ANNEX

ANNEX A

ENGINEERING

FEASIBILITY STUDY FOR NORTH MANKWE

ANNEX A: ENGINEERING

A.1.1 ASSUMPTIONS FOR PLANNING OF INFRASTRUCTURE

The following technical assumptions have been made in the planning of water supply infrastructure in this Feasibility Study.

1. Clear Water Pumping Stations

- At least 50 % standby equipment is provided.
- Number of pumps comprises two sets on duty and one set for standby.

2. Bulk and Distribution Pipeline

Flow rate and peak factors

	Flow rate
Bulk water delivery supply line to bulk reservoir which supplies a service reservoir	1.5 AADD
Bulk water delivery supply line to service reservoir which supplies a distribution network	1.5 AADD
Bulk water delivery supply line to distribution network	4.5 AADD

AADD : Annual Average Daily Demand

Type of pipe to use

Diameter range (mm)	Internal Pressure	Type of pipe
<= 400	<=1600 kPa	uPVC, Steel (API 5L Grade B), FC
<= 400	> 1600 kPa	Steel (API 5L Grade B)
> 400	<7000 kPa	Steel (API 5L Grade B)

Pipelines which will be subjected to a pressure more than 9 kg/cm2 is planned as steel; and pipelines less than 9 kg/cm2 is planned as uPVC.

3. Reservoirs

Service Reservoir

Water Source	Bulk Storage Provision	Service Reservoir Storage requirement
From Magalies Water direct by gravity or pumped to service reservoir		
by gravity to service reservoir	-	24 h
pumped to service reservoir	-	48 h
From Bulk Reservoir of Magalies water	24 h	
by gravity to service reservoir		24 h
pumped to service reservoir		48 h

Note : in hours of Annual Average Daily Demand

Reservoir Construction : Material

Type of storage	Capacity	Material
Elevated Service Reservoir	0 - 0.5 Ml	Pressed Steel
Ground Regional Reservoir	0.5 Ml and Larger	Concrete

4. Reticulation

Residual Pressures

Type of connections	Minimum design pressures	
	For connections	For services mix
House connections	12 m	12 m
Yard taps	10 m	
Street taps*	5 m	

* : 10 l/min of water flow from each tap should be secured

Pipe Selections for Reticulations

Pipe Diameter	Pipe material and Class
63 dia up to 250 dia	uPVC class 9 with push-fit couplings or z-lock

Sizing of Reticulation

In order to cost the proposed infrastructure it is necessary to estimate the length of pipework and hence the cost of the reticulation in each community. With a total of 76 communities in the three Feasibility Study areas it is neither practicable nor necessary to design the reticulation in each community in detail during the feasibility

study. Therefore a methodology was developed for estimating the length of pipework and number of standpipes required.

Initially the reticulation required in each pilot project community was considered however this sample was not sufficiently representative of the entire Study Area so instead the communities in Klipvoor West were considered (a total of 6 excluding Ga Rasai). The average area of these communities is 224 ha and they include a range of different sizes of settlement so the sample is representative of the communities in the feasibility study areas. When designing RDP level reticulation systems, it is normal practise in South Africa to allow for future upgrading by designing for the higher demand but then omitting some of the pipes for the RDP case. This obviates relaying pipes with a slightly larger size when demand increases.

For each of the six communities mentioned above the reticulation system was designed in detail using the 1:10,000 scale Orthophotos for Level B and then some of the pipes were removed to represent the Level A scenario. The data obtained from this exercise was then used to investigate the correlation between various parameters. Pipe length was tested against population, population density and area and unit length (metres of pipework per capita) was tested against the same parameters; population, population density and area. It was found for both Level A and B that pipe length versus area gave the best correlation. The relationships that were established are as follows:

Level A - $y = 36.657 x + 4473.8$

Level B - $y = 25.77 x + 155.24$

where y is the total pipe length and x is the area of service (this is determined from the orthophotos and constitutes approximately 90 or 95% of the households in a given community i.e. those which are still sufficiently dense to warrant an RDP level standpipe system)

From the six communities for which the reticulation was designed in detail, a good correlation was found for Level A between the area of supply and the number of standpipes. The relationship is as follows:

$$y = 0.0453 x + 2.6399$$

where y is the number of standpipes and x is the area of supply.

For Level B, there are still 10% of households which will remain on standpipes. It is assumed that these will be those households on the periphery of the communities where the cost of upgrading will be highest. By investigating the six typical communities in Klipvoor West it was found that the average number of standpipes per community for Level A is 13 while the average number required for Level B is still 10. This proportion was used for all of the communities.

Having established the total length of pipework required to reticulate a community to each level of service, it is still necessary to determine the breakdown for each pipe size. To do this a standard reticulation design was prepared for Level B for a fictional community. The layout corresponded with the average area of the 35 communities in the Klipvoor Area and the total length of pipework corresponded to the average length for the Klipvoor Area. Each component of the network was sized for the average summer peak daily demand which gave the proportion of each size for a typical system. As the pipe sizes for Level A tend to be of larger diameter than the additional pipes added for Level B, and as the actual size is dependant on the diameter of the incoming pipeline from the service reservoir, a range of incoming sizes was considered and a series of variations from the typical case were determined to allow for variations in this key parameter.

For Level A it was assumed that all pipes of 125 mm diameter and above from the Level B design will also be necessary for Level A. For pipes smaller than 125 mm diameter, the standard design amended for Level A was used to derive the distribution in pipe sizes.

To derive the number of yard connections, 90% of households are assumed to require yard connections as is assumed for the Level B service level. For Level A, no yard connection are included.

From the above methodology it is possible to determine the length of pipework of each size and the number of yard connections and standpipes in each community given the area to be supplied and the diameter of the incoming pipeline.

FigureA.1-1 CORRELATION OF AREA AND RETICULATION PIPE LENGTH

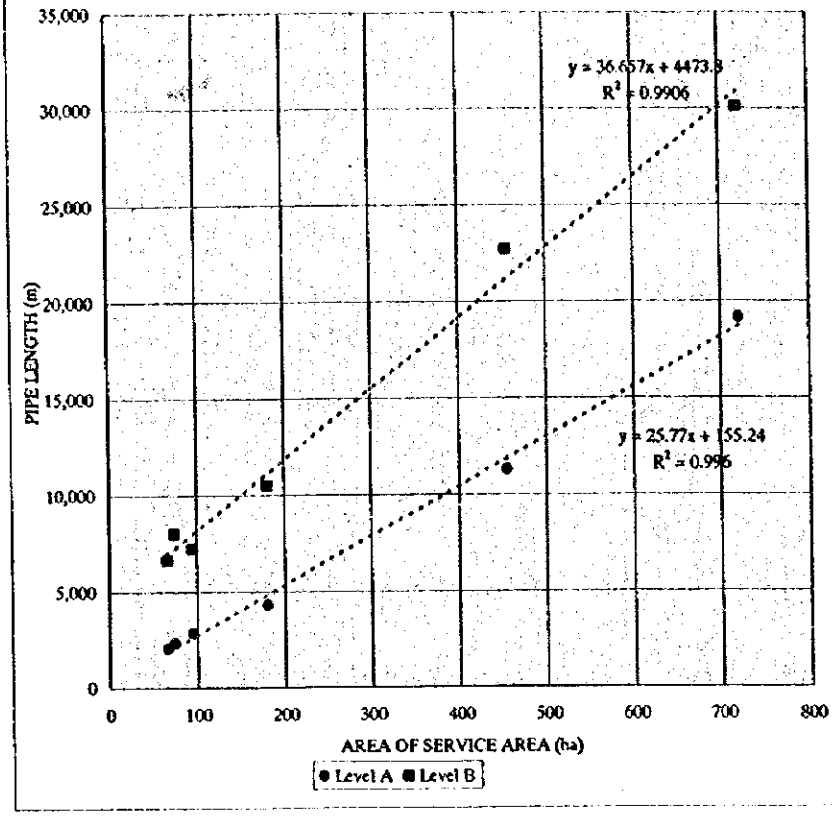
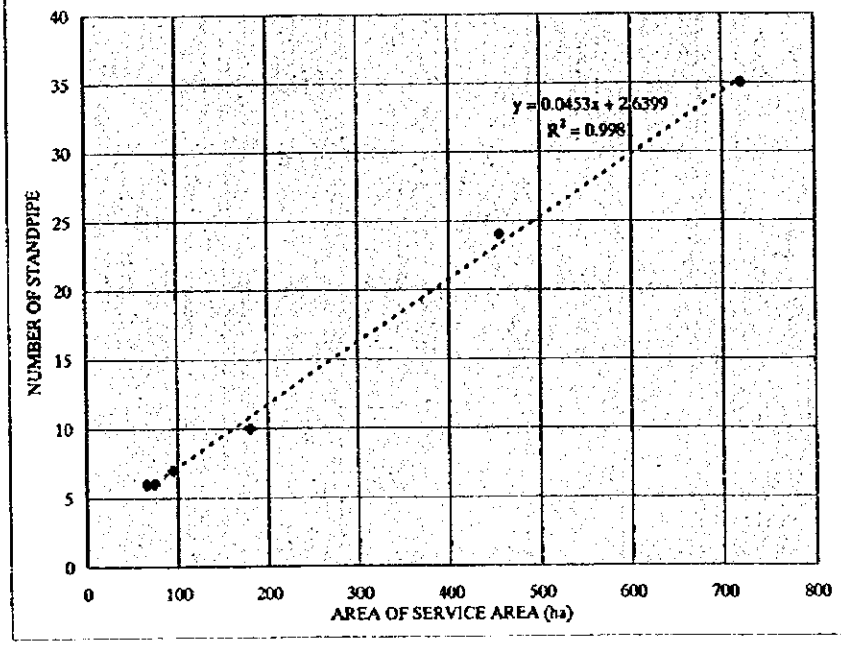


Figure A.1-2 CORRELATION OF AREA AND NUMBER OF STANDPIPE



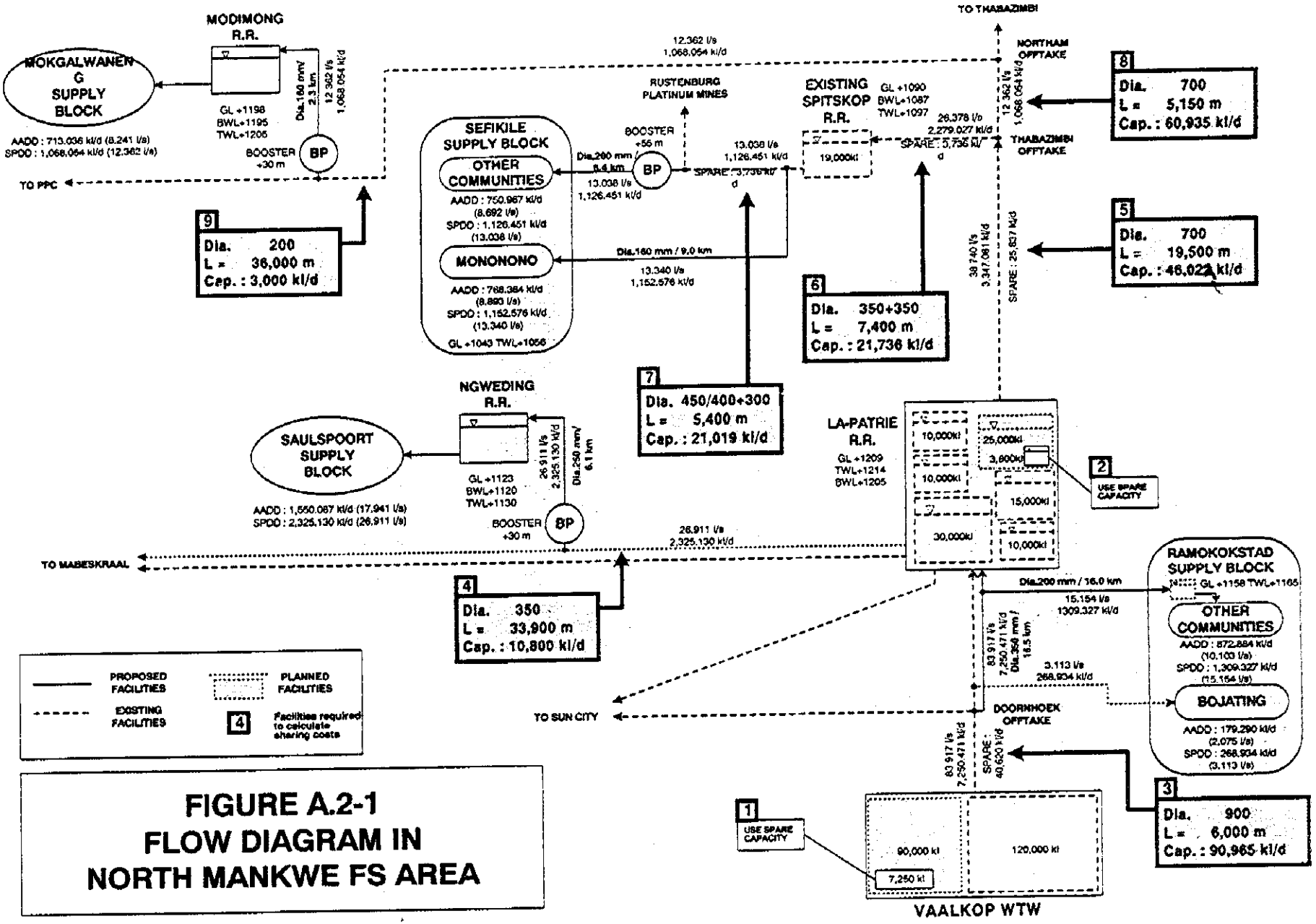


FIGURE A.2-1
FLOW DIAGRAM IN NORTH MANKWE FS AREA

FIGURE A.2-2 FLOW DIAGRAM IN MOKGALWANENG SUPPLY BLOCK

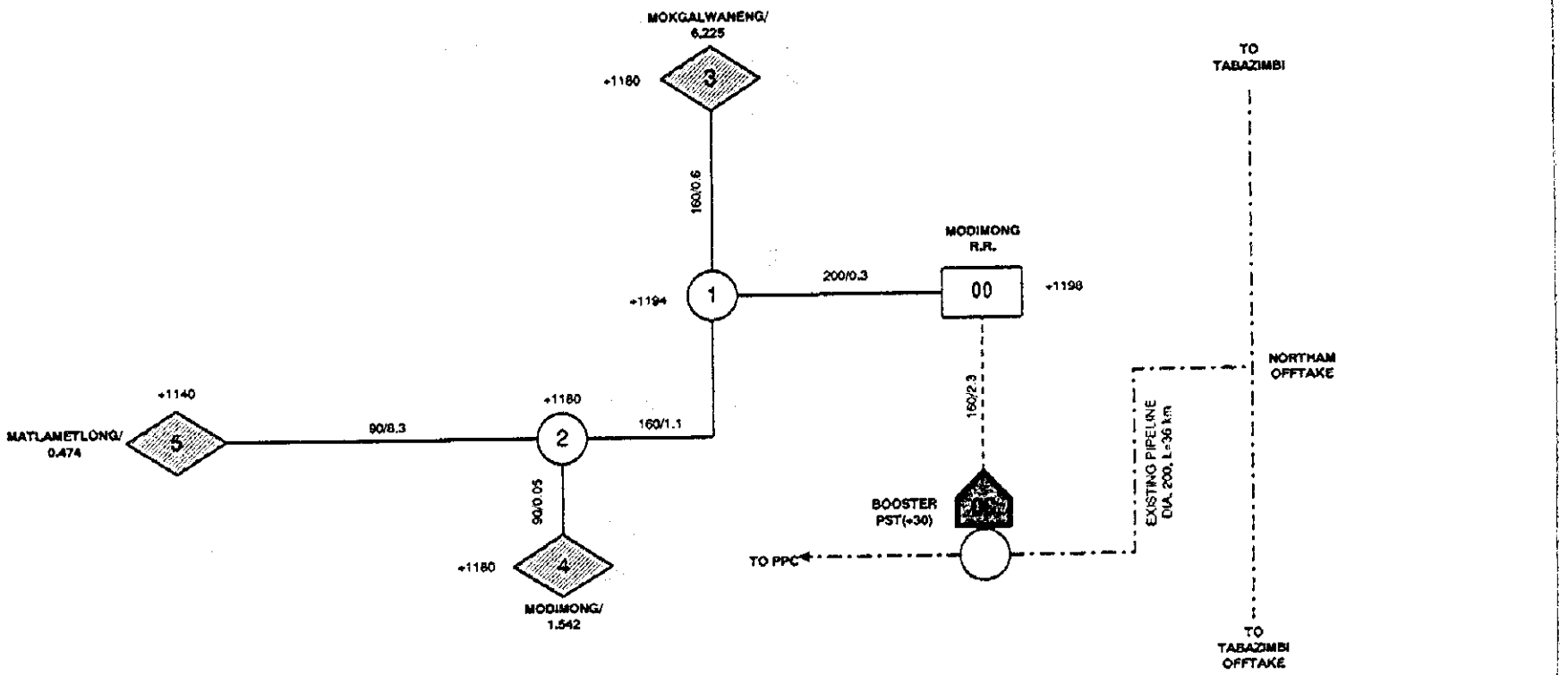


FIGURE A.2-3 FLOW DIAGRAM IN RAMOKOKSTAD SUPPLY BLOCK

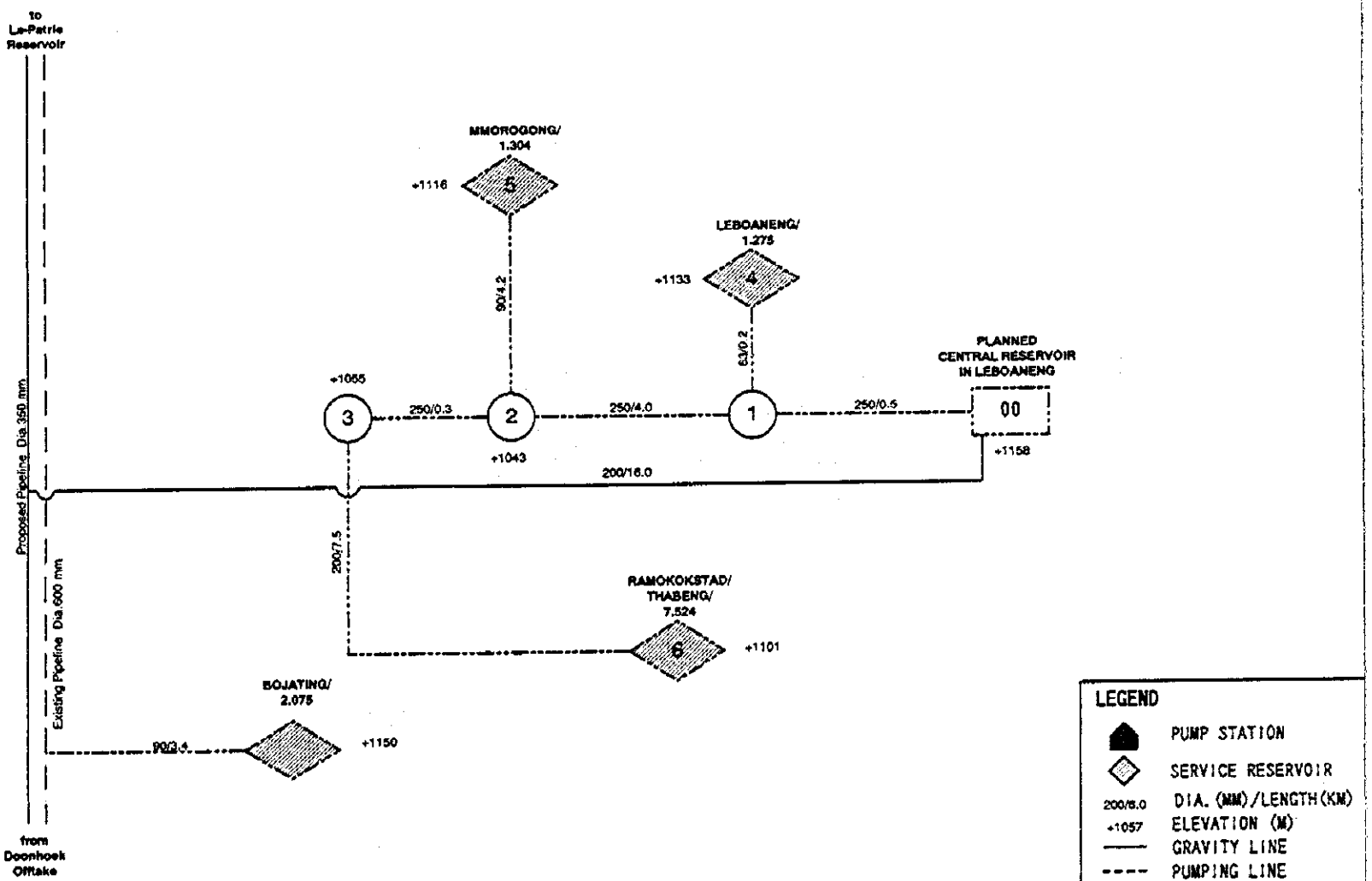


FIGURE A.2-4 FLOW DIAGRAM IN SAULSPOORT SUPPLY BLOCK

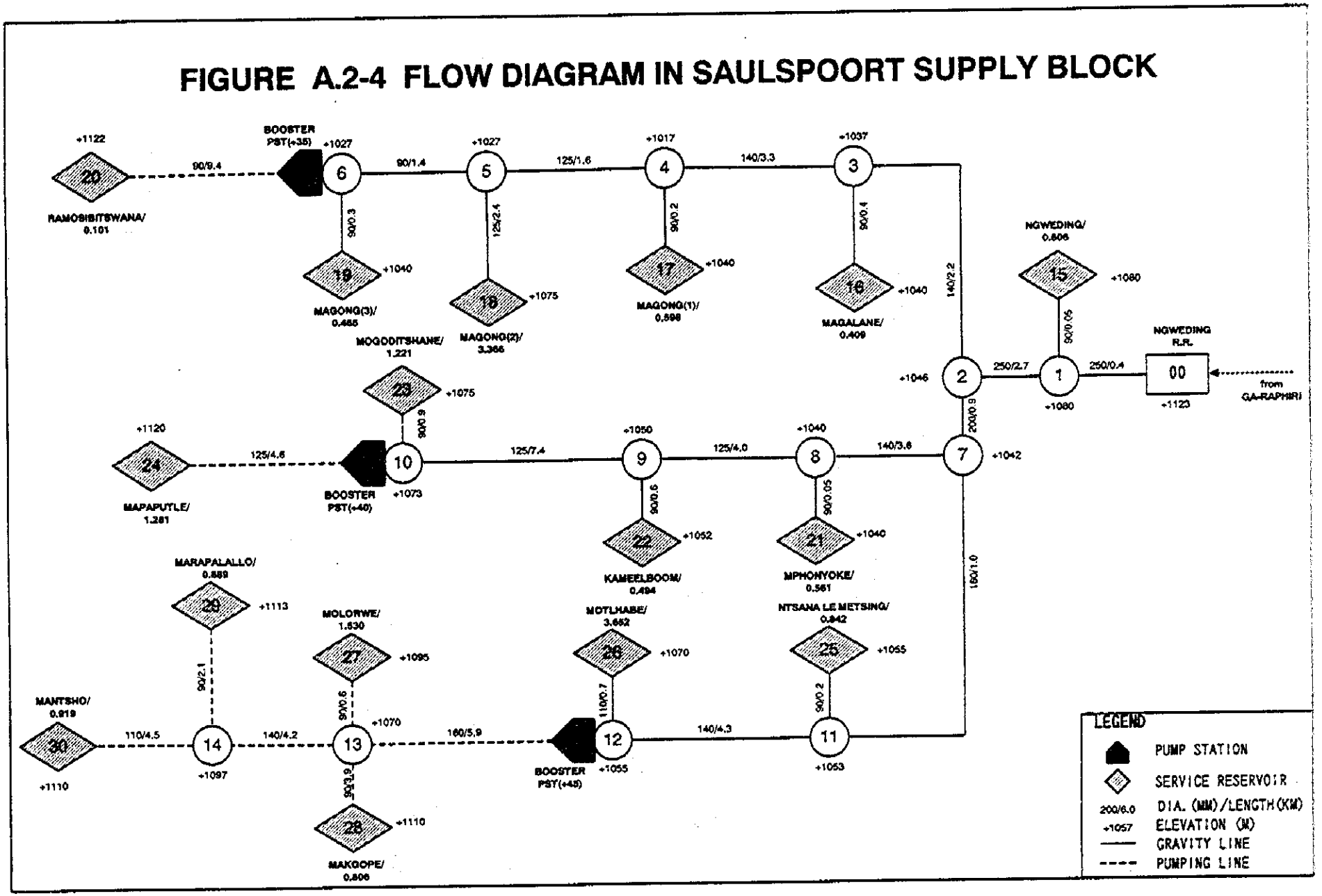


FIGURE A.2-4 FLOW DIAGRAM IN SAULSPOORT SUPPLY BLOCK

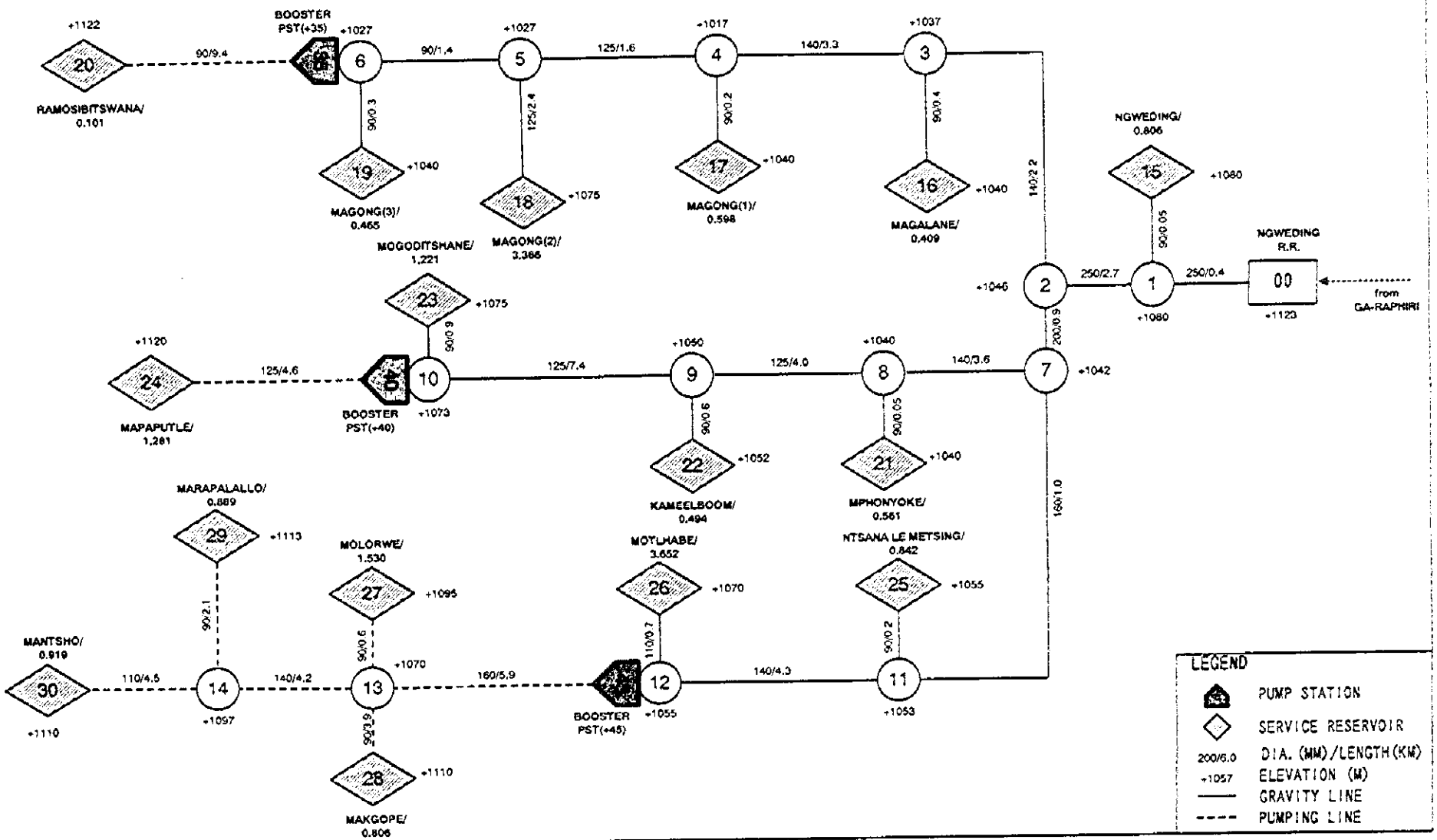


FIGURE A.2-5 FLOW DIAGRAM IN SEFIKILE SUPPLY BLOCK

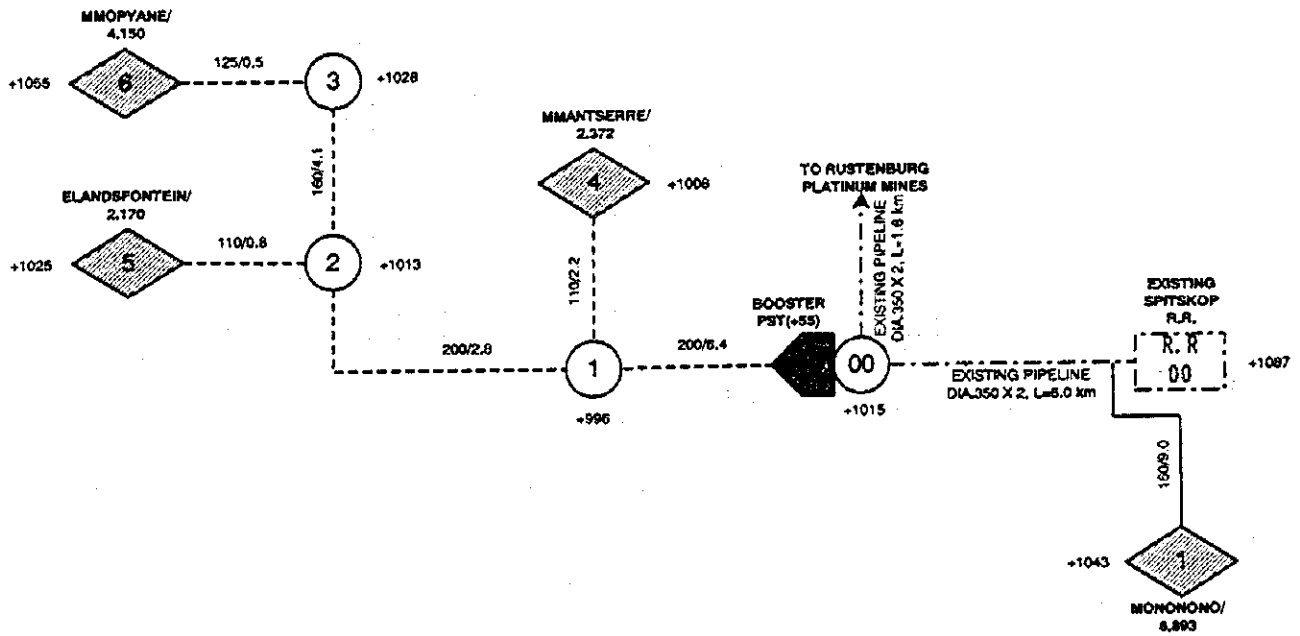


FIGURE A.2-5 FLOW DIAGRAM IN SEFIKILE SUPPLY BLOCK

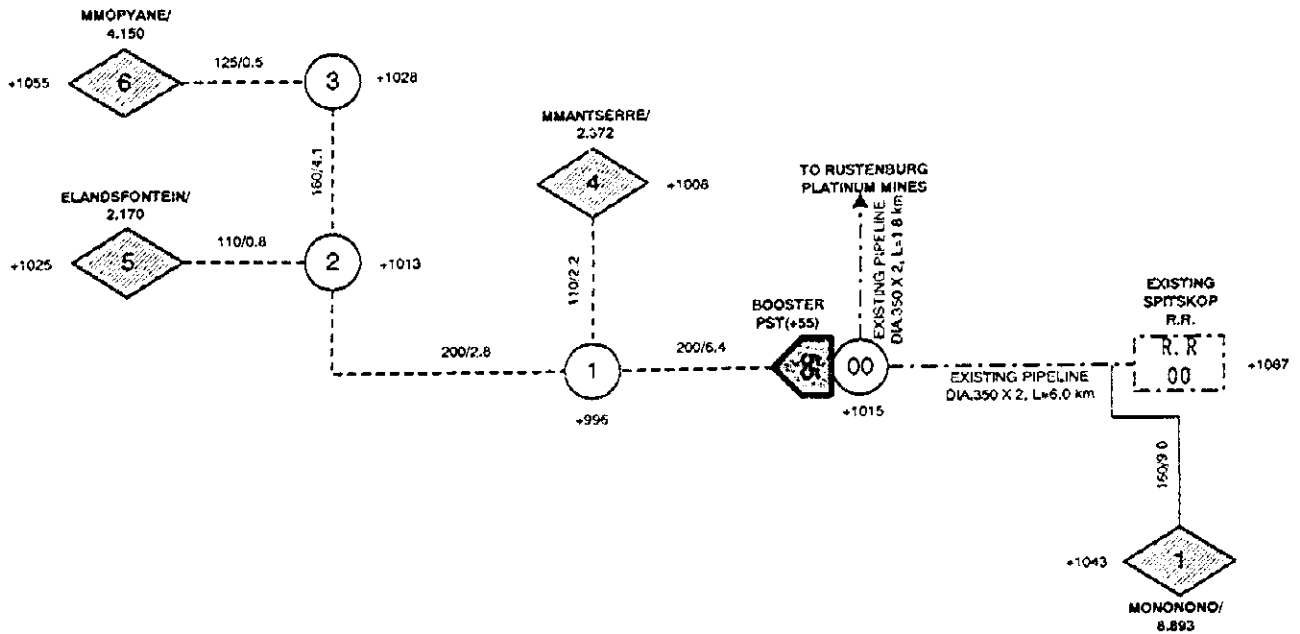


TABLE A.3-1 SUMMARY OF RESERVOIRS

Reservoirs	Capacity Required		Height	Existing/Planned	Reservoir for Level A					Reservoir for Level B					
	Level B (m3)	Level A (m3)	G=Ground (m)	Capacity (m3)	Addition (m3)	Capacity (m3)	Number (nos)	Unit Cost (x1,000 R)	Cost (x1,000 R)	Addition (m3)	Capacity (m3)	Number (nos)	Unit Cost (x1,000 R)	Add. Cost (x1,000 R)	Total Cost (x1,000 R)
Mokgalwaneng Supply Block															
Regional Reservoir	*712*	*267*	*G*	*0*	*267*	*270*	*1*	*230*	*230*	*442*	*500*	*1*	*320*	*320*	*550*
Modimong	712	267	G		267	270	1	230	230	442	500	1	320	320	550
Service Reservoir	*712*	*267*		*267*	*0*	*0*	*0*	*0*	*0*	*445*	*450*	*3*	*385*	*385*	*385*
Matlametlong	41	15	10	15	0	0	0		0	26	30	1	60	60	60
Mokgalwaneng	538	202	10	202	0	0	0		0	336	330	1	220	220	220
Modimong	133	50	10	50	0	0	0		0	83	90	1	105	105	105
Sefikile Supply Block															
Regional Reservoir	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
N.A.		0			0				0	0				0	0
Service Reservoir	*2,270*	*852*		*288*	*564*	*580*	*3*	*505*	*505*	*1,402*	*1410*	*4*	*895*	*895*	*1,400*
Mmantserre	410	154	15		154	160	1	175	175	250	250	1	190	190	365
Elandsfontein	375	141	10		141	150	1	140	140	225	230	1	180	180	320
Mmopyane	717	269	10		269	270	1	190	190	447	450	1	260	260	450
Mononono	768	288	10	288	0	0	0		0	480	480	1	265	265	265
Ramokokstad Supply Block															
La-Patrie Reservoir (Share)									420						1,064
Regional Reservoir	*873*	*327*	*G*	*542*	*0*	*0*	*0*	*0*	*0*	*331*	*400*	*1*	*300*	*300*	*300*
Central (Planned)	873	327	G	542	0		0		0	331	400	1	300	300	300
Service Reservoir	*1,232*	*462*		*617*	*3*	*0*	*0*	*0*	*0*	*615*	*630*	*4*	*530*	*530*	*530*
Bojating	359	135	10	281	0	0	0	0	0	78	80	1	95	95	95
Ramokokstad/Thabeng	650	244	10	256	0	0	0	0	0	394	400	1	250	250	250
Mmorogong	113	42	10	40	2	0	0	0	0	73	80	1	95	95	95
Leboaneng	110	41	10	40	1	0	0	0	0	70	70	1	90	90	90
Soutpoort Supply Block															
Regional Reservoir	*1,550*	*581*	*G*	*0*	*581*	*600*	*1*	*350*	*350*	*950*	*1000*	*1*	*520*	*520*	*870*
Ngweding	1,550	581	G		581	600	1	350	350	950	1000	1	520	520	870
Service Reservoir	*2,029*	*761*		*345*	*492*	*520*	*10*	*780*	*780*	*1,164*	*1220*	*13*	*1400*	*1,400*	*2,180*
Ngweding	70	26	10		26	30	1	60	60	40	40	1	70	70	130
Mugalane	35	13	10		13	20	1	50	50	15	20	1	50	50	100
Magong (1)	52	20	10		20	20	1	50	50	32	40	1	70	70	120
Magong (2)	291	109	15		109	110	1	135	135	181	190	1	205	205	340
Magong (3)	40	15	10		15	20	1	50	50	20	20	1	50	50	100
Ramosibitswana	17	6	10	24	0	0	0		0	-7	0	0		0	0
Mphonyoke	49	18	15	48	0	0	0		0	1	0	0		0	0
Kameelboom	43	16	15	44	0	0	0		0	-1	0	0		0	0
Mogoditshane	106	40	15		40	40	1	70	70	66	70	1	110	110	180
Mapaputle	221	83	10	83	0	0	0		0	138	140	1	135	135	135
Ntsana Le Metsing	73	27	10	27	0	0	0		0	46	50	1	75	75	75
Motlhabe	316	119	10	119	0	0	0		0	197	200	1	170	170	170
Molorwe	264	99	10		99	100	1	110	110	164	170	1	150	150	260
Marapalallo	154	58	10		58	60	1	85	85	94	100	1	110	110	195
Mantsho	159	60	10		60	60	1	85	85	99	100	1	110	110	195
Makgope	139	52	10		52	60	1	85	85	79	80	1	95	95	180

Total of Regional Reservoir	3,135	1,175		542	848	870	2	580	1,000	1,723	1,900	3	1,140	1,140	2,784
Total of Service Reservoir	6,243	2,342		1,517	1,059	1,100	13	1,285	1,285	3,626	3,710	24	3,210	3,210	4,495
Total	9,378	3,517		2,059	1,907	1,970	15	1,865	2,285	5,349	5,610	27	4,350	4,350	7,279

TABLE A.3-1 SUMMARY OF RESERVOIRS

Reservoirs	Capacity Required Level B (m3)	Capacity Required Level A (m3)	Height G=Ground (m)	Existing/Planned Capacity (m3)	Reservoir for Level A Addition (m3)	Reservoir for Level A Capacity (m3)	Reservoir for Level A Number (nos)	Reservoir for Level A Unit Cost (x1,000 R)	Reservoir for Level A Cost (x1,000 R)	Reservoir for Level B Addition (m3)	Reservoir for Level B Capacity (m3)	Reservoir for Level B Number (nos)	Reservoir for Level B Unit Cost (x1,000 R)	Reservoir for Level B Add. Cost (x1,000 R)	Reservoir for Level B Total Cost (x1,000 R)
Mokgalwaneng Supply Block															
Regional Reservoir	*712*	*267*	*G*	*0*	*267*	*270*	*1*	*230*	*230*	*442*	*500*	*1*	*320*	*320*	*550*
Modimong	712	267	G		267	270	1	230	230	442	500	1	320	320	550
Service Reservoir	*712*	*267*		*267*	*0*	*0*	*0*	*0*	*0*	*445*	*450*	*3*	*385*	*385*	*385*
Matlametlong	41	15	10	15	0	0	0		0	26	30	1	60	60	60
Mokgalwaneng	538	202	10	202	0	0	0		0	336	330	1	220	220	220
Modimong	133	50	10	50	0	0	0		0	83	90	1	105	105	105
Sefikile Supply Block															
Regional Reservoir	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
N.A.		0			0				0	0				0	0
Service Reservoir	*2,270*	*852*		*288*	*564*	*580*	*3*	*505*	*505*	*1,402*	*1410*	*4*	*895*	*895*	*1,400*
Mmantserre	410	154	15		154	160	1	175	175	250	250	1	190	190	365
Elandsfontein	375	141	10		141	150	1	140	140	225	230	1	180	180	320
Mmopyane	717	269	10		269	270	1	190	190	447	450	1	260	260	450
Mononono	768	288	10	288	0	0	0		0	480	480	1	265	265	265
Ramokokstad Supply Block															
La-Patrie Reservoir (Share)									420						1,064
Regional Reservoir	*873*	*327*	*G*	*542*	*0*	*0*	*0*	*0*	*0*	*331*	*400*	*1*	*300*	*300*	*300*
Central (Planned)	873	327	G	542	0	0			0	331	400	1	300	300	300
Service Reservoir	*1,232*	*462*		*617*	*3*	*0*	*0*	*0*	*0*	*615*	*630*	*4*	*530*	*530*	*530*
Bojating	359	135	10	281	0	0	0	0	0	78	80	1	95	95	95
Ramokokstad/Thabeng	650	244	10	256	0	0	0	0	0	394	400	1	250	250	250
Mmorogong	113	42	10	40	2	0	0	0	0	73	80	1	95	95	95
Leboaneng	110	41	10	40	1	0	0	0	0	70	70	1	90	90	90
Saulspoort Supply Block															
Regional Reservoir	*1,550*	*581*	*G*	*0*	*581*	*600*	*1*	*350*	*350*	*950*	*1000*	*1*	*520*	*520*	*870*
Ngweding	1,550	581	G		581	600	1	350	350	950	1000	1	520	520	870
Service Reservoir	*2,029*	*761*		*345*	*492*	*520*	*10*	*780*	*780*	*1,164*	*1220*	*13*	*1400*	*1,400*	*2,180*
Ngweding	70	26	10		26	30	1	60	60	40	40	1	70	70	130
Magalane	35	13	10		13	20	1	50	50	15	20	1	50	50	100
Magong (1)	52	20	10		20	20	1	50	50	32	40	1	70	70	120
Magong (2)	291	109	15		109	110	1	135	135	181	190	1	205	205	340
Magong (3)	40	15	10		15	20	1	50	50	20	20	1	50	50	100
Ramosibitswana	17	6	10	24	0	0	0		0	-7	0	0		0	0
Mphonyoke	49	18	15	48	0	0	0		0	1	0	0		0	0
Kameelboom	43	16	15	44	0	0	0		0	-1	0	0		0	0
Mogoditshane	106	40	15		40	40	1	70	70	66	70	1	110	110	180
Mapaputle	221	83	10	83	0	0	0		0	138	140	1	135	135	135
Ntsana Le Metsing	73	27	10	27	0	0	0		0	46	50	1	75	75	75
Motlhabe	316	119	10	119	0	0	0		0	197	200	1	170	170	170
Molorwe	264	99	10		99	100	1	110	110	164	170	1	150	150	260
Marapalallo	154	58	10		58	60	1	85	85	94	100	1	110	110	195
Mantsho	159	60	10		60	60	1	85	85	99	100	1	110	110	195
Makeope	139	52	10		52	60	1	85	85	79	80	1	95	95	180
Total of Regional Reservoir	3,135	1,175		542	848	870	2	580	1,000	1,723	1,900	3	1,140	1,140	2,784
Total of Service Reservoir	6,243	2,342		1,517	1,059	1,100	13	1,285	1,285	3,626	3,710	24	3,210	3,210	4,495
Total	9,378	3,517		2,059	1,907	1,970	15	1,865	2,285	5,349	5,610	27	4,350	4,350	7,279

TABLE A.3-2 SUMMARY OF BULK SUPPLY PIPELINES (*Total 2 Sheets*)

BULK SUPPLY PIPELINE	UNIT	LENGTH	UNIT COST x 1000 R	TOTAL COST x 1000 R
Mokgalwaneng Supply Block				
Thabazimbi Offtake to Northam Offtake				
Sharing MW Pipeline : Sharing Cost	m		N.A.	74
Northam Offtake to Modimong Offtake				
Sharing MW Pipeline : Sharing Cost	m		N.A.	2,871
Modimong Offtake to Modimong Regional Reservoir				
160 mm Dia. Steel incl. materials and construction	m	2,300	0.170	391
Sub-Total		2,300		3,336
AFTER MODIMONG REGIONAL RESERVOIR				
400 mm Dia. Steel incl. materials and construction	m		0.495	0
350 mm Dia. Steel incl. materials and construction	m		0.428	0
300 mm Dia. Steel incl. materials and construction	m		0.360	0
250 mm Dia. Steel incl. materials and construction	m		0.292	0
250 mm Dia. uPVC incl. materials and construction	m		0.220	0
200 mm Dia. Steel incl. materials and construction	m		0.224	0
200 mm Dia. uPVC incl. materials and construction	m	300	0.166	50
160 mm Dia. Steel incl. materials and construction	m		0.170	0
160 mm Dia. uPVC incl. materials and construction	m	1,700	0.120	204
140 mm Dia. Steel incl. materials and construction	m		0.143	0
140 mm Dia. uPVC incl. materials and construction	m		0.108	0
125 mm Dia. Steel incl. materials and construction	m		0.123	0
125 mm Dia. uPVC incl. materials and construction	m		0.086	0
110 mm Dia. Steel incl. materials and construction	m		0.102	0
110 mm Dia. uPVC incl. materials and construction	m		0.082	0
90 mm Dia. Steel incl. materials and construction	m		0.075	0
90 mm Dia. uPVC incl. materials and construction	m	8,350	0.066	551
Sub-Total		10,350		805
Sub-Total of Mokgalwaneng Supply Block		***12,650***		***4,141***
Sefikile Supply Block				
La-Patrie Reservoir to Thabazimbi Offtake				
Sharing MW Pipeline : Sharing Cost	m		N.A.	1,169
Thabazimbi Offtake to Spitskop Reservoir				
Sharing MW Pipeline : Sharing Cost	m		N.A.	664
Spitskop Reservoir to RPM Offtake				
Sharing MW Pipeline : Sharing Cost	m		N.A.	253
Sub-Total		0		2,086
AFTER RPM OFFTAKE AND TO MONONONO				
400 mm Dia. Steel incl. materials and construction	m		0.495	0
350 mm Dia. Steel incl. materials and construction	m		0.428	0
300 mm Dia. Steel incl. materials and construction	m		0.360	0
250 mm Dia. Steel incl. materials and construction	m		0.292	0
250 mm Dia. uPVC incl. materials and construction	m		0.220	0
200 mm Dia. Steel incl. materials and construction	m	9,200	0.224	2,061
200 mm Dia. uPVC incl. materials and construction	m		0.166	0
160 mm Dia. Steel incl. materials and construction	m	4,100	0.170	697
160 mm Dia. uPVC incl. materials and construction	m	9,000	0.120	1,080
140 mm Dia. Steel incl. materials and construction	m		0.143	0
140 mm Dia. uPVC incl. materials and construction	m		0.108	0
125 mm Dia. Steel incl. materials and construction	m	500	0.123	62
125 mm Dia. uPVC incl. materials and construction	m		0.086	0
110 mm Dia. Steel incl. materials and construction	m	3,000	0.102	306
110 mm Dia. uPVC incl. materials and construction	m		0.082	0
90 mm Dia. Steel incl. materials and construction	m		0.075	0
90 mm Dia. uPVC incl. materials and construction	m		0.066	0
Sub-Total		25,800		4,205
Sub-Total of Sefikile Supply Block		***25,800***		***6,291***

TABLE A.3-2 SUMMARY OF BULK SUPPLY PIPELINES (*Total 2 Sheets*)

BULK SUPPLY PIPELINE	UNIT	LENGTH	UNIT COST x 1000 R	TOTAL COST x 1000 R
Ramokokstad Supply Block				
Vaalkop WTW to Doornhoek Offtake				
Sharing MW Pipeline : Sharing Cost	m		N.A.	513
Doornhoek Offtake to La-Patrie Reservoir				
350 mm Dia. Steel incl. materials and construction	m	16,500	0.428	7,062
Sub-Total		16,500		7,575
AFTER OFF-TAKE POINT				
400 mm Dia. Steel incl. materials and construction	m		0.495	0
350 mm Dia. Steel incl. materials and construction	m		0.428	0
300 mm Dia. Steel incl. materials and construction	m		0.360	0
250 mm Dia. Steel incl. materials and construction	m		0.292	0
250 mm Dia. uPVC incl. materials and construction	m		0.220	0
200 mm Dia. Steel incl. materials and construction	m	16,000	0.224	3,584
200 mm Dia. uPVC incl. materials and construction	m		0.166	0
160 mm Dia. Steel incl. materials and construction	m		0.170	0
160 mm Dia. uPVC incl. materials and construction	m		0.120	0
140 mm Dia. Steel incl. materials and construction	m		0.143	0
140 mm Dia. uPVC incl. materials and construction	m		0.108	0
125 mm Dia. Steel incl. materials and construction	m		0.123	0
125 mm Dia. uPVC incl. materials and construction	m		0.086	0
110 mm Dia. Steel incl. materials and construction	m		0.102	0
110 mm Dia. uPVC incl. materials and construction	m		0.082	0
90 mm Dia. Steel incl. materials and construction	m		0.075	0
90 mm Dia. uPVC incl. materials and construction	m		0.066	0
Sub-Total		16,000		3,584
Sub-Total of Ramokokstad Supply Block		***32,500***		***11,159***
Saulspoort Supply Block				
La-Patrie Reservoir to Ngweding Offtake				
Sharing MW Pipeline : Sharing Cost	m		N.A.	3,124
Ngweding Offtake to Ngweding Regional Reservoir				
250 mm Dia. Steel incl. materials and construction	m	6,100	0.292	1,781
Sub-Total		6,100		4,905
AFTER NGWEDING REGIONAL RESERVOIR				
400 mm Dia. Steel incl. materials and construction	m		0.495	0
350 mm Dia. Steel incl. materials and construction	m		0.428	0
300 mm Dia. Steel incl. materials and construction	m		0.360	0
250 mm Dia. Steel incl. materials and construction	m		0.292	0
250 mm Dia. uPVC incl. materials and construction	m	3,100	0.220	682
200 mm Dia. Steel incl. materials and construction	m		0.224	0
200 mm Dia. uPVC incl. materials and construction	m	900	0.166	149
160 mm Dia. Steel incl. materials and construction	m		0.170	0
160 mm Dia. uPVC incl. materials and construction	m	6,900	0.120	828
140 mm Dia. Steel incl. materials and construction	m	5,500	0.143	787
140 mm Dia. uPVC incl. materials and construction	m	12,100	0.108	1,307
125 mm Dia. Steel incl. materials and construction	m	4,000	0.123	492
125 mm Dia. uPVC incl. materials and construction	m	16,000	0.086	1,376
110 mm Dia. Steel incl. materials and construction	m		0.102	0
110 mm Dia. uPVC incl. materials and construction	m	5,200	0.082	426
90 mm Dia. Steel incl. materials and construction	m	2,350	0.075	176
90 mm Dia. uPVC incl. materials and construction	m	17,750	0.066	1,172
Sub-Total		73,800		7,395
Sub-Total of Saulspoort Supply Block		***79,900***		***12,300***
Total		***150,850***		***33,891***

TABLE A.3-3 SUMMARY OF BOOSTER PUMP STATIONS

Level B	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT Operation	Stand-by	Total	FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
											56,031
Mokgalwaneng Supply Block											
at Modimong Offtake	12.362	0.742	30	2	1	3	0.371	3.7	11.1	19,611	56,031
											166,580
Sefikile Supply Block											
at RPM Offtake	13.038	0.782	55	2	1	3	0.391	11.0	33.0	58,303	166,580
											336,188
Saulspoort Supply Block											
at Ngweding Offtake	26.911	1.615	30	2	1	3	0.807	11.0	33.0	58,303	166,580
Magong (3)	0.151	0.009	35	2	1	3	0.005	2.0	6.0	10,601	30,287
Mogoditshane	1.922	0.115	40	2	1	3	0.058	3.7	11.1	19,611	56,031
Motlhabe	6.216	0.373	45	2	1	3	0.186	5.5	16.5	29,151	83,290

Level A	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT Operation	Stand-by	Total	FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
											37,354
Mokgalwaneng Supply Block											
at Modimong Offtake	4.636	0.278	30	1	1	2	0.278	3.7	7.4	13,074	37,354
											75,718
Sefikile Supply Block											
at RPM Offtake	4.889	0.293	55	1	1	2	0.293	7.5	15.0	26,501	75,718
											188,790
Saulspoort Supply Block											
at Ngweding Offtake	10.092	0.605	30	1	1	2	0.605	7.5	15.0	26,501	75,718
Magong (3)	0.057	0.003	35	1	1	2	0.003	2.0	4.0	7,067	20,191
Mogoditshane	0.721	0.043	40	1	1	2	0.043	3.7	7.4	13,074	37,354
Motlhabe	2.331	0.140	45	1	1	2	0.140	5.5	11.0	19,434	55,527

TABLE A.3-3 SUMMARY OF BOOSTER PUMP STATIONS

Level B	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT Operation	Stand-by	Total	FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
											56,031
Mokgalwaneng Supply Block											
at Modimong Offtake	12.362	0.742	30	2	1	3	0.371	3.7	11.1	19,611	56,031
											166,580
Sefikile Supply Block											
at RPM Offtake	13.038	0.782	55	2	1	3	0.391	11.0	33.0	58,303	166,580
											336,188
Saulspoort Supply Block											
at Ngweding Offtake	26.911	1.615	30	2	1	3	0.807	11.0	33.0	58,303	166,580
Magong (3)	0.151	0.009	35	2	1	3	0.005	2.0	6.0	10,601	30,287
Mogoditshane	1.922	0.115	40	2	1	3	0.058	3.7	11.1	19,611	56,031
Motlhabe	6.216	0.373	45	2	1	3	0.186	5.5	16.5	29,151	83,290

Level A	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT Operation	Stand-by	Total	FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
											37,354
Mokgalwaneng Supply Block											
at Modimong Offtake	4.636	0.278	30	1	1	2	0.278	3.7	7.4	13,074	37,354
											75,718
Sefikile Supply Block											
at RPM Offtake	4.889	0.293	55	1	1	2	0.293	7.5	15.0	26,501	75,718
											188,790
Saulspoort Supply Block											
at Ngweding Offtake	10.092	0.605	30	1	1	2	0.605	7.5	15.0	26,501	75,718
Magong (3)	0.057	0.003	35	1	1	2	0.003	2.0	4.0	7,067	20,191
Mogoditshane	0.721	0.043	40	1	1	2	0.043	3.7	7.4	13,074	37,354
Motlhabe	2.331	0.140	45	1	1	2	0.140	5.5	11.0	19,434	55,527

TABLE A.3-4 SUMMARY OF INTAKE PUMP STATIONS

VAALKOP WTW

INTAKE PUMP STATION	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT			FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
				Operation	Stand-by	Total					*280,157*
Vaalkop WTW											
Level B	88.113	5.287	24	2	1	3	2.643	18.5	55.5	98,055	280,157

INTAKE PUMP STATION	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT			FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
				Operation	Stand-by	Total					*151,436*
Vaalkop WTW											
Level A	33.042	1.983	24	1	1	2	1.983	15.0	30.0	53,003	151,436

TABLE A.3-4 SUMMARY OF INTAKE PUMP STATIONS

VAALKOP WTW

INTAKE PUMP STATION	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT Operation	Stand-by	Total	FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
Vaalkop WTW											*280,157*
Level B	88.113	5.287	24	2	1	3	2.643	18.5	55.5	98,055	280,157

INTAKE PUMP STATION	FLOW (l/sec)	FLOW (m3/min)	HEIGHT (m)	NO. OF UNIT Operation	Stand-by	Total	FLOW/UNIT (m3/min)	Pm REQUIRED (Kw)	TOTAL Pm (Kw)	COST OF PUMP SET (R)	PUMP STATION COST (R)
Vaalkop WTW											*151,436*
Level A	33.042	1.983	24	1	1	2	1.983	15.0	30.0	53,003	151,436

TABLE A.3-5 SUMMARY OF RETICULATION PIPELINES (Total 4 Sheets)

North Mankwe		Number of House-hold	Calculated Population	Water Demand AADD (l/day)		Area (ha)	Level A	Level B	Level B											Level B								
									Proportion of Pipe Diameter (%)											Length of Pipeline for Each Diameter (m)								
									Diameter (mm)											Diameter (mm)								
Settlement	Alternative Name			Level A	Level B		Length of Reticulation Pipe (m)	Length of Reticulation Pipe (m)	63	75	90	110	125	140	160	200	Tot.	63	75	90	110	125	140	160	200	Tot.
1 Matlameliong		80	512	15,360	40,960	79.0	2,191	7,370	44.75	33.10	22.15						100.0	3,298	2,439	1,632	0	0	0	0	0	7,370
2 Mokgalwaneng	Mokgalwana	1,050	6,720	201,600	537,869	775.0	20,127	32,883	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	9,536	7,563	5,590	3,617	2,631	1,973	1,315	658	32,883
3 Modimong	Diyako	260	1,664	49,920	133,187	294.5	7,745	15,269	32.76	24.23	16.21	11.99	8.87	5.94			100.0	5,002	3,700	2,475	1,831	1,354	907	0	0	15,269
Sub-Total for Mokgalwaneng		*1,390*	*8,896*	*266,880*	*712,036*	*1,148.5*	*30,063*	*55,522*										*17,836*	*13,702*	*9,698*	*5,448*	*3,985*	*2,880*	*1,315*	*658*	*55,522*
4 Mmopyane		700	4,480	134,400	358,579	252.5	6,662	13,730	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	3,982	3,158	2,334	1,510	1,098	824	549	275	13,730
5 Elandsfontein		366	2,342	70,272	187,486	138.5	3,724	9,551	29.43	23.12	17.10	11.44	8.46	6.26	4.19		100.0	2,811	2,208	1,633	1,093	808	598	400	0	9,551
6 Mmannerro	Varkensvlei/Mahobiestad	400	2,560	76,800	204,902	237.0	6,263	13,162	29.43	23.12	17.10	11.44	8.46	6.26	4.19		100.0	3,873	3,043	2,251	1,506	1,113	824	551	0	13,162
7 Mononono		1,500	9,600	288,000	768,384	189.5	5,039	11,420	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	3,312	2,627	1,941	1,256	914	685	457	228	11,420
Sub-Total for Setlhile		*2,966*	*18,982*	*569,472*	*1,519,351*	*817.5*	*21,688*	*47,862*										*13,978*	*11,036*	*8,159*	*5,365*	*3,933*	*2,931*	*1,958*	*503*	*47,862*
8 Bojating		350	2,240	67,200	179,290	202.5	5,374	11,897	29.43	23.12	17.10	11.44	8.46	6.26	4.19		100.0	3,501	2,751	2,034	1,361	1,006	745	498	0	11,897
9 Ramokokstad / Ga-Ramokoka/Lotwana/Thabeng		1,269	8,122	243,648	650,053	551.0	14,355	24,672	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	7,155	5,675	4,194	2,714	1,976	1,480	987	493	24,672
10 Mmorogong		220	1,408	42,240	112,696	74.5	2,075	7,205	36.04	24.11	17.83	13.19	8.83				100.0	2,597	1,737	1,285	950	636	0	0	0	7,205
11 Leboaneng		215	1,376	41,280	110,135	75.0	2,088	7,223	36.04	24.11	17.83	13.19	8.83				100.0	2,603	1,741	1,288	953	638	0	0	0	7,223
Sub-Total for Ramokokstad		*2,054*	*13,146*	*394,368*	*1,052,174*	*903.0*	*23,891*	*50,996*										*15,856*	*11,904*	*8,801*	*5,978*	*4,254*	*2,225*	*1,485*	*493*	*50,996*
12 Mapaputle	Schoongezicht	216	1,382	41,472	110,647	87.0	2,397	7,663	36.04	24.11	17.83	13.19	8.83				100.0	2,762	1,848	1,366	1,011	677	0	0	0	7,663
13 Mogoditshane	Vlaksplaats	206	1,318	39,552	105,525	169.0	4,510	10,669	36.04	24.11	17.83	13.19	8.83				100.0	3,845	2,572	1,902	1,407	942	0	0	0	10,669
14 Maropalallo	Dekameelkuil	150	960	28,800	76,838	109.0	2,964	8,469	37.69	27.88	20.63	13.80					100.0	3,192	2,361	1,747	1,169	0	0	0	0	8,469
15 Mantsho	Moskietdogrens	155	992	29,760	79,400	118.0	3,196	8,799	37.69	27.88	20.63	13.80					100.0	3,316	2,453	1,815	1,214	0	0	0	0	8,799
16 Mokgope	Groenfontein	136	870	26,112	69,667	87.5	2,410	7,681	37.69	27.88	20.63	13.80					100.0	2,895	2,142	1,585	1,060	0	0	0	0	7,681
17 Motorwe	Bierkraal	258	1,651	49,536	132,162	73.5	2,049	7,168	32.76	24.23	16.21	11.99	8.87	5.94			100.0	2,348	1,737	1,162	859	636	426	0	0	7,168
18 Motlhabe		616	3,942	118,272	315,550	371.0	9,716	18,074	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	5,241	4,157	3,073	1,988	1,446	1,084	723	361	18,074
19 Ntsenalemetsing	Welgewaagd	142	909	27,264	72,740	54.5	1,560	6,472	37.69	27.88	20.63	13.80					100.0	2,439	1,804	1,335	893	0	0	0	0	6,472
20 Ngwoding		136	870	26,112	69,667	56.0	1,598	6,527	37.69	27.88	20.63	13.80					100.0	2,460	1,820	1,346	901	0	0	0	0	6,527
21 Magalane		69	442	13,248	35,346	39.0	1,160	5,903	44.75	33.10	22.15						100.0	2,642	1,954	1,309	0	0	0	0	0	5,903
22 Magong	Rhenosterkraal/Ngokwane	747	4,781	143,424	382,655	424.5	11,095	20,035	29.00	23.00	17.00	11.00	8.00	6.00	4.00	2.00	100.0	5,810	4,608	3,406	2,204	1,603	1,202	801	401	20,035
23 Kameelboom	Mphonyoke	178	1,139	34,176	91,182	262.0	6,907	14,078	37.69	27.88	20.63	13.80					100.0	5,306	3,925	2,904	1,943	0	0	0	0	14,078
24 Ramosibitswana		17	109	3,264	8,708	51.0	1,470	6,343	44.75	33.10	22.15						100.0	2,839	2,100	1,405	0	0	0	0	0	6,343
Sub-Total for Seulgpoort		*3,026*	*19,366*	*580,992*	*1,550,087*	*1,902.0*	*51,033*	*127,881*										*45,096*	*33,488*	*24,355*	*14,649*	*9,303*	*5,712*	*3,524*	*762*	*127,881*
TOTAL		9,436	60,390	1,811,712	4,833,648	4,771	126,674	281,262										92,765	70,121	51,013	31,440	17,476	10,748	6,283	2,416	282,262

TABLE A.3-5 SUMMARY OF RETICULATION PIPELINES (Total 4 Sheets)

North Mankwe

Settlement	Alternative Name	Number of House-hold	Calculated Population	Water Demand AADD (l/day) Level A	Water Demand AADD (l/day) Level B	Area (ha)	Level A Length of Reticulation Pipe (m)	Level B Length of Reticulation Pipe (m)
1 Matlameilong		80	512	15,360	40,980	79.0	2,191	7,370
2 Mokgalwaneng	Mokgalwaas	1,050	6,720	201,600	537,869	775.0	20,127	32,480
3 Modimong	Disake	260	1,664	49,920	133,187	294.5	7,745	15,269
Sub-Total for Mokgalwaneng		***1,390***	***8,896***	***266,880***	***712,036***	***1,148.5***	***30,063***	***55,522***
4 Mmopyane		700	4,480	134,400	358,579	252.5	6,662	13,730
5 Elandsfontein		366	2,342	70,272	187,486	138.5	3,724	9,551
6 Mmamserve	Varkensvlei/Mahobiestad	400	2,560	76,800	204,902	237.0	6,263	13,162
7 Mononono		1,500	9,600	288,000	768,384	189.5	5,039	11,420
Sub-Total for Sefikile		***2,966***	***18,982***	***569,472***	***1,519,351***	***817.5***	***21,688***	***47,862***
8 Boisting		350	2,240	67,200	179,290	202.5	5,374	11,897
9 Ramokokstad / Ga-Ramokoka/Lotwane/Thabeng		1,269	8,122	243,648	650,053	551.0	14,355	24,672
10 Mmorogong		220	1,408	42,240	112,696	74.5	2,075	7,205
11 Leboaneng		215	1,376	41,280	110,135	75.0	2,088	7,223
Sub-Total for Ramokokstad		***2,054***	***13,146***	***394,368***	***1,052,174***	***903.0***	***23,891***	***50,996***
12 Mapapetle	Schoongezicht	216	1,382	41,472	110,647	87.0	2,397	7,663
13 Mogodinshane	Vlakplaats	206	1,318	39,552	105,525	169.0	4,510	10,669
14 Marapalallo	Dekameetkuil	150	960	28,800	76,838	109.0	2,964	8,469
15 Maansho	Moskietdogtens	155	992	29,760	79,400	118.0	3,196	8,799
16 Makgope	Groenfontein	136	870	26,112	69,667	87.5	2,410	7,681
17 Molorwe	Bierkraal	258	1,651	49,536	132,162	73.5	2,049	7,168
18 Motlhabe		616	3,942	118,272	315,550	371.0	9,716	18,074
19 Nisanalemetsing	Welgewaagd	142	909	27,264	72,740	54.5	1,560	6,472
20 Ngweding		136	870	26,112	69,667	56.0	1,598	6,527
21 Magalane		69	442	13,248	35,346	39.0	1,160	5,903
22 Magong	Rhenostorkraal/Ngokwane	747	4,781	143,424	382,655	424.5	11,095	20,035
23 Kameelboom	Mphonyoke	178	1,139	34,176	91,182	262.0	6,907	14,078
24 Ramosibitswana		17	109	3,264	8,708	51.0	1,470	6,343
		3,026	***19,366***	***580,992***	***1,550,087***	***1,902.0***	***51,033***	***127,881***
TOTAL		9,436	60,390	1,811,712	4,833,648	4,771	126,674	282,262

Settlement	Alternative Name	Level A Proportion of Pipe Diameter (%) Diameter (mm) 63	75	90	110	125	140	160	200	Tot.
1 Matlameilong		31.24	39.06	29.70						100.0
2 Mokgalwaneng	Mokgalwaas	6.29	30.87	32.89	29.95					100.0
3 Modimong	Disake	6.87	31.75	30.59	30.79					100.0
Sub-Total for Mokgalwaneng										
4 Mmopyane		6.29	30.87	32.89	29.95					100.0
5 Elandsfontein		6.29	30.87	32.89	29.95					100.0
6 Mmamserve	Varkensvlei/Mahobiestad	6.29	30.87	32.89	29.95					100.0
7 Mononono		6.29	30.87	32.89	29.95					100.0
Sub-Total for Sefikile										
8 Boisting		6.29	30.87	32.89	29.95					100.0
9 Ramokokstad / Ga-Ramokoka/Lotwane/Thabeng		6.29	30.87	32.89	29.95					100.0
10 Mmorogong		7.08	29.62	31.54	31.76					100.0
11 Leboaneng		7.08	29.62	31.54	31.76					100.0
Sub-Total for Ramokokstad										
12 Mapapetle	Schoongezicht	7.08	29.62	31.54	31.76					100.0
13 Mogodinshane	Vlakplaats	7.08	29.62	31.54	31.76					100.0
14 Marapalallo	Dekameetkuil	21.47	31.19	26.86	20.48					100.0
15 Maansho	Moskietdogtens	21.47	31.19	26.86	20.48					100.0
16 Makgope	Groenfontein	21.47	31.19	26.86	20.48					100.0
17 Molorwe	Bierkraal	6.87	31.75	30.59	30.79					100.0
18 Motlhabe		6.29	30.87	32.89	29.95					100.0
19 Nisanalemetsing	Welgewaagd	21.47	31.19	26.86	20.48					100.0
20 Ngweding		21.47	31.19	26.86	20.48					100.0
21 Magalane		31.24	39.06	29.70						100.0
22 Magong	Rhenostorkraal/Ngokwane	6.29	30.87	32.89	29.95					100.0
23 Kameelboom	Mphonyoke	21.47	31.19	26.86	20.48					100.0
24 Ramosibitswana		31.24	39.06	29.70						100.0

Settlement	Alternative Name	Level A Length of Pipeline for Each Diameter (m) Diameter (mm) 63	75	90	110	125	140	160	200	Tot.
1 Matlameilong		684	856	651	0	0	0	0	0	2,191
2 Mokgalwaneng	Mokgalwaas	852	4,183	4,457	4,058	2,631	1,973	1,315	658	20,127
3 Modimong	Disake	377	1,741	1,677	1,688	1,356	907	0	0	7,745
Sub-Total for Mokgalwaneng		***1,914***	***6,780***	***6,785***	***5,747***	***3,985***	***2,880***	***1,315***	***658***	***30,063***
4 Mmopyane		246	1,209	1,288	1,173	1,098	824	549	275	6,662
5 Elandsfontein		121	592	631	575	808	598	400	0	3,724
6 Mmamserve	Varkensvlei/Mahobiestad	257	1,165	1,241	1,130	1,113	824	551	0	6,263
7 Mononono		173	850	906	825	914	685	457	228	5,039
Sub-Total for Sefikile		***778***	***3,816***	***4,066***	***3,703***	***3,933***	***2,931***	***1,958***	***503***	***21,688***
8 Boisting		196	964	1,027	936	1,006	745	498	0	5,374
9 Ramokokstad / Ga-Ramokoka/Lotwane/Thabeng		593	2,908	3,098	2,821	1,974	1,480	987	493	14,355
10 Mmorogong		102	426	454	457	636	0	0	0	2,075
11 Leboaneng		103	430	457	461	638	0	0	0	2,088
Sub-Total for Ramokokstad		***994***	***4,728***	***5,037***	***4,673***	***4,254***	***3,225***	***1,485***	***493***	***23,891***
12 Mapapetle	Schoongezicht	122	510	543	546	677	0	0	0	2,397
13 Mogodinshane	Vlakplaats	253	1,057	1,125	1,135	940	0	0	0	4,510
14 Marapalallo	Dekameetkuil	636	925	796	607	0	0	0	0	2,964
15 Maansho	Moskietdogtens	686	997	858	655	0	0	0	0	3,196
16 Makgope	Groenfontein	517	752	647	494	0	0	0	0	2,410
17 Molorwe	Bierkraal	68	314	302	304	636	426	0	0	2,049
18 Motlhabe		384	1,883	2,007	1,927	1,446	1,084	723	361	9,716
19 Nisanalemetsing	Welgewaagd	335	486	419	319	0	0	0	0	1,560
20 Ngweding		343	499	429	327	0	0	0	0	1,598
21 Magalane		362	453	345	0	0	0	0	0	1,160
22 Magong	Rhenostorkraal/Ngokwane	446	2,188	2,331	2,125	1,603	1,202	801	401	11,095
23 Kameelboom	Mphonyoke	1,483	2,154	1,855	1,415	0	0	0	0	6,907
24 Ramosibitswana		659	574	436	0	0	0	0	0	1,470
		6,994	***12,791***	***12,095***	***9,750***	***5,303***	***3,712***	***1,524***	***762***	***51,033***
TOTAL		9,779	28,115	27,983	23,874	17,476	10,748	6,283	2,416	126,674

TABLE A.3-5 SUMMARY OF RETICULATION PIPELINES (Total 4 Sheets)

North Mankwe — Level A

Length of Pipeline for Each Diameter (m)

Settlement	Alternative Name	63	75	90	110	125	140	160	200	Tot.
1 Matlametlong		684	856	651	0	0	0	0	0	2,191
2 Mokgalwaneng	Mokgalwana	852	4,183	4,457	4,058	2,631	1,973	1,315	658	20,127
3 Modimong	Disake	377	1,741	1,677	1,688	1,354	907	0	0	7,745
Sub-Total for Mokgalwaneng		*1,914*	*6,780*	*6,785*	*5,747*	*3,985*	*2,880*	*1,315*	*658*	*30,063*
4 Mmopyane		246	1,209	1,286	1,173	1,098	824	549	275	6,662
5 Elandsfontein		121	592	631	575	808	598	400	0	3,724
6 Mmantserre	Varkensvlei/Mahobiestad	237	1,165	1,241	1,130	1,113	824	551	0	6,263
7 Mononono		173	850	906	825	914	665	457	228	5,039
Sub-Total for Sefikile		*778*	*3,816*	*4,064*	*3,703*	*3,933*	*2,931*	*1,958*	*503*	*21,688*
8 Bojating		196	964	1,027	936	1,006	745	496	0	5,374
9 Ramokokstad / Ga-Ramokoka/Lotwane/Thabeng		593	2,908	3,098	2,873	1,974	1,480	987	493	14,355
10 Mmorogong		102	426	454	457	636	0	0	0	2,075
11 Leboaneng		103	430	457	461	638	0	0	0	2,088
Sub-Total for Ramokokstad		*994*	*4,728*	*5,037*	*4,675*	*4,254*	*2,225*	*1,483*	*493*	*23,891*
12 Mapaputle	Schoongezicht	322	510	543	546	677	0	0	0	2,597
13 Mogodiatshane	Vlakplaats	253	1,037	1,125	1,133	942	0	0	0	4,510
14 Marapalalo	Dekamoelkuil	636	925	796	607	0	0	0	0	2,964
15 Mantsho	Moskietdogrens	666	997	858	655	0	0	0	0	3,196
16 Makgope	Groenfontein	517	752	647	494	0	0	0	0	2,410
17 Molorwe	Bierkraal	66	314	302	306	636	426	0	0	2,049
18 Motlhabe		384	1,863	2,007	1,827	1,446	1,084	723	361	9,716
19 Nkaanalemetsing	Welgewaagd	335	486	419	319	0	0	0	0	1,560
20 Ngweding		343	499	429	327	0	0	0	0	1,598
21 Magalane		362	453	345	0	0	0	0	0	1,160
22 Magong	Rhenosterkraal/Ngokwane	446	2,188	2,331	2,123	1,603	1,202	801	401	11,095
23 Kameelboom	Mphonyoke	1,483	2,154	1,855	1,415	0	0	0	0	6,907
24 Ramoshibitswana		459	574	436	0	0	0	0	0	1,470
Sub-Total for Saulspoort		*6,094*	*12,791*	*13,095*	*9,750*	*5,303*	*2,713*	*1,524*	*763*	*51,833*
TOTAL		9,779	28,115	27,983	23,874	17,478	10,749	6,283	2,418	126,874

Level A — Length of Existing/Planned Pipeline for Each Diameter (m)

Settlement	63	75	90	110	125	140	160	200	Tot.
1 Matlametlong	2,820	1,850	250	200					5,120
2 Mokgalwaneng	6,600	4,300		1,000			5,000		16,900
3 Modimong	3,600	1,100	1,600	1,000					7,300
Sub-Total for Mokgalwaneng	*13,020*	*7,250*	*1,850*	*2,200*	*0*	*0*	*5,000*	*0*	*29,320*
4 Mmopyane									0
5 Elandsfontein									0
6 Mmantserre									0
7 Mononono	5,100	1,450	680	250					7,480
Sub-Total for Sefikile	*5,100*	*1,450*	*680*	*250*	*0*	*0*	*0*	*0*	*7,480*
8 Bojating	6,044	1,095	261	517	394		378	520	9,209
9 Ramokokstad / Ga-Ramokoka/Lotwane/Thabeng	13,884	8,427	5,772	3,416		1,122	992		33,513
10 Mmorogong	5,011		260	96		310			5,677
11 Leboaneng	2,166		335	682					3,183
Sub-Total for Ramokokstad	*27,105*	*9,522*	*6,628*	*4,711*	*394*	*1,432*	*1,370*	*520*	*51,582*
12 Mapaputle	4,400	800	200						5,400
13 Mogodiatshane									0
14 Marapalalo									0
15 Mantsho									0
16 Makgope									0
17 Molorwe									0
18 Motlhabe	7,425	2,752		995			1,575	1,005	13,752
19 Nkaanalemetsing	515	1,623	671						2,809
20 Ngweding									0
21 Magalane									0
22 Magong									0
23 Kameelboom	10,050	1,960	560	835					13,405
24 Ramoshibitswana	1,850								1,850
Sub-Total for Saulspoort	*24,240*	*7,135*	*1,431*	*1,830*	*0*	*0*	*1,575*	*1,005*	*37,216*
TOTAL	69,465	25,357	10,589	8,991	394	1,432	7,945	1,525	125,598

Required Pipe Length for Level A — Diameter (mm)

Settlement	63	75	90	110	125	140	160	200	Tot.
1 Matlametlong	0	0	401	0	0	0	0	0	401
2 Mokgalwaneng	0	0	4,457	3,058	2,631	1,973	0	658	12,776
3 Modimong	0	641	77	688	1,354	907	0	0	3,668
Sub-Total for Mokgalwaneng	*0*	*641*	*4,935*	*3,747*	*3,985*	*2,880*	*0*	*658*	*16,845*
4 Mmopyane	246	1,209	1,286	1,173	1,098	824	549	275	6,662
5 Elandsfontein	121	592	631	575	808	598	400	0	3,724
6 Mmantserre	237	1,165	1,241	1,130	1,113	824	551	0	6,263
7 Mononono	0	0	226	575	914	665	457	228	3,065
Sub-Total for Sefikile	*604*	*2,966*	*3,384*	*3,453*	*3,933*	*2,911*	*1,958*	*503*	*19,734*
8 Bojating	0	0	766	419	612	745	120	0	2,663
9 Ramokokstad / Ga-Ramokoka/Lotwane/Thabeng	0	0	0	0	1,974	358	95	493	2,920
10 Mmorogong	0	426	194	361	636	0	0	0	1,617
11 Leboaneng	0	430	122	0	638	0	0	0	1,190
Sub-Total for Ramokokstad	*0*	*856*	*1,083*	*780*	*3,860*	*1,103*	*215*	*493*	*8,390*
12 Mapaputle	0	0	343	546	677	0	0	0	1,566
13 Mogodiatshane	253	1,037	1,125	1,133	942	0	0	0	4,510
14 Marapalalo	636	925	796	607	0	0	0	0	2,964
15 Mantsho	666	997	858	655	0	0	0	0	3,196
16 Makgope	517	752	647	494	0	0	0	0	2,410
17 Molorwe	66	314	302	306	636	426	0	0	2,049
18 Motlhabe	0	0	2,007	832	1,446	1,084	0	0	5,369
19 Nkaanalemetsing	0	0	0	319	0	0	0	0	319
20 Ngweding	343	499	429	327	0	0	0	0	1,598
21 Magalane	362	453	345	0	0	0	0	0	1,160
22 Magong	446	2,188	2,331	2,123	1,603	1,202	801	401	11,095
23 Kameelboom	0	194	1,295	580	0	0	0	0	2,069
24 Ramoshibitswana	0	574	436	0	0	0	0	0	1,010
Sub-Total for Saulspoort	*3,312*	*7,952*	*10,916*	*7,920*	*5,303*	*2,713*	*801*	*401*	*39,317*
TOTAL	3,916	12,415	20,318	15,900	17,081	9,607	2,974	2,055	84,287

North Mankwe — Level B

Length of Pipeline for Each Diameter (m)

Settlement	Alternative Name	63	75	90	110	125	140	160	200	Tot.
1 Matlametlong		3,296	2,439	1,632	0	0	0	0	0	7,370
2 Mokgalwaneng	Mokgalwana	9,536	7,563	5,590	3,617	2,631	1,973	1,315	658	32,883
3 Modimong	Disake	5,002	3,700	2,475	1,831	1,354	907	0	0	15,269
Sub-Total for Mokgalwaneng		*17,834*	*13,702*	*9,698*	*5,448*	*3,985*	*2,880*	*1,315*	*658*	*55,522*
4 Mmopyane		3,982	3,158	2,334	1,510	1,098	824	549	275	13,730
5 Elandsfontein		2,811	2,208	1,633	1,093	808	598	400	0	9,551
6 Mmantserre	Varkensvlei/Mahobiestad	3,873	3,043	2,251	1,506	1,113	824	551	0	13,162
7 Mononono		3,312	2,627	1,961	1,256	914	665	457	228	11,420
Sub-Total for Sefikile		*13,978*	*11,036*	*8,179*	*5,365*	*3,933*	*2,911*	*1,957*	*503*	*47,862*
8 Bojating		3,501	2,751	2,034	1,361	1,006	745	498	0	11,897
9 Ramokokstad / Ga-Ramokoka/Lotwane/Thabeng		7,155	5,675	4,194	2,714	1,974	1,480	987	493	24,672
10 Mmorogong		2,597	1,737	1,285	950	636	0	0	0	7,205
11 Leboaneng		2,603	1,741	1,288	953	638	0	0	0	7,223
Sub-Total for Ramokokstad		*15,856*	*11,904*	*8,801*	*5,978*	*4,254*	*2,225*	*1,485*	*493*	*50,996*
12 Mapaputle	Schoongezicht	2,762	1,848	1,366	1,011	677	0	0	0	7,663
13 Mogodiatshane	Vlakplaats	3,845	2,572	1,902	1,407	942	0	0	0	10,669
14 Marapalalo	Dekamoelkuil	3,192	2,361	1,747	1,169	0	0	0	0	8,469
15 Mantsho	Moskietdogrens	3,316	2,453	1,815	1,214	0	0	0	0	8,799
16 Makgope	Groenfontein	2,895	2,142	1,585	1,060	0	0	0	0	7,681
17 Molorwe	Bierkraal	2,348	1,737	1,162	859	636	426	0	0	7,168
18 Motlhabe		5,241	4,157	3,073	1,989	1,446	1,084	723	361	18,074
19 Nkaanalemetsing	Welgewaagd	2,439	1,804	1,335	893	0	0	0	0	6,472
20 Ngweding		2,460	1,820	1,346	901	0	0	0	0	6,527
21 Magalane		2,642	1,954	1,308	0	0	0	0	0	5,903
22 Magong	Rhenosterkraal/Ngokwane	5,810	4,608	3,406	2,204	1,603	1,202	801	401	20,035
23 Kameelboom	Mphonyoke	5,306	3,925	2,904	1,943	0	0	0	0	14,078
24 Ramoshibitswana		2,839	2,100	1,405	0	0	0	0	0	6,343
Sub-Total for Saulspoort		*45,096*	*33,480*	*24,335*	*14,649*	*5,303*	*2,713*	*1,524*	*763*	*127,881*
TOTAL		92,765	70,121	51,013	31,440	17,478	10,748	6,283	2,418	282,262

Level B — Length of Existing/Planned Pipeline for Each Diameter (m)

Settlement	63	75	90	110	125	140	160	200	Tot.
1 Matlametlong	2,820	1,850	250	200	0	0	0	0	5,120
2 Mokgalwaneng	6,600	4,300	0	1,000	0	0	5,000	0	16,900
3 Modimong	3,600	1,100	1,600	1,000	0	0	0	0	7,300
Sub-Total for Mokgalwaneng	*13,020*	*7,250*	*1,850*	*2,200*	*0*	*0*	*5,000*	*0*	*29,320*
4 Mmopyane	0	0	0	0	0	0	0	0	0
5 Elandsfontein	0	0	0	0	0	0	0	0	0
6 Mmantserre	0	0	0	0	0	0	0	0	0
7 Mononono	5,100	1,450	680	250	0	0	0	0	7,480
Sub-Total for Sefikile	*5,100*	*1,450*	*680*	*250*	*0*	*0*	*0*	*0*	*7,480*
8 Bojating	6,044	1,095	261	517	394	0	378	520	9,209
9 Ramokokstad / Ga-Ramokoka/Lotwane/Thabeng	13,884	8,427	5,772	3,416	0	1,122	992	0	33,513
10 Mmorogong	5,011	0	260	96	0	310	0	0	5,677
11 Leboaneng	2,166	0	335	682	0	0	0	0	3,183
Sub-Total for Ramokokstad	*27,105*	*9,522*	*6,628*	*4,711*	*394*	*1,432*	*1,370*	*520*	*51,582*
12 Mapaputle	4,400	800	200	0	0	0	0	0	5,400
13 Mogodiatshane	0	0	0	0	0	0	0	0	0
14 Marapalalo	0	0	0	0	0	0	0	0	0
15 Mantsho	0	0	0	0	0	0	0	0	0
16 Makgope	0	0	0	0	0	0	0	0	0
17 Molorwe	0	0	0	0	0	0	0	0	0
18 Motlhabe	7,425	2,752	0	995	0	0	1,575	1,005	13,752
19 Nkaanalemetsing	515	1,623	671	0	0	0	0	0	2,809
20 Ngweding	0	0	0	0	0	0	0	0	0
21 Magalane	0	0	0	0	0	0	0	0	0
22 Magong	0	0	0	0	0	0	0	0	0
23 Kameelboom	10,050	1,960	560	835	0	0	0	0	13,405
24 Ramoshibitswana	1,850	0	0	0	0	0	0	0	1,850
Sub-Total for Saulspoort	*24,240*	*7,135*	*1,431*	*1,830*	*0*	*0*	*1,575*	*1,005*	*37,216*
TOTAL	69,465	25,357	10,589	8,991	394	1,432	7,945	1,525	125,598

Required Pipe Length for Level B — Diameter (mm)

Settlement	63	75	90	110	125	140	160	200	Tot.
1 Matlametlong	478	589	1,382	0	0	0	0	0	2,450
2 Mokgalwaneng	2,936	3,263	5,590	2,617	2,631	1,973	0	658	19,668
3 Modimong	1,402	2,600	875	831	1,354	907	0	0	7,969
Sub-Total for Mokgalwaneng	*4,816*	*6,452*	*7,848*	*3,448*	*3,985*	*2,880*	*0*	*658*	*30,087*
4 Mmopyane	3,982	3,158	2,334	1,510	1,098	824	549	275	13,730
5 Elandsfontein	2,811	2,208	1,633	1,093	808	598	400	0	9,551
6 Mmantserre	3,873	3,043	2,251	1,506	1,113	824	551	0	13,162
7 Mononono	0	1,177	1,281	1,006	914	665	457	228	5,728
Sub-Total for Sefikile	*10,666*	*9,586*	*7,499*	*5,115*	*3,933*	*2,911*	*1,958*	*503*	*42,170*
8 Bojating	0	1,656	1,773	844	612	745	120	0	5,751
9 Ramokokstad / Ga-Ramokoka/Lotwane/Thabeng	0	0	0	0	1,974	358	95	493	2,920
10 Mmorogong	0	1,737	1,025	854	636	0	0	0	4,252
11 Leboaneng	437	1,741	953	271	638	0	0	0	4,040
Sub-Total for Ramokokstad	*437*	*5,134*	*3,751*	*1,969*	*3,860*	*1,103*	*215*	*493*	*16,962*
12 Mapaputle	0	1,048	1,166	1,011	677	0	0	0	3,901
13 Mogodiatshane	3,845	2,572	1,902	1,407	942	0	0	0	10,669
14 Marapalalo	3,192	2,361	1,747	1,169	0	0	0	0	8,469
15 Mantsho	3,316	2,453	1,815	1,214	0	0	0	0	8,799
16 Makgope	2,895	2,142	1,585	1,060	0	0	0	0	7,681
17 Molorwe	2,348	1,737	1,162	859	636	426	0	0	7,168
18 Motlhabe	0	1,405	3,073	993	1,446	1,084	0	0	8,001
19 Nkaanalemetsing	1,924	181	664	893	0	0	0	0	3,663
20 Ngweding	2,460	1,820	1,346	901	0	0	0	0	6,527
21 Magalane	2,642	1,954	1,308	0	0	0	0	0	5,903
22 Magong	5,810	4,608	3,406	2,204	1,603	1,202	801	401	20,035
23 Kameelboom	0	1,965	2,344	1,108	0	0	0	0	5,417
24 Ramoshibitswana	989	2,100	1,405	0	0	0	0	0	4,493
Sub-Total for Saulspoort	*39,421*	*26,345*	*22,934*	*12,819*	*5,303*	*2,713*	*801*	*401*	*100,737*
TOTAL	45,341	47,517	42,001	23,351	17,081	9,607	2,974	2,056	188,947

TABLE A.3-5 SUMMARY OF RETICULATION PIPELINES (Total 4 Sheets)

North Mankwe

Level A

Required Pipe Length and Cost

		Diameter (mm)								
		63	75	90	110	125	140	160	200	Tot.
Mokgalwaneng Supply Block	Pipe Length (m)	0	641	4,935	3,747	3,985	2,880	0	658	16,845
	Cost (R)	0	35,890	325,694	307,221	342,712	311,037	0	109,171	1,431,726
Sefikile Supply Block	Pipe Length (m)	604	2,966	3,386	3,453	3,933	2,931	1,958	503	19,734
	Cost (R)	30,823	166,103	223,489	283,124	338,278	316,525	234,917	83,498	1,676,758
Ramokokstad Supply Block	Pipe Length (m)	0	856	1,083	780	3,860	1,103	215	493	8,390
	Cost (R)	0	47,922	71,458	63,930	331,977	119,129	25,842	81,910	742,169
Saulspoort Supply Block	Pipe Length (m)	3,312	7,952	10,916	7,920	5,303	2,712	801	401	39,317
	Cost (R)	168,912	445,290	720,434	649,480	456,072	292,926	96,167	66,515	2,895,797
TOTAL	Pipe Length (m)	3,916	12,414	20,319	15,899	17,082	9,626	2,974	2,055	84,287
	Cost (R)	199,735	695,206	1,341,076	1,303,754	1,469,039	1,039,618	356,926	341,095	6,746,450

North Mankwe

Level B

Required Pipe Length and Cost

		Diameter (mm)								
		63	75	90	110	125	140	160	200	Tot.
Mokgalwaneng Supply Block	Pipe Length (m)	4,816	6,452	7,848	3,448	3,985	2,880	0	658	30,087
	Cost (R)	245,627	361,323	517,945	282,729	342,712	311,037	0	109,171	2,170,545
Sefikile Supply Block	Pipe Length (m)	10,666	9,586	7,479	5,115	3,933	2,931	1,958	503	42,170
	Cost (R)	543,958	536,793	493,634	419,413	338,278	316,525	234,917	83,498	2,967,015
Ramokokstad Supply Block	Pipe Length (m)	437	5,134	3,751	1,969	3,860	1,103	215	493	16,963
	Cost (R)	22,297	287,509	247,555	161,460	331,977	119,129	25,842	81,910	1,277,681
Saulspoort Supply Block	Pipe Length (m)	29,421	26,345	22,924	12,819	5,303	2,712	801	401	100,727
	Cost (R)	1,500,495	1,475,324	1,512,955	1,051,153	456,072	292,926	96,167	66,515	6,451,607
TOTAL	Pipe Length (m)	45,341	47,517	42,001	23,351	17,082	9,626	2,974	2,055	189,947
	Cost (R)	2,312,377	2,660,950	2,772,089	1,914,754	1,469,039	1,039,618	356,926	341,095	12,866,848
Pipe Unit Cost (R/m)		51	56	66	82	86	108	120	166	

TABLE A.3-6 SUMMARY OF STANDPIPES (Level A & Level B)

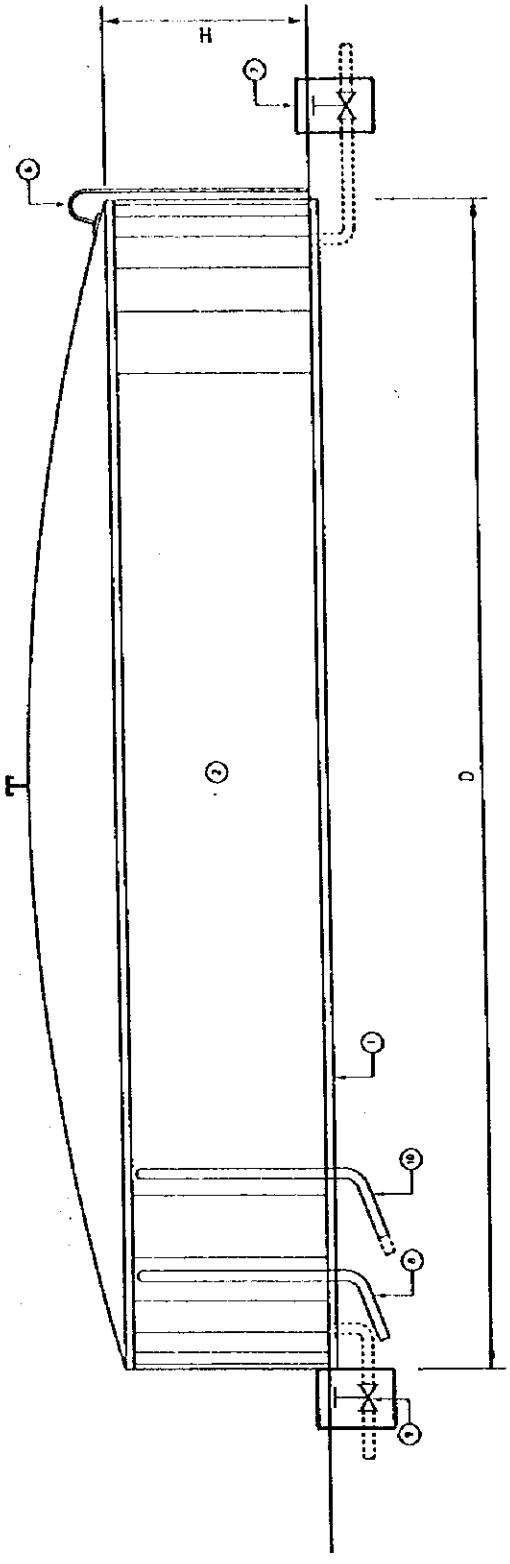
North Mankwe		Number of House-hold	Calculated Population	Water Demand AADD (l/day)		Area (ha)	Calculated Number of Standpipes required		Existing/ Planned Standpipes (nos)	Required Number of Standpipes required	
Settlement	Alternative Name			Level A	Level B		Level A (nos)	Level B (nos)		Level A (nos)	Level B (nos)
1 Matlameliong		80	512	15,360	40,980	79.0	6	5	12	0	0
2 Mokgalwaneng	Mokgalwana	1,050	6,720	201,600	537,869	775.0	38	29	24	14	5
3 Modimong	Disake	260	1,664	49,920	133,187	294.5	16	12	10	6	2
Sub-Total for Mokgalwaneng		***1,390***	***8,896***	***266,880***	***712,036***	***1,148.5***	***60***	***46***	***46***	***20***	***7***
4 Mmopyane		700	4,480	134,400	358,579	252.5	14	11		14	11
5 Elandsfontein		366	2,342	70,272	187,486	138.5	9	7		9	7
6 Mmantserre	Varkensvlei/Mahobiestad	400	2,560	76,800	204,902	237.0	13	10		13	10
7 Mononono		1,500	9,600	288,000	768,384	189.5	11	8	18	0	0
Sub-Total for Sefikile		***2,966***	***18,982***	***569,472***	***1,519,351***	***817.5***	***47***	***36***	***18***	***36***	***28***
8 Bojating		350	2,240	67,200	179,290	202.5	12	9	39	0	0
9 Ramokokstadt	Ga-Ramokoka/Lotwane/Thabeng	1,269	8,122	243,648	650,053	551.0	28	22	78	0	0
10 Mmorogong		220	1,408	42,240	112,696	74.5	6	5	14	0	0
11 Leboaneng		215	1,376	41,280	110,135	75.0	6	5	12	0	0
Sub-Total for Ramokokstad		***2,054***	***13,146***	***394,368***	***1,052,174***	***903.0***	***52***	***41***	***143***	***0***	***0***
12 Mapaputle	Schoongezicht	216	1,382	41,472	110,647	87.0	7	5	13	0	0
13 Mogoditshane	Vlakspiaats	206	1,318	39,552	105,525	169.0	10	8		10	8
14 Marapalallo	Dekameelkuil	150	960	28,800	76,838	109.0	8	6		8	6
15 Mantsho	Moskieldogrens	155	992	29,760	79,400	118.0	8	6		8	6
16 Makgope	Groenfontein	136	870	26,112	69,667	87.5	7	5		7	5
17 Molorwe	Bierkraal	258	1,651	49,536	132,162	73.5	6	5		6	5
18 Motlhabe		616	3,942	118,272	315,550	371.0	19	15	35	0	0
19 Ntsanalemetsing	Welgewaagd	142	909	27,264	72,740	54.5	5	4	8	0	0
20 Ngweding		136	870	26,112	69,667	56.0	5	4		5	4
21 Magalane		69	442	13,248	35,346	39.0	4	3		4	3
22 Magong	Rhenosterkraal/Ngokwane	747	4,781	143,424	382,655	424.5	22	17		22	17
23 Kameelboom	Mphonyoke	178	1,139	34,176	91,182	262.0	15	12	21	0	0
24 Ramosibitswana		17	109	3,264	8,708	51.0	5	4	17	0	0
Sub-Total for Saulspoort		***3,026***	***19,366***	***580,992***	***1,550,087***	***1,902.0***	***121***	***94***	***94***	***70***	***54***
TOTAL		9,436	60,390	1,811,712	4,833,648	4,771.0	280	217	301	126	89

Cost of Standpipes	Unit Cost	Quantity	Cost
Total			
Level A	1,600	126	201,600
Level B	1,600	89	142,400
Mokgalwaneng Supply Block			
Level A	1,600	20	32,000
Level B	1,600	7	11,200
Sefikile Supply Block			
Level A	1,600	36	57,600
Level B	1,600	28	44,800
Ramokokstad Supply Block			
Level A	1,600	0	0
Level B	1,600	0	0
Saulspoort Supply Block			
Level A	1,600	70	112,000
Level B	1,600	54	86,400

TABLE A.3-7 SUMMARY OF YARD CONNECTIONS (Level B)

North Mankwe		Number of House-hold	Calculated Population	Water Demand AADD (l/day)		Area (ha)	No. of Yard Connection (nos)
Settlement	Alternative Name			Level A	Level B		
1 Matlameliong		80	512	15,360	40,980	79.0	72
2 Mokgalwaneng	Mokgalwana	1,050	6,720	201,600	537,869	775.0	945
3 Modimong	Disake	260	1,664	49,920	133,187	294.5	234
Sub-Total for Mokgalwaneng		***1,390***	***8,896***	***266,880***	***712,036***	***1,148.5***	***1,251***
4 Mmopyane		700	4,480	134,400	358,579	252.5	630
5 Elandsfontein		366	2,342	70,272	187,486	138.5	329
6 Mmantserre	Varkensviel/Mahobiestad	400	2,560	76,800	204,902	237.0	360
7 Mononono		1,500	9,600	288,000	768,384	189.5	1,350
Sub-Total for Sefikile		***2,966***	***18,982***	***569,472***	***1,519,351***	***817.5***	***2,669***
8 Bojating		350	2,240	67,200	179,290	202.5	315
9 Ramokokstadt	Ga-Ramokoka/Lotwane/Thabeng	1,269	8,122	243,648	650,053	551.0	1,142
10 Mmorogong		220	1,408	42,240	112,696	74.5	198
11 Leboaneng		215	1,376	41,280	110,135	75.0	194
Sub-Total for Ramokokstad		***2,054***	***13,146***	***394,368***	***1,052,174***	***903.0***	***1,849***
12 Mapaputle	Schoongezicht	216	1,382	41,472	110,647	87.0	194
13 Mogoditshane	Vlakspfaats	206	1,318	39,552	105,525	169.0	185
14 Marapalallo	Dekameelkuil	150	960	28,800	76,838	109.0	135
15 Mantsho	Moskietdogrens	155	992	29,760	79,400	118.0	140
16 Makgope	Groenfontein	136	870	26,112	69,667	87.5	122
17 Molorwe	Bierkraal	258	1,651	49,536	132,162	73.5	232
18 Motlhabe		616	3,942	118,272	315,550	371.0	554
19 Ntsanalemetsing	Welgewaagd	142	909	27,264	72,740	54.5	128
20 Ngweding		136	870	26,112	69,667	56.0	122
21 Magalane		69	442	13,248	35,346	39.0	62
22 Magong	Rhenosterkraal/Ngokwane	747	4,781	143,424	382,655	424.5	672
23 Kameelboom	Mphonyoke	178	1,139	34,176	91,182	262.0	160
24 Ramosibitswana		17	109	3,264	8,708	51.0	15
Sub-Total for Saulspoort		***3,026***	***19,366***	***580,992***	***1,550,687***	***1,902.0***	***2,721***
TOTAL		9,436	60,390	1,811,712	4,833,648	4,771.0	8,490

Cost of Yard Connections	Unit Cost	Quantity	Cost
Total			
Level B	1,050	8,490	8,914,500
Mokgalwaneng Supply Block			
Level B	1,050	1,251	1,313,550
Sefikile Supply Block			
Level B	1,050	2,669	2,802,450
Ramokokstad Supply Block			
Level B	1,050	1,849	1,941,450
Saulspoort Supply Block			
Level B	1,050	2,721	2,857,050



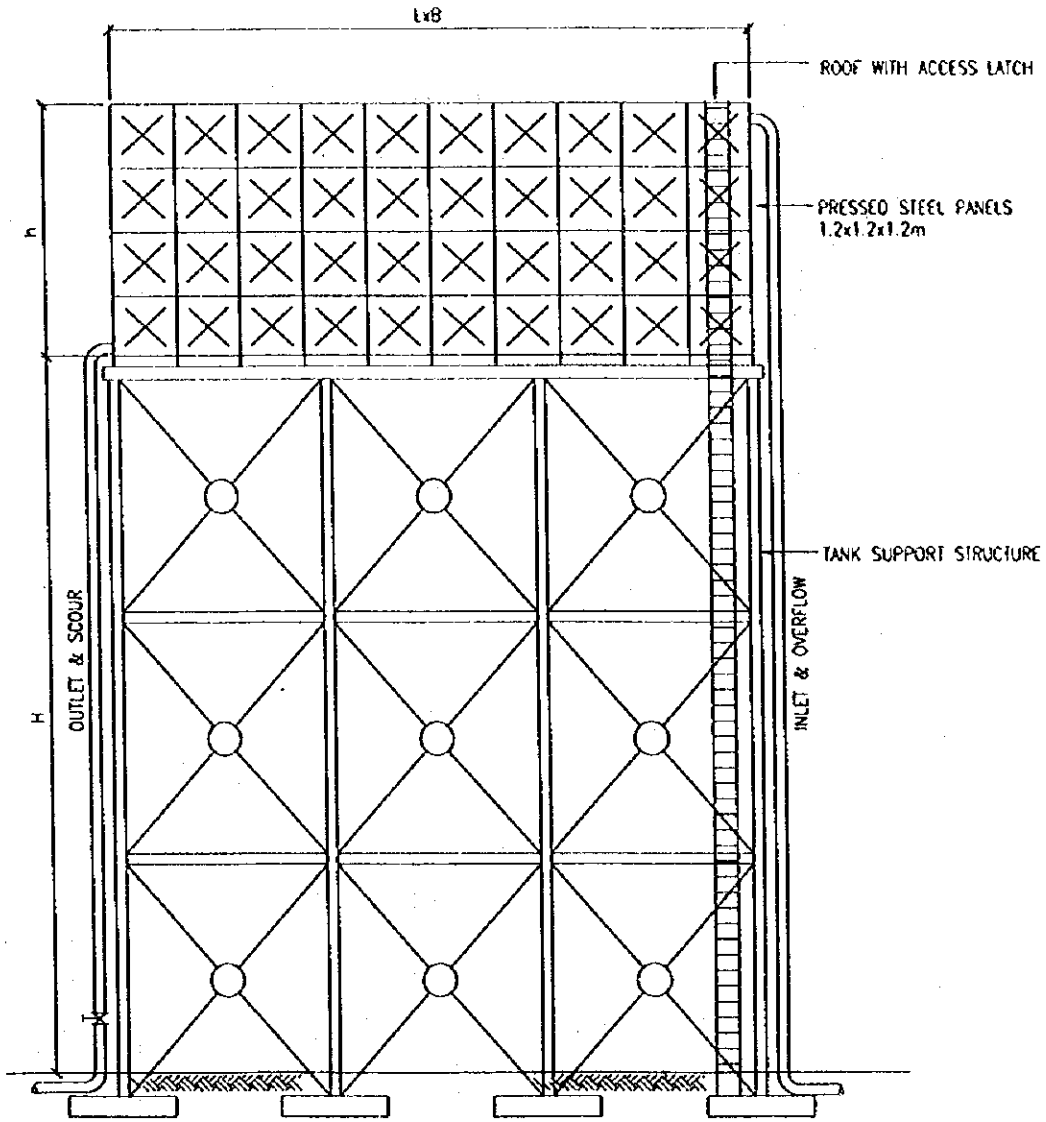
SIZE RANGE D x H(m)	CAPACITY kl
FROM: 10 x 5.4	400
TO: UNLIMITED D x 9	UNLIMITED

ELEVATION
1:50

LEGEND:

1. CONCRETE FLOOR 200mm THICK WITH UNDERFLOOR DRAINAGE SYSTEM: 75mm NO-FINES CONCRETE PLUS GEOPOPES NETWORK.
2. REINFORCED (POST-TENSIONED) CIRCULAR WALL: MINIMUM THICKNESS 300mm.
3. MOVEMENT JOINTS @ 15m, SEALED INSIDE WITH BANDAGE TYPE ELASTIC SEAL.
4. DOMED ROOF (POST-TENSIONED): SEGMENTAL OR IN-SITU CONSTRUCTION: MINIMUM THICKNESS 80mm.
5. VENTILATORS.
6. ACCESS LADDER - GALVANISED STEEL, INTERNAL STAINLESS STEEL.
7. SCOUR SUMP & PIPE 300mm dia LOCKABLE VALVE BOX.
8. TOP INLET PIPE.
9. OUTLET PIPE WITH VALVE BOX.
10. TOP OVERFLOW PIPE - 400mm dia.

FIGURE A.4-1
REGIONAL RESERVOIR



SIZE RANGE LxBxhxH(m)	CAPACITY Kl
2,4x2,4x1,2x3,0	6,9
10	650
12,2x12,2x4,8x25	

FIGURE A.4-2
SERVICE RESERVOIR

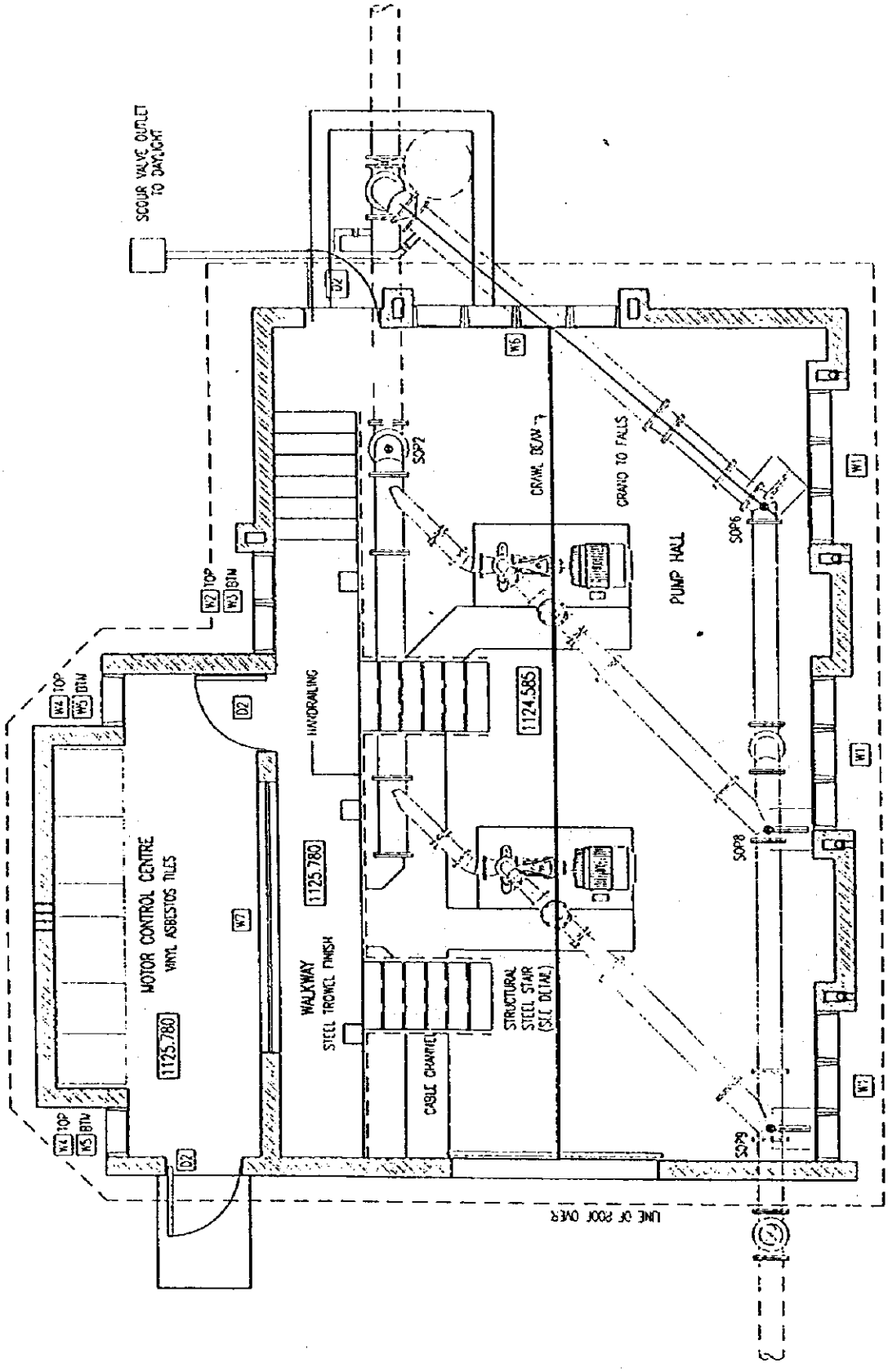


FIGURE A.4-3
PUMP STATION

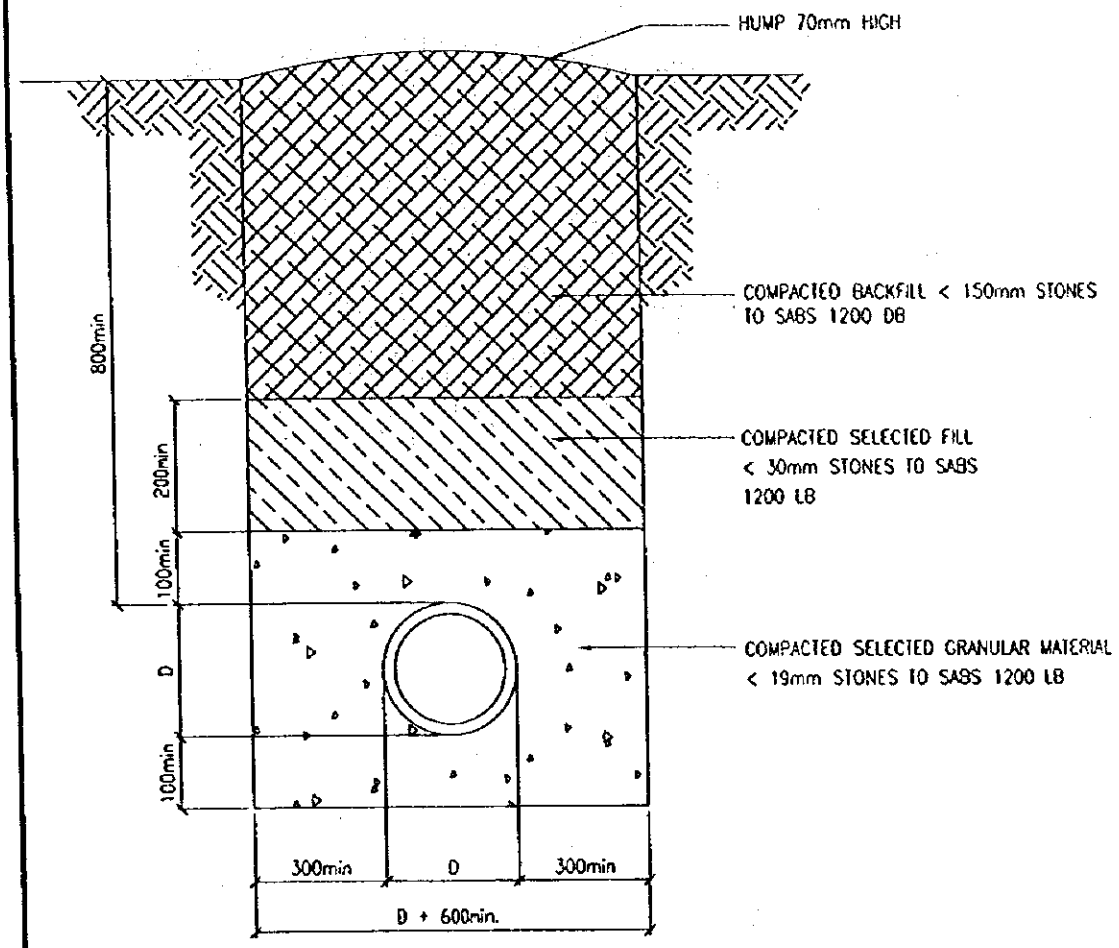
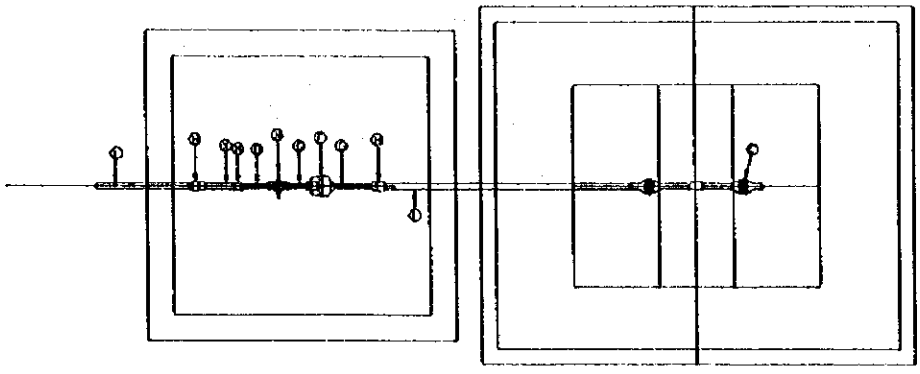
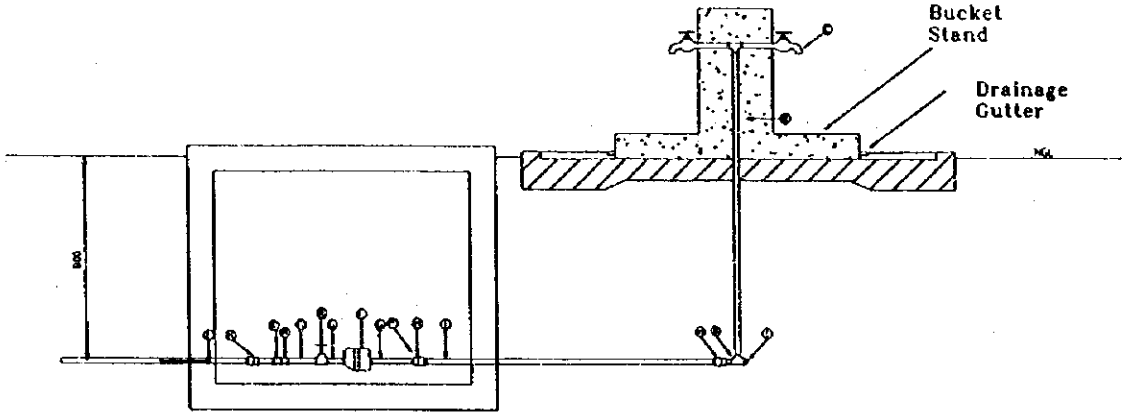


FIGURE A.4-4
PIPE TRENCH



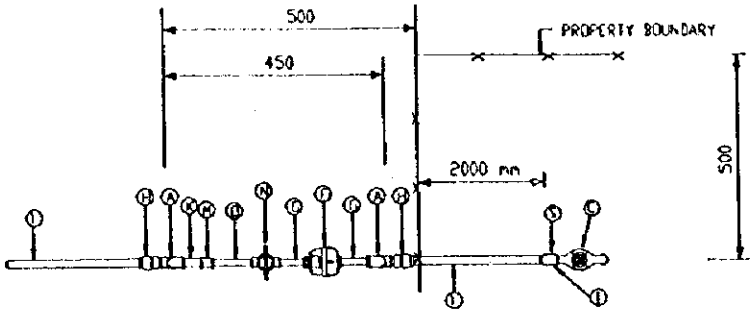
PLAN



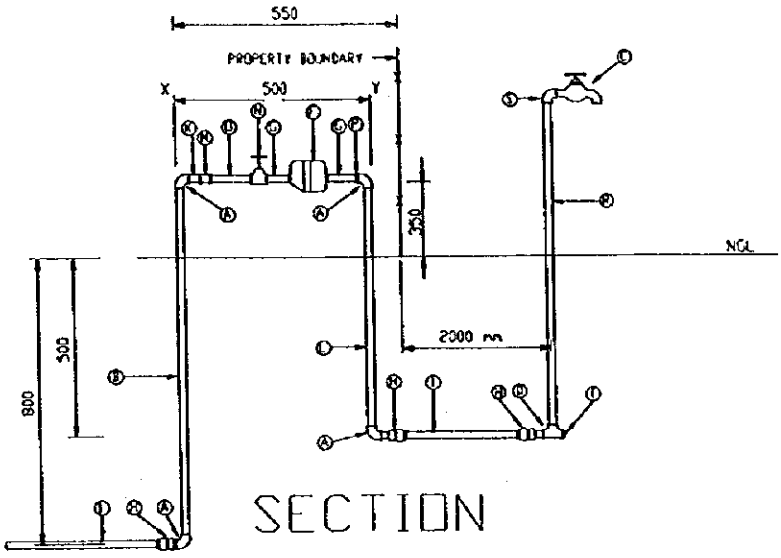
SECTION

	SINGLE CHF CONN (mm) SIZE	QTY	DESCRIPTION
A	20		90 DEG MALLEABLE CAST IRON (MCI) FEMALE ENDED ELBOW
B	20		GMS PIPE PIECE - L=1095mm
C	15		15mm ROUGH BRASS HOSE BIB TAP WITH 20mm OUTLET
D	20x15		MCI T-PIECE
E	15		KCHF PSM SIZE 3 WATER METER
F	15		GMS PIPE PIECE - L=1000mm
H	20x3/4"		PLASSON MALE COMPRESSION ADAPTOR
I	20		20 mm MALLEABLE CAST IRON PLUG
J	20		HDPE PIPE, FITTINGS NOT INCLUDED (LENGTH TO BE DETERMINED ON SITE)
L	20		GMS PIPE PIECE - L=785mm
K	20		GMS PIPE PIECE L=50mm
M	20x15		GMS REDUCING SOCKET
N	15		15mm BOSSINE BALL VALVE
O	15		GMS PIPE PIECE - LENGTH TO BE SUCH THAT DIMENSION XY= 500mm
P	15x20		GMS REDUCING BUSH
G	15		GMS 40mm TAILPIECE WITH UNION NUT
S	15		90 DEG MALLEABLE CAST IRON (MCI) FEMALE ENDED ELBOW

FIGURE A.4-5
STANDPIPE



PLAN



SECTION

	SINGLE ERF CONN (mm) SIZE	QTY	DESCRIPTION
A	20		90 DEG MALLEABLE CAST IRON (MCI) FEMALE ENDED ELBOW
B	20		GMS PIPE PIECE - L=1085mm
C	15		15mm ROUGH BRASS HOSE BIB TAP WITH 20mm OUTLET
D	20x15		MCI T-PIECE
F	15		KENT PSM SIZE 3 WATER METER
R	15		GMS PIPE PIECE - L=1000mm
H	20x3/4"		PLASSON MALE COMPRESSION ADAPTOR
I	20		20 mm MALLEABLE CAST IRON PLUG
J	20		HDPE PIPE, FITTINGS NOT INCLUDED (LENGTH TO BE DETERMINED ON SITE)
L	20		GMS PIPE PIECE - L=785mm
K	20		GMS PIPE PIECE L=50mm
M	20x15		GMS REDUCING SOCKET
N	15		15mm BOSSINI BALL VALVE
O	15		GMS PIPE PIECE - LENGTH TO BE SUCH THAT DIMENSION XY= 500mm
P	15x20		GMS REDUCING BUSH
G	15		GMS 40mm TAILPIECE WITH UNION NUT
S	15		90 DEG MALLEABLE CAST IRON (MCI) FEMALE ENDED ELBOW

FIGURE A.4-6
YARD CONNECTION

ANNEX B

ENVIRONMENTAL

FEASIBILITY STUDY FOR NORTH MANKWE

ANNEX B : ENVIRONMENTAL

B.1 TOR and Scope of ROIP

1.1 Terms of Reference

This study constitutes an assessment of the potential environmental impacts which can be expected from options considered as part of the Master Plan to expand the capacity of Magalies Water. Inevitably, development leads to modifications in the environment and negative environmental impacts, which often result from in appropriate management of development activities because of a lack of appreciation of the potential problems. All components of the environment that might be involved were identified so that appropriate ameliorative actions can be integrated with the project as a whole to obtain the best possible results.

It is important to note that the environmental study at this stage of the project preparation is at a feasibility level to prepare a prognosis of relevant issues. Accent has been placed on the impacts of the proposed pipelines and other related surface structures as these were seen as the element causing greatest concern.

Relevant data from preliminary investigation reports were extracted to provide baseline information. Additional, more detailed information was obtained to update the existing information as was presented in the ROIP 1 Report.

The construction of pipelines, reservoirs and treatment works could have an impact on the socio-economic aspects, i.e land use, settlement, infrastructure and population, and the ecological aspects, i.e. the vegetation, fauna, habitat, changes in flow regime and changes in water quality. The study was undertaken on an incremental basis with the relevant environmental impact prognosis phase 2 (ROIP 2) as the second feasibility phase.

The ROIP 2 will identify the anticipated environmental impacts and state the feasibility of the proposed options from an environmental, both ecological and socio-economical, viewpoint. The socio-economical impacts are presented in another module. The need for further more detailed studies will be identified from the data available at this point. The extent of further work needed on the ecological and socio-economical aspects will be defined in the ROIP 2 report.

1.2 Scope of the ROIP2

The ROIP 2 constitutes an assessment of the potential environmental impacts which can be expected from options for extending the water supply network in the North Mankwe Project Area.

The scope of this assessment is to investigate the environmental impacts associated with the proposed water treatment works, pipelines, reservoirs, elevated tanks and pump stations to increase the existing capacity of Magalies Water. This scheme is the preferred option which has been proposed to augment the water supply in the Project Area. Accent has been placed on the impacts of the proposed pipelines and the other surface structures as this is seen as the component likely to cause the greatest impact over the largest area.

No viable alternative surface water sources than Vaalkop Dam are available to supply the North Mankwe Area so it is proposed to supply the unserved areas from Vaalkop Water Treatment Works. Magalies Water is currently implementing a 60 Mld expansion of the treatment facilities which includes sufficient spare capacity to meet the projected primary water demands in the North Mankwe Study Area. No further additional treatment capacity is needed. In addition some of the bulk pipelines are known to have spare capacity which may be utilised however the situation is still being reviewed as part of the ongoing Phase 2 Study.

The aspects that will be addressed in this report are:

- the effect of abstraction from Vaalkop Dam and the Hex, Elands and Crocodile Rivers
  downstream of the dam.
- the impact of the construction of pipelines, pump stations, reservoirs and elevated tanks.

The main activities to be expected during the construction of the proposed developments are the following:

- Pre-construction phase: Surveying, clearing of vegetation and construction of access routes.
- Construction phase: Typical activities will be clearing of vegetation, stripping and stockpiling topsoil, excavations, disposal of excess material, transport of pipes, drilling, blasting additions or alterations to existing infrastructure and the importation of foreign workers, including their accommodation and recreational facilities.
- Post-construction and operational phase: Rehabilitation of disturbed areas,

implementation and maintenance of the pipelines, reservoirs, elevated tanks and pump stations. Also included will be the impacts on sanitation due to the increased water consumption.

B.2 Report of ROIP2

2.1 Executive Summary

2.1.1 General Project Description

The Mankwe Feasibility Study Area (Figure 1) comprises four discrete areas lying within Mankwe Magisterial District of North West Province. The four areas lie within the Crocodile River basin and also drain to the Bierspruit and Brakspruit which are tributaries of the Crocodile River. Vegetation is predominantly bushveld although a variety of veld types are represented. Average annual rainfall is approximately 420 mm and summer rainfall predominates falling mainly between October and March. Annual average evaporation is around 2,500 mm and is higher in summer than in winter and annual monthly temperatures vary from 12 to 25° C. Prevailing winds are light to moderate in a north-easterly direction, occasionally south-easterly in winter, and typical wind speeds are 2.7 to 3.8 m/s. The Area does not include any Nature Reserves or National Parks which require particular consideration from an environmental perspective.

The project components are the following and describes the proposed water supply option to the North Mankwe Study Area:

As a general principle, water from a treatment works will be pumped to a regional reservoir from where it will be distributed through bulk supply pipelines to service reservoirs which will be constructed in each community.

No viable alternative surface water sources, except water from Vaalkop Dam, are available to supply the North Mankwe Area so it is proposed to supply the unserved areas from Vaalkop Water Treatment Works. Magalies Water is currently implementing a 60 Mld expansion of the treatment facilities which includes sufficient spare capacity to meet the projected primary water demands in the Feasibility Study Area. No further additional treatment capacity is needed. In addition some of the bulk pipelines are known to have spare capacity which may be utilised however the situation is still being reviewed as part of the ongoing Phase 2 Study. The details of the

proposed infrastructure such as the need for booster pumping stations and their location, pipeline routes and the exact location of service reservoirs has yet to be determined however in general terms the communities will be supplied as follows.

The communities in the Mokgalwaneng Supply Block will be supplied from the private pipeline to the PPC cement factory west of the Study Area. This is fed from the Magalies Water pipeline between Vaalkop and Thabazimbi where it passes through Northam.

The Sefikile Supply Block will be supplied from the Magalies Water pipeline to Rustenburg Platinum Mines facility at Swartklip.

The Ramokokstad Supply Block will be supplied from a branch off the pipelines from Vaalkop WTW to the regional reservoirs at La Patrie. A scheme to supply Bojating (Elandsfontein) from this source is being implemented however this will need to be extended to connect with the proposed reticulation serving the four communities further east.

The unserved part of the Saulspoort Supply Block which comprises the fourth part of the North Mankwe Area will be served from an extension of the pipeline around the northern side of the Pilannesburg which supplies the Saulspoort communities.

This ROIP 2 gives a general overview of expected impacts and recommends further investigations to be done during the detail design phase.

2.1.2 General Environmental Description

The Study Area is predominantly bushveld with the following bushveld trees: *Acacia galpinii*, *Acacia erioloba*, *Acacia nigrescens*, *Combretum imbrebe*, *Spirostachys africana*, *Scherocarya caffra*, *Lannea discolor* and *Ficus natalensis*. The other types of vegetation which are present in this region are Turf Thornveld (which is also present on the eastern side of the Study Area on the north western banks of the Elands River), Kalahari Thornveld and Sandy Grassveld. Turf Thornveld is a naturally open thornveld, which tends to thicken as a result of poor grazing practices.

The proposed pipelines within existing road or pipeline reserves are not seen as areas of major impact as the areas are seen as having low aesthetic values and a highly disturbed

natural environment. Construction activities could cause further disturbance of the area, which could result in the infestation of invasives which could be transported to the area in a number of ways.

The conservation status of the rivers is likely to be poor in most instances, as all the rivers are regulated by dams and weirs. The impact on the rivers as a result of the proposed project is seen as negligible although it will depend on future management of the dams and future return flows from the catchments.

2.1.3 Important Environmental Impacts

(1) Negative impacts:

The list of disadvantages that could arise due to the construction of the pipelines and related surface works are presented. This is a comprehensive list and many of these impacts are not considered to be severe.

a. The construction of the pipelines and its related infrastructure could:

- cause disturbance within the existing road reserves;
- have a negative impact on the aesthetic value of an area;
- cause erosion on the exposed slopes;
- cause/accelerate the invasion by exotic terrestrial plants;
- cause disturbance of a section of the river channels where pipelines crosses the channels;
- cause increased sediment loads within the rivers.
- noise pollution;
- water pollution;
- the introduction and encroachment of alien plants;
- inconveniences to affected local farmers and other local residents;
- social disruption;
- inconveniences to affected road users.

All these impacts are of a temporary nature during construction except for the invasion of exotic terrestrial plants.

b. Three technical alternatives were evaluated during the Master Plan stage. As part of this Feasibility Study, those alternatives were re-examined using the Case B water demand. At Service Level B (Case B) 90 % of households will be supplied through yard connections (85.6 lcd) and the remaining 10 % through stand pipes (30 lcd) in accordance with the RDP level of service, giving a weighted average per capita consumption rate of 80 litre per capita per day including an allowance of approximately 15 % for leakage.

c. At present very little information is available on the occurrence of archaeological and historical sites and a field survey is proposed before any construction is started.

In summary, the major negative impact includes the disturbance of an already highly disturbed area of low ecological value, coupled with a low conservation status and aesthetic value.

No fatal flaw has been found that renders the proposed project non-viable from an environmental impact point of view but certain aspects must be addressed in more detail in later phases of the project.

(2)Positive impacts:

a. A reliable water supply to an increased number of people in the Project Area.
b. The construction activities could cause temporary economic upliftment in the immediate vicinity.

2.1.4 Conclusion

The construction of pipelines and related infrastructure will not cause substantial disturbance. The environmental consequences associated with these impacts are not considered to be significant if managed during and after construction as stipulated in the environmental management plan.

The impacts of abstraction from dams on the dam itself and downstream of the dams are not considered to be insignificant, but with a degree of uncertainty.

2.1.5 Recommendations

The issues to be determined in the detail design phase of the schem are summarised as follows:

(1)Social impacts

- The social and economic impacts associated with construction disturbances on the farming activities along the pipeline routes.
- This investigation should include meetings with the local communities to determine the preferences of the communities to any options or alternative developments, especially in the siting of the regional and service reservoirs.
- The lack of existing sanitation facilities need to be investigated.

(2) Ecological impacts

- A Phase 1 archaeological survey of the proposed pipeline routes and especially the reservoir sites are recommended.
- General rehabilitation measures.
- Identify birds and their nesting sites where appropriate.
- Liaise with all the interested and affected parties.
- Compile an Environmental Management Plan for the construction phase and draw up appropriate rehabilitation guidelines to mitigate the disturbances and aesthetic impacts caused by the construction of the pipeline and associated infrastructure.
- Alert the contractor and labourers to the ecological and social impacts associated with the construction activities.
- Landscaping specification for the river and canal crossings as well as the permanent access roads.

2.2 Terminology

Abbreviations used in the ROIP 2 are the following (for the purpose of simplicity some Afrikaans abbreviations are used in the English version of the ROIP):

AV	AVERAGE
DCD	DATA CONFIDENCE DEGREE
EC	ELECTRICAL CONDUCTIVITY
ENDAN	ENDANGERED
IEM	INTEGRATED ENVIRONMENTAL MANAGEMENT
IMP	IMPORTANCE
INDETERM	INDETERMINATE
ISD	IMPACT SEVERITY DEGREE
MAP	MEAN ANNUAL PRECIPITATION
MAR	MEAN ANNUAL RUNOFF
MAX	MAXIMUM
MIN	MINIMUM
MCD	MITIGATION IMPACT CONFIDENCE DEGREE
MDC	MITIGATED DATA CONFIDENCE
MID	MITIGATED IMPACT DEGREE
ROIP	Relevante Omgewingsinvloedprognose - RELEVANT ENVIRONMENTAL IMPACT PROGNOSIS
SCD	SEVERITY CONFIDENCE DEGREE
SRCE	SOURCE OF INFORMATION
TDS	TOTAL DISSOLVED SALTS
VULNER	VULNERABLE

2.3 Main Report of ROIP 2

Chapter 1 Introduction

The Department of Water Affairs and Forestry (DWAF) follows a procedure of Integrated Environmental Management (IEM) for all proposed developments. This IEM procedure consists of certain successive levels of impact studies of which the Relevant Environmental Impact Prognosis 2 (ROIP - the Afrikaans acronym), which relates to a feasibility phase, is the second.

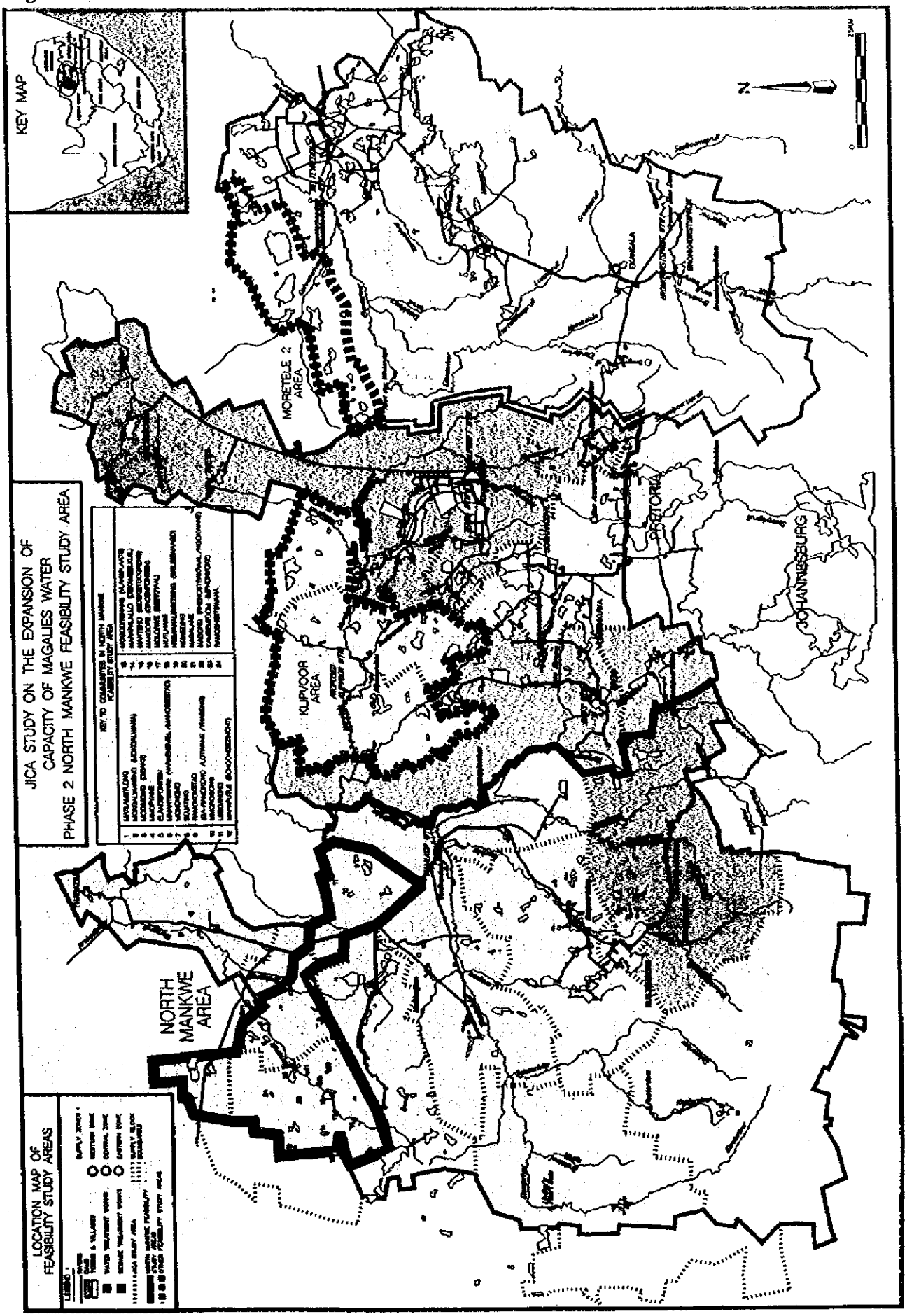
The numerical values used in the ROIP are as follows:

SOURCE (Column 3):		The source of the information given in column 3 is given a letter which correlates with the source, as listed in the references.
DCD (Column 4)	:	Data Confidence Degree is rated on a scale from 0 to 4 from no data available with unreliable conclusions to data sufficient and adequately verified.
ISD (Column 5)	:	Impact Severity Degree relates to the severity of the proposed scheme on the aspect that is being evaluated and is rated on a scale from 0 to 4 with 0 being no impact and 4 being an impact of the most important significance.
SCD (Column 6)	:	Severity Confidence Degree of the identified impact is rated so that the reliability increases with an increase in numeric value, on a scale from 0 to 4. Source of the mitigation measure relates to the listed reference.
MDC (Column 8)	:	Mitigation Data Confidence is rated on a scale from 0 to 4, with totally reliable information receiving a rating of 4 and totally unreliable information receiving a rating of 0. This refers specifically to an evaluation of the suggested mitigation measure.
MID (Column 9)	:	Mitigated Impact Degree or impact (as determined in column 5) after mitigation is rated on a scale from 0 to 4, with a severe impact after mitigation receiving a rating of 4 and no impact after mitigation receiving a rating of 0.
MCD (Column 10)	:	Mitigation Impact Confidence Degree of the proposed mitigation increases with an increase in numeric value, on a scale from 0 to 4.
ADVANTAGES:		
1	:	Unimportant advantage
2	:	Medium important
3	:	High important
FURTHER WORK:		
1	:	Necessity of work needs to be determined (low or high importance)
2	:	Medium priority work - to be undertaken after an option is deemed acceptable
3	:	High priority - to be undertaken immediately - before determining the preferred option/acceptability of any option

Chapter 2 Locality of the Area

The attached figure-1 illustrates location of the Project Area

Figure 1 : Location Map

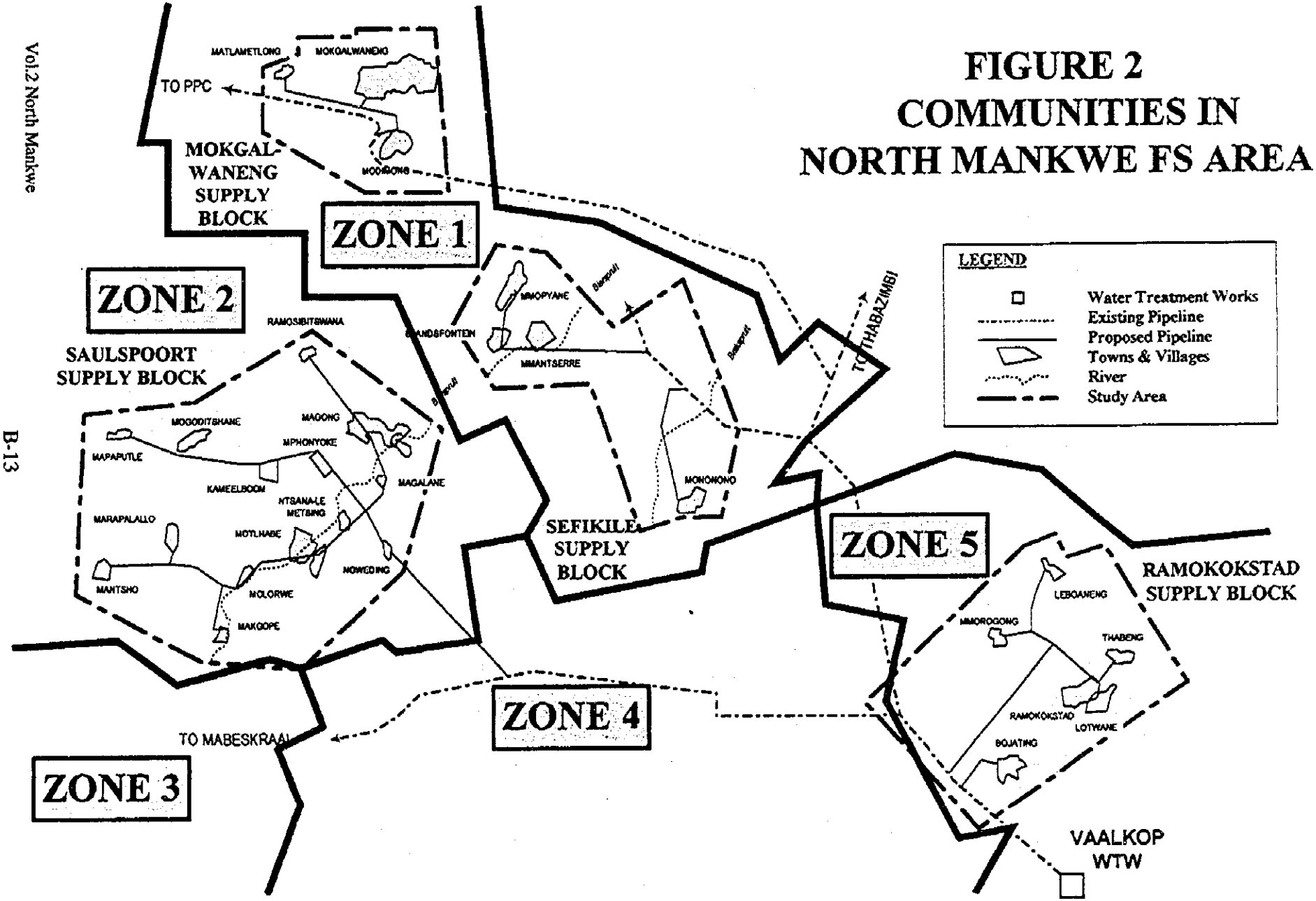


NO	COMPONENT	DATA DESCRIPTION	SRCE
3.1	NAME OF SCHEME	Study on the Expansion of the Capacity of Magalies Water	1
3.2	PURPOSE OF THE PROJECT	To confirm the feasibility of planning for the three selected priority areas (North Mankwe, Klipvoor and Moretele 2) North Mankwe will be discussed in this ROIP 2 document	i
3.3	STARTING DATE	1997	
3.4	COMPLETION DATE	1997	
3.5	WHITE PAPER NO	Not applicable	
3.6	PLANNING REPORT	Interim Report, July 1997	2
3.7	COSTS (R X 10^6)	Not applicable	-
3.8	LOCALITY		
	Province	GAUTE / MPUM / NP / NWP	
	Districts	Moretele 2, Brits, Moretele 1, Odi 1, Mankwe, Bafokeng, Rustenburg, Koster, Swartruggens, KwaNdebele, Cullinan, Bronkhorstspruit, Wonderboom, Waterberg (part), Thabazimbi (part) and Warmbath (part)	
	Game-, Nature Reserve, Wilderness Area, National Heritage site (Study Area)	Rust de Winter Dam, Klipvoor Dam, Pilanesberg, Roodeplaat Dam and Hartbeespoort Dam	

3.1 Project Detail

No viable alternative surface water sources, except water from Vaalkop Dam, are available to supply the North Mankwe Area so it is proposed to supply the unserved areas from Vaalkop Water Treatment Works (Figure -2). Magalies Water is currently implementing a 60 Mld expansion of the treatment facilities which includes sufficient spare capacity to meet the projected primary water demands in the Feasibility Study Area. No further additional treatment capacity is needed. In addition some of the bulk pipelines are known to have spare capacity which may be utilised however the situation is still being reviewed as part of the ongoing Phase 2 Study.

FIGURE 2
COMMUNITIES IN NORTH MANKWE FS AREA



The details of the proposed infrastructure such as the need for booster pumping stations and their location, pipeline routes and the exact location of service reservoirs has yet to be determined however in general terms the communities will be supplied as follows.

The communities in the Mokgalwaneng Supply Block will be supplied from the private pipeline to the PPC cement factory west of the Study Area. This is fed from the Magalies Water pipeline between Vaalkop and Thabazimbi where it passes through Northam.

The Sefikile Supply Block will be supplied from the Magalies Water pipeline to Rustenburg Platinum Mines facility at Swartklip.

The Ramokokstad Supply Block will be supplied from a branch off the pipelines from Vaalkop WTW to the regional reservoirs at La Patrie. A scheme to supply Bojating (Elandsfontein) from this source is being implemented however this will need to be extended to connect with the proposed reticulation serving the four communities further east.

The unserved part of the Saulspoort Supply Block which comprises the fourth part of the North Mankwe Area will be served from an extension of the pipeline around the northern side of the Pilannesburg which supplies the Saulspoort communities.

3.2 Special Remarks

This ROIP 2 gives an overview of expected impacts and recommends further environmental investigations to be done during the detail design phase.

NO	COMPONENT	DATA DESCRIPTION	SRCE
4.1	State of habitat disturbance	See remarks	1, 3, 4
4.2	Ground cover	See remarks	5
4.3	Game-, Nature Reserve, Wilderness Area, National Heritage Site	None	5
4.4	Aesthetic value	See remarks	1, 3
4.5	Land use	See remarks	1, 2

REMARKS

4.1 - The proposed development is within a rural development area where the roads and housing facilities have already disturbed the area from its original state.

- The route of the proposed pipelines are where possible along existing pipeline routes and road reserves. These areas are already disturbed.
- The pump stations, reservoirs, elevated tanks are also along the pipeline routes and one could assume at least some form of habitat disturbance.

4.2 - The Study Area is predominantly bushveld with the following bushveld trees: *Acacia galpinii*, *Acacia erioloba*, *Acacia nigrescens*, *Combretum imbrebe*, *Spirostachys africana*, *Scherocarya caffra*, *Lannea discolor* and *Ficus natalensis*. The other types of vegetation which are present in this region are Turf Thornveld (which is also present on the eastern side of the Study Area on the north western banks of the Elands River), Kalahari Thornveld and Sandy Grassveld. Turf Thornveld is a naturally open thornveld, which tends to thicken as a result of poor grazing practices.

4.4 - Many parts have low aesthetic value due to the rural development taking place.

- The major land use in the area is agriculture, rural development and natural veld.

Chapter 5 Description of the Impacts of the Proposed Development

5.1 Physical Environment

5.1.1 Climate

NO	COMPONENT	DATA DESCRIPTION								DATA SRCE	DATA DCD
a.	WIND Prevailing wind directions										
	summer:	N	NE	E	SE	S	SW	W	NE	2	2
	winter:	N	NE	E	SE	S	SW	W	NW	2	2
b.	TEMPERATURE (?C) Summer: Winter:	Adv		Max		Min					
c.	RAINFALL (mm per year)	MAP = 420				SUMMER		WINTER		6	2

MEASURING STATION : LOCALITY

The following representative weather stations were used in the study: Marble Hall, Warmbad, Pilanesberg and Pretoria.

a. Wind:The prevailing wind direction is south-east and typical wind speeds are 2,7 to 3,8 m/s.

b. Temperature: The annual monthly temperatures vary from 12?C to 25?C.

c. Rainfall: The average annual rainfall is approximately 420 mm. Annual average evaporation is over 2 500 mm and is higher in summer than in winter.

5.1.2 Geology

NO	COMPONENT	DATA DESCRIPTION	DATA SRCE	DATA DCD
	GEOLOGY	See remarks	7	2

REMARKS

- See the report on the geology for detailed information [7]. The geology will however

not be impacted upon by the proposed development.

5.1.3 Topography

NO	COMPONENT	DATA		IMPACT		MITIGATION			
		SRCE	DCD	ISD	SCD	SRCE	MDC	MID	MCD
	TOPOGRAPHY	5	2	0	3	Not applicable			

DATA

- The majority of the pipeline routes follow the road and existing pipeline routes and are within an existing reserves.

IMPACT

- The pipeline will be buried and therefore there will be no impact on the topography.

5.1.4 Soils

NO	COMPONENT	DATA		IMPACT		MITIGATION			
		SRCE	DCD	ISD	SCD	SRCE	MDC	MID	MCD
a	SOIL SERIES/TYPE	7	2	Not applicable					

DATA

- **Soil series/type** :The soil types occurring within the Project Area are diverse and complex. This is due to the variety and the complex distribution of rock types in the Project Area and the fact that the geological substratum generally enjoys a close relationship to soil and land type. See the report on the soils for detailed information[7]. The project will not have an impact on the soils but the soils may have an impact on the project and need to be examined before detailed design takes place.

IMPACT

- Construction activities on slopes could trigger and accelerate soil erosion.

MITIGATION MEASURE

- Careful planning of construction activities accompanied by landscape rehabilitation measures in the immediate vicinity of the pipeline could minimise the problems associated with erosion.

- The topsoil which is removed during construction should be replaced after construction. The seeds in the topsoil will accelerate the rehabilitation process.

IMPACT AFTER MITIGATION

- Success of the landscape rehabilitation measures on the pipeline routes are likely to be relatively high, especially if the topsoil removed during construction is replaced with that same topsoil. The impact after mitigation is likely to be relatively low.

SOILS		SRCE	IMP
FURTHER WORK	? Landscape rehabilitation measures should be determined ? Problem soil areas need to be investigated	3	2
ADVANTAGES	Not applicable	3	-

5.1.5 River Characteristics

NO	COMPONENT	DATA		IMPACT		MITIGATION			
		SRCE	DCD	ISD	SCD	SRCE	MDC	MID	MCD
a1	FLOW REGIME - see data	1, 8	2	3	2	3	2	2	2

DATA

- The Project area lie within the Crocodile River catchment. Vaalkop Dam is situated at the confluence of the Hex, Elands and Crocodile Rivers.

IMPACT

- Dams will probably not have much less water as most of the water extracted from the dam will be from the incremental increase of return flows from the catchment to the system.

MITIGATION MEASURE

- If a situation should develop where overflow is less frequent appropriate water releases for the downstream environment may be a solution. This could however impact on the availability of water for the other downstream users.

IMPACT AFTER MITIGATION

- The impact after mitigation will be decreased, but the confidence level is low.

NO	COMPONENT	DATA		IMPACT		MITIGATION			
		SRCE	DCD	ISD	SCD	SRCE	MDC	MID	MCD
a2	FLOW REGIME - Pipeline	3	2	1	3	3	1	0	3

DATA

- The pipelines will have an impact on the river flows during construction as it crosses the rivers. The pipelines will be buried and will only cause a temporary obstruction of flow which is negligible.

IMPACT

- The flow in the rivers will be temporarily disrupted during construction at the site where the pipeline crosses the river. The whole river bed will not be closed off, but only half of it at any given time during construction.

MITIGATION MEASURE

- Work in the river bed should be done during low flow periods such as during the winter months. Only half of the river bed should be closed off at any given time and all obstructions cleared after construction.
- Areas of construction disturbance should be clearly defined, so as to minimise the impact on the flow regime.

IMPACT AFTER MITIGATION

- The impact after mitigation will be insignificant as after construction the flow regime should not be modified.

NO	COMPONENT	DATA		IMPACT		MITIGATION			
		SRCE	DCD	ISD	SCD	SRCE	MDC	MID	MCD
b	SEDIMENT LOAD	9	3	2	3	3	3	0	3

DATA

- The vegetation and stone/rock cover at the site where the pipelines crosses the rivers will be removed exposing the bottom alluvium of the river bed thus potentially increasing the sediment load of the river in that particular area.

IMPACT

- Construction activities within a section of the river will disturb riverine habitats and lead to increased sediment loads entering the river. This is a short term impact.

MITIGATION MEASURE

- Work in the river bed should be done during low flow periods such as during the winter months. Only half of the river bed should be closed of at any given time.
- Disturbance within the river channel should be minimised and appropriately rehabilitated

IMPACT AFTER MITIGATION

- The impact after mitigation will be insignificant.

RIVER CHARACTERISTICS		SRCE	IMP
FURTHER WORK	Landscaping specifications required for erosion protection, specifically at the river and canal crossings	9	2
ADVANTAGES	Not applicable	3	-

5.1.6 Water Quality

Vaalkop Dam

SRCE	DCD	PARAMETERS					
10	3	TEMP	pH	EC	TDS	PO_4 as P	$NO_3 + NO_2$ as N
UNIT		?C		$mS.m^{-1}$	mg/l	mg/l	mg/l
Minimum		-	7.5	36.2	255	<0.005	0.05
Median		-	8.2	52.3	380	0.023	0.20
Mean		-	8.2	58.9	420	0.028	0.22
90%		-	8.5	83.0	608	0.042	0.28
Maximum		-	8.6	88.3	678	0.155	0.70
ISD			1	1	1	1	1
SCD			3	3	3	3	3
MID			0	0	0	0	0
MCD			2	2	2	2	2

REMARKS

- Water quality records of the Department of Water Affairs and Forestry were used for information of the present water quality monitoring systems in the Project Area.
- The project will have no impact on the water quality but the water quality may have an impact on the project. If the water quality deteriorates, the purification costs will increase. The water quality changes that will take place will depend on the present and future land use activities.
- The water is generally of a good quality for domestic use although not always within the Ideal water quality guideline ranges as specified in the guidelines for domestic use(11). No comments can be made on the bacteriological and other biological qualities of the water as not data are available.
- The quality of ground water in the Project Area is generally poor[2].
- The increase of the availability of drinking water in the Study Area may have an impact on the sanitation of the area. As no sanitation facilities exist it is expected that the area could be negatively impacted by the increase of water. It is expected that the waste and excess water will be discarded randomly. The areas surrounding the houses and stand

pipes may become wet depending on the drainage potential of the soils in the area. This may also lead to an increase in the potential for polluting the surface water in the area. Depending on the soils and the groundwater potential of the area it may also impact the groundwater quality of the area. The lack of sanitation facilities can also have a health implication for the communities.

WATER QUALITY		SRCE	IMP
FURTHER WORK	Water quality monitoring programme should be established	3	2
ADVANTAGES	Not applicable	3	-

5.2 Aesthetics

NO	COMPONENT	DATA		IMPACT		MITIGATION			
		SRCE	DCD	ISD	SCD	SRCE	MDC	MID	MCD
a	EXCEPTIONAL	Not applicable							

NO	COMPONENT	DATA		IMPACT		MITIGATION			
		SRCE	DCD	ISD	SCD	SRCE	MDC	MID	MCD
b	HIGH	Not applicable							

NO	COMPONENT	DATA		IMPACT		MITIGATION			
		SRCE	DCD	ISD	SCD	SRCE	MDC	MID	MCD
c1	LOW : Dams	3	2	0	1	Not applicable			

DATA

- The aesthetics of the Project Area is generally low as most of the area is developed into rural settlements.

IMPACT

- The riparian vegetation may possibly be impacted by additional abstraction from dams if there are less frequent spills from the dam walls. This impact is expected to be negligibly small.

MITIGATION MEASURE

- No mitigation measures will be possible from the project point of view, except perhaps improving the operating rules of the dams.

NO	COMPONENT	DATA		IMPACT		MITIGATION			
		SRCE	DCD	ISD	SCD	SRCE	MDC	MID	MCD
c2	LOW; Pipeline routes	3	3	2	3	3	3	0	2

DATA

- Some of the pipeline routes are in areas that have been developed and these areas are of a relatively low aesthetic value. The status of the proposed areas for reservoirs are not always low and special care should be taken in the final siting of the reservoirs.

IMPACT

- The construction of the pipeline in the road reserve will cause some disturbance and scar the roadside on a temporary basis rather than a permanent basis as the pipeline will be buried.
- The manholes with section, air and scour valves will be visible.
- The construction of the reservoirs, elevated tanks and pump stations will cause some disturbance and will have to be sited carefully because they will be a permanent feature on the landscape.
- The disposal of domestic and construction wastes will have a negative impact on the surrounding area.

MITIGATION MEASURE

- Appropriate rehabilitation procedures should be detailed to reduce the disturbance of the pipeline. The placing of the reservoirs, elevated tanks and pump stations should be done in such a manner as to make them as inconspicuous as possible.
- The location of waste dumps and spoil heaps, as well as the development of an appropriate protocol for the disposal of wastes, requires careful attention.

IMPACT AFTER MITIGATION

- It is likely that the disturbances associated with the construction of the pipelines can be almost totally mitigated except for the section, air and scour valves at manholes and the other surface structures.

AESTHETICS		SRCE	IMP
FURTHER WORK	- Suitable rehabilitation measures to be identified and enforced. - Remedial works for the rehabilitation of disturbed areas should be planned as an integral part of the project.	9	2
ADVANTAGES	Not applicable	3	-