. For example, the Western Province study showed that the marginal costs of consumption in Lukulu and Namushakende at 1981 prices would be $8.63n/m^3$ and $11.80n/m^3$ respectively. However, the 1981-3 increases in the price of diesel mean that these costs will have doubled since 1981, and 1983 marginal costs would be around $17n/m^3$ and $24n/m^3$ respectively. The consumption savings necessary to justify metering are only 435 litres and 308 litres per connection per day, i.e. 62 litres and 44 litres per person per day in Lukulu and Namushakende respectively. Since the failure to meter will induce additional consumption far in excess of these figures, universal metering and charging consumers on a quantity used basis is a necessity in such townships.

6.16.7. More Equitable Distribution and Reduced Shortage of Water

In both situations where existing capacity is insufficient to meet present unmetered demand, i.e. (i) where it is below present metered demand and (ii) where it is between present metered and unmetered demands, metering will result in an additional unquantified benefit. In the former case it will ensure that, prior to augmentation, the limited water is distributed more equitably among competing consumers. In the latter case it will ensure that all consumer demands are met in full immediately and continue to be met for a longer period in the future. Furthermore, if funds for augmentations are not available later when increased capacity is needed, the limited water will again be distributed more equitably among competing consumers. Even in Western Province which has recently been provided with new township water supplies and where metering would currently only save operational costs, the costs of not metering will include problems of water shortage within 5 years. This is because it is unlikely that augmentations to the new schemes will be implemented in time, even though the first phase included many components designed to 1995.

6.16.8 Other Minor Benefits

In addition to the major benefits of metering described above there may be a few other minor non-quantifiable benefits. For example (i) loss detection from the distribution system may be facilitated and (ii) the large quantity of consumption data will be extremely useful for future water supply planning. The newly available data should assist the development of optimum design criteria and will also improve future metering decisions. For example a comparison of the consumption in newly metered towns over the next two to three years with consumption elsewhere will produce accurate data on the effect of metering at a given price structure.

6.16.9 Local Factors

The metering decision should not be divorced from the characteristics of the local situation. For example in townships where it is believed that an above average potential for reducing wastage exists, the case for metering is stronger. In townships where there is suspended matter in the water or where the supply is intermittent, the cost of meter maintenance and repair will be considerably higher, and the case for metering weakened. Hence when DWA is deciding which townships should receive metering priority, either in the near future for the installation of new meters for large consumers, or if and when universal metering is undertaken, factors such as water quality should be taken into account.

6.16.10 Conclusion Based on Financial Costs

Precise metering decisions will not be able to be made until there is better data available, particularly on the effect that metering has on consumption. Nevertheless it can be concluded that:

(1) All major consumers must be metered.

(2) As far as the average consumer is concerned Sections 6.16.4 and 6.16.5 showed that capital cost savings alone justify metering where:

   (i) a new supply/major augmentation is now, or will shortly, be required in order to meet metered demands, provided that the effect of metering is taken into account during the design stage so that the potential cost savings are actually achieved.

   (ii) a new supply/major augmentations is now, or will shortly be, required in order to meet unmetered demand, but where metering will permit a significant delay in incurring the necessary development expenditure.

Since the water supply development in Zambia is now at the stage where most supplies fall into one or other of these categories, metering is often justified by capital savings.

At supplies where there is considerable spare capacity for example at supplies where major augmentations have recently been completed, metering can only be justified at the moment by variable cost savings. In this case metering should be restricted to major consumers unless variable costs exceed $4n/m^3$. Low cost consumers should only be metered if variable costs exceed $10n/m^3$.

Hence it can be concluded that universal metering is recommended at most supplies in Zambia. The only exceptions being those with spare capacity and marginal costs below $4n/m^3$. At supplies with spare capacity and with marginal costs between $4n/m^3$ and $10n/m^3$, consumers other than low cost housing residents should be metered.

6.16.11. Foreign Exchange Implication of Metering

Due to the unavailability of appropriate shadow prices an economic analysis of metering would be a rather dubious exercise. However, due to the significance of foreign exchange in both the cost of metering, and in the additional costs of not metering, the consultants have attempted to present the foreign exchange implications of the metering decision.

The approximate foreign exchange costs of metering are as follows:-

	Total Cost (K)	Forex Element (%)	Forex Cost (K)
Consumer meter	60	50	30
Fittings and valves	30	50	15
Meter manholes or chambers	15	20	3
Labour and other charges	15	10	1.5
Total	120		49.5

The foreign exchange cost of cleaning and testing meters would be very low, i.e. under 10% or less than K1, though the foreign exchange cost of spares will be around 50%, i.e. K5. The foreign exchange costs of the additional metering, reading, billing and collection costs associated with metering are assumed to be zero.

Thus the present value foreign exchange cost of metering will be K49.5 for meter purchase and installation, and K6 for maintenance and repairs assuming that those take place as suggested in Section 6.11.3, and that the discount rate is 6.5%. Hence, the total present value foreign exchange cost of metering = K55.5. Assuming a meter life of 8 years the annual foreign exchange cost = K9.11. Hence the foreign exchange cost of metering is approximately one third of the overall cost.

Section 3.11.1 shows that the foreign exchange cost of water supply development is typically around 40%. Hence, from a foreign exchange point of view metering at all supplies where there is no spare capacity is even more favourable than it is from a straight financial cost point of view. At supplies where there is plenty of spare capacity, but where the use of diesel means that marginal costs exists justify metering, the foreign exchange element of these marginal costs will be around 33% and, therefore, metering will be justified from a foreign exchange point of view, to a similar degree by which it is justified on purely financial grounds. Unfortuantely the consultants were unable to discover any reliable data on the forex context of Zambian generated electricity. However, guesstimates suggest that the forex context of the short term variable costs when a supply uses electricity is around 20%. Consequently in order for metering to be justified on a foreign exchange saving criterion the short term variable costs would have to exceed the costs of metering by at least 50%.

6.16.12 Overall Conclusion

The high level of metering recommended above is based on a cost trade off decision. However, the final decision must also take other factors into account.

Hence the recommendation to pursue a policy of universal metering must also take a number of other factors into consideration. The most important is the willingness of DWA/councils to charge for water on a quantity used basis and their ability to enforce this pricing method. If this cannot be achieved there is no point in incurring the costs of metering. Secondly the authorities must have the capacity to handle the technical and administrative burden that will result from universal metering.

It is, therefore, suggested that while universal metering is recommended for most supplies, DWA/councils should only install the number of meters that they can adequately service, both technically and administratively. Since it would be worthwhile to devote resources to building up this capability, it is hoped that donor assistance will be made available in order to achieve this objective. An appropriate package is discussed in Section 6.19. At the moment DWA/councils should concentrate on metering major consumers in order to maximise the value of their limited resources. This policy of selective metering is discussed below.

6.17 Selective Metering

Even where:(a) capacity at a supply exceeds demand and where the only cost saved by metering is a variable operational cost which is estimated to be below the level that would justify universal metering and (b) where metering is considered ecenomically viable, but where the existing manpower, foreign exchange and other constraints limit implementation capacity, there is considerable merit in adopting a policy of selective metering. The level of "selective" would largely depend on the capacity of the water supply agency. In the large urban areas it may mean total metering in high and medium cost housing areas in addition to all industrial, commercial and institutional consumers. Low cost housing and squatter areas may be measured on an area basis only. However, if local flow meters assist in identifying high use consumers living in low cost housing areas, these connections could also be metered. At DWA supplies, selective would probably mean major consumers only, i.e. mainly commercial and institutional. If local flow meters assisted in identifying high use domestic consumers, they could also be classified as "major consumers" and be metered. Even where metering is restricted to major consumers it may be worthwhile to install meters on a small representative sample of all connections since this should provide consumption and loss data necessary for operation and planning purposes.

A major advantage of the selective approach is that efforts can be concentrated on high use consumers, whose accurate metering and subsequent billing is especially important since their consumption represents a high proportion of potential revenue.

6.18 Bulk and Branch Line Meters

Bulk flow and strategically located branch line meters will provide data on total production, distribution losses and consumption by area. Hence they are important to provide data inputs for an effective understanding of what is happening in a system. They will provide indications of trends and unfavourable developments and assist in identifying excessive leakage, consumption or wastage by non-metered consumers. They are, therefore, useful for both efficient day to day operation and for planning future developments. Given the limited capability of most township water supply organisations it will probably be appropriate for these meters to be installed and maintained by a centrally organised unit.

6.19 Donor Assistance for Metering

The proposal to increase the level of effective metering will, as was discussed in Section 6.12 require prior improved billing and revenue collection, improved meter maintenance facilities and considerable funding.

It is, therefore, recommended that NORAD provides a metering assistance programme to cover all urban and township water supplies and which would;

(i) undertake a sample meter survey in order to determine the percentage of installed meters currently working and, in particular, the percentage of the meters which are currently non-operational but which could be repaired.

(ii) provide the new meters required.

(iii) determine the appropriate meter maintenance facilities.

(iv) provide the required maintenance facilities including the necessary transport.

(v) provide the necessary trained personnel.

Since improved billing and revenue collection is a pre-condition for metering to be worthwhile, it is proposed that this donor assistance programme should follow and be dependent upon the improvement of billing and revenue collection. Hopefully this will result from the donor assistance programme proposed in Section 14.6 for this purpose.

An order of magnitude costing of a metering assistance programme to DWA is estimated as follows:-

Cost of Survey	=	K 60,000
Cost of 5000 consumers meters	=	K 300,000
Cost of larger meters	=	K 300,000
Cost of spare part provision	=	K 100,000
Cost of maintenance failities	=	K 50,000
Cost of training personnel	=	K 200,000
Miscellaneous costs	=	K 40,000
Total	=	K1,050,000

7. WASTAGE REDUCTION

7.1 Introduction

Serious efforts must be made to reduce wastage whether or not universal metering is introduced. However, the magnitude of the problem is far greater when no, or only a limited, number of consumers are metered. Consequently this chapter outlines the problem and a number of ideas for combatting it.

A significant proportion of total production/consumption is wasted unnecissarily for a variety of reasons. If these losses could be reduced in a situation where present demand was being met:-

(i) recurrent expenditures on electricity, chemicals, etc. could be reduced.

(ii) existing capacity would meet future demand for a longer period and hence augmentations could be delayed, thus saving capital expenditure.

If the losses could be reduced in a situation where present demand is not being met:-

(i) a greater proportion if not all of the present demand could be met without increases in costs.

(ii) revenue would increase.

Hence it is important to reduce all unnecessary losses/wastage. The greatest potential is clearly in those towns where apparent per capita consumption is far above accepted design criteria.

The main unnecessary losses/wastage are due to:-

(i) defective plumbing, i.e. faulty taps, overflowing WC cisterns, etc. The socio-economic servey showed that the average leakage loss per individual connection from faulty taps alone was 102 litres/day in Katete and 82 litres/day in Mumbwa. Overall this represented between 5 and 6 percent of domestic consumption in high and medium cost houses. The AESL study* estimated that

* Zambia Water Wastage Study. Associated Engineering Services Ltd. 1977.

losses from all faulty plumbing as a percentage of water produced were approximately 10 percent in Lusaka and Kitwe. AESL also discovered that 3 percent of garden standpipes flowed continually and that 8.5 percent of communal standpipes in Kitwe were leaking to some extent.

(ii) consumer mis-use i.e. leaving taps running. The AESL study estimated that these losses were approximately 7 percent in Lusaka and Kitwe.

(iii) unnecessary distribution losses. Some distribution losses are inevitable but with reasonable maintenance they should be held to below 15 percent. However, inadequate maintenance of plant and equipment often creates unnecessary losses. Inlet float valves fail to prevent service reservoirs from overflowing, sluice valves and hydrants leak through their spindle glands, etc. AESL estimated that preventable system losses were 10 percent of treated water production, 7 percent being losses from leakages that could be detected and repaired.

Hence in Lusaka and Kitwe unnecessary losses and wastage were approximately 25 percent of production, It is unlikely that the figure at most DWA supplies is lower. Furthermore, this figure excludes savings that could be made in garden wastage and other uses by a more water conservation conscious public.

7.2 Possible Methods of Reducing Wastage

7.2.1. Consumer Losses

Water losses from faulty fittings and other consumer wastage will be related to (i) the price/price structure and (ii) to meter reading and billing and disconnection efficiency. If metering is not widespread or if there are major inefficiencies in meter reading, billing and disconnection, increasing the price of water may have no, or limited effect, on the increasing consumer losses.

Even though the consultants have recommended a major increase in the level of metering, a low level of metering will be the reality in the near future at most D.W.A. schemes. Therefore solutions to the problem of reducing wastage at (i) individual connections in a non metered situation, and at (ii) communal standpipes whether metering is common or not, must be found.

It is recommended that councils and D.W.A. give increased attention to the problem of reducing wastage. Minimising losses and wastage should be given much higher priority than at present. In the larger towns it may be possible to form small waste water section supported by a small van but at the smaller township supplies, one man on a bicycle would suffice at present. The major functions of the personnel involved would be:-

- (i) the immediate identification of leakages. People do report the lack of water, but do not usually report leakages.
- (ii) the identification and warning of illegal gardeners (c.f. Section 7.3)
- (iii) the policing of communal standpipes. This will include checking that consumers are using the standpipes properly especcially where any pressure or "waste not" taps are installed, checking that taps are not left running, and instructing consumers who are found misusing the supply in any way, including failing to turn off taps, on the importance of behaving properly. It is possible that one man riding round a township on a bicycle, turning off taps he finds left running could justify his salary on this one activity alone.

In actively pursuing reduced wastage, there are a number of strategies which DWA and councils should investigate. These include:-

- (i) Limited metering
- (ii) Improved publicity
- (iii) Restricted supply
- (iv) Restricted flow devices
- (v) Repairs and better maintenance of council house fittings
- (vi) Waste-not taps at communal standpipes.

These are all discussed in Sections 7.2.2. to 7.2.7. below.

7.2.2. Limited Metering

Selective metering was discussed in Section 6.17. Nevertheless for completeness it is necessary to emphasise here that one of the greatest wastage saving potentials exists at institutions, where losses due to faulty fittings and consumers wastage are especially prevelant. Hence, installation, maintenance and monitoring of institutional connection meters is important now in order to minimise losses at those points when current and potential losses are high. Later, after an efficient bulk and branch line metering system has been established it should be possible to identify other consumers whose consumption and/or wastage is above an acceptable limit, they should then be metered to further reduce wastage.

Another strategy to reduce wastage, or at least get revenue for it, would be to bill low cost housing consumers on the basis of the average consumption of their residential area based on a branch line meter reading. Wastage would still represent a"public good" problem, but at least it and gardening would become a local issue and there may be local pressures to restrict them both.

7.2.3. Improved Publicity

Although requests to consumers to conserve water are not a solution by themselves, they may contribute towards an improvement if consumers are approached effectively. Hence a campaign aimed at making the public water conservation conscious should be undertaken.

At present there is a very limited water conservation awareness among the Zambian public. It is, therefore, important to make people aware of the need to use expensively produced water carefully. The necessary programme to influence public opinion and to provide the public with information could be conducted through a combination of posters, public meetings, radio, television and the press. One important but often neglected channel could be direct contact by DWA personnel. For example talks to school children which could cover the way DWA discharges its duties, the costs of water production and the need to use it properly. DWA must be conscious of developing good public relations since people will react more positively to exhortations if they are treated politely and provided with information.

AESL reported that in one area of Lusaka a real reduction of wastage was achieved when the public became conservation conscious through observing efforts made to physically reduce leakages, etc. This effect on consumer behaviour resulted in a greater saving of water than the physical measures did.

Consultants reports often include such recommendations, but they are rarely followed up. Hence, it is proposed that NORAD could provide the finance and an experienced PRO in order to implement this proposal. It may be appropriate to start the campaign in different provinces using different combinations of the available publicity channels in order to determine the most effective one.

7.2.4. Restricted Supply

Another strategy to reduce wastage and gardening may be to restrict the supply to certain hours, for example to the daylight hours. The merits of such restrictions will vary depending on the characteristics of a supply, for example on the ratio of the volume of the main treated water storage tanks to demand. Furthermore an intermittent supply may only achieve a large watering reduction if daytime watering is successfully restricted. Hence, an intermittent supply strategy must be examined carefully before implementation, especially as lack of care in restarting the supply could lead to additional bursts, wastage and meter cleaning. If the strategy is felt appropriate for a particular township the water supply agency should ensure that consumers are kept informed so that they can plan their consumption in order to minimise inconvenience.

7.2.5. Restricted Flow Devices

The consultants considered the possibility of restricting the consumption of flat rate consumers by means of a restricted flow device, i.e. small orifices, although the lack of experience and field data meant that the subject could not be studied quantitatively.

In order to provide a low cost housing family with their design consumption of 100 litre/person/day, house storage of 250 litres would be required. It is estimated that this would cost approximately K60, and that if the tank was placed on the roof,or in the attic the total cost of including fittings may increase this to K120. On the face of it this cost could be justified. The annual capital cost assuming a 10 year life, and a discount rate of 6.5 percent would be under K17 per annum or K1.40 per month. If the restricted flow resulted in per capita consumption being reduced from

150 litres/person/day to 100 litres/person/day, and the overall reduction could well be considerably greater than this, the water saved in an average household with 7 consumers would be over 10 m^3 monthly. This saving may not justify the installation costs in townships where considerable spare capacity exists, but it would certainly justify those costs in most townships where present day demand is close to or exceeds capacity. Another possibility would be to leave the provision of storage to the individual consumer. Not only would this reduce the cost to the government dramatically, but would even reduce the total cost since individuals would have greater flexibility in providing cheaper types of storage for themselves. Even now consumers provide some storage. For example, in towns where the water supply is normally adequate, the sale of buckets increases dramatically when water is rationed.

However the consultants are unable to recommend widespread adoption of restricted flow devices in a country where there is no experience of (i) consumers reaction, (ii) effect on consumption and (iii) the actual costs, which in practice may be rather different from the theoretical ones which were calculated from basic cost data.

Nevertheless, the idea is sufficiently promising for the recommendation that one township be chosen for a "restricted flow pilot scheme". It is suggested that this be implemented as soon as possible and that all experience is monitored and records kept of all relevant data so that the real value of the idea for water supplies nationwide can be judged. It is further proposed that one of the Western Province townships be selected. The reasons for this are:-

(i) the experiment should be carried out in a township where the scheme is capable of supplying all demands so that the restriced flow is not further restricted by supply constraints.

(ii) Ostlandkonsult's continuing presence means that they could supervise both the physical activities and the necessary monitoring.

Another method to restrict the supply which could be adopted at the time when extensions are planned is to provide minimum sized pipes, based on the consumption criteria, for minor branch lines which are supplying limited areas. These could act as restricted flow devices for perhaps 50 households rather than for the individual consumer. The problem of course is that it may be difficult to avoid the situation where some consumers are still able to waste water while others are deprived on their basic requirements.

7.2.6. Repair and Maintenance of Taps and WCs by Councils*

A major responsibility for losses due to faulty consumer fittings must rest with councils. In Lusaka the council owns 50 percent of all properties that receive mains water through individual connections. Another 20 percent are owned by the government. In Kitwe the council owns 37 percent of all metered premises and 80 percent of unmetered houses. Hence, the overall condition of consumer fittings is highly dependant on the conditions prevailing at council properties. Generally these are rather poor. In high cost housing areas which are mostly privately owned fitting losses were estimated at 5 percent in Lusaka and 7percent in Kitwe. But in low cost housing areas which are council owned, losses were over 20 percent. This is not surprising since councils and government neither maintain the plumbing services on their properties properly nor carry out inspections to check for losses due to plumbing faults.

In the large urban areas the burden of these omissions falls on the council itself since it is also responsible for the water undertaking. However, in the smaller townships the councils completely escape from the results of their poor mainteance. DWA incurs extra costs and consumers may suffer if the supply capacity fails to meet demand. One possible way to bring pressure on the council to improve maintenance to reduce these losses would be to bulk meter the flow into every major council housing area and for DWA to bill the council. The council would then obtain water rates from consumers in a similar manner to that of larger urban councils, by including a water component in the rents of low cost housing.

7.2.7. Waste-Not Taps

One possible method to reduce wastage resulting from communal consumers leaving taps running would be pressure or "waste-not" taps. Some towns

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* The data for Lusaka and Kitwe in this Section was derived from the AESL Study (op. cit.).

have experimented with such taps and during the fieldwork the consultants discussed pressure taps with numerous water supply personnel. Those who had experience of them were mixed in their reactions to the idea of widespread adoption all over Zambia. In Chipata where they had only been in operation for a few months they seemed to be working reasonably well. Some officers, who although believing that it is inevitable that they will sometimes be left open, felt that they could still be worthwhile since they would still dramatically reduce wastage. However, others argued that the cost of repairs resulting from mis-use would be so great that they would not represent a feasible strategy.

Unfortunately the consultants do not have the data to reach a firm conclusion on the merits of "waste not" taps. However, they believe that they have a part to play in communal water provision in Zambia. Their costs are more visible than the benefits, i.e. the need for frequent repairs is easier to see than the electricity, chemicals etc. which are not used. It is even more difficult to view the very real benefits of supplies where capacity is still insufficient even after wastage is reduced, i.e. the greater proportion of water that is usefully consumed. In additon frequent visits by DWA personnel and informal advice concerning proper behaviour should reduce the frequency of damage and need for repairs. DWA could also wait one week before repairing a communal standpipe so that consumers have to walk to their next nearest tap. This combined with good public relations should asist in increasing the care with which consumers treat their standpipes/taps.

As a first approach to a quantitative analysis the consultants' guesstimate that the taps have to be repaired/replaced every four months at an average cost of K20. But, since standard taps have to be repaired/replaced quite frequently the net cost is assumed to be K13. This results in a daily cost of about 11n. Since the probable saving of water may average $1m^3$/day/standpipe, this cost is more than justified.

Hence although limited data does not yet allow the formation of a firm recommendation for or against "waste not" taps it appears that they will be economically feasible. The same appreach as was recommended for restricted flow devices is proposed, i.e. a pilot scheme in one township, possibly in

Western Province where Ostlandskonsult could again supervise the physical activities and monitor the results.

7.2.8. Reduction in Losses in the Distribution System

There is a clear need to improve staff training so that they know more about the equipment with which they are involved. The responsibility for loss control must be given to one individual, probably the officer in charge, who must see that the operation and maintenance rules are properly enforced. These should include following a programme for systematically checking valves, hydrants, etc. However, this will only be possible to achieve when sufficient recurrent finance is available. The task of township water supply staff in identifying distribution losses would be considerably eased by the installation of sufficient strategically placed flow meters (c.f. Section 6.18). Regular readings would enable them to maintain a continuous check on flows into the main distribution areas so that sudden or unexplained changes in flows can be investigated.

7.3 The Major Problem of Garden Watering

It became clear early in the fieldwork that garden watering had an important bearing on the study. All over Zambia the amount of water being used for gardening is substantial. There are usually no restrictions and rarely any effective restrictions on its use. The consultants estimate that 33 percent of dry season consumption at DWA supplies may be used for gardening. Within local residential areas this may increase to 50 percent and some individuals may apply 75 percent of their dry season use to their gardens. It is believed that if garden watering did not take place, total dry season use would be similar to total wet season use. The AESL study tended to corroborate these estimates, although, as may have been expected in large urban areas where industrial and commercial use is high, the overall percentage effects were lower. For example in Lusaka it was estimated that gardening often took 30 percent of maximum demand in low density areas but was not significant elsewhere. In localised areas the figure increased to 50 percent. It was guesstimated that 50 percent more was being supplied than was necessary for plant growth and that 5-6 percent of total water consumption was wasted by excessive application to gardents. The findings in Kitwe were similar with 8 percent of total dry season consumption being used for gardening. At times up to 20 percent of total consumption was used for watering gardens.

The socio-economic survey provided additional evidence that garden watering represents an important use of water from township supplies. It was found that 80 percent of high service consumers in Mumbwa and about 40 percent of consumers in Katete water their gardens from the supply. Although it was not proved, it is hypothesised that the difference in the percentages of consumer watering their gardens in Mumbwa and Katete is due, at least in part, to the method of charging. In Mumbwa all consumers pay a monthly flat rate so garden watering will not cost them anything. In Katete an effort is made to charge consumers on a quantity used basis and hence garden watering has to be paid for by consumers whose meters are working. It can, therefore, be argued that garden watering represents a greater problem for DWA township supplies than for councils in urban areas. Not only does gardening represent a larger percentage of total demand but a far larger proportion of water used for gardens is metered and thus paid for. Whereas in the urban areas many of those with large gardens will be metered, at most DWA supplies few of the heaviest waterers will be metered. The socio-economic survey also found that 30 percent of low service consumers use their standpipes for garden watering. However they use very limited quantities of water and garden watering by communal standpipe consumers does not represent a problem.

Small gardens around consumers residences have considerable merit. The benefits include:-

(a) improvement in the nutritional value of the diet of the poorer sections of the community.
(b) financial savings for the individual family on food.
(c) increased national food production.
(d) aesthetic value.

Hence the development of small gardens should be encouraged. Consequently the consultants are keen that this section should not be seen as a blanket discouragement of gardening activities but rather as guidance to achieve a balance between the needs of vegetable production and the proper use of a water supply.

Since garden watering adds to peak demand it not only increases recurrent costs, but also increases the capacity required and leads to augmentations being required several years before they would otherwise have been. It, therefore, increases capital costs. Therefore, it must often be restricted or discouraged. There are two main ways in which watering gardens can be discouraged. Firstly by formal restriction of use. Secondly by the introduction of universal metering accompanied by a pricing structure in which domestic use above a certain level is charged at much higher prices, i.e. pricing would be used as the rationing/ restriction tool. This is the appropriate solution for some areas in the larger urban areas. Indeed some DWA personnel said that too much water is being used for gardening in their township and that metering was the only way to stop excessive garden watering. Hence, it may also be the appropriate longer term solution for DWA but it may not always be possible in the shorter term for two reasons. Firstly it would be extremely expensive and secondly it would be beyond DWA's present adminstrative and technical capacities.

There are two situations in which watering gardens should be discouraged. The first is where dry season demand exceeds the capacity of the supply, i.e. where gardening by some consumers may deprive other consumers of sufficient water for their more basic domestic requirements. In such a situation all consumers must be discouraged from watering their gardens during those hours when the demand exceeds the capacity of the supply. Thus if the problem relates to peak hours only it may only be necessary to restrict gardening to certain hours. However, in some cases it may be necessary to forbid gardening throughout the dry season, The first step to reduce/forbid gardining is for a council to issue a water restriction notice, an example of which is shown below.

N D O L A   U R B A N   D I S T R I C T   C O U N C I L

WATER RESTRICTIONS

Notice is hereby given that there is an acute shortage of water this year because the dry season water demand is in excess of the present capacity of water treatment works. The situation is worsened by meagre rainfall during the year and hence the following water restrictions are imposed to conserve water until the situation improves.

1. Water supply to Chifubu, Pamodzi, Kawama, Masala, Kabushi, Mushili, Lubuto and high level areas of Northrise (Areas above Nawaitwika Road, including Kalewa Barracks, Kansenshi Police, Kansenshi Prison and Nkwazi Township will be shut from 09.00 hours to 15.00 hours. This is in addition to the water restrictions already in force from 21.00 hours to 05.00 hours.

2. Water supply to Itawa, Ndeke and Kanini will be shut from 09.00 hours to 15.00 hours.

3. All industries are asked to limit their water consumption to possible minimum.

4. Garden watering in all areas is permitted only between 16.00 hours to 18.00 hours. Offenders are wardned that usage outside this period may result in their water supply being cut off.
   Consumers in affected areas are advised to store sufficient water. With public co-operation it is hoped that the above measures will see us through the remaining dry season.

C.M. CHITOSHI
DISTRICT EXECUTIVE SECRETARY

Civic Offices
P.O. Box 70197
Ndola.

Unfortunately just requesting people to stop gardening is insufficient and recent discussions within Ndola council have highlighted the large misuse of water and the fact that certain taps "were never closed for hours". Consequently the second step would be to form an anti-water wastage squad or similar body, as Ndola Urban District Council has done recently. Its major role would be to go round and check on misuse of water by consumers and to report on them.

Guilty consumers would be issued with warnings, if they were found watering again within the same dry season action has to be taken against them. If nothing is done warnings will be ineffective as they usually are at present. The consequence would be that the councils and DWA would fail to provide sufficient water to some consumers for their basic needs, i.e. they will fail to do the job for which they have been appointed The possible courses of action which could be taken include:-

(i) the imposition of fines. This could involve the courts and may be complicated and time consuming.

(ii) the confiscation of hosepipes. This has considerable merit provided that it could be implemented in such a way to exclude abuse. For example hosepipes should only be confiscated against an official confiscation receipt.

(iii) disconnection of the consumer. This is the recommended course of action. It is proposed that DWA and the councils should use the arguments presented here to press government to pass legislation to allow them to disconnect consumers who ignore the warning letter to stop garden watering. Given this power it would be possible for them to disconnect guilty consumers in exactly the same way as they disconnect consumers who fail to pay their bills. They would, of course, reconnect the watering culprits as soon as they paid their reconnection fees. If the system was allowed to operate without outside interference the effect would be that DWA and the councils would be indirectly fining the guilty gardeners. If, as is proposed, the reconnection fee is dramatically increased (c.f. Section 11.17). the system should deter consumers from abusing their water supply and depriving other residents of water. The main problem to this proposal is that local politicians may oppose such disconnections. In this case there is little that the water supply authorities can do to bring the offenders to heel. But it should be pointed out that the ensuing failure of DWA and councils to provide water to some of its consumers is NOT THEIR FAULT and that they cannot possibly do the job which they have been appointed to do without political backing, let alone with political opposition.

The second situation where gardening should be discourgated is where unmetered consumers who are paying fixed monthly water rates use large quantities of water for gardening. Thus increasing recurrent costs and advancing the time when the next augmentation will be required. Unfortunately this situation is common in every township in Zambia, but no one has yet found the answer to the problem. Since universal metering has been ruled out in the short term what can be done? The consultants suggest that unmetered consumers be forbidden to water their gardens but that all unmetered consumers have the right to request that they are metered. This would entail their paying the cost of the meter and subsequently paying for water on a quantity used basis. They would have the right to water their garden subject to seasonal restrictions discussed above as soon as they had paid the fee for their meter, i.e. even if the capacity of the water authority was unable to cope with the demand and long delays occurred in installing the meter and charging the consumer on a quantity used basis, he would be permitted to water his garden. Unmetered consumers found watering their garden illegally (legislation is required to implement the recommendation), would be subject to the same procedure discussed above. The first offence would result in a warning and the second offence in disconnection. Reconnection would follow immediately the reconnection fee was paid.

Of course, this proposal is sub-optimal. For example, it wouldn't matter if consumers applied limited amounts of water to their gardens Unfortunately there is no way in which this could be allowed without widespread abuse.

The consultants are also aware that this proposal is likely to encounter major opposition, and would on request from the client withdraw it from the Final Report. However, it should be remembered that:-

(i) the proposal is not aimed at preventing people from watering their gardens, it is simply aimed at insisting that they pay for the water.

If growing vegetables is worthwhile it would be worthwhile for the consumers to pay for the water.

(ii) these consumers are now effectively obtaining free water for gardening and so insisting that they pay for it can be analgous to insisting that they pay for their vegetable seeds and fertiliser at the local store.

Of course, even if the water supply authorities support the proposal there will again be a major political obstacle to overcome before the necessary legislation could be passed. However, it should be made clear that there are only three possible scenarios.

(i) that the present unsatisfactory situation is which unmetered consumers are applying excessive amounts of "free" water to their gardens is by default endorsed by the government.

(ii) that universal metering be adopted. This would require not only a major capital investment for meters and maintenance facilities by government, of which a major portion would represent foreign exchange,but also a dramatic increase in the technical competence of DWA to install, clean and maintain the meters.

(iii) the implementation of the consultants proposal. Even given adequate political backing the councils and DWA would be faced with a major checking exercise. However, this would be a simpler task than that resulting from universal metering.

The proposal is sub-optimal for places where garden watering by unmetered consumers can still be provided within the existing capacity of the supply and where the marginal costs are low. In this case the cost/benefit matrix justifies government subsidisation of the additional costs. However, this situation is not common in Zambia today. In most townships garden watering in the dry season usually increases demand to beyond the capacity of the supply. In addition there are a few supplies, usually where the power is provided by the diesel fuel, where the marginal costs are considerable. Since the advantages of having a uniform national policy for this type of issue are considered to outweigh the disadvantages, it is recommended that the proposal be adopted in all townships.

It is very important that this type of proposal is not implemented until it has been well publicised. This can be done by sending cyclo-styled information sheets to every consumer, by posters with the township, and by information and discussions on the radio. The later warning letters must be completely clear and unambiguous; if the consumer repeats the offence he will be disconnected and will only be reconnected when he pays the reconnection fee.

8. COMMUNAL STANDPIPE PAYMENT

8.1 Low Current Level of Collection from Communal Standpipe Consumers

At present the level of collection from communal standpipe users is extremely low. A number of different consultants' reports refer to the fact that in the township under study, standpipe revenue never exceeded X per cent of total revenue, where X percent does not exceed 10 percent. Sometimes it is as low as 1 percent.

The performance of large council operated schemes is also poor. For example Ndola only collects 10 percent of the revenue due from site and service areas and nothing from the squatter areas to which the council supplies water. It was reported that no serious effort is made to collect the money since officials were convinced that a debt collection team would fail. The story is the same in all informal housing areas simply because the operating agency has no effective weapon to force consumers to pay, except for disconnecting the supply. Even in Lusaka where considerable efforts were devoted to communal point collection, revenue was below 50 percent of what it should have been. Furthermore, while in some areas dominated by government employees, collection was very high, up to 90 percent, in other areas very very little revenue was collected.

8.2 The Real Problem

The real problem in achieving a high level of rate collection from communal standpipes is that it is difficult to differentiate between those who pay and those who do not pay. The result is that some who fail to pay continue to draw water freely. Other consumers who see them getting away without paying soon follow suit. It is, therefore, not surprising that experience from all water supplies in Zambia shows that although consumers utilise the supplies they often resist paying their water rates. The socio-economic survey shows that this resistance is not due to an unwillingness to pay but is due to a well founded belief that they can get away with it. In fact, it could be said that communal consumers who continue to pay in certain towns are either silly or extremely virtuous depending on one's point of view.

A differentiation between formal and informal housing residents who use communal points is justified because however difficult it is/would be for

DWA/councils to collect money from formal housing areas, it is/would be simple compared to the difficulties that would have to be overcome in collecting from informal housing areas. The socio-economic survey suggested that the willingness to pay in informal areas is as high as in formal housing areas. Hence, the difference stems from the even greater ability of informal residents to evade payment.

8.3 Recommendation in the Western Province Report

In the Western Province report the consultants presented the following argument "it is recommended that water from communal water points in the townships be provided freely to all consumers other than (a) government, (including council) employees and (b) any others renting houses from the councils. This policy is not totally satisfactory but does have a number of advantages discussed below. The three main criticisms to which it is subject are:-

(i) it is inequitable that Government/council employees should pay while others do not.

(ii) even the poorer urban people have better access to a range of services than the rural population. If they receive them free it would be unfair to the population living outside the townships.

(iii) it reduces the level of rate collection and the financial viability of the water supplies.

It would be clearly inequitable for senior government employees to have to pay water bills if senior employees of other organisations did not have to pay but all such persons will presumably have their own house connections.

However, it is considered less unfair for junior government employees and any other people living in council houses to have to pay for using communal points while other consumers obtain water freely. Firstly the government employees are often living in subsidised accommodation and are paying a lower rent than many other consumers living in similar standard accommodation. Recent studies have shown that the government currently provides considerable subsidies either directly or indirectly to the public housing sector. Secondly they have a higher level of job security than other people. Unfortunately nothing in life is completely fair and the consultants' proposal is not too inequitable. It has the merit that some finance would be collected for communal point use and as is pointed out below this is likely to be the greater part of the money that could realistically be collected.

It is admitted that the policy may not be equitable vis à vis the rural population since the urban population is already privileged as regards the provision of services. However, this report also recommends free water in the rural areas. Furthermore free water for the poorer sections of the community means that the policy is fair within the townships".

The consultants still believe that the Western Province proposal had considerable merit but discussions with water supply personnel suggested that even if the division between those expected to pay and those to whom water was provided freely was reasonably equitable, it would still be unpopular with government workers. The point was made that even if the workers grudgingly accepted it, their wives may cause problems and attempt to refuse access to those who do not have to pay. This is somewhat dubious since a particular tap will usually be surrounded by one type of housing, for example council houses, site and service, informal etc. Nevertheless, the consultants accept that the opposition could be widespread and has a solid foundation. Hence the proposal to formalise any payment differential between different classes of communal standpipe consumers is rejected. However, it is very possible that the result of the proposals discussed below will be a similar, but informal, arrangement.

8.4. <u>The Policy of Free Communal Water Supplies</u>

There is a strong case for providing free water from communal points which can be summarised as follows:-

(i) it is considered appropriate that the minimum water supply service provided by communal points should be regarded as a social service, rather than as a public utility.

(ii) consumers only obtain a low level of service, they only take limited quantities of water which they have to carry home.

(iii) unless supplies are close to capacity, marginal costs will be low and thus free water accords with an economic efficiency criterion,

(iv) the consumers ability to pay is very limited.

(v) free water supplies allow the government to subsidise the poorer sections of the community,

(vi) in those areas where other, if very unsatisfactory, sources are available, only free water may persuade some people to use the communal tap instead of the poorer quality source,

(vii) there is an external benefit arising from township water supplies since there is a public health risk if consumers use alternative polluted sources,

(viii) the policy would save the high cost of collecting rates from standpipes,

(ix) the revenue lost will only represent a small percentage of total revenue and costs.

The case against providing free water from communal points is usually based on two main arguments:-

(i) there is a risk of greater wastage. A free water policy does mean that a certain amount of wastage (allowed for in the design) has to be accepted and efforts to reduce this by various means, such as self-closing taps must be made. However the claim that free water will increase wastage is only true if a free policy is being compared with charging for water from communal points on a quantity used basis. But Section 8.6 suggests that charging communal standpipe consumers on a quantity used basis has little merit. Subsequently free water should not lead to any greater usage or wastage than a low flat rate charge would, since consumers in both cases would be paying zero marginal cost for actual usage/wastage.

(ii) it entails a loss of revenue for the water supply authority, and, therefore, a greater financial burden falls on other consumers, or on government finances. However, as is discussed below it is possible that the Zambian Government will be unsuccessful in achieving a high level of rate collection even if it tries to collect rates from communal point consumers. Furthermore extremely successful collection will only result in a limited increase in revenue. Consequently this argument against free water must be seen in the terms of the probable rather limited loss, rather than in terms of any theoretical decrease in revenue.

In fact, the real financial loss, of either completely free communal supplies and especially of the Western Province report proposal, i.e. whereby consumers who are government or council employees, or who occupy a council house, are charged, may be even less than a direct calculation would suggest. This is because local authorities/DWA freed from the burden of chasing communal point debtors would be able to concentrate their limited resources on more meaningful activities that could increase the rate performance from individual connections with much less effort than would be required to raise revenue from communal points. In other words given the existing situation, attempts to enforce rate payment from communal water points would at best be an inefficient use of resources, (better devoted to other aspects of rate collection or to other areas of the water supply operation), and at worst would be a complete waste of money and effort.

Therefore, a policy of free communal water while being practical, administratively simple, popular with consumers and politically attractive would in practice only result in limited revenue losses. Hence the consultants believe that free communal standpipe water has considerable merit. Some DWA and council officials agree with the consultants that collecting from communal standpipe consumers is unlikely to be successful and a lot of trouble will be saved and limited revenue will be lost by making communal water officially free. However, other officials often say that while agreeing with the social and economic arguments for free water the fact remains that they are incurring high costs in providing the water and must, therefore, recoup some revenue, and the question is how to raise that revenue.

8.5. The Financial Significance of Alternative Communal Standpipe Pricing Policies

The financial significance of a universal free communal water policy will be dependant on the percentages of consumers in a town who utilise a communal point and those who have their own connection. In Addis Adaba (Browne 1974) it was found that although a high proportion of consumers relied on communal points, a 10 percent increase in the price paid by consumers with their own connections would have made up the financial loss that would have ensued from providing communal point users with free water. The very small price increase required to cover to potential loss was due to the fact that although individual connection owners constituted a minority of consumers they utilised a high proportion of the water consumed.

Table 8.1 shows the percentage of water consumed by communal standpipe consumers in a typical township supply together with the corresponding figures in towns where the percentages of water consumed by communal consumers are near the top and bottom of the probable range. (cf. Appendix G)

Table 8.1

Consumption by Communal Standpipe Consumers

	Percentage of total water consumption taken by;		
	Low cost II consumers	Informal housing consumers	Total from communal taps
Projected Estimate	18.9	23.8	42.7
Optimistic Variation	12.7	11.7	24.4
Pessimistic Variation	21.5	40.1	61.6

It can be seen that communal consumers are expected to take about 40% of all water consumed, with corresponding optimistic and pessimistic figures of 25% and 60%. These relatively high figures are dependent upon universal metering which will ensure that individual connection consumers restrict their consumption and limit wastage. If only major consumers are metered it is probable that the total consumption by communal point consumers would fall to well under 30% and if the present metering situation was to be perpetuated it would be considerably further reduced.

The financial implications of a free communal water policy are spelt out in Section 10.8 There it is shown that the consultants' probable projection, based on the recommended pricing structure suggests that only 8% of gross revenue will be derived from communal point consumers. Since it is likely that the costs of collecting communal point rates will take a higher proportion of gross revenue than the costs of collecting other rates will, this would mean that a completely free communal point policy,(even when 40% of water consumed is taken from communal taps),may reduce total net revenue from the township water supplies by less than 8%.

8.6 Basis of Collection

The water supply agency (DWA/council) could charge for water on a quantity used,or a flat rate, basis.

If consumers were to be charged on a quantity used basis collectors would have to be stationed at every communal point throughout the period when the taps are open. However, this strategy has no real merit. It is unlikely that the average collector would do much more than cover his salary, if communal point users were charged rates which were equitable in relation to those charged to low use individual connection owners. The major effect would be to reduce consumption. The pattern of use would also become more irregular since some consumers may use alternative sources at times and many may use less water than is desirable. Consequently the benefits of the communal points would be reduced. Furthermore, due to this low and irregular use, revenue would be much less than anticipated. Charging on a quantity used basis would not increase the financial viability of the supplies. Hence a policy of charging communal standpipe consumers on a quantity used basis cannot be supported.

The alternative method of charging communal point consumers a flat monthly rate for their water has greater merit. The fee would be levied on a houshold basis and may, or may not, be related to the size of the household. The discussion below, of the best means of enforcing payment, is based on the assumption that communal standpipe consumers will be charged flat monthly water rates.

8.7. Alternative Approaches to Enforcing/Encouraging Rate Payment by Communal Standpipe Consumers

The present collection procedure whereby communal consumers are supposed to visit the council's revenue offices to pay their water rates is rather ineffective. Even if DWA was to take over collection there is unlikely to be a dramatic improvement in the level of communal point collection unless it is combined with more positive steps to encourage payment.

An alternative method of collection would be to have a water authority employee visit every house, in all areas served by communal points, that does not have its own connection. However, this will also fail to overcome the resistance to pay communal water rates, since there would be no control at the communal point unless the authority stationed men at the standpipes. Hence even if house to house collection represents an improvement over the present system of expecting consumers to visit the council's revenue office, the question of collection procedure evades the real issue of how to enforce payment.

Under the present system of enforcement the authority has two choices, to accept that they have to supply water freely or to disconnect communal taps. The latter action has three major disadvantages: (i) disconnections of a tap will only be fair if all consumers using that tap have refused to pay, otherwise those who have been paying will be made to suffer along with those who have not; (ii) the water authorities' objective of supplying potable water to the entire population within the supply area will obviously not be met if the authority itself denies access to part of the population; (iii) the closures may become a political issue. Furthermore, if individual isolated standpipes in very localised areas of non payment are closed, the affected consumers will simply draw from another communal point in the vicinity or they may even take less desirable action such as opening hydrants. Nevertheless, a number of officers reported that they do occasionally close shared or communal points when most consumers fail to pay. It was even reported that when the few who are paying complain, DWA informs them who the culprits are in the hope that they will pressurise them to pay. However, it is unlikely that communal point disconnection constitutes the basis for a long term widespread solution. Consequently the consultants searched for ideas that would assist in improving the level of collection. The following possibilities exist:-

(i) DWA should lock communal points, so that only those who paid their rates and had keys would have access to the water. Unfortunately there are too many faults for this strategy to have a realistic chance of success. How would DWA retrieve keys from consumers with arrears? How could the lending of keys be prevented? How would lock breaking be prevented?

(ii) DWA should refuse to repair communal standpipes breakdowns until the consumers using that point had paid their arrears. This idea has considerable attraction, but the problem of what to do, if some consumers do pay while others do not remains.

(iii) DWA should report all exployed offenders to their head of department, etc. However this would only be meaningful if offenders represented a small minority rather than the overwhelming majority.

(iv) government should involve the Party (UNIP) by giving responsibility for collection to ward chairmen. The consultants discussed this idea and existing experience in their Western Province report.

and concluded that the involvement of party personnel would be unlikely to represent a solution.

(v) the government should mount an intensive education campaign aimed at the average communal point consumer. This might involve sending explanatory letters to every home, the use of the radio and television, the briefing of newspaper editors, etc. The basic message would be that the local authorities require considerable sums of money every year to operate and maintain the water supplies, and that even though communal point charges are low they are needed if the authority is to continue to run the supply efficiently and provide water to all areas of the townships. This approach while representing a useful supporting tool does not by itself represent a solution. Exhortation must be accompanied by enforcement. An offshoot of the education campaign could be the long term development of social sanctions so that the consumers themselves would pressurise their neighbours with arrears to pay. However, this is only a realistic hope for a situation where a high rate of collection is being achieved so that the majority are trying to influence the minority rather than vice-versa. Hence, again if under present circumstances initial concentrated efforts to encourage payment on the grounds of it being a social duty, etc. were to meet with success, the rate of non-payment would again soon increase and it would prove impossible to successfully collect rates from communal point users over a long period, without a harsher or stricter basic approach to the problem.

(vi) government should deduct its employees water rates from their salaries at source. In Section 14.9 the question of deducting government employees' individual connection rates at source is dismissed because the time involved before the council/DWA receive the money may be so long that the individual concerned has already been disconnected, even though he has actually "paid" his water rates. However, the delays with communal standpipe consumers are less important since disconnection is extremely unlikely. If a deduction system were to work and the water authority were to receive standpipe revenue eventually, an improvement on the present situation would have been achieved. However, discussions with government officials suggested that while in theory there should be no insuperable problem to direct deductions and onward remittance by individual ministries, in practice the problems created may not be justified by the results. Hence, this strategy should not be given high priority.

(vii) council/DWA should supervise the communal standpipes. This could be done by stationing an employee at the standpipes, by appointing a local resident to act on its behalf on a part-time salary basis, or by selling the communal supply concession to local entrepreneurs (c.f. Section 8.9). Whether the guardian of a standpipe was an employee or a part-time local employee there would be the possibilities that (i) payment should be made at the standpipe or (ii) at a local office or (iii) collected from house to house. It is recommended that a house to house collection be made bimonthly and that the local office which receives rates from other consumers should also be available for communal point consumers, who did not pay the house to house collector, to pay. Consumers should keep their receipts to show on demand. There are three potential problem associated with standpipe supervision. Firstly the problem of identifying consumers. One family's receipt could be used illegally by a number of neighbours. However, this problem should recede as the standpipe guardian gets to know all the family members in the supply area of his tap. Secondly the refusal to allow access to non payers could lead to all sorts of problems and even fights. Thirdly continuous supervision of all standpipes would lead to the problem of insufficient staff or to a very high cost of supervision. However, this latter problem can be largely overcome by appropriate partial supervision. This is discussed below.

8.8. Partial Standpipe Supervision

At a few towns in Northern Province the officer in charge of the water supply claimed that he was succeeding in collecting water rates from communal standpipe consumers. On a selected day the officer in charge sends out staff to every communal standpipe. These men refuse to allow women to draw water unless they can produce a current receipt. At the same time rate collectors are placed at a few strategic spots in town in order that the boma should not be congested. It is claimed that "the women go home and tell their husbands that they refuse to collect water that day unless he gives them the money for the water rate", and that the system is successful.

Since the consultants neither saw the system in action nor any revenue figures they cannot endorse the claim. However, it is the only proposal put forward by officers in charge which has real potential. It would not be possible to permanently guard all communal standpipes, but a three-four day period just after pay day could prove an effective incentive for consumers to pay. Once consumers accepted the idea that they had to pay and got into the habit of doing so it may be possible to reduce the level of guarding standpipes.

The system has a number of potential drawbacks. Firstly consumers may circulate receipts so that only a small proportion of them actually pay. But as mentioned above this problem can be overcome reasonably quickly if the same man guards the same standpipe every month since he will soon come to know the people who use that water point. Secondly consumers may use traditional sources for a few days. This may represent a major rate evasion threat if the standpipes are only guarded for one day as at present, but if as is proposed the period was extended to three or even four days the threat would be reduced. Yet another possibility is that those with receipts could fetch water for those without receipts. The likelihood of this can only be known after the system has been tried and evaluated over several months. Although consumers who fail to pay could use the standpipes for 90 percent of the time, it is possible that, if the majority of women did pay, the social pressures on the non payers may result in them also having to pay. So far the method has not been applied over a long period. In Mporokoso it was tried in April and May 1982 only. The officer in charge felt that it would not be fair to pressurise the women for money when their men were busy cultivating. However, this should not prove a problem once it is generally accepted that water must be paid for. The only way to do this is to introduce the system in a township and pursue it rigorously. If it fails the revenue situation will be no worse than it is now. If it succeeds consumers will accept that they cannot get away without paying for water and will subsequently pay willingly. As is discussed elsewhere people are willing to pay for water. They don't simply because they have found that they can get away without paying for it.

The consultants have no idea whether the method would succeeed if implemented by DWA. According to the consultants report for Kapiri Mposhi (Colquhuon 1976) the council abandoned a similar system after finding that they were still collecting little revenue. However, since it appears to be the best idea put forward to date it is strongly receommended that DWA introduces the system in at least one supply in every province for a period of one year. One man should be allocated the function of evaluating the results. He would monitor the revenue collected, identify the reasons for success or failure in the various pilot townships, and recommend appropriate modifications to the system. The system has a number of attractions if it were to succeed. Invoicing would be unnecessary, the only paperwork would be the issuing of receipts against payment. Standpipes would be regularly inspected for cleanliness, leakages and poor consumer behaviour at no additional cost.

8.9. Water Kiosks

Another possible approach to the problem of low rate collection from communal standpipe consumers would be to rent water concessions to individual businessmen. These concessionaires would pay a monthly fee to the water supply authority and would collect payment from consumers. Such supply points are sometimes known as water kiosks. The water is usually sold by the container. This method ensures that waste is minimal but it will also result in sub-optimal consumer use. Furthermore since it might be difficult to control the unit rate charge by the vendors the result could be to reduce consumption to below the level that would be achieved if the authority employed revenue collectors to sell by the bucket and is, therefore, on social/health criteria, less desirable.

Alternatively it would be possible for individuals to receive the concession on the basis that they charge consumers fixed monthly fees. The consumers would then be able to consume as much water as they wished. This would also mean that the level of supervision that would be required would be lower. Consequently the concessionaires' costs would be lower. If the tap was located beside the concessionaires house and some family members work at home, the opportunity costs of supervision would be minimal and limited profits may provide sufficient incentive to potential entrepreneurs. The system would (i) generate some standpipe revenue, (certainly more than DWA and councils receive today), (ii) limit public tap wastage since the threat of losing the concession could ensure that the concessionaire does not allow taps to be left open when not in use, and (iii) limit vandalism.

It would be necessary for the water supply authority to stipulate maximum charges in order to prevent exploitation. If monthly consumer rates of K 2 per household per month were allowed and the concession fees were based on K 1 for every potential consumer household, the result could be significant income for DWA/councils and a healthy profit for the businessmen, at rates which most township households are willing to pay.

In order to encourage profit motivated efficiency the concession for an entire township could be leased to one entrepreneur who would be allowed to use his own initiative to maximise his profits subject to permitting free access at all reasonable hours to all consumers who have paid a government determined maximum monthly fee.

The consultants feel that they cannot recommend the concession approach since it would involve a political judgement which is outside their competence. However, the strategy does ensure the water supply authority income from communal facilities. Therefore, if DWA and councils wish to generate revenue from communal standpipes they should not dismiss the above proposal without discussing the issues involved. The whole concept might be justified on wastage reduction alone.

8.10 Summary of the Possible Courses of Action to Encourage Communal Rate Payment

Idea	Conclusion
(1) Lock communal points	Would cause too many problems.
(2) Refuse repairs of a standpipe until arrears are paid	Has merit if the problem of only some consumers paying can be overcome.
(3) Report offenders to heads of department.	Insufficient by itself.
(4) Involve the Party	Not a solution.
(5) Mount an education campaign	Necessary, but by itself insufficient.
(6) Deduct government employees rates at source from salaries.	Unlikely to work smoothly.
(7) Supervision of standpipes	Full-time supervision would be too expensive but partial supervision has considerable merit and is the consultants' recommended strategy.
(8) Water kiosks	A practical solution that would yield revenue but which requires a political judgement.

8.11 Conclusion and Recommendation

Hence the optimum approach at the moment would be partial supervision of standpipes with the standpipe guardian refusing access to those unable to produce a current receipt. However, even this may not work despite claims by some DWA officials that it would.

If it does not work the consultants feel that the Western Province recommendation is still the best policy and that recommendation remains the basis for future policy. However, it is clear that it cannot be presented to the public in its previous format.

Therefore, the future policy as presented to the public is that all households using communal standpipes must pay K2 per month (cf. Section 10.5) for access. Councils should deduct K2 from the monthly salary of all its employees and transfer this money to its water undertaking account or to DWA. All other occupants of council or government housing should have this K2 per month water rate added to their rent bill. This will not ensure payment since councils are unwilling to evict residents in arrears with their rents, but it would dramatically improve the probability of collection. Transfers would then be made to the water undertaking account or to DWA. Finally all other consumers will be "expected" to pay K2 to the council/DWA. The council/DWA may encourage the fulfilment of this expectation by partial supervision of the water points possibly supported by an information/education programme and by reporting employed offenders to their heads of department.

It is suggested that DWA does whatever it can to encourage officers in charge of supplies to "encourage" consumers to pay via partial supervision of communal standpipes, etc. For example by using the percentage of expected revenue as one criterion of success and by annually publicising the results within DWA. However, the actual decision as to how much effort should be put into rate payment encouragement should be left to the initiative of the officers in charge. The local situation, consumers' attitudes, the personality and views of the senior administrative officials, etc. will vary from township to township. If an officer feels that manpower resources would be wasted in attempting to enforce standpipe payment, his view should be respected. On the other hand officers who pursue payment enforcement must be supported by headquarters whenever they need assistance. For example in convincing district governors and local politicians that preventing access to consumers in order to pursue the government's overall objective of reducing subsidisation is a rational policy.

If a programme to increase rate collection from consumers who are neither council employees nor occupy a council/government house is successful, in spite of the consultants' sceptism, the overall rate collection will be high. If these measures are not successful the consultants' Western Province recommendation will be being implemented, a considerable proportion of the "expected" revenue will be collected, but the opposition to the original proposal will not have any points to which they can object.

9. CONNECTION FEE POLICY

9.1. Current Level of New Connections

Table 9.1. presents the number of new connections installed since the beginning of 1981 at a cross section of supplies as estimated by the officers in charge.

Table 9.1.
New Connections in 1981 and 1982 at 21 Supplies

D.W.A. Supplies	1982*	1981
Chizela	5	-
Kabompo	4	6
Kaputa	0	0
Katete	4	0
Kawambwa	3	2
Luwingu	0	1
Mkushi	2	4
Mporokoso	3	4
Mumbwa	3	5
Mwinilungu	0	7
Nchelenge	2	1
Nyimba	4	4
Petauke	7	10
Serenje	7	2
Siavonga	6	2
Average per supply	3.33	3.43
Council Supplies**		
Chipata***	150	200
Kasama	50	50
Kitwe	150	135
Luanshya	20	30
Mufulira	50-100	50-100
Ndola	250	300

Notes

* only includes connections made prior to the consultant's field trip in late 1982. On average a ten month period was covered. Hence, the extrapolated average for the whole of 1982 is approximately 4 new connections per supply.

** all figures are approximations.

*** D.W.A. operated.

Table 9.1 shows that the number of new connections being made at DWA supplies is rather limited. The current average is approximately four per supply per annum. Since the average population of the listed townships is around 5000 persons the uptake is approximately one new connection per 180 households.

The number of new connections at DWA supplies is often constrained by impletmentation capacity, i.e. by lack of pipes and fittings and by insufficient plumbers. Although potential consumers sometimes supply the materials in order to obtain a connection more quickly, DWA is often unable to satisfy requests for connection for a considerable period. In a number of townships the consultants heard of consumers who had been waiting several months to be connected. It is, therefore, hoped that a small fraction of any future resources devoted to township supply augmentations will be applied to connection provision so that connections are available to potential consumers on demand, i.e. as soon as they pay the connection fee.

The number of new connections in the large towns where the councils are responsible for the supplies is naturally larger due to their larger populations, but only in Chipata is the uptake significantly greater, relative to its population.

9.2. Current Connection Fees

DWA's present connection fee policy is that the charge should cover the cost of connection. The current connection fee if K 100 plus the cost of pipes in excess of 100 feet. It is composed as follows:-

15 or 20 mm water meter	K 50
6 metre length of G.1. pipe	K 15
Fittings and valves	K 20
Meter manhole or chamber	K 10
Labour charge	K 5
Total	K 100

In fact DWA charges this standard K 100 fee everywhere provided that not more than 5 lengths of pipe (30 metres) are required. However, local differences arise when the length of the connection exceeds 100 feet. The solutions include: insisting that the consumer provides the extra pipes himself, charging him for the extra pipes at cost and providing the extra pipes freely. However, most officers reported that 30 metres of pipe is sufficient for the majority of new consumers.

At council supplies the cost of a ½" connection varies from K 50 up to K 200. The latter fee has only been charged by Ndola since July 1982.

9.3. Cost of Connection

PWEs and officers in charge of water supplies were asked to estimate the average cost of providing a new connection. Figures of, or close to, K 150 for a connection without a meter and K 200 for a connection with a meter were the usual responses by both DWA officers and town engineers. At most DWA schemes the average number of lengths of pipe was 3-4 per connection, but since the consumer is usually liable for payment of pipes in excess of 5, the average number to be paid for within the fixed connection fee is likely to average 2. In urban areas the averages are similar to those in DWA townships, but officers in charge in the Copperbelt towns make a clearer distinction between connections which do and do not require a road crossing. The need to provide a road corssing is likely to add approximately 12 metres to the length of pipe required.

The consultants' estimate of the current cost of connection is presented below. All the figures represent typical averages. For example ½" meters cost from just under K 40 to K 60 depending on the make and casing material.

15 or 20 mm water meter	K 50
2 lengths of 6 metre G.I. pipe	K 50
Fittings, valves	K 50
Meter manhole or chamber	K 15
Labour and transport	K 30
Total	K 195

An independant breakdown, which was not taken into consideration when preparing the above estimate of DWA costs, was calculated for Kitwe and is shown overleaf.

Without road crossing		Additional costs when road crossing is required.	
½" meter	K 47	2 additional pipes	K 78
1 length 1" G.I. pipe	K 39	Additional labour	K 40
Elbows	K 15	Road reinstation	K 90
Valve	K 10	Sub-total	K 208
Saddle clamp	K 12		
Labour/transport	K 25		
Total	K 148	Total	K 356

These figures are reasonably consistent with the consultants' above estimate based on information from DWA officers. Assuming a cost increase of 15 percent between 1982 and 1983 the current average cost of a new DWA connection is now K 224. The approximate 1983 costs for larger connections are estimated as K 400 and K 1200 for 1" and 2" connections respectively.

9.4. Failure to Cover the Costs of Connections

It can be seen that the current DWA connection fee of K 100 only covers half of the cost of providing a new connection. This is not surprising since this only reflects the level of inflation since the last increase in the fee. Similarly most councils aim to break even on their connection provision activities by basing their charges on average costs. However, they still make a loss on connection since the connection fee is only increased, to the current estimated cost, periodically. From the moment of the price increase inflation results in the creation of a growing gap between costs and the fee charged. At present only Ndola is covering the costs of connection.

9.5. DWA Officers' Views on Connection Fees

The unanimous view of water supply officials is that the connection fee should cover all the costs involved. Subsequently when the respondents were asked what they felt the current connection fee should be, their responses ranged from K 100 - K 250. None of those of the lower end of the suggested range had provided good answers to the question of how much it costs to provide a connection today and were under the impression that K 100 covered the cost. The recommendations of all those who recognised that the present fee does not cover all the costs were generally between K 150 and K 250. This concern to relate fees to actual costs was further borne out by the responses to two further questions. Approximately two thirds of respondents felt that metered and unmetered connections should be charged different connection fees since they believed that the provision of a meter should be paid for by the consumer receiving it. In addition two thirds of officials questioned believed that the same connection fee should be charged for individual connections and for individual standpipes irrespective of the fact that they would be providing consumers with different levels of service. Those in favour of the same fee invariably pointed out that the costs to DWA would be the same for an individual standpipe as for a house connection. The average rate proposed by those in favour of a lower rate for individual standpipe connections was K 190 for individual house connections and K 120 for standipe connections.

9.6. Recommended Policy for High and Medium Cost Housing Residents and Non-Domestic Consumers

For all consumers other than those living in low cost housing, it is recommended that the connection fee should reflect the full costs of making the connection. Therefore, DWA should introduce a new connection fee of K 250. This figure will cover DWA's costs until mid 1984. It should be revised in mid 1985 to a figure which will cover costs until mid 1986. While K 250 represents a dramatic 150% increase in the present fee, it still represents an insignificant sum compared to the cost of constructing a new medium or high cost house.

It is also recommended that the present practice, whereby consumers who need a connecting line in excess of 30 metres must pay for the additional pipes, be continued. The case against this recommendation is that it is inequitable that the connection fee paid by an individual is dependent upon the distance that he lives from the nearest branch line. There is no social reason why people who accidently live nearer a branch line should be rewarded with a lower connection fee.

The case for the recommendation is that: government must limit subsidisation of the wealthier section of the community due to the financial constraints which it is facing; those living more than 30 metres from an existing branch line are already being subsidised on 18 metres of their pipeline; medium and high cost housing residents have a sufficient ability to pay and will connect even at the new higher fee; potential consumers who have built houses at a considerable distance from a branch line may have already benefitted if the lack of water was reflected in the cost of their plot. Since the additional fee should reflect the cost of the pipe and a small allowance for the cost of labour, it is recommended that at ½" connections a charge of K 30 should be made per additional pipe length in excess of five.

For larger than minimum size connections it is strongly receommended that all consumers are charged the full cost of connection. Hence, minimum rates of K 450 and K 1350 are recommended for 1" and 2" connections respectively. Where actual costs exceeds these figures, the consumers should be charged actual cost.

The consultants believe that at urban supplies the connection fee for the smallest diameter connections should be the same whether or not a road crossing is involved, i.e. the connection fee should reflect the average cost of connections with and without road crossings in order to achieve equity between domestic consumers. Otherwise the fee a consumer is charged becomes a lottery depending on which side of the road the council laid the branch line. With larger connections a policy of charging the actual cost of the connection is supported.

One potential problem, arising from the recommendation that a consumer should pay for pipes in excess of five, is that it is unclear whether he can later refuse to allow other new connection applicants to connect to his pipes. Even if these pipes go over public limit it would be inequitable for consumers obtaining connections later to have the benefit of his pipes without payment. On the other hand it would be unreasonable for him to be able to refuse his neighbours the right to connect to his pipe if it traverses public land, as long as the capacity of the pipe is sufficient. It is, therefore, proposed that people making connections at a later date should have the right to utilise existing privately paid for pipes which traverse public land, on the condition that they reimburse the "owner" part of the costs he incurred on the pipeline up to the point from which they intend to divert water.

9.7. Recommended Connection Fee Policy for Low Cost Housing Residents

Consumption typically multiplies by a factor of five when a family acquires its own connection. This results in very significant health and other social benefits and it is proven that the benefits arising from house connections are much greater than those from communal points. The socio-economic survey showed that many low cost families currently using standpipes display a very significant willingness to pay monthly rates for individual connections, typically K 5 per month. Furthermore, the larger the number of individual connections, the higher the revenue collection.

Hence, the probable benefits, apparent willingness to pay and potential increased revenue together suggest that there is a strong case for encouraging individual connections. This can be done by fixing house connection fees low enough so as not to exclude most low income consumers from connecting. This, of course, could conflict with the view, represented by the majority of water supply personnel in Zambia that connection fees should cover the cost of connection.

The survey showed that the willingness of low cost housing residents to pay connection fees is very low. The average willingness was K 30. Thus even if the survey underestimated the willingness to pay for connection, it is clear that the current fee of K 100 acts as a deterrent to most low service consumers.

The consultants tend to disagree with the view that connection fees must cover all costs of connection for every category of consumer because the fee decision should not be based solely on financial criteria. The spreading of the benefits of large government investments must be encouraged, if necessary by subsidisation. On the other hand the consultants are unable to disregard costs and financial criteria to the extent that they could recommend fees which the majority of low cost housing residents would be willing to pay, i.e. K 30. Hence, while a certain degree of subsidisation of connection fees of low cost housing consumers is considered justified, the appropriate level is difficult to establish. The following factors must be taken into consideration:-

(a) the encouragement of individual connections is a "good thing" since more connections will both increase the benefits of the supply to the population and increase the revenue to the authority. Once most consumers become used to the luxury of their own connection they will not be willing to do without it, and will continue to pay monthly rates quite willingly. The encouragement is only necessary to overcome any initial resistence to investing in a connection.

(b) an increase in the number of connections can sometimes lower the average connection costs. Although the cost of connecting the first individual in a particular area may be high, the subsequent cost of connecting his neighbours will be much lower.

(c) any subsidised fees must be large enough to deter any frivolous requests for connections, which would have to be disconnected soon afterwards due to non payment of water rates. Section 10.5 shows that it is estimated that most low cost housing residents will be expected to pay K4-6 per month in 1983 prices. It is suggested that a connection fee representing more than one year's water rates should have the effect of restricting new connections to those who will be able to afford water rates.

(d) the present fee of K100 represents well under one month's income for the majority of low cost housing families. Thus even though the survey suggests that few are willing to pay this sum, it would be affordable by many low cost housing families if they really wanted a connection.

Based on these factors the consultants recommend that the fee for low cost housing residents should remain at K 100, until the standard fee for other consumers is increased beyond the current proposed figure of K 250.

In the Western Province Study the consultants stated that it was inequitable that the connection fee required from the poorer members of society should be dependent on where they happen to live in relation to the minor branch pipelines. They, therefore, proposed that "where new one tap connections are provided to low cost houses, and where the service line is a maximum of 10 mm, consumers should only pay a connection fee of K 60, not K 100, irrespective of how many lengths of pipe are used . Where abnormally long connection lines would be required it would be necessary to consider every case on its merits. The authority would have to decide whether to heavily subsidise the connection or whether to turn down the request unless the consumer pays for the cost of the connection".

However it is now recommended that all low service consumers should be charged the cost of pipes in excess of 30 metres. The reasons are:-

(i) it is now felt that although the earlier recommendation had considerable merit, the result would often be that distant consumers would simply be refused a connection.

(ii) the current proposal is consistent with that recommended for other consumer categories.

(iii) the recommended connection fee for low cost housing consumers already contains a high subsidy element and even though social criteria are important, financial criteria cannot be completely ignored.

In order to complement the above recommendation it is strongly suggested that wherever there are three or more low cost housing residents who are living near each other and who are willing to pay K 100 for their own connections, but where the distance to the existing branch line exceeds 30 metres, DWA should extend a minor branch line into the area free of charge. The connection fees should then be calculated based on the distance from the new extension. An important factor in determining the priority which DWA should accord to such extensions would be whether or not there are likely to be other potential consumers who could be connected to the same extension.

One possible method of encouraging low income consumers to acquire connections would be to introduce some kind of extended payment arrangement. However, the consultants believe that this would be too difficult to administer effectively. If some staff members were capable of implementing such a scheme their abilities could be better used in other aspects of rate collection. Furthermore, a highly subsidised connection fee of K 100 for low cost housing consumers should reduce the need for easy term payment.

Even if a connection fee of K 100 was introduced for low income consumers it does not necessarily mean that the subsidy would be permanent. It would be possible to recoup it as part of the water rates so that new consumers pay higher rates until their fees were paid off. However, this is, in effect, an extended payment arrangement and is subject to the criticism mentioned above. Alternatively water rates could be based on the total costs of the schemes including minor distribution and connection costs. However, since the rates, in most Zambian townships, will not cover more than a part, if any, of the capital costs of augmentations, it is probable that the subsidy would be a permanent one. However, if as is possible, the marginal revenues from the increased number of individual connection consumers exceeds the marginal costs of supplying them with water, the subsidisation of connection fees will not increase the total subsidy to water supplies by as much as it appears to.

Finally, it should be pointed out that even if the government feels that subsidisation of low cost housing connections is impossible due to financial constraints, the connection fee in low cost housing areas should be approximately K 30 less than in other housing areas. The average length of pipe required to medium and high cost houses is approximately 5 metres or 1 pipe length more than in the low cost areas. Since the residents of low cost areas have a lower ability to pay, it is recommended that the lower average costs incurred of approximately K 30 should be reflected in the connection fees. This is equally true in the large urban areas, and hence councils should also charge lower fees to low cost housing residents than those which they charge in other areas.

9.8. Council/Government Housing Tenants

The above discussion on low cost connection fees was presented in terms of resident owners. Most of the arguments would also apply to all other low cost consumers. In practice the majority of low cost housing is owned by councils/government who would probably be responsible for the cost of connections. Hence, if most low cost consumers are to be connected, the cost may well be borne directly or indirectly be the government. Thus, the actual connection fee would only determine the distribution of the cost of connection between different government ministries/agencies. In this case, the question is whether it is worth K 200 of public funds to provide a family with its own house connection. The consultants believe that this investment would be worthwhile due to the additional social/health benefits that would result. Furthermore the total costs of connecting all low cost residents willing to pay the monthly rates would be low compared to the capital costs of recent and future augmentations to the treatment plant, storage facilities and main distribution lines of township water supplies.

If councils paid the costs of connections, there would still be merit in them charging the tenants K 100 to deter frivolous claims regarding willingness to pay subsequent monthly rates. This would be returnable if the tenant had to move and was up to date with his monthly rate payment.

Another strategy which would allow low cost tenants, council or private, to have their own connections, would be to permit tenants to pay for their connection. In order to encourage this, it is proposed that tenants who have paid for their own connection should be refunded the original connection fee when they leave the house. At this point, if the council/landlord was unwilling to take over the responsibility the incoming tenant would have the option of paying the original connection fee, which after several years may be below the current fee. If the fee was paid neither by the council nor by the incoming tenant the house would be, and remain, disconnected.

9.9. Identical Fees for Metered and Non-Metered Connections

It is possible that there will be some connections installed in the next few years without meters. It is recommended that, contrary to the majority view within DWA, the fee for these connections should be the same as for those with meters. This will enable DWA to generate a limited amount of additional income, and will be equitable since the decision of whether or not to meter a certain consumer, area or township will not usually be made by the consumer. Consequently if different connection fees were to be levied based on whether or not a meter was installed, it would be a matter of luck for the consumer whether or not he lived in a township in which all consumers were metered.

The corollary to this recommendation is that whenever it becomes appropriate to meter a particualr town, meters should be installed free of charge. If on the other hand, lower connection fees were charged for non metered consumers it might be necessary to charge consumers for a meter when it was later installed. Consumers' opposition to this would be understandable since they might feel that they were being charged for nothing, or even worse, to allow the authority to subsequently increase their monthly bills.