CHAPTER 2

PROJECT AREA

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CHAPTER 2 PROJECT AREA

2.1 Climate and Geophysical Environment

The Klipvoor Feasibility Study Area is shown on the Project Location Map. The Area comprises the northern parts of the Odi 1 and Moretele 1 magisterial districts of North West Province and is essentially rural in nature.

Average annual rainfall is approximately 500 mm and summer rainfall predominates falling mainly between October and March. Annual average evaporation is over 2,200 mm and is higher in summer than in winter. Annual monthly temperatures vary from 12 to 25° C. Prevailing winds are light to moderate in a northeasterly direction, occasionally southeasterly in winter, and typical wind speeds are 2.5 to 3.5 m/s.

The Area drains to the Moretele River or its tributaries and most of the area lies in the catchments upstream of Klipvoor Dam.

The Borakalalo Nature Reserve is located within the area and the sensitivity of the environment to the proposed development of infrastructure for water supply within the Reserve requires particularly careful consideration. This issue is discussed in detail in Chapter 8.

2.2 Present Water Supply Conditions

Within the FS Area the existing sources of water for domestic use comprise groundwater (74%) and water vendors (21%), while untreated surface water is also used for domestic purposes in some parts. Water vendors can be seen where groundwater is inadequate in terms of quality, quantity or both. The source of the water supplied by water vendors is mostly untreated surface water and partly groundwater.

Almost 50% of the existing boreholes for which information regarding depth is available are less than 60 m deep. The depth to groundwater rest level is less than 30 m in 85% of the boreholes for which information is available. As a result these boreholes are quite susceptible to human contamination. Most of the boreholes in use provide a point supply source without reticulation pipes and are equipped with either a handpump (71%) or a diesel engine. Electric motor drives or windmills were more widely used in the past but are now seldom used. More than half of the borehole users (56%) who answered the JICA questionnaire survey conducted in March 1997 replied that they experience frequent problems

regarding the operation and maintenance of the boreholes. Mechanical breakdown of pumps and drying up of boreholes were cited as the two major sources of problems.

The quality and yield of groundwater is generally unsatisfactory and in many cases inadequate. There are localized areas of high fluoride concentrations (especially north of Klipvoor Dam) and nitrate concentrations, and instances of faecal contamination are common. Accessibility (the probability of a borehole yielding more than 0.1 l/s) is greater than 60% while exploitability (the probability of a borehole yielding more than 2 l/s) is as low as 20 to 30%.

The current average monthly water consumption per household is 2,178 litres which, in terms of average per capita water consumption, is 10.7 lcd assuming 6.8 persons per household.

2.3 Socio Economic Conditions

The Klipvoor Area comprises 35 communities and has an estimated 16,885 households or a population of 114,818 based on 6.8 persons per household. These figures were based on interviews with leaders in each community supplemented where necessary by counting the number of houses.

The Area is rural and contains no significant industry. Although some arable and cattle farming takes place many of the residents commute to jobs in urban centres such as Brits, Pretoria or even Johannesburg (around 82%), others rely on pensions (around 14%) or income remitted from urban areas. The main development axis runs south of the Area from Ga Rankuwa through Mabopane and Winterveld to Temba.

The average monthly income indicated by the JICA survey was R1,167 per household. On average residents are paying water vendors R54.00 per month or if they obtain water from boreholes they are paying R16.00 per month. The average willingness to pay for the RDP level of service was R9.00 per household per month however for yard connections, the figure per household was R23.80 per month.

Almost all of the households who answered the JICA questionnaire survey expressed the view that water supply is a higher priority than sanitation. Women play a central role in the management (fetching and storing) of household water in 66% of the households that responded.

2.4 Institutional Situation

2.4.1 First and Second Tiers

The key second tier stakeholders in the water sector within the Area are Magalies Water and the Department of Water Affairs and Forestry (DWAF). DWAF is an important role player at both National and Provincial level. The traditional role of MW was that of a bulk supplier however under current water and sanitation policy, water boards are also tasked with third tier support functions. On 1 April 1996, MW took over the functions of North West Water Authority (NWWA) in parts of Bophuthatswana lying within the proclaimed MW supply area. As a result, MW assumed responsibility for the maintenance of many boreholes and pipelines, a third tier function. The staff from NWWA joined MW on secondment for an initial one-year period until a new management structure, new roles and personal terms and conditions could be determined. This secondment arrangement has since been extended.

The headquarters of the former Moretele Region of NWWA passed to Rand Water at the time of the merger so the management and administration of this district has been located in the District Office at Temba and placed under the overall control of the Eastern Business Unit of MW. Magalies Water took over the organization responsible for technical support in the Area however NWWA did not function efficiently and the organization was fragmented at the time of the merger. The Soshanguve / Ga Rankuwa was taken over by Rand Water so ongoing O&M has not taken place as it should.

2.4.2 Third Tier

The third tier comprises a complex variety of statutory and non-statutory bodies, which are diverse in terms of size, complexity, funding and purpose. In many cases the organizations making up the third tier and their respective roles vary from community to community.

In terms of service delivery, District Councils are the most important third tier role players as they are responsible for delivering retail water services. They are statutory bodies covering a wide area and are charged with raising finances and providing services to areas of need.

Moretele 1 and Odi 1 Districts, within which the Klipvoor FS Area lies, fall under the jurisdiction of Eastern District Council that lacks capacity. A system for allocating zonal councilors has been implemented within the Eastern DC area but development and service initiatives to date have been much fewer.

CHAPTER 3

WATER DEMAND

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CHAPTER 3 WATER DEMAND

3.1 Population Served

The Study Team conducted a comprehensive study of demographic and socio-economic conditions in the JICA Master Plan Area during 1996. The study envisaged that while movement of the rural population from outside the Master Plan Area to Soshanguve, Wonderboom, Brits, Moretele 1 and Odi 1 will continue, less significant numbers of the rural population living within the Master Plan Area will move out to PWV and other urban areas, and that the overall growth rate of the population in the Area will therefore remain at 2.7 % during the next two decades, slightly higher than the current national natural population growth rate of around 2.3 %.

The Master Plan Study also forecasted that the primary growth will take place in the Pretoria, Ga-Rankuwa, Mabopane and Temba areas in the central region, and that a secondary growth area will be that of Rustenburg in the western region with a growth axis extending up to Monakato - Mogwase - Northam - Thabazimbi.

With regard to the communities in the Klipvoor FS Area, the Master Plan viewed that there will be no future growth in population, as natural growth in these communities will be offset by migration of an approximately equal number of people to urban areas.

In February and March 1997, the Study Team conducted extensive surveys of these communities, which included questionnaire surveys regarding the present population and number of households. These surveys were based on interviews with leaders in each community supplemented where necessary by counting the number of houses. Comparison of the information obtained from these surveys with the 1/10,000-scale ortho-photos of the communities taken in 1989 reinforced the view adopted during the master plan, in that virtually no increase in the number of households in these communities was observed. For this reason, it is also assumed in this Feasibility Study that there will be no growth of population in these communities in the future.

Table 3-1 shows the population and number of households estimated for each of the communities included in the FS Area. In this Feasibility Study it is assumed that the water supply plan proposed will serve all of the population enumerated in the table.

Table 3-1 Population, Level of Service & Water Demand for Klipvoor Area

Klipvoor		Number of Households	Population	Water Demand (AADD in l/day)*			
				Service Level A	Service Level B		
				100%	90 % Y.C. + 10 % S.P.***		
Settlement	Alternative Name			RDP **	Y.C.	S.P.	Total
1 Dipetloana		250	1,700	51,000	130,968	5,100	136,068
2 Makekeng		960	6,528	195,840	502,917	19,584	522,501
3 Makgapha		160	1,088	32,640	83,820	3,264	87,084
4 Mogohlwaneng incl. Olverton		904	6,147	184,416	473,580	18,442	492,022
5 Renostervlei	Tloonane	150	1,020	30,600	78,581	3,060	81,641
6 Selepe	Deputten	96	653	19,584	50,292	1,958	52,250
7 Ngobi		1,256	8,541	256,224	657,983	25,622	683,606
8 Swaartboom	Swartboom	535	3,638	109,140	280,272	10,914	291,186
9 Transaksie		304	2,067	62,016	159,257	6,202	165,459
Sub-Total for Moretele North		*4,615*	*31,382*	*941,460*	*2,417,669*	*94,146*	*2,511,815*
10 Ga-Tsogwe	Waterval	160	1,088	32,640	83,820	3,264	87,084
11 Fafung	Bultfontein	660	4,488	134,640	345,756	13,464	359,220
12 Ga-Rasai		160	1,088	32,640	83,820	3,264	87,084
13 Ga-Tsefoge	Tswee	255	1,734	52,020	133,587	5,202	138,789
14 Kgomo-Kgomo	Dinaletsane	154	1,047	31,416	80,676	3,142	83,818
15 Legonyane		640	4,352	130,560	335,278	13,056	348,334
16 Sephai		190	1,292	38,760	99,536	3,876	103,412
Sub-Total for Klipvoor West		*2,219*	*15,089*	*452,676*	*1,162,472*	*45,268*	*1,207,740*
17 Boltantlokwe		260	1,768	53,040	136,207	5,304	141,511
18 Dikebu incl. Ranteberg		2,000	13,600	408,000	1,047,744	40,800	1,088,544
19 Lebotlwane North		2,800	19,040	571,200	1,466,842	57,120	1,523,962
20 Little	Lebotlwane South	400	2,720	81,600	209,549	8,160	217,709
21 Mokobyane	Mmukubyane	260	1,768	53,040	136,207	5,304	141,511
22 Rabosula		96	653	19,584	50,292	1,958	52,250
23 Sutelong Agricultural		940	6,392	191,760	492,440	19,176	511,616
24 Tlholwe	Flink	250	1,700	51,000	130,968	5,100	136,068
25 Dikgophaneng		75	510	15,300	39,290	1,530	40,820
26 Makgabetlwane		650	4,420	132,600	340,517	13,260	353,777
27 Moiletswane/Buffelsdoorn		772	5,250	157,488	404,429	15,749	420,178
28 Slagboom		350	2,380	71,400	183,355	7,140	190,495
29 Shakung		450	3,060	91,800	235,742	9,180	244,922
30 Ga-Hadebi		350	2,380	71,400	183,355	7,140	190,495
31 Modiane		40	272	8,160	20,955	816	21,771
32 Ga-Moti		8	54	1,632	4,191	163	4,354
33 Garantlapane		20	136	4,080	10,477	408	10,885
34 Botshabelo		130	884	26,520	68,103	2,652	70,755
35 Diponpong		200	1,360	40,800	104,774	4,080	108,854
Sub-Total for Klipvoor East		*10,051*	*68,347*	*2,050,404*	*5,265,437*	*205,040*	*5,470,478*
TOTAL		16,885	114,818	3,444,540	8,845,579	344,454	9,190,033

* : including an allowance of approximately 15% for leakage

** : per capita consumption for RDP lev 30 lcd

***: Yard Connection, per capita consun 85.6 lcd

: Standpipe, per capita consumption : 30.0 lcd

: weighted average per capita consun 80.0 lcd

3.2 Level of Service

In the Phase 1 Master Plan Study it was envisaged that the level of service required in these communities would mostly be the RDP minimum so the preliminary water supply infrastructure development plans were prepared for these communities primarily on the basis of the RDP level of service.

However, surveys conducted by the JICA Study Team in February and March 1997 clearly indicated that communities are demanding a water supply through yard connections rather than through standpipes, and that they are willing to pay a higher price for this higher level of service.

Generally, communities express dissatisfaction with the RDP level of service and show a preference for supply through yard connections. In some areas, communities have rejected newly installed RDP water supply schemes and, in some extreme cases, the facilities have been vandalized. Such communities cite the following as the major reasons for their rejection of the RDP standpipe supply.

- A long cartage distance
- A uniform water charge per household being applied irrespective of the actual consumption rate of each household

Experience indicates that community acceptance of the service level is the key to the success of a water supply project, including achieving cost recovery. On the other hand, it is still questionable whether or not communities can actually afford to pay for the level of service they are demanding. A decision regarding the appropriate service level can only be made after a comparison has been made of the following two parameters.

1) the amount of the water tariff which needs to be levied to recover both capital and operational costs

2) the level of affordability

In the provision of water supply, it has been the clear policy of the new South African Government that it will subsidize the full capital cost for providing the RDP level of service (25 lcd and 200 m cartage distance), but that if communities want a higher level of service, they should pay for any additional costs which are necessary to acquire such a service.

Not withstanding this, Government policy for the planning and funding of RDP water supply schemes has been as follows:

- Even for a water supply scheme based on the RDP level of service, certain components of the infrastructure should be constructed with a larger capacity from the outset, as this will facilitate the future upgrading of the service level. The capital cost for providing this extra capacity will also be fully subsidized by Government.

- Such infrastructure includes clear water bulk pipelines, raw water conduits, clear water distribution mains between service reservoirs and reticulation systems, as well as other infrastructure for which the incremental capital cost of providing a slightly larger capacity is marginal at the time of initial construction but much higher if done at a later stage. Pumping stations, water treatment works, reservoirs and reticulation systems are not included under this policy, as they can readily be constructed on an incremental basis and can be easily upgraded in the future by adding extra units or additional pipes.

- The extra capacity to which this Government policy is applicable is for yard connections with a per-capita consumption rate of approximately 80 lcd on an annual average daily demand (AADD) basis.

Against the background mentioned above, the Study Team developed the following two levels of service for estimating water demands and the subsequent planning of infrastructure.

Service Level A : 100% of households in the community will be supplied through standpipes at the RDP level of service at an average per capita consumption rate of 30 lcd (AADD) including an allowance of approximately 15 % for leakage.

Service Level B : 90% of households in the community will be supplied through yard connections (85.6 lcd) and the remaining 10% through standpipes (30 lcd) in accordance with the RDP level of service, giving a weighted average per capita consumption rate of 80 lcd (AADD) including an allowance of approximately 15% for leakage.

Households that will still be supplied through standpipes for Service Level B are those around the periphery of a community. The extension of the reticulation to such households is not economically viable, as it would result in a significant increase in the reticulation cost.

3.3 Water Demand

The per capita consumption rate of water is an important factor that determines the size of water demand. In general, the rate gradually increases as the standard of living improves. A planning horizon of approximately 10 years is therefore usually adopted in a feasibility study to determine the future water demand based on which the size or capacity of infrastructure is determined.

As mentioned earlier in Section 3.2, the survey conducted by the Study Team in February and March 1997 provided a different perspective to this. The real issue was identified as being not the gradual increase of the per capita consumption rate, but rather the matter of whether water supply should, from the outset, be planned on the basis of RDP standpipes or on the basis of yard connections. The survey indicated that the expectation of communities is already higher than the RDP level of 25 lcd, and that the real question therefore is whether or not communities can actually afford to pay for the level of service that they are demanding.

The average water consumption rate of 25 lcd (85% of 30 lcd) assumed for standpipes is not likely to increase in the future, given the labour intensive nature of water cartage. Similarly it is also unlikely that the average per capita consumption rate of 73 lcd (85% of 85.6 lcd) assumed for yard connections will increase significantly within the next decade. In terms of summer peak day demand, these consumption rates are 38 lcd (150% of 25 lcd) and 110 lcd (150% of 73 lcd) respectively assuming a peak day factor of 1.5.

For the reasons mentioned above, no provision has been made for the future increase of these per capita water consumption rates, instead water demand was estimated for each of the two service levels discussed in Section 3.2 using the assumed population served mentioned in Section 3.1.

Table 3-1 shows the water demand estimated for each of the two service levels. The figures shown in the table were presented at both the Project Execution Group (PEG) Meeting held in Rustenburg on 20 March 1997 and at the Project Steering Committee (PSC) Meeting held in Pretoria on 25 March 1997 and they were accepted by all of the stakeholders for use by the Study Team for the subsequent infrastructure planning and other purposes associated with the Feasibility Study. The same figures were also included in the Interim Report that was issued by the Study Team in July 1997 and accepted by the stakeholders in the joint PSC/PEG meeting held in Pretoria on 29 July 1997.

CHAPTER 4

PROPOSED WATER SUPPLY PLAN AND CONSTRUCTION COST

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CHAPTER 4 PROPOSED WATER SUPPLY PLAN AND CONSTRUCTION COST

4.1 Assumptions for Planning of Infrastructure

Technical assumptions used in this Feasibility Study have been discussed with key stakeholders such as DWAF and Magalies Water. Such assumptions were first prepared during the Phase 1 Study and compiled in the Databook of the Mater Plan Study Final Report which was issued in December 1996; during this Feasibility Study, they have been further reviewed and refined in conjunction with the stakeholders for finalization. Major technical assumptions used in this Feasibility Study for planning infrastructure are compiled in A.1 of Annex A.

4.2 Study of Alternative Water Supply Plans

4.2.1 Alternative Water Supply Plans

With respect to the planning of water supply infrastructure, three technical alternatives were evaluated for this FS Area during the Master Plan Study. As part of this Feasibility Study, the Study Team re-evaluated those technical alternatives on the basis of Service Level B. This exercise was conducted to identify the most preferable water supply option for this FS Area as well as to determine the capital cost for implementation.

Figures 4-1, 4-2 and 4-3 illustrate these three alternative water supply plans.

Under Alternative 1, the entire area, which consists of Klipvoor West Supply Block, Klipvoor East Supply Block and Moretele North Supply Block is assumed to be supplied from the new Klipvoor WTW, located at Klipvoor Dam. Unlike the other two options, this alternative therefore does not require a supplementary supply from sources other than Klipvoor Dam.

In Alternative 2, it is assumed that the Moretele North Supply Block is supplied from Klipdrift WTW, either through the existing Klipdrift-Nylstroom pipeline or through a new pipeline from Klipdrift WTW, while both the Klipvoor West Supply Block and the Klipvoor East Supply Block are supplied from the new Klipvoor WTW.

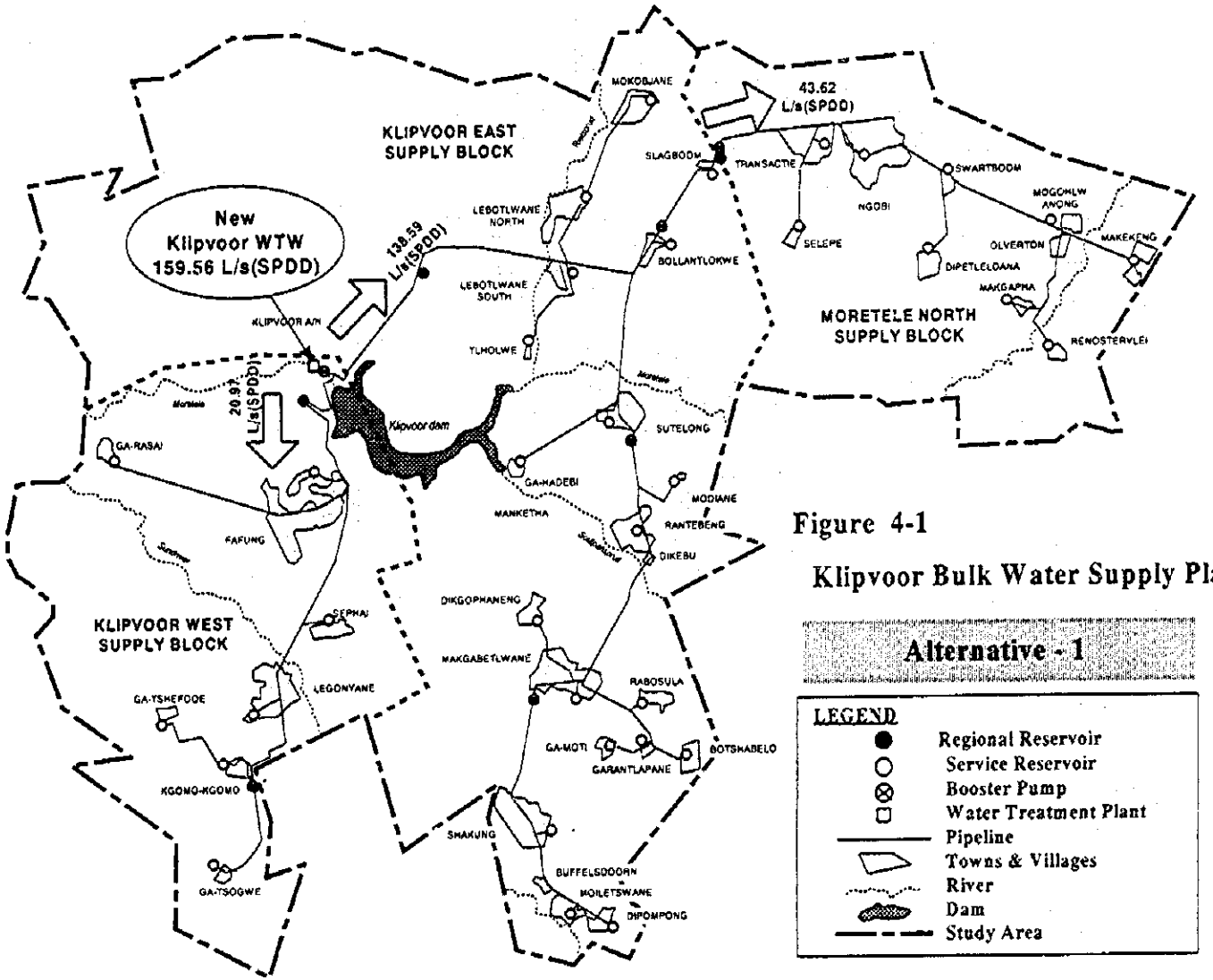


Figure 4-1

Klipvoor Bulk Water Supply Plan

Alternative - 1

LEGEND

- Regional Reservoir
- Service Reservoir
- Booster Pump
- Water Treatment Plant
- Pipeline
- Towns & Villages
- River
- Dam
- Study Area

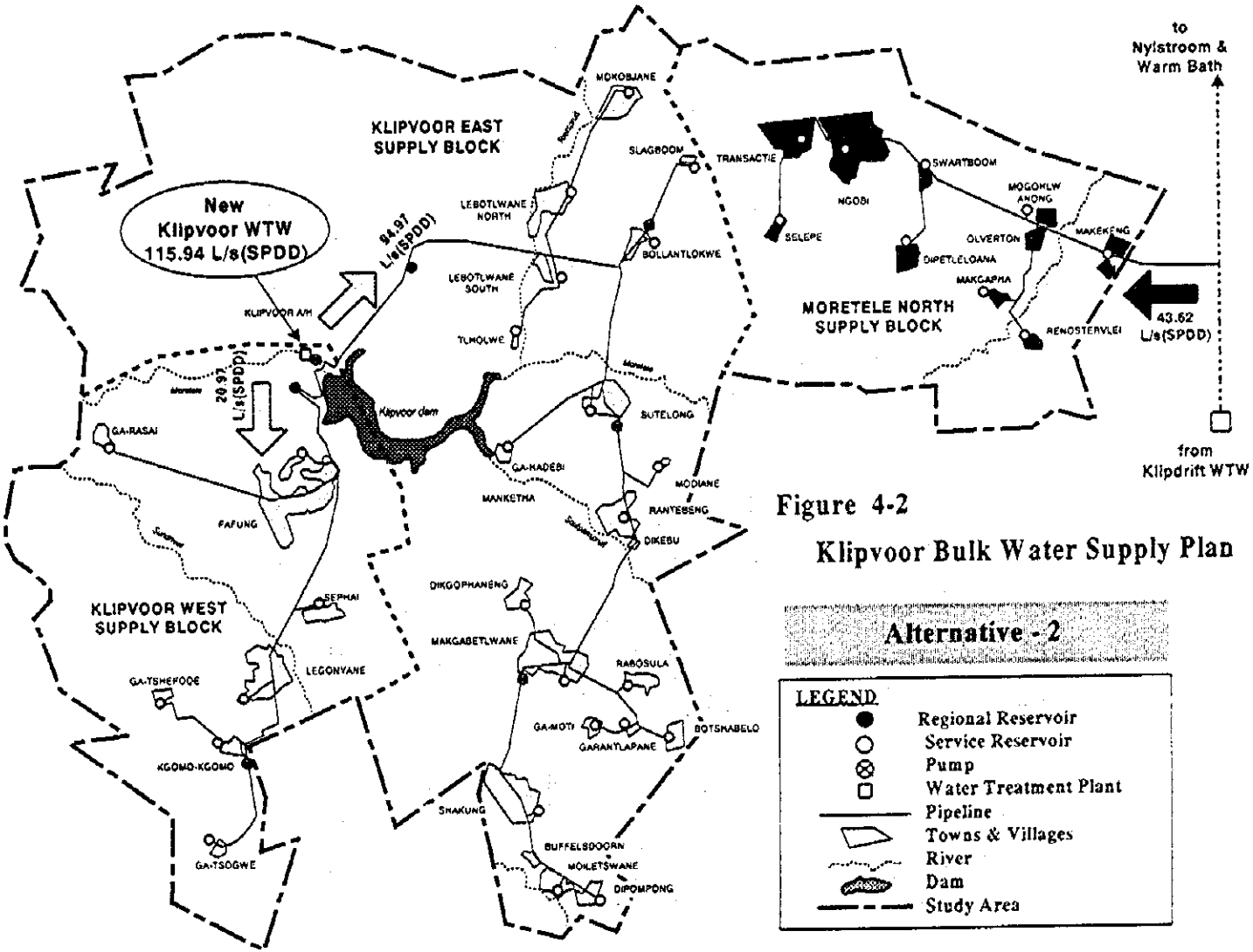


Figure 4-2

Klipvoor Bulk Water Supply Plan

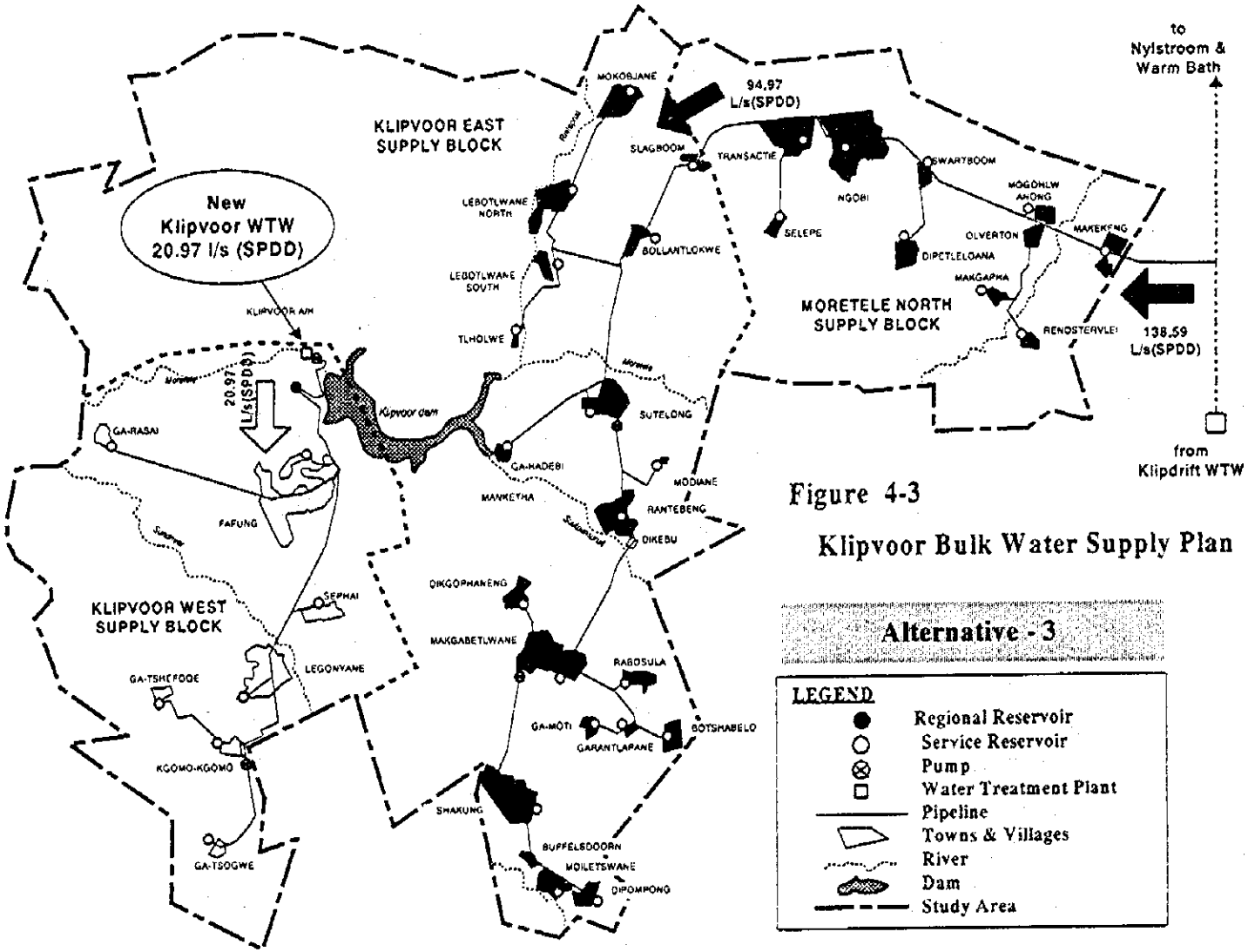


Figure 4-3

Klipvoor Bulk Water Supply Plan

Under Alternative 3, both the Klipvoor East Supply Block and the Moretele North Supply Block are assumed to be supplied from Klipdrift WTW either through the existing Klipdrift-Nylstroom pipeline or through a new pipeline from Klipdrift WTW, while the Klipvoor West Supply Block is supplied from the new Klipvoor WTW.

4.2.2 Infrastructure Planning

For each of the three alternatives, a plan for the requisite water supply infrastructure was developed and costed. The alternatives are shown schematically in Figures A.2-1 through A.2-7 of Annex A. A summary of the proposed infrastructure and the associated costs is shown in Tables 4-1 through 4-3. Tables A.3-1 through A.3-8 of Annex A provide greater detail.

As a general principle, water from a treatment works is assumed to be pumped to a regional reservoir from where it is distributed through bulk supply pipelines to service reservoirs constructed in each community. A water meter on the service reservoir inlet is assumed to form the interface between bulk and retail infrastructure, thus service reservoirs form part of the retail infrastructure.

The methodology adopted by the Study Team in developing infrastructure plans is described briefly as follows.

(1) Bulk Infrastructure

FS communities were identified on 1/10,000 ortho-photos and a location was selected for a service reservoir on high ground either within or immediately adjacent to each village. Water will be supplied to these service reservoirs from either a treatment works or from a regional reservoir through bulk supply pipelines. The service reservoirs will in turn feed the reticulation system in the community by gravity. Given the relatively small capacity required to serve most communities, it is planned that most will be pressed cellular steel elevated tanks.

Bulk supply pipelines connecting water treatment works to service reservoirs were then routed on 1/50,000 scale standard maps and 1/10,000 scale ortho-photos. The routes selected follow existing roadways to minimize both the amount of land acquisition that is necessary and adverse impacts of pipeline construction on the environment.

Table 4-1 Summary of Alternative-1 (Service Level B)

KLIPVOOR

ITEM			KLIPVOOR WEST	KLIPVOOR EAST	KLIPVOOR NORTH	MORETELE TOTAL
POPULATION AND WATER DEMAND						
No. of Communities		nos.	7	19	9	35
No. of Households		nos.	2,219	10,051	4,615	16,885
Population		person	15,089	68,347	31,382	114,818
Ave. No. of Persons per Household		person	6.8	6.8	6.8	6.8
Pop. Served by Yard Connection		person	13,580	61,512	28,244	103,336
Pop. Served by Standpipe		person	1,509	6,835	3,138	11,482
Total Water Demand (AADD)		kl/day	1,208	5,470	2,512	9,190
Total Water Demand (SPDD)		kl/day	1,812	8,206	3,768	13,785
OUTLINE OF PROPOSED INFRASTRUCTURE						
BULK SUPPLY INFRASTRUCTURE						
Source of Water			Klipvoor Dam	N.A.	N.A.	
Raw Water Supply Pipeline	400 mm	km	0.1	N.A.	N.A.	0.1
Water Treatment Works/Pump Stations		ml/day	15.0	N.A.	N.A.	15.0
Regional Reservoirs	0.5 to 5.0 ML	nos. of tank	2	2	2	6
Bulk Supply Pipelines	90 to 400 mm	km	69	113	49	231
Pump Stations		nos.	1	3	1	5
RETAIL SUPPLY INFRASTRUCTURE						
Service Reservoirs	10 to 480 m3	nos. of tank	14	43	22	79
Reticulation Pipelines	63 to 200 mm	km	89	228	122	438
Yard connections		nos.	1,998	9,046	4,154	15,198
Standpipes		nos.	68	177	95	340
CAPITAL COST OF PROPOSED INFRASTRUCTURE						
BULK SUPPLY INFRASTRUCTURE						
Intake/Pump Station		x 1,000 R	454	N.A.	N.A.	454
Raw Water Pipeline		x 1,000 R	50	N.A.	N.A	50
Klipvoor WTW/Pump Station		x 1,000 R	10,000	N.A.	N.A.	10,000
Bulk Supply Pipelines		x 1,000 R	9,939	26,057	8,190	44,186
Regional Reservoirs		x 1,000 R	2,500	3,400	1,800	7,700
Pump Stations		x 1,000 R	167	901	454	1,522
Sub-Total		*x 1,000 R*	*23,109*	*30,358*	*10,444*	*63,912*
RETAIL SUPPLY INFRASTRUCTURE						
Service Reservoirs		x 1,000 R	1,525	7,135	4,230	12,890
Reticulation Pipelines		x 1,000 R	5,896	14,999	8,109	29,004
Yard Connections		x 1,000 R	2,098	9,498	4,362	15,958
Standpipes		x 1,000 R	109	283	152	544
Sub-Total		*x 1,000 R*	*9,628*	*31,915*	*16,853*	*58,396*
Total		**x 1,000 R**	**32,737**	**62,273**	**27,297**	**122,307**

Table 4-2 Summary of Alternative-2 (Service Level B)

KLIPVOOR

ITEM			KLIPVOOR WEST	KLIPVOOR EAST	MORETELE NORTH	TOTAL
POPULATION AND WATER DEMAND						
No. of Communities		nos.	7	19	9	35
No. of Households		nos.	2,219	10,051	4,615	16,885
Population		person	15,089	68,347	31,382	114,818
Ave. No. of Persons per Household		person	6.8	6.8	6.8	6.8
Pop. Served by Yard Connection		person	13,580	61,512	28,244	103,336
Pop. Served by Standpipe		person	1,509	6,835	3,138	11,482
Total Water Demand (AADD)		kL/day	1,208	5,470	2,512	9,190
Total Water Demand (SPDD)		kL/day	1,812	8,206	3,768	13,785
OUTLINE OF PROPOSED INFRASTRUCTURE						
BULK SUPPLY INFRASTRUCTURE						
Source of Water			Klipvoor Dam	N.A.	Roodeplaat Dam	
Raw Water Supply Pipeline	350-450 mm	km	0.1	N.A.	0.1	0.2
Water Treatment Works/Pump Stations		ml/day	11.0	N.A.	18.0	29.0
Regional Reservoirs	0.5 to 3.4 ML	nos. of tank	2	2	0	4
Bulk Supply Pipelines	90 to 400 mm	km	69	113	49	231
Pump Stations		nos.	1	3	0	4
RETAIL SUPPLY INFRASTRUCTURE						
Service Reservoirs	10 to 480 m3	nos. of tank	14	43	22	79
Reticulation Pipelines	63 to 200 mm	km	89	228	122	438
Yard connections		nos.	1,998	9,046	4,154	15,198
Standpipes		nos.	68	177	95	340
CAPITAL COST OF PROPOSED INFRASTRUCTURE						
BULK SUPPLY INFRASTRUCTURE						
Intake/Pump Station		x 1,000 R	280	N.A.	454	734
Raw Water Pipeline		x 1,000 R	43	N.A.	56	99
WTW/Pump Station		x 1,000 R	7,790	N.A.	11,970	19,760
Bulk Supply Pipelines		x 1,000 R	9,939	21,662	12,932	44,533
Regional Reservoirs		x 1,000 R	2,500	2,800	0	5,300
Pump Stations		x 1,000 R	167	677	0	843
Sub-Total		***x 1,000 R***	***20,719***	***25,139***	***25,412***	***71,270***
RETAIL SUPPLY INFRASTRUCTURE						
Service Reservoirs		x 1,000 R	1,525	7,135	4,230	12,890
Reticulation Pipelines		x 1,000 R	5,896	14,999	8,109	29,004
Yard Connections		x 1,000 R	2,098	9,498	4,362	15,958
Standpipes		x 1,000 R	109	283	152	544
Sub-Total		***x 1,000 R***	***9,628***	***31,915***	***16,853***	***58,396***
Total		**x 1,000 R**	**30,346**	**57,054**	**42,265**	**129,665**

Table 4-3 Summary of Alternative-3 (Service Level B)

KLIPVOOR

ITEM			KLIPVOOR WEST	KLIPVOOR EAST	MORETELE NORTH	TOTAL
POPULATION AND WATER DEMAND						
No. of Communities		nos.	7	19	9	35
No. of Households		nos.	2,219	10,051	4,615	16,885
Population		person	15,089	68,347	31,382	114,818
Ave. No. of Persons per Household		person	6.8	6.8	6.8	6.8
Pop. Served by Yard Connection		person	13,580	61,512	28,244	103,336
Pop. Served by Standpipe		person	1,509	6,835	3,138	11,482
Total Water Demand (AADD)		kl/day	1,208	5,470	2,512	9,190
Total Water Demand (SPDD)		kl/day	1,812	8,206	3,768	13,785
OUTLINE OF PROPOSED INFRASTRUCTURE						
BULK SUPPLY INFRASTRUCTURE						
Source of Water			Klipvoor Dam	N.A.	Roodeplaat Dam	
Raw Water Supply Pipeline	160-450 mm	km	0.1	N.A.	0.1	0.2
Water Treatment Works/Pump Stations		mL/day	2.0	N.A.	18.0	20.0
Regional Reservoirs	0.5 to 3.4 ML	nos. of tank	2	2	0	4
Bulk Supply Pipelines	90 to 400 mm	km	69	96	92	257
Pump Stations		nos.	1	2	0	3
RETAIL SUPPLY INFRASTRUCTURE						
Service Reservoirs	10 to 480 m^3	nos. of tank	14	43	22	79
Reticulation Pipelines	63 to 200 mm	km	89	228	122	438
Yard connections		nos.	1,998	9,046	4,154	15,198
Standpipes		nos.	68	177	95	340
CAPITAL COST OF PROPOSED INFRASTRUCTURE						
BULK SUPPLY INFRASTRUCTURE						
Intake/Pump Station		x 1,000 R	83	N.A.	454	538
Raw Water Pipeline		x 1,000 R	17	N.A.	56	73
WTW/Pump Station		x 1,000 R	2,980	N.A.	11,970	14,950
Bulk Supply Pipelines		x 1,000 R	9,939	18,135	34,056	62,130
Regional Reservoirs		x 1,000 R	2,500	2,800	0	5,300
Pump Stations		x 1,000 R	167	621	0	787
Sub-Total		*x 1,000 R*	*15,686*	*21,556*	*46,536*	*83,778*
RETAIL SUPPLY INFRASTRUCTURE						
Service Reservoirs		x 1,000 R	1,525	7,135	4,230	12,890
Reticulation Pipelines		x 1,000 R	5,896	14,999	8,109	29,004
Yard Connections		x 1,000 R	2,098	9,498	4,362	15,958
Standpipes		x 1,000 R	109	283	152	544
Sub-Total		*x 1,000 R*	*9,628*	*31,915*	*16,853*	*58,396*
Total		**x 1,000 R**	**25,314**	**53,471**	**63,389**	**142,174**

The routes selected were plotted on the 1/10,000 scale ortho-photos and nodes were defined at off-take point to service reservoirs and at high points along the pipeline routes and allocated numbers. The distance between adjacent nodes was measured on the ortho-photos and the elevation of nodes was recorded.

All of the above information was used as the inputs to a series of hydraulic analyses that were conducted on the basis of Service Level B. The purpose of the analyses was to ensure that the dynamic water pressure will always remain higher than the ground elevations along the proposed bulk supply pipeline routes, and that the summer peak day demand can be met in each community. This exercise determined the size of bulk supply pipelines as well as the head where pumping was found to be necessary.

(2) Retail Infrastructure

The capacity of each service reservoir was determined taking into account the water demand of the community and whether the reservoir is fed by pumping or by gravity. This exercise was done for both Service Level A and Service Level B, and the number of units and their capacities were determined for each of these two service levels.

Reticulation pipelines were firstly planned for Service Level B. Pipelines were sized to ensure that the residual dynamic pressure throughout the reticulation system is adequate to maintain a supply through yard connections under the designed instantaneous peak flow condition. For Service Level A, some of the pipes planned for Service Level B were omitted, taking the distribution of standpipes into consideration.

4.2.3 Comparison of Alternative Water Supply Plans

The three alternatives were further evaluated and a comparison made as shown in Table 4-4. As can be seen from the table, Alternative 1 will require the least capital cost followed by Alternative 2 with Alternative 3 being the most expensive.

Table 4-4 Comparison of Water Supply Alternatives

KLIPVOOR

ITEM	UNIT	ALTERNATIVE-1 (SERVICE LEVEL B)	ALTERNATIVE-2 (SERVICE LEVEL B)	ALTERNATIVE-3 (SERVICE LEVEL B)
Total Water Demand(SPDD)	kl/day	13,785	13,785	13,785
	l/sec	159.55	159.55	159.55
Supply from WTW(SPDD)				
Klipdrift WTW	kl/day	0	3,768	11,974
	l/sec	0	43.61	138.59
Klipvoor WTW	kl/day	13,785	10,018	1,812
	l/sec	159.55	115.95	20.97
Total	kl/day	13,785	13,786	13,786
	l/sec	159.55	159.56	159.56
Amount of Intake for Treatment				
Klipdrift WTW	Ml/day	0	3.96	12.57
Klipvoor WTW	Ml/day	14.47	10.52	1.90
Total	Ml/day	14.47	14.48	14.48
Treatment Capacity to be Installed				
Klipdrift WTW *	Ml/day	0	18	18
Klipvoor WTW	Ml/day	15	11	2
Total	Ml/day	15	29	20
Capital Cost Required	x 1000R	122,307	129,665	142,174
Impacts on Operation of Existing System		Low	Medium	High
Operability of Klipvoor WTW(in terms of scale)		Good	Fair	Poor
Total Energy Required for Pumping	m3/sec x m	43.3	45.6	55.1

* Minimum expandable treatment stream size is 18.0 Ml/day.

The present capacity of Klipdrift WTW (18.0 Mld) has already been fully committed or utilized, therefore expansion of the treatment works is necessary in the case of both Alternatives 2 and 3. In terms of the additional treatment capacity required, Alternatives 2 and 3 require the works to be extended by 4.0 Mld and 13.0 Mld respectively. Magalies

Water has confirmed that the minimum expandable treatment stream size for the works is 18.0 Mld, and that there are no immediate plans to extend the works. For this reason, the full cost of an 18.0 Mld extension of the works has been included for Alternatives 2 and 3 despite the much smaller water demands.

A hydraulic analysis of the existing bulk supply line from Klipdrift WTW to Warmbaths and Nylstroom indicated that the pipeline can accommodate the Alternative 2 water demand, but that the hydraulic capacity is too small to carry the Alternative 3 demand while also meeting the existing demands for Warmbaths and Nylstroom. Further analysis indicated that a separate new 400 mm diameter pipeline approximately 35 km in length is required from Klipdrift WTW to Klipvoor to meet the Alternative 3 water demand. For Alternative 2, a cost was included for sharing the existing bulk supply pipeline that was calculated on the following basis.

Sharing Cost = A x (B / C)

where,

A: construction cost at current prices

B: Alternative 2 water demand

C: hydraulic capacity of existing pipeline

Under Alternative 3, the treatment capacity to be provided at Klipvoor WTW is only 2.0 Mld, which appears to be too small for continuous operation (i.e. on a 24 hours per day and 7-days per week basis). Although the size increases to 11.0 Mld for Alternative 2, this still seems to be relatively small for continuous operation. Some extra treatment capacity, therefore, might have to be added for Alternatives 2 and 3 in order for the works to be able to operate on an 8 hours per day and 5 days per week basis. No extra costs however have been included in this regard for Alternatives 2 and 3 for the purpose of this comparison.

For each alternative, the energy required for pumping was estimated as the product of (a) volume of water to be pumped and (b) required head of the pump.

This calculation was conducted for each pumping station and the products obtained were summed for each alternative. Table A.4-1 of Annex A shows the results of this exercise, which indicated that Alternative 1 would require the least energy from among the three alternatives. With respect to other components of O&M costs such as those for chemicals and personnel, there seems to be no significant difference between the three alternatives.

Alternative 1 is self-contained and will have no impact on the operation of existing water supply systems. However, if Alternatives 2 or 3 were pursued it would have some implications for the operation of the existing Klipdrift water supply system.

Taking all of the above into consideration, the JICA Study Team identified Alternative 1 as the most preferable water supply plan for the Klipvoor Feasibility Study Area.

4.2.4 Further Study of the Recommended Water Supply Plan

Following the exercise mentioned in Section 4.2.3 which identified Alternative 1 as the most preferable water supply option for this FS Area, the same water supply plan was then re-examined on the basis of Service Level A. Pumping stations, the water treatment works, reservoirs and reticulation systems were planned or sized to meet the RDP level of service and the capital cost required to implement the same water supply scheme but on the basis of the RDP level of service was identified. The difference in capital cost between the two different levels of service was then calculated. The costs for each level are presented in Tables 4-5 and 4-6.

4.3 Proposed Water Supply Plan and Availability of Raw Water

4.3.1 Proposed Water Supply Plan

The water supply plan proposed for this FS Area is shown in Figure 4-4. Two separate high lift pumping systems are proposed from Klipvoor Water Treatment Works. The smaller system, rated at 20.97 l/s (based on the summer peak day demand for Service Level B), will supply the Klipvoor West Supply Block from a regional reservoir on top of the Mogosane Hills which form the southern abutment of Klipvoor Dam. From the regional reservoir, the system will supply communities to the south as far as Kgomo Kgomo under gravity including a branch to Fafung and Ga Rasai. A booster pumping station is required at Kgomo Kgomo to supply Ga-Tsogwe, the most southerly community in this system.

Table 4-5 Summary of Alternative-1 (Service Level A)

KLIPVOOR

ITEMS			KLIPVOOR WEST	KLIPVOOR EAST	MORETELE NORTH	TOTAL
POPULATION AND WATER DEMAND						
No. of Communities		nos.	7	19	9	35
No. of Households		nos.	2,219	10,051	4,615	16,885
Population		person	15,089	68,347	31,382	114,818
Ave. No. of Persons per Household		person	6.8	6.8	6.8	6.8
Pop. Served by Yard Connection		person	0	0	0	0
Pop. Served by Standpipe		person	15,089	68,347	31,382	114,818
Total Water Demand (AADD)		kL/day	453	2,050	941	3,445
Total Water Demand (SPDD)		kL/day	679	3,076	1,412	5,167
OUTLINE OF PROPOSED INFRASTRUCTURE						
BULK SUPPLY INFRASTRUCTURE						
Source of Water			Klipvoor Dam	N.A.	N.A.	
Raw Water Supply Pipeline	400 mm	km	0.1	N.A.	N.A.	0.1
Water Treatment Works/Pump Stations		ml/day	6	N.A.	N.A.	6.0
Regional Reservoirs	0.5 to 3.0 ML	nos. of tank	1	1	1	3
Bulk Supply Pipelines	90 to 400 mm	km	69	113	49	231
Pump Stations		nos.	1	3	1	5
RETAIL SUPPLY INFRASTRUCTURE						
Service Reservoirs	10 to 410 m3	nos. of tank	7	21	10	38
Reticulation Pipelines	63 to 200 mm	km	42	103	59	204
Yard connections		nos.	0	0	0	0
Standpipes		nos.	88	228	124	440
CAPITAL COST OF PROPOSED INFRASTRUCTURE						
BULK SUPPLY INFRASTRUCTURE						
Intake/Pump Station		x 1,000 R	303	N.A.	N.A.	303
Raw Water Pipeline		x 1,000 R	50	N.A.	N.A.	50
Klipvoor WTW/Pump Station		x 1,000 R	4,950	N.A.	N.A.	4,950
Bulk Supply Pipelines		x 1,000 R	9,939	26,057	8,190	44,186
Regional Reservoirs		x 1,000 R	1,800	1,500	800	4,100
Pump Stations		x 1,000 R	111	601	303	1,015
Sub-Total		*x 1,000 R*	*17,152*	*28,158*	*9,293*	*54,603*
RETAIL SUPPLY INFRASTRUCTURE						
Service Reservoirs		x 1,000 R	670	3,055	1,710	5,435
Reticulation Pipelines		x 1,000 R	3,250	8,052	4,580	15,882
Yard Connections		x 1,000 R	0	0	0	0
Standpipes		x 1,000 R	141	365	198	704
Sub-Total		*x 1,000 R*	*4,061*	*11,472*	*6,489*	*22,021*
Total		**x 1,000 R**	**21,213**	**39,629**	**15,781**	**76,624**

Table 4-6 Comparison of Alternative-1 (Service Level B) and Alternative-1 (Service Level A)

KLIPVOOR

ITEM		KLIPVOOR WEST	KLIPVOOR EAST	MORETELE NORTH	TOTAL
ALTERNATIVE-1 (SERVICE LEVEL B)					
CAPITAL COST OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Intake/Pump Station	x 1,000 R	454	N.A.	N.A.	454
Raw Water Pipeline/Pump Statio	x 1,000 R	50	N.A.	N.A.	50
Klipvoor WTW/Pump Station	x 1,000 R	10,000	N.A.	N.A.	10,000
Bulk Supply Pipelines	x 1,000 R	9,939	26,057	8,190	44,186
Regional Reservoirs	x 1,000 R	2,500	3,400	1,800	7,700
Pump Stations	x 1,000 R	167	901	454	1,522
Sub-Total	*x 1,000 R*	*23,109*	*30,358*	*10,444*	*63,912*
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs	x 1,000 R	1,525	7,135	4,230	12,890
Reticulation Pipelines	x 1,000 R	5,896	14,999	8,109	29,004
Yard Connections	x 1,000 R	2,098	9,498	4,362	15,958
Standpipes	x 1,000 R	109	283	152	544
Sub-Total	*x 1,000 R*	*9,628*	*31,915*	*16,853*	*58,396*
Total	**x 1,000 R**	**32,737**	**62,273**	**27,297**	**122,307**
ALTERNATIVE-1 (SERVICE LEVEL A)					
CAPITAL COST OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Intake/Pump Station	x 1,000 R	303	N.A.	N.A.	303
Raw Water Pipeline/Pump Statio	x 1,000 R	50	N.A.	N.A.	50
Klipvoor WTW/Pump Station	x 1,000 R	4,950	N.A.	N.A.	4,950
Bulk Supply Pipelines	x 1,000 R	9,939	26,057	8,190	44,186
Regional Reservoirs	x 1,000 R	1,800	1,500	800	4,100
Pump Stations	x 1,000 R	111	601	303	1,015
Sub-Total	*x 1,000 R*	*17,152*	*28,158*	*9,293*	*54,603*
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs	x 1,000 R	670	3,055	1,710	5,435
Reticulation Pipelines	x 1,000 R	3,250	8,052	4,580	15,882
Yard Connections	x 1,000 R	0	0	0	0
Standpipes	x 1,000 R	141	365	198	704
Sub-Total	*x 1,000 R*	*4,061*	*11,472*	*6,489*	*22,021*
Total	**x 1,000 R**	**21,213**	**39,629**	**15,781**	**76,624**
(SERVICE LEVEL B) - (SERVICE LEVEL A)					
CAPITAL COST OF PROPOSED INFRASTRUCTURE					
BULK SUPPLY INFRASTRUCTURE					
Intake/Pump Station	x 1,000 R	151			151
Raw Water Pipeline/Pump Statio	x 1,000 R	0			0
Klipvoor WTW/Pump Station	x 1,000 R	5,050			5,050
Bulk Supply Pipelines	x 1,000 R	0	0	0	0
Regional Reservoirs	x 1,000 R	700	1,900	1,000	3,600
Pump Stations	x 1,000 R	56	300	151	507
Sub-Total	*x 1,000 R*	*5,957*	*2,200*	*1,151*	*9,309*
RETAIL SUPPLY INFRASTRUCTURE					
Service Reservoirs	x 1,000 R	855	4,080	2,520	7,455
Reticulation Pipelines	x 1,000 R	2,646	6,947	3,529	13,122
Yard Connections	x 1,000 R	2,098	9,498	4,362	15,958
Standpipes	x 1,000 R	-32	-82	-46	-160
Sub-Total	*x 1,000 R*	*5,567*	*20,443*	*10,364*	*36,375*
Total	**x 1,000 R**	**11,524**	**22,644**	**11,516**	**45,683**

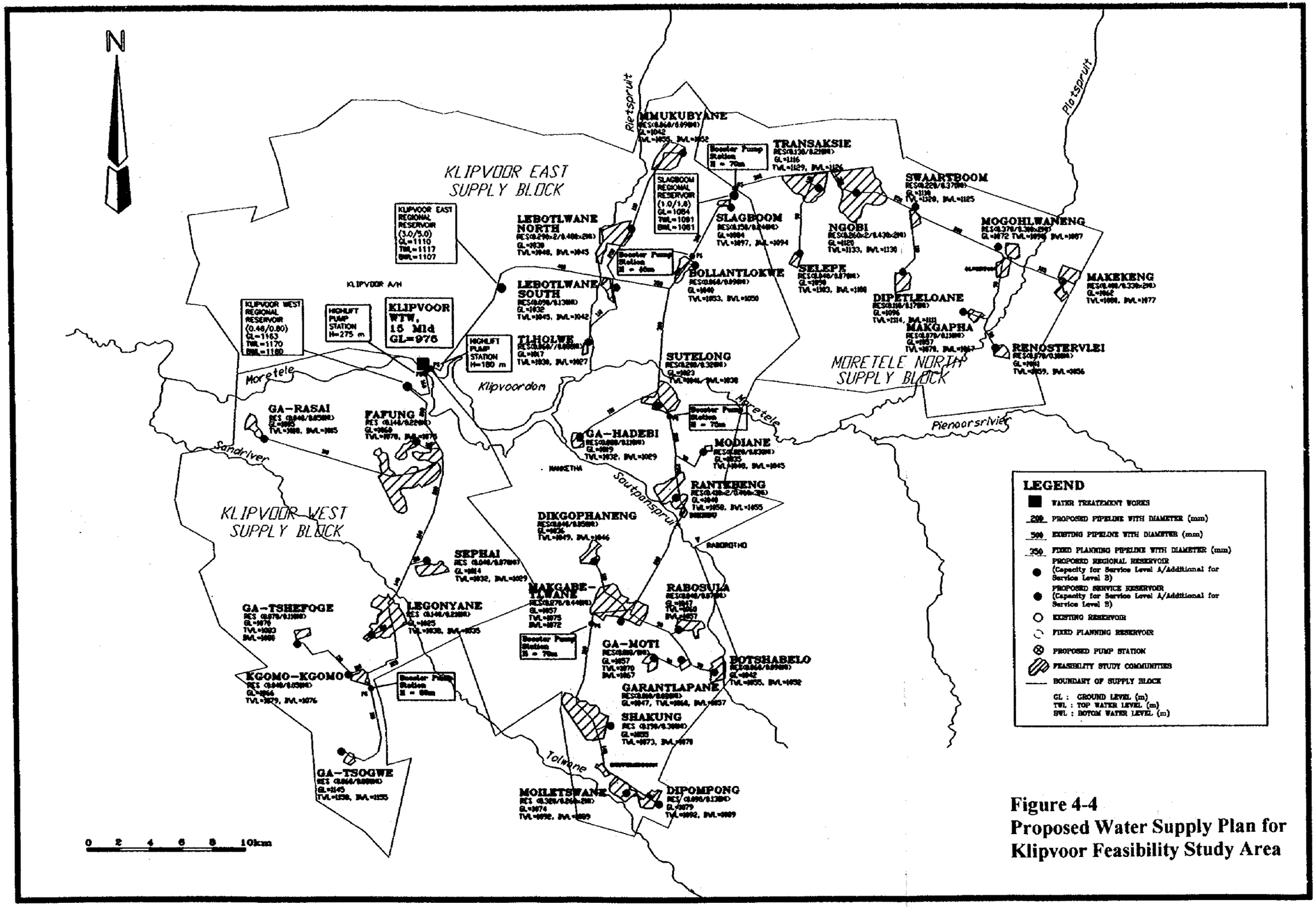


Figure 4-4
Proposed Water Supply Plan for Klipvoor Feasibility Study Area

The other system, (rated at 138.59 l/s based on summer peak day demand for Service Level B), will supply the remaining areas comprising the Klipvoor East and Moretele North Supply Blocks. A regional reservoir to serve this system will be located approximately 7.6 km north-east of the treatment works at the high point in the system. From here the pipeline will run eastwards with branches to the north to Lebotlwane North and Mmukubyane and south to Lebotlwane South and Tlholwe before reaching a major bifurcation.

The southern fork will cross the Moretele River after which a branch will supply Sutelong and Ga-Hadebi. South of Sutelong a booster pumping station is required. From Makgabetlwane a branch supplies Dikgophaneng while another branch supplies Botshabelo and the neighbouring communities. A further booster pumping station is required south of Makgabetlwane to supply the southern extremity of this system through Shakung as far as Dipompong.

The northern fork will supply Bollantlokwe after which a booster pumping station is necessary to supply Slagboom where a further regional reservoir will also be located. Due to the higher elevation of the communities in the Moretele North Supply Block it is necessary to provide a further booster pumping station downstream of the regional reservoir. From here the main pipeline heads east through Transaksie, Ngobi, Swartboom and on to Makekeng with branches off southwards to Selepe, Dipetleloane and Makgapha and Renstervlei en route.

4.3.2 Availability of Raw Water

The Department of Water Affairs and Forestry has confirmed that there is excess water available in the Pienaars River system so water availability will not be a problem. The natural runoff is heavily supplemented by return flows from a number of sewage treatment works serving the urban areas of Pretoria North, Temba and Soshanguve. These include Rooiwal STW (200 Mld), Wallmannsthal STW (50 Mld), Baviaanspoort STW, Temba STW and Makapanstad STW. Return flows (currently estimated to be around 90 mcm/a on an annual average basis) are likely to increase as water consumption rises and sewerage systems become more widespread. This will give rise to increased capital and operational costs for providing water treatment and will present a challenge as regards management of water quality in both rivers and impounding reservoirs. An initiative by the Finnish ODA is currently looking at this issue in the catchment, particularly for the Apies River.

4.4 Preliminary Design of Major Infrastructure

Figure 4-5 shows the proposed layout plan of the Klipvoor WTW. The required treatment capacity based on peak summer daily demand is 6 Mld for Service Level A or 15 Mld for Service Level B. Two streams of 3 Mld would be constructed in the event that Service Level A is feasible with provision for expansion by a further three streams in the event of Service Level B being required at a later date. Alternatively five streams could be built at the outset if Service Level B is feasible. The area of land required for the WTW is approximately 3 ha for Service Level A or 5 ha for Service Level B. The proposed site is on the right (north) bank of the Moretele River immediately downstream of Klipvoor Dam. An investigation of the site using a hand auger indicated red sandy topsoil approximately 1 m deep overlying a harder layer of similar material. There was no indication of underground water. The harder material appears to be a suitable founding strata.

The site proposed for the raw water intake is shown in Figure 4-6. It is proposed that raw water will be abstracted immediately upstream of a gauging weir on the Moretele River; the weir is approximately 750m downstream of the dam. This site was identified by the Study Team as being a suitable raw water intake site.

The weir is operated by DWAF who have confirmed that they have no objection to the weir being used to provide a pond for the intake provided that the primary purpose of the weir is not compromised.

The Moretele River has low turbidity that is consistent with conditions upstream in the Pienaars River catchment. Seasonal algal growth is significant in both the impounding reservoir and the Moretele River and will necessitate additional treatment to remove taste and odour. A comparison of water quality taken from the DWAF database for the dam and the downstream weir indicates that water quality improves in the river with respect to the average concentrations of most parameters and especially with respect to peak levels of nitrites / nitrates, phosphates and ammonia.

The treatment process proposed comprises powdered activated carbon dosing, flocculation, dissolved air flotation, rapid gravity filtration and disinfection. It is proposed that provision should also be made for a sedimentation stage, which would probably be required infrequently but may be necessary to deal with high turbidity during times of exceptionally high rainfall. This is based on recent operational experience at Klipdrift where operational problems were

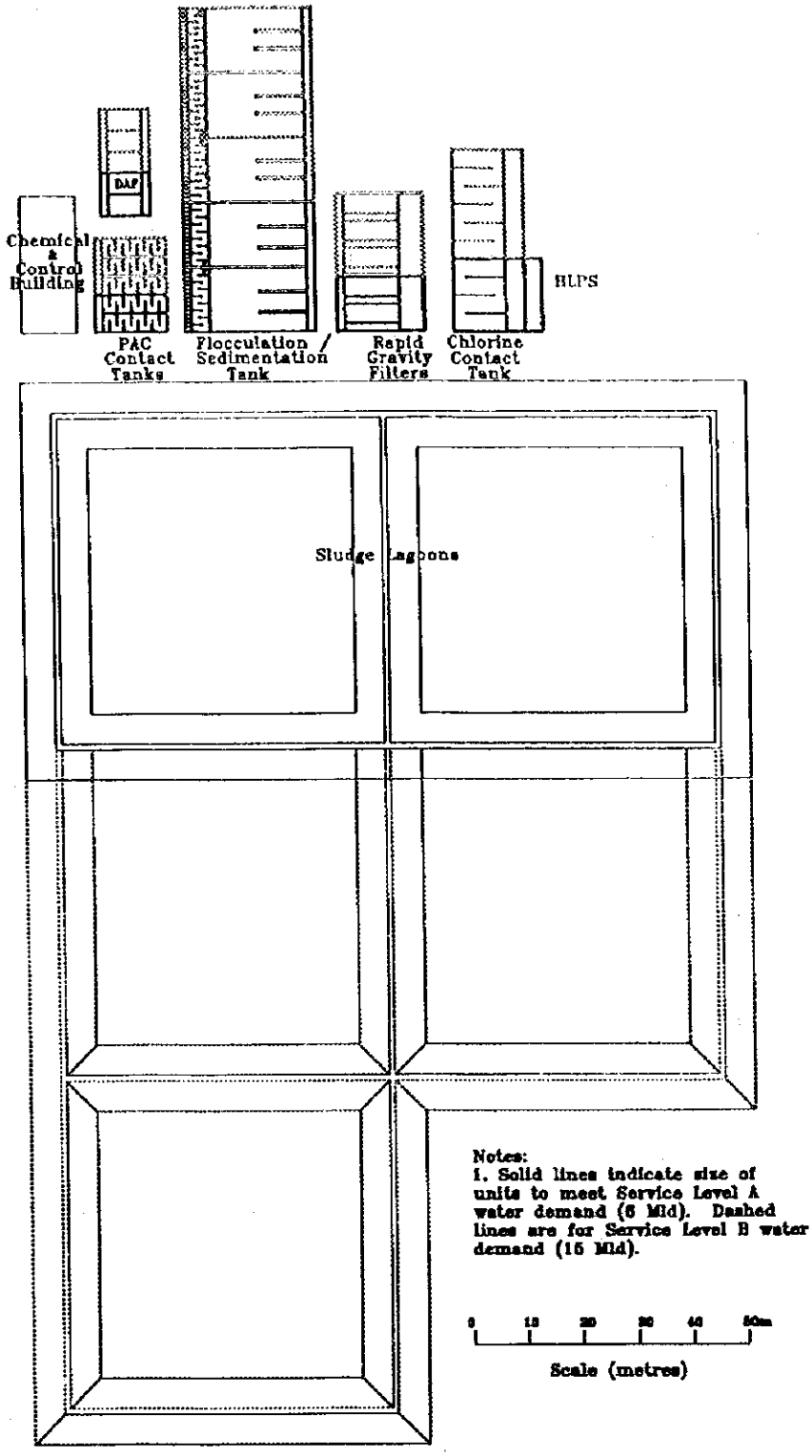
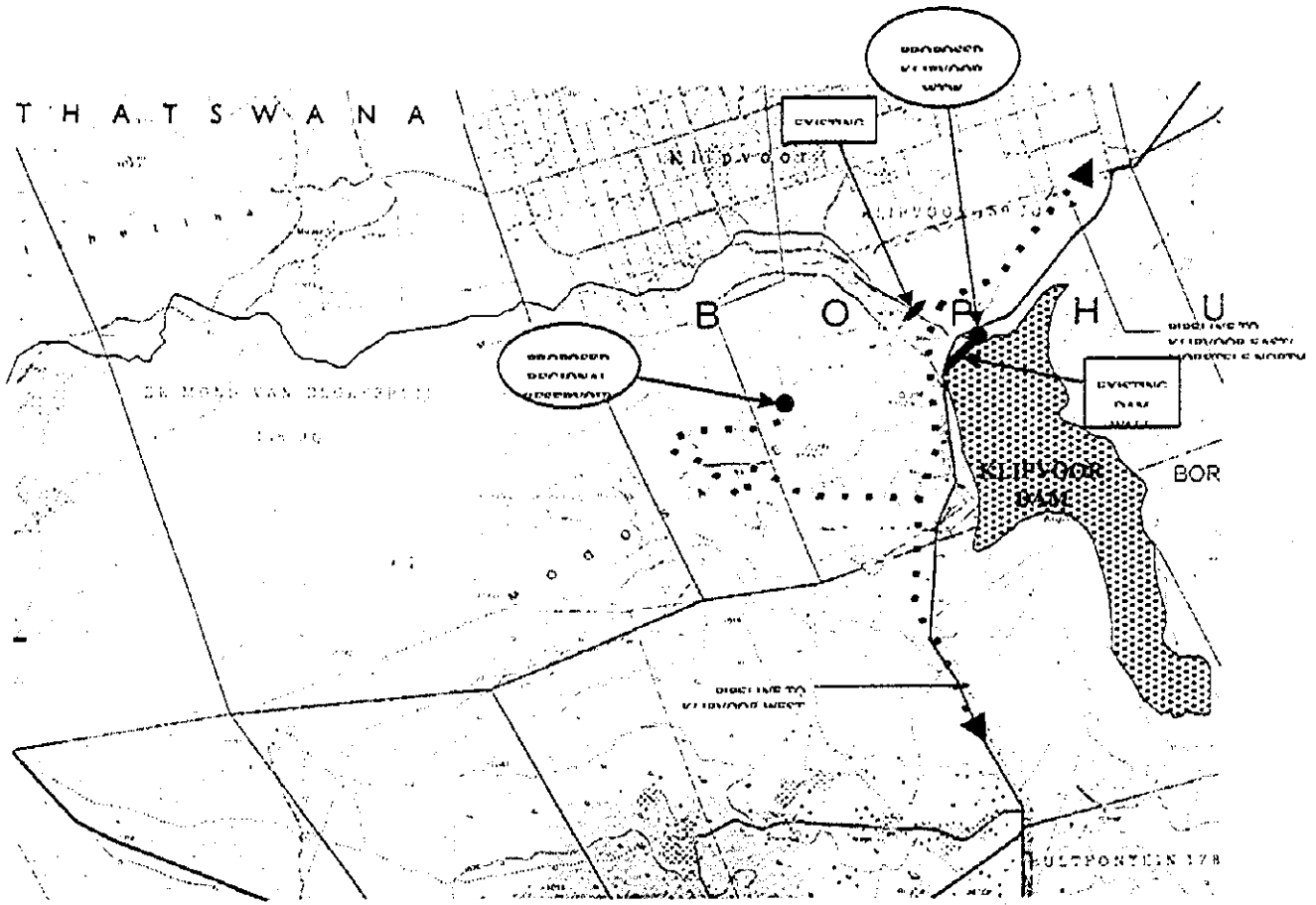


Figure 4-5

Proposed Layout for Klipvoor WTW

Figure 4-6 Proposed Infrastructure Around Klipvppr Dam



experienced recently as a result of the absence of a sedimentation stage. The works has been sized on the basis of continuous operation due to the high capital cost of constructing additional capacity to facilitate intermittent operation, and due to the size of the plant which is not insignificant.

The sites identified for the proposed intake, water treatment works, one regional reservoir and associated access roads and pipework at Klipvoor Dam lie within the Borakalalo Nature Reserve. The sites proposed for this infrastructure are shown in Figure 4-6. Possible impacts of the infrastructure on the environment within the nature reserve both during and after construction have been assessed by the Study Team, and are discussed in detail in Chapter 8. The Study Team also studied two alternatives, both of which considered siting the water works and regional reservoir outside the nature reserve area. The results of that study are compiled in A.5 of Annex A. In summary, the study indicated that arranging the infrastructure at the sites as shown in Figure 4-6 comprises the most economical solution.

Preliminary designs for the other major components of the water supply system such as regional reservoirs, service reservoirs, pumping stations and pipework are shown in Figures A.6-1 through A.6-6 of Annex A. These preliminary designs are only intended to indicate general features of the infrastructure included in the proposed water supply plan. Designs meeting the site-specific requirements will be prepared during the detailed design stage.

4.5 Construction Costs at 1997 Prices

Costs for the proposed water supply plan (Alternative 1 / Service Level B) shown in Table 4-1 are pure construction costs at 1997 prices and do not include P&G or any contingencies. Construction costs estimated on the same basis but for the RDP level of service (Service Level A) are presented in Table 4-5.

For each of the two levels of service, the difference in construction cost is provided in Table 4-6 for each component of the water supply system. As can be seen in the table, the cost difference is not as significant for bulk infrastructure as it is for retail infrastructure. This is mainly because the cost of bulk supply pipelines, which usually comprises a major portion of the total bulk infrastructure cost, is same for both levels of service. In summary, the construction costs estimated for each service level are as follows:

Service Level	Construction Costs at 1997 Price
Alternative 1, Service Level B	R122,307,000
Alternative 1, Service Level A	R 76,624,000
Difference (Level B - Level A)	R 45,683,000

As mentioned earlier, these costs are pure construction costs at 1997 prices to which various other costs and fees, such as P&G, an allowance for physical contingencies, inflation, engineering fees, administration costs and VAT must be added to derive the actual project cost.

It should be noted that the construction cost for Service Level B includes the cost of providing yard connections to 90 % of households in each community, which amounts to approximately R 16 million, constituting a significant portion (around 35%) of the difference in cost between the two levels of service.

Considering the relatively small size and capacity of the constituent components of the scheme, and given the manufacturing capability of local industry, it was assumed that all of the materials, equipment and goods required for the construction of the proposed infrastructure, (such as pumps, motors, pipes, fittings, valves, etc.), are manufactured within South Africa.

CHAPTER 5

FINANCIAL APPRAISAL

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CHAPTER 5 FINANCIAL APPRAISAL

5.1 Preliminary Analysis on Case A and Case B

On the basis of the facility planning, the following possible options were analysed and assessed mainly from financial viewpoints:

Case A: Implementation of the level A services (standpipe) only; and

Case B: Implementation of the level B services (yard connection: 90% + standpipe: 10%) only

5.1.1 Premises

(1) Willingness to Pay and Affordability

The socio-economic survey showed that the average monthly income for households in Klipvoor is about R1,167. The average size of the household is approximately 6.8 persons, 65% of monthly income is derived from employment. Consumers in the Klipvoor Area currently spend R54.0 per month on water purchased from vendors or R16.1 per month on borehole water, but water purchased from vendors only represented 21% of total water purchases. Consumer's average Willingness to Pay (WTP) for the RDP level of service was R9.0 per month and R23.8 per month for yard connections as shown in Figure 5-1. The average willingness to pay for yard connections only represents 2.04% of total monthly household income. Current income and affordability levels of beneficiaries in the Project Area will impact on the size of the tariff that can be levied and expected revenues / income.

Generally, respondents seem to state their income smaller, but expenditures bigger. As such, they also have tendency to express lesser amount as WTP, and approximately 3 % of household income is applicable for their affordability to water supply on the basis of World Bank's experience in the planning of this sector.

In addition, the beneficiaries are categorised into three groups in terms of their income with their affordability for water supply as shown below:

Table 5-1 Income Group and Affordability

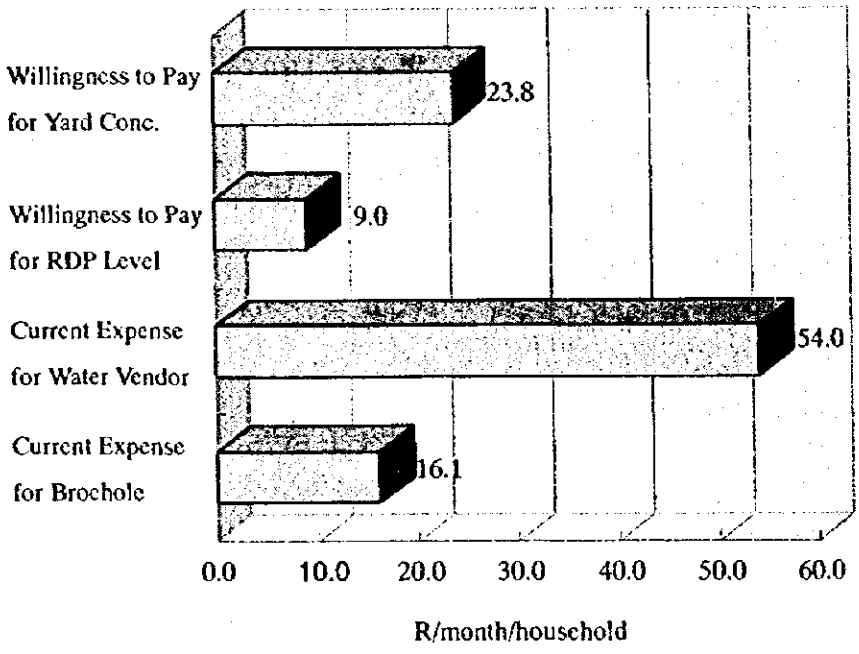
Income Group (%)	Ave. Monthly Income (R)	Affordability (R)
Low : - R499/m (32%)	332	9.96
Middle : R500 - R1,999/m (49%)	980	29.40
High : R2,000/m - (19%)	3,002	90.06
Average	1,167	35.01

Figure 5-1 Comparison of Current Expese and Willingness to Pay

Klipvoor

Current Expense for Borehole	16.1	R/month/household	1.38%
Current Expense for Water Vendor	54.0	R/month/household	4.63%
Willingness to Pay for RDP Level	9.0	R/month/household	0.77%
Willingness to Pay for Yard Conc.	23.8	R/month/household	2.04%
Average Monthly Income	1,167	R/month/household	

Comparison Of Current Expense And Willingness to Pay



(2) Implementation Period

In both cases of A and B, overall implementation would requires five (5) years including fund procurement procedures, detailed design and construction supervision as well as institutional development.

5.1.2 Project Cost

(1) Initial Capital Cost

To determine the required initial capital cost, the following cost model has been applied to the bulk and the retail water supply system excluding the specific cost of yard connections.

- Direct Construction Cost (DCC);
- Provisional and General (P&G) Cost: 15% of (1);
- Base Cost: (1) + (2);
- Engineering Fee: 10% of (3);
- Miscellaneous: 2% of (1);
- Institutional Support and Development: 2.5% of (3);
- Sub-total: (3) + (4) + (5) + (6);
- Physical Contingency: 15% of (7);
- Price Contingency: 10% of compound rate for the sum of (7) and (8) at the specified year of disbursement; and
- VAT: 14% of sum of (7), (8) and (9)
- Initial Capital Cost: Sum of (7), (8), (9) and (10)

The cost of the yard connections consists of a direct construction cost, a price contingency and VAT.

Direct construction cost has been estimated on the basis of the proposed water supply system and represents pure construction cost excluding P&G's, any allowance for physical contingencies and the other factors described in (2) to (10) above. More detail concerning the engineering aspects of the assumptions are provided in Chapter 4 of this report.

The estimated initial capital cost for both Case A and Case B is summarised in Table 5-2 and in greater detail in Table C.1-2 of Annex C. In this table, the following definition is applied:

Bulk Supply: Bulk water supply infrastructures covering from raw water intake to bulk supply pipeline until service reservoirs;

Retail Supply: Retail water supply infrastructures covering from service reservoirs to standpipes; and

Yard Connection: Connecting facilities between reticulation pipeline and yard taps.

Table 5-2 Composition of Initial Capital Cost (Unit : R 1,000)

	Case A	Case B	Difference
Bulk Supply			
Base Cost	62,795	73,499	10,704
Engineering etc.	8,941	10,465	1,524
Contingencies	45,112	52,476	7,364
VAT	16,359	19,102	2,743
Total	**133,207**	**155,542**	**22,335**
Retail Supply (Main)			
Base Cost	25,324	48,804	23,480
Engineering etc.	3,165	6,100	2,935
Contingencies	18,632	35,907	17,275
VAT	6,597	12,714	6,117
Total	**53,718**	**103,525**	**49,807**
Yard Connections			
Direct Construction Cost	-	15,958	15,958
Price Contingency	-	7,449	7,449
VAT	-	3,277	3,277
Total	**-**	**26,684**	**26,684**
Total Capital Cost	**186,925**	**285,751**	**98,826**

(2) Operation and Maintenance Cost

To operate the water supply system, expenses such as raw water, power for pumping, and chemicals for purification are incurred as well as salaries for staff. The operation and maintenance costs for bulk water supply and the administration cost for retail water supply are estimated separately.

The estimated annual operation and maintenance cost for both Case A and Case B is summarised in Ttable 5-3 and in greater detail is provided in Table C.1-3 of Annex C.

Table 5-3 Annual Operation and Maintenance Cost (Unit : R1,000)

Case (Annual Demand)	Bulk Water Supply						Retail Water Supply	Total
	Raw water	Electricity	Chemicals	Salaries	Maintenance	Sub-Total	Administration	
	0.17R/kl	0.15R/kl	0.05R/kl	0.17R/kl	0.05R/kl			
Case A (1,257,257kl)	213.7	225.2	62.9	213.7	62.9	778.4	342.3	1,120.7
Case B (3,352,686kl)	570.0	600.5	167.6	570.0	167.6	2,075.7	695.1	2,770.8

(a) Operation and Maintenance Cost for Bulk Water Supply

The operating cost for Klipvoor WTW and other bulk water supply infrastructure in the Klipvoor Area are estimated from data for existing Magalies Water schemes.

i) Raw Water Cost: 0.17 R/kl
Klipvoor Dam, which will be the source of raw water for Klipvoor WTW, is currently used only for irrigation purpose and is operated by an Irrigation Board. Klipvoor dam raw water tariff is not available. The raw water charge for Klipvoor WTW is assumed to be 0.17 R/kl and is calculated from the average raw water cost in 1996 of the four purification schemes managed by Magalies Water

ii) ESKOM Power: 0.15 R/kl
The cost of energy for all of the pumps and purification plant is assumed to be 0.15 R/kl of purified water produced. Any real price increase is estimated at 3% per annum and is based on data from Eskom.

iii) Chemicals:0.05 R/kl
The cost of chemicals is assumed to be 0.05 R/kl . This is more costly than the 0.03 R/kl spent at Vaalkop WTW on chemicals in 1996 due to the poor quality of rw water.

iv) Salaries: 0.17 R/kl
Staff salaries are calculated based on the salary expenses incurred by MW in 1996 and on bulk water production.

v) Maintenance Cost: 0.05 R/kl
Maintenance cost is assumed to be 0.05 R/kl, the average for MW in 1996.

(b) Administration Cost for Retail Water Supply

The administration cost of the Water Services Provider, which will also be the implementation institution for retail water supply, is estimated based on the institutional development plan. The cost is calculated from the organisational structure together with the number of staff for Service Level A (RDP minimum level) and Service Level B (90%Yard Connections and 10% RDP minimum level).

The proposed organisational structure is determined based on the size of the community. For example, a small community is assumed to have a population of 2,100 or 350 Households (approximately 6 persons/household) while a medium size community is assumed to have a population of 4,800 or 800 households. The 35 communities in the Klipvoor Area consist of 7 medium sized communities and 28 small communities.

The costs to a small community for Service Level A and Service Level B are estimated to be R700 per month and R1,150 per month respectively. Whereas the costs of Service Level A and B to a medium sized community are R1,275 and R3,675 per month respectively. The applicable annual retail supply administration costs for Service Level A and Service Level B are R342,300 and R695,100 respectively (See Table C.1-4 through C.1-6 of Annex C).

5.1.3 Calculated Tariff and Implications

(1) General

The financial consideration of the proposed project has two different aspects: the supply side and the demand side approach through which sustainability of the project will be sought.

In considering the financial aspects, the following basic conditions have been applied:

- While the first tier (DWAF) will subsidise the initial capital cost required for the RDP level of service (Case A), it will not extend financial support for a service level higher than the RDP minimum level. This includes grant funding, subsidies, or loan guarantees on behalf of a Services Authority or Services Provider;
- The average affordability of beneficiaries for water supply is around 3% of their household income;
- The real rate of interest in South Africa is around 8% per annum;
- Future perspectives of the inflation rate range from 8% to 10% per annum;
- Full cost recovery (i.e. 100% tariff collection);
- Analysis period is 30 years.

(2) Water Tariff

By applying the basic conditions above, an overall water tariff was determined. Viewed from the standpoint of a Water Services Provider the water tariff should be enough to cover the bulk and retail supply systems.

(a) Case A

i) Bulk Water Tariff
In the cash flow analysis for the bulk water supply system, basic information such as operation, maintenance and administration costs were compared with Magalies Water's current activities, especially relating to Vaalkop WTW. A bulk water tariff of R0.74/kl (at constant 1997 prices) which included replacement cost for components with an economic life less than the analysis period was computed. This tariff was also applied to the tariff calculation of the retail water supply system

ii) Retail Water Tariff
In regard to the third tier, a retail water tariff was also computed as a means to offset the recurrent costs including the bulk water tariff, maintenance and administration costs. This computation resulted in a tariff of R1.19/kl or R6.05/household at constant 1997 prices in 2003 when all beneficiaries will be able to receive the RDP level of service. The same tariff represents about 1.8% and 0.5% of household income of the lower income (R332/month in 1997) and the average income (R1,167/month) groups respectively.

(b) Case B

The water tariff for Case B has been calculated subject to the following additional conditions:

- Long-term loan : real rate of interest 8%, 20 yerars equal repayment
- Yard connection fee is included in the tariff calculation.

i) Bulk Water Tariff
Bulk supply is similar to Case A except that the second tier will acquire loan funding for the initial capital cost for the service level higher than the RDP level. A tariff of R1.28/kl was calculated for the bulk water supply system.

ii) Retail Water Tariff

The retail water tariff to cover recurrent costs and loan repayment was computed resulting in R3.94/kl. The calculated figure implies monthly expenditure per household for water supply of R54.6 and R20.1 for the average and low-income groups respectively. This is equivalent to 4.7% and 6.1% of the monthly income of each respective group.

Caluculation of tariff setting for bouth Case A and Case B is attached in Table C.1-7 of Annex C.

(2) Implications

Project evaluation included the financial viability and sustainability of Case A and Case B. The results of the evaluation are summarised in Table 5-4.

Table 5-4 Implication of Case A and B

		Case A	Case B
Service Level	Standpipes	100%	10%
	Yard Connections	0%	90%
	Consumption (AADD)	25 lcd	68 lcd
1. Community Preference		Very low	Rather High
2. Monthly Tariff	Low Group	R6.1 (25 lcd)	R20.1 (25 lcd)
	Avge. Group	R6.1 (25 lcd)	R54.6 (68 lcd)
3. Affordability	Low Group	R10.00	R10.00
	Avge. Group	R35.01	R35.01
4. Risk of Illegal / Unauthorised connections		Very high	Possibly low
5. Fund Mobilisation	2nd Tier	Not necessary	Possibly no problem
	3 rd Tier	Not necessary	Rather difficult
6. Institutional Capacity	2nd Tier	No problem	No problem
	3 rd Tier	Need reinforcement	Need strong reinforccement

As can be seen from the table, Case A is affordable to the beneficiaries of the low-income group. However, the community survey conducted by the Study Team showed that the RDP minimum level of service is, generally, not welcomed by the communities and has a higher risk of illegal or unauthorised connections. Non-payment is also a major problem. On the other hand, Case B which provides the higher service level with 90% yard connections is the preferred alternative to most communities but the tariff is higher than the affordability level of beneficiaries. Consequently, a reponsible Services Provider may face great difficulty in

mobilising the external funding required for the initial capital investment and working capital requirements..

5.2 Staged Development Approach

5.2.1 General

Based on the above evaluation, it would appear that neither simply implementing Case A nor Case B would be the best alternative considering the viability and sustainability of the project. To this end, it is proposed that a staged development approach, "Case C", be introduced that will start the project with Case A in the earlier years and then upgrade the system towards Case B. The proposed option includes a period of five years operation at Service Level A after completion of the infrastructure development in year 2002.

5.2.2 Alternative Plan

To implement the proposed option as Case C, the following two options were further reviewed from financial viewpoints:

Case C-1: A part of the cost required for upgrading service level shall be borne by beneficiaries through prior deposit during the Service Level A period, which must be included in the water tariff of the Level A.

Case C-2: The full cost required for upgrading service level shall be procured through an external loan fund.

5.2.3 Water Tariff and Implications

As similar manner that was applied for financial analysis of Case A and Case B in the earlier part of this chapter, a water tariff is calculated as shown in Table 5-5 and its implications are evaluated in Table 5-6.

Table 5-5 Water Tariff for Case C-1 and C-2

	2002-2007 R/HH	2008-2012 R/Kl	2013-2017 R/Kl	2018-2022 R/Kl	2023-2027 R/Kl
Case C-1	39.02	2.56	2.60	2.65	2.70
Case C-2	6.02	3.93	3.98	4.02	4.07

As mentioned in Table 5-6, it can be said that Case C-1 will be the most realistic option for implementing Klipvoor Water Supply Scheme under the framework of Magalies Water Expansion Project.

Table 5-6 Evaluation on Alternative Plans (Cases C-1 and C-2)

<table>
<tr><td colspan="2" rowspan="2">Particulars</td><td colspan="4">Alternative Plan (Case)</td></tr>
<tr><td colspan="2">C-1</td><td colspan="2">C-2</td></tr>
<tr><td rowspan="4">Water Tariff and Beneficiaries' Share
(While the zero growth for beneficiaries' income is expected, the tariff includes real increase of electricity charge at 3% per annum.)</td><td>1st Stage</td><td colspan="2">Since the tariff includes reserve fund for upgrading service level (a part of retail water supply facility and connection fee), it occupies about 3% of household income of average income group, while it does 11.8% of household income of low income group.</td><td colspan="2">The tariff occupies less than 3% of household income in both average and low income groups.</td></tr>
<tr><td>2nd Stage</td><td colspan="2">Through introduction of quantity base water tariff, it occupies 3.0-3.2% of household income of average income group. On the other hand, it does 3.9-4.2% of that of low income group, respectively.</td><td colspan="2">Similar to Case C-1, the tariff occupies 4.1-4.4% of household income of average group. On the other hand, it does 6.1-6.4% of that of low income group, respectively.</td></tr>
<tr><td rowspan="2">Total Water Charges per Household (2002-2027) (Rand)</td><td>Average Income Group</td><td>Low Income Group</td><td>Average Income Group</td><td>Low Income Group</td></tr>
<tr><td>11,089</td><td>5,557</td><td>12,678</td><td>5,257</td></tr>
<tr><td colspan="2">Contribution to Improvement of Financial Ground of Service Provider</td><td colspan="2">Through the reserve fund accumulated during the 1st Stage, Klipvoor will be able to secure about 33.4 million Rand as original fund. Due to the original reserve fund, credibility of service providers will be improved for external funding institutions, and it facilitates the service providers to obtain the required loan more easily than Case C-2 in the 2nd Stage.</td><td colspan="2">All the cost to be required for upgrading the service level will be depending on external funding institutions, the proposed service provider, especially Eatern District Councils as 3rd Tier will face lack of credibility taking into account the present financial situation.</td></tr>
<tr><td colspan="2">Overall Evaluation</td><td colspan="4">While the tariff in Case C-1 for the 1st Stage exceeds affordability of low income group due to reserve fund as prior investment in the FS area, the tariff for the 2nd Stage occupies household income by 1.61 to 1.7% lower than Case C-2. As for total expenditure for water charge during the calculation period of 25 years, average group of Case C-1 bears lesser burden than Case C-2, low income group of Case C-1 must expend a little bit more water charge by about 300 Rand for 25 years than Case C-2. In this context, the low income group of Case C-1 situates rather severer position than Case C-2, the average group of Case C-1 could enjoy more favourable condition than Case C-2 in terms of their cost sharing for water tariff. In addition, Case C-1 will be able to improve credibility of service providers. Therefore, the Case C-1 is considered the most realistic option when proper measures will be taken for the low income group.</td></tr>
</table>

5.3 Details of Case C-1

5.3.1 Development Concept

The proposed option "Case C-1" aims to ultimately provide the service level B (yard connection) to all beneficiaries of the target communities in the Klipvoor FS area, with lesser cost burden to the beneficiaries and with sound management of the supply system by the service provider. The proposed option shall start to provide the water supply facilities under the service level A, which does not impose any financial burden for the initial capital cost to the beneficiaries. During the course of the service level A, every community has enough time to discuss and to obtain consensus about the possibility to upgrade the water supply system to the service level B. Especially, countermeasures must be fully argued among community members, which should support the low income group.

In order to attain the said target on the sustainable basis, it is prerequisite to reinforce and strengthen the institutional capacity of the 3rd tier including the target communities. In this connection, the proposed staged development approach will facilitate the required institutional development. The way and method of the institutional development of the 3rd tier are detailed in Chapter 6 of this report.

The scenario of the proposed option is shown schematically in Figure 5-2.

5.3.2 Project Cost and Allocation

(1) Initial Cost

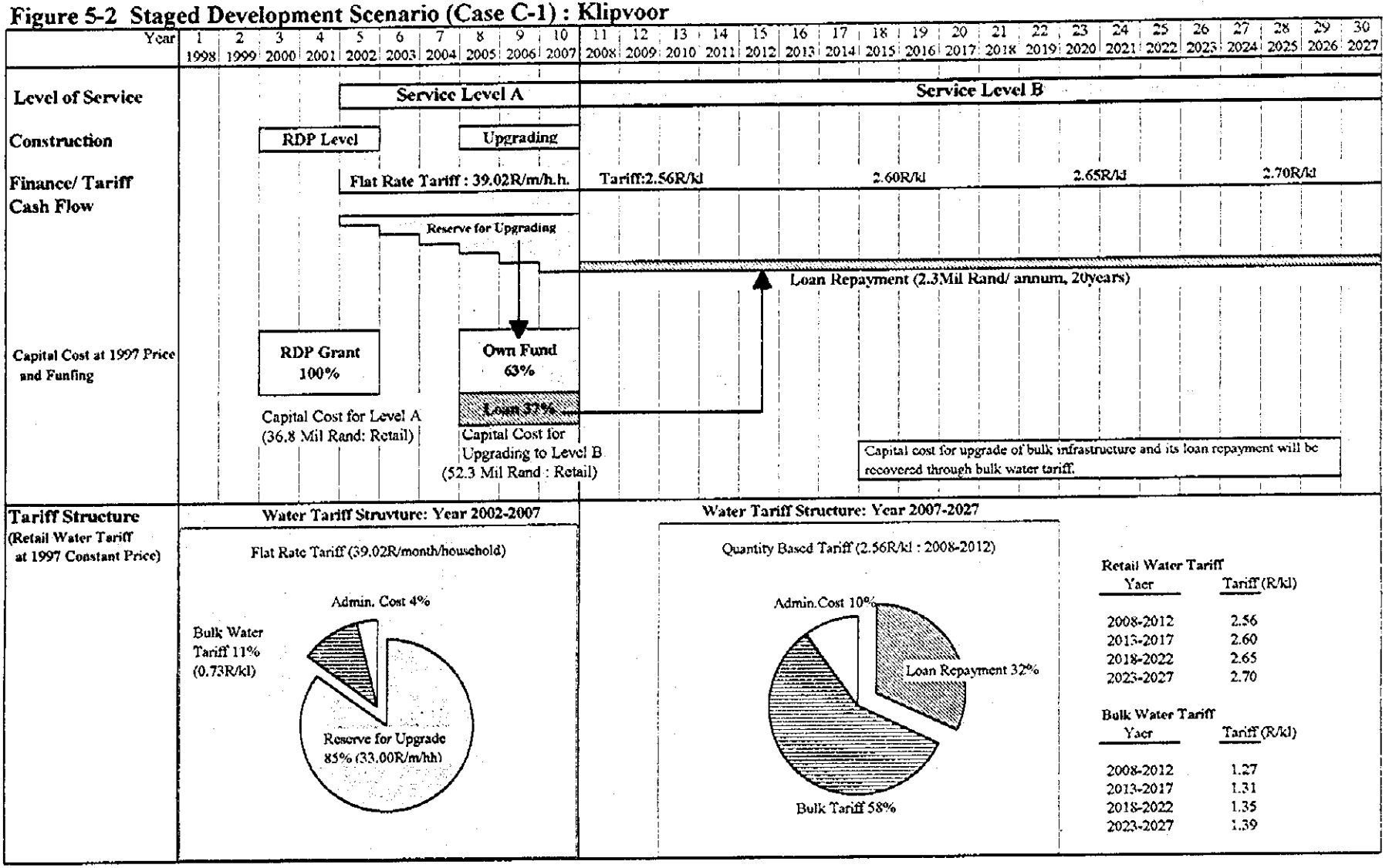
The proposed option requires two sets of initial capital investment, firstly those cost to be invested for providing the infrastructure under the level A services and an institutional development; and secondly those for upgrading the infrastructure from the level A to the level B services and institutional development. Table 5-7 Summarises the initial investment cost, of which detail is given in Table C.1-8 of Annex C.

Table 5-7 Initial Investment Cost (Case C-1) (Unit: R1,000)

	1st Stage (Level A)	2nd Stage (Upgrade)	Total	Executing Body
Bulk Supply	133,207	35,972	169,179	MW
Retail Supply	53,718	80,213	133,931	JV (MW + EDC)
Yard Connection	-	42,974	42,974	- ditto -
Total	186,925	159,159	346,084	
Remarks	1998-2002	2003-2007		

Note: At 1997 prices with price escalation of 10% p.a.

Figure 5-2 Staged Development Scenario (Case C-1) : Klipvoor



The necessary fund for the 1st stage amounting to R187 million must be shouldered by the 1st tier (DWAF Central Office), while those fund for the 2nd stage will be arranged both by the service provider (JV of MW and EDC) and the beneficiaries. A part of the cost required for the 2nd stage should be collected from the beneficiaries as water tariff.

Disbursement schedule of initial cost is shown in Table 5-8 below, and its detail in Table C.1-8 of Annex C.

Table 5-8 Disbursement Schedule of Initial Cost for Case C (Unit:R1,000)

Stage	Stage 1						Stage 2						Total
Year	1	2	3	4	5	Sub-Total	6	7	8	9	10	Sub-Total	
	1998	1999	2000	2001	2002		2003	2004	2005	2006	2007		
Bulk Supply	394	3,352	39,041	63,020	27,400	133,207	108	920	13,642	17,140	4,162	35,972	169,179
Retail Supply	159	1,048	9,990	30,433	12,088	53,718	237	1,565	22,717	71,180	27,488	123,187	176,905
Total	553	4,400	49,031	93,453	39,488	186,925	345	2,485	36,359	88,320	31,650	159,159	346,084

(2) Operation and Maintenance Cost

In order to maintain the project facilities on sustainable basis, an operation and maintenance cost (O&M cost) including administration cost will be required. The basis for calculating the O&M cost is stated in the earlier part of this Chapter. The proposed project requires the following operation and maintenance cost:

Table 5-9 Annual Operation and Maintenance Cost for Case C (Unit: R1,000)

	Stage 1 (Level A)	Stage 2 (Level B)	Executing Body
Bulk Supply	778	2,171	MW
Retail Supply	342	695	JV (MW + EDC)
Total	1,120	2,866	
Remarks	2002 – 2007	2008 onward	

All the O & M cost must be reflected in the proposed water tariff.

5.3.3 Water Tariff

(1) General

The Klipvoor FS area is located in economically backward area, and most of all communities have almost none of economic prospect in future, resulted in difficulty to expect income

growth of community people. On the other hand, Eastern District Council as the 3rd tier institution for water supply sector has very short history since established in 1994, and its financial ground is still weak, relying on a half of revenue from levies, taxes and grants from the central government.

Under such situation, it is quite difficult for the proposed option Case C-1 to fully satisfy with the requirements from both the supply side and the demand side, in other words, the option faces so-called antinomy. In this context, quite careful analysis on financial aspect of the proposed option has been carried out. However, the result of water tariff calculation is not favourable for the low income group for which careful attention should be paid as mentioned below.

(2) Cash Flow Analysis

By applying the same method and provisions that are used in the preliminary analysis for Case A and Case B in this Chapter 5, cash flow analysis is carried out for both the bulk supply and the retail supply. In this cash flow analysis, firstly the bulk water supply system is analysed for MW as the service provider under the closed system of the proposed option. Then, the retail water supply system is done taking a calculated bulk tariff into consideration. These processes of analysis are shown in Annex C of this report.

(3) Retail Water Tariff

During the 1st stage operation (Level A: 2002 – 2007), a flat rate of water tariff, R39.02 per month per household will be charged, of which 85 %, 11 % and 4 % are allocated to the reserve fund for upgrading, the bulk water tariff and the administration cost, respectively. In other words, R1.18 per month per household is a pure water tariff to be charged to beneficiaries. In year 2007, the accumulated reserve fund will occupy about 63 % of the upgrading cost (R52.3 million), and the rest 37 % or R19.58 million will be secured from the external fund agency.

After upgraded to the level B services, a retail water tariff of R2.56-2.70 per Kl will be chargeable, which includes redemption of a part of the initial capital cost (upgrading cost) and O & M cost.

(4) Issues Relating to Water Tariff Setting

(a) Community level

It is rather difficult to introduce different service levels into a single community from

technical viewpoint, hence the community must obtain consensus of community members on the service level. During the process on the above, community members should discuss on appropriate consideration for the low income group including:

- Possibility of cross-subsidisation within the community
- Positive utilisation of low income group for labour works during construction stage as income increase even temporary basis
- Mobilisation of low income group for O&M works of water supply facilities within the community

(b) Service Provider level

In order to attain full recovery of water tariff, the following items will be examined:

- It is defined that the operation and maintenance of facilities and water charge collection are responsible for the community itself, and incentive and penalty system will be applied on the occasions
- To prepare and distribute easily understandable document on the impact of the reserve fund and to remove uneasiness of beneficiaries through preparation of separate accounting system for the reserve fund for which periodical audit will be applied

(c) Low income group level

In order that the group will be able to participate for the higher service level, the following item must be examined:

- To reduce cost burden of connection cost between the retail supply pipe and yard tap, the low income group shall contribute by offering their efforts for the required labour works

(d) Feedback of experience obtained from Pilot Project

In order to realise the various measures stated above, experiences and best practices obtained during the process and the implementation of the pilot projects, must be reflected including on the following items:

- Approach method and process of establishing Local Project Steering Committees in the three pilot project communities; and
- Method of water tariff computed on the own initiative of the concerned communities (Kameelboom and Segokgo) and the process to obtain consensus of community members on the set tariff.

5.3.4 Funding

(1) General

Table 5-10 shows selected financial data of stakeholders responsible for providing retail water supply to FS areas. These institutions are also responsible for securing funding required to finance the cost of bulk and retail infrastructure for the proposed water supply projects. MW is the designated second tier authority (Water Board) currently responsible for bulk water supply to the Klipvoor FS area while eastern DC has responsibility for retail water supply. MW is statutory not-for-profit organisations (also known in South Africa as Section 21 companies) which can borrow short and long-term funds from the capital market or commercial and investment banks. It receives no central government subsidies or loan guarantees. It also has to follow sound business practices and are subject to certain regulatory, labor law, and accounting standards and practices as commercially-driven enterprises.

As section 21 companies, MW is not allowed to make a profit or declare dividends. Net operating income is appropriated to various funds such as a Capital Redemption Fund used for providing redemption of loans for capital expenditure. Other funds include Betterment/Improvement Funds used to finance future capital expenditure and upgrading and Depreciation and Replacement Funds used to replace existing plant and equipment that has become worn-out or obsolete. The programs and activities of MW are guided through a board of directors who are all appointed for a specific duration by the Minister for Water Affairs & Forestry. The role of the Board is to set broad policy guidelines and procedures on the MW's activities, ensures that policies are being interpreted and implemented correctly and reviews major policy areas in order to keep them current. The Board has responsibility for preparing annual financial statements that fairly represent the financial position and the results of the water utilities.

The directors are also responsible for ensuring that the MW's maintains adequate accounting records and systems of internal control. These are designed to provide reasonable assurance as to the reliability of the annual financial statements and to adequately safeguard the utility's assets and detect irregularities. As a pre-requisite, most borrowers in South Africa require that fund applicants have a solid financial track record and be in good financial standing evidenced by a strong balance sheet.

The EDC covering the FS area has only been in existence since 1994 and is primarily responsible for retail water supply in rural areas where the presence of local government does not exist. Because of their recent development, the RDC does not have a strong movable and immovable asset base and do not meet most of the funding criteria required by lending institutions.

Table 5-10 Financial Status of Stakeholders

(Unit: '000R)

Description	1996 Magalies Water	1996 Rand Water	1996 Eastern DC	Bud. 6/77 Highveld DC	1996 Rustenbrg DC	1996 Brits TLC
Revenues/Income						
Bulk water sales	36,227	948,899	22,300	0	14,246	8,682
Levy income	0		16,000	65,132	36,597	
Central/Provincial Govt. transfers/allocations	0					166
Subsidies & grants	0		10,063		670	
Interest on investments					3939	
Other (sundry income, regional function)	611		2,448	2,790	647	146
Total (budgeted) revenues	**36,838**	**948,899**	**50,811**	**67,922**	**56,099**	**8,994**
Less expenses/budget allocations						
Water purchases	5,002	109,369	20,300	0	14,246	256
Lesotho Highlands Water Project Levy		123,591				
Operating costs	13,262	433,059	4,505	6,677	4,261	8,849
Contributions: provisions and reserves	0				28,264	105
Regional function			14,927	29,270		
Contributions/Allocations to: local bodies, capital outlay			6,607	25,659	1,106	104
Other						
Total expenses	**18,264**	**666,019**	**46,339**	**61,606**	**47,877**	**9,314**
Net operating income/surplus	**18,574**	**282,880**	**4,472**	**6,316**	**8,222**	**-320**
Net margin %	50.42%	29.81%	8.80%	9.30%	14.66%	-3.56%
Less:						
Interest and finance charges	8,339	39,241				
Statutory Transfers		130,088				
Betterment Fund		52,298				
Redemption Fund	0	77,790		25		
Annual Appropriations/Net Surplus	**10,235**	**113,551**	**4,472**	**6,291**	**8,222**	**-320**
Appropriation to Funds						
Betterment Fund		51,985				
Reserve Fund		54,566				
Depreciation & Renewals Fund		7,000				
Current assets (cash, inventory, accounts receivable)	22,560	326,264		22,987	20,632	6,625
Current liabilities (accounts payable)	10,893	230,028		21,238	10,239	6,625
Net current assets (working capital)	**11,667**	**96,236**	**0**	**1,749**	**10,393**	**0**
Fixed assets	194,912	2,301,850		2,735	113	16,765
Investments	69,139	35,560		22,987	24,000	11,027
Other assets	16,162	0			167	
Total	**280,213**	**2,337,410**	**0**	**25,722**	**24,280**	**27,792**
Total assets	**302,773**	**2,663,674**	**0**	**48,709**	**44,912**	**34,417**
Long-term debt (loans, long-term commitments)	184,670	900,205		2,735	113	16,765
Reserves and provisions	44,444			22,094	34,560	9,335
Capital contributions	62,766	73,700		0		
Accumulated Funds	0	1,459,741		2,642		1,692
Total	**291,880**	**2,433,646**	**0**	**27,471**	**34,673**	**27,792**
Total liabilities	**302,773**	**2,663,674**	**0**	**48,709**	**44,912**	**34,417**

Source: RW 1996 Annual Report; MW 1996 Annual Report; Eastern DC, Highveld DC; Rustenberg DC, Brits TLC

Unlike MW, they do not have direct sources of revenue since a substantial percentage of their income is derived from levies (taxes), subsidies and grants. Personnel is typically the largest single item of local government expenditures and the ability of local authorities to recruit, train, and motivate staff is critical to its ability to provide retail water delivery services efficiently.

Under the Green Paper on Local Government published October 1997, local authorities (such as DC's, TRCs, and TLCs) are responsible for delivery of retail water and sewage services to end users/consumers. Loan financing by local authorities for water supply infrastructure has several desirable attributes. Firstly, it depoliticizes the allocation process on the basis of the user's willingness to incur debt. Secondly, lending also forces potential beneficiaries to reveal their degree of commitment to the project. The private market's demonstrated interest in South Africa in lending to local authorities without any implicit or explicit subsidies is extremely limited. Long-term financial commitment of any kind to local authorities is viewed as extremely risky because, as political entities local authorities lack readily marketable collateral and is typically viewed as unattractive to private capital. Local authorities are unable to attract private capital on market terms or obtain the assistance of central government.

(2) Financial Viability and Possible Funding Source

(a) 1st Tier (DWAF)

DWAF is currently implementing water projects under RDP Programmes 1, 2 and 3 of which main features are summarised in Table 5-11.

Table 5-11 RDP Budget Allocation

RDP Number	Target Population	Numbers of Projects	Estimated Cost (Millions)	Remarks
1	978,000	12	282	The projects are completed or nearing completion
2	2,765,000	328	629	Projects have been started under this programme
3	2,664,000	345	950	Projects have been started under this programme

From the above table, unit project cost varies from R1.92 million in RDP 3 to R23.5 million in RDP 1. Following to the above, RDP Programme 4 is planned and budgeted amounting to R1.3 billion including R0.3 billion of RDP 2 and 3 cost overruns. Except the cost overrun, the budget allocated new RDP 4 Programmes will be disbursed over 4 years from 1997/98 to 2000/01.

Under the RDP 4, total of R639 million has been allocated for new water projects in which KwaNdebel (Project No. 4101) receives the highest budget for single project, amounting to R28.9 million. In this context, the required capital cost for the Level A services in the Klipvoor FS area, about R187 million is comparatively high, therefore, it is prerequisite for DWAF to secure external loan funding to implement the proposed project in due course.

(b) 2nd Tier (MW)

MW was established September 1983 through a name change of the Vaalkop Water Board, established January 1970. It has a strong balance sheet and a solid financial track record evidenced by a current ratio (CR) of 2.1; return on capital (ROC) of 9.5%; and a current asset base of over R300 million. Its working ratio (i.e. the ratio of operating costs to operating revenues, excluding depreciation and interest payments) is about 0.37. Sound financial management for water and wastewater utilities requires that this ratio be well below 1. Water sales during 1996 amounted to R36.2 million of which direct operating expenses were R18.3 million resulting in a net margin of 50.4%. MW has two funds into which net operating income is appropriated:

- Fund for Reserves and Provisions	R44.4 million
- Capital Contribution	R62.8 million
Total	R107.2 million

Of the R184.7 million in long-term loans, R107.2 million (58%) has been appropriated. The remaining amount is collected through tariffs from industrial consumers and appropriated to the two Funds. As of February 29, 1996 MW had a total outstanding debt of R95.8 million, most of which represents MW stock. Its interest coverage ratio, which reveals the number of times interest is covered by operating income in 1996, is 2.2 indicating that MW is able to meet its interest obligations with room to spare. The strongest asset and reliable consumer base of MW is another demonstration of a financially well positioned utility which meets practically all the necessary funding criteria required by financial institutions.

(c) 3rd Tier (EDC)

As can be seen from Table 5-10, Eastern DC is the weakest of the three institutional It has no assets and no customer base, which are major pre-requisites of lending institutional. EDC is also not directly engaged in retail water delivery service and receives 51% of its income in levies, grants and subsidies, a situation whish is unsustainable in the long term.

It is proposed that the portion of the tariff over and above the O&M component be transferred to a reserve fund and invested with reasonable and safe return on investment over the five year

period for operating at Service Level A. At a flat rate of R39.0/month, 85% (R33.00) of the tariff could be transferred to the reserve fund. The goal is to accumulate 63% of the R52.3 million (at 1997 price) required to upgrade the system from Service Level A to Service Level B. It is anticipated that 63% of the capital cost for upgrading from Level A to B will be available from the reserve fund after five years. It is also hoped that the financial position of the Services Provider would have greatly improved after the five-year period so that loan funding will be possible, when the reserved fund will be kept and accumulated in a certain bank account who will become a possible lending institution to the service provider (JV of MW and EDC).

The possibility of obtaining funding in the form of soft loans or grants is extremely limited due to the current policy of DWAF of not obtaining loans, grants or guaranteeing loans on behalf of local authorities. This limits the funding sources to primarily DBSA, Commercial Banks (including special infrastructure and developments funds), and Merchant Banks (e.g. public finance departments) who would lend at commercial interest rates.

CHAPTER 6

INSTITUTIONAL DEVELOPMENT

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