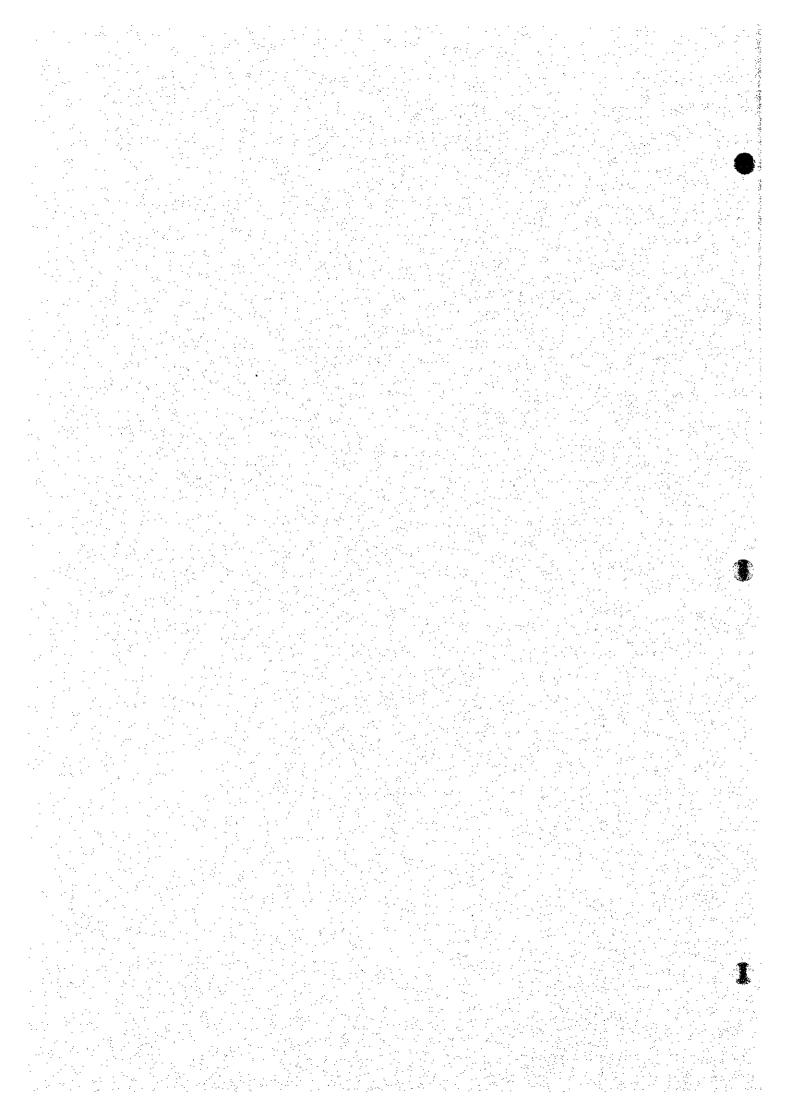
# THE STUDY ON WATER SUPPLY FOR SEVEN TOWNS IN EASTER PROVINCE IN THE REPUBLIC OF KENYA

APPENDIX L

PRELIMINARY COST ESTIMATES





# APPENDIX L PRELIMINARY COST ESTIMATES

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#### 1 UNIT CONSTRUCTION PRICES

A review of current construction prices in Kenya has been conducted, based on a combination of recent tender rates for the construction of similar works, and suppliers quotations for materials.

The unit rates derived from this review are given in *Table L-1*. These rates have been used to make a preliminary estimate of construction costs for the works identified under this Master Plan phase of the study. The table also provides "all in" costs for concrete, pipeline construction using different materials and estimates for the costs of standard reservoir sizes.

Preliminary and general items have not been included in the unit rates, as these will generally differ between different locations, and for different types of construction contracts. These have therefore been estimated separately for each scheme.

The base date for the costs is October 96, with an exchange rate of 1 US\$ = 56 Kshs.

#### 2 CONSTRUCTION COST ESTIMATES

Quantities have been taken off for each of the proposed schemes, and bills of quantities priced using the above unit construction prices, to prepare preliminary cost estimates of the proposals to meet the 2010 water demand requirements. Preliminary bills of quantities are included on the cost estimate sheets attached to this Appendix, with a separate breakdown for each treatment works. The treatment plant quantities are given for full treatment in each case, regardless of level of treatment proposed, so that the impact of changing the level of treatment, on costs, can be readily estimated. The costs of the proposed level of treatment only however, has been carried forward to the scheme estimates.

The resultant estimates are summarised on *Table L-2*. This indicates that the cost per capita averages at about US \$ 62 per capita, with 70% of the costs incurred during the initial phase, 20% during the second phase and 10% spread evenly over the design horizon for the construction of annual extensions to the distribution system.

The main costs are related to the transmission and distribution systems, followed by treatment, the costs of raw water pipelines and storage.

The electrical and mechanical components of the schemes represent less than 5% of the total, due to the conceptual basis of the designs to reduce operation and maintenance costs to a minimum.



#### 3 RECURRENT COSTS

#### (1) Operation and Maintenance

Historic levels of operation and maintenance costs have generally been low. However, to safeguard investments so that they continue to provide a reliable service for their expected lifetimes, it is advisable to budget for higher levels of maintenance costs. The 1986 Design Manual suggests guidelines for annual maintenance budgets which are in reasonable agreement with figures used in other developing countries. These are based on a percentage of the investment costs, which can be simplified to the following categories:

Annual maintenance cost
as % of investment costs
1%
1%
5%

The actual maintenance costs will tend to increase as the assets become older. However, the above rates represent a reasonable average to be expected over the asset lifetime, and have therefore been applied to the investment costs to arrive at the annual maintenance cost of assets.

#### (2) Economic Life

All assets have an economic lifetime, after which it is no longer considered economic to maintain them. The 1986 Design Manual provides the following guidance:

Asset	Economic Lifetime
	Years
Civil works	30
Pipelines	30
Electrical & Mechanical works	
(assuming electrical power)	10

These economic lifetimes are again similar to those used in other developing countries, although they are much lower than those currently used in most developed countries. This is probably due to the harsher conditions in developing countries, and the higher levels of training and commercialisation in developed countries.

#### (4) Power Costs

Power costs are not generally very significant for the proposed schemes, due to the fact that they are all designed for gravity flow. Power however will be required for treatment plant site lighting and for backwashing. The annual costs have been calculated using the Kenya Power and Lighting Tariff Method B1, (Oct 1996) for supplies metered at a pressure of 240 volts single phase, or 415 volts three phase as follows:

- 1) a fixed charge of Shs 500 per month
- 2) unit consumption charge of Shs 4.40 per unit
- 3) Shs 250 per month per KVA of demand.

### (5) Staffing Costs

Staffing requirements have been estimated for each treatment plant and distribution system. Staffing includes for local management, meter reading, billing and collection for each individual scheme, but does not include Ministry overheads at District and National headquarters. The annual projections are shown, using similar salary scales as currently applicable for Government staff, in the individual scheme cost estimate sheets attached to this appendix.

### (6) Chemical Costs

Chemical costs have been estimated using current unit costs for supply of chemicals, as quoted by suppliers, and using dosage rates appropriate to the raw water quality for each scheme. The cost per m3 of treated water range from Shs 0.7 per m3 for chlorination alone, to Shs 1.3 per m3 when Aluminium sulphate (Alum) is added at a dosage rate of 20 mg/l. The annual cost of chemicals for each scheme is given in the cost estimate sheets for the individual schemes.

## (7) Transport

The cost of some basic transport has also been included in the annual projections. Replacement of vehicles has been assumed to be every 5 years, and an operation and maintenance budget amounting to 20% of vehicle costs per annum has been allowed.

**TABLES** 

**\*** 

## Table L-1 Unit Construction Prices

	Exchange ra	ite				Oct-96		1US \$ =	56	Shs
	Preliminarie	s and Gene	eral Items ar	e NOT inclu	ided within the	following rat	es			
ieneral Ite										Rate Shs 35
	General exc	avation in n	iormal mate	rial not exce	eding 3.0m de	epth			m3 m3	1,50
	EQ for rock.	for dame	Soft						m3	1
	Earthworks	for dams -	Rock			**1			m3	1,0
	Earthfill for o	lams							m3	3
	Filter/draina	ge material	for dams						m3	1,5
										1,6
										8,0
	Concrete Cl	ass 30	_						m3	12,00 6,00
	Mass concre	ete tot dam	S						tonne	65,0
	Formwork F	:11							m2	4
										7
	Blockwork v	alling	.,		.,					1,2
	"All in' cost	for reinforc	ed concrete			*******			m3	20,1
ipswork							г			
ssumptio					9			uPVC	Steel	
								10% 15%	0% 15%	1:
								15%	15%	21
								5%	1%	-
									mm + nomin	
								1200	mm + nomina	al dia.
									10%	
									15%	
PVC Pipe	elines		Materials de				"All in" pipe c		5.46	
	Trench	Lay, joint	uPVC	uPVC	uPVC	uPVC	uPVC	uPVC	uPVC	uP
Dia	Excav'n	etc	6 bar	9 bar	12 bar	15 bar	6 bar	9 bar	12 bar Shs/m	15 Shs
ന്ന	Shs/m	Shs/m	Shs/m	Shs/m	Shs/m	Shs/m	Shs/m	Shs/m	Sustin	Site
63	482	40	75	125	155	200	597	647	677	<del>,</del>
90	1 1	60	187	242	298	365	757	812	868	٤
110	1	60	252	362	442	562	843	953	1033	11
160	1	100	506	747	943	1155	1191	1432	1628	18
225	659	140	1000	1380	1825	2104	1799	2179	2624	29
280	725	180	1450	2125	2504	3262	2355	3030	3409	41
315	1 1	200	1837	2660	3374	4124	2806	3629	4343	50
400	880	280	3074	4374	l		4234	5534	L	<u>-</u> -
المعمل معط	Di Dinalina		Materials d	alivarad to s	ito		"All in" pipe c	osts		
teel and	DI Pipeline Trench	Lay, joint	ivialendis u	slivered to s	Steel	DI	All III pape e	0313	Steel	
	Excavin	etc							[	
	Shs/m	Shs/m			Shs/m	Shs/m			Shs/m	Shs
dia	1		··							
80		70			i	1235				18
100	1 1	90			1115	1518			1725	21
150	1 1	140			2049	2285			2763 3984	29 39
200		200			3154	3080 4073			5357	50
250		260			4408 5794	4073 5166			6864	6:
300 350	1 1	320 380			7301	6386	1		8495	7:
400	1 1	450	1		8921	7663			10251	89
400	1 1	510	1		10036	9097	1		11495	10
450		580	[		11152				12752	<b>.</b>
450 500										
							<del>,</del>			·
500	rs	50	100	150	200	250	300	400	500	2 200
500 <b>Reservoir</b> Capacity (	(m3)			940,000	1,070,000	1,290,000	1,520,000	1,940,000	2,350,000	3,360,0
500 Reservoir Capacity ( 'All in' co	(m3)	550,000	780,000			E 160	5,067	4,850	4,700	4,4
500 Reservoir Capacity ( 'All in' co	(m3)		780,000 7,800	6,267	5,350	5,160		L	<del></del>	
500 Reservoir Capacity ( 'All in' cor Cost/m3	(m3) sts	550,000	1 1		5,350	3,100	· · · · · · · · · · · · · · · · · · ·			
500 Reservoir Capacity ( 'All in' cor Cost/m3	(m3) sts	550,000 11,000	7,800	6,267			Unit	rale		<del></del>
500 Reservoli Capacity ( 'All in' co Cost/m3 Borehole Basic cos	(m3) sts s s ts for 50 m d	550,000 11,000 eep boreho	7,800	6,267			Unit Lurnp sum	rale 87,500	quantity	87.5
Fleservoir Capacity ( 'All in' cost/m3  Borehole Basic cost Additional	(m3) sts s ts for 50 m d I costs for de	550,000 11,000 eep boreho	7,800	6,267			Unit Lump sum m	rale 87,500 875	quantity 1 50	Arno 87,5 43,7
Reservoir Capacity ( All in* co Cost/m3 Borehole Basic cost	(m3) sts s ts for 50 m d I costs for de	550,000 11,000 eep boreho	7,800	6,267			Unit Lurnp sum	rate 87,500 875 37340	quantity 1 50 50	87.5



Flow(I/s) . (I/s)

(l/s)



Head (m) Efficiency (m) (effy) (effy)

(m)

kW (l/s) x (m)/(102 x (effy) (l/s) x (m)/(102 x (effy)

Estimated costs Shs x 1,000 400 x KW^.675 360 x KW^.6

Table L-2 Summary of Investment and Operational Cost

Scheme		I	nvestment	Cost US	S\$ x 1,000			
	Meru	Nkubu	Isiolo	Chuka	Chogoria	Maua	Tigania	Totals
Rehabilitation	179	18	61	22	49	16		345
Intake	175	37	29	318	184	4	135	882
Raw Water Pipeline	1,139	93	466	697	331	20	191	2,937
Treatment Plant	1,542	551	312	337	284	552	294	3,872
Storage	960	92	111	200	96	59	95	1,613
Transmission	2,938	230	688	383	701	149	1,260	6,349
Ancillaries	1,733	255	417	489	411	200	494	3,999
Preliminaries	1,300	191	313	367	309	150	370	3,000
Total Phase 1	9,963	1,467	2,396	2,814	2,365	1,150	2,839	22,994
Borcholes			133					133
Treatment Plant	1,165	274		237	197		207	2,080
Storage	537	92	102	55	42	59	87	974
Transmission	963		105	76	5 105	44	81	1,374
Ancillaries	666	91	85	92	2 86	26	94	1,140
Preliminaries	500	69	64	69	65	19	70	856
Total Phase 2	3,830	526	489	529	) 495	147	540	6,556
Additional Distribution	1,158	55	199	489	200	55	384	2,540
TOTAL	14,951	2,048	3,084	3,832	3,060	1,352	3,763	32,090
Supply Area Details					***			
Design Population	251,668	15,611	43,648	64,433	3 44,376	13,344	83,121	516,201
Design Demand (m3/day)	22,725	1,915	6,372	4,403	3 2,886	1,496	3,778	43,575
Supply Arca (km2)	185	4	45	88	3 58	5	92	477
Cost/capta (US\$/capita)	59	117	71	59	9 69	101	. 45	521
Cost/m3/day(US\$?m3/day)	658	955	484	870	0 1,060	906	996	731
Average Incremental Costs at 9	9%							0
Investment Costs (US\$/m3)	0	0	0	(	0 1	]	. 1	0
Annual Costs (US\$/m3)	0	0	0	(	0 0	(	) 0	0
Total Costs (US\$/m3)	1	. 1	1		1 1	1	1	1
Total Costs (Shs/m3)	30	30	3,5	3	4 43	39	39	36
(1 US\$= 56 Shs)								

Table L-3 Cost Estimates Meru Water Supply

Investment costs Exchange rate														3-Dc1-97			
nvestme		E) Descriptio		te		US \$ ≠ L	56] Init	Ooto I		Civit	FRM	Pines	7	Civil	E&M	Pipes	
Element		lia (mm S								US \$ x 1,000		US\$ x 1,000	Quantity	US 5 x 1,0	US \$ x 1.00	US \$ x 1,000	- 1
Rehabilit	ation						1		item item	17.9 174.5	17.9	142.9					
raake Raw pipa	olion	500	nm dia ste	el nine		1,	rn	227.714	5,000	11.4.0		1,138.6			1		
raw pipe Trealmer			m3/d capac				nr [	1,541,589	1	1,310.4	231.2			0000	4747		1
			m3/d expar				nr [	1,164,536	4.5	700.0			1,0 6.0	989,9 360,0	174.7		i
Reservoi	irs		m3 reservo			- 1	nr nr	60,000 34,643	12	720.0 34.6			1.0	34.6			[
			m3 reservo m3 reservo				nr	27,143	1	27.1			1.0	27.1			
	1		m3 reservo				nr .	23,036	4	92.1			2.0	46.1			- 1
			m3 reservo			1	nr i	19,107	2	38.2			2.0	38.2 16.8			
			m3 reservo m3 reservo				er er	16,786 13,929	2	33.6 13.9			1.0	13.9			1
Transmis	ssion		mm dia uP				m l	98.821	3,800		Į.	375.5	1		1	-	1
		315	mm dia uP	VÇ (12 ba/)			m	77.554	15,300		1	1,186.6	2,800		į	170.5	
	ļ			VC (12 bar)			m m	60.875 46.857	3,000			182.6 468.6	9,000		1	421.7	- 1
				VC (12 bar) VC (12 bar)			m	28,982	25,000			724.6	12,800	1		371.0	!
Ancillaria	ı es/conting		min did of	, , , , , , , , , , , , , , , , , , , ,		1		25%	Į	615.6		1,054.8		381,7	43.7 32.8	240.8 180.6	
Prelimin	arles ]		·					15%	<u></u>	461.7 3,539.6	46.7 358.1	791,1 6,055.2		286.2 2,194.5		1,384.5	
Total									Phase	3,339.0			Phase 2		1		Ì
Total ph	ased costs	3							T Hase								
Annual	CUSCS	110	mm da uP	VC (12 bar)	)		m	18.446	3,000		1	55	3,000			55	1
distribu	noln	90	mm dia uP	VC (12 bar)	)		m	15,500	2,000		i	31 36	2,000			31 24	
pipes		63	mm dia uP	VC (12 bar			m	12.089	3,000		-	123	-,,,,,,,,	<del></del>		111	
Total	ort Requir	rements					-	U\$\$x1,000	1998				2003				
, ranspi	1	Saloon ca					rif .	17.9	1			18 63	[ ]			18 63	{
		4WD veh					ut ut	62.5 21.4		l		63 43	3			64	
		Pickup Lerni					DL LH	107.1		ļ		214	2			214	
	1	Lorry	NA COLUMN TO THE PARTY OF THE P						Transp		E&M	Pipes					
		its as % (	of Investm	ents					20%				1				]
Econor						·			<del> </del>		3 Fixed	Variable	-	2000	Fixed	Variable	
Power		Power to	riff (Oct 199	ia (a)			Power Re-	quirements	1		20			<u>L</u>	20	20	
1		Unit ener	gy cost				US\$/unit	0.0785714		-							{
l	-			เอกให้			US\$/month US\$/month	7.8571429 4.4642857									
u	resource		nana charg	9	10		OSS:MOIN	Rate/yr	<del> </del>	199	8		I	2000		V	
riuman	Hestraite	•						US\$x1,000		TWks2	Dist'n	US\$x1,000	TWks 1	TWks2	Dist'n	US\$x1,000 3.86	
l		Engineer	1				Shs/yr	3.86		1		1 3.86	1		l a		
ļ		Engineer					Shs/yr Shs/yr	3.21 2.36		2		3 11.79	2	2 2	2 3	16.50	
1		Senior O				1	Shs/yr	1.29		2	1	4 7.71	3		2 5		1 1
1		Operator					Shs/yr	0.96		3	-1	5 8.68 0 16.07	2		2 5		1
ļ		Watchm	an/Line pat	rolman/Cler	ks		Shs/yr Shs/yr	0.64	} :	1	2 2	54.54	1 `	기 `	-	69.54	
CI	cal costs	<u></u>	approximate the second				Onsyr	ÚS\$/kg	199	Dosage	(mg/i)	Cost/m3	2000	Desage		Ccst/m3	1 1
Ciremin	ca, cobio	Alum						0.45			0	0.000		19	2	0.004	
į .		Chlorine						6.25 0.25			2	0.013			<u>.</u> D	0.000	]
l		Soda as Total che	n emical cost	per m3				0.20				0.013				0.017	
-					Increm-	Investment	Schedule	ł	1	1	O&M	Power	Labour	Transor	Chemic	a Total	Total
Year	Population	Water	Population Coverage		ental supply	Treatment Civil	E&M	Pipes	1	o Total Investme	arichete.	Costs		1		Recurrent	Costs
Į		m3/d	Coverage %	m3/d				US\$ x 1,000	US5x1	0 US\$ x 1.00	00 US\$ x 1.	0:US\$ x 1 000	US\$ x 1.0	Cy US\$ x 1.0	OUS\$ x 1 0	QUES x 1,000	USS x 1.000
1996				34.CP-4-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-		[							1	1			
1997	165.980		31%		-	3,540	358	6,065	339	10,30	ا ه					-	10,300
1993	171,806 177,657	11,219	28% 50%	3,172 6,090	2.918	3,340	336	123		123	3 112						385
2000	183,527	13,188	55%	7,253	4,081	Ļ	L	123	3	12							392 399
2001	189,554	13,974	60%	8,384	5,212	}		123 123		12		_					406
2002	195,741 202,094	14,794 15,649	65% 70%	9,616 10,954	6,444 7,782	2,195	251						70	72	2 36	355	4,545
2003	208,618	16,541	75%	12,406	9,234	.,.55	}	111	i	11	1 167	2 18					489 501
2005	215,318	17,470	80%	13,976	10,804			111		11							513
2006	222,199	18,438	85% 90%		12,501 14,330	[		111	3	11			3	72	2 89	416	527
2007	229,268 236,531	19,447	95%		16,299	{	358			82	8 18	1 21	70	) 72	2 101		1,272
2009	243,996	21,589	98%	21,049	17,877		1	111		11							567 579
2010	251,668	22,725	100%	22,725	19,553			111		11							580
2011	251,668 251,668		100%	22,725 22,725	19,553 19,553	1		111		ii	1 18	5 23	70	7:	2   121	471	581
2012			100%	22,725	19,553	1	251										1.202 593
2014	251,668	22,725	100%		19,553	i		111		11						1	595
2015			100%		19,553 19,553	1	1	111		11		0 23	70	o i 7:	2 12	i 495	596
2016 2017	251,668 251,668		100%		19,553	-(1,298)		(770	0) -(7:				3 70	7:	2 12	1 471	-{351}
	<u> </u>			]		Note: Re		les in (brack	ets)			1				US\$ x 1 0	00 USS ¥ 1,000
Net P	resent val				m3 x 1.00 16,435		T	·		11,50		<del></del>	1	T		1,895	
		15% 12%			22,164		-			12,23	2			İ		2,377	
	1	9%			30,660		1	1		13,69			1			3,056 4,039	
		6%	s]		43,589	<u></u>	<u></u>	<u></u>		14,12 US\$/m						US\$/m3	
Avera	ige incren	nental co	sta (Shs/n	13)	T	Т	-r		T	0.3		Т	· · · · · ·	1	-	0.12	0.82
1		15% 12%					1	ļ		0.5	55			ŀ	1	0.11	
1				1	1	1	1	1	1	0.4		1		1		0.10	
	1	12% 6%		1	1	ł	1	Į.	į.	0.3	23	1		1	- 1	0.09	0.42



Investo	ment costs		Exchange r					rmates KShs				1998	Phase 2			. 2003	3-Oct-97
	Ì	Descripți	on	4.0		1000*	Unit	Rate	1 (1836)	Civil	E&M	Pipes	THOSE E	Civil	E&M	Pipes	3-04-97
Elemer		dia (mm	Size	<del></del>				US \$			-		Quantity	US \$ x 1,000	US \$ x 1,00		
Rehabi	litation								item	1.8	1.8	14.3					
intake Raw pi	celine	150	mm dia ste	aal nina			m	49.339	item 1,013	37.0		50.0	ŀ				•
. т р.			mm dla st				m	71,143	600			42.7					
Treatm	ent		m3/d capa				n/	551,411	1	468.7	82.7						
_		1,000	m3/d expa				nr	273,464	l	[			1,0	232.4	41.0		
Reserv	oirs	500	m3 reserve			;	t) E	41,964	1	42.0			1.0	42.0			ļ
	1	400 300	m3 reserve				ut.	34,643 27,143	١.	27.1						1	
		250	m3 reserve				nr nr	23.036	1	23.0				:			i
		200	m3 reserve				nr	19,107	i .							1	
		150	m3 reserve				nr	16,786		-				-		İ	
<b>~</b>	,	100	m3 reserve				nr	13,929	}	-				-		1	
Transn	าเรรเอก	400 315		PVC (9 bar) PVC (12 ba			rn m	98.821 77.554	1							] -	
		280		VC (12 ba			m m	60.875	1			] :				]	
į		225		VC (12 ba			m	46.857	1,300			60.9					
		160	mm dia uf	PVC (12 ba	F)		LU3	28.982	2,300			66,7			1		
	ries/conline	gencies						25%	1	149.9	21.1	58.6	1	68.6	10.3	-	
Prelim: Total	naries							15%	Ļ	112.4	15.8	44.0		51.5	7.7		1
Consumers of	hased cost	5	···				<del></del>		Phase	862.0	121.5	337.1	Phase 1	394.5	59.0	453.4	ł
	l coats			<del></del>				···	1111111111	<u> </u>		. ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	i nase z		1-1-11-11-1-1-1-	. 455.4	1
Annua	!	110	mm dia uf	VC (12 ba	r)		m	18.446	<u> </u>	T	1	T		T		<del></del>	1
qlantp	ution	90		VC (12 ba			m	15.500	200			3.1	200		ļ	3.1	1
pipes		63	mm dia ul	VC (12 ba	"}		m	12.089	200	<u> </u>	<u></u>	2.4	200	<u> </u>		2.4	1
Total	ort Reguli	romonte	*********					USSx1,000	1000	ļ	<u></u>	5.5	0000		L	5.5	ł
1,0112	- on noquil	Saloon o	ar				nr	17.9	1998	<del> </del>			2003	<del> </del>		· · · · · · · · · · · · · · · · · · ·	ł
1		4WD vel					nr	62.5	ő	ı		_	ő	1		-	
ĺ		Pickup					nr	21.4	1			21.4	1			21.4	
<u> </u>		Lorry		-			nr	107.1	0		1222		0	L		······································	1
Annua	1 D&M .c.	te oc e -	f Investme	nte					Transpo 20%	1,00%	E&M 4.00%	Pipes 1.00%	1				
	mic lite	18 88 760	III III OSLIIM	1168					20%				1				
Powe					*******	<del>o of 10 th</del> do not to			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		Fixed	Variable		2003	Fixed	Variable	
1			riff (Oct 19					ulrements			10	10			10	10	
ŀ		Unit ene	rgy cost				US\$/unit	0.0785714						·			Ì
		HIXEG C	narge per m	ionth			US\$/month US\$/month	7.8571429 4.4642857									]
Hume	n resource	S AV OR	mand charg			727711	023/15/001	Rate/yr		1998	<del>hardrates</del> va		<del></del>	2003	<del></del>		
								US\$x1,000	TWks 1	TWks2	Dist'n	US3x1,000	TWks i		Dist'n	US\$x1,00	0
		Enginee					Shs/yr	3,86	1	}	0		[	Ī	i	3.86	)
1		Enginee Inspecto					Shs/yr Shs/yr	3,21		-	1 1		l .		1	3.21	
		Senior C					Shs/yr	2.35 1.29	2 2		2	9.43 5.14	2		2	9.43 6.43	
		Operato					Shs/yr	0,96	2		5	6.75	2		5	6.75	
l		Watchm	an/Line pat	rolman/Cle	rks		Shs/yr	0.64	3		8	7.07	3		8	7.07	
	,						Shs/yr					31.61				36.75	]
Chom	ical costs	Alum						US\$/kg 0.45	1998	Dosage (r 0		Cost/m3	2003	Dosage (m		Cost/m3	
		Chlorine						6.25	l	2		0.000		20 2		0.009	•
		Soda as	h					0.25	1	0		0.000	l	5		0.001	
		Total ch	emical cost	per m3							National Assessment	0.013				0.023	
V	Pepulatio <i>r</i>	141-101	Population	144	, ,	Investmen	Schedule	D	<b></b>								
Year	ropulation				ental supply	Treatment Civil	E&M	Pipes	Transpo	lictal Investmen	O&M Costs	Power Costs	Labour	Transport	Chemica		Total
L	L	m3/d	%	m3/d			US\$ x 1.000	US\$ x 1,000	US\$ x 1.00				US\$ x 1.00	CUS\$ x 1,000	USS×100	Recurrent	USSELAM
1996								-	1	1	1	T		1	324.30	207 41,000	-24 - 1,000
1997	9,471	940		-	-							1	ĺ	1		İ	
1998 1999	9,853 10,246	1,004	50%	- 535	- 535	862.0	121.5	337.1	21.4	1,342.0		,,	01.0		1 :	1	1,342.0
2000	10,648	1,142	55%	535 528	535 628			5.5 5.5		5.5 5.5	16.9 17.0	7.8	31.6 31.6	4.3	2.4 2.9	63.0	68.5
2001	11,064	1,204	60%	722	722		<u> </u>	5.5	·	5.5	17.0	8.3	31.6	4.3	3.3	63.7 64.5	69.3 70,0
2002	11,497	1,270	65%	825	825			5.5		5.5	17.1	8.6	31.6	4.3	3.8	65.3	70.8
2003	11,946	1,338	70% 70%	937	937	394.5	59.0	:	21.4	474.9	23.4	8,9	36.8	4.3	4.3	77.5	552.4
2004 2005	12,412 12,896	1,410 1,485	75% 80%	1,057 1,188	1,057 1,188		1	5.5 5.5		5,5	23.4	9.2	36.8	4.3	8.8	82.4	87.9
2005	13,398	1,563	85%	1,329	1,329		1	5.5		5.5 5.5	23.5 23.5	9,5 9,9	36.8 36.8	4.3 4.3	9.8 11.0	83.9 85.5	89.4 91.0
2007	13,920	1,646	90%	1,481	1,481		1	5.5	1	5.5	23.6	10.3	36.8	4.3	12.3	87.2	91.0
2008	14,462	1.731	95%	1,645	1,645		121.5	5.5	21.4	148.4	28.5	10.8	36.8	4.3	13.6	93.9	242.3
2009	15,025	1,821	95%	1,776	1,776		1	5.5		5.5	28.6	11.1	36.8	4.3	14.7	95.4	100.9
2010	15,611 15,611	1,915	100%	1,915 1,915	1,915	· · · · · · · · · · · · · · · · · · ·		5.5 5.5		5,S 5.5	28.6 28.7	11.5	36.8 36.8	4.3	15.9	97.0	102.5
2012	15,611	1.915	100%	1,915	1,915			5.5		5.5	28.7	11.5 11.5	35.8	4.3 4.3	15.9 15.9	97.1 97.1	102.6 102.6
2013	15,611	1,915	100%	1,915	1,915		59.0	5.5	21.4	85.9	31.1	11.5	36.8	4.3	15.9	99.5	185.4
2014	15,611	1,915	100%	1,915	1,915			5.5		5.5	31.2	11.5	36.8	4.3	15.9	99.6	105,1
2015	15,611	1,915	100%	1,915	1,915	}		5.5		5.5	31.3	11,5	36.8	4.3	15.9	99.6	105.2
2016 2017	15,611 15,611	1,915 1,915	100% 100%	1,915 1,915	1,915 1,915	• 316.1	- 59.7	5.5 88.0	- 4.3	5.5 - 292.1	31.3 26.6	11.5	36.8	4.3	15.9	99.7	105.2
[ ``''	10,011	.,515	""	.,,,,,	1,573			s in (bracket		292.1	20.6	11.5	36.8	4.3	15.9	95.0	- 197.1
Net P	esent valu				#13 x 1,00x			www.adassar		US3 × 1,000	<del>(</del> )				<del>                                     </del>	U5\$ x 1.000	US\$ × 1,000
		15%			1,862			1	1-1-1-1	1,420.8	Γ	1	I	[		416.8	1,837.6
		12% 9%			2,464		1	1		1,495.7	1		1	1		519.4	2,015.1
Aver	ne Incrers		ts (Shs/m3	<u> </u>	3.346	L	1	<u></u>		1,578.9 US\$/m3		L	<b>L</b>		-	663.2	2,242.1
Liveis	Se unctalle	15%	, , , , , , , , , , , , , , , , , , , ,	f	· · · · · ·	Ι	r	1	Τ	0.76	<del> </del>	T	Γ	1	<del> </del> -	US\$/m3 0.22	USS/m3 0.99
		12%							1	0.61				1	1	0.22	0.82
		9%	ı	I	1	4	1	1	1	0.47	1	1	1	1	ı	0.20	0.67







	ment costs			ite									hase 2.			2003	3-Oct
		Descripti					Jn <sub>i</sub> t	Rate		Civil	E&M	Pipes			E&M	Pipes	
lemer	nt	ď∙a (mm	Size									000,1×2 EU	Quantily	US \$ x 1.000	US \$ x 1.00	US \$ x 1 000	
ehabi	ilitation								item	3.6	3.6	53.6					
itake									itern	29.1						i	
law pij	ipeline		mm dia ste				m	49.339	2,156			106.4				1	
			mm dia ste				m	71.143	5,054		40.0	359.6				1	
reatm	ent		m3/d capad				nr	311,954	1	265.2	46.8	l l					
	i	2,000	m3/d expar	rsion		Į	ror -	237,286							*		
oreno	oles	100	m deep			1	nr	6,021	- }		-		5.0	30.1	400.0		
oreno	ole pumps	7	kW boreho	le pumps		- 1	กเ	20,662		-		i i	5.0		103.3		
lese iv		750	m3 reserva	ir			ນເ	60,000	1 1	60.0	9.0		1.0	60.0			
		500	m3 reservo	ir			nr	41,964	1 1	42.0			1.0	42.0			
			m3 reservo				nr	27,143	1	-			Į.		i	1	
		l .	m3 reservo				nr }	23,036		-	'	ļ	1	-		į į	
		200	m3 reservo				nr	19,107		-			ĺ				
			m3 reservo			}	กเ	16,786	]	-		l i	- {	-			
		100	m3 reservo			l	nr	13,929		-		ľ		_			
						ł	m	98.821									
ransm	nission	400	mm dia uP			}	m	77.554								- 1	
		315	mm dia uP					60.875	4,700			286.1				_	
		280	mm dia uP			ì	ui	46.857	5,300		}	248.3	1,000	ļ		46.9	
		225		VC (12 bar)		1	W				ì	153.6	2,000		l l	58.0	
		160	mm dia uP	VC (12 bar)	l		m	28.982	5.300	00.0	1.0		2,000	22.0	25.8	26.2	
Ancilla	mes/conting	gencies					1	25%	i	99.9	14.8	301.9		33.0			
<sup>o</sup> relimi	inaries	ì					1	15%	l	75.0	11.1	226.4		24.8	19,4	19.7	
Cotal										574.7	85.3	1,735.9		189.9	148.5	150.7	
	hased cost	ls							Phase :	1		2.395.9	Phase 2			489.0	
	l costs																
Annua		110	mm dia uf	VC (12 bar	1		m	18.446	200			4	200			3.7	
distrib		90	mm dia uF				rn	15.500	500	1		7.8	500	1		7.8	
	PERIOR	63	mm dia uf			ļ	m	12.089	700	1	ļ	8.5	700	1		8.5	
plpes		03	Tilli Giù Gi	VO 1:2 00.	·	,						19.9		·		19.9	
(otal								US\$x1,000	1998			-	2003				
rans	port Requi						Lit	17.9		<b></b>			2003	<del> </del>			
		Saloon						62.5				62.5	1			62.5	
		4WO ve	nicle				nr or	21.4		ł		21.4	1	}		21.4	
		Pickup				i		107.1	ه ا	}			0				
		Lorry	-				វារ	107.1			ICE14	Toinne		<del></del>	-		
									Transpo		E&M	Pipes 1.00%				[	
Annus	al O&M cos	sts 28 % (	ıf investme	nts					20%	1.00%	4.00%					l	
Econo	omic life								5							احبببي	
Powe	) T								L	1998	Fixed	Variable		2003	Fixed	Variable	
		Power to	ariff (Oct 199	36)			Power Rec	julrements			. 10	10			10	35	
		Unit ens	rgy cost				US\$/unit	0.079								i	
		Fixed c	harge per m	enth			US\$/month	7.857	·[								
		kVA de	mand charg	6			US\$ morth	4,464	ıi.								
Huma	n resource		X			4-M-M-M-		Rate/yr	1	1998	}			2003	3		
. [ tal 1965]								US\$x1,000	TWks 1	TWks2	Dist'n	US\$x1.000	TWks 1	TWks2	Dist'n	US\$x1,000	)
		Engine	r 1				Shs/yr	3.86	1	1	1	3.86	i	1	1	3.86	
		Enginee					Shs/yr	3.21	1	1	1 1	3,21			1	3.21	
		Inspecto					Shs/yr	2.36	1	1	2		1		2	7.07	
			n Operator				Shs/yr	1.29	2	ţ	1 2		2	,	] 2	5.14	
							Shs/yr	0.96	2		1 3	1	2		3	4.82	
							Shs/yr	0.64		1	1 7				I .		
		Operato		ent-manifolds			O) IS/YI		1 3	1		1 6.43	3		9	7,71	
			r nan/Line pat	rolman/Cle	ıks		Chehir	0.04	3		1	6.43	3	1	9	, ,,,,	
				roiman/Cle	rks	Married School Street	Shs <i>lyi</i>				7000	30.54		Dosage (m		31.82	
Chem	ilcal costs	Watchn		roiman/Cle		Married Selection 4	Shs/y/	US\$/kg		Dosage (		30.54 Cost/m3		Dosage (m	19/1)	31.82 Cost/m3	
Chem	ilcal costs	Watchn	nan/Line pat	rolman/Clei			Shs/y/	US\$/kg 0,45	1998	Dosage (	}	30.54 Cost/m3 0.000			ng/i) }	31.82 Cost/m3 0.000	
Chem	ilcal costs	Watchn Alum Chloring	nan/Line pat	rolman/Cle			Shs/y/	US\$/kg 0,45 6,25	1998	Dosage (	?	30.54 Cost/m2 0.000 0,013		2	ng/l)	31.82 Cost/m3 0.000 0.013	
Chem	ilcal costs	Watchn Alum Chlorine Soda as	nan/Line pat					US\$/kg 0,45 6,25 0,25	1998	Dosage (	)	30.54 Cost/m2 0.000 0.013 0.000			ng/l)	31.82 Cost/m3 0.000 0.013 0.000	
Chem	ilcal costs	Watchn Alum Chlorine Soda as	nan/Line pat	per m3				US\$/kg 0,45 6,25	1998	Dosage (	)	30.54 Cost/m2 0.000 0,013		2	ng/l)	31.82 Cost/m3 0.000 0.013	gr jank miller skale
		Alum Chlorine Soda as Total ch	nan/Line pat	per m3	Increm-	Investmen	Schedule	US\$/kg 0,45 6.25 0.25	1998	Dosage (	) ) )	30.54 Cost/m2 0.000 0.013 0.000 0.013	2003	0 2 0	  g/i} 	31.82 Cost/m3 0.000 0.013 0.000 0.013	Total
		Alum Chloring Soda as Total ch	nan/Line pat	per m3	Increm-	Investmen	Schedu'e	US\$/kg 0,45 6,25 0,25	1998	Dosage (	O&M	30.54 Cost/m2 0.000 0.013 0.000 0.013		2	  g/i}   	31.82 Cost/m3 0.000 0.013 0.000 0.013	Total
		Alum Chloring Soda as Total ch	nan/Line pat	per m3	Increm- ental	Investmen Treatment	Schedu'e	US\$/kg 0,45 6,25 0,25	1998 Transpo	Dosage (i	O&M	30.54 Cost/m2 0.000 0,013 0.000 0.013 Power Costs	2003 Labour	2 0 Transport	Ohernica	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total	Costs
		Alum Chloring Soda as Total ch	enan/Line pate	per m3	Increm- ental	Investmen Treatment	Schedu'e	US\$/kg 0,45 6,25 0,25	1998 Transpo	Dosage (i	O&M	30.54 Cost/m2 0.000 0.013 0.000 0.013	2003 Labour	2 0 Transport	Ohernica	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total	Costs
	Population	Alum Chloring Soda as Total ch Water Deman	enan/Line pate	per m3 Water Supplied	Increm- ental	Investmen Treatment	Schedu'e	US\$/kg 0,45 6,25 0,25	1998 Transpo	Dosage (i	O&M	30.54 Cost/m2 0.000 0,013 0.000 0.013 Power Costs	2003 Labour	2 0 Transport	Ohernica	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total	Costs
Year 1996	Population	Alum Chloring Soda as Total ch r Water Deman	enan/Line pate	per m3 Water Supplied	Increm- ental	Investment Treatment Civil US\$ x 1,000	Schedule E8M US3 x 1,000	US\$/kg 0.45 6.25 0.25 P/pes	1998 Transpo US\$ × 1 0	Dosage (i	O&M Costs	30.54 Cost/m2 0.000 0,013 0.000 0.013 Power Costs	2003 Labour	2 0 Transport	Ohernica	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total	Costs uss x 1,
Year 1996 1997	Population	Alum Chloring Soda as Total ch r/Water Deman m3.5	nan/Line pat	per m3 Water Supplied m3/d	Increm- ental	Investmen Treatment	Schedu'e	US\$/kg 0,45 6,25 0,25	1998 Transpo US\$ × 1 0	Dosage (i	O&M Costs	30.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs cust x 1.000	2003 Labour US\$ x 1 00	Transport	Chemica	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total Recurrent cuss x 1.000	Costs uS\$ x 1.0 2,479
Year 1996 1997 1998	Population  7 25,679 26,746	Alum Chlorini Soda at Total ch water Deman m3/d 3,334 3,534	e in emical cest Population Coverage % 84% 79%	per m3 Water Supplied m3/d 2.800 2.800	Increm- ental supply m3/d	Investment Treatment Civil US\$ x 1,000	Schedule E8M US3 x 1,000	US\$/kg 0.45 6.25 0.25 P/pes	1998 Transpo	Dosage (i	O&M Costs Us\$x1.00	30.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs cust × 1.000	2003 Labour	Transport	(Chemica US\$ x 1.00	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total Recurrent cuss x 1.000	Costs us\$ x 1. 2,479
Year 1996 1997 1998 1999	Population  25,679  26,746  27,862	Alum Chlorine Soda as Total ch Water Deman m3:d 3,334 3,534 3,745	Population Coverage 84% 79%	per m3 Water Supplied #3/d 2,800 2,800 3,370	Incremental supply m3/d	Investment Treatment Civil US\$ x 1,000	Schedule E8M US3 x 1,000	US\$/kg 0.45 6.25 0.25 P/pes US\$ x 1.000	Transpo US\$ × 1.0	Total Investment (USt x 1.000)	O&M Costs 1 US\$ x 1.00	30.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs cust×1.000	2003 Labour US\$ x 1 00	Transport x 1 000 16.8	Chemica uss x 1.00 2.6 5.3	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total Recurrent cuss x 1.000	2,479
Year 1996 1997 1998 1999 2000	Population 7 25,679 8 26,746 9 27,862 29,029	Alum Chlorini Soda as Total ch Water Deman m3/d 3,334 3,534 3,745 3,968	Population Coverage 84% 79% 90%	per m3 Water Supplied m3/d 2.800 2.800 3.370 3.968	Incremental supply m3/d	Investment Treatment Civil US\$ x 1,000	Schedule E8M US3 x 1,000	US\$/kg 0.45 6.25 0.25 P/pes US\$ × 1.000 1,735.9 19.9	1998 Transpt US\$ × 1.0	Total Investment (US\$ x 1.000 2,479.8 19.9 19.9	O&M Costs Just x 1.00	30.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs cust × 1.000	2003 Labour US\$ × 1 00	Transport Quest x 1 600 16.8	Chemica USS x 1.00 2.6 5.3	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total Recurrent cuss x 1.000	Costs us\$ x 1. 2,475 105
Year 1996 1997 1998 1999 2000	Population  25,679  26,746  27,862  29,029  30,243	Watchn Alum Chlorini Soda as Total ch Deman m3/d 3,334 3,534 3,745 3,968 4,160	Population Coverage \$44% 79% 90% 100%	per m3 Water Supplied #3/d 2.800 2.800 3.370 3.968 4,160	Incremental supply m3/d - - 570 1,168	Investment Treatment Civil US\$ x 1,000	Schedule E8M US3 x 1,000	US\$/kg 0.45 6.25 0.25 US\$ x 1.000 1,735.9 19.9 19.9	Transpo USS × 1 0	Total Investme. Ust x 1.000 19.9 19.9	O&M Costs Us\$x1.00	30.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs cuss x 1.000 9.1 9.5 9.7	2003 Labour US\$ x 1 00 30.5 30.5	Transport  Auss x 1 000  16.8  16.8  16.8	Chemica USS x 1.90	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent cuss x 1.000 	2,475 105 105 116 116
Year 1996 1997 1998 1999 2000 2001 2002	Population 25,679 26,746 27,862 29,029 30,243 31,505	Alum Chloring Soda as Total ch Deman m3/d 3,334 3,534 3,745 3,968 4,160 4,361	Population Coverage 84% 90% 100%	per m3 Water Supplied m3/d 2.800 2.800 3.370 3.968 4,160 4,361	Incremental supply m3/d - 570 1.168 1,360	Investment Treatment Civil US\$ x 1,000 574.7	Schedule E&M uss x 1,990 85,3	US\$/kg 0.45 6.25 0.25 Pipes US\$ x 1.000 1,735.9 19.9 19.9	1998 Transpo	Dosage (c) ( ( ( ( ( ( ( ( ( ( ( ( ( ( ( ( ( (	O&M Costs uss x1,00 26.7 26.9 27.1	30.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs cus\$x1.000 9.1 9.5 9.7 9.9	2003 Labour US\$ x 1 00 30.5 30.5 30.5 30.5	Transport  VUSS x 1 000  16.8  16.8  16.8  16.8	Chemica USS x 1.00 - 2.6 5.3 6.2 7.1	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent cuss x 1.000 	2,475 105 105 116 116
Year 1996 1997 1998 1999 2000 2001 2002 2003	Population 7 25,679 8 26,746 9 27,862 9 29,029 1 30,243 2 31,505 3 32,817	Alum Chlorini Soda at Total ch n Water Deman m3/d 3,334 3,745 3,968 4,160 4,361 4,572	Population Coverage 84% 79% 100% 100% 100%	per m3 Water Supplied m3/d 2.800 2.800 3.370 3.968 4,160 4,361 4,572	Incremental supply m3/d 570 1,168 1,360 1,561 1,772	Investment Treatment Civil US\$ x 1,000	Schedule E8M US3 x 1,000	US\$/kg 0.48 6.25 0.25 P:pes US\$ x1.000 1,735.9 19.9 19.9 19.9	1998 Transpo	Total Investment USt x 1.000 19.9 19.9 19.9 573.0	O&M Costs USS x 1.00 26.7 26.9 27.1 27.3 36.7	30.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs cust × 1.600  9.1 9.5 9.7 9.9 20.6	2003 Labour U95 x 1 cc 30.5 30.5 30.5 30.5 31.8	Transport  VUSS x 1 000  16.8  16.8  16.8  16.8	USS x 1 90  - 2.6 - 5.3 - 6.2 - 7.1 - 8.1	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent v/ss x 1.000 85.7 89.1 90.3	2,475 100 110 111 68
Year 1996 1997 1998 1999 2000 2001 2002 2003 2004	Population  25.879 26,746 27,862 29,029 30,243 31,505 3 32,817 3 34,183	Alum Chloring Soda at Total of Water Deman m3:6 3,334 3,745 3,968 4,160 4,361 4,361 4,794	Population Coverage 84% 79% 90% 100% 100% 100% 100%	per m3 Water Supplied m3/d 2.800 3.370 3.970 4,361 4,561 4,572 4,794	Incremental supply m3/d 570 1.168 1,360 1.561 1,772 1,994	Investment Treatment Civil US\$ x 1,000 574.7	Schedule E&M uss x 1,990 85,3	US\$/kg 0.45 6.25 0.25 P/pes US\$ × 1.000 1,735.9 19.9 19.9 19.9 19.0 150.7	1998 Transpo	Total Investme uss x1.000 2,479.8 19.9 19.9 19.9 19.9 19.9	O&M Costs US\$x1,00 26.7 26.9 27.1 27.3 36.7 36.9	30.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs cust × 1.000  9.1 9.5 9.7 9.9 20.6 21.3	2003 Labour US\$ x 1 00 30.5 30.5 30.5 30.5 31.3	Transport  US\$ x 1 600  16.8  16.8  16.8  16.8  16.8	Chemica USS x 1.60 2.66 5.3 6.2 7.1 8.1 9.1	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total Recurrent 495 x 1.000 85.7 89.1 90.3 91.6 114.0	2,475 100 100 111 68 13
Year 1996 1997 1998 2000 2001 2002 2003 2004 2005	Population  25,679 3 26,746 27,862 29,029 30,243 31,505 3 32,817 4,4183 335,604	Alum Chlorins Soda as Total ch Deman m3:d 3,334 3,745 3,968 4,160 4,361 4,572 4,794 4,592 4,794 5,026	Population Coverage \$44% 79% 90% 100% 100% 100% 100%	per m3 Water Supplied m3/d 2.800 3.370 3.968 4,160 4,361 4,572 4,794 5,026	Incremental supply m3/d - 570 1,168 1,360 1,561 1,772 1,994 2,226	Investment Treatment Civil US\$ x 1,000 574.7	Schedule E&M uss x 1,990 85,3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1.000 1,735.9 19.9 19.9 19.9 19.9 19.9	Transpo US\$ x 1 0 83.9	Dosage (	O&M Costs USS x 1.00 26.7 26.9 27.1 27.3 36.7 36.9 37.1	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs cus\$x1.000 9.1 9.5 9.7 9.9 20.6 21.3 21.9	2003 Labour US\$ x 1 00 30.5 30.5 30.5 31.3 31.3	Transport Transp	Chemica USS x 1.00 	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent vuss x1.000 85.7 89.1 90.3 91.6 114.0 115.8	2,477 100 101 111 68 13
Year 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006	Population 25,679 3 26,746 27,862 29,029 31,505 3 32,817 4 34,183 35,604 37,084	Alum Chloring Soda at Total ch Peman 3,334 3,534 3,745 3,968 4,160 4,361 4,572 4,794 5,296 5,270	hanA.ine pat	per m3  Water Supplied m3/d  2.800 2.800 3.370 3.968 4,160 4,361 4,572 4,794 5,026 5,270	Incremental supply m3/d 570 1.168 1,360 1,561 1,772 1,994 2,226 2,470	Investment Treatment Civil US\$ x 1,000 574.7	Schedule E&M uss x 1,990 85,3	US\$/kg 0.45 6.25 0.25 P:pes US\$ x1000 11,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9	Transpo US\$ × 1.0 83.9	Total Investment of the state o	O&M Costs USS x 1.00 26.7 26.9 27.1 27.3 36.7 36.9 37.1 37.3	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.055 x 1,000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6	2003 Labour US\$ x 1 00 30.5 30.5 30.5 30.5 31.8 31.8 31.8 31.8	Transport QUSS x 1 000 16.8 16.8 16.8 16.8 16.8 16.8	Chemics USS x 1.00 2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent vuss x 1.000 85.7 89.1 90.3 91.6 114.0 115.8 117.7	2,47; 10 10 11; 68 13 13
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007	Population 25,679 3 26,746 2 29,029 30,243 3 32,817 4 34,183 5 35,604 5 37,084 7 38,625	Alum Chlorinus Soda at Total ch Deman m3/d 3,334 3,745 3,968 4,160 4,361 4,572 4,794 5,026 5,270 5,526	han/Line pat h.h. emical cest Population Coverage % 84% 79% 90% 100% 100% 100% 100% 100%	per m3 Water Supplied m3/d 2.800 2.800 3.968 4,160 4,361 4,572 4,794 5,026 5,526	Incremental supply m3/d	Investment Treatment Civil US\$ x 1,000 574.7	Schedule E&M USS x 1,000 85,3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x 1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	Transpr Us\$ x 1 0 83.9	Total Investme. US\$ x 1.000 19.9 19.9 19.9 19.9 19.9 19.9 19.	O&M Costs US\$ x 1,00 26.7 26.9 27.1 27.3 36.9 37.1 37.3 37.5	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3	2003 Labour US\$ × 1 00 30.5 30.5 30.5 31.8 31.8 31.8 31.8	Transport  Transport  16.8  16.8  16.8  16.8  16.8  16.8  16.8  16.8  16.8  16.8	Chernica USS x 160 2.66 5.3 6.2 7.1 8.1 10.2 11.3 12.4	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total Recurrent uss x1.000 85.7 89.1 90.3 91.6 114.0 115.8 117.7 119.7 121.8	2,473 100 101 111 688 133 133 144
Year 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008	Population  25,679 26,746 27,862 29,029 30,243 2,31,505 3,2817 34,183 5,35,604 37,084 7,084 7,084 7,086 8,40,230	Alum Chlorins Soda at Total ct Deman m3:d 3,334 3,745 3,968 4,160 4,361 4,572 4,794 5,026 5,270 5,526 5,526	Population Coverage % 79% 90% 100% 100% 100% 100% 100% 100% 100	per m3 Water Supplied m3/d 2.800 3.370 3.968 4,160 4,361 4,572 4,794 5,026 5,270 5,526 5,794	Incremental supply m3/d 570 1.168 1.360 1.561 1.772 1.994 2.226 2.470 2.726 2.994	Investment Treatment Civil US\$ x 1,000 574.7	Schedule E&M uss x 1,990 85,3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo US\$ x 1 0 83.9 83.9	Total Investment (95 x 1.000 ) 19.9 19.9 19.9 19.9 19.9 19.9 19.9 19	ORM Costs uss x1.00 26.7 26.9 27.1 27.3 36.7 36.9 37.1 37.5 41.1	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs cuss×1.000 9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1	2003 Labour US\$ x 1 00 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chemics USS x 1.00  2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3 12.4 13.7	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent vuss x1.000 85.7 89.1 90.3 91.6 114.0 115.8 117.7 121.8 127.4	2,473 100 100 111 111 688 133 134 314
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007	Population  25,679 26,746 27,862 29,029 30,243 2,31,505 3,2817 34,183 5,35,604 37,084 7,084 7,084 7,086 8,40,230	Alum Chlorins Soda at Total ct Deman m3:0 3,334 3,745 3,968 4,160 4,361 4,572 4,794 5,026 5,270 5,526 5,794	Population Coverage % 79% 90% 100% 100% 100% 100% 100% 100% 100	per m3  Water Supplied m3/d 2.800 2.800 3.370 3.968 4,160 4,361 4,572 4,794 5,026 5,270 5,526 5,794 6,076	Incremental supply m3/d 570 1,168 1,360 1,561 1,772 1,994 2,470 2,726 2,994 3,275	Investment Treatment Civil US\$ x 1,000 574.7	Schedule E&M USS x 1,000 85,3	US\$/kg 0.45 6.25 0.25 Pripes US\$ x1000 11,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	Transpo US\$ x 1 0 83.9	Total Investment of the state o	O&M Costs Us\$x1,00 26.9 27.1 27.3 36.7 36.9 37.1 37.3 41.1	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.us\$x1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9	2003 Labour US\$ x 1 cc 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chemics USS x 1.00 2.6 5.3 6.2 7.1 8.1 10.2 11.3 12.4 13.7 14.9	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent USS x 1.000 85.7 89.1 90.3 91.6 114.0 115.8 117.7 119.7 121.8 127.4 129.7	2,477 100 101 111 683 133 134 314 314
Year 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008	Population 25,679 3 26,746 27,862 29,029 30,243 31,505 3 32,817 4 34,183 37,084 7 38,625 8 40,230 9 41,933	Alum Chloring Soda as Total ch nWater Deman m3:d 3,334 3,745 3,968 4,160 4,361 4,572 4,794 5,796 5,270 6,576 6,076	AnnA.ine pat	per m3 Water Supplied m3/d 2.800 2.800 3.968 4,160 4,361 4,572 4,794 5,026 5,794 6,076	Incremental supply m3/d - 570 1,168 1,360 1,561 1,772 1,994 2,226 2,470 2,726 2,994 3,276	Investment Treatment Civil US\$ x 1,000 574.7	Schedule E&M USS x 1,000 85,3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x 1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	Transpo US\$ x 1 0 83.9 83.9	Total Investment of the control of t	O&M Costs US\$ x1,00 26.7 26.9 27.1 27.3 36.9 37.1 37.3 37.5 41.1 41.3	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7	2003 Labour US\$ x 1 fx 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chemics USS x 1.00  2.6 5.3  6.2  7.1  8.1  10.2  11.3  12.4  13.7  14.9  16.3	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total Recurrent uss x 1.000 85.7 89.1 90.3 91.6 114.0 115.8 117.7 119.7 121.8 127.4 129.7	2,479 100 110 111 68 13 13 14 31 14
Year 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2006 2006 2008 2008 2008 2008 2008	Population 25,679 26,746 27,862 29,029 30,243 2,31,505 34,183 32,817 4,34,183 35,604 5,37,084 7,38,625 8,40,230 9,41,903 9,41,903	Alum Chlorint Soda at Total ch Deman m3:0 3,334 3,745 3,968 4,361 4,361 4,361 4,572 5,226 5,279 6,526 6,076 6,676 6,676	han/Line pat  h conical cost  Population Coverage  84%  79%  90%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%	per m3  Water Supplied m3/d 2.800 2.800 3.370 3.968 4,160 4,361 4,572 4,794 5,026 5,270 5,526 5,794 6,076	Incremental supply m3/d 570 1,168 1,360 1,561 1,772 1,994 2,470 2,726 2,994 3,275	Investment Treatment Civil US\$ x 1,000 574.7	Schedule E&M USS x 1,000 85,3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo US\$ × 1 0 83.9 83.9	Total Investment (95 x 1.000 ) 19.9 19.9 19.9 19.9 19.9 19.9 19.9 19	ORM Costs USS x 1.00  26.7  26.9  27.1  27.3  36.7  36.7  36.7  37.5  41.1  41.5	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs cuss x 1.000 9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7	2003 Labour US\$ x 1 00 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8	Transport  Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chemics USS x 1.00  2.6 5.3 6.2 7.1 8.1 10.2 11.3 12.4 13.7 8 14.9 16.3 16.3	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent vuss x 1.000 85.7 89.1 90.3 91.6 114.0 115.8 117.7 121.8 127.4 129.7 132.1	2,473 10 10 11 68 13 13 14 31 14 15
Year 1996 1997 1998 2000 2001 2003 2004 2005 2006 2007 2008 2009 2009 2010	Population  25,679 26,746 27,862 29,029 30,243 31,505 31,505 332,817 34,835 35,604 37,084 738,625 840,230 44,903 44,903 44,903 44,648	Alum Chlorins Soda at Total cf Deman m3:6 3,334 3,745 3,968 4,160 4,361 4,572 4,794 5,026 5,270 5,526 5,794 6,676 8,760 8,760	Population Coverage % 84% 79% 90% 100% 100% 100% 100% 100% 100% 100	per m3 Water Supplied m3/d 2.800 2.800 3.968 4,160 4,361 4,572 4,794 5,026 5,794 6,076	Incremental supply m3/d - 570 1,168 1,360 1,561 1,772 1,994 2,226 2,470 2,726 2,994 3,276	Investment Treatment Civil US\$ x 1,000 574.7	Schedu'e E8M US\$ x 1,990 85,3 148,5 85,3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo	Total Investment (USE x 1.000) 19.9 19.9 19.9 19.9 19.9 19.9 19.9 19.	O&M Costs Us\$x1,000 26.7 26.9 27.1 27.3 36.7 36.9 37.1 41.3 41.5 41.5	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs couss×1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7 25.7 25.7	2003 Labour US\$ x 1 cc 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chemics USS x 1.00  2.6 5.3 6.2 7.1 8.1 10.2 11.3 12.4 13.7 13.7 14.9 16.3 16.3 16.3	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent vuss x1.000 85.7 89.1 90.3 91.6 114.0 115.8 117.7 119.7 121.8 127.4 129.7 132.1 132.3 132.5	2,479 100 101 111 68 13 13 14 31 14 15
Year 1996 1997 1998 1999 2000 2003 2004 2005 2007 2008 2009 2010 2011	Population  25,679  26,746  27,862  29,029  30,243  32,817  34,183  35,604  37,084  41,903  41,903  41,903  43,648  24,3648	Alum Chloring Soda as Total ch Deman m3:d 3,334 3,745 3,968 4,160 4,361 4,572 4,794 5,526 5,270 6,526 6,572 8,6372 8,6372 8,6372	AnnAine pat	per m3 Water Supplied m3/d 2,800 2,800 3,370 3,968 4,160 4,361 4,572 4,794 5,026 5,270 5,526 5,794 6,076 6,372 6,372	Incremental supply m3/d 570 1,168 1,360 1,561 1,772 1,994 2,2470 2,726 2,994 3,275 3,572 3,572	Investment Treatment Civil US\$ x 1,000 574.7	Schedule E&M USS x 1,000 85,3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo	Total Investment (USE x 1.000) 19.9 19.9 19.9 19.9 19.9 19.9 19.9 19.	O&M Costs Us\$x1,000 26.7 26.9 27.1 27.3 36.7 36.9 37.1 41.3 41.5 41.5	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7 25.7 25.7 25.7	2003 Labour US\$ x 1 cc 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chernica USS x 1.00 2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3, 12.4 13.7 14.9 16.3 16.3 16.3 16.3 16.3 16.3 16.3	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total Recurrent uss x 1.000 85.7 89.1 90.3 91.6 114.0 115.8 117.7 119.7 121.8 127.4 129.7 132.3 132.5 132.3	2,479 100 110 111 68 13 13 14 31 14 31 15 15
Year 1996 1997 1998 1999 2000 2001 2002 2003 2006 2007 2008 2009 2010 2011 2012 2012 2013	Population 25,679 3 26,746 27,862 29,029 3 02,43 3 32,817 4 34,183 3 7,084 7 38,625 8 40,230 9 41,903 0 43,648 1 43,648 2 43,648	Alum Chlorint Soda at Total ch Deman m3:0 3,334 3,534 3,745 3,968 4,160 4,361 4,361 4,361 4,572 6,526 6,794 6,076 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372	anA.ine pat  h. conical cost  Population Coverage  84%  79%  90%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%	per m3 Water Supplied m3/d 2.800 2.800 3.968 4,160 4,361 4,572 4,794 5,026 5,270 5,794 6,076 6,372 6,372 6,372	Incremental supply m3/d - 570 1,168 1,360 1,561 1,772 2,226 2,726 2,294 2,276 3,572 3,572 3,572 3,572	Investment Treatment Civil US\$ x 1,000 574.7	Schedu'e E8M US\$ x 1,990 85,3 148,5 85,3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1 000 1,735.9 19.9 19.9 150.7 19.9 19.9 19.9 19.9 19.9 19.9 19.9	Transpr US\$ × 1 0 83.9 83.9	Total Investment (USE x 1.000) 19.9 19.9 19.9 19.9 19.9 19.9 19.9 19.	O&M Costs US\$ x1,00 26.7 26.9 27.1 27.3 36.9 37.1 37.3 41.5 41.5 41.7 41.9 41.9	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7 25.7 25.7	2003 Labour US\$ x 1 cc 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chernica USS x 1.00 2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3, 12.4 13.7 14.9 16.3 16.3 16.3 16.3 16.3 16.3 16.3	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent vuss x 1.000 85.7 89.1 90.3 91.6 114.0 115.8 127.4 129.7 121.8 127.4 132.3 132.5 138.8	2.479 2.479 100 100 110 111 11 68 13 13 14 15 15 15
Year 1996 1997 1998 2000 2001 2002 2003 2004 2005 2006 2007 2008 2010 2011 2012 2013 2014	Population  25,679 3 26,746 9 27,862 9 30,243 3 31,505 3 32,817 4 34,163 5 37,084 7 38,625 8 40,230 41,903 0 43,648 1 43,648 4 43,648 4 43,648	Alum Chloring Soda at Total of n Deman m3:d 3,334 3,745 3,968 4,160 4,361 4,794 5,026 5,206 5,794 6,076 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372	nan/Line pat  h  propulation Coverage %  84% 79% 90% 100% 100% 100% 100% 100% 100% 100	per m3  Water Supplied m3/d 2.800 3.370 3.968 4,160 4,361 4,572 4,794 5,026 5,270 5,526 5,794 6,076 6,372 6,372 6,372 6,372 6,372	Incremental supply m3/d 	Investment Treatment Civil US\$ x 1,000 574.7	Schedu'e E8M US\$ x 1,990 85,3 148,5 85,3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo US\$ x 1 0 83.9 83.9	Dosage (	O&M Costs US\$ x 1,00 26.7 26.9 27.1 27.3 36.9 37.1 37.5 41.1 41.3 41.5 41.7 44.8 48.0	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs cuss x 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7 25.7 25.7 25.7 25.7	2003 Labour US\$ x 1 00 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chemica USS x 1.00 Chemica USS x 1.00 Chemica USS x 1.00 Chemica Chemi	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent vuss x 1.000 85.7 89.1 90.3 91.6 115.8 117.7 121.8 127.4 129.7 132.1 132.3 132.5 138.6	2.47/ 100 100 111 111 688 133 133 144 155 155 159
Year 1996 1997 1998 1999 2000 2001 2002 2003 2006 2007 2008 2010 2011 2012 2013	Population 25,679 25,679 3 26,746 2 29,029 3 30,243 32,817 4 34,183 5 40,233 9 41,903 9 43,648 1 43,648 4 43,648 5 43,648 5	Alum Chloring Soda as Total ch Deman m3:d 3,334 3,745 3,968 4,160 4,361 4,572 4,794 5,526 5,270 6,526 6,372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372 8,6372	AnnAine pat h. h. cmical cost coverage % 100% 100% 100% 100% 100% 100% 100% 1	per m3 Water Supplied m3/d 2.800 2.800 3.370 3.968 4,161 4,572 4,794 5,526 5,794 6,076 6,372 6,372 6,372 6,372 6,372 6,372	Incremental supply m3/d 570 1.168 1.360 1.561 1.772 1.994 2.726 2.994 3.276 3.572 3.572 3.572 3.572 3.572 3.572 3.572	Investment Treatment Civil US\$ x 1,000 574.7	Schedu'e E8M US\$ x 1,990 85,3 148,5 85,3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1,000 19,9 19,9 19,9 19,9 19,9 19,9 19,9	1998 Transpo US\$ x 1 0 83.9 83.9	Total Investment of the state o	O&M Costs Us\$x1,000 26.7 26.9 27.1 27.3 36.7 36.9 37.1 41.3 41.5 41.5 41.6 48.4 48.4	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs Cus\$x1.000  9.1 9.5 9.7 9.9 20.6 21.3 22.6 23.3 24.1 24.9 25.7 25.7 25.7 25.7 25.7 25.7	2003 2003 2003 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chemics USS x 1.00  2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3 12.4 16.3 16.3 16.3 3 16.3 3 16.3 3 16.3 3 16.3 3 16.3	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent vuss x1,000 85.7 89.1 90.3 91.6 114.0 115.7 127.4 129.7 132.3 132.5 138.6 138.6 138.6 139.0	2.47 10 10 11 11 68 13 13 14 15 15
Year 1996 1997 1998 2000 2001 2002 2003 2004 2005 2006 2011 2012 2013 2014 2015	Population 25,679 26,746 27,862 29,029 31,505 31,505 33,1505 34,183 35,604 738,625 41,903 043,648 43,648 43,648 43,648 43,648 43,648	Alum Chlorint Soda at Total ch Deman m3:d 3,334 3,745 3,968 4,160 4,361 4,361 4,361 4,572 6,526 6,794 6,527 6,637	anA.ine pat  h. conical cost  Population Coverage  84%  79%  90%  100%	per m3 Water Suppfied m3/d 2.800 3.968 4,160 4,361 4,572 4,794 5,026 5,270 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372	Incremental supply m3/d - 570 1,168 1,360 1,561 1,772 2,226 2,470 2,726 2,994 3,276 3,572 3,572 3,572 3,572 3,572 3,572 3,572	Investment Crivil US\$ x 1,000 574.7	Schedule E8M uss x (.000 85.3 148.5	US\$/kg 0.45 6.25 0.25 P/pes US\$ ×1 000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	Transpo US\$ × 1 0 83.9 83.9	Total Investment of the control of t	O&M Costs USS x 1,00 26.7 26.9 27.1 27.3 36.9 37.1 37.3 37.5 41.1 41.5 41.6 41.6 48.6 48.6 48.6	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7 25.7 25.7 25.7 25.7 25.7	2003 Labour US\$ x 1 00 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chernica USS x 1.00 2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3 12.4 13.7 14.9 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total Recurrent uss x 1.000 85.7 89.1 90.3 91.6 114.0 115.8 117.7 119.7 121.8 127.4 129.7 132.3 132.5 138.6 138.6 138.8 139.0 139.2	2,47 10 10 11 11 68 13 14 14 15 15 15 15 15 15 15 15 15 15 15 15 15
Year 1996 1997 1998 1999 2000 2001 2002 2003 2006 2007 2008 2010 2011 2012 2013	Population 25,679 25,679 3 26,746 2 27,862 29,029 3 31,505 3 35,604 5 37,084 7 38,625 41,933 0 43,648 43,648 43,648 443,648 6 43,648 6 43,648 6	Alum Chlorint Soda at Total ch Deman m3:d 3,334 3,745 3,968 4,160 4,361 4,361 4,361 4,572 6,526 6,794 6,527 6,637	anA.ine pat  h. conical cost  Population Coverage  84%  79%  90%  100%	per m3 Water Suppfied m3/d 2.800 3.968 4,160 4,361 4,572 4,794 5,026 5,270 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372	Incremental supply m3/d 570 1.168 1.360 1.561 1.772 1.994 2.726 2.994 3.276 3.572 3.572 3.572 3.572 3.572 3.572 3.572	Investment Treatment Civil US\$ x 1 000 574.7 189.9	Schedu'e E8.M USS x 1,000 85.3 148.5 85.3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo US\$ x 1 0 83.9 83.9 83.9	Total Investment of the state o	O&M Costs USS x 1,00 26.7 26.9 27.1 27.3 36.9 37.1 37.3 37.5 41.1 41.5 41.6 41.6 48.6 48.6 48.6	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 23.3 24.1 24.9 25.7 25.7 25.7 25.7 25.7 25.7 25.7 25.7	2003 2003 2003 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chernica USS x 1.00 2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3 12.4 13.7 14.9 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total Recurrent USS x 1.000 85.7 89.1 90.3 91.6 114.0 115.8 117.7 121.8 127.4 129.7 132.1 132.3 132.5 138.6 138.0 139.0	2,47 10 10 11 11 68 13 14 14 15 15 15 15 15 15 15 15 15 15 15 15 15
Year 1996 1997 2000 2001 2002 2003 2004 2005 2006 2011 2012 2013 2014 2015 2016 2017	Population 25,679 25,679 3 26,746 29,029 30,243 32,817 4 34,183 57,084 40,233 9 41,903 9 43,648 43,6	Alum Chlorins Soda at Total ct Peman m3:0 3,334 4,351 4,361 4,361 4,361 4,361 4,572 5,526 5,579 6,372 8 6,372 8 6,372 8 6,372 8 6,372 8 6,372 8 6,372 8 6,372 8 6,372 8 6,372 8 6,372	anA.ine pat  h. conical cost  Population Coverage  84%  79%  90%  100%	per m3 Water Suppfied m3/d 2.800 3.968 4,160 4,361 4,572 4,794 5,026 5,270 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372	Incremental supply m3/d 570 1.168 1.360 1.561 1.772 1.994 2.226 2.470 2.726 2.994 3.276 3.572 3.572 3.572 3.572 3.572 3.572 3.572	Investment Treatment Civil USS x 1 000 574.7 189.9	Schedu'e E8.M USS x 1,000 85.3 148.5 85.3	US\$/kg 0.45 6.25 0.25 P/pes US\$ ×1 000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo US\$ x 1 0 83.9 83.9 83.9	Dosage (	O&M Costs Uss x1,000 26.7 26.9 27.1 27.3 36.7 36.7 37.5 41.5 41.1 41.9 41.6 48.6 48.6 48.6 48.6 48.6	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7 25.7 25.7 25.7 25.7 25.7	2003 Labour US\$ x 1 00 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chernica USS x 1.00 2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3 12.4 13.7 14.9 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent vuss x1.000 85.7 89.1 90.3 91.6 114.0 115.8 127.4 129.7 121.8 132.3 138.6 138.6 138.6 139.0 139.2 137.4	2.47 10 10 11 11 655 13 14 15 15 15 15 15 15 15 15 15 15 15 15 15
Year 1996 1997 2000 2001 2002 2003 2004 2005 2006 2011 2012 2013 2014 2015 2016 2017	Population 25,679 26,746 27,862 29,029 31,505 31,505 33,1505 34,183 35,604 738,625 41,903 043,648 43,648 43,648 43,648 43,648 43,648	Watchn  Alum Chlorint Soda at Total ch  NWater Deman m3:0  3,334 3,745 3,968 4,160 4,361 4,361 4,361 4,572 6,794 6,527 6,676 6,637 6	anA.ine pat  h. conical cost  Population Coverage  84%  79%  90%  100%	per m3 Water Suppfied m3/d 2.800 3.968 4,160 4,361 4,572 4,794 5,026 5,270 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372	Incremental supply m3/d	Investment Treatment Civil Uss x 1 000 574.7 189.9	Schedu'e E8.M USS x 1,000 85.3 148.5 85.3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo US\$ x 1 0 83.9 83.9 83.9	Total Investment (USE x 1.000 19.9 19.9 19.9 19.9 19.9 19.9 19.	O&M Costs Uss x 1,00 26.7 26.9 27.1 36.9 36.7 37.3 37.5 41.5 41.5 41.8 48.0 48.4 48.6 48.6 48.7	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7 25.7 25.7 25.7 25.7 25.7	2003 Labour US\$ x 1 00 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chernica USS x 1.00 2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3 12.4 13.7 14.9 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent vuss x1,000 85.7 89.1 90.3 91.6 114.0 115.8 117.7 119.7 121.8 127.4 129.7 132.1 132.5 138.6 139.0 139.2 137.4	2,477 10 10 11 11 65 13 13 14 15 15 15 15 15 15 15 15 15 15 15 15 15
Year 1996 1997 1998 1999 2000 2001 2002 2003 2006 2007 2011 2011 2012 2013 2014 2015 2016 2017	Population 25,679 25,679 3 26,746 29,029 30,243 32,817 4 34,183 57,084 40,233 9 41,903 9 43,648 43,6	Alum Chlorinus Soda at Total ch Deman m3/d 3,334 3,534 3,745 3,968 4,160 6,4794 5,270 6,526 6,372 3,6372 3,6372 3,6372 3,6372 3,6372 3,6372 3,6372 3,6372	an/Line pat  h  princal cest  Population  Coverage  \$44  79% 90% 100% 100% 100% 100% 100% 100% 100	per m3 Water Suppfied m3/d 2.800 3.968 4,160 4,361 4,572 4,794 5,026 5,270 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372	Incremental supply m3/d	Investment Treatment Civil Uss x 1 000 574.7 189.9	Schedu'e E8.M USS x 1,000 85.3 148.5 85.3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo US\$ x 1 0 83.9 83.9 83.9	Dosage (	O&M Costs US\$ x1,00 26.7 26.9 27.1 27.3 36.9 37.1 37.3 37.5 41.1 41.3 41.5 41.7 48.4 48.6 48.6 48.6 48.7	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7 25.7 25.7 25.7 25.7 25.7	2003 Labour US\$ x 1 00 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chernica USS x 1.00 2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3 12.4 13.7 14.9 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3	31.82 Cost/m3 0.000 0.013 0.000 0.013 Recurrent vss x 1.000 85.7 89.1 90.3 91.6 114.0 115.8 127.4 129.7 132.3 132.5 138.8 139.0 1	2,479 100 101 111 68 13 13 14 15 15 15 15 15 15 15 15 15 15 15 15 15
Year 1996 1997 1998 1999 2000 2001 2002 2003 2006 2007 2011 2011 2012 2013 2014 2015 2016 2017	Population 25,679 25,679 3 26,746 29,029 30,243 32,817 4 34,183 57,084 40,233 9 41,903 9 43,648 43,6	Watchn  Alum Chlorint Soda at Total ch  NWater Deman m3:0  3,334 3,745 3,968 4,160 4,361 4,361 4,361 4,572 6,794 6,527 6,676 6,637 6	an/Line pat  h  princal cest  Population  Coverage  \$44  79% 90% 100% 100% 100% 100% 100% 100% 100	per m3 Water Suppfied m3/d 2.800 3.968 4,160 4,361 4,572 4,794 5,026 5,270 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372	Incremental supply m3/d 1.168 1.360 1.561 1.772 1.994 2.226 2.994 3.276 3.572 3.572 3.572 3.572 3.572 3.572 3.572 4.484 1.000	Investment Treatment Civil Uss x 1 000 574.7 189.9	Schedu'e E8.M USS x 1,000 85.3 148.5 85.3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo US\$ x 1 0 83.9 83.9 83.9	Dosage (	O&M Costs Uss x1,000 26.7 26.9 27.1 27.3 36.7 36.9 37.1 37.3 37.5 41.5 41.7 41.9 44.8 48.6 48.6 48.6 9 48.6	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7 25.7 25.7 25.7 25.7 25.7	2003 Labour US\$ x 1 00 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chernica USS x 1.00 2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3 12.4 13.7 14.9 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3	31.82 Cost/m3 0.060 0.013 0.000 0.013 Total Recurrent vuss x1.000 85.7 89.1 90.3 91.6 114.0 115.8 127.4 129.7 121.8 132.3 138.6 138.6 139.0 139.2 1	2,479 100 100 110 110 110 110 110 110 110 11
Year 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2010 2011 2012 2013 2014 2015 2016 2017	Population 25,679 25,679 3 26,746 29,029 30,243 32,817 4 34,183 57,084 40,233 9 41,903 9 43,648 43,6	Alum Chlorinus Soda at Total ch Deman m3/d 3,334 3,534 3,745 3,968 4,160 6,4794 5,270 6,526 6,372 3,6372 3,6372 3,6372 3,6372 3,6372 3,6372 3,6372 3,6372	an/Line pat  h  population Coverage %  84% 79% 90% 100% 100% 100% 100% 100% 100% 100	per m3 Water Suppfied m3/d 2.800 3.968 4,160 4,361 4,572 4,794 5,026 5,270 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372	Incremental supply m3/d	Investment Treatment Civil Uss x 1 000 574.7 189.9	Schedu'e E8.M USS x 1,000 85.3 148.5 85.3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo US\$ x 1 0 83.9 83.9 83.9	Total Investment (USE x 1.000 19.9 19.9 19.9 19.9 19.9 19.9 19.	O&M Costs Uss x 1,00 26.7 26.9 27.1 27.3 36.9 37.1 37.3 41.5 41.5 41.7 41.9 48.4 48.4 48.6 48.7	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7 25.7 25.7 25.7 25.7 25.7	2003 Labour US\$ x 1 00 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chernica USS x 1.00 2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3 12.4 13.7 14.9 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3	31.82 Cost/m3 0.000 0.013 0.000 0.013 Total Recurrent US\$ x 1.000 85.7 89.1 90.3 91.6 114.0 115.8 117.7 121.8 127.4 129.7 132.3 132.5 138.6 139.0 139.2 137.4 US\$ x 1.000	Costs US\$ x 1. 2. 4775 1000 1100 1100 1100 1100 1100 1100 1
Year 1996 1997 1998 2000 2001 2002 2003 2004 2005 2007 2008 2010 2011 2012 2013 2014 2015	Population  25,679 3 26,746 27,862 29,029 31,505 3 32,817 4 34,183 3 35,604 5 37,084 6 37,084 3 43,648 3 43,648 4 43,648 4 43,648 6 43,648 6 43,648 6 43,648	Alum Chlorint Soda as Total ch n Water Deman m3:d 3,334 3,534 3,968 4,160 4,361 4,361 4,572 6,526 6,072 8,6372 8,764 8,7	anA.ine pat  h. conical cost  Population Coverage  84%  79%  90%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%  100%	per m3 Water Supplied m3/d 2.800 2.800 3.370 3.968 4,160 4,361 4,572 4,794 5,926 5,270 5,526 5,794 6,076 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372	Incremental supply m3/d 1.168 1.360 1.561 1.772 1.994 2.226 2.994 3.276 3.572 3.572 3.572 3.572 3.572 3.572 3.572 4.484 1.000	Investment Treatment Civil Uss x 1 000 574.7 189.9	Schedu'e E8.M USS x 1,000 85.3 148.5 85.3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo US\$ x 1 0 83.9 83.9 83.9	Dosage (	O&M Costs Uss x 1,00 26.7 26.9 27.1 27.3 36.9 37.1 37.3 41.5 41.5 41.7 41.9 48.4 48.4 48.6 48.7	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7 25.7 25.7 25.7 25.7 25.7	2003 Labour US\$ x 1 00 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chernica USS x 1.00 2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3 12.4 13.7 14.9 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3	31.82 Cost/m3 0.000 0.013 0.000 0.013 Recurrent vss x1.000 85.7 89.1 90.3 91.6 114.0 115.8 127.4 129.7 132.3 132.5 138.6 138.0 139.0 13	Costs US\$x 1.7  2.47% 10:9 10:9 10:9 11:16 13:13:13:14 13:15:15:5 15:5 15:5 15:5 15:5 15:5 15:
Year 1996 1997 1998 2000 2001 2002 2003 2004 2005 2007 2008 2010 2011 2012 2013 2014 2015	Population  25,679 3 26,746 27,862 29,029 31,505 3 32,817 4 34,183 3 35,604 5 37,084 6 37,084 3 43,648 3 43,648 4 43,648 4 43,648 6 43,648 6 43,648 6 43,648	Alum Chlorint Soda at Total of Deman m3/d 3,534 3,745 3,968 4,160 6,526 6,726 6,526 6,372 3,637 2,38 6,372 3,637 2,38 6,372 3,637 2,38 6,372 3,637 2,38 6,372 3,637 2,794 6,77	an/Line pat  h conical cost  Population Coverage  84%  79% 90% 100% 100% 100% 100% 100% 100% 100	per m3 Water Supplied m3/d 2.800 2.800 3.370 3.968 4,160 4,361 4,572 4,794 5,926 5,270 5,526 5,794 6,076 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372	Incremental supply m3/d 1.168 1.360 1.561 1.772 1.994 2.226 2.994 3.276 3.572 3.572 3.572 3.572 3.572 3.572 3.572 4.484 1.000	Investment Treatment Civil Uss x 1 000 574.7 189.9	Schedu'e E8.M USS x 1,000 85.3 148.5 85.3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo US\$ x 1 0 83.9 83.9 83.9	Total Investment (USE x 1.000 19.9 19.9 19.9 19.9 19.9 19.9 19.	O&M Costs US\$ x 1,00 Co	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7 25.7 25.7 25.7 25.7 25.7	2003 Labour US\$ x 1 00 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chernica USS x 1.00 2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3 12.4 13.7 14.9 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3	31.82 Cost/m3 0.060 0.013 0.000 0.013 Recurrent vss x 1.000 85.7 89.1 90.3 91.6 114.0 115.8 117.7 121.8 127.4 129.7 132.3 132.5 138.8 139.0 139.2 137.4 USS x 1.000 USS x 1.000 SB1.3 724.1 924.1 USS/m3 0.17	2.4754 103 116 116 116 116 116 116 116 116 116 11
Year 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2007 2003 2010 2011 2012 2013 2014 1015 2016 2017	Population  25,679 3 26,746 27,862 29,029 31,505 3 32,817 4 34,183 3 35,604 5 37,084 6 37,084 3 43,648 3 43,648 4 43,648 4 43,648 6 43,648 6 43,648 6 43,648	Alum Chlorint Soda as Total ch n Water Deman m3:d 3,334 3,534 3,968 4,160 4,361 4,361 4,572 6,526 6,072 8,6372 8,764 8,7	an/Line pat  h  propulation  Coverage %  84% 79% 90% 100% 100% 100% 100% 100% 100% 100	per m3 Water Supplied m3/d 2.800 2.800 3.370 3.968 4,160 4,361 4,572 4,794 5,926 5,270 5,526 5,794 6,076 6,372 6,372 6,372 6,372 6,372 6,372 6,372 6,372	Incremental supply m3/d 1.168 1.360 1.561 1.772 1.994 2.226 2.994 3.276 3.572 3.572 3.572 3.572 3.572 3.572 3.572 4.484 1.000	Investment Treatment Civil Uss x 1 000 574.7 189.9	Schedu'e E8.M USS x 1,000 85.3 148.5 85.3	US\$/kg 0.45 6.25 0.25 P/pes US\$ x1.000 1,735.9 19.9 19.9 19.9 19.9 19.9 19.9 19.9 1	1998 Transpo US\$ x 1 0 83.9 83.9 83.9	Total Investment of the control of t	O&M Costs Uss x1,000 Costs Uss x1,000 Costs Uss x1,000 Costs Uss x1,000 Costs Uss x1,000 Costs Uss x1,000 Costs Uss x1,000 Costs Uss x1,000 Costs Cost	90.54 Cost/m2 0.000 0.013 0.000 0.013 Power Costs 0.05 × 1.000  9.1 9.5 9.7 9.9 20.6 21.3 21.9 22.6 23.3 24.1 24.9 25.7 25.7 25.7 25.7 25.7 25.7	2003 Labour US\$ x 1 00 30.5 30.5 30.5 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8 31.8	Transport  16.8 16.8 16.8 16.8 16.8 16.8 16.8 16.	Chernica USS x 1.00 2.6 5.3 6.2 7.1 8.1 9.1 10.2 11.3 12.4 13.7 14.9 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3 16.3	31.82 Cost/m3 0.000 0.013 0.000 0.013 Recurrent vss x1.000 85.7 89.1 90.3 91.6 114.0 115.8 127.4 129.7 132.3 132.5 138.6 138.0 139.0 13	2.477 100 111 111 116 133 134 134 155 155 155 155 155 155 155 155 155 15

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# Table L-6 Cost Estimates Chuka Water Supply

	-					iice - T	681	(Shs	Phasa 1			1998	Phase 2			2003	3-Oct-97
nvestn	ent costs (1	aj Descriptio	xchange ra n	l <b>e</b>	<u> </u>		Jnit	Rate	i ilase i			Pipes				Pipes	- 5 Co. 37
Elemen		ila (mm S						JS <b>\$</b>		US \$ x 1,000	US\$ x 1.00		Quantity	US \$ x 1,000	US \$ x 1,00	US \$ x 1,000	
Rehabili									item	4.5	7	17.9	Ţ		I	1	l
intake Raw pip	etine	250	mm dla ste	el pipe			m	95.661	item 3,100	318.4		296.5	ŀ				}
ian pip			mm dia ste				m	71.143	5,633			400,7	ł				
Treatme	of		m3/d capac				nr	336,964	1	286.4	50.5		1.0	201.7	35.6	; l	ļ
Reservo			m3/d expan m3 reservoi				nr nr	237,286 60,000	1	60.0	·		1.0	201.7	33.0		1
neservo	ліз		m3 reservoi			2	Df	41,964	1	42.0			ŀ	-			1
	İ		mi3 reservoi				nr	34,643	1	34.6		1	Į	-		İ	
	l		m3 reservo				n/	27,143 23,036	1 1	27.1				:			
			m3 reservoi m3 reservo			1	nr nr	19,107	1	19.1	[	}	2.0	38.2		i	
			m3 reservo				nr	16,786	1	16.8	}	ļ	1.0	16.8			
			m3 reservo				nr	13.929		-			ļ	-			
Transm	ission		mm dia ນຄື <sup>ນ</sup>			•	m	98.821 77.554			ļ		- 1		i I	[ ]	
	1		mm dia uP' mm dia uP'			1	m l	60.875	2,900			176.5				- 1	
			mm dia uP				m	46.857	2,800			131.2	1,000			46.9	
			mm dia uP	VC (12 bar)	)		m	28.982	2,600	2002	40.0	75.4	1,000	640		29.0 19.0	
	les/conting					ļ	1	25% 15%	1	202.2 151.7	12.6 9.5	274.6 205.9	i	64.2 48.1	8.9 6.7	14.2	
Total	ies/conting	encies					السسسي	10.0	<u> </u>	1,162.9	72.7	1,578.7		369.0	51.2	109.0	
THE RESERVE	nased costs	S					W# 3########		Phase	1			Phase 2			529.2	
Annual			~~~									V-10710000		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			
Annual			mm dia u				m	18.446	500	[		15.5	500 1,000		1	9.2 15.5	
distribi pipes	ution		mm dia uP mm dia uP				m I	15.500 12.089				24.2	2,000			24.2	
Total			GIA UI				استحسمتن				1	48.9				48.9	
	ori Rogul							US\$x1,000					2003				
	•	Saloon ca					nr	17.9		1			0			- 62.5	
		4WD veh Pickup	iicie				nr nr	62.5 21.4				62.5 42.9	2			42.9	
		Lony					nr	107.1	0	<u> </u>			ō				
	لمدسيبيس								Transpo		E8M	Pipes					İ
		ts as % c	f Investme	nte					20%	1			1		-	i	
Power	inic life			<del></del>	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	~		and the state of t	<del></del>		Fixed	Variable	<del> </del>	2003	Fixed	Variable	
rowa!	<b>'</b>	Power to	riff (Oct 199	(6)	١		Power Red	uirements	Ł	1 1990	. 10	10	<u>]</u>		10	10	
		Unit ene	rgy cost				US\$/unit	0.0785714	4								
1			n 16d able:				US\$/month	7.8571429									
Hume	n resource		nand charg	٠	740.		US\$-month	4.4642857 Hate/yr	<u> </u>	1998	,	NA PRIMER INCOME.		2003	<del>,</del>	rag mongrupusans	İ
l''Greet	. 10500160							US\$x1,000		TWks2	Dist'n	US\$x1,000	TWks 1		Dist'n	US\$x1,00	
	1	Engineer					Shs/yr	3,86		[	4	1	<u> </u>		1	3.86	
1		Enginee					Shs/yr Shs/yr	3.21 2.36		,		3.21	2		1 2	3.21 9.43	
		Inspecto Senior C					Shs/yr	1.29					2		3		l
l		Operator					Shs/yr	0.96	1	2	1 .	5.79	2		5	6.75	I
1		Watchm	an/Line pat	rolman/Cle	rks		Shs/yr	0.64	4 3	3	1:	9.64	3	1	17	12.86 42.54	
					endakımı am.		Shs/yr	US\$/kg	100	Dosage (	mad)	33.21 Cost/m3	2003	Dosage (n	າດທັ	Cost/m3	ł
Chain	ical costa	Alum						0.45			0 0	0.000		(		0.000	1
		Chlorine						6.25			2	0.013		á		0.013	
1		Soda as						0.25			0	0.000	<del> </del>		)	0.000	
	1	Fotal ch	emical cost	per m3	Increm-		l Schedule				T	0.013		-	1	0.01.3	
Year	Population	Water	Population	Water	ental	Treatment		Pipes	Transp	oTotal	O&M	Power	Labour	Transport	Chemica		Total
ļ			Coverage			Civil	E&M		İ	Investme		Costs				Recurrent	
422		m3/d	%	m3/d	m3/d	US\$ x 1,000	US\$ x 1,000	US\$ x 1,000	(US\$ x 1.0	XUS\$ × 1.000	1US\$ x 1.00	OUS\$ x 1,000	US\$ x 1,00	406\$ x 1 000	U35 x 1.00	AUS\$ x 1,000	มธร x 1,000
1996 1997	41,502	1,537	[	-				1	1	-	1			1			
1998	43,046	1,741			-	1,162.9	72.7	1,578.7					]		-	-	2,919.6
1999	44,622		50%	980	980	1		48.9		48.9			33.2 33.2	21.1			145.9 147.7
2000	46,238 47,904	2,192	55% 60%	1,205 1,425	1,205	<del> </del>	-	48.9		48.9			33.2				149.5
2002	47,904		65%	1,669	1,669	}		48.9	e j	49.5	32.3	8.3	33.2	21.1	7.6	102.5	151.4
2003	51,373	2,770	70%	1,939	1,939	369.0	51.2	109.0									754.7
2004		2,980	75% 80%	2,235 2,559	2,235	]		48.9 48.9		48.9 48.9			42.5 42.5				171,3 173,6
2005		3,199	80% 85%	2,559	2,559	]		48.9		48.9			42.5				176.1
2007	58,743		90%	3,295	3,295	1	1	48.9	9	48.9	41.	10.2	42.5	21.1	15.0	129.9	178.8
2008	60,638	3,902	95%	3,707	3,707	l	72.7	48.9					42.5				362.6
2009			98% 100%	4,046	4,046 4,403	l	ļ	48.9 48.9		48.9			42.5 42.5				187.0 189.5
2010	64,433		100%	4,403	4,403	-	1	48.9		48.9							190.0
2012	64,433	4,403	100%	4,493	4,403		1	48.9	9	48.9	9 46.4	11.5	42.5	21.1	20.1	141.6	190.9
2013			100%		4,403		51.2										349.6
2014			100%		4,403		1	48.9 48.9		48.9 48.9							
2015 2016			100%				ĺ	48.5		48.5					(		
2017						- 426.4		161.3	3 - 21.					1			
					<del></del>		esidual valu	es in (brack	ets)	<del> </del>				1			-
Not P	resent val		1	T	m3 × 1,00 3,993	<u></u>	·	T	<del></del>	US\$ x 1.0				- 1		US\$ x 1 00 628.4	
	1	15%			5,993					3,037.		1	1	1	ļ	780.4	
	1					1	1	1	1	3,469.	9		1	L	1	993.1	
		9%		L	7,295												
Aver	ge Increm	9% wiital cos	ets (She/m	3}	7,295	. <del> </del>		- <sub>1</sub>	- p	US\$/m		-т	1	7		US\$/m3	
Averd	ige Increm	9% wiital cos 15%	sts (Shs/m	3)	7,295	- <del>                                    </del>				0.7	7	T				0.16	0.93
Áverd	igo Incron	9% wiital cos	sts (Shs/m	3)	7,295	<u> </u>					7						0.93 0.76







Table L-7 Cost Estimates Chogoria Water Supply

						· · · · · · · · · · · · · · · · · · ·		70C	Ober			tonai	Thees ?			2003	3-Oct-97
investm	ent costs		xchange ra	te	1		Jna 56	KShs Rate		Civil	E&M	Pipes				Pipes	
Element		Description of the description o				ال		US \$	Quantity	JS & x 1,000	USSX10	US \$ X 1,000	Quantity				- 1
Rehabili		uia uinii c	3120						item	8.9	-	40.0					
intake	SESSON								ite <i>r</i> n	184.0		i					ł
Raw pip	etino		mm dia stee			į.	m	49.339				202.4	1		Į		1
	ŀ		mm dia ster				m (	71.143	4.654		.0.0	331.1				ļ	- 1
Treatme	nt I		m3/d capac				nr	284,161	1	241.5	42.6	1	1.0	167.4	29.5		j
<b>5</b>			m3/d expan			3	ות הר	196,932 60,000				1	1.0		20.0		
Reservo	are		m3 reservo				nr l	34,643			1			-	ŀ		ļ
	ļ		m3 reservo				nr	27,143	2	54.3		ı		-	ŀ	į	ŀ
			m3 reservo				UL.	23,036	1	23.0		- 1	1.0	23.0	l		
			m3 reservo			1	nr	19,107	1 1	19.1			1.0	19.1	1		
			ovrezen Em			1	វាវ	16,786		-		ı		•	- 1	- 1	
			m3 reservo				ល	13,929		•				•	ł		<b>,</b>
Transm	Ission		mm dia uP				m :	98.621									1
			mm dia uP				tu Tu	77.554 60.875	1		}						ĺ
			mm dia uP'				m In	46.857	5,000			234.3	1,000	-		46.9	į
			mm dia uP				m	28,982	16,100			466.6	2,000	1	ļ	58.0	İ
Ancillari	es/conting		IIIII CIQ GI	*** (·:: DW)		Į.		25%		132.7	10.7	263.0		52.4	7.4	26.2	1
Prelimin						1		15%		99.5	0.8	201.0		39.3	5.5	19.7	
Total		<del></del>								763.1	61.3	1,541.0		301.3	42.5	150.7	- 1
	ased cos	ts							Phase 1			2,365.4	Phase 2			494.4	1
Annual									+								]
Annual		110	mm dia uP			,	m	18.446				8	500			- 8	1
distribu	noitu		mm dia uP				m	15.500	500 1,000			12	1,000	, 1		12	I
pipes		63	mm dia uP	vC (12 bar	<u></u>		π	12.089	1,000			20	1,000			20	1
Total								US3x1,000	1998				2003				
Transp	ort Requi						nr	17.9					0			· ·	Ì
l		Salcon c 4WD veh				l	nr	62.5				63	1			63	
		Pickup	11010				nr	21.4				21	2			43	
1		Lorry					ΒΓ	167.1	0		-		0				1
		damento 40124							Transpo		E&M	Pipes	ļ			į	1
		sts as %	of investm	ents					20%	1.00%		1.00%					ı
	mic life								1		Fixed	Variable		2003	Fixed	Variable	ł
Power	r		11.10				Daylor Da	guirements	L		10	10			10	10	. }
			riff (Oct 199				US\$/unit	0.079			.4	I		i			
			rgy cost harge per m				USsmonth	7.857									
1			mand charg				US\$/manth	4.464									
Humar	resourc							Rate/yr		1998		T:		2003		11104-1-00	. 1
								US\$x1,000		TWks2	Dist'n	US\$x1,000	TWks 1	TWKs2	บเราก	US\$x1.000	' !
1		Enginee					Shsiyr	3.86	1		١,	3.21	ĺ	1	1	3.21	
i		Enginee					Shs/yr	3.21 2.36	1 1		2		Ιı	·	2	7.07	
		Inspecto					Shs/yr Shs/yr	1.29		i	3		2		3	6.43	
1		Senior C Operato					Shs/yr	0.96			1 4	5,79	2		4	5.79	
1			ian/Line pati	roiman/Cler	ks		Shs/yr	0.64		ş	12		3		14	10.93	
1							Shs/yr	<u> </u>				32.14	<u></u>	<u> </u>		37.29	
Chemi	cal costs			****				US3/kg		Dosage		Cost/m3		Dosage 0		Cost/m3 0,000	
		Alum						0.45			0 2	0.000		2		0.013	1
1		Chlorine						6.25			0	0.000		ō		0.000	[
		Soda as		por m3				0.20				0.013	l			0.013	
		TOTAL CH	emical cost	cei iiis.,	Increm-	Investmen	Schedule	T			T	Contract Name of Street, Square, and	-	T	]	1	
Year	Populatio	n Water	Population	Water		Treatment		Pipes	Transp		O8M	Power	Labour	Transpor	Chemica		Total
1'50	. opaiailo		Coverage		supply	Civil	E&M	1	'	Invesime	n Costs	Costs	l	1.		Recurrent	Costs
		rn3/d		m3/d			USS x 1,00	0 US\$ x 1,000	US\$ x 1 (	US\$ x 1,60	0 LS\$ x 1.0	US\$ × 1.000	US5 x 1.0	QUSS x 1.00	1US\$ x 1.00	US\$ x 1 000	USS x 1.000
1996		-			[			1		1		1	1	Į	1		
1997	32,134		0%	-	-	700			1	0.440	, [	1			.		2,449
1998	33,086		0%	744	, , ,	763	61	1,541		2,449		8	32	17	3	85	105
1999	34,016		50% 55%	711 867	711 867		1	20		20			32	17	_4	97	106
2000	34,920 35,833		60%	1,013	1,013		<del> </del>	20		20			32	17	5	83	108
2001	35,833		65%	1,173	1,173			20	)	20	) 2€	8	32		5	89	109
2003	37,684		70%	1,348	1,348	301	42							21	6	106	706
2004	38,621		75%	1,537	1,537			20		20			37	21	7 8	107	127 128
2005	39,565	5 2,178	80%	1,742	1,742			50		50			37	21	9	110	130
2006	40,516	2,311	85%	1,964	1,964			20		20				21	10	112	132
2007	41,473	2,448	90%	2,203	2,203		61	50					37	21	11	116	303
2008	42,435		95% 93%	2,459 2,665	2,459		1 "	20		20			37		12	118	138
2009 2010			100%	2,883	2,883		1		)   <u> </u>	20	o   36	11	37	21	13	119	139
2011	44,376			2,883	2,883		Ι	20		20			37		13	120	139
2012			100%	2,883	2,683	1	1	20		20					13	120 122	140 289
2013	44,378	6 2,883		2,883	2,883		42								13	122	142
2014	44,376			2,883	2,883	Į	1	20		20					13	122	142
2015					2,883	1	1	20		20			1		13		142
2016					2,883	- (280)	- (35								13		(155)
2017	44,376	6 2,883	100%	2,003	1 2,000			ues in (brack		<u>.                                    </u>	1		L				- Samturini Malitaria
No D	resent va	lues	<del></del>		/m3 x 1.00					US\$ x 1.0						US\$ x 1.00	
INEL P	- Cubits Va	15%	,	]	2,713	T	T			2,54	Ö			1	1	545	
1		12%	ó	1	3,605	1	1			2,68			1	1	1	675 858	3,360
L		99	6		4,915	<u></u>				2,86			1		+	US\$/m3	
Aver	ge incre	mental co	osts (Shs/m	3)	1		1	<u> </u>		U\$\$/m			т		1	0.20	
1		15%	6		ļ			1	}	0.5						0.19	0.93
1	1	129			1		1		1	0.5			1			0.17	



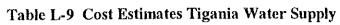
Table L-8 Cost Estimates Maua Water Supply

nvest	ment coats	Т	Exchange i	rate		1 US % =	C.F.	KShs	Phase 1			1009	Phase 2			. 2003	3-Oct-97
	1	Descripti	on				Unit	Rate	, ,103# I	Civil	E&M	Pipes	. 11008 2	Civil	E&M	Pipes	3-DC+97
Elemen	nt	dia (mm		<del></del>				US \$		US\$ x 1,000		US \$ × 1,000	Quantity	US \$ × 1,000			<b>j</b> 1
Rehabi	lifation								item	1.8		14.3	1				
Intake Raw pi	celine	150	mm dia st	eel cine			m	49.339	dem 400	4.2		19.7		Î			
			mm dia st				m	71.143	- 400							1	
Treatm	ent	1,500	rn3/d capa	city plant			nr	552,357		469.5	82.9					}	1 1
	. 1		m3/d expa				rsr .	٠.		[			]	-	-	1	
Reserv	oirs		m3 reserv				nr 	41.964	1	42.0			1.0	42.0		1	
		300	m3 reserv				nr	34,643 27,143		1	l		1		}		}
	ļ	250	m3 reserv				nt	23,036		-	1	ļ	<b> </b>	_	}	1	
		200	m3 reserv				Dr.	19,107	[				l				i i
		159	m3 reserv				nr	16,786	1	16.8	1		1.0	16.8	-	1	
Tranco	nission	100	m3 reserv				nt	13,929	l	٠.				-		1	1 1
rransn	mssion	400 315		<sup>D</sup> VC (9 bar) PVC (12 ba			m m	98.821 77.554	1				1				
		580		<sup>2</sup> VC (12 ba			m	60.875	1			] [	l			1 .	
		225		PVC (12 ba			m	46.857	1,500			70.3	!				1
		160	mm dia uf	PVC (12 ba	r)		m	28.982	2,700			78.3	1,500			43.5	
	ries/conting						ĺ	25%		133.6	20.7	45.6	l	14.7	-	10.9	
Cotal	nesicolari	Jencies					<u> </u>	15%	L	100.2 768.0	15.5 119.1	34,2 262,4	<b></b>	11.0 84.5		62.5	
	hased cost	5							Phase		113.1	. 1,149.5	Phase 2			. 146.9	
Annua	costs								- CO								•
Annua		110		PVC (12 ba		·	rn	18.446	1			<del></del>	[	· · · · · · · · · · · · · · · · · · ·	T	-	
distrib	rution	90		PVC (12 ba			m	15.500	200			3.1	200			3.1	
pipes Total		63	inin dia ti	PVC (12 ba	<u></u>		m	12.089	200			2.4	200		<del> </del>	2.4	
	port Requi	rements			<del></del>		I	US\$x1,000	1998		<u></u>	5.5	2003	<del></del>		5.5	
		Saloon o					nr	17.9		<b>——</b>		<del></del>	2003	t			
		4WD vei	hicle				nr	62.5				-	o	1			
1		Pickup					ηr	21.4	1 1			21.4	1			21.4	
		Lony					DI	107.1	Transpo	Civil	E&M	Piece	0	L			
Annus	I O&M coa	ts as %c	of investme	nts					1ranspo	1.00%		Pipes 1.00%	ł				
	omic lite								5	30			l				<b>!</b>
Powe	r									1998	Fixed	Variable		2003	Fixed	Variable	
l			riff (Oct 19		J		Power Red	uirements			10	10	L	J	10		
		Fiver A	rgy cost narge per m				US\$/unit	0.079 7.857	1								
1			narge per n rnand charc				US\$!month US\$!month	4.464									
Huma	n resource			6				Rate/yr	<b></b>	1998		-	Ι	2003			j
]							<u> </u>	US\$x1,000	TWks 1	TWks2	Dist'n	US\$x1,000	TWks 1		Dist'n	US\$x1,00	
		Enginee					Shs/yr	3.86	1		0	•			1	3.86	
		Enginee Inspecto					Shs/yr	3.21	_		1	3.21	<u> </u>	İ	1 1	3.21	
1		Senior C					Shs/yr Shs/yr	2.36 1.29	2 2		1 2	7.07 5.14	2 2		2 2		
1		Operato					Shs/yr	0.96	2		3		2		3		[
		Watchm	an/Line pal	trolman/Cle	ııks		Shs/yr	0.64	3		8	7.07	3		10	8.36	
-	leal area	<u> </u>			*traffradi'nabi'n.com		Shs/yr			<u> </u>	<u> L</u>	27.32			<u> </u>	34.82	
Chem	ical costs	Alum	<del> </del>					US\$/kg 0.45	1993	Dosage (r		Cost/m3	2003	Dosage (m		Cost/m3	1
		Chlorine	,					6.25	ļ	20 2		0.009 0.013	l	20 2		0.009	Į .
		Soda as	<u>h</u>					0.25	<u></u>	5		0.001	L	5		0.001	]
		Total ch	emical cost	per m3								0.023			,	0.023	
Vane	Population	Water	Population	Water	Increm-	Investmen		Diago	T	Total	Cert	Danie	l		CL		T.,
Year	гориацюг				ental supply	Treatment Civil	E&M	Pipes	Transpo	Total Investmen	O&M Costs	Power Costs	Labour	Transport	Chemica	Total Recurrent	Total
	1	m3/d	%	m3/d	m3/d		US\$ < 1,000	US\$ x 1,000	US\$ x 1.00			U091S US\$ x 1,000	US\$ x 1 00	US\$ x 1.000	US\$ x L m		
1996						***************************************	1	-		1	,	1		1	227.7.1.00	1	,_00,,,000
1997	5.537	552		-	-		I	ì		1		1	1	i			
1998		603	1000		:	768.0	119.1	262.4	21.4	1.170.9					-	l :	1,170.9
1999 2000		659 719	100% 100%	659 719	659 719	<b> </b>	I	5.5 5.5		5.5 5,5	15.1 15.2	8.6 8.8	27.3 27.3	4.3	5.5	60.8	66.3
2001		774	100%	774	774		<del> </del>	5.5		5,5	15.2	9.0	27.3	4.3	6.0	61.6 62.2	67.1 67.8
2002	7.766	832	100%	832	832	1	1	5.5		5.5	15.3	9.2	27.3	4.3	ŧ	63.0	58.5
2003		896	100%		898	84.5	] -	62.5	21.4	168.4	16.8	9.4	34.8	4.3	7.4	72.7	241.1
2004		963	100% 100%		963	İ		5.5		5.5	16.8	9.7	34.8	4.3	8,0	73.5	79.1
2005		1,115	100%		1,036	[		5.5 5,5	1	5.5 5.5	16.9 16.9	9.9	34.8	4.3	8.6	74.5	80.0
2007		1,119	100%		1,113			5.5	1	5.5	17.0	10.2 10.5	34.8 34.8	4.3 4.3	9.2 9.9	75.4 76.5	81.0 82.0
2008	11,655	1,290	100%	1,290	1,290	[	119.1	5.5	21.4	146.0	21.8	10.8	34.8	4.3		82.4	228.4
2009		1,388	100%	1,388	1,388			5.5		5.5	21.9	11.1	34.8	4.3	11.5	83.6	89.1
2010		1,493	100%	1.493	1,493	ļ	ļ <u>.</u>	5.5	ļ	5.5	21.9	11.5	34.8	4.3	12.4	84,9	90.4
2011	13,344 13,344	1,493	100% 100%	1,493 1,493	1,493			5.5 5.5		5.5	22.0	11,5	34.8	4.3		84.9	90.4
2012		1,493	100%		1,493			5.5	21.4	5.5 28,9	22.0 22.1	11.5 11.5	34.8 34.8	4.3	12.4 12.4	85.0 85.0	90.5 112.0
2014		1,493	100%	1,493	1,493	[		5.5		5.S	22.1	11.5	34.8	4.3	12.4	85.0	90.6
2015	13,344	1,493	100%	1,493	1,493			5.5		5.5		11.5	34.8	4.3		85.1	90.7
2016		1,493	100%		1,493			5.5		5.5	22.2	11.5	34.8	4,3	12.4	85.2	90.7
2017	13,344	1,493	100%	1,493	1,493	- 281.6				- 282.9	18.7	11,5	34.8	4.3	12.4	81.7	- 201.2
Not D	resent valu	L		L	m3 x 1,600		Pidnal Asine	es in (bracke	(8)	1,20	<del></del>		<u> </u>		Ļ	-	1.00
net P	PRANT ARIT	15%	T	ĭ	1,688	<del></del>	Τ	[	·	1.133.2		T	T	T	<del> </del>	US\$ × 1,000	
l	]	12%		1	2,193					1.178.3		1				472.8	1,514.8 1,651.1
		9%			2,924	L	1			1,225.1	<u> </u>	L		L	L	600.1	1,825.1
Avera	ge Increme		ts (Shs/m3	}		1		· · · · · · · · · · · · · · · · · · ·		US\$/m3						US\$/m3	USS/m3
1		15% 12%							1	0.67	1	1				0.23	0.90
l .		12%	}					1	1	0.54 0.42	1		1			0.22	0.75 0.62
				<u> </u>	1.					U.72	1	1	I .		1	. 0.21	, 0.621









																0000	
Investo	ent costs		Exchange ta	ste		I US \$ =		KShs	Phase 1							2003	3-00197
		Description				ľ	Unit	Rate				Pipes				Pipes	
lemen	1 ]	dia (mm	Size					US \$		US \$ x 1,000	US \$ x 1,00	US\$ x 1,000	Cluantity	US \$ x 1 000	US \$ x 1.00	US 1 x 1,000	1
Rehabil	itation								item		-	- 1				į	1
ntake						- 1	•		item	134.9						1	- 1
Raw pip	eline	250	mm dia ste	el pipe		- 1	m	95.661	2,000	ĺ	]	191,3				j	1
			mm dia ste			- 1	m	71.143			l'	- 1				l l	1
Treatme	ent [		m3/d capac				nr	294,196	1	250.1	44,1	]		.70.0			1
	- 1	2,000	m3/d expar	ารโอท			nr	207,018				1	1.0	176.0	31.1		1
Reservo	oirs	500	m3 reservo	if			nr	41,964	1	42.0	<b>!</b>				l l		
	Ì	400	m3 reservo	il e			nř	34,643		-	<b>j</b>		1.0	34.6		ì	
		300	m3 reservo	ir		Į.	ut	27,143		-				-		[	
		250	wg tesetvo	ir		1	nr i	23,036			i i			i .i.			
		200	m3 reservo	alr		1	er :	19,107	1	19.1		1	1.0	19.1		•	
	Į.	150	m3 reservo	ir		1	nr }	16,786	2	33.6	Į		2.0	33.6	i i		1
	- [	100	m3 reservo	oir			DΓ	13,929	ł	-				i -	1		- 1
Transm	ission	400	mm dia uP			- 1	m	98.821		•		-				- 1	1
		315	mm địa uP	VC (12 bar	)		m	77.554			1	^				•	1
		280	mm dia uP			l	m	60.875	11,800			718.3		İ			- 1
		225	mm dia vP	VC (12 bar	)	ţ	m	46.857	8,900		ì	417.0				1	]
	-	160	mm dia uP	VC (12 bar	)	1	រា	28.982	4,300			124.6	2,800	l		81.2	1
Ancillar	ies/conting	jencies				- 1		25%	ĺ	119.9	11.0	352.8		65.8	7.8	20.3	1
Prelimi	naries							15%	<u>L</u>	89.9	8.3	272.1		49.4	5.8	15.2	l
Total										689.5	63.4	2,086.2		378.5	44.6	116.7	- 1
Total of	rased cost	5	,						Phase	1		2,839.1	Phase 2			539.8	
Annual		·+f6++													~~~~		
Annual		110	mm dia uF	VC (12 bar	)		m	18.446	1,000			18	1,000	1		18.4	i
distrib		90	mm dia uP	VC (12 bat	)		m	15.500	500		1	7.8	500			7.8	
pipes		- 63	mm dia uF	VC (12 bar	)		m	12.089	1,000		<u>L</u>	12.1	1,000			12.1	ļ
Total										1	1	38.3	L	<b></b>		39.3	. 1
	ort Requis	rements				-		US\$x1,000	1998				2003				
110,000		Saloon	ar				пг	17.9	0	-		-	Ü			-	
		4WD vel					nr	62.5	1 1	}		62.5	í	1		62.5	
		Pickup					ПГ	21.4	2	:]		42.9	2			42.9	i
		Lony				i	nr	107.1	0				. 0	1			ļ
					-				Transpo	Civil	E&M	Pipes					i
Annua	O&M cos	ta sa % c	f investme	nts					20%	1.00%	4,00%	1.00%	}				
	mic life								5	30	10	30					1
Power										1998	Flxed	Variable	T	2003	Fixed	Variable	1
	·	Power to	riff (Oct 199	36)			Power Rec	quirements			. 10	10		1	10	10	ļ <u></u>
,			igy cost				US\$/unit	0.079						•			1 1
			aige per m				US\$/month	7.857	]								Į į
			mand charg				US\$/month	4.464	ļ								
Human	resource							Rate/yr		1998	)			2003			1
								US\$x1,000	TWks 1	TWks2	Dist'n	US\$x1,000	TW ks 1	TWks2	D <sub>i</sub> st'n	US\$x1.00	9
		Enginee	7 1				Shs/yr	3.86		T	1	3.86		1	1	3.86	1 1
		Enginee					Shs/yr	3.21	1	ļ	1 1	3.21	l	i	2		1 1
		Inspecto					She/yr	2.36	] 1	ļ	2	7.07	1	1	3		l i
l		Senior C				ì	Shs/yr	1.29	2	s <b>i</b>	3	6.43	2		4	1	l I
		Operato					Shs/yr	0.96	2		1 4	5.79	2		5		1
i		Watchm	an/Line pal	rolman/Cle	rks		Shs/yr	0.64	] 3	·I	12		3	) [	19		i [
							Shs/yr		L			36.00	<u> </u>	<u> </u>	1	48.32	] [
Chemi	cal costs							US\$/kg	1999	Dosage (r	ng/l)	Cost/m3	2003	Dosage (m		Cost/m3	1 1
		Alum						0.45	1	0		0,000		C		0,000	l I
		Chlorine						6.25	l	2		0.013		2		0.013	l i
		Soda as	h					0.25	<u></u>	0	) <u> </u>	0.000			)	0.000	1 1
		Total ch	emical cost	per m3						444		0.013			<del>~~~~</del>	0.013	
					Increm-	investment			L	L .		<u></u>	l	l	١	<b>.</b>	l
Year )	Population	Water	Population	Water	ental	Treatment		Pipes	Transpo		O&M	Power	Labour	Transport	Chemica		Total
		Demana	Coverage	Supplied	supply	Civil	E&M	i	Į.	Investmen		Costs	1	ł		Recurrent	
		m3/d	%	m3/d	m3/d	US\$ × 1.000	US\$ × 1.000	US\$ x 1 000	US <b>\$</b> x 1.0	US\$ x 1.000	US\$ x 1.00	US\$ x 1,000	US\$ x 1.00	US\$ x 1,000	US1 x 1.00	US\$ × 1,000	US\$ x 1.000
1996			]						ł			ł		1	Ì		{ <b>i</b>
1997	63,891	1,532	<b>,</b>	-	- '		•							1	1		<b>.</b> l
1998	65,515	1,723	i l	-		689.5	63.4	2,086.2	105.4	2,944.5				l	1		2,944.5
1999	67,103	1,921	50%	960	960		İ	38.3		38.3		7.6	36.0		4.4	99.8	136,1
2000	68,650	2,125	55%	1,169	1,169			38,3	ļ	38.3		7.9	36.0	21,1	5.3	101.4	139.7
2001	70,186	2,271	60%	1,363	1,363		i	38.3	1	38.3		8.2	36.0	21.1	6.2	102.9	141.2
5005	71,708	2,421	65%	1,574	1,574		1	38.3	1	38.3		8.5	36.0		7.2	104.6	142.8
2003	73,214	2,576	70%	1,803	1,803	378.5	44.6	116.7	105,4	645.1		8.8	48.3	21.1	8.2	125.0	770.1
2004	74,702	2,735	75%	2,052	2,052	1	į.	38.3		38.3		9,1	48.3	21.1	9.4	126.8	165.1
2005	76,169	2,899	80%	2,319	2,319	1		38.3		38.3		9.5	48.3	21.1	10.6	128.8	167.1
2006	77,613	3,067	85%	2,607	2,607	1		38.3		38,3		9.9	48.3	21.1	11.9	130.9	169.2
2007	79,033	3,239	90%	2,915	2,915	ł.		38.3	ļ	38.3		10.3	48.3	21.1	13.3	133,1	171.4
2008	80,425	3,415	95%		3.244	l	63.4	38.3	105.4			10.8	48.3	21.1		138.0	345.0
2009	81,789	3,595	98%	3,505	3,505		l	38.3	1	38.3		11.1	48.3	21.1		139.9	178,2
2010	83,121	3,778	100%	3,778	3,778	<u> </u>	ļ	38.3	<b></b>	38.3		11.5	48.3	21.1		141.9	180.2
2011	83,121	3,778	100%	3,778	3,778			38.3		38.3		11.5	48.3			142.3	180.6
2012	83,121	3,778	100%	3,778	3,778			38.3		38.3		11.5	48.3			142.7	181.0
2013	83,121	3,778	100%	3,778	3,778	1	44.6	38.3				11.5	48.3			144.8	333.1
2014		3,778	100%	3,778	3,778	1	1	38.3		39.3		11.5	48.3			145.2	183.5
2015		3,778	100%	3,778	3,778		1	38.3		38.3		11.5	48.3			145.6	183.9
2016	83,121	3,778	100%		3,778			38.3		38.3		11.5				146.0	184.3
2017		3,778			3,778	- 252.8				137.4	48.3	11.5	48.3	21.1	17.2	146.4	283.8
[		l	L		1	Note: Re	sidual valu	es in (bracke	15)				1		ļ		<b></b>
Net P	resent val	ues			m3 x 1,00	0				US\$ x 1.00		,	T		<del> </del>	US\$ x 1,0X	
1	T	15%	,	1	3,502		1	1	1	3,087.5		1	1	1		643.3	3.730.8
1		12%		1	4,779	1	1		1	3,271.5			Į	1	1	798.3	4,069.8
i	1	9%		l	6,506	<u>L_</u>	L			3,498.4						1,014.8	4,513.3
Avera	ge Increm		sta (Shs/m3	3)						US\$/m3		.,				US\$/m3	US\$/m3
1	ľ	15%		T	T	T	ĭ	]		0,86			1			0.18	1.04
ĺ	1	12%		1		1	t		1	0.68	3		1			0.17	0.85
1																0.16	0.60





Table L-10 Meru Water Supply Cash Flow

Year  Rural Demand ICs Closks Chroan demand ICs Total Livestock Industry Industry Total Total Total Total Total Total Revenue Rural Demand ICs Rural Demand ICs Closks Livestock Industry Institutional Health Commodal	1997 1.370 913 3,854	19981	0				2			i			i	i
mend nel ai ai arnand arnand anal			1	2000	202	7004	000	1000	2007	צעעצ	200	888.9	6 881	7.368
ai ai ai ai anand ai ai	ო	1,878	2,410	2,965	3,041	3,732	851.78	4. 9.00 9.00	1, 20 rt 20 rt 21 rt	, t	909.0	20.4	362	808
ai ai smand smand smand smand smand smand ai ai ai ai ai ai ai ai ai ai ai ai ai		961	803	741	1002	674	750	200	1 0	1 0 0	1	0000	0 K	0 002
nei mand emand nai		4,210	4,592	5,002	5,308	5,633	D (0)	2 t	0 7 5	2 0	9 4	0,0 0,0 0,0 0,0 0,0 0,0 0,0 0,0 0,0 0,0	) (	187
ari and ariand all all all all all all all all all al	260	545	526	504	5,15	524	488	77	200	noc :	000	0.00	- 6	1,000
nel mand mand f	6,697	7,493	8,332	9,212	9,872	10,564	11,286	12,041	12,830	13,652	- LC,41	0.4.0	855,0	- 10.7:
neal rnand rnand naal	237	241	246	251	256	261	267	272	277	283	289	294	9	3
ai mand emand nai	2.392	2.473	2,558	2,645	2,729	2,817	2,907	0,00 100	3,097	3,196	3,299	3,405	3,514	3,627
an and smand smand a s	514	532	550	268	587	909	626	646	299	688	710	732	756	6/4
ai mand emand nasi		821	(C)	158	163	168	174	179	185	191	197	204	210	217
mand emand nai	000	33.1	242	354	363	377	389	401	414	428	441	455	470	485
mand mand K nal	000	0+0 ++	10101	12 188	12 074	1 2 7 9 4	15 649	18.541	17 470	18.438	19.447	20.496	21,589	22.725
mand mand K nal	10.00	817,11	۲, ۱۵	25.52	1									
imand emand k k nai						2102								
	USS x 1,000		Exchange ra	œ.	US\$ =	SID 00								Ţ
	1997	1998	1999	2000	2001	2002	2.003	2,004	2.005	2,006	2,007	2,008	2,009	2.010
			165	203	229	255	283	312	342	372	404	437	471	505
			5	ő	1-1	ic.	33	31	58	27	24	23	9	16
			1 00	 }	, C Z	4 0 17 0 17	479	508	539	572	607	643	682	724
ck y ional cial			000	 P 6	) 1	, (	e c	a c		000		Ş	Š	6
Livestock Industry Institutional Health Commotal	-		'n	S.	Ņ	7	0	3	S	6.7	3	}	}	
Livestock Industry Institutional Health Commotal				 (	L.	ď	90	22	- 20	o o	80	6	σ.	Se
Industry Institutional Health Commotal			ış N	Q i	3	2 1	3 6	ì	į	1 (	3 6	3 3	1 11	7.73
Institutional Health Commotal			333	345	928	9	n	- 6	† (c	÷ (	5	1	9	} (
Health Commoial Total			32	ဗ္ဗ	 8 8	 96	(m)	0	) Y	5	4	3	4 1	D 4
Commoial			20	5	2	22	23	23	24	25	98	27	27	28
1012			45	46	48	94	£	52	72	96	28	59	51	ន
			1.057	1,138	1,202	1,269	1,338	1,411	1,487	1,556	1,648	1,734	1,623	1.916
												-		
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		000												
Expenditure	1 × 1×/200	3	1000,	1000	1000	0000	000	1000	3000	3000	2002	9 00 G	9000	0000
	1997	1993	1999	2000	2001	2002	2,003	4.00.4	2,003		4,00,	2,000		3.0.1
O&M Costs US\$ x 1,000	1,000		112	113	114	ກ ກ	161	162	163	25	166		182	3 6
Power Costs US\$ x 1,000	1,000		3	16	<u></u>	17	φ	φ,	<u>თ</u>	ล .	2	พ	7.7	S
	000		55	55	55	55	20	2	2	2	2	20	2	70
	000		ď	œ	ac ac	98	72	72	72	72	72	72	72	72
	9 6		9 ;	0 0	3 6			57	67	1	000	101		77
incesses O	900		2 6	090	276	286	33.6	6. 6.	390	403	410	445	456	468
inerwierii	3_		707	2	7		}	;						
Depreciation							_							
ioan									- 300		9	L,	737	400
Total Costs Shs x 1	1,000		262	589	276	284	355	379	380	403	D 4	440	400	004
Revenue minus expenditure			794	698	926	98.5	983	1,032	1,096	1,163	1,232	1,289	1,367	1,447
Accumulated net revenue					•						•			
			•	(	(		,	ç	0			(°	6	000
i	(Shs/m3)		e e	3.5	13.2	3,5		?	2 7	2 .	2 7	2 6	9 7	
Investment costs US\$ x 1,000	00	10,300	123	23	 SZ C	3	P. 1. 25	=		•• ••	-	0 70	:	-
			1		-	-	7				-			





A Carron Sales

Table L-11 Nkubu Water Supply Cash Flow

Comparison   Com	388 4 - 4 - 6 - 1 - 6	Projected flows (#13/dav)	ws (m3/dav)							2000	9000	2002	1 800 6	600 2	2,010
Communication   Communicatio	×031	1997	1998	1999	2000	2001	2002	2,003	2,004	2,003	200	22.2	756	252	271
Note   Column   Col	Domend	20	69	88	109	122	137	152	167	3 6	3 9	- I	1 10	(m)	-
Command   Comm			32	92	27	56	52	23	22	2	D 0	- 420	7		1.260
Name   Notice   Name   Notice   Name   Notice   Name   Notice   Name   Notice   Name   Notice   Name   Notice   Name			658	697	742	782	825	870	917	796	020	2,0		2 %	35
Name		,	8	25	90	ဗ္ဗ	8	<u>က</u>	დ ც	22	3	2 5	7 1	200	1 577
cock         Cock <th< td=""><td></td><td></td><td>186</td><td>845</td><td>808</td><td>961</td><td>1,017</td><td>1,076</td><td>1,138</td><td>1,203</td><td>1,2/1</td><td>342</td><td>~~ ₹.</td><td>9</td><td>30</td></th<>			186	845	808	961	1,017	1,076	1,138	1,203	1,2/1	342	~~ ₹.	9	30
March   Color   Colo	Total	3 8	3 8		6	2	22	22	23	83	 83	24	47	3 (	5 6
March   Marc	Livestock	3 1	3 1		- 6	. 7	67	99	72	75	78	<u></u>	20	ò	ה ה
The color   The	Industry	g g	70	 2	7 5	5 6		99	8	72	74	14	စ္ထ	25 4	λi
The color   The	Institutional	53	 ဂ	 ò	n n	9 1			α	09	62	65	67	20	<u></u>
1	Toom:	3	94	84	20	ົດ	, ,	3 9	) (	 C C	2	 6	28	6	8
March   Marc	Con Horizon	38	40	4	43	44	46	40	200	30,	555	1 646	1 751	1.821	1,915
USS x1 000   Exchange rate   USS x1 000   E		076	1 004	1.071	1.142	1.204	1,270	1.338	0.4.	- C04-	2000	2			
Costs   Cost												-	-		
Control   Cont		100 1 100		er occertor	,	= \$571	5618								100
Fig. 19   1989	Revenue	00, L × 400		Xcriange ia	Ħ		0000		2004	2 005	2.006	2,007	2,008	2.009	2,010
Femantic   Figs   Fig		1997	1998	1999	2000	2001	2002	2,003	, i	30,7	407	148	0 97	17.3	18.5
Cooks   Cook			-	6.0	7.4	4.8	<b>4</b>	4.0	4.1.4	0.4		9 6	ο α	20	9.0
Control   Costs   Co				r.	1,4	4.	<u>ნ</u>	1.2				n (	9 6	0 16 C	103.0
Control         Costs         LUSS/VIX.X1.000         2.0				י ער פי מי	י עי סי	62.7	66.1	69.7	73.5	77.55	81.7	36.2	D (	0 0	2
Costs         USS x 1,000         Costs				) 4	, t		1.6	9:1	1.7	1.7	1.7	1.7	 	o.	?
Costs         USSAY/X 1,000         2.0	Kosk	·		0	<u>.</u>	 	<del></del>								!
Oct         Oct         Cols         12.0         6.7         6.7         6.7         6.7         6.7         7.5         6.7         7.5 </td <td>EVII-M</td> <td></td> <td></td> <td>(</td> <td>(</td> <td>Ċ</td> <td></td> <td>0</td> <td></td> <td>2.3</td> <td>S.S.</td> <td>2.3</td> <td>2.4</td> <td>4,</td> <td>27</td>	EVII-M			(	(	Ċ		0		2.3	S.S.	2.3	2.4	4,	27
y y column         Y/8         1/8         5.4         4.0         4.2         4.0         4.2         4.0         4.2         4.0	Livestock			 D (	0.4		1 a	io	40	8,0	10.2	10.5	11.0	11.4	x : 1
Sonal   Solution   S	Industry			7.8	I	0 (	1 .	- o	4	4	4.4	4 10	1.4	6.4	
Costs   USS x 1,000   USS x	Institutional			ෆ ෆ	υ Ω	(O)	o 1	1 (	ייי	. ν. . α.	0	4.8	8.8	o	ر ان ان
diffure   SS   SS   SS   SS   SS   SS   SS	Health			6.2	eo eo	6.7	0.7	4 0	) ii	. u		7.3	7.6	7.9	8.2
diture         (55)         106         106         106         116         117.0         17.0         2004.0         2.005.0 <th< td=""><td>Commercial</td><td></td><td></td><td>5.4</td><td>5.6</td><td>5.8</td><td>6.0</td><td>6.3</td><td>6.0</td><td>0.0</td><td>1,00,</td><td>136.8</td><td>143.9</td><td>151.3</td><td>159.0</td></th<>	Commercial			5.4	5.6	5.8	6.0	6.3	6.0	0.0	1,00,	136.8	143.9	151.3	159.0
diture    USSP/IX 1,000	1012			89.7	95.5	100 6	106.0	111.6	C:/[L	123.0					
diffure by the costs USS x1,000	300					-		-				1		4	
Costs   USS x1,000   USS x1,0		2 2 2 2 2 2 1	000					!			}.	1	10000	0 000	0000
Costs         USS x 1,000         1,390 (Matter)	Expenditure	V 2/2/2		0 000 1	0 000 6	2 001.0	2.002.0		2,004.0	2,005.0	2,006.0	٥, د	71	2,008.0	21
Costs         USS x 1,000         7.6         8.0         8.5         8.6         8.9         9.2         9.5         9.5         9.0         10.3         10.1           Costs         USS x 1,000         7.6         8.0         8.1         8.6         8.6         8.6         9.6         9.5         10.3         10.3         11.1           oot         USS x 1,000         2.4         4.3 <th< td=""><td></td><td>- !</td><td>7,886.0</td><td>0.888.</td><td>21</td><td>2,1</td><td>171</td><td>. 1</td><td>23.4</td><td>23.5</td><td>23.5</td><td></td><td>28.5</td><td>28.6</td><td>28.0</td></th<>		- !	7,886.0	0.888.	21	2,1	171	. 1	23.4	23.5	23.5		28.5	28.6	28.0
Costs         US\$ x 1,000         31.6         31.6         36.8	Costs	000,1		9.91	0.7.	0 (	- 0	, a	ď	co co	<u>ئ</u>		10.8	11.1	
Ort US\$ x 1,000	Costs	000,10		7.8	20	2 9	0 0	9 0	α α	808	36.8		36.8	36.8	36.8
ort US\$ x 1,000		000,17		31.6	31.6	3.1.5	5 0 0	0.00	9 6	9 6	4		4 E.3	4.	4.3
clears         USS x 1,000         2.4         2.9         3.3         3.8         4.3         6.5         77.5         82.4         83.9         85.5         87.2         93.9         95.4         8           Ciation of religion of strong locals         Strongle local strong locals         63.0         63.7         64.5         65.3         77.5         82.4         83.9         85.5         87.2         93.9         95.4         8           Storing local strong loc	to	000,1		6.4	6. 6.	4. ເນັ	4	3. 4	2 0	ro	) C		13.6	14.7	15.9
Headling   Headling		x 1.000		2.4	2.9	හ හ	ω; ω;	4	0 9	9 0	- u		9 6	95.4	97.0
ist on foreign loan.  Costs Shs x1,000  Losts Shs x1,000  Eas. 0 63.7	Becument	× 1.000		63.0	63.7	54.55	65.3	J. 77	00 7,1 4	n 0	3		?		
Page   Page	oistion														
Shs/m3)	interest on foreign loan			-									0 00	05.4	0.70
Shs/m3)	And Charles of the Paris of the	100		63.0	63.7	64.5	65.3		82.4				93.8	4.00	
Shs/m3)	cigo														•
Shs/m3)	Revenue minus expenditure	'		26.7	8. 8.	36.1	40.7	34.0	35.1	39.8	8.	49.6	20.0	တ် တ	62.0
(Shs/m3)(Shs/m3)	Accumulated net revenue													!	ì
US\$×1,000 1,342.0 5.5 5.5 5.5 5.5 4/4.9 3.9		l 3)sh	-	12.8	12.8	12.8	12.8	12.8	12.8	12 m 80 m	Ω π ω π	6. 10 60 10	12.7	7.7.	5.5
		× 1,000	1,342.0	ro ro	გე - დ	ໝ	ი ი	4 4 5	0	?	)	) }			
			Ĺ				-								

Weter Sales	Projected 1	Projected flows (m3/day)												
Year	1997	1998	1999	2000	2001	2002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010
Rural Demand ICs		20	52	31	ਝ	38	42	46	20	\$	85	62	67	71
Kiosks		69	8	69	20	2	20	7	7	ĸ	71	71	E.	<u>.</u>
Urban demand ICs		1,005	1.131	1,268	1,357	1,451	1,551	1,658	1,772	1,892	2,021	2,157	2,302	2,457
Klosks	(s)	242	234	224	229	233	237	241	245	249	252	256	258	261
Total	1,220	1,335	1,459	1,592	1,689	1,792	1.90	2,016	2,138	2,267	2,403	2,547	2,699	2,859
Livestock	199	203	202	212	216	220	225	229	234	238	243	248	253	258
Industry	138	143	140	156	162	169	176	183	6	198	202	216	225	234
Institutional	1,624	1,692	1,762	1,835	1,912	1,992	2,075	2,161	2,251	2,345	2,442	2,544	2,650	2,760
Health	7	74	1	80	83	87	9	94	88	102	106	1.2.1	115	120
Commeial	83	98	8	83	97	101	106	5	114	139	124	129	135	140
Total m3/d	3.3	3.534	3.745	3.968	4,160	4.361	4,572	4.794	5,026	5,270	5,526	5,794	6,076	6,372
Revenue	US\$ × 1,000		Exchange rate.	ite	- \$S∩	56 Shs	Shs							
	1997	1998	1999	2000	2001	2002	2,003	2,004	2.005	2,006	2,007	2.008	2,009	2,010
Bural Demand ICs			1.7	2.1	2.4	2.6	2.9	3.2	3.4	3.7	4.0	4.3	4.6	8,4
			3.6	3.6	3.6	6.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Urban demand (Cs	<u> </u>		50.7	101.6	108.7	116.3	124.3	132.9	142.0	151.7	162.0	172.9	184.5	196.9
			12.2	11.7	9.11	12.2	12.4	12.6	12.8	13.0	13.2	13.3	13.5	13.6
				••	•••									•
Livestock			20.3	20.7	 	27.55	22.0	22.4	22.8	23.3	23.8	24.2	24.7	25.2
Industry			19.5	20.3	21.1	22.0	22.9	23.69	24.9	25.9	27.0	28.1	29.3	30.5
institutional			103.4	107.7	112.2	116.8	121.7	126.8	132.1	137.5	143.3	149.2	155.4	6,19
Health			10.0	10,4	10.9	<u>ئ</u> ئ	11.8	12.3	12.8	6.6	13.9	14.4	15.0	15,7
Commodal			11.7	12.2	12.7	13.2	13.8	14.3	14.9	15.5	16.2	16.9	17.6	18.3
Total			273.0	290.3	304.6	319.6	335.4	352.0	369.4	387.7	406.9	427.1	448.4	470.7
Expanditure	US\$/vr x 1,000	000												
	1997	1,998.0	1,999.0	2.000.2	2.001.0	2,002.0	2,003.0	2,004.0	2.005.0	2,006.0	2,007.0	2,008.0	2,009.0	2,010.0
O&M Costs US\$ >	US\$ × 1,000		26.7	56.9	27.1	27.3	36.7	36.9	37.1	37.3	37.5	41.1	41.3	41,5
Power Costs US\$ >	US\$ × 1,000		<u>.</u>	D D	9.7	တ တ	20.6	21.3	27.9	22.6	23.3	24.1	24.9	25.7
Labour US\$ >	US\$ x 1,000		30.5	30.5	30.5	30.5	တ တ် (	9. 8.	လ စ်	€. ∞.	<u>س</u> س	9. 8.	8.1.8	31.8
Transport US\$ >	US\$ × 1,000		16.8	16.8	16.8	16,8	16.8	9.0	 6.	8,0	16.8	16.8	16.8	16.8
icals	US\$ × 1,000		2.6	6.	6.2		60	 	10.2	<u>.                                    </u>	12.4	13.7	9.4.	16.3
Total Recurrent US\$>	US\$ x 1,000		85.7	89.1	90.3	9;0	114.0	12.0	117.7	119.7	121.8	127.4	129.7	132.1
Depreciation												-		
est on foreign loan														
Total Costs Shs x	Shs x 1,000		85.7	89.1	90.3	91.6	1,40	115.8	117.7	119.7	121.8	127.4	129.7	132.1
Revenue minus expenditure			187.3	201.2	214.2	228.0	221.4	236.1	251,6	267.9	285.1	299.7	318.6	338.6
Accumulated net revenue						•			<del>,</del>	<del></del>				
(Average tariff)(Shs/m3)	s/m3)		4.	11.2	11.2	11.2	11.3	5.	11.3	11.3	11.3	11.3	5.1.3	6.
investment costs US\$ x	US\$ × 1,000 I	2,479.8	9.00	9,91	19.9	19.9	573.0	9.9	9.9	19.9	9.9.	189.2	19.9	0. 0.
												1		





Table L-13 Chuka Water Supply Cash Flow

Water Sales	Projected 1	Projected flows (m3/day)												
Year	1997	1998	1999	2000	2001	2002	2,003	2,004	2,005	2,006	2,007	2,008	2.009	2,010
Rural Demand ICs	414	568	728	395	1,009	1,127	1,249	1,375	1,506	<u>7</u>	1,780	1924	2,071	2,223
	301	286	268	250	240	230	219	207	195	182	167	153	137	121
Urban demand ICs		330	385	450	508	571	639	711	788	869	954	1,042	1,132	1,225
	Ş		5.	25	57	. 19	65	20	74	78	81	82	88	06
Total	-		1,433	1,648	1,814	1,989	2,172	2,363	2,562	2,769	2,983	3,203	3,429	3,659
i New York	1		8	82	84	95	87	68	9	35	94	96	86	8
industry.	133		143	148	153	158	163	169	175	180	187	193	98	506
Inchitational	103		-	17	119	123	128	132	137	141	146	151	155	160
3. Continue 1	33		38	900	4	4 51	43	45	46	4 80	S	51	3	52
Commoial	45		72	160	1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00	171	177	183	189	195	202	208	216	223
Total m3/d	-	1741	1,959	2.192	2,375	2,568	2,770	2.980	3,199	3,426	3,661	3.902	4.150	4,403
					1									
Boyonite	USS x 1 000	00	change	rate	nss=	56 Shs	Shs							
	1997	1998	1999	1	~~	2002	2.003	2.004	2,005	2.006	2,007	2,008	2,009	2,010
			800	64.2	-	77.1	1	94.1	103.0	112.3	121.8	131.6	141.7	152.1
Tural Certains			0,0	0 0		. 0		10.8	10.2	9.5	8,7	0.8	7.2	6.3
	2		0 0		40.5	8 8	51.2	57.0	63.1	9.69	76.4	83.5	80.8	98.2
Orogen derivation		•	9 6	- 10		0		0	ω m	0.4	4 (i	4	4.6	4.7
2	n C			 ì		 !					-			
1 ivestock	_		7.9	0.0	8.2	8.3	8.5	09.7	φ σ	0.6	9.2	4.0	9.6	89.
Industry			3.6	19.3	0)	20.6	21.3	22.0	22.8	23.5	24.3	25.1	26.0	26.9
l Institutional				6,7	2.0	7.2	7.5	7.7	8.0	υ, ω	8.6	8.8	0	4.0
Tool			0	ζ,	ιο (C)	50. 50.	5.7	æ,	6.1	6.0	6.5	6.7	6.9	7.1
Commodel			20.1	20.8	21.5	22.3	23.0	23.8	24.6	25.4	26.3	27.2	28.1	29.0
Total			155.4	173.1	187.2	201.9	217 4	233.6	250.4	267.9	286.0	304.7	323.9	343.5
Expenditure	1.1SS/vr × 1.000	000												
	1997	1,998.0	1,999.0	2,000.0	2,001.0	2.002.0	2,003.0	2,004.0	2,005.0	2,006.0	2,007.0	2,008.0	2,009.0	2,010.0
Ì	US\$ × 1.000		30.8	31.3	31.8	32.3	39.1	39.6	40.1	40.6	4	<b>4</b> ro	<b>4</b>	45.4
Costs	US8 x 1 000		7.5	7.7	8.0	ຄ.	မ်	9. 9.	6.0	9.7	10.2	10.7	11.1	11.5
	USS x 1,000		33.2	33.2	33.2	33.2	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Ę	x 1,000		21.1	21.1	21.7	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1
Ø	US\$ × 1,000		4	5.5	6.5	7.6	8.8	10.2	11.7	13.3	15.0	16.9	18.5	20.1
Recurrent	US\$ x 1,000		97.0	98.8	100.6	102.5	120.2	122.3	124.7	127.2	129.9	135.7	138.1	140.6
Depreciation														
Interest on foreign loan														
Total Costs Shs x	× 1,000		97.0	93.8	100.6	102.5	120.2	122.3	124.7	127.2	129.9	135.7	138.1	140.6
Revenue minus expenditure			58.3	74.3	86.6	89.5	97.3	111.3	125.8	140.7	156.2	169.1	185.8	202.9
Accumulated net revenue							-		***					
(Average tariff) (St	(Shs/m3)	-	12.2	12.1	12.1	12.1	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
ts	US\$ x 1,000	2,919.6	48.9	9.8	9.8 6.9	6. 8.	634.5	4. 0.0	48.9	6.8 9.9	6.8	226.9	48.9	48.9
											7			

Table L-14 Chogoria Water Supply Cash Flow

Water Sales	Projected	u) swoj					000	, , ,	1000	200	2007	9 00 c	9000	2.010
Year	1997			2000	2001	2002	2,003	4,00,2	2,003	000.7	, s, s	000	000	1054
Rural Demand ICs	362		637	784	384	987	1,095	206	1321	440	563	200	20,5	) i
- Xi	Kiosks   242		212	196	187	178	168	158	147	92	57.		0 0	- 7
Urban demand ICs		146	159	173	184	195	202	220	234	77 14 19	263	5/20	68	7
	 		19	- 22	00	9	<u>τ</u>	9	ଷ	20	Q N	6	21	2
		890	1,028	1.172	1.274	1,380	1,489	1,603	1,721	1,843	1,969	2,059	2,233	2,371
100 S	4		64	20	52	01 22	53	50 44	55	98	57	g g	90	19
industry.			60	83	85	87	06	9	96	96	ტ ტ	101	103	8
Tackit tions	173		100	600	93	198	203	208	213	218	224	559	234	239
			7	90	75	58	9	9	စ္ပ	4	99	29	8	7
			700	788	 8	ဗ္ဗ	စ္တ	Ö	32	ક્ષ	34	34	35	36
	ļ		00,	4 697	003 +	4 POR	1 005	050 6	2 178	2311	2 448	2.589	2.734	2.883
Total m3/d	1,131	1,2/4	1,420	1/5'1		200.1	246,1	7.000	2		2	22		
					***	0,00								Ī
Revenue	USS × 1 000	000	Exchange rate		US\$ =	SPS SPS	١							
	1997	7 1998	1999	2000	2001	2002	2,003	2,004	2,005	2.006	2.007	2,008	2,009	2,010
Bural Demand			4	25	90	68	75	82	06	66	107	116	125	8
	Kinsks		7	10	10	<b>o</b>	Ø	ø	ω	7	ဖ	ဖ	'n	4
out the way week!	?		c	7.	นก รา	16	17	φ	0	8	21	22	24	52
	- See 17		2 +			· ·		γ-		-	_	•	-	Υ-
2	 0 4	~-			•									
1 ( ( ( ( ( ( ( ( ( ( ( ( ( ( ( ( ( ( (			L.	ц	ır	LC.	цŋ	ເດ	ιΩ	9	ம	φ	φ	Ģ
,			, ;		) <del>,</del>	· ·	0	0	c	<u>e:</u>	Ç.	(7)	2	4
industry			- ;		- Y	- ;	i ç	10	2 (*)	) (f	) (f)	· E	7	4
ากรบเบนอกสม				- ,	- 1	1 0	1 0	i o	α	α	0 0	0	σ	σ
Health			` '	` `	` •	0 5	0 4	0 <	0 4	0 <	0 7	D 7	 5 L	) IC
Commoial	_		ţ.	4	4	1	7	t	,	<b>+</b>	r	1 9	,	) (
Total			105	116	125	133	142	151	160	0/1	180	ეგ: :	N.	212
				_										T
Expanditure	US\$/yr x													
	1997	7 1998		2000	2001	2002	2,003	2.004	2,005	2,006	2,007	2,008	2.009	2,010
	US\$ x 1,000		26	28	56	56	33	33	33	33	ຮ	36	36	98
Costs	x 1,000		60	<b></b>	ω	(0)	ග	o	თ	ç	9	<del>-</del>		11
	US\$ x 1,000		32	32	32	32	37	37	37	37	37	37	37	37
יב	000 L x 3		17	17	1,7	17	27	12	2.2	23	20	27	2	23
u	USS × 1 000	•	6	4	ம	w	ဖ	7	ω	O	5	F	12	5
The Current	1.55 × 1.000		iù iù	87	88	8	106	107	109	2	112	116	118	91
Siation	-					-								-
Interest on foreign loan				•		•								
1000	25.24.000		38	78	ά	98	106	107	601	110	112	116	118	119
COSIS	000'1 X		3	; ;	3	3			-					ľ
Revenue minus expenditure			20	30	37	4	36	4	52	9	89	74	88	၉၈
-								-						
Accumulated net revenue	-													
(Average tariff) (S	(Shs/m3)	-	11.3	11.3	11.3	5.0	11.3	1.3	11.3	11.3	±1.3	11.3	11.s	11.3
	US\$ x 1,000	2,449	20	8	8	8	000	8	<sub>당</sub>	2	20	186	2 2	20





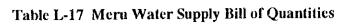
Table L.15 Mana Water Supply Cash Flow

1956   2000   2001   2002   2.003   2.004   2.005   2.006   2.007   2.003   2.003   2.004   2.005   2.006   2.007   2.003   2.003   2.004   2.005		Projected 8	Droipoted flows (m3/day)										2000	0000	0,00
Communication   Composes   Comp	Water Dures	7001	8001	19991	2000	2001	2002	2,003	2.004	2,005	2.006	7,00,7	2.000	4,003	200
March   Marc		, <u>CE</u>	2	c	c	c	0	0	0	0	0	0	0	0	0
March   Marc			) C	0 0	0 6		0	0	0	O	0	O	0	0	0
Marcolan   Cookes			- ·	7 0	0 00	740	585	633	988	742	803	869	941	1,018	.101
Marche   March   Mar			5 !	7	1 0	) U	29	8	99	69	71	73	9/	78	8
14   14   14   15   15   15   15   15	-		n i	0 1	0 11	 G	4 1 (0)	269	752	811	874	942	1,015	1,095	1,181
State   Stat	Total	417	90.4 90.4	n ;	000	) r	7	4	4	5	10	τ̈́	10	φ	9
March   1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	Livestock	Š	5	2	2 9	2 1	. 0	. u	Lr)	on Lo	83	88	72	7	83
Marcol   150   1	Industry	8	37	96	4 (	 	2 7	1 4	9 8	ကို	4	4	47	99	25
Marcol   M	Institutional	22	24	92	, N	R		- C	6	ď	E.	27	40	43	94
March   Marc	1 T	6	20	22	23	52	27	0.7	2 1	3 3	1 (	3 6	0	40.5	114
Costs   Cost	Commission	4	ŗ0	54	58	62	99	71	76	81	/8	2	an co	2000	707
Costs   Cost	10.01	555	603	629	719	774	832	896	963	1,036	1,115	1.199	1,230 OK2,1	000,1	
Costs   Cost				<b></b>											
Coording National Coording   Coording National				7.0000000000000000000000000000000000000	0	ď	5618	hs							
Costs   Cost	Rovenue	0.1× \$20		a School	Н	5	0000	٥	2004	2.005	2.006	2,007	2.008	2,009	2,010
Cooks   Cook		1997	1998	1999	2000	2001	2002	۲,000	1,000		i	C	c	00	0.0
Control   Cont				0.0	0.0	0.0	0.0	0.0	0.0	) (	9 6	9 6	200	0	0.0
Control   Cost				0.0	0.0	0.0	0.0	0.0	0,0	) ) )	2 5	) (	, i	. 4	000
Control   Cont				35.8	40.0	40.3	46.9	50.8	φ. φ.	0.85 0.85	4 1		† (C	 > ~	10
Consist         USS x 1,000         S.S.         6.5         6.3         1.3         1.3         1.4         1.4         1.4         1.4         1.5				0.6	0	9.7	ල දැ	හ. හ.	დ 4	დ. დ.	3.7	2)	n n	t	
Oche         13         13         13         13         13         13         13         13         13         14         14         14         14         15         15         13         13         14         14         15         15         13         13         13         14         14         15         1	20007											l	L V	4	4
Name   Name				67	6	5.	6.	4.	4.	4	4	υ, C	Ú.		- 0
Yorkal         1.5         1.6         1.7         1.8         2.0         2.1         2.3         2.4         2.6         2.6         2.6         2.6         2.6         2.6         2.6         2.6         2.6         2.6         3.2         3.2         4.5         4.5         4.5         2.6         2.6         3.2         3.2         4.5         4.5         4.5         2.6         3.6         3.7         3.2         3.2         4.5         4.5         4.5         4.5         4.5         4.5         4.5         4.5         3.6<	Livesitos			ľ	ທ	ю Ф.	6.3	6.7	7.2	7.7	8.2 2	00	4. (	- 6 - 6	9 0
Costs   USS x 1,000   USS x	Augnous				9	1.7	80.	2.0	2.1	2.3	2.4	2.6	25.	٠ ١	2.0
cial         Fig. 10         F	Institutional			3	. 6	C.	ις 10	3.7	න හ	4.2	4 7	8.4	5. 2.	5.6	0.0
diffure LSS <sub>Y</sub> (x 1,000	Health			1 1	1 (	 ! τ	00	<u>ග</u>	0)	10.6	11.3	12.1	13.0	13.9	14.8
diture    USS x1, 1000   1.996.0   1.996.0   2.0001.0	Commotal			100	2	0 00	71.6	77.1	82.9	89.2	0.96	103.3	111.2	119.6	128.7
diture         USS x/1 (2000)         1.098 (-1.998 (	Total			8	8.10	2									
diture    USSYI x 1 000															
Costs USS x 1,000	Expenditure	US\$/yr x 1				,,,,,,	0000		Ş	5	2 006 0	2,007.0	2.008.0	2,009.0	2,010.0
Costs         USS x1,000         15.1         15.2         15.3         15.8         15.8         15.9         15.1         15.8         34.8	·	1987		1.998.0	2,000.0	ဂၤ	0	21	21	21	,	2,7,7	!!	1	21.9
Costs USS x 1,000  8.6 8.8 9.0 9.2 9.4 9.7 9.7 9.8 9.7 9.8 9.7 9.8 9.7 9.8 9.7 9.8 9.7 9.8 9.7 9.8 9.7 9.8 9.7 9.8 9.7 9.8 9.7 9.8 9.7 9.8 9.7 9.8 9.7 9.8 9.8 9.8 9.8 9.8 9.8 9.8 9.8 9.8 9.8	Costs	1,000		15.1	15.2	15.2	- - - - - - - - - - - - - - - - - - -	8	20.0	D (0	0 0	2 4	0.0	) Y-	4) H)
ort US\$ x 1,000  4.3	Coete	000		8.6	80	0.6	9	4.00	). G	ָת מ	7.0	0.0	2 3	- 0	α 4
port USS x 1,000	200	000		27.3	27.3	27.3	27.3	34.8	8.48	34.8	34.8	8,4%	ν. τ	0 0	, ,
Pooff US\$ x 1,000         US\$ x 1,000         5.5         6.0         6.4         6.9         7.7         8.0         8.6         9.2         9.9         10.7         11.5           clease US\$ x 1,000         60.8         61.6         62.2         63.0         72.7         73.5         74.5         75.4         75.5         82.4         83.6           Aciation sciton foreign loan ston foreign loan         60.8         61.6         62.2         63.0         72.7         73.5         74.5         75.4         76.5         82.4         83.6           Costs         Shs x1,000         60.8         61.6         62.2         63.0         72.7         73.5         74.5         75.4         76.5         82.4         83.6           Turnel minus expenditure         7.1         0.3         4.3         8.6         4.4         9.4         14.8         20.6         26.9         26.8         36.0           mulaided net revenue         13.2         13.2         13.2         13.2         13.2         13.2         13.2         13.2         13.2         13.2         13.2         13.2         13.2         13.2         13.2         15.5         5.5         5.5         5.5         5.5         5.		000			4	4	6,4	φ. 4	6.4	<b>4</b> . ε.	4 6	6.4 6.	4.	J. 4	<b>,</b>
Heading   US\$ x 1,000   Heading		5000		) u	, u	4	0	4.7	8.0	8.6	Q)	<u>ග</u>	10.7	5.5	12.4
Recurrent US\$ x 1,000   Ou.b   Ot.2   Ot.2   Ot.2   Ot.2   Ot.2   Ot.3	icals	1,000		9	9 4	0 0	0.68	707	73.5	74.5	75.4	75.5	82.4	φ. Ω.	84.9
reign loan costs Shs x 1 000	Recurrent	0 0 1		90.8	p.	2.20	3	i						-	
sst on foreign loam  Costs Shs x 1,000  Egge tariff)  Egge	Depreciation														
Costs         Shs x 1,000         60.8         61.6         62.2         63.0         72.7         73.0         72.7         73.0         73.0         20.6         26.9         28.8         36.0           nue minus expenditure         -	Interest on foreign loan					Š		7 07	72.5	7.05	75.4.1	76.5			84.9
15.7 13.2 13.2 13.2 13.2 13.2 13.2 13.2 13.2	Costs Shs x	1,000		60.3	61.6	62.2	3	1 2.1	5	A* ii.					
Shs/m3). 13.2 13.2 13.2 13.2 13.2 13.2 13.2 13.	Revenue minus expenditure	, 		4.	0.3	6.4 E.3	8.6	4.	<b>Q</b>	14.8	20.6	26.9	28.8	36.0	43. 83.
(Shs/m3). 13.2 13.2 13.2 13.2 13.2 13.2 13.2 13.	Accumulated net revenue	· P-	. — • •	<del></del>											
US\$ x 1,000 1,170.9 5.5 5.5 5.5 168.4 5.5 5.5 5.5 5.5 146.0 5.5		- <del>(</del>		13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
		1,000	1,170.9		5.5	5.5	5.5	168.4	υ. Ω	ຜ	ro ro	ro ro	146.0		5.5
		_													

**新** 

Table L-16 Tigania Water Supply Cash Flow

Water Sales	Projected f	Projected flows (m3/day)								0000	1 200	1 000	0000	0100
Year	1997	1998	1999	2000	2001	2002	2,003	2,004	2,005	6 50,0 7	3.6	2,000	2,009	0.00
Rural Demand 1Cs	536	734	942	1,158	1,304	1,455	1,613	1,775	1,943	2,116	2,294	2,477	99 i	90°2
	545	527	202	485	475	463	154	438	423	408	391	373	es X	438
Urban demand ICs			,			,	•		,	,	•	•	•	
			•	•	,	,	,			•	'			. :
[ato]	1 082	1.262	449	1.642	1,779	1,919	2,064	2,213	2,366	2,524	2,685	2,851	3,020	3,193
ivestock	80	191	102	104	106	108	113	5	<del>រ.</del>	117	<u>8</u>	122	125	127
100000000000000000000000000000000000000	07	ic.	22	 65	25	33	56	2	28	230		62	8	8
Indian y	5 4 5	145	1 0	152	155	159	162	165	169	172	175	178	181	\$
	7 00	2 5	- 14		43	4	45	46	47	84	48	49	S S	57
Togath Con Hando	100	3 10	- 6	<u> </u>	134	136	139	141	44	147	550	153	156	159
100	477 ·	201.	, ,	2010	0 073	2 401	2 578	2 735	2 899	3.067	3.239	3,415	3,595	3,778
Total m3/o	7,550,1	1,722	178::	۲. ا	2,6/	- - - -	2 2 2 2							
					100	-4010E	24.0							
Revenue	US\$ × 1,000		Exchange ra		3 600	100	- 1		1000	0000	1 2000	9000	9000	0,00
	1997	1998	1999	2000	2001	2002	2,003	2,004	2,005	2.006	2.00/	2,008	5,008	7,010
Burst Demand			84.4	79.2	89.2	9.66	110.3	121.4	132.9	144.7	156.9	169.5	182.3	195.5
			26.4	25.3	24.7	24.2	23.5	22.8	22.1	21.3	4.02	19.5	18.5	17.4
					· '			•	•	'	,			,
Orban demaria						•		,	•	•	•	'	1	,
NOSKS												-		
			, C		70	, 6	8 0	11.0	11.2	2	11.7	9.	12.2	12.4
Livestock			5 (	4 0	† (	1 0	1 0	, t	1 (4	1	0	α	a	4
Industry			2.9	 Di	j.	, (	? (	1 0	. c		. c	5	. Ç	200
Institutional			8.7 .~	တ တ	 		D) Lj	, i	n (	- 6	3 (	2	2 6	1 9
Health	•—		4.0	υ. υ.	9.G	5.7	ල ල	0.0	9	60	က် လ	4.0	9	). 0
Commoial			16.7	17.1	17.4	17.7	18.1	18.4	18.8	19.2	19.5	19.9	20.3	20.7
Total			138.4	153.1	163.5	174.3	185.4	196.8	208.6	220.7	233.0	245.7	258.7	271.9
11.00.00 Library	1.5\$Avr x 1.000	000												
	1997	1.998.0	1,999.0	2,000.0	2,001,0	2,002.0	2,003.0	2,004.0	2.005.0	2,006.0	2,007.0	2,008.0	2,009.0	2.010.0
1,000	ı		7 08		31.4	31.8	38.6	38,9	39.3	39.7	40.1	43.0	43.4	43.8
Costs	3 8		. "	- 0	. «	) (0)	00	0	9.0	o)	0.01	10.8	1.1	11.5
Power Costs USA 1,000	200		2 6	2 6	100	3 6	48.5	48.3	48.3	48.3	48.3	48.3	48.3	48.3
	000		2.00	9 6	9 7	2 6		1 10	1.10		7	21.7	2	21.1
	000			- (	- (	- ( - 1 V	- 0	. 0	- 4 - ¢	. 0	. e	α ! τ	4	47.0
icals	000,		4, 6	7 .	7 0	4. 6	7 0	r 0	2 0	0.0	· ·	7	0 0	0.14
Total Recurrent US\$ x 1,000	000,		ю. 000	4.101	9.20	0.45.	0.00	0.02	0.00	9	-	2	2	) -
Depreciation					•••		_	-		-				
Interest on foreign loan														0
Shs x	1,000		83.8	101.4	102.9	104.6	125.0	126.8	128.8	130.9	3	138.0	138.9	y. 4
Revenue minus expenditure	,		38.6	51.7	80.6	8.69	4.09	70.0	79.8	8.68	6.08	107.7	18.8	130.0
Accumulated not revenue														
Average tariff)(Sins/m3)	/m3)		1.1	* *	11.0	0.11.0	11.0	11.0	11.0	11.0	11.0	0.11	11.0	11.0
	000,1	2,944.5	38.3	38,3	38.3	38.3	645.1	36.3	36.3	6.86 8.0	38.3	207.1	6,88 8,00	38.3
								1		-	¥	+		



DESCRIPTION	Unit	Quantity	Rate	Amount
take				
Site clearance	m2	1,000	35	35,0
Excavation Normal excavation	m3	1,000	350	350,0
EO for rock excavation	m3	500	1,500	750,0
Bank protection	rn3	500	1,630	815,0
River diversion	item		250	2,000,0
Roads	m2	12,000	350	4,200,0
Concrete "all In prices"	m3	125	12,000	1,500,0
Concrete 30/20 in base slab do in walls	m3	10	12,000	120,0
Sub total, intake	1115			9,77 <u>0,</u> 0
w Water Pipeline				
500 dia steel pipe	m	5,000	12,752	63,760,0
450 dia steel pipe	m	•	11,495	63,760,0
Sub total, raw water pipeline				03,700,0
satment Plant				
Site works Site clearance	m2	20,000	35	700,0
Roads	rn2	8,000	350	2,800,0
Fence	m	600	1,500	9,000
<u>Sub total. Site works</u>				4,400,0
orizontal Sedimentation Tanks				
Excavation	m3	6,303	350	2,205,9
Normal excavation EO for rock excavation	m3	3,001	1,500	4,501,9
Concrete "all in prices"	,-	- 1	-	
Concrete 30/20 in base stab	m3	990	20,000	19,808,4
do in walls	m3	1,148	20,000	22,952,
Pipework	item	[ - ]	15% 15%	7,420, 7,420,
Ancillaries	item	l or	15%	64,309,
<u>Sub total Horizontal Sed. Tank</u> apid Sand Fliters	(8)	nr		04,003,
Excavation				
Normal excavation	m3	1,849	350	647,
EO for rock excavation	m3	770	1,500	1,155,
Media inc. gravel	m3	280	1,500	420,
Concrete "ali in pricez"		-	20,000	4,236,
Concrete 30/20 in base slab	m3	212 713	20,000	14,260,
do in walfs Pipework	m3 item		40%	8,287.
Anciliaries	item		30%	6,215,
Sub total Rapid Sand Filters	!	Pr		35,222
lear Water Storage			}	
Excavation	ļ		350	1,298,
Normal excavation	m3	3,710	1,500	1,545,
EO for rock excavation	m3	1,031	1,500	1,040,
Concrete "all in prices"  Concrete 30/20 in base slab	m3	680	20,000	13,603,
do in walis	m3	366	20,000	7,319,
Pipework	ilem		15%	3,565.
Ancillaries	item		15%	3,565,
Sub total Clear Water Reservoir(s)	(2)	fit		30,897
Bulldings		1		
Chemical/Laboratory All in building costs	m2	207	22,000	4,554,
Pipework and ancillaries	item		15%	683
Sub total Chemical building	l .			5,237
Office/Store/Workshop				
All in building costs	m2	138	22,000	3,036 455
Add for furnishings etc	item		15%	3,491
Sub total Admin Building	·	<del> </del>		5,491
Pumping station Excavation	1		Ì	
Excavation Normal excavation	m3	520	350	182
EO for rock excavation	m3	248	1,500	371
Concrete "all in prices"				
Concrete 30/20 in base slab	m3	82	20,000	1,634 2,241
do in walls	m3	112	20,000	2,241
All in building costs	m2	124	22,000	1.430
Pipework	item nr	2	1,782.403	3,564
Pumpa Anciliaries	item	1	15%	1,073
Sub total Pumping Station	I .		<u></u>	13,222
Sludge concentrators	Depth		A	m
Excavation	1	1 .	1	100
Normal expavation	m3	564 282	350 1,500	197
EO for rock excavation	m3	282	1,300	
Cencrete "all in prices"  Concrete 30/20 in base slab	m3	254	20,000	5,076
do in walls	m3	194	20,000	3,872
Pipowork	item	-	10%	957
Ancillaries	item		10%	
Sub total Sludge concentrators	(4)	<u> </u>	<u>",</u>	11,48
Sludge dryling Beds		i		
Excavation			350	23
Normal excavation	m3	662	<b>,</b>	
EO for rock excavation	m3 m3	300	4	
Sand bed Concrete *all in prices*	1115	-		1
Concrete 121 in prices  Concrete 30/20 in base slab	m3	303		
do in walls	m3	59	20,000	1,17
Pipework Inc.drainage	item	-	25%	
Ancillaries	item	1	10%	
Sub total; Studge drying bed		nr		10,79





# Table L-18 Nkubu Water Supply Bill of Quantities

DESCRIPTION	Unit	Quantity	Rate	Amount
take				
Site clearance	m2	200	35	7,000
Excavation Normal excavation	m3	100	350	35,000
EO for rock excavation	m3	100	1,500	150,000
Bank protection	.m3	75	1,630	122,250
River diversion Roads	item m2	2,400	350	500,000 840,000
Concrete "all in prices"	1112	-	550	0101000
Concrete 30/20 in base slab	m3	25	12,000	300,000
do in walls	m3	10	12,000	120,000
Sub total, intake aw Water Pipeline				2,074,250
200 dia steel pipe	m	600	3,984	2,390,400
150 dia steel pipe	m	1,013	2,763	2,798,91
Sub total, raw water pipeline				5,189,31
restment Plant Site works				
Site clearance	m2	8,400	35	294,000
Roads	m2	2.000	350	760,00
Fence	m .	380	1,500	570,000
Sub total, Site works ortzontal Sedimentation Tanks			·	1,564,000
Excavation				
Normal excavation	m3	798	350	279,41
EO for rock excavation	m3	380	1,500	570,24
Concrete *all In prices*	0		00.000	2 500 05
Concrete 30/20 in base slab do in walls	m3 m3	125 ± 270	20,000 1 20,000	2,509,05 5,409,60
Pipework	item		15%	1,315,24
Ancillaries	item		15%	1,315,24
Sub total Horizontal Sed, Tank	(4)	til		11,398,80
lapid Sand Filters Excavation				
Normal excavation	m3	403	350	141,12
EO for rock excavation	m3	168	1,500	252,00
Media inc. gravel	m3	50	1,500	75,00
Concrete "all in prices"	0	46	29,000	924,00
Consrete 30/20 in base slab do in walls	m3 m3	224	20,000	4,485,00
Pipework	item		40%	2,350,84
Ancillaries	item	1	30%	1,763,13
Sub total Rapid Sand Faters	(4)	nr		9,991,10
Clear Water Storage Exceptation				
Normal excavation	m3	461	350	161,28
EO for rock excavation	m3	128	1,500	192,00
Concrete "all le prices"	_	· .		
Concrete 30/20 in base slab do in walls	m3 m3	84	20,000 20,000	1,689,60 2,450,88
Pipework	item	163	15%	674,06
Ancillaries	item	ŀ	15%	674,06
Sub total Clear Water Reservoir(s)	(2)	nr	·	5,841,88
Buildings Chamleal/Laboratory		į		
All in building costs	m2	63	22,000	1,821,60
Pipework and ancillaries	item		15%	273,2
Sub total Chemical building				2,094.84
Office/Store/Workshop		104	00.000	0.027.00
All in building costs Add for furnishings etc	m2 item	104	22,000 15%	2,277,00 341,5
Sub total Admin Building			10%	2,618,5
Pumping station				
Exenuation				
Normal excavation	m3	157	350	55.0
EO for rock excavation Concrete fall in prices	m3	75	1,500	112,3
Concrete 30/20 in base slab	m3	25	20,000	494,2
do in wails	m3	54	20,000	1,081,9
All in building costs	m2	124	22,000	2,724,4
Pipework Pumps	item	2	20% 1,175,947	893,5 2,351,8
Ancillaries	item	-	1,175,947	670,1
Sub total Pumping Station			.5.0	8.383.6
Sludge concentrators	Depth		4	m
Excavetion				_
Normal expavation	ın3	91 45	350	31,7 67,9
EO for rock execution	ma		1,500	l 67,9
EO for rock excavation Concrete "all in prices"	m3	."	1	
EO for rock excavation Concrete "all in prices" Concrete 30/20 in base slab	m3 m3	- 41	20,000	815,1
Concrete "all in prices" Concrete 30/20 in base slab do in walls	m3 m3	-	20,000	815,1 1,343,9
Concrete "all in prices" Concrete 30/20 in base slab do in walls Pipawork	m3 m3 item	- 41	20,000 10%	1,343,9 225,8
Concrete "all in prices" Concrete 30/20 in base slab do in walls Pipawork Anciliarles	m3 m3 item	41 67	20,000	1,343,9 225,8 225,8
Concrete "all in prices"  Concrete 30/20 in base slab  do in walls  Plpawork  Ancilharles  Sub total Studge concentrators	m3 m3 item	- 41	20,000 10%	1,343,9 225,8 225,8
Concrete "all in prices" Concrete 30/20 in base slab do in walls Pipawork Anciliarles	m3 m3 item	41 67	20,000 10%	1,343,9 225,8 225,8
Concrete "all in prices" Concrete 30/20 in base slab do in walls Pipawork Anciliaries Sub total Sludge concentrators Sludge drying Bedo Excavation Normal excavation	m3 m3 item item (3)	nr	20,000 10% 10% 350	1,343,9 225,8 225,8 2,710,5 27,7
Concrete "all in prices"  Concrete 30/20 in base slab  do in walls  Pipawork Ancilharies  Sub total Studge concentrators  Studge drying Bode  Excavation  Normal excavation  EO for rock excavation	m3 m9 item item (3) m3 m3	11 41 67 nr	20,000 10% 10% 350 1,500	1,343,9 225,8 225,8 2,710,5 27,7 19,8
Concrete "all in prices"  Concrete 30/20 in base slab do in walls  Plpawork Anciliaries  Sub total Studge concentrators  Sludge drying Bode  Excavation  Normal excavation  EO for rock excavation  Sand bed	m3 m3 item item (3)	nr	20,000 10% 10% 350 1,500	1,343,9 225,8 225,8 2,710,5 27,7 19,8
Concrete "all in prices"  Concrete 30/20 in base stab do in walls  Plpawork Ancillaries  Sub total Studge concentrators  Studge drying Bedo  Excavation Normal excavation Sand bed Concrete "all in prices"	m3 m9 item item (3) m3 m3	79 13 300	20,000 10% 10% 350 1,500	1,343,9 225,8 225,8 2,710,5 27,7 19,8 36,0
Concrete "all in prices"  Concrete 30/20 in base slab do in walls  Plpawork Anciliaries  Sub total Studge concentrators  Sludge drying Bode  Excavation  Normal excavation  EO for rock excavation  Sand bed	m3 m9 item item (3) m3 m3	11 41 67 nr	20,000 10% 10% 350 1,500 1,200 20,000	1,343,9 225,8 225,8 2,710,5 27,7 19,8 36,0
Concrete "all in prices"  Concrete 30/20 in base slab do in walls  Pipawork Ancilharies  Sub total Studge concentrators  Studge drying Bedo  Excavation Normal excavation EO for rock excavation Sand bed  Concrete "all in prices" Concrete 30/20 in base sleb	m3 m9 ttern item (3) m3 m3 m3	79 13 30	20,000 10% 10% 350 1,500 1,200 20,000	1,343,9 225,8 225,8 2,710,5 27,7 19,8 36,0 726,0 368,0 294,3





# Table L-19 Isiolo Water Supply Bill of Quantities

	DESCRIPTION	Unft	Quantity	Rate	Amount
)anı	River Intake				
	Excavation				
	Normal excavation	m3	54,000	175	9,450,00
	EO for rock excavation	m3	22 500	1,000	22,500,00
	Rockfill	m3 m3	459,000 63,850	1,630 1,550	748,170,00 106,717,50
	Fiter/drainage material Rip-rap and underlayers	m3 m3	45,900	1,630	74,817,00
	Grout curtain	item	45,800	1,000	90,000,00
ŧ	Concrete 'all in prices"		·	ì	.,
	Concrete	m3	1,950	12,000	23.400,00
	Bridge	item	-		15,000,00
(	Drawoff works				0.000.05
	Concrete in tower	m3	500	12,000	6,000 <u>.</u> 00 3.000 00
	Pipework	item		1	10,000,00
	Access bridge Sitemorke	item item		ļ.	25,000,00
	Ancillaries	item			10,000,00
	Contingencies	item			229,000,00
	Sub total_intake				1,373,054,50
	Water Pipeline				
	300 dia steel pipe	m.	1,108	8,864	7,605.31
	250 dia steel pipe	m	2,110	5,357	11,303.27
	Sub total raw water pipeline		ļ	<del>  </del>	18,908.58
	ment Plant		i	İ	
•	Site works	<b>n</b>	8,400	15	126,00
	Site clearance	m2 m2		350	420,00
	Roads Fence	אוע	1.200	1,500	420,00
	rence Sub total. Site works		•	1,300	546,00
orl»	ontel Sadimentation Tanks	·····	<del></del>		370,01
	Excavation				
	Normal excavation	m3	1,408	350	492.68
	EO for rock excavation	m3	670	1,500	1,005.48
-	Concreta "ali in pricea"				•
	Concrete 30/20 in base slab	m3	221	20.000	4,424.11
	do in wals	m3	371	20,000	7.418,8
	Pipework	riem	-	15%	2 001,1
	Ancillarios	item		15%	2.001,17
	Sub total Horizontal Sed. Tank	L <sup>42</sup>	[F/		17.343,50
	i Send Filtore Excevetion	ł			
	Normal excavation	m3	624	350	218,40
	EO for rock excavation	m3	260	1,500	390,00
	Media inc. gravel	m3	83	1.500	123.75
	Concrete "all in prices"		-		-
	Concrete 30/20 in base slab	m3	72	20,000	1,430 0
	do in walls	m3	316	20,000	6,325.0
	Płpework	tlem	-	40%	3.394.8
	Ancillaries	item	1	30%	2 546,1
	Sub total Rapid Sand Filters	(5)	17		14,428,1
	Water Storage			i l	
	Excavation	m3	840	350	293.9
	Normal excavation EO for rock excavation	m3	233	1,500	349.9
	Concrete "ail in prices"	"5	233	1,000	442.3
	Concrete 30/20 in base slab	m3	154	20,000	3,079.2
	do in walks	m3	169	20,000	3,378.2
	Plpework	item		15%	1,065,2
	Ancillarles	item		15%	1,065.2
	Sub total Clear Water Reservoir(s)	(2)	rr		9,231,8
Sulla	egnit			}	
	Chemical/Laboratory			1	
	All in building costs	m2	83	22.000	1,821,6
	Pipework and ancitaties	item	1	15%	273.2
	Sub total Chemical building	<u> </u>	ļ	<del> </del>	2,094,8
	Office/Stere/Workshop		104	22,000	2,277.0
	All in building costs	ni2	104	15%	341,5
	Add for furnishings etc	dem		12.8	2,618,5
	Sub total Admin Building Pumping station		<del> </del>		2,0,0,0
	Excavation	1	}		
	Normal excavation	m3	240	350	8,68
	EO for rock excavation	m3	114	1,500	371,1
	Concrete "all in prices"	1	1		-
	Concrete 30/20 in base slab	rn3	38	20,000	752,9
	do in walks	ოვ	75	20,000	1,491,0
	All in building costs	m2	124	22,060	2,724,4
		tem		20%	1,044.6
	Pipawork		1		2.688.8
	Purape	nr	2	1,344,417	
	Puripo Ancillaries	nr item	2	1,344,417 15%	
•	Pumpo Ancillarios Sub total Pumping Statem	ra item		15%	9,740,3
Slud	Purmo Ancillarios <u>Sub total Purming Staton</u> (go concentrators	nr item			
Slud	Pumpo Ancillaries Sub total Pumping Station [50 concentrators Execution	ra item Depth		15%	9,740,3 m
Slud	Pumpo Ancillaries Sub total Pumping Station go concentratore Executation Normal excavation	ra item Depth	143	15% 4 350	9,740,3 m 50,1
Slud	Pursos Ancillaries Sub total Pursoing States (ge concentratore Execution Normal excavation EO for rock excavation	ra item Depth		15%	9,740,3 m 50,1
Slud	Pumpo Ancillarios Sub total Pumping Statem (so concentrators Executation Normal executation EO for rock executation Concrete "all in prices"	Depth	143 72	15% 4 350 1,500	9,740,3 m 50,1 107,5
Slud	Pumpo Ancillarios Sub total Pumping Stateor (se concentratore Execution Normal excavation EO for rock excavation Concrete "all in pricee" Concrete 30/20 in base slab	Depth	143 72	15% 4 350 1,500 20,000	9,740,3 m 50,1 107,5 1,290,1
Slud	Purpo Ancillarios Sub total Purping States (go concentratore Execustion Normal excavation EO for rock excavation Concrete "all in priceo" Concrete 30/20 in base slab do nwals	Depth	143 72	15% 4 350 1,500	9,740,3 m 50,1 107,5 1,290,1 1,690,8
Slud	Purpos Ancillaries  Sub total Purping Staton (se concentrators Executation Normal excavation EO for rock excavation Concrets "all in prices" Concrete 30/20 in base slab do in walk Pipawork	Depth	143 72	15% 4 350 1,500 29,000 20,000	9,740,3 m 50,1 107,5 1,290,1 1,690,6 313.8
Sluđ	Purspo Ancillarios  Sub total Pursping Stateor  (se concentratore Execution Normal excavation EO for rock excavation Concrete "all in pricee" Concrete 30/20 in base slab do in walls Pipawork Ancillarioe	Depth	143 72	15% 4 350 1.500 20,000 20,000 10%	9,740,3 m 50,1 107,5 1,990,1 1,690,6 313,8
	Purpos Ancillarios  Sub total Purping Statest (go concentrators Execution Normal excavation EO for rock excavation Concrets "all in prices" Concrets 30/20 in base slab do invals Pipamork Ancillarios Sub total Studge concentrators	Depth	143 72	15% 4 350 1.500 20,000 20,000 10%	9,740,3 m 50,1 107,5 1,690,8 313,8
	Purpos Ancillaries  Sub total Purping Staton (se concentrators Executation Normal excavation EO for rock excavation Concrete "all in prices" Concrete 30/20 in base slab do nvals Pipamork Ancillaries Sub total String concentrators (se drying Bods	Depth	143 72	15% 4 350 1.500 20,000 20,000 10%	9,740,3 m 50,1 107,5 1,690,8 313,8
	Purpos Ancillarios  Sub total Purping Statest (go concentrators Execution Normal excavation EO for rock excavation Concrets "all in prices" Concrets 30/20 in base slab do invals Pipamork Ancillarios Sub total Studge concentrators	Depth	143 72	15% 4 350 1.500 20,000 20,000 10%	9,740,3 m 50.1 107,5 1,990,1 1,690,2 313,8 313,8 3,766,3
	Pumpo Ancillarios  Sob total Pumping Stateor  (se concentratore Execution Normal excavation EO for rock excavation Concrete "all in prices" Concrete "30/20 in base slab do nivals Pipamork Ancillarios  Sub total Sindo concentrators  (se dryling Bode Execution	Depth	143 72 65 85	15% 4 350 1,500 20,000 20,000 10% 10%	9,740,3 m 50.1 107.5 1.290,1 1,690,8 313.8 313.6 3,766,3
	Purpos Ancillarios  Sub total Purping States  (go concentrators Execution Normal excavation EO for rock excavation Concrets "all in priceo" Concrets 30/20 in base slab do nivals Pipamork Ancillarios Sub total Sivilge concentrators  (go drying Bods Excavation Normal excavation	Depth	143 72 - 65 85	15% 4 350 1,500 20,000 20,000 10% 10%	9,740,3 m 50,1 107,5 1,290,1 1,690,8 313,8 313,6 3,766,3
	Purpos Ancillaries  Sub total Purping Stator  (se concentrators Exeavation Normal excavation EO for rock excavation Concrets "all in prices" Concrets 30/20 in base slab do nwals Pipawork Ancillaries Sub total Single concentrators  (se drying Bode Excavation Normal excavation EO for rock excavation EO for rock excavation EO for rock excavation	Depth	143 72 -65 85 -74	15% 4 350 1,500 20,000 20,000 10% 10% 350 1,500 1,200	9,740,3 m 50,1 107,5 1,990,1 1,690,6 313,8 313,6 3,766,3 50,8 36,3 72,0
	Pumpo Ancillarios  Sob total Pumping Stateor  (se concentratore Execution Normal executation EO for rock executation Concrete "all in prices" Concrete 30/20 in base stab do in walts Pipamork Ancillarios  Sub total Sindoe concentrators  (se dryling Bode Executation Normal executation EO for rock executation Sand bed	rr item  Depth	143 72 65 65 65 	15% 4 350 1,500 20,000 20,000 10% 10% 350 1,500 1,200	9,740,3 m 50.1 107.5 1.290.1 313.8 313.8 3,766,3 50.8 36.3 72,0
	Purpo Ancillarios  Sob total Purping Statest  (se concentratore Execution Normal execution EO for rock execution Concrete "all in prices" Concrete 30/20 in base slab do in walk Pipamork Ancillarios  Sub total Sindoe concentrators  (se drying Bode Execution Normal execution EO for rock execution Sand bed Concrete "all in prices" Concrete 30/20 in base slab do in walk	rr item  Depth	143 72 -65 85 -74	15% 4 350 1,500 29,000 20,000 10% 10% 350 1,500 1,200 20,000 20,000	9,740,3 m 50.1 107.5 1,290,1 1,690,6 313.8 3,766.3 50.8 36.3 72.0 1,391.6 483.0
1	Purpos Ancillaries  Sub total Purping Stator  (ge concentrators Execution Normal excavation EO for rock excavation Concrete "all in prices" Concrete 30/20 in base slab do n wals Pipamork Ancillaries Sub total Strings concentrators  (ge drying Bode Excavation Normal excavation EO for rock excavation Sand bed Concrete "all in prices" Concrete 30/20 in base slab	rr item  Depth	143 72 65 65 65 	15% 4 350 1,500 20,000 20,000 10% 10% 350 1,500 1,200	50.1 107.5 1.990.1 1.990.3 313.8 313.8 3,766.3 50.8 36.3 72.0 1.331.0 493.0





# Table L-20 Chuka Water Supply Bill of Quantities

DESCRIPTION	Unit	Quantity	Rate	Amount
niake Site clearance	m2	600	35	21.000
Excevation	mz	600	35	21,000
Normal excavation	m3	400	350	140,000
EO for rock excavation	m3	200	1,500	300,000
Bank protection	m3	400	1,630	652,000
River diversion	item			5,000,000
Roads	m2	28,000	350	9,800,000
Concrete "all in prices"	_	il		_
Concrete 30/20 in base slab	m3	140	12,000	1,680,000
do in walls	m3	20	12,000	240,000
Sub totat, intake Rew Water Pipeline	<del> </del>	·		17,833,000
250 dia steel pipe	m	3,100	5,357	16,606,700
200 dia steel pipe	m	5,633	3,984	22,441,872
Sub total, raw water pipeline	""	5,005	0,504	39,048,572
restment Plant				
Site works				
Site clearance	rn2	8,400	35	294,000
Roads	m2	6,000	350	2,100,000
Fence	m	380	1,500	570,000
Sub total, Site works				2,964,000
orizontal Sedimentation Tanks	l	1 1		
Excavation		8		
Normal excavation	m3	1,408	350	492,685
EO for rock excevation  Concrete "all in prices"	m3	670	1,500	1,005,480
Concrete "all in prices"  Concrete 30/20 in base stab			An art	
do in walls	m3 m3	221	20,000 20,000	4,424,112 7,412,990
Pipework	item	3/1	20,000 15%	7,418,880 2,001,174
Ancillaries	ilem	'	15%	2,001,174
Sub total Horizontal Sed. Tank		nr	1070	17,343,504
Repld Sand Filters	J			
Excavation	1	]		
Normal excavation	m3	624	350	218,400
EO for rock excavation	m3	260	1,500	390,000
Media inc. gravel	m3	83	1,500	123,750
Concrete "ail in prices"	İ			
Concrete 30/20 in base slab	m3	72	20.000	1,430,000
do in walls	m3	316	20.000	6,325,000
Pipework	item	- 1	40%	3,394,860
Ancillaries	item	į l	30%	2,546,149
Sub total Rapid Sand Filters	(5)	_rr		14,428,155
Clear Water Storage Excevation		1		
Normal excavation	. m3	840	350	000.000
EO for reck excavation	m3	233	1,500	293,933 349,920
Concrete "ail in prices"	IIIo	233	1,390	349,920
Concrete 30/20 in base slab	m3	154	20,000	3,079,296
do in walls	m3	169	20,000	3,378,240
Plpawork	item		15%	1,065,208
Ancillaries	item	1	15%	1,065,208
Sub total Clear Water Reservoir(s)	(2)	nr		9,231,805
Buildings				
Chomical/Laboratory				
All In building costs Pipework and ancillaries	m2 item	83	22.000	1,821,600
Sub total Chemical building			15%	273,240
Office/Store/Workshop	\ <del></del>	<del> </del>	<del></del>	2,094,840
All in building costs	rn2	104	22,000	2,277,000
Add for furnishings etc	item	104	15%	341,550
Sub total Admin Building			1370	2,618,550
Pumping station	·	<u> </u>	<del></del>	2,010,00
Excavation		1		
Normal excavation	m3	240	350	83,84
EO for rock expavation	m3	114	1,500	171,120
Concrete "all in prices"		-		-
Concrete 30/20 in base slab	n:3	38	20,000	752,920
do in walls	m3	69	20,000	1,371,720
All in building costs	m2	124	22,000	2,724,480
Pipework Purese	item	*	20%	1,020,81
Pumps Anclilaries	ht item	2	1,344,417	2,688.83
Sub total Pumping Station	item		15%	765,618
Sludge concentrators	Depth	<del></del>	4	9,579,36
Excevation	Ooptii	I	"	""
Normal excavation	m3	143	350	50,17
EO for rock excavation	m3	72	1,500	107,51
Concrete "all In prices"			1,000	101,01
Concrete 30/20 in base slab	m3	65	20,000	1,290,15
do in walls	m3	85	20,000	1,690,80
Pipowork	item	.	10%	313,86
Ancillaries	item		10%	313,86
Sub total Studge concentrators	(3)	<u> </u>		3,766,37
Sludge drying Beds				1
Excavation	1			
Normal excavation	m3	145	350	50,82
EO for rock excavation	m3	24	1,500	36,30
Sand bed	m3	60	1,200	72,00
Concrete "all in prices"	1		]	-
Concrete 30/20 in base stab	m3	67	20,000	1,331,00
do in walls	m3	24	20,000	483,00
Pipework Inc.drainage Ancillaries	item item		25%	
Sub total: Studge drying beds		nr	10%	197,313





# Table L-21 Chogoria Water Supply Cash Flow

DESCRIPTION	Unit	Quantity	Rate	Amount
fake				
Site clearance	m2	600	35	21,00
Excavation				<b>70.0</b> 0
Normal excavation	m3	200	350	70,00
EO for rock excavation	m3 -	100	1,500	150,00 391,20
Bank protection	m3	240	1,630	1,000,00
River diversion Roads	item m2	24,000	350	8,400,00
Concrete "ali in prices"	1616	-	***	-,
Concrete 30/20 in base slab	m3	18	12,000	210,00
do in walls	m3	5	12,000	60,0
<u>Şub totaf, intake</u>	<u> </u>			10,302,2
aw Water Pipeline			0.004	40 544 5
200 dia steel pipe	m	4,654	3,984	18,541,55 18,5 <u>41,5</u> 5
Sub total, raw water pipeline				10,341,3
reatment Plant	[		•	
Site works Site clearance	m2	8,400	35	294,0
Roads	m2	4,000	350	1,400,0
Ferce	m	380	1,500	570,0
Sub total, Site works				2,264,0
orizontal Sedimentation Tanks				
Excavation				
Normal excavation	m3	1,105	350	386,8
EO for rock excavation	m3	526	1,500	789,4
Concrete "all in prices"			00.000	3,473,7
Concrete 30/20 in base slab	m3	174 325	20,000 20,000	3,473.7 6,491.5
do in walls	m3	325	20,000	1,671,2
Pipework	item item		15%	1,671,2
Ancillaries Sub total Horizontal Sed. Tanl		nr	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	14,484,0
Soo total Floria Sect. Fam.	. 12.2	10		
Excavation				
Normal excavation	m3	624	350	218.4
EO for rock excavation	m3	260	1,500	390,0
Media inc. gravel	m3	83	1,500	123,7
Concrete "all in prices"	İ	· :		
Concrete 30/20 in base slab	m3	72	20,000	1,430,0
do in walls	m3	316	20,000	6,325,0 3,394,8
Pipework	item		30%	2,546,1
Ancillaries Sub total Bapid Sand Filler	item	n/	1 30%	14,428,1
Short Water Storage	1 101	กา,		
Excavation	1			
Normal excevation	m3	650	350	227,4
EO for rock excavation	rn3	181	1,500	270,7
Concrete "all in prices"				
Concrete 30/20 in base slab	m3	119	20,000	2,382,6
do in walls	m3	147	20,000	2,947,6
Pipework	item	•	15%	874,2
Ancillaries	item		15%	874,2 7,576,9
Sub total Clear Water Reservoir(s	113	fil	<del></del>	1,5105
Buildings Chemical/Laboratory	1			
Ail in building costs	m2	83	22,000	1,821,6
Pipework and ancillaries	item		15%	273,2
Sub total Chemical buildin				2,094.8
Office/Store/Workshop	-			
All in building costs	m2	104	22,000	2,277,0
Add for furnishings etc	item		15%	341,5
Sub total Admin Buildin	9			2,618,5
Pumping station				
Excevation	_		250	
Normal excavation	m3	187	350	65,6
EO for rock excavation	m3	89	1,500	133,5
Concrete "all in prices"	m3	29	20,000	589,
Concrete 30/20 in base slab	m3 m3	59		1,178,
do in walls All in building costs	m2	124	· ·	2,724,
All in building costs Pipework	item		20%	1
Pumps	nt	2		2,490,
Ancillaries	item	Ī	15%	
Sub total Fumping Statio		<u> </u>	<u> </u>	8,824,
Sludge concentrators	Depth		4	m
Excavation	1	1		
Normal excavation	m3	115	· ·	40.
EO for rock excavation	m3	58	1,500	86.
Concrete "all in prices"			20,000	1,039
Concrete 30/20 in base slab	m3	52 76		1,517,
do in walls	m3	/6	10%	
Pipework Appliferies	item item		10%	
Ancillaries Sub total Studge concentrator	100	or	•	3,220
Studge drying Beds	- 124		T	1
Stuage arying beas Excavation	1			
Normal excavation	m3	119	350	41,
EO for rock excavation	m3	20		
Sand bed	m3	48		57.
Concrete "all in prices"			1	
	rn3	54		
Concrete 30/20 in base slab			20,000	437,
Concrete 30/20 in base stab do in walls	m3	22		
		- 22	25%	413



Table L-22 Maua Water Supply Bill of Quantities

DESCRIPTION	Unit	Quantity	Rete	Amount
take	m2	50	35	1,75
Site clearance Excavation	m2	50	35	1,10
Normal excavation	m3	20	350	7,00
EO for rock excavation	m3	10	1,500	15,00
Bank protection	m3	20	1,630	32,60
River diversion	item			20,00
Roads	m2	200	350	70,00
Concrete "all in prices"		5	12,000	54,00
Concrete 30/20 in base slab do in walls	m3 m3	3	12,000	36,00
Sub total, intake	ş :- ş	3	12,000	236,35
aw Water Pipeline				200,00
150 dia steel pipe	1 m	400	2,763	1,105,20
Sub total, raw water pipeline	1			1,105,20
reatment Plant				
Site works				
Site clearance	m2	8,400	35	294,00
Roads	m2	1,600	350	560,00
Fence	m	380	1,500	570,00
<u>Sub total, Site works</u> ortzontal Sedimentation Tanks	<b>_</b>			1,424,00
Excavation  Excavation				
Normal excavation	m3	553	350	193,4
EO for rock excavation	m3	263	1,500	394.7
Concrete "all in prices"			.,,550	A= 411
Concrete 30/20 in base slab	rn3	87	20,000	1,736,8
do in walls	m3	162	20,000	3,245,7
Plpework	item	-	15%	835,6
Anclilaries	itern	ļ l	15%	835,6
Sub total Florizontal Sed. Ten	(2)	nr		7,242,0
Rapid Sand Filters	}	1		
Excavation		316	350	440.0
Normal excavation EO for rock excavation	m3 m3	132	1,500	110,6 197.6
Media inc. gravel	m3	40	1,500	59,6
Concrete "all in prices"	1113		1,300	
Concrete 30/20 in base slab	m3	36	20,000	724,6
do in walls	m3	173	20,000	3,450,0
Plpowork	item	-	40%	1,817.0
Ancillaries	item		30%	1,362.8
Sub total Rapid Sand Filters	(3)	nr		7,722,5
Clear Weter Storage	1			
Excavation		245	252	444.0
Normal excavation	m3	318	350	111.3
EO for rock excavation	m3	88	1,500	132,5
Concrete "all In prices"  Concrete 30/20 in base slab	m3	58	20,000	1,166,3
do in walls	m3	73	20,000	1,457.2
Plpswork	tem	, , ,	15%	430.1
Ancillaries	item		15%	430,1
Sub total Clear Water Reservoir(s	(t)	pr		3,727,7
Bulldings				
Chemical/Laboratory				
All in building costs	m2	69	22,000	1,518,0
Pipework and ancillaries	item		15%	227,7
Sub total Chemical building Office/Store/Workshop	'———			1,745,7
All in building costs	m2	83	22.000	1,821,6
Add for furnishings etc	item	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	15%	273,2
Sub total Admin Buildin		ĺ	10%	2,094,8
Pumping station	`	·		
Excavation				
Normal excavation	m3	157	350	55,0
EO for rock excavation	m3	75	1,500	112,3
Concrete "all in prices"				,
Concrete 30/20 in base slab	ภาจิ	25	20,000	494,2
do in walls	m3	54	20,000	1,081,9
All in building costs	m2 item	124	22,000	2,724,4
Plpework Pumps	ur (em	2	20% 1,344,417	893,5 2,688,6
Ancillaries	m	"	1,344,417	670,1
Sub total Pumping Statio	1		'3.º	8,720,5
Studge concentrators	Deoth		4	m
Excavation	1		ĺ	
Normal excavation	m3	64	350	22,5
EO for rock excavation	m3	32	1,500	48,2
Concrete 'all in prices"	1	-	ļ	
Concrete 30/20 in base slab	m3	29	20,000	579,0
do in walls	m3	46	20.000	924,8
Pipework	item		10%	157,4
Ancillaries Sub total Sixtae conceptrator	item	l ar	10%	157,
<u>Sub total Sludge concentrator</u> Sludge drying Beds	- her	ar	i	1,889,
Excavation		1	1	[
Normal excevation	m3	59	350	20,
EO for rock excavation	m3	10	1,500	14.
	m3	24	1,200	28,
Sand bed	1			
Sand bed Concrete "all in prices"				
	m3	27	20,000	544,
Concrete "all in prices"	m3 m3	27	20,000 20.000	
Concrete "all in prices" Concrete 30/20 in base slab		1		218, 206,



# Table L-23 Tigania Water Supply Bill of Quantities

DESCRIPTION	Unit	Quantity	Rate	Amount
rizke			ar	14,00
Site clearance	m2	400	35	14,01
Excavation Normal excavation	m3	64	350	22,40
EO for rock excavation	m3	32	1,500	48,00
Bank protection	m3	80	1,630	130,40
River diversion	item		. 1	100,06
Roads	m2	20,000	350	7,000,00
Concrete "ail in prices"		1.5	40,000	180.00
Concrete 30/20 in base slab	m3	15	12,000	60,0
do in walls	m3	5	12.000	7,554,8
Sub total, intake				7,034,0
aw Water Pipeline	ın	5,000	5,357	26,785,0
250 dia steel pipe <u>Sub total, raw water pipeline</u>	741	]		26.785,0
optiment Plant				·
Site works			Ì	
Site clearance	m2	8,400	35	294,0
Roads	m2	4,000	350	1,400,0
Fence	m	380	1,500	570,0
<u>Sub total, Site works</u>		<del> </del>		2,264,0
orizontal Sedimentation Tanks		}		
Excavation	_	1	350	492,6
Normal excavation	m3	1,408	1,500	1,005,4
EO for rock excavation	m3	670	1,300	1,000,
Concrete "all in prices"	m3	221	20,000	4,424,
Concrete 30/20 in base slab do in walls	m3	371	20,000	7,418,
go in waiis Ploework	item	] 1	15%	2,001,
Ancillaries	item	ļ	15%	2,001,
Sub lotal Horizontal Sed. Tank		nr		17,343,
apid Sand Filtors		, , ,		
Excavation				218.
Normal excavation	m3	624	350 1,500	218, 390,
EO for rock excavation	m3	250 83	1,500	123,
Media inc. gravel	m3	83	1,300	120,
Concrete "ail in prices"	m.a	72	20,000	1,430.
Concrete 30/20 in base slab	m3 m3	316	20,000	6,325
do in walls Ploework	item	1	40%	3,394.
Apcillaries	item		30%	2,546,
Sub total Hapid Sand Filters	3	Gf		14,428,
lear Weter Storage				
Excavation		i		
Normal excavation	m3	461	350	161
EO for rock excavation	m3	128	1,500	192
Concrete "all in prices"			20,000	1,689
Concrete 30/20 in base slab	m3	84 123	20,000	2,450
do in walis	m3 item	123	15%	674
Pipework Anciliaries	ilem:		15%	674
Sub total Clear Water Reservoir(s)		Pf		5,841
Bulldings				
Chemical/Laboratory	1			
All in building costs	m2	83	22,000	1,821
Pipework and ancillaries	item		15%	273
Sub total Chemical building		<del></del>		2,094
Office/Store/Workshop		104	22,000	2,277
All in building costs	m2 ilem	104	15%	341
Add for furnishings etc	1			2,618
Sub total Admin Building	' <del> </del>			
Pumping station Excavation	1			
Normal excavation	m3	240	350	83
EO for rock excavation	m3	114	1,500	171
Concrete "all in prices"	I	•		
Concrete 30/20 in base slab	m3	38	20,000	752
do in walls	m3	69	20,000	1,371
All in building costs	m2	124	20% 20%	2,724
Plpework	item		1,344,417	2,686
Pumps	nr	2	1,344,417	765
Ancillaries	item	· ·		9,579
Sub total Pumping Station	Depth		4	m
Studge concentrators			1	
Excevation Normal excevation	m3	143	350	50
EO for rock excavation	m3	72	1,500	107
Concrete "ali in prices"	1		1	1
Concrete 30/20 in base slab	m3	65	20,000	1.290
do in walls	m3	85	20,000	1,690
Pipework	item	•	10%	310
Ancillaries	item		10%	310
Sub total Sludge concentrators	<u> </u>	nr	·	3,76
Sludge drying Beds	1			1
Excevation	1 .		350	50
Normal excavation	m3	145	1	3
EO for rock excavation	m3	24	1	7:
Sand bed	m3	60	1,200	1
Concrete "all in prices"		67	20,000	1,33
Concrete 30/20 in base slab	m3 m3	24		48
do in walls	item		25%	
Pipework inc.drainage Anciliaries	ilem		10%	
	,e	1	1	2.66





# ATTACHMENT

#### **Unit Construction Prices**

Notes

Exchange rate	56	Shs
General Items	Unit	Rate Shs
General excavation in normal material not exceeding 3.0m depth	m3	3:

	Fore	gn/L.o.	cal cu	rency b	reakdo	พก	
	Cost	<b>Break</b>	down		%F	%L	%Tax
	1. Fo	relgn i	materi	als	. 90%	10%	0%
	2. Lo	cal ma	ateriais	s	15%	70%	15%
	3. La	bour			. 5%	75%	20%
	4 Cor	nstruc	llon pi	ant	85%	5%	10%
hs			Lab		%F	%L	%Tax
	%F	%L	1		<u></u>	<u> </u>	<u> </u>
350	0%	0%	75%	25%	25%	58%	18%

Gettelat excasation at house	ar triateral net executing a series		4					coari	t accert	Lanez	4 6 07	1
EO for rock		m3	. [	1,500	0%			50%	45%	}	15%	ı,
Earthworks for dams - Soft		m3		175	0%		1	1	65%	: 1	13%	ī
Earthworks for dams - Rock	***************************************	m3		1,000	0%		•	}	69%		12%	1
				310	0%			1	69%	1 1	12%	
Filter/drainage material for d	lams	m3	1	1,550	0%				65%	23%	13%	İ
Rin ran material for dams		m3	1	1,630	0%	0%	20%	80%	69%	19%	12%	į
Concrete Class 25		m3	i	8,000	0%	82%	14%	4%	16%	68%	16%	ł
Concrete Cises 30		m3	3	12,000	0%	83%	13%	4%	17%	68%	15%	l
Mace constate for dame		m3	3 1	6,000	0%	80%	15%	4%	16%	68%	16%	١
				65,000	80%	10%	9%	1%	75%	22%	3%	۱
Community E4			2	475	0%	10%	77%	13%	16%	65%	18%	Į
Caroniark C2		m2	≥ 1	750	0%	14%	73%	13%	17%	65%	18%	1
Pleaterster Piec		rnž	2	1,200	0%	10%	80%	10%	14%	68%	19%	ł
BIGCKWOIK WARING	oncrete	m²	1	20.175	25%	45%	25%	5%	35%	53%	12%	Į
All tu, cost tot tellilotoed co	niciete		1								l	١
									'		ļ	١
pework		Di (Ol	- 601		ł			1	1	1 1	ł	ı
ssumptions	Type of pipe	uPVC	Steel	DI		1			1		ĺ	l
Manufacturers discount		10%	0%	0%	[				1	!!	ĺ	i

pework ssumptions Type of pipe  Manufacturers discount  Tax and dutles  Transport and handling  Wastage	uPVC 10% 15% 15%	Steel 0% 15% 15%	DI 0% 15% 20%	0%	0%	20%	80%	69%	19%	12%
Pipe trench width	1200	mm + nomin mm + nomin 10% 15%	al dia.					12 ha		

UBIVO I	PVC Pipelines Materials delivered to site "All in" pipe costs Currency breakdown for 12 bar uPVC																
ar vo r	Trench	1.ay, joint	uPVC	uPVC	uPVC	uPVC	uPVC	uPVC	uPVC	uPVC	Mate	ials	Lab	Pint	%F	%L	%Tax
Dia	Excavn	etci	6 bar	9 bar	12 bar	15 bar	6 bar	9 bai	12 bar	15 bar	%F	%L	Ì		1	ĺ	'
mm	Shs/m	Shs/m	Shs/m	Shs/m	Shs/m	Shs/m	Shs/m	Shs/m	Shs/m	Shs/m						<u></u> _	Ĺ
12.07											•	Į			1.	ļ	
63	482	40	75	125	155	200	597	647	677	722			58%		1	55%	16%
90	510		187	242	298	365	757	812	868				49%			54%	
110	531	60	252	362	442	562	843	953	1033		1	t	43%		1	53%	
160		100	506	747	943	1155	1191	1432	1628				32%		1	51%	1
225	659		1000	1380	1825	2104	1799	2179	2624				23%	1 1	1	50%	1
280			1450	2125	2504	3262	2355	3030	3409		•		20%		1 '	49%	į.
315	769		1837	2660	3374	4124	2806	3629	4343	5093	31%	47%	17%	6%	41%	49%	11%
400	880		3974	4374			4234	5534			Щ.	<u> </u>				L	L

Steel a	nd DI Pipe	lines	Materials delivered to site			"All in" pipe costs		r:				631 1		
Т	Trench	Lay, joint		Steel	ÐI	Si	eet Di				wn for			,——
l	Excav'n	etc					1	Mate	rlats	į.ab	PInt	%F	%L	%Tax
	Shs/m	Shs/m		Shs/m	Shs/m	She	s/m Shs/m	%F	%L					<u> </u>
dia							4004					1		i
80	499	70	i I	1	1235		1804				200	400/	4301	400
100	520	90	1	1115	1518			1	26%	1	9%	1	42%	
150	574	140		2049	2285	27	763 2999	44%	30%	19%			40%	1
200	630	200		3154	3080	39	84 3910	48%	32%	16%	5%	53%	39%	89
	689	260	1 1	4408	4073		357 5022	49%	33%	13%	4%	54%	38%	89
250	750	-	1	5794	5166	68	6236	51%	34%	12%	4%	55%	38%	89
300	750; 814	380		7301	6386	8.	195 7580	52%	34%	11%	4%	55%	37%	8%
350 400	880			8921	7663	103	251 8993	52%	35%	10%	3%	55%	37%	7%
			li I	10036	9097	11	195 10556	52%	35%	10%	3%	56%	37%	79
450 500	949 1020			11152	5001		752		35%			56%	37%	7%

Reservoirs																
Capacity (m3)	50	100	150	200	250	300	400	500	750						1 1	
"All in" costs	550,000	780,000	940,000	1,070,000	1,290,000	1,520,000	1,940,000	2,350,000	3,350,000	25%	45%	25%	5%	35%	53%	12%
Cost/m3	11.000	7.800	6,267	5,350	5,160	5,067	4,850	4,700	4,480	L						
3444					h	L										



Tarelessee	1. Phas	ed Inves	tment C	Costs	Exchanga r	ate	1 US \$ =	56	KShs	Phase 1.			1998	Phase 2			2005	
March   Marc			Description	מכ	<u></u>	-		Urei			Civil	E8M	Pipes		Civil		Pipes	
Water   19			ua (mm)/	SIZE					vos					Quantity	U3 1 x 1,000	US \$ x 1 500	US \$ x 1,000	
Transmitton   10,000 and Contractory interference   10,000 and Contractory   10,000 and Contra	Intake	ļ								item		"			<b>!</b>			
1000											9007		1,326.4		ļ	[		
Color	neamen									, ,	cub /	1424		1 1	667.9	35.2		
Reservoirs		Į		Staff housi	rig			t.t.	35,268			ŀ		i				
Total and interest							-							٠,				
Column   C	Reservoi	rs					1											
220 m3 reservors							-		34,643			} :		2				
200 in diseasers		- 1								-							]	
150 and restrict										1						1		
Transmission   100 mm do selenje   m   15:21   3500   m   10:00   10:00   m										- 1						1		
300	_						-			l . : l	-			2	27.9			
316 m/m of a PCC (12 bar)	Iransmis	5:0n						1							Į		1	
222		ļ				ı								i			- 1	
150   min ad wPCC (12 ber)   m														1.500	1		- 1	
## 110 mm de uPCC (2 bur)		Ì													1			
## Accordance   15%   28%   42.0   80%   23.3   5.3   15.9														24,300	}		721.7	
Preference   1596   3324   270   9211   2687   61   1277   72   7319   7327   7319   7327   7319   7327   7319   7327   7319   7327   7319   7327   7328   7319   7328				mm da uP	VC (12 bar)	)		nı .		3,400				ł				
Tribing   Control   Cont			cies															
Solid   Soli							· i		1376	· · · · · · · · · · · · · · · · · · ·				<del>                                     </del>				
Annual   110 mm de a PVC (17 bar)   m   18 46   2650   43   2650   33   2010   31   2010   2011					~~~~~~					Phase 1.				Phase 2				
		ıal inves										,		<del></del>	· · · · · · · · · · · · · · · · · · ·	<del></del>		
Page   S3   men as un UPC (12 bas)   m   12 c85   3,000   3.0   2.000   7.00		lion																
Temptor purchase costs												1			İ			
Saloun care	Total								·									
A. Annual Colfe Costs   Free Colfe Colfe Costs   Free Colfe Costs   Free Colfe Costs   Free Colfe Costs   Free Costs   F	3. Tran	sport pu												2003	1			
Pick-p   Fire   107.1   2   1   2   2   2   2   2   2   2	1													1 :				1.
Learny   A. Annual OSM costs and   Annual OSM costs as 5, of investment costs   Trings of Civil   Costs   Fees			Pickup					nr	21.4	2			43	3				
4. Annual OSM costs and Economic (life   Economic (life of exists)   Economic (life o			Lorry					nr	107.1						<u> </u>	~	214	
Committee   Comm	A Box		4_		4		Dr 61					<del> </del>	†	ł				
Power tent   Cot 1965   Power Requirements										· <del>•</del>				i				
Power florif (Cot 1989)					CCGAOINC	416 07 63561			· · · · · · · · · · · · · · · · · · ·	<u>`</u>	·		<del></del>	<del></del>	2006	Telved	Vocatio	1
Unit entering cost	". " "	161 0030		riff (Oct 199	6)	1		Power Rec	pirements	L	1980			1	2003			· .
MA demand chatring			Un₁t ene	rgy cost				US\$funit	0.08				· · · · · · · · · · · · · · · · · · ·					1
Relevant   September   Septe	1																	Ì
Engineer   Sinsky   Sinsky   3 2   1   1   1   1   1   1   1   1   3   3	6. Hun	ian Resc			***************************************			C34 Monthly	<del>}</del>	<del></del>	1999			т	2005			ł
Engineer   Shript		141774234		30313				]		TWks 1			US\$x1,000	TVVks 1			US\$x1.000	1
Inspector	ĺ									1		1	3.86		1	1	3.86	1
Schior Operator   Shedy   129   2   1   4   9.00   2   1   5   10.28   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   5   10.28   10.28   5   10.28										,		2			, ,			
Continue											۱ ،	ا ا						
Story   Chemical Costs   USS to   USS										2	2			2	2 2	: 5	868	1
Chemical Costs	ł		Watchm	an/Line patro	ol nan/Clerk	s			0.64	3	] 3	3 20		3	3  4	1 29		ļ
Abrun   Circuins   Sode ash   Circuins   Sode ash   Circuins   Sode ash   Circuins   Sode ash   Circuins   Sode ash   Circuins   Sode ash   Circuins   Sode ash   Circuins   C	7. Che	mical Co	i					Sharp	USSka	1938	Dosegu (ro	.d	f*	200	L. Dosana (		<del></del>	ł
Sodia sh   O.25   O   O.000   O   O.000   O   O.000		,																
Section   Projection of Costs   Information   Projection of Costs   Information   Projection of Costs   Information   Information   Projection of Costs   Information   Information   Projection of Costs   Information   Inform	1																	
Real Population   Fig.   Population   Popu	i				er m3				,							<u>.                                    </u>		
Year   Population   Water   Water   Population	8. Ann	ual Prois						nt Schedul	e		·····						0.013	
13   13   13   13   13   13   14   15   15   15   15   15   15   15			Water	Population						Transpor	Total				Transport	Chemicals	Total	Total
(1)   (2)   (3)   (4)   (5)   (6)   (7)   (8)   (9)   (10)   (11)   (12)   (13)   (14)   (16)   (15)   (16)   (17)   (1997)   165,980   103,080   31%   3.25%   3.25%   460   2.487   212   7.061   338   10.098   171,806   11.219   29%   3.25%   3.684   460   116   116   116   105   14   56   65   2   2.45   3.25%   2.200   189,524   13,974   40%   5.889   2.396   116   116   116   105   15   56   68   6   2.51   3.200   189,524   13,974   40%   5.889   2.396   116   116   116   107   15   56   68   11   257   3.200   189,524   13,974   40%   5.889   2.396   116   116   116   109   16   56   68   11   257   3.200   2.200   2.205   2.11   1.11	] [		Demand	Coverage	Supplied				.104	lune					J			
1999   165,920   103,02   31%   3,194	100	(2)																US\$ x 1,000
1998   171,806   11,219   29%   3,233   60   2,487   212   7,061   338   10,098     6   6   0   0   10,0098       1999   177,667   12,181   30%   3,684   460   116   116   116   116   105   14   56   68   2   245   3,0098   2,396   116   116   116   107   15   56   68   0   251   3,0098   2,396   118   3,0098   118   3,0098   3,098   3,0098	1997	165,980	10,302	31%	3,194	-				1			<del> ,</del>	1-1:2/-	1	1-1.3/	1 - 1.07	l \'''
2000		171,806			3,253		2,487	212										10,098
2001   189,554   13,974   40%   5,589   2,396   116   116   107   15   66   68   11   257   32   32   32   32   32   32   32   3							l	1										362 368
2002   195.741   14.794   45%   6.657   3,463   116   116   109   16   56   68   16   284   52   2003   202,094   16.649   50%   7,624   4,631   116   116   116   111   17   67   72   21   285   7   2004   208,618   16,541   55%   9,997   5,904   116   116   111   17   67   72   27   233   336   38   2005   221,99   18,438   68%   12,538   9,344   1004   104   104   148   18   67   72   43   338   38   2007   229,268   19,447   7651   14,779   11,566   104	2001	189,554	13,974	40%	5,589			<del> </del> -										374
2004   208.618   16,641   5555   9,097   5,904   116   116   116   117   17   67   72   27   293   205   215,318   17,470   60%   10,482   7,288   2,060   46   1,401   3,507   147   17   67   72   33   336   3,8   2007   222,199   18,436   66%   12,588   9,344   1004   1004   148   18   67   72   43   348   2007   229,288   19,447   7655   14,779   11,556   1004   1004   149   19   67   72   53   360   2008   236,531   20,496   34%   17,217   14,023   212   104   359   675   159   20   67   72   64   382   1,0   2009   243,996   21,589   92%   19,861   16,668   1004   1004   160   22   67   72   76   396   2010   251,668   22,725   100%   22,725   19,531   1004   1004   161   23   67   72   89   411   5   5   5   5   5   5   5   5   5				45%	6,657	3,463	ŀ		116		116	109	16	56	68	16	264	380
2005   215,318   47,470   60%   10.482   7.286   2.060   46   1.401   3.507   147   17   67   72   33   336   3.8							ĺ											761 409
2008   222,199   18,438   66%   12,638   9,344   104   104   104   148   18   67   72   43   348   68   2007   229,268   19,447   76%   14,779   11,586   104   359   675   159   20   67   72   53   360   2008   236,531   20,496   84%   17,217   14,023   212   104   359   675   159   20   67   72   76   396   150   2009   243,996   21,589   92%   19,861   16,688   104   104   160   22   67   72   76   396   150   2010   251,668   22,725   100%   22,725   19,531   104   104   161   23   67   72   89   411   50   2011   251,668   22,725   100%   22,725   19,531   104   104   163   23   67   72   89   413   50   50   50   50   50   50   50   5	2005	215,318	17,470	60%	10,482		2,060	46										3,843
2008   236,531   20,496   84%   17,217   14,023   212   104   359   675   159   20   67   72   64   382   1,0		222,199				9,344	1		104		104	148	18	67	72	43	348	452
2009   243,996   21,589   92%   19,861   16,688   104   104   160   22   67   72   76   396   50   2010   251,668   22,725   100%   22,725   19,531   104   104   104   102   23   67   72   89   411   50   2011   251,668   22,725   100%   22,725   19,531   104   104   104   102   23   67   72   89   413   50   2013   251,668   22,725   100%   22,725   19,531   104   359   463   164   23   67   72   89   415   50   2014   251,668   22,725   100%   22,725   19,531   104   104   104   165   23   67   72   89   415   50   2014   251,668   22,725   100%   22,725   19,531   104   104   104   165   23   67   72   89   416   50   2014   251,668   22,725   100%   22,725   19,531   46   104   151   168   23   67   72   89   416   50   2016   251,668   22,725   100%   22,725   19,531   46   104   151   168   23   67   72   89   418   50   50   50   50   50   50   50   5							i	212										464 1.057
2010   251,668   22,725   100%   22,725   19,531   104   104   161   23   67   72   89   411   2011   251,668   22,725   100%   22,725   19,531   104   104   103   23   67   72   89   413   5   2012   251,668   22,725   100%   22,725   19,531   104   104   163   23   67   72   89   413   5   2013   251,668   22,725   100%   22,725   19,531   104   104   359   463   164   23   67   72   89   415   5   2014   251,668   22,725   100%   22,725   19,531   104   104   165   23   67   72   89   416   5   2014   251,668   22,725   100%   22,725   19,531   46   104   151   168   23   67   72   89   416   5   2015   251,668   22,725   100%   22,725   19,531   46   104   151   168   23   67   72   89   416   5   2016   251,668   22,725   100%   22,725   19,531   46   104   151   168   23   67   72   89   420   6   2017   251,668   22,725   100%   22,725   19,531   46   104   104   169   23   67   72   89   420   6   2017   251,668   22,725   100%   22,725   19,531   46   104   104   169   23   67   72   89   420   6   2017   251,668   22,725   100%   22,725   19,531   46   104   104   169   23   67   72   89   356   450   400	2009	243 996	21,589	92%	19,861			212										1,057 500
2012   251,668   22,725   100%   22,725   19,531   104   359   463   164   23   67   72   89   413   5   6   6   6   72   72   72   72   72	2010	251,668	22,725	100%	22,725	19,531	<b>!</b>	<u> </u>	104	<u> </u>	104	161	23	67	72	89	411	516
2013   251,668   22,725   100%   22,725   19,531   104   359   463   164   23   67   72   89   415   80   80   80   80   80   80   80   8								ĺ										517
2014   251,668   22,725   100%   22,725   19,531   46   104   104   165   23   67   72   89   416   59																		518 878
2016   251,668   22,725   100%   22,725   19,531   -{2,148}   -{80}   -{3,863}   -{72}   -{6 163}   106   23   67   72   89   420   6   6   6   6   6   6   6   6   6	2014	251,668	22,725	100%	22,725	19,531	]		104	i	104	165	23	67	72	89	416	520
2017   251,663   22,725   100%   22,725   19,531   -(2,148)   -(80)   -(3,863)   -(72)   -(6 163)   106   23   67   72   89   356   -(5,8 10 10 10 10 10 10 10 10 10 10 10 10 10								46										569
Note: Residual values in (brackets)   US\$x 1 000   US\$x 1 000   US\$x 1 000   US\$x 1 000   US\$x 1 000   US\$x 1 000   US\$x 1 000   US\$x 1 000   US\$x 1 000   US\$x 1 000   US\$x 1 000   US\$x 1 0000   US\$x 1 000   US\$							-(2.148)	-(80)										524 (5.806
15%   12,399   10,432   1,661   12,76   12,599   10,891   2,076   12,976   12,976   12,976   12,976   12,976   12,976   12,976   13,375   11,295   2,660   13,375   11,572   3,504   15,77   10,000   15%   15%   0,84   0,13   0,12   0,63   0,12   0,9%   0,46   0,11   0,0   0,11   0,0   0,045   0,11   0,0   0,11   0,0   0,0   0,11   0,0   0,												1 "	20	"	12	69	326	-(3.0Vb
15%	9. Net	Present								¬ ·							US\$ v 1.000	US\$ x 1,000
9%   24,823   11,295   2,660   13,6   15,0					1											1	1,661	12,093
6%   36.450   11.572   3.504   15(   10. Average Incremental Costs (Shs/m3)   US\$/m3   US\$/m3   US\$/m3   US\$/m3   US\$/m3   US\$/m3   0.13   0.12   0.63   0.12   0.64   0.11   0.0   0.01   0.					1	24,823		1	1							1		12,957 13,955
10. Average Incremental Costs (Shs/m3)	<u> </u>		67	6]	<u></u>	36,450	<u> </u>		<u> </u>				1	<u>i</u>	<u>L.</u>			15,076
15% 12% 0.63 0.12 0 0.11 0 0.11 0	10. Av	erage In			(Shs/m3	)			- pur-ve				<del></del>				US\$#m3	US\$/m3
9% 0.46 0.11 0					1		1	}	1									0 98
	1		99	6[	1		1	1	1	1			1	1		1		0.75 0.56
	L				<u> </u>		<u> </u>	}	<u></u>				1	<u> </u>	1			0.41









Meru Water Supply - Phasing costs broken down into major components

The column   Proper   The column   Proper   The column					800			Dhaca 2		2005	2005 Phase 2			Currency breakdown	sakdown	
Circle   C		Phase 1		- 1	Phase I			Ţ		1	Foreign	lecol	Taxes			
17.5   17.5		,	E SE	Pipes	Local	Foreign ISSV1000	taxes 15.5 v 1 000	000	US 5 x 1,000 U	55×1,000	USS x 1,000	US \$ × 1,000	US 5 x 1,000			æx
17.5   17.5   17.5   14.2   18.7   26.9   18.7   26.9   18.7   26.9   27.5	dia (ಗಾಗಾ)/ Size	3	00,1 × 0,50	000' × 4 80	000 - x 6 60	000	8 86						-	30%	82%	15%
Second   S	Rehabilitation	9.70	6.	142.9		7.00	, c , c , c	·	,	,		,	,	35%	53%	12%
la steel raw water pic. 1, 226.4	Intake	224.0	1	,		2	) ) )					,	,			
Second   S	Raw water pipeline			13284		490.8	92.9	!		,	,	ı	•	26%	37%	%2
Cappertry plant   Cappertry   Capp	To though plant			) )							,	•				į
Particle   Particle	reatment plant	808.7	1474	į		503.0	113.9	ı	'	1	1	ı	•	35%	23%	12%
Propertition   105.8   1.05.	10,000 m3/d capacity plant	5	1.1	,	•	,			35.2	1	246.1	372.6	84.4	35%	23%	12%
155   156	10,000 m3/d expansion	· (	1	,		ű	148		<u></u>	,	80	21.5	4	25%	61%	14%
10.0   10.0	Staff housing	9 1	,			1,1	, K			,		,	•	25%	61%	14%
seervoir         390.0         -         126.0         190.8         412.0         35%         53%	Branch offices	0.0		į		0.0	2	Menson in			٠	,	,			
1   1901   1902   1903   1904   1905   190	Storage reservoirs	1			, (		. 6	-	,		128.0	190.8	43.2	35%	23%	12%
oil         1800         -         630         954         2.15         6.00         -         24.3         36.7         8.3         35%         53%           oil         693         -         -         24.3         -         -         24.3         36.7         8.3         35%         53%           oil         - <th< td=""><td></td><td>380.0</td><td>ı</td><td></td><td>126.0</td><td>0.00</td><td>5.4</td><td>_</td><td></td><td></td><td>5 6</td><td>9 6</td><td>7 7 7</td><td></td><td>23%</td><td>17%</td></th<>		380.0	ı		126.0	0.00	5.4	_			5 6	9 6	7 7 7		23%	17%
oif		180.0	•	•	8	90.4	21.6		'	,	2 6	1 9			700	12%
oir 23.0		99.3	,	1	24.3	36.7	ю. Ю		'		. 47 	200	9 (		200	7007
19.1   23.0   19.1   19.1   19.2   2.8   115.2   115.2   19.1		1	,		,			54.3		,	0.61	20.0	0.0		80	12.70
191   191		23.0	,	,	8.1	12.2	12.8	115.2		1	40.3	61.0	13.8		5 5 8 8 8	9,7
See   Pipe   See		5		٠	/\ (C)	10.1	2.3	57.3	•	,	20.1	30.4	6.60 6.00		23%	12%
Parameter   Para		<u>.</u>		•			,	50.4	'	٠	17.6	26.7	6,0	_	23%	12%
eel pipe eel				ı				07.0		•	60	14.8	3.3		23%	12%
eel pipe - 1,031.5 567.3 381.7 82.5 666 6 389.5 257.4 46.7 666 6 37% eel pipe - 1,031.5 567.3 381.7 82.5 1,031.5 567.3 381.7 82.5 1,031.5 567.3 381.7 82.5 1,031.5 567.3 381.7 82.5 1,031.5 567.3 381.7 82.5 1,031.5 567.3 381.7 82.5 1,031.5 567.3 381.7 82.5 1,031.5 567.3 381.7 82.5 1,031.5 141.2 173.0 86.3 1,031.5 141.2 173.0 86.3 1,031.5 141.2 173.0 86.3 1,031.5 141.2 173.0 86.3 1,031.5 141.2 173.0 86.3 1,031.5 141.2 173.0 86.3 1,031.5 141.2 173.0 86.3 1,031.5 141.2 173.0 86.3 1,031.5 141.2 173.0 86.3 1,031.5 141.2 173.0 86.3 1,031.5 141.2 173.0 86.3 - 1,031.5 141.2 141	100 m3 reservoir	1				•						•				
lia steel pipe	Transmission pipelines	way err			. !		, (	rda							37%	7%
lia steel pipe lia steel pipe lia steel pipe lia steel pipe lia steel pipe lia steel pipe lia uPVC (12 bar) lia uPVC (12		,	'	695.6	389.5		48.7			'					37%	8
Ila uPVC (12 bar)         -		,	1	1,031.5	567.3		62.5	;	•	'	,		'		200	1107
Isa uPVC (12 bar)         1         353.1         141.2         173.0         38.8         1         141.2         173.0         38.8         1         1         49%         49%         49%         49%         49%         49%         49%         49%         49%         49%         49%         49%         49%         49%         49%         49%         49%         552.9         215.6         270.9         48.6         1         721.7         267.0         360.8         93.8         37%         50% <t< td=""><td></td><td>1</td><td></td><td>659.2</td><td>270.3</td><td></td><td>72.5</td><td>1</td><td></td><td>ı</td><td></td><td>1</td><td>•</td><td></td><td>48%</td><td></td></t<>		1		659.2	270.3		72.5	1		ı		1	•		48%	
tist uPVC (12 bar)         282.9         215.9         215.9         66.3         -         337.4         131.6         165.3         405         389%         49%           tist uPVC (12 bar)         -         373.9         138.3         186.9         48.6         -         721.7         267.0         360.8         93.8         37%         50%           tist uPVC (12 bar)         -         52.7         169.2         27.9         17.9         -         7.9         -         360.8         93.8         50%         48%         50%         48%         50%         48%         50%         48%         50%         48%         50%         48%         50%         48%         50%         48%         50%         48%         50%         48%         50%         50%         48%         50%         50%         48% </td <td></td> <td>,</td> <td></td> <td>353.1</td> <td>1412</td> <td></td> <td>38.8</td> <td>,</td> <td>•</td> <td>,</td> <td></td> <td>1</td> <td>•</td> <td></td> <td>868</td> <td><u>~</u></td>		,		353.1	1412		38.8	,	•	,		1	•		868	<u>~</u>
tial are VC (12 bar)         -			,	557 Q	-		66.3	1		337.4	131.6	165.3	40.5		49%	2%
Inal LPVC (12 bar)         282.1         21.3         51.4         78.7         21.2         23.6         5.3         158.9         142.9         206.0         48.9         44%         45%           Inal LPVC (12 bar)         282.1         24.0         800.9         27.9         7.8         7.9         7.8         7.9         7				272.0			48.6	;		7.21.7	267.0	360.8	93.8		20%	13%
Paris   Pari				, r	Market .		21.2	1		,	•	,	•	34%	52%	14%
Part   Part	(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)			, t			6,7	٠	•			'			93%	15%
Phase 1.         25.4.4         27.6         92.1.1         564.2         579.5         129.5         268.7         6.1         182.7         164.3         236.9         56.3         44%         45%           ponents         224.4         27.6         921.1         564.2         579.5         46.5         1,400.6         1,259.7         1,815.9         431.3         44%         45%           cotansmission system         48.9         16.6         25.4         6.8         47         6.8         37.2         47.7         52.4         6.8         34%         52%           dia uPVC (12 bar)         -         31.2         10.0         16.5         4.7         7.3         13.1         3.9         50%         54%           sia uPVC (12 bar)         -         31.2         10.9         16.5         5.8         -         7.3         13.1         3.9         50%         54%		000	Ċ	- 0.00			1126		5.3	158.9	142.9		6.84		46%	10%
ponents         2 487.3         4.325.6         4.442.5         992.5         2.059.8         46.5         1,400.6         1,259.7         1,815.9         431.3         44%         46%           to transmission system         48.9         16.6         25.4         6.8         47         6.8         47         52.8         48         52%           dia uPVC (12 bar)         1.0.0         16.5         25.4         6.8         4.7         5.8         4.7         5.8         5.8         54% <td< td=""><td></td><td>202 304.4</td><td>2 4 5</td><td>92.50</td><td>TO LO</td><td></td><td>129.5</td><td></td><td>6.1</td><td>182.7</td><td>164.3</td><td></td><td>56.3</td><td></td><td>46%</td><td>10%</td></td<>		202 304.4	2 4 5	92.50	TO LO		129.5		6.1	182.7	164.3		56.3		46%	10%
Phase 1	Table	2 487 3	2119	7.081.4	4 325 8	4	992.5	7	46.5	1,400.6	1,259.7	<u>"</u>	431.3		46%	10%
to transmission system  to transmission system  dia uPVC (12 bar)  10.0	total for major composeries	2 2 2	2:1	0100			a 750 6	۳		3,506.8				-		
system 48.9 16.6 25.4 6.8 48.9 16.6 25.4 6.8 34% 52% 53% 31.2 10.0 18.5 4.7 5.8 5.8 53% 54.0 5.8 5.8 5.8 5.8 5.8 5.8 5.8 5.8 5.8 5.8	Total phased costs	Phase 1		8,760.0			2007.0	4								
mm dia uPVC (12 bar)	Annual extensions to transmission sy	stem					Ö			0 07	7.00	X 30	8 9		52%	14%
mm dia uPVC (12 bar) - 31.2 10.0 16.5 4.7 - 24.2 7.3 13.1 3.9 54% mm dia uPVC (12 bar) - 36.3 10.9 19.6 5.8 - 24.2 7.3 13.1 3.9 54%		1	,	48.9	,	25.4	9 1 9			4 g	9 6	7 7 7	7 (		1 K	15%
mm dia uPVC (12 bar) - 36.3 10.9 19.6 5.8 - 24.2 7.3 13.1 3.3 3.6.3		i.	'	31.2	<u>-</u>	16.5	4,1	1	'	7 0	9 5	<u> </u>	i e		2000	18%
		ı	'	36.3	***	19.6			-	7.47	. J	į	0.0		2	

verse.
Foreign, local and tex components determined from an analysis of materials, labour and plant requirements for each element, as indicated on Table 5.1

## BILL OF QUANTITIES - Summary

			· •				Feasibility Study
	The Notice of th			ite Shs/US \$		56.0	·
Item	DESCRIPTION	Phase	Phase	Phase 1	Phase 2	Phuse 1	Phase 2
	1	1	2	KShs	KShs	US \$	US S
	Summary						
	Rehabilitation			10,007,200		178,700	-
	Intake			12,551,175		224,128	-
	Raw water pipeline			74,280,400		1,326,436	-
	Treatment plant			53,144,962	39,372,650	949,017	703,083
	Staffhousing			5,925,000	1,975,000	105,804	35,268
	District Offices (168m2@25,000)		1	4,200,000	ŀ	75,000	-
	Reservoirs	]				-	-
	4500 m3	.	1	20,160,000	20,160,000	360,000	360,000
	750 m3		2	10,080,000	6,720,000	180,000	120,000
	400 m3	1 1	2	3,880,000	3,880,000	69,286	69,286
	300 m3	- 1	2		3,040,000	-	54.286
	250 m3		5	1,290,000	6,450,000	23,036	115,179
	200 m3	1	3	1,070,000	3,210,000	19,107	57,32
	150 m3	-	3	-	2,820,000	-	50,357
	100 m3	-	2	-	1,560,000	-	27,857
	Transmission mains			216,729,200	59,305,500	3,870,164	1,059,027
						-	-
	Add for ancillaries and contingencies			61,997,691	22,273,972	1,107,102	397,750
	Add for preliminary items			71,297,344	25,615,068	1.273,167	457,412
and and a to a	Totals	<del> </del>	***************************************	546,612,972	196,382.190	9.760,946	3,506,825





Item	DESCRIPTION	Unit	Quantity	Rate	Amount
1	Intake				
	EXCAVATION				-
	Excavation - pipelines (included in all in rate)	m			-
	Exeavation - Structures	m3	840	350	294,000
	EO for rock	m3	840	1500	1,260,000
	Gabions	m2	- 1	1000	-
	CONCRETE ine formwork and reinforcement		-	2000	101.000
	Blinding 15/20 80mm thick	m3	23	8000	184,000
	Concrete 30/20 base	m3	63	20175	1,271,025
	Concrete 30/20 base	m3	8	20175 20175	161,400 1,371,900
	Concrete 30/20 walls	m3	68	20175	1,571,900
	PIPEWORK		-	20173	_
	1		<u> </u>		_
	The following pipes and fittings	m	23	26000	598,000
	1000 dia steel pipe	ın	16	15300	244,800
	600 dia steel pipe Sluice gate 1000x1000	IM III	10	120000	120,000
		m	1	40000	40,000
	Sluice gate 300x300	1"		70000	-70,000
	Access	$_{\mathrm{m2}}$	17,100	200	3,420,000
	Add for ancillaries	11.00	11,100	200	3,586,050
Total	Intake			1	12,551,175
Total	mary				
2	Rehabilitation works				8,002,400
3	Raw water pipeline 500 dia	m	5,825.00	12752	74,280,400
	Di 1 Dinglian				_
4	Phase 1 Pipelines			ļ	
	Transimission and distsribution mains	ļ	3,800	10251	38,953,800
	400 dia steel pipelins	m m	6,800	8495	57,766,000
	350 steel pipe	""	0,000	0.75	27,700,070
	315 dia uPVC pipelines	m	8,500	4343	36,915,500
	280	m	5,800	3409	19,772,200
	225	m	11,800	2624	30,963,200
	160	m	12,900	1623	20,936,700
	110	$\mathbf{m}$	8,200	1033	8,470,600
	90	m	3,400	868	2,951,200
					- 44,851,800
	Ancillaries and contingencies Preliminaries				51,579,570
Total	Prentminaries		+		395,443,370
	Phase 2 Pipelines				And the second s
					-
	Transimission and distsribution mains				-
	400 dia steel pipelins	m	-	10251	-
	350 steel pipe	m	-	8495	-
	315 dia uPVC pipelines	m		4343	-
	280	m		3409	-
	280	m	7,200	2624	18,892,80
1	160	in	24,900	1623	40,412,70
	100	111	27,700	.025	70,712,10°
	Ancillaries and contingencies				8,895,82
	Preliminaries				10,230,19
Total	Phase 2 Pipelines				78,431,52

Item	DESCRIPTION	Alternative	Full Works	Phase 1 KShs	Phase 2 KShs
	Treatment Plant Summary			KSIISA	121127
	Treatment I have own thrown				
1	Inlet chamber		317,228	317,228	317,228
2	Flocculation Basins		4,340,713		
3	Sedimentation tanks		29,900,328	29,900,328	29,900,328
4	Rapid sond filters		18.054,841		
5	Slow sand Filters	80,880,688			
6	Chlorination building		850,493	850,493	
7	Clear water reservoir		5,785.491	5,785,491	5,785.491
8	Sludge concentrators		7,529,525		
9	Sludge drying beds		8,390,801		
10	Administrative building		3,552,217	3,552,217	
11	Chemical building		2,478,750		
12	Site works		12,739,206	12,739,206	3,369,603
	Total for treatment works		93.939,591	53,144,962	39,372,650
	Equivalent costs in US S @ (Shs/USS)	. 56	1,677,493	949,017	703,083
13	Staff housing (3 or in Phase 1, 1 in Phase 2) 3 or in phase 1			5,925,000	1,975,000
<u> </u>	1 ur in phase 2 Equivalent costs in US \$ (@ (Shv USS)	56	<u> </u>	105,804	35,268









ini i	DESCRIPTION	Unit	Quantity	Rate	Amoun
P1	Inlet Structure				-
l	EXCAVATION				-
	Excavation - pipelines (included in all in rate)	m			-
	Exeavation - Structures	m3	7	350	2,450
	EO for rock	m3	2	1500	3,000
	and the second s		İ		-
	CONCRETE ine formwork and reinforcement	സ്	0.6	8000	4,800
	Blinding 15/20 80nun thick Concrete 30/20 in base slab	m3	2.0	20175	40,350
	do in walls	ຫ3	3.9	20175	78,683
	at II nans	1		i	-
	PIPEWORK			- 1	-
	The following pipes and fittings	nı			51.00
	500 dia valve	иt	1 1	51000 51000	51.00
	500 dia penstock	nr	١ ' إ	31000	31.00
	STEELWORK				-
	Weir plate	ու	1	16000	10,00
		Į.		1	-
	MISCELLANEOUS METALWORK	1	{ 		-
	Handrailing	m	5	2500	12.50
					63,44
otal	Add for ancillaries works Inlet Structure			<del></del>	317,22
utal	IMPLEMENTS		dayakan casara radii		THE SPECIAL PROPERTY OF THE PERSON NAMED IN
172	l-loccultation basins				-
	EXCAVATION	ĺ			-
	Excavation - pipelines (included in all in rate)	m		350	109.90
	Excavation - Structures	m3	314 105	1500	157,50
	EO for rock	m3 m3	103	1300	127,34
	Compacted fill beneath floor	m3	•	l í	•
	CONCRETE ine formwork and reinforcement	1			-
	Blinding 15:20 80mm thick	m3	8.4	8990	67.2
	Concrete 30/20 in base slab	1113	52.3	20175	1,055.1.
	do in walls 500 thick	ա3	58.5	20175	1,180,2
	do in walls 300 thick	т3	17.6	20175	355,0
	j	ļ		1	-
	PIPEWORK	111			_
	The following pipes and fittings	""			-
	600 dia control penstocks	្រាវ	6	50000	300.0
	150 dia drainage penstocks	nr	3	10000	30,0
		1			
	MISCELLANEOUS METALWORK			2500	217,5
	Handrailing	m	87	2500	217,3
					868,1
Total	Add for ancillaries Floccultation basins		1		4.340,
TP3	Sedimentation tank		11 000		T
•			1		
	EXCAVATION		1		
	Excavation - pipelines (included in all in rate)	m	2.00	350	862,-
	Execution - Structures	n:3 n:3	2,464 1,056	1	
	EO for rock	າກນ	1,000	1200	,,,,,,,,
	CONCRETE inc formwork and reinforcement	ļ	ļ		
	Blinding 15/20 80mm thick	ա3	56,4	8000	451,
	Concrete 30/20 in base slab	m3	563.1	1	
	do in walls	m3	370.1		
	1		55.1	20175	1,111,
	PIPEWORK		50	2763	138,
l	150 dia sludge drawoff pipework	iii	1	21500	1
	150 dia sludge drawoff valves	nr m	40		
l	300 dia drainag pipework	111 121		31000	1
	300 dia penstock 500 dia outlet	pr		51000	
	1990 ale marier				
j .	STEELWORK		1		
	Weir plate	item		50000	50
	MISCELLANEOUS METALWORK	]	14	4 2500	360
1	Handrailing	m	"	7 2.100	]
1	Add for ancillaries				5,980

tem	DESCRIPTION	Unit	Quantity	Rate	Amou
TP4	Rapid Sand Filters		<del> </del>		
	EXCAVATION	·			
	Excavation - pipelines (included in all in rate)	m			-
	Exeavation - Structures	m3	798	350	279,30
	EO for rock	m3	532	1500	798,00
	Filter sand	m3	96	2500	240,00
	Gravel	m3	44	2500	110,00
	CONCRETE inc formwork and reinforcement		-	ļ	
	Blinding 15/20 80mm thick	m3	22	8000	176,00
	Concrete 30/20 in base slab	m3	213	20175	4,297,2
	do in walts	m3	238	20175	4,801.6
	PIPEWORK		-	20175	
	The following pipes and fittings				-
	Inlet pipework	m	20	6864	137,2
	Outlet pipework	m	20	6864	137.2
	Backwash pipework	m	30	10251	307,5.
	control valves	nr	12	36000	432,0
	CTUPL WORK		-		-
	STRELWORK Underdrainage system		- 4	250000	1 000 0
	Oracicuanage system	m.	4	250000	1,000,0
	MISCELLANEOUS METALWORK		-		-
	Handrailing	m	72	2500	180,0
	Add for ancillaries		-	į	5.158.53
otal	Rapid Sand Filters		<del> </del>		18.054.84
P5	Slow Sand Filters				
	(design loading rate of 0.15 m/hr) EXCAVATION				
	Excavation - pipelines (included in all in rate)	m	]	i	-
	Exeavation - Structures	m3	9,752	350	2 412 3
	EO for rock	m3	3,251	1500	3,413,2
	Filter sand	m3	3,072	2500	4,876,5 7,680,0
	Gravel	n13	923	2500	2,305,0
	Siture:	m3	923	3,100	2,303,0
	CONCRETE inc formwork and reinforcement	1	[ ]	ì	-
	Blinding 15/20 80mm thick	m3	261	8000	2,088,0
	Concrete 30/20 in base slab	m3	1,626	20175	32,804,5
	do in walls 500 thick	m3	536	20175	10,813,8
			-		-
	PIPEWORK		-		
	The following pipes and fittings	nr	-		-
	Control penstocks	nr	1	41000	41,0
	150 dia drainage penstocks	nr 	1 1	25000	25,0
			-		-
	MISCELLANEOUS METALWORK Handrailing	ns	263	2500	-
	- Action of the Control of the Contr	"		2390	657,5 -
Total	Add for ancillanes Slow Sand Filters				16,176,1
ГР6	Chlorination Building				80,880,6
•	EXCAVATION	1			
	Excavation - pipelines (included in all in rate)	m	_	1	_
	Exeavation - Footings	m3	16	350	5,6
	Excavation - bulk	m3	11	350	3,8
	EO for rock	m3	9	1500	13,5
	COMPRISE in a formation of the Community		-		-
	CONCRUTE inc formwork and reinforcement		- [		-
	Blinding 15/20 80mm thick Concrete 30/20 in footing	m3	3	8000	24,0
	Concrete 30/20 in base slab	m3	4	20175	80,7
	do in walls	]កា3  កា3	7	20175	141,2
	ao m nuits	111.5	6	20175 20175	121,0
	BLOCKWORK (plastering and painting inc.)		_	20112	
	200 Thick blockwork	m	85	1500	127,5
	ROOFING	nr			,-
	GMS rooting	m2	38	3600	136,8
		nr			-
	Add for ancillaries		-		196,2







tem	DESCRIPTION	Unit	Quantity	Rate	Amou
FP7	Clear Water Reservoir				-
	EXCAVATION		i		-
	Excavation - pipelines (included in all in rate)	m	ļ		_
	Execution - Structures	m3	432	350	151,20
	EO for rock	m3	180	1500	270,00
	Embankment	m3	288	500	144,00
					-
	CONCRETE inc formwork and reinforcement		i i	ŀ	=
	Blinding 15/20 80mm thick	m3	9.7	8000	77,60
	Concrete 30/20 in base slab	m3	72.0	20175	1,452,60
	do in walls	m3	77,0	20175	1.553,4
	do in roof slab	m3	30.3	20175	611,30
	PIPEWORK		1	1	-
	The following pipes and fittings				-
	Inlet pipework	m	5	10250	51,2
	Outlet pipework	m	5	10250	51,2
	Overflow	m	20	8495	169,9
	control valves	nr	2	41000	82,0
	Washout pipework	m	5	2763	13,8
	Washout pipework	]"	"	2703	10,0
Cotal	Add for ancillaries Clear Water Reservoir		<del> </del>		1,157,0 5,785,4
P8	Sludge concentrators				2,.00,
110	Siduge concentrators		. 1		
	ENCAVATION				
	Excavation - pipelines (included in all in rate)	ធា		į	
	Exeavation - Structures	m3	366.44	350	128,2
	EO for rock	m3	219.86	1500	329.7
	·	m3	21,,50		
	CONCRETE inc formwork and reinforcement	1			
	Blinding 15/20 80mm thick	m3	14.70	8000	117.0
	Concrete 30/20 in base slab	m3	146.60	20175	2,957,0
	do in walls 300 thick	m3	101.80	20175	2,053,8
			] [		
	PIPEWORK			ļ	
	The following pipes and fittings	nr	1	į	
	draw off pipes	m	4.00	2763	11,0
	Overflow and outlet pipes	m	12.00	3984	47,8
	Control valves	nε	8	26000	208,0
		1			
	MISCELLANEOUS METALWORK		67.06	2500	169.6
	Handrailing	111	67.86	2,500	109,0
	Add for ancillaries				1,505.9
Total	Sludge concentrators				7,529,
TP9	Sludge drying beds				
	EXCAVATION	- 1		i i	
	Excavation - pipelines (included in all in rate)	m		ĺ	
	Excavation bulk	m3	652.68	350	228,
	EO for rock	m3	163.17	1500	244.
	CONCRETE ine formwork and reinforcement	1 .			
	Blinding 15/20 80mm thick	m3	52.30	8000	418,
	Concrete 30/20 in base slab	m3	163.20	20175	3,292,
	do in walls	m3	87.80	20175	1,771,
	do in channels	m3	31.10	20175	627.
	PIPEWORK	1			
	The following pipes and littings	nr			
	handstops	nτ	10	5000	50,
	Outlet	nr	20	3984	79.
	Add for ancillaries				1,678
Total	Sludge drying beds	i i	1	1	8,390,



:m 24	DESCRIPTION	Unit	Quantity	Rate	Amour
_	Administration building				
	EXCAVATION				_
1	Exeavation - pipelines (included in all in rate)	nι			=
- 1	Excavation - Footings	m3	129	350	45,150
	Excavation - floor	m3	150	350	52,500
	EO for rock	m3	39	1500	58,500
					-
	CONCRETE ine formwork and reinforcement				-
	Blinding 15/20 80mm thick	ւր3	15.6	8000	124,800
	Concrete 30/20 in footings	m3	12.9	20175	260,25
	Concrete 30/20 in floor	m3	37.5	20175	756,56
	do in ring beam	m3	6.5	20175	131,13
		m3	-		-
	BLOCKWORK (plastering and painting ine.)			- 1	-
	200 Thick blackwork	m	258.00	1500	387,00
	ROOFING	nr	-		-
i	GMS roofing	m2	182	3600	655,20
					-
					-
					-
-					
	Include for furnishing	nr	0		370,66
	Add for ancillaries				710,44
ılai	Administration building	<del> </del>			3,552.21
P11	Chemical Building	1			-
	(125×8 m)	1			
	EXCAVATION	1			-
	Excavation - pipelines (included in all in rate)	m	[		-
	Excavation - Footings	m3	77	350	26,95
	Excavation - floor	m3	100	350	35,00
	EO for rock	ın3	25	1500	37,50
	CONCRETE inc formwork and reinfereement	İ	{		٠.
	Blinding 15/20 80mm thick	m3	10.8	8000	86,40
	Concrete 30/20 in footings	m3	7.?	20175	155.3-
	Concrete 30:20 in floor	m3	25.0	20175	50-1,33
	do in ring beam	m3	1.0	20175	20,17
	i i i i i i i i i i i i i i i i i i i	m3	"	33.11.	
	BLOCKWORK (plastering and painting inc.)	1"""			]
	200 Thick blockwork	m	258.00	1500	387.00
	ROOFING	nr	1 2000		
	GMS roofing	m2	131	3690	171.60
				30.0	-
					-
	Include for famishing	l <sub>nr</sub>	1 0		258,6
	Add for ancillaries				495,7
otal	Chemical Building		<del> </del>		2,478,7
P12					
		1			
	General site clearance	m2	15,000	50	750,0
	Remove trees girth 1 - 2 m	E) I	2	5000	10,0
	, The state of the		1 .		
	Precast paving slabs	ra2	180	1800	324.0
	Precast manholes	Nr	10	40000	400,0
	PIPEWORK	-	J .		1 .
	The following paper and fittings	nr			
	400 dia pipework	m m	50	16251	512,5
	300 dra pipework	m	75	6864	514,8
	200 dia pipework	m	30	3934	318.7
		1"	"	7/34	
	150 dja drajn	m	200	1100	230,0
	300 dia drain	m	200	3500	1
		l	1 200	1 32.00	7.50,0
	Roads	m2	1,250	350	437,5
			-		-
	Fencing	m	500	1500	750,0
	Gates	nr	2	20000	1 .
	Septic tank and sonkoway	nr	i	100000	1 '
	1	1	.		
	Electricity supply	item	-		6,000,0
			-		
	Add for ancillaries 1B24		<u> </u>	<b></b>	1,661.6
Total	Site works			1	12.739,2





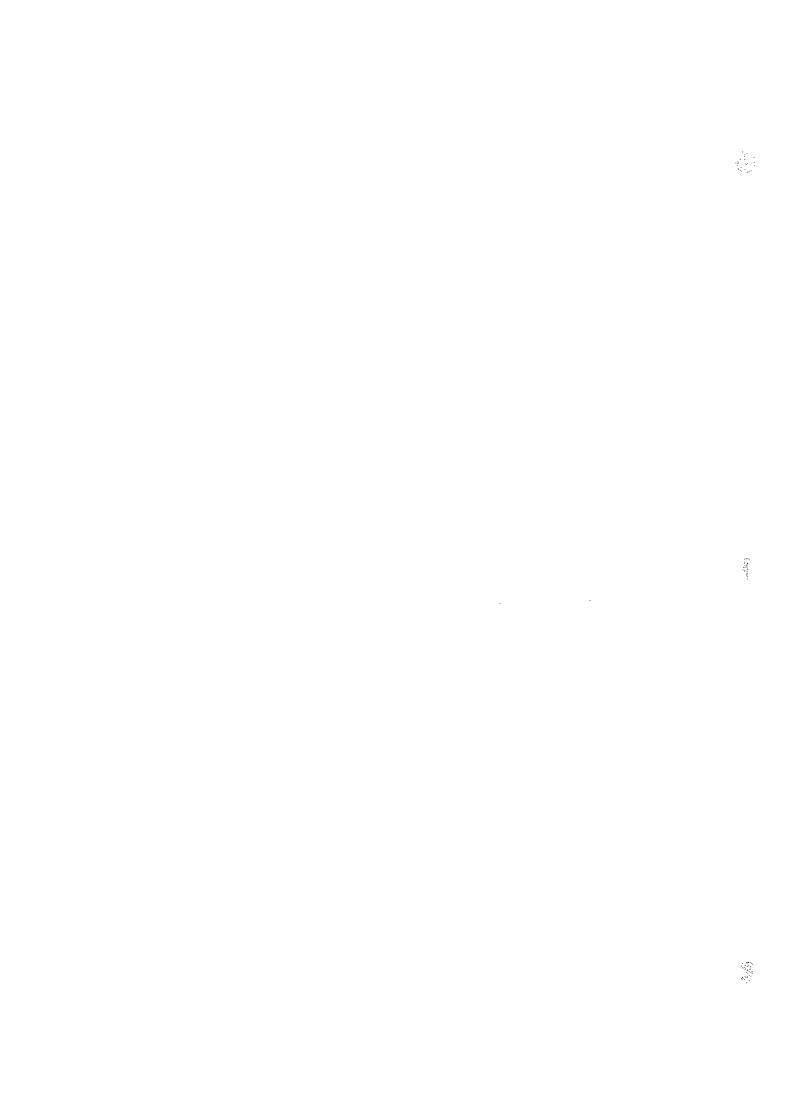




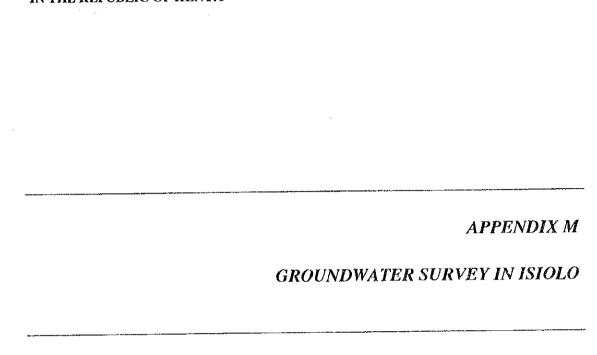
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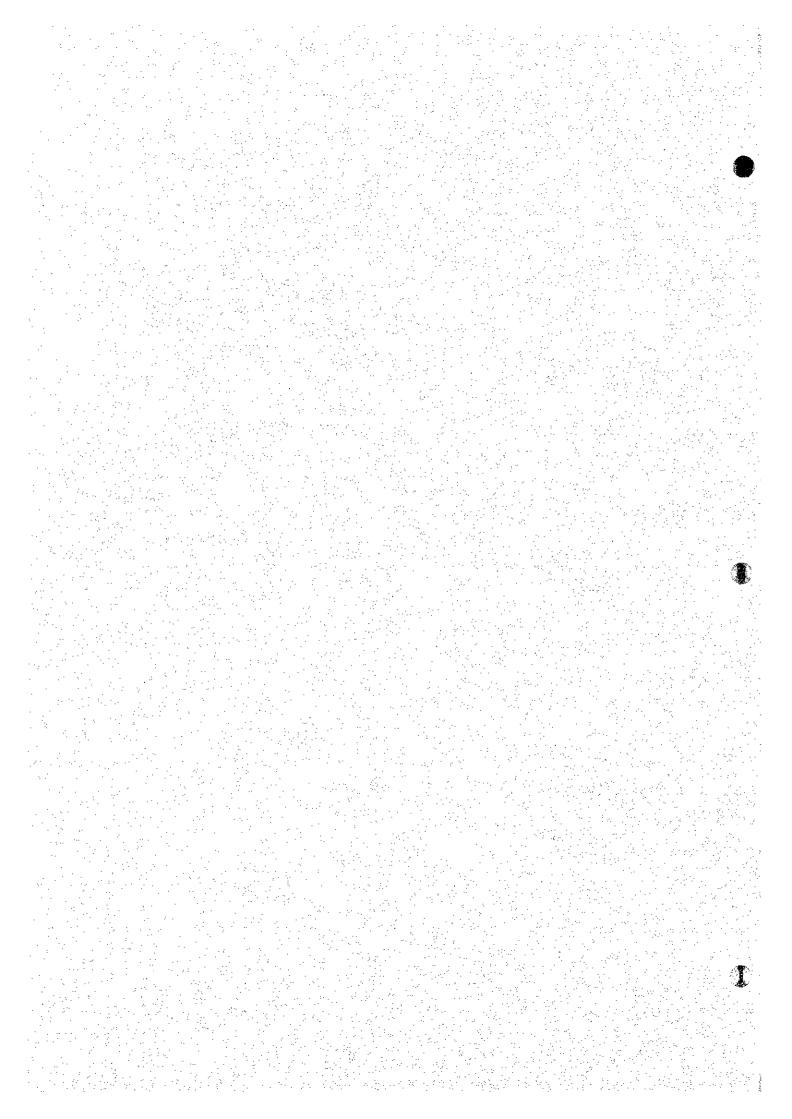


Reservoir Ouantities									<del></del>
					000	COCC	007	500	750
Capacity (m3)	50	100	150	200	nc7	2000	1	3	
			1		U V	Cu	000	250	375
Excavation vol	25	50	75	100	c7	OC.	2004	2003	
Concrete					î	70 77	18 70	22.00	34.05
Floor slab	4.53	6.80	8.31	9.54	11.78	14.60	0.10	20.03	49.00
Walls	4.75	5.85	6.48	6.95	7.74	8.52	87.6	10.00	13.23
Poof + supports	3,90	5.82	60.7	8.13	10.01	12.10	15.83	19.52	7.87
Walve chambers	1.32	1.85	2.19	2.46	2.95	3.49	4.43	5.35	09.
Total cope volume	14.49	20.32	24.07	27.09	32.49	38.36	48.75	58.84	83.59
Reservoir Costs									
Acciming 10% rock excertation									
Technical and the control of the con	12 500	25 000	37.500	50,000	62,500	75,000	100,000	125,000	187,500
Characol	707 707	410 044	485 690	546.451	655,388	773,912	983,489	1 187 001	1,686,369
Concrete	45 730	85.257	78.478	89 468	107,683	127,337	162,523	196.800	281,080
Pipework etc	40,700	100,004	120 224	137 184	165 114	195,250	249,203	301,760	430,990
Site works	70,135	000,000	100,000	115 234	138,696	164.010	209,330	253,479	362,032
Ancillaries	218,80	04,030	148 500	421,605	158.510	187 440	239,234	289,690	413,750
Contingencies	07,328	000,08	020,011	000,101	2,000				
Res'rcosts	250,000	780,000	940,000	1,070,000	1,290,000	1,520,000	1,940,000	2,350,000	3,360,000
Cost per unit of storage volume	volume								
Coetims eforade	11 000	7.800	6.267	5,350	5,160	5,067	4,850	4,700	4,480
COSTING SICH RIGH					STATES OF THE PARTY OF THE PART				



# THE STUDY ON WATER SUPPLY FOR SEVEN TOWNS IN EASTER PROVINCE IN THE REPUBLIC OF KENYA





# APPENDIX M GROUNDWATER SURVEY IN ISIOLO

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### 1 ELECTRIC PROSPECTING

A reconnaissance electrical prospecting survey was conducted in the Isiolo area in order to obtain information on underground soil and geological strata, and to determine the most suitable locations for drilling exploratory wells.

## 1.1 Basic Theory and Implementing Methodology

The Vertical Electric Sounding (VES) method of electrical prospecting was used. As shown in the fugure below, this method uses the Wenner configuration by applying an electric current to the ground at electrodes C1 and C2, and the potential difference is measured from two other electrodes, P1 and P2, located symmetrically from a central point, and equi-distant from C1 and C2 along a straight line. Variations of the potential difference are recorded as the distance between electrodes is gradually increased, keeping them symmetrical from the central point. The apparent resistivity at this central point is calculated from the difference of the measurement between the applied current and the resulting potential difference between electrodes P1 and P2 using the following formula:

$$\rho = 2\pi a \frac{V}{I}$$
where,  $\rho = \text{Apparent resistivity} \qquad (\Omega - m)$ 

$$a = \text{Electrode interval} \qquad (m)$$

$$V = \text{Potential difference} \qquad (mV)$$

$$I = \text{Applied current} \qquad (mA)$$

The illustration of Wenver's Configuration is given in the figure below

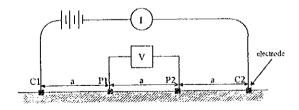


Figure M-1 Illustration of Wenner's Configuration

where, C1, C2 = Current Electrode P1, P2 = Potential Electrode a = Electrode Interval



The instruments used in the prospecting were a resistivity meter, (OYO McOHM model-2115), details of which is given in the table below and a 12V battery for power supply. The current and voltage were read from the digital display of the resistivity meter. For the surveys, 25 VES points were established with 30 measurements at each point, with the electrodes interval raging from 0.5 m to 200 m.

Table M-1 Specification of McOHM (MODEL - 2115)

1)	Transmitter	
	Output voltage	400 Vp-p max.
	Output current	1, 2, 5, 10, 20, 50, 100, 200 mA
	Operating potential	12 V DC
2)	Receiver	
	Input impedance	1 M-Ω
	Measurement potential	±0.6V, ±6V (auto range)
	Resolution	20 micro - V
	Noise reduction ratio	90 dB (with 50/60 Hz power)
	No. of stackings	1, 4, 16, 64 (Stackings can be stopped, as desired)
	Time of one measurement	3.5 sec.
	Cycle	
3)	Power	DC 12 V battery
4)	Operable temperature range	0-50 °C
5)	Dimensions	206 x 281 x 200 mm
6)	Weight	Approx. 7.5 kg

### 1.2 Selection of Inspecting Location

As described in the following section 2.3, data from existing wells around the town of Isiolo was collected and assessed. These wells are partly used for drinking purpose, however the great majority of them are used for irrigation and industrial purposes. Of these wells, saline water is evident, especially in the immediate vicinity and in the northern part of the town, where the alluvial plain prevails. Taking this and following reasons in account, the location for electric inspecting was chosen to be in the southern part of Isiolo.

### (1) Topographic Configuration

Mt. Kenya which is located to the south of Isiolo is the origin of most of the surface and groundwater sources of the peripheral area. The groundwater being



constantly recharged from the high rainfall area around the summit and descends through permeable lava and tuff layers and a part of it reaches near the town of Isiolo. Thus, the more one travels southward, the higher the potential of groundwater.

### (2) Geological Aspect

To the west of Isiolo, deposits of Pre-Cambrian schists and gneisses are found, and deep weathering may not have progressed in these deposits. The potential of groundwater is not therefore generally high in such geological conditions. Whereas, the south and southeastward areas are mainly covered by lava, tuff and tuff breecia of lower Nyambeni volcanic products of Quaternary age, which generally contain a large amount of groundwater in this region.

### (3) Accessibility

VES points are mainly established along the existing roads due to ease of accessibility. When considerably high potential for groundwater has been identified, the water extracted will be transmitted by pipeline for drinking purpose as a part of source water of Isiolo water supply system. The location of VES points are shown in *Figure M-2*.

### 1.3 Results of Surveys

According to the analysis of the p-a curves obtained from the surveys, the under ground strata on each VES point was identified to constitute three to four layers. The first layer consists of weathered surface soil, and the second, basaltic lava of lower Nyambeni volcanic products. The third layer consists of tuff and tuff breccia of lower Nyambeni volcanic products, and the fourth layer, tuff of lower Nyambeni volcanic products or Pre-Cambrian layer.

The apparent resistivity on the VES points is tabulated for each profile line as given in the table shown below. In compliance with the geological configuration and measured apparent resistivities, the third layer is interpreted as an aquifer extending over the fourth layer which is identified as an impermeable layer. This aquifer tends to decrease its thickness towards Isiolo.

The aquifer was found to have a thickness of more than 50 m was at VES points No. 2, 3, 4, 21 and 22 on the profile line No. 1 - No. 22, the VES points No. 8 to 13 on the profile line No. 13 - No. 24 and the VES point No. 16 on the profile line No. 20 - No. 25.

Out of these potential VES points, No. 8, No. 10 and No. 16 were accordingly selected for the exploratory well sites in this Study. The resistivity sections for each profile line is given in *Figure M-3 to M-5*.

Table M-2 Apparent Resistivity on the Profile Line

Profile Line		Apparent Res	sistivity $(\Omega - m)$	
	1st Layer	2 <sup>nd</sup> Layer	3 <sup>rd</sup> layer	4th Layer
No. 1 - No. 22	4 ~ 460	162 ~1360	90 ~ 390	11 ~ 83
No. 24 - No. 13	3 ~ 690	200 ~ 1380	100 ~ 630	18 ~ 190
No. 25- No. 20	4 ~ 310	75 ~ 900	54 ~ 300	30 ~ 190

### 2 GEOLOGY AND HYDROGEOLOGY

### 2.1 Introduction

Following the reconnaissance study of geology in the Study Area as presented in the Interim Report, a detail geological investigation was carried out in the Isiolo area under this Study. The geological investigation mainly consisted of an Electrical Prospecting (Electrical Resistively Survey) and exploratory well drilling followed by a series of pumping tests in the drilled wells.

### 2.2 Regional Geology

Isiolo region is underlain by the following three geological systems; (1)Pre-Cambrian Basement System, (2) Pleistocene Series and (2) Recent Deposits.

Pre-Cambrian Basement System consists of schist and gneiss and this system underlie the area to the west of Isiolo as the geological basement. The system is partly covered by the Colluvium deposit, resulting that the system outcrops discontinuously.

The Pleistocene Series is subdivided into Lower Nyambene Volcanic Series, Upper Kenya Volcanic Series, and Parasitic Volcano in ascending order.

The Lower Nyambone Volcano Series consists of basaltic lava and pyroclastic rocks; and underlies the south-east area of the Study Area including Isiolo town. The Lower Nyambone Volcano Series is the main target geological unit as a possible groundwater resources in this Study as explained later. Upper Kenya Volcanic Series consisting of basaltic lava, underlies the area about 13 km south to Isiolo and covers the Lower Nyambone Volcano Series. Parasitic Volcano consists of volcanic products and outcrop sporadically in the areas more the 10 km to the east of Isiolo.







Colluvium deposit underlies the western area, and alluvium deposit does the northern area of Isiolo. These resent deposits are considered to consist of unconsolidated sand and gravel intercalated by clayey layers.

The regional Geological map in and around Isiolo town is shown in Figure M-6.

### 2.3 Target Geological Unit as the Groundwater Resource

As Pre-Cambrian basement system usually consists of compact hard rocks such as schist and gneiss, the system is not likely to bear groundwater unless it is deeply weathered or highly fractured. Whereas, the Pleistocene volcanic products consisting of lava and pyroclastic rocks (tuff, tuff breecia, volcanic sand etc.) has relatively large porosity, therefore it is likely that the volcanic products bear sufficient groundwater to be developed.

It is believed that the most of the surface and groundwater originate from Mt. Kenya, which is located to the south of Isiolo. It is also believed that being constantly recharged from the high rainfall area around the summit of Mt. Kenya, the groundwater flows from higher elevation toward lower elevation through permeable lava and pyroclastic rocks of Pleistocene volcanic products and a part of the groundwater reaches the areas near Isiolo town. Thus, it is considered that the more south the location is from Mt. Kenya, the higher groundwater potential will be.

### 2.4 Information of the Existing Wells

Figure M-7 and Table M-6 show the locations of the existing wells, their specification and test results, respectively.

An existing well IW5 (C10573) located to the west, was drilled to a depth of 150m but did not reach the Pre-Cambrian basement at the bottom of the well. The drilling record available indicates that the well IW5 was drilled in talus deposit that consists of clay, clayey sand and gravel, and limnological deposit (lake deposit). It is generally understood that this sort of geological constitutions does not form a good aquifer. Whereas, the other existing wells located south of Isiolo, IW6 to IW9 were penetrated in a different type of geological units consisting of volcanic products that are considered to form good aquifers.

Available information of water quality of the existing wells IW1, IW3, IW4 IW5, IW7 and IW8 revealed that the wells IW1, IW3, IW4 and IW5 that are located in the



northern area to an altitude of approximately 1100m, show higher electric conductivity values above 1700-7000  $\mu$ s/cm. On the other hand the existing wells IW7 and IW8 that are located in the southern area to the altitude of approximately 1100m, show lower electrical conductivity values of around 700  $\mu$ s/cm. This information implies that the above-mentioned northern area might bear saline groundwater, whereas the southern area bear fresh groundwater, and that the boundary might exist at the altitude of approximately 1100 m as shown in *Figure M-8*.

### 2.5 Determination of the Locations of Ground Water Development

The review of the geological and hydrogeological information mentioned above are summarized as follows.

- (1) Pre-Cambrian System, and Talus deposit will not bear sufficient groundwater to be developed.
- (2) Pleistocene Lower Nyambene volcanic products might bear sufficient groundwater to be developed.
- (3) The more south a location is from Mt. Kenya, the higher groundwater potential will be.
- (4) However, the northern area of the possible hydrogeological boundary that is located at the altitude of approximately 1100m might bear saline groundwater, whereas the southern area from the boundary might bear fresh water.

Having considered the above information, the Study team resolved that the investigation was therefore to be carried out in the area of Upper Kenya Volcanic Series of Pleistocene Era southern area to Isiolo town as shown in *Figure M-9*.

### 2.6 Exploratory Well Drilling and Pumping Test

(1) Location of Exploratory Wells and Work Quantity

The review of the existing information of drilling and geological investigations, and the electrical resistivity survey carried out in this study all suggest that there is a potential for groundwater development from the tuff breecia strata of the Lower Nyambene Volcanic Products in the area located to the south and south east of Isiolo. Exploratory drilling sites were therefore selected in this area as shown in *Figure M-10*. The detail of the drilling works is as shown in *Table M-4*.







### (2) Method and Drilling Procedure

The drilling works were performed with a drilling rig of DRILL TECH using an air percussion drilling method.

The operation time of the drilling wells is summarized in *Table M-5*. The Table shows that actual drilling operation totaled to approximately 37% in the whole operation between the commencement of a drilling and the demobilization, whereas the works were suspended for approximately 10% of working time due to machine troubles,

The standard working procedure for drilling operation is summarized as follows.

Drilling a hole was commenced with 8 inch drilling bid first to a certain depth. The drilling bid was replaced with 6 inch bid if the geological conditions required so, and drilling was continued to the required depth. Temporary work casing pipe of 8 inch or/and 10 inch were also installed to a hole to protect the drilled hole from caving or collapsing.

Geological log was prepared by observing rock-cuttings ejected from the hole while drilling, and the geological log of each hole is presented in *Figure M-11*, *Figure M-12* and *Figure M-13*.

### (3) Geophysical Logging

The purpose of geophysical logging is to obtain information on the lithological condition and determine the exact location of each aquifer. Gamma-ray logging was carried out as geophysical logging in the well TW1 and TW2. The logging was not carried out in TW3 due to a trouble of the logging equipment. The results of the logging are shown in *Figure M-11* and *Figure M-12*.

### (4) Casing and Screen

Steel pipes of a diameter 6 inch were used as casings for the test wells. The screen installed was of slotted easing pipes; size of a slot is 14cm long, 0.15cm wide; number of the slots is six (6) around a circle and forty two (42) in a casing pipe of 6 m long. Depth of easing pipe to be installed was determined by lithology and geophysical logging to the depths of water bearing formations. The easing pipes were joined by threaded and coupled joints.



The detail schedule of the casing pipes and screen pipes is as shown in *Table M-6*.

### (5) Gravel packing

Sieved gravel of 2mm - 4mm size consisting of volcanic rocks was used for filling the annular space between the casing pipes/slotted screens of the test wells. Above the gravel filling rock-cuttings were filled and on top of the cutting, cement was placed to the ground surface. The detail of gravel packing to the test holes is shown in *Figure M-11*, *Figure M-12* and *Figure M-13*.

### (6) Partial Backfilling of the Test Wells

During the drilling of TW2 and TW3, it was observed that electric conductivity became larger as the drilling progressed deeper. The maximum electric conductivity value reached 2,099 micro-S/cm at the bottom of TW2 and 2,320 micro-S/cm at the bottom of TW3 respectively. It was therefore decided that the bottom part of these two (2) holes be backfilled with cement grout. The detail depths of the backfilling are as shown in *Figure M-12* and *Figure M-13*.

### (7) Development

Development was carried out by airlift method using air pipes that were lowered down to the bottom of a drilled hole and compressed air was continuously sent for about 6 hours down to the bottom through the pipes to blow accumulated cuttings out of the hole until the water became free of sand particles. Thereafter, water was pumped up at a higher pumping rate than normal until the water became clearer.

### (8) Pumping Test

### 1) General

The objectives of the pumping test are to determine the hydraulic characteristics of the water bearing formation, and ascertain the performance of the test well. There are three types of tests involved in a pumping test: the step drawdown test, the time drawdown test, and recovery test. The step drawdown test is performed to evaluate the efficiency of the test well. The time drawdown test and time recovery test are performed to determine the hydraulic properties of aquifer.

Pumping tests were carried out in the three holes TW1, TW2 and TW3 and



the results are summarized in *Table M-7* and in *Figure M-11* and *Figure M-12*.

### 2) Step Drawdown Test

The step drawdown test was performed to ascertain the aquifer behavior at different discharge rates and evaluate the well loss of a well. Test duration of two (2) hours was adopted for one step; relations between yield and drawdown of the rest wells were plotted to estimate 'well loss' and 'aquifer loss' of the wells. The test results are shown in *Figure M-11* and *Figure M-12*. As it can be seen in *Figure M-12*, the maximum discharge of the pump used for the test appeared to be insufficient.

### 3) Time Drawdown and Time Recovery Test

Time drawdown test and Time recovery test were carried out to determine the hydraulic characteristic of aquifers. The time drawdown and time recovery test data were interpreted by Jacob's non-equilibrium equation. The summary of the pumping test analysis is shown in *Table M-7* and Time-Drawdown curves of the test wells are shown in *Figure M-11* and *Figure M-12* and the curves of the existing wells are shown in *Figures M-14* to *M-18*.

### 2.7 Regional Groundwater Behavior

Static groundwater level available from the existing well and the test wells drilled in this study clearly demonstrate that the apparent groundwater elevation gradually decreases from the south area to the north, which is a direct information that the groundwater is being supplied from the south area to the north area.

### 2.8 Recommendation of Pumping Ratio

In this study, the optimum pumping ratio is recommended based on permissible maximum drawdown in a hole<sup>1</sup>.

### (1) Permissible Maximum

Permissible maximum drawdown may be determined from the following two

<sup>&</sup>lt;sup>1</sup> Study with a consideration of water balance among (1)rainfall, (2)runoff, (3)evaporation and (4)recharge to aquifer was not made within the scope of works.

factors.

- Water drawndown level should be kept above the installed submerged pump or the top of the screens in the well.
- Water flow velocity at the entrance of the installed screens must be kept below an allowable level so that sand particles should not be sucked into the well.

For an assessment of the permissible maximum pumping ratio under the factor 1), the following equation is applicable. By using this equation permissible drawdown, Sw that should be above the screens or the pump whichever at a shallower depth, is calculated.

$$Sw = BQ + CQ^2$$

Where,

Sw: Total Drawdown,

Q: Discharge from a Well

B : Aquifer Coefficient

C: Well Loss Coefficient

For an assessment of the permissible pumping rate under the factor 2), the maximum velocity of 3 cm/sec that was empirically determined and is widely accepted for design of wells, is adopted as the permissible velocity at an entrance of screens.

The results of the assessment of permissible maximum pumping rate is shown in *Table M-8*. As can be seen in the table, permissible maximum pumping rate is given as 10 l/sec for TW1 and TW3; 3 l/sec for TW2 respectively.

### (2) Recommended Pumping Rate

### 1) TW-1

It is noted that the permissible maximum discharge estimated from both entrance velocity and drawdown for TW1 is in the same range. If the static water level should be lower than the current level, drawdown might take place below an upper part of the installed screens when the maximum





permissible pumping water of 10 l/sec should be discharged. Furthermore, due to insufficient capacity of the used pump for the test, the well has not experienced discharge more than 5 l/sec approximately. It is therefore prudent that the pumping rate from the well TW-1 should be kept at around 5 l/sec.

### 2) TW-2

Table M-8 indicated that the permissible maximum pumping rate is 3 l/sec. Although sand particles were not observed when approximately 5 l/sec was discharged during the pumping test of TW-2, it is recommended that 3 l/sec should be adopted as the optimum pumping rate for a long term operation of the well TW-2.

### 3) TW-3

The calculation results shown in Table M-8 shows that the permissible maximum discharge of TW-3 is over 10 l/sec. However, because the well TW-3 has not experienced a discharge more that approximately 5 l/sec during the pumping test due to the capacity limitation of the pump, it is considered to be prudent that the maximum pumping ratio from the well should be kept at around 5 l/sec.

The summary of the recommended Pumping Rate from the test wells is as shown below.

Well	Permissible Maximum l	Discharge (l/sec)	Recommended
	Estimated from Entrance	Estimated from	Pumping Rate (l/sec)
	Velocity	Total Drawdown	
TW1	10	10	5
TW2	3	16	3
TW3	10	23	5

It should be noted that the permissible maximum discharge will increase, if openness of screen or the number of casing pipes increases.

### 4) Recommendation

Pumping rate for each well was recommended based on the assessment of entrance velocity and total drawdown. However no consideration has been

given, within the scope of this study, to water balance in a groundwater basin around Isiolo town. It is therefore uncertain if the development of additional groundwater from wells to be constructed might affect the existing well conditions. Thus, a further study is recommended in which water balance is to be analyzed on the basis of information on rainfall, surface runoff, evaporation, and recharge to the groundwater. To facilitate to the further study, long term monitoring of groundwater level in as many wells as possible is strongly recommended.





**TABLES** 

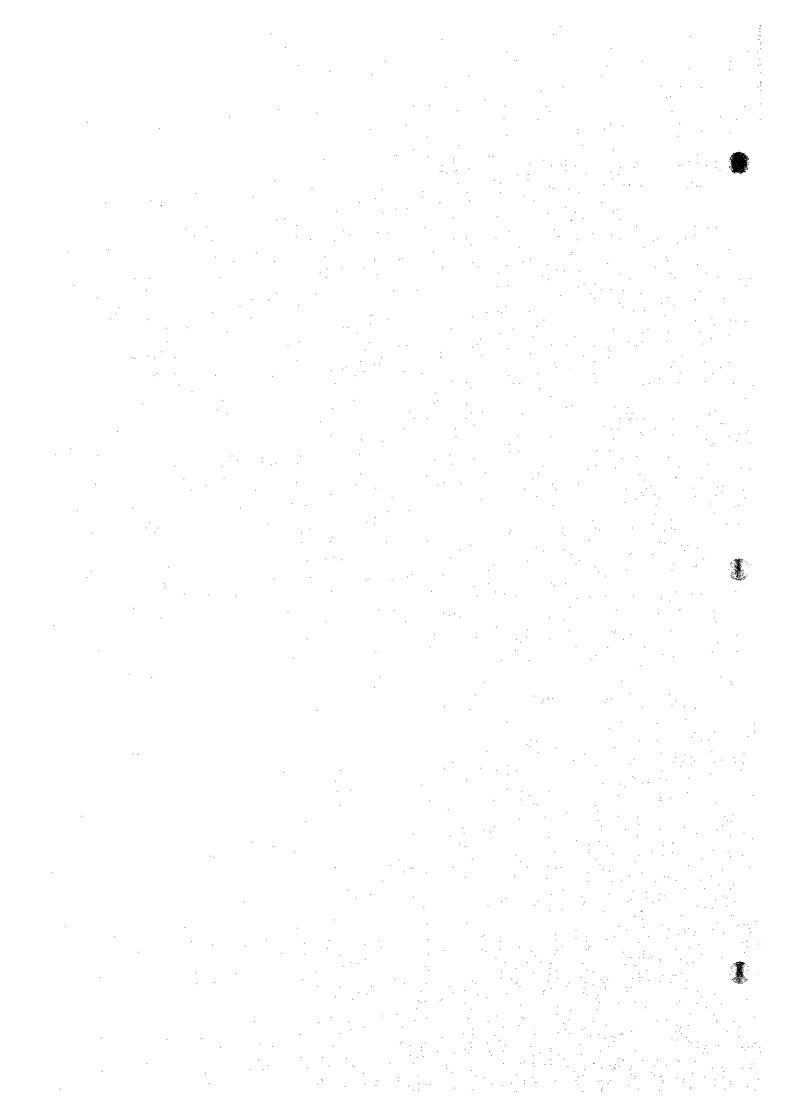




Table M-3 List of Existing Wells in Isiolo Area

		Loation	well Depm	Level Water Level	Levei	Water Level	Rate		
No.	Code		(m)	(mm)	(m)	(m)	(m3/day)	(\mus/cm)	
IW1 C	3-8976	C-8976 Ngare Mara Village	45.7			21.00	750	1700	10-Jan-90
IW2 C	3-7925	C-7925 Ngare Mara River	48.0	, , , ,		19.00	009		26-Oct-89
	3-7927	C-7927 Near 79 Barracks	78.0	1 1 1		15.00	720	1696	25-Sep-89
IW4	2-7924	C-7924 Isiolo Air Strip	184.0	t	, i	18.00	•	7278	31-Jul-89
	:-10573	C-10573 Isiolo Asal Kldp	150.6	152	121.60	132.00	345	1800	5-Dec-93
1W6 C	10558	C-10558 Isiolo Asiamka Farm	101.0	203	33.65	75.50	184		25-Jul-93
IW7 C	.10575	C-10575 Isiolo Barka Farm	82.0	160	14.70	15.48	277	610	6-Oct-93
IW8 C	>10576	IW8 C-10576 Isiolo Barka Farm	106.0	160	23.15	27.82	264	098	27-Nov-96
IW9 C	:-10574	IW9 C-10574 Isiolo Barka Farm	106.0	168	22.23	35.67	230		26-Oct-93

Data Source: NLRRWD

-: Data Not Availale

# Table M-4 List of Test Wells

Well	Well Location	Elevation	Well	Drilling	Diameter	Depth	Screen	ជ	Screen	Static I	Pumping .	Screen Static Pumping Pumping
Š			Completed	Rig			Position	on	Length	Length Water Water	Water	Test
			Date							Level Level	Level	Yeild
		(m)			(mm)	(m)	(m)	(m)	(m) (m)	(m)	(m)	(1/sec.)
TW1	TW1 Ruisi Meru 1254.74	1254.74	7-Mar-93	7-Mar-93 Drill TECH	155	109.70	- 00.79	79.00	12.00 24.71	24.71	38.17	5.28
							85.00	109.00	24.00		:	i i
TW2	TW2 Ruisi Meru	1280.00	16-Mar-93	16-Mar-93 Drill TECH	155	00.96	82.00	94.00	12.00	06.0	13.33	4.90
						(122.00)	(100.00) -	(118.00)	18.00			
TW3	TW3 Ruisi Meru 1262.51	1262.51	23-Mar-93	23-Mar-93 Drill TECH	155	83.00	30.00	36.00	00.9	2.53	6.25	5.38
							42.00	54.00	12.00			
					•		- 00.09	78.00	18.00			
						(120.00)						

Note: \* Elevation data based on the leveling survey
 \* Depth in parenthesis was drilled depth
 \* Depth without parenthesis was final well depth after backfilling.

Carrier S

Table M-5 Operatation Time of Well Drilling

TO SERVICE SER

Well No.	Unit	TW1	TW2	TW3	Total	Total/(12)	Total/(13)
Drilling Depth	(m)	109.7	122.0	120.0			
(1) Site Preparation, Transportation and Assembly of rig	(hrs)	51.5	6.0	7.5	65.0	9.7%	:
(2) Drilling Operation	(hrs)	100.0	46.0	64.5	210.5	31.3%	37.1%
(3) Electrical Logging	(hrs)	4.0	4.0	0.0	8.0	1.2%	1.4%
(4) Instalation of Casing and Screen	(hrs)	22.0	14.0	15.0	51.0	7.6%	%0.6
(5) Gravel Packing and Cementing	(hrs)	1.0	1.0	9.0	11.0	1.6%	1.9%
(6) Development	(hrs)	7.0	7.0	6.0	20.0	3.0%	3.5%
	(brs)	72.0	62.0	72.0	206.0	30.6%	36.3%
(8) Mechanici Trouble	(hrs)	26.5	0.0	35.0	61.5	9.1%	10.8%
(9) Disassemble	(hrs)	12.0	12.0	15.5	39.5	5.9%	:
(10) Transportation	(hrs)	:					
(11) Off Day	(hrs)						
(12) Total<(1)to(11)>	(hrs)	296.0	152.0	224.5	672.5		
(13) Total<(2)to(8)>	(hrs)	232.5	134.0	201.5	568.0		

Table M-6 Schedule of Casing and Screen in Test Wells

				WIZ			WI3	
Don'th Tv	11 July 2	it I enoth	Denth	Type	Unit Length	Depth	Type	Unit Length
	<u>.</u>		(m) - (m)		(m)	(m) - (m)		(m)
(111) = (111)		(111)	10	IQ PI AIN	3.00	١		6.03
	SCREEN SCREEN		118 19 112 08	NA NOR HEN	6.11	i •		6.04
00.00	SCREEK	- 20.7	112.08 - 105.98		6.10	71.39 - 65.34	SCREEN	6.05
			Ė	S SCREEN	:			6.02
777.61	PI AIN		. 1		:	i : 1		6.15
71.50	NHH X	:	; ;			: : 1		6.04
65.40 S.			ŀ		į	١.		6.04
30.0	Z		- 1					6.03
30.	AIN		. 1			ŧ		6.02
53.27 - 47.19 PL	AIN	<del></del>	·		•			6.03
4719 - 4112 PI	Z	•	1		:	٠		6.07
41 12 - 35 06 PE	Z		. •		:	1		6.24
•	AIN		, <b>.</b>		1	1		6.00
28.98 - 22.92 PL	AIN	:	44.98 - 38.88		:	4.701.34		6.04
,	AIN	<del>:</del> -	1			:		: : : : : : : : : : : : : : : : : : : :
٠	AIN	!	1			1		
10.77 - 4.72 PL	AIN		; 1					
4.721.35 PL	AIN		. 4		:		:	1
	•	:	,	1		1	:	1
:		:	8.07 - 1.9	1	; ;			
	:	!	i <b>4</b>	:	Ó	1		
Total SCR	SCREEN	38.17	Tota			Total	SCREEN	30.16
:	N	72.81	Total		88.71	Total	PLAIN	54.64
$\exists$		110.98	TOT	AL	125.33	TOT	V.	84.80
Diameter of casing: 6"						GroundTotal	SCREEN PLAIN	216.16

Diameter of casing: 6" Screen: Slotted casing pipc;

\* a slot of 14cm long and 0.15cm wide; \* 6 slots around a circle, 42 slots in a casiing pipe.

Table M-7 Summary of The Pumping Test

	Transmissivity	<recoverytest></recoverytest>	(m2/day)			52.5					129				;	80				,	126					ı				i			1				Y.	?	
Transmissivity	<jacob td="" timedraw<=""><td>down&gt;</td><td>(m2/day)</td><td>-</td><td></td><td>55.6</td><td></td><td></td><td></td><td> •</td><td>129</td><td></td><td></td><td></td><td>-</td><td>76</td><td></td><td>_</td><td></td><td>1</td><td>105</td><td></td><td></td><td></td><td>· ·</td><td>7.7</td><td></td><td></td><td></td><td>417</td><td></td><td></td><td>24.1</td><td></td><td></td><td></td><td></td><td>3</td><td></td></jacob>	down>	(m2/day)	-		55.6				•	129				-	76		_		1	105				· ·	7.7				417			24.1					3	
Ratio of Well	Loss	(CQ2)/(BQ+CQ2	(%)	34.8	16.4	25.2	31.0		16.1	pad pad	12.6	13.8	16.1	60.7	47.8	55.7	583	61.1		1				: .			1		1								:: : : /		
lotal	Drawdow	Q	(m)	13.53	3.88	7.44	10.75	13.02	15.79	9.70	11.45	12.86	15.79	4.83	2.14	3.48	4.12	4.95		<del>-</del>				;	· · ·				:			:	!	·· <del>·</del>					
Weil	Loss	(CxQ2)	(w)	4.71	0.64	1.87	3.33	4.45	2.54	1.07	1.45	1.78	2.54	2,92	1.02	194	2.40	3.03						1 :	1			-   -				!	:						
Aquiter	Sso	(BxQ)	(m)	8.82	3.24	5.56	7.42	8.57	13.25	8.63	10.00	11.09	13.25	1.89	1.12	1.54	1.72	1.93											:		;	-	i	:					i :
	Well Loss	Coeffient	O	0.17	0.17	0.17	0.17	0.17	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.10	0.10							:		1				: 			:	i : :		· !	:	
Aguiter	Loss	Coeffient	<u></u> М	1.67	1.67	1.67	1.67	1.67	2.70	2.70	2.70	2.70	2.70	0.35	0.35	0.35	0.35	0.35			1					:			:				 		: : : : : : : : : : : : : : : : : : : :		. :	!	
		O/wS	(s/I/m)	2.55	1.98	2.87	2.49	2.50	2.54	3.04	3.09	2.87	2.47	1.16	0.51	0.65	0.67	0.64	33.01	! ! !				13.36	14.24	12.89	15.40	256		1	· ·	9.12	13.30	1 3 0 1		35.45	38.57	32.67	
	Specific	Capacity	(I/sec/m)	0.39	0.50	0.35	0.40	0.40	0.39	0.33	0.32	0.35	0.40	98.0	. 1.96	1.54	1.50	1.56	0.03					0.07	0.07	0.08	0.07	95 ()	) 	!		0.11	0.08	] ] :	:	0.03	0.03	0.03	
	Drawdow	n(Sw)	(E)	13.46	3.85	9.55	11.05	12.85	12.43	9.70	11.45	11.78	12.12	6.25	1.63	2.86	3.26	3.52	132.05	     		i ! !		35.67	24.20	29.27	35.67	13.46			:	27.82	24.20	72.00		75.50	51.30	28.80	
	Discharge		(I/sec)	5.28	1.94	3.33	44.4	5.13	4.90	3.19	3.70	4.10	4.90	5.40	3.20	4.40	4.90	5.50	4.00		!	· · · · · · · · · · · · · · · · · · ·		2.67	1.70	2.27	2.65	\$ 28		!		3.05	1.82	04.4	:	2.13	1.33		
	Statistic	Water Level	(E)	24.71	23.72		:		06.0	000			:	2.53	2.24		:	1	116.16		:			15.88				7471			:	21.94				31.74	:		
		TestTvpe		U	ST-1	ST-2	ST-5	ST-4	U	ST-1	ST-2	ST-3	ST-4	U	ST-1	ST-2	ST-3	ST-4	Ü	ST-1	ST-2	ST-3	ST-4	Ü	ST-1	ST-2	ST-3	4 7	ST-TS	ST-2	ST-3 ST-4	Ü	ST-1	7-18	. 4.T.S	ن	ST-1	ST-2	ST-4 ST-4
		Well No.				T.W.1					: TW2		:			: Tw3		!		í : : :	C10573	:		-		C10574			•	C10575	· · · · · · · · · · · · · · · · · · ·			2/2017				C10558	

Table M-8 Estimation of Permissible Pumping Rate

Well No.	Discharge(Q)	Permissible Entrance Velocity	Estimated Entrance Velocity	Aquifer Loss Coefficient	Well Loss Coefficient	Aquifer Loss (BxQ)		Total Drawdow n(BQ+CQ 2)	Distance between Static Water Level and Screen or Pump
!	(I/sec)	(cm/sec)	(cm/sec)	. В	: : c	(m)	(m)	! (m)	(m)
	1.00	<del></del>	0.29	1,67	0.17	5.88	0.17	6.05	
	2.00		0.58	1.67	0.17	3.34	0.68	4.02	
	3.00		0.88	1.67	0.17	5.01	1.52	6.53	
	4.00	:	1.17	1.67	0.17	6.68	2.70	9.39	
	5.00		1.46	1.67	0.17	8.36	4.23	12.58	
	6.00	<del></del>	1.75	1.67	0.17	10.03	6.08	16.11	
	7.00	<del></del> :	2.05	1.67	0.17	11.70	8.28	19.98	
TW1	8.00		2.34	1.67	0.17	13.37	10.82	24.18	
	9.00	.;	2.63	1.67	0.17	15.04	13.69	28.73	
	10.00	3.00	2.92	1.67	0.17	16.71	16.90	33.61	40.29
	12.00	glūtis z mysiki sis i	3.51	1.67	0.17	20.05	24.34	44.39	
	14.00	· · · · · · · · · · · · · · · · · · ·	4.09	1.67	0.17	23.39	33.12	56.52	
	16.00	·	4.68	1.67	0.17	26.74	43.26	70.00	• - i
	18.00	<del>:</del> :	5.26	1.67	0.17	30.08	54.76	84.83	;
	20.00		5.85	1.67	0.17	33.42	67.60	101.02	
	1.00	;	0.93	2.70	0.11	2.70	0.11	2.81	
	2.00		1.85	2.70	0.11	5.41	0.42	5.83	
	3.00	3.00	2.78	2.70	0.11	8.11	0.95	9.06	
	4.00	1.22.7.07.22.2	3.70	2.70	0.11	10.82	1.69	12.51	<del> </del>
1'W2	5.00		4.63	2.70	0.11	13.52	2.64	16.16	<b>.</b>
1 17 2	6.00		5.56	2.70	0.11	16.22	3.80	20.03	
	7.00	<u>-</u>	6.48	2.70	0.11	18.93	5.17	24.10	
	8.00		7.41	2.70	0.11	21.63	6.76	28.39	· •
	9.00	· · · · · · · · · · · · · · · · · · ·	8.33	2.70 . 2.70	0.11	24.34	8.55	32.89	<u> </u>
	10.00		9.26	2.70	0.11	: 27.04	10.56	37.60	
	12.00		11.11	2.70	0.11	32.45	15.21	47.65	
	14.00	<del></del>	12.96	2.70	0.11	37.86	20.70	58.55	
	16.00		14.81	2.70	0.11	43.26	27.03	70.30	79.91
	18.00	<u>-</u>	16.67	2.70	0.11	48.67	34.21	82.89	1.7.71 
	20.00		18.52	2.70	0.11	54.08	42.24	96.32	
	1.00		0.31	0.35	0.11	10.00	0.10	10.10	ı
								1.10	· :
	2.00		0.62	0.35	0.10	0.70	0.40 0.90		<u>.</u>
	3.00 4.00		1.23	0.35	0.10	1.05	1.60	1.95 3.00	i
				- ;	7			+	ļ
	5.00		1.54	0.35	0.10	1.75	2.50	4.25	<u></u>
	6.00		1.85	0.35	0.10	2.10	3.60	5.70	<u>i</u>
TNI	7.00		2.16	0.35	0.10	2.45	4.90	7.35	
TW3	8.00	.:	2.47	0.35	0.10	2.80	6.40	9.20	!
	9.00	TOTAL SAFETY	2.78	0.35	0.10	3.15	8.10	11.25	: :
	10.00	3.00	3.09	0.35	0.10	3.50	10.00	13.50	1
	12.00		3.70	0.35	0.10	4.20	14.40	18.60	ļ · · · ·
	14.00		4.32	0.35	0.10	4.90	19.60	24.50	
	16.00		4.94	0.35	0.10	5.60	25.60	31.20	ļ ·- · - ·
	18.00		5.56	0.35	0.10	6.30	32.40	38.70	· · · · · · · · · · · · · · · · · · ·
	20.00	.:	6.17	0.35	0.10	7.00	40.00	47.00	
	21.00	:	6.48	0.35	0.10	7.35	44.10	51.45	<del></del>
	22.00		6.79	0.35	0.10	7.70	48.40	56.10	
	23.00		7.10	0.35	0.10	8.05	52.90	60.95	63.00
	24.00		7.41	0.35	0.10	8.40	57.60	66.00	<u>:</u>

