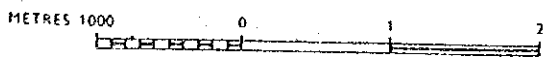


from Ragati River

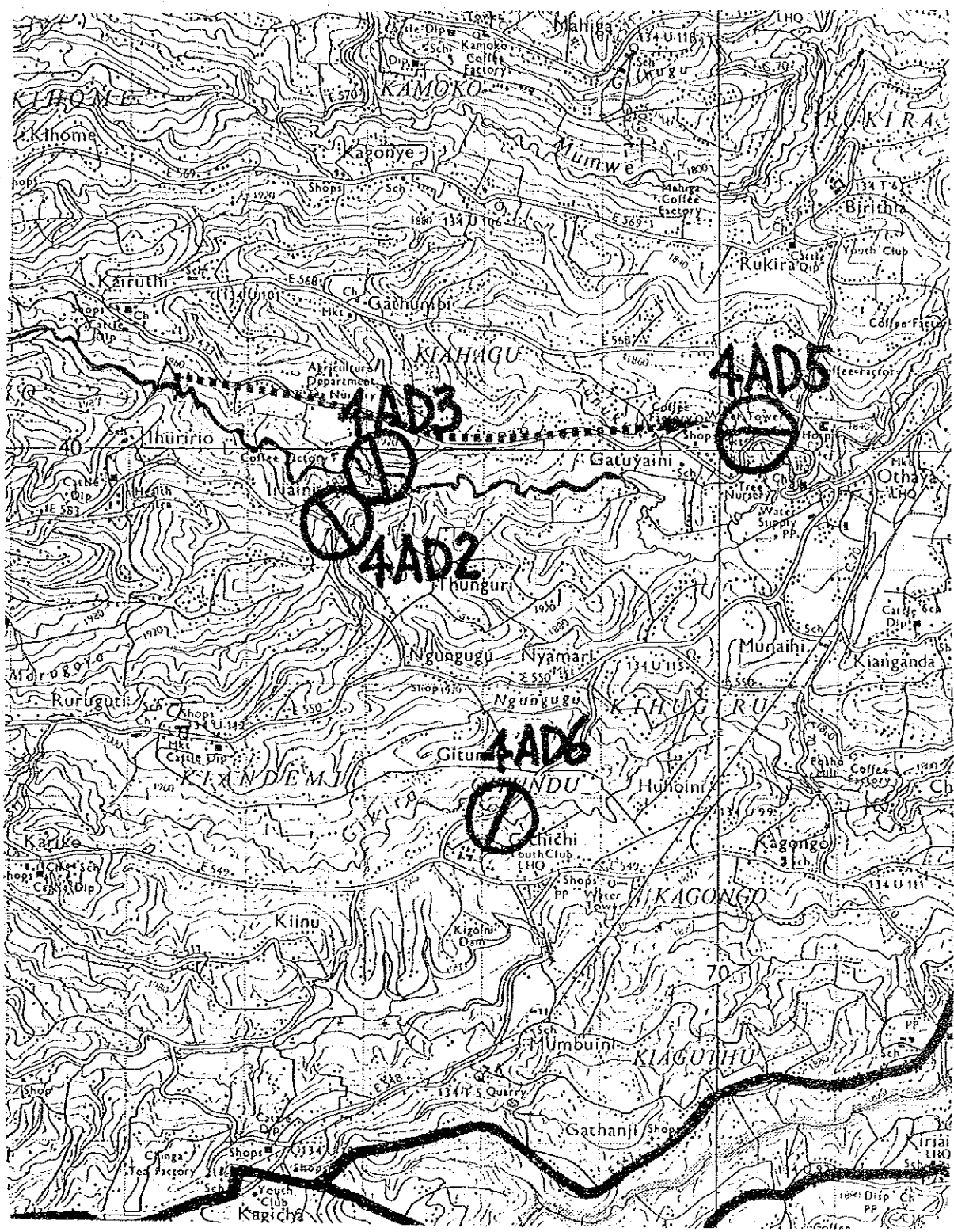
U- 20 Karatina

U 254.2 121/3 4BA



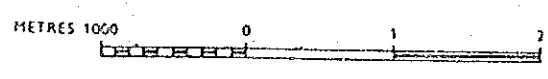
THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i
2					National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92
4	Code No.	250	U- 21			Rate		25.2
5	-----							
6	Name of Urban:		Othaya		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 (guess):							
9	District:		Nyeri	Location :	256.1 Kilims			
10	Map (1/50,000) :		134/2	Coordinates X:	36°57'		Y:	S 00°32'
11	Sub-basin Code:		4AD	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Gikira R.			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)	250			
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		4,800	10,900	18,400	
22	Residential Demand		(m3/d)		595	1,380	2,381	
23	Non-residential Demand		(m3/d)		99	224	380	
24	Livestock Demand		(m3/d)		8	19	35	
25	Industrial Demand		(m3/d)		0	0	0	
26	Total Demand		(m3/d)		702	1,623	2,796	
27	Area Served (estimated net)		(ha)		36	81	137	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Tuthi river			River No:		
31	Raw Water System:		H (m)=	0 L (m)=	5,000			
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		451.6	921.6	1,172.3	2,545.5
37	Source Works		(US\$'000)		5.8	10.0	11.9	27.7
38	Pump Cost		(US\$'000)		0.0	0.0	0.0	0.0
39	Raw Water Main		(US\$'000)		210.7	233.5	243.6	687.8
40	Treatment		(US\$'000)		271.8	437.8	463.1	1,144.7
41	Storage		(US\$'000)		46.5	70.3	80.0	196.8
42	Distribution		(US\$'000)		286.8	364.4	448.1	1,099.3
43	Miscellaneous (20%)		(US\$'000)		164.3	217.2	249.7	631.3
44	Admi. & Engineering		(US\$'000)		98.6	130.3	149.8	378.8
45	Contingency		(US\$'000)		216.9	286.7	329.7	833.3
46	Total Cost		(US\$'000)		1,301.4	1,720.2	1,978.0	4,999.6
47	Cost per Capita		(US\$/c)		271.1	282.0	263.7	
48	Cost per ha		(US\$/ha)		36,304.1	37,762.0	35,315.4	
49	Cost per m3		(US\$/m3)		2.9	1.9	1.7	2.0
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		63.1	86.0	98.9	
53	Capital Costs		(US\$'000)		134.0	177.2	203.7	
54	Total Annual Cost		(US\$'000)		199.1	263.2	302.6	
55	Unit Cost per m3		(US\$/m3)		1.2	0.3	0.7	
56	-----							
57	Remarks:							
58								
59								
60								
61								
62								
63	-----							



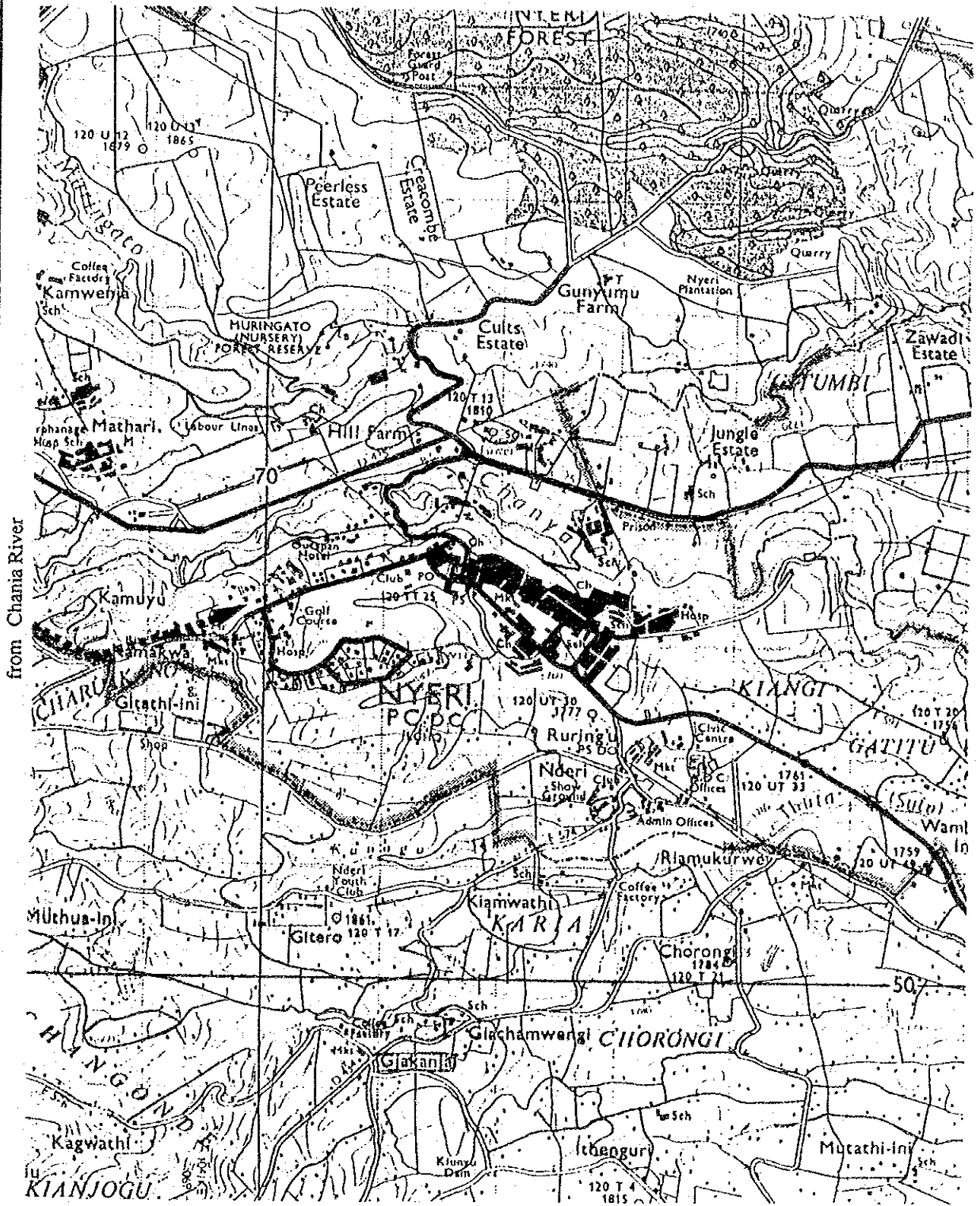
U- 21 Othaya

U 256.1 134/2 4AD



THE STUDY
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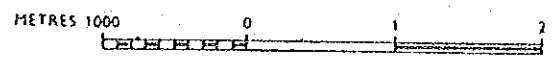
a	b	c	d	e	f	g	h	i
2					National Water Master Plan			
3			URBAN WATER SUPPLY				Feb-92	
4	Code No. 250		U- 22			Rate		25.2
5	-----							
6	Name of Urban:		Nyeri		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 (guess):							
9	District:		Nyeri	Location :	257 Nyeri Municipality			
10	Map (1/50,000):		120/4	Coordinates X:	36°56'		Y:	S 60°24'
11	Sub-basin Code:		4AC	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Chania River			River No:		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)	5890			
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		97,000	218,600	370,700	
22	Residential Demand		(m3/d)		12,016	27,680	47,959	
23	Non-residential Demand		(m3/d)		2,010	4,530	7,682	
24	Livestock Demand		(m3/d)		167	389	715	
25	Industrial Demand		(m3/d)		1,366	2,443	3,362	
26	Total Demand		(m3/d)		15,559	35,042	59,718	
27	Area Served (estimated net)		(ha)		724	1,632	2,768	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Chania River			River No:		
31	Raw Water System:		H (m)=	0 L (m)=	4,100			
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		9,668.9	19,483.4	24,676.1	53,828.3
37	Source Works		(US\$'000)		58.0	98.2	117.2	273.4
38	Pump Cost		(US\$'000)		0.0	0.0	0.0	0.0
39	Raw Water Main		(US\$'000)		359.5	485.5	544.4	1,389.4
40	Treatment		(US\$'000)		1,161.4	1,982.4	2,510.8	5,654.6
41	Storage		(US\$'000)		416.4	839.1	1,062.7	2,318.2
42	Distribution		(US\$'000)		5,795.1	7,264.8	9,087.0	22,146.9
43	Miscellaneous (20%)		(US\$'000)		1,558.1	2,134.0	2,564.4	6,356.5
44	Admi. & Engineering		(US\$'000)		934.9	1,280.4	1,598.6	3,813.9
45	Contingency		(US\$'000)		2,056.7	2,816.9	3,517.0	8,390.6
46	Total Cost		(US\$'000)		12,340.2	16,901.3	21,102.2	50,343.7
47	Cost per Capita		(US\$/c)		127.2	139.0	138.7	
48	Cost per ha		(US\$/ha)		17,035.3	18,611.7	18,577.9	
49	Cost per m3		(US\$/m3)		1.5	0.9	0.9	0.9
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		617.0	845.1	1,055.1	
53	Capital Costs		(US\$'000)		1,271.0	1,740.8	2,173.5	
54	Total Annual Cost		(US\$'000)		1,888.0	2,585.9	3,228.6	
55	Unit Cost per m3		(US\$/m3)		0.5	0.4	0.4	
56	-----							
57	Remarks:							
58								
59								
60								
61								
62								
63	-----							



from Chania River

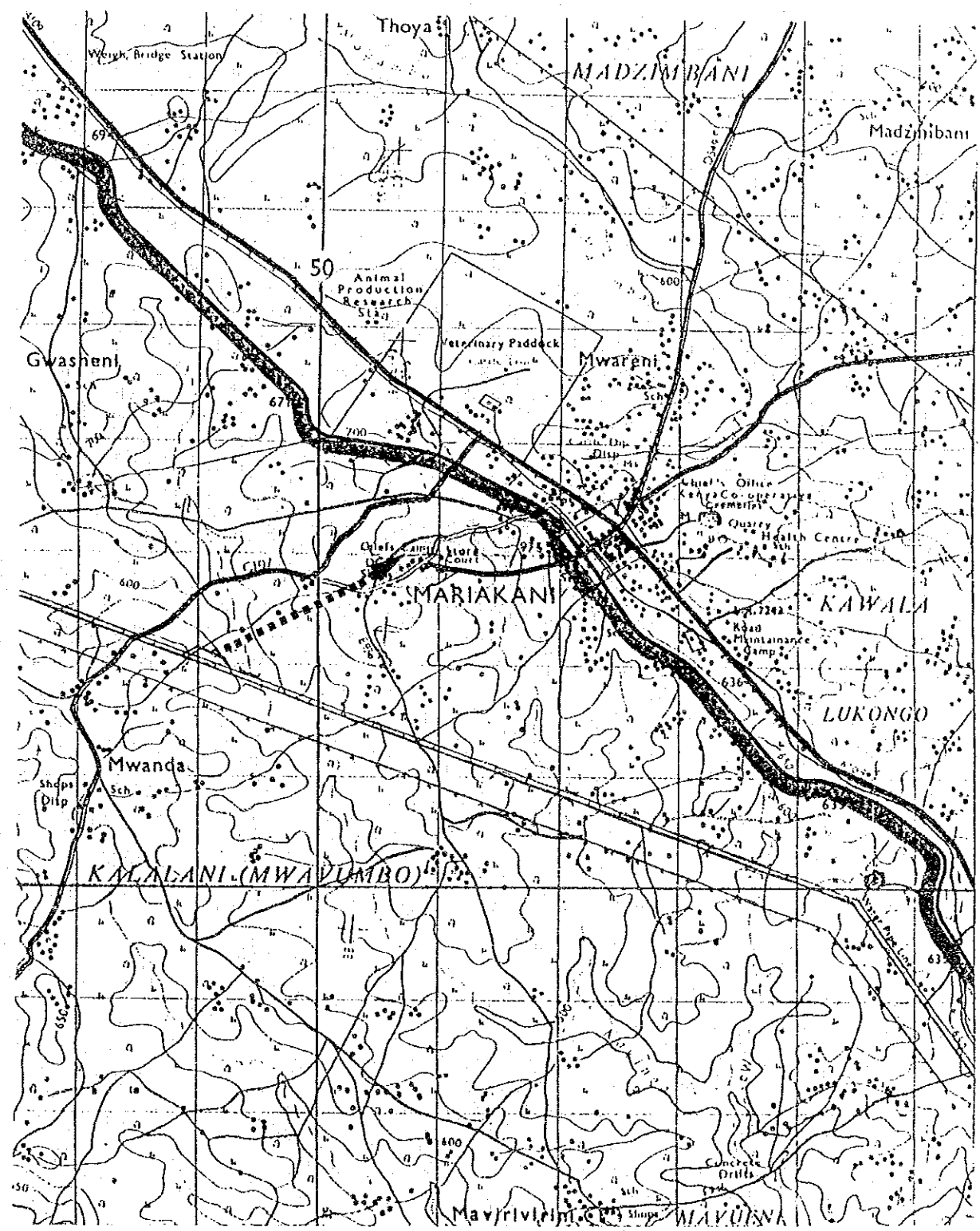
U- 22 Nyeri

G 257.0 120/4 4AC



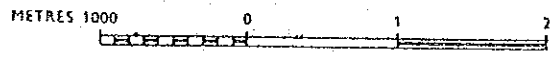
THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
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a	b	c	d	e	f	g	h	i	
2	National Water Master Plan								
3	URBAN WATER SUPPLY								
4	Code No. 310	U- 23	Rate			Feb-92 25.2			
5	-----								
6	Name of Urban:	Mariakani	LGL Notice No:						
7	Organization:								
8	Per Capita GRDP in 1988 (guess):								
9	District:	Kilifi	Locataion :	311.3 Mariakani					
10	Map (1/50,000) :	197/4	Coordinates X:	39°22'		Y:	S 03°49'		
11	Sub-basin Code:	3MB	Elevation (El. m):						
12	-----								
13	Existing Facilities								
14	Raw Water Source:	Mzima pipeline	River No						
15	Raw Water System:	H (m)=	L (m)=						
16	Treatment:	Capacity (m3/d)		650					
17	Distribution System:								
18	-----								
19				1990	2000	2010			
20	-----								
21	Projected Population	(no)		7,600	19,500	33,100			
22	Residential Demand	(m3/d)		941	2,469	4,282			
23	Non-residential Demand	(m3/d)		158	403	686			
24	Livestock Demand	(m3/d)		9	22	37			
25	Industrial Demand	(m3/d)		2,846	4,624	5,497			
26	Total Demand	(m3/d)		3,954	7,518	10,502			
27	Area Served (estimated net)	(ha)		57	146	247			
28	-----								
29	Future Development Plan								
30	Raw Water Source:	2nd Mzima P/L		River No:			2,400		
31	Raw Water System:	H (m)=	0 L (m)=						
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost			1990	2000	2010		Total	
36	Incremental Capacity	(m3/d)		3,304.5	3,563.7	2,984.1		9,852.3	
37	Source Works	(US\$'000)		25.9	27.5	24.0		77.4	
38	Pump Cost	(US\$'000)		0.0	0.0	0.0		0.0	
39	Raw Water Main	(US\$'000)		147.9	151.0	143.9		442.7	
40	Treatment	(US\$'000)		0.0	0.0	0.0		0.0	
41	Storage	(US\$'000)		142.3	153.5	123.7		419.5	
42	Distribution	(US\$'000)		454.1	710.9	812.5		1,977.5	
43	Miscellaneous (20%)	(US\$'000)		154.0	208.6	220.8		583.4	
44	Admi. & Engineering	(US\$'000)		92.4	125.1	132.5		350.1	
45	Contingency	(US\$'000)		203.3	275.3	291.5		770.1	
46	Total Cost	(US\$'000)		1,219.9	1,651.9	1,748.9		4,620.7	
47	Cost per Capita	(US\$/c)		160.5	138.8	128.6			
48	Cost per ha	(US\$/ha)		21,494.3	18,588.1	17,219.8			
49	Cost per m3	(US\$/m3)		0.4	0.5	0.6		0.5	
50	-----								
51	Present Value of Water at DF=10 %			1990	2000	2010		Total	
52	Direct O & M Costs	(US\$'000)		61.0	82.6	87.4			
53	Capital Costs	(US\$'000)		125.7	170.1	180.1			
54	Total Annual Cost	(US\$'000)		186.7	252.7	267.6			
55	Unit Cost per m3	(US\$/m3)		0.2	0.2	0.2			
56	-----								
57	Remarks:								
58									
59									
60									
61									
62									
63	-----								



U- 23 Mariakani

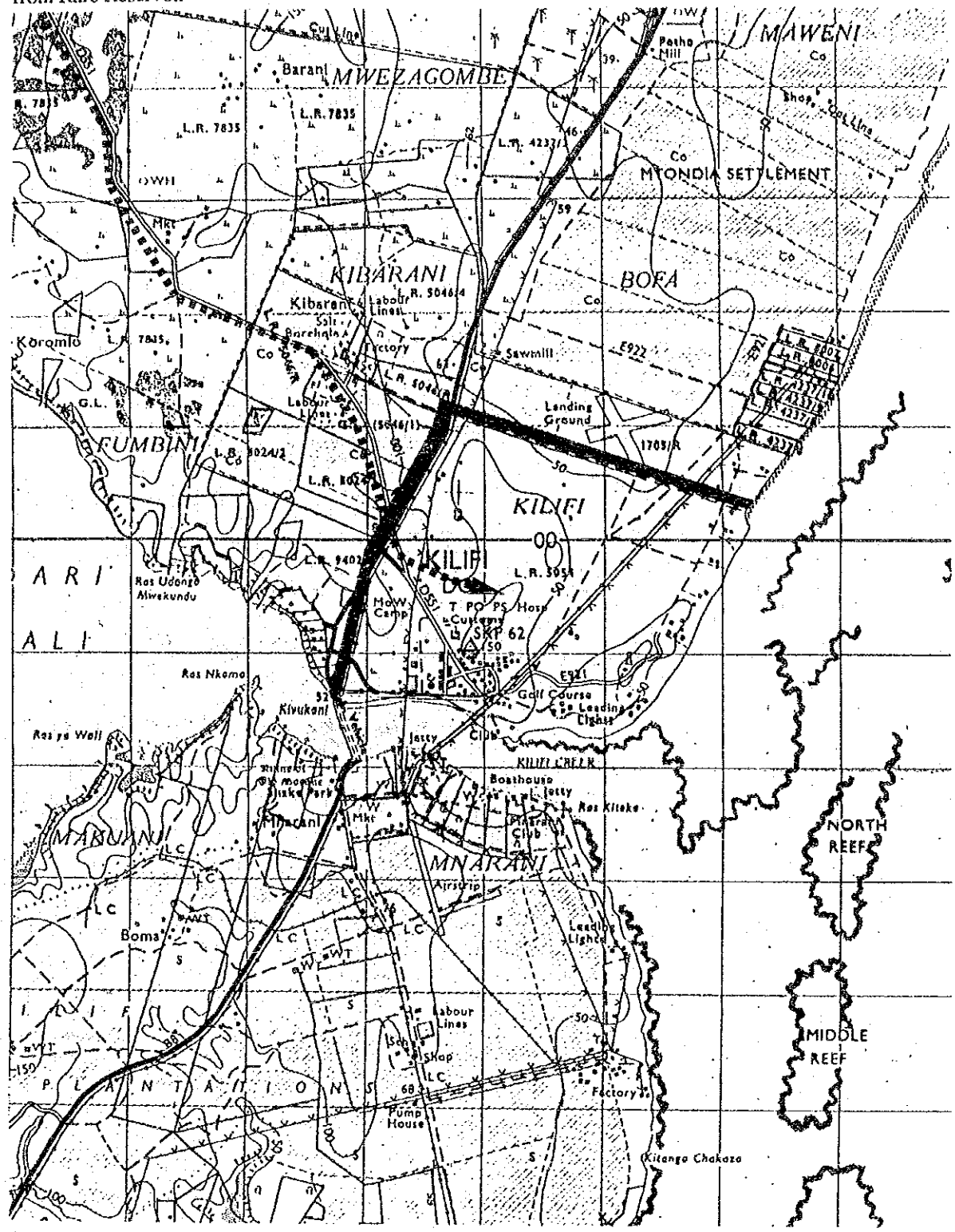
U 311.2 197/4 3MB



THE STUDY
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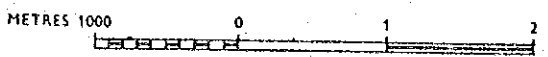
a	b	c	d	e	f	g	h	i	
2						National Water Master Plan			
3					URBAN WATER SUPPLY			Feb-92	
4	Code No.	310	U- 24			Rate		25.2	
5	-----								
6	Name of Urban:		Kilifi		LGL Notice No:				
7	Organization:								
8	Per Capita GRDP in 1988 (guess):					313.2 Tezo			
9	District:		Kilifi	Locataion :					
10	Map (1/50,000):		198/2	Coordinates X:		39°50'	Y:	S 03°37'	
11	Sub-basin Code:		3LA	Elevation (El. m):					
12	-----								
13	Existing Facilities								
14	Raw Water Source:		Sabaki pipeline			River No			
15	Raw Water System:		H (m)=	L (m)=					
16	Treatment:			Capacity (m3/d)		2450			
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population		(no)			12,500	32,000	54,500	
22	Residential Demand		(m3/d)			1,548	4,052	7,051	
23	Non-residential Demand		(m3/d)			259	663	1,128	
24	Livestock Demand		(m3/d)			15	35	60	
25	Industrial Demand		(m3/d)			297	538	755	
26	Total Demand		(m3/d)			2,119	5,288	8,994	
27	Area Served (estimated net)		(ha)			93	239	407	
28	-----								
29	Future Development Plan								
30	Raw Water Source:		Rare reservoir			River No:			
31	Raw Water System:		H (m)=	70 L (m)=			13,900		
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity		(m3/d)			0.0	2,838.0	3,705.9	6,543.9
37	Source Works		(US\$'000)			0.0	23.1	28.3	51.4
38	Pump Cost		(US\$'000)			0.0	6.9	7.2	14.1
39	Raw Water Main		(US\$'000)			0.0	822.4	884.1	1,706.5
40	Treatment		(US\$'000)			0.0	729.2	823.6	1,552.8
41	Storage		(US\$'000)			0.0	121.3	133.7	255.0
42	Distribution		(US\$'000)			0.0	1,165.0	1,344.2	2,509.2
43	Miscellaneous (20%)		(US\$'000)			0.0	573.6	644.2	1,217.8
44	Admi. & Engineering		(US\$'000)			0.0	344.2	386.5	730.7
45	Contingency		(US\$'000)			0.0	757.1	850.4	1,607.5
46	Total Cost		(US\$'000)			0.0	4,542.9	5,102.3	9,645.1
47	Cost per Capita		(US\$/c)			0.0	233.0	226.8	
48	Cost per ha		(US\$/ha)			0.0	31,195.6	30,365.5	
49	Cost per m3		(US\$/m3)			0.0	1.6	1.4	1.5
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)			0.0	227.1	255.1	
53	Capital Costs		(US\$'000)			0.0	467.9	525.5	
54	Total Annual Cost		(US\$'000)			0.0	695.1	780.6	
55	Unit Cost per m3		(US\$/m3)			0.0	0.7	0.6	
56	-----								
57	Remarks:	Source works does not include the cost of Rare reservoir, which should be added separately							
58		(see Sectoral Report M)							
59		Alternative water source will be the extension of Sabaki pipeline.							
60									
61									
62									
63	-----								

from Rare Reservoir



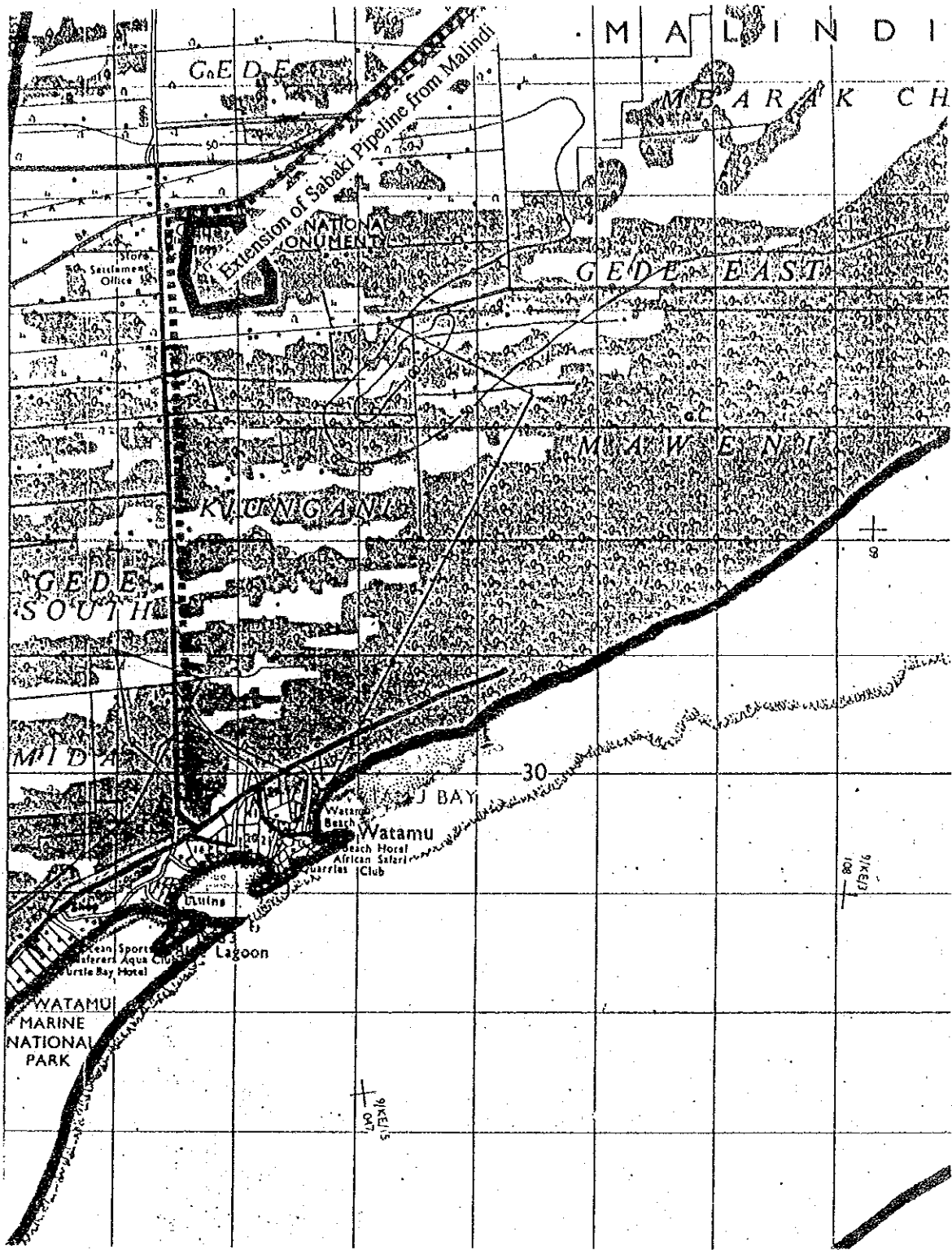
U- 24 Kilifi

U 313.2 198/2 3LA



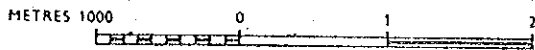
THE STUDY
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JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i	
2					National Water Master Plan				
3			URBAN WATER SUPPLY					Feb-92	
4	Code No. 310		U- 25			Rate		25.2	
5	-----								
6	Name of Urban:		Watamu		LGL Notice No:				
7	Organization:								
8	Per Capita GRDP in 1988 (guess):								
9	District:		Kilifi		Locataion :	314.3 Gede			
10	Map (1/50,000):		193/3		Coordinates X:		40°01'	Y: S 03°21'	
11	Sub-basin Code:		3HD3		Elevation (El. m):				
12	-----								
13	Existing Facilities								
14	Raw Water Source:						River No		
15	Raw Water System:		H (m)=		L (m)=				
16	Treatment:				Capacity (m3/d)				
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population		(no)			2,100	5,400	9,200	
22	Residential Demand		(m3/d)			260	684	1,190	
23	Non-residential Demand		(m3/d)			44	111	189	
24	Livestock Demand		(m3/d)			2	6	10	
25	Industrial Demand		(m3/d)			0	0	0	
26	Total Demand		(m3/d)			306	801	1,389	
27	Area Served (estimated net)		(ha)			16	40	69	
28	-----								
29	Future Development Plan								
30	Raw Water Source:		Sabaki pipeline					River No:	
31	Raw Water System:		H (m)=		0 L (m)=		20,100		
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity		(m3/d)			306.1	494.6	588.5	1,389.3
37	Source Works		(US\$'000)			4.4	6.2	7.1	17.7
38	Pump Cost		(US\$'000)			0.0	0.0	0.0	0.0
39	Raw Water Main		(US\$'000)			810.5	856.8	876.8	2,544.2
40	Treatment		(US\$'000)			0.0	0.0	0.0	0.0
41	Storage		(US\$'000)			36.6	49.1	54.4	87.4
42	Distribution		(US\$'000)			125.5	197.2	227.0	549.6
43	Miscellaneous (20%)		(US\$'000)			195.4	221.9	233.1	650.3
44	Admi. & Engineering		(US\$'000)			117.2	133.1	139.8	390.2
45	Contingency		(US\$'000)			257.9	292.8	307.7	858.4
46	Total Cost		(US\$'000)			1,547.5	1,757.1	1,846.0	5,150.6
47	Cost per Capita		(US\$/c)			736.9	532.5	485.8	
48	Cost per ha		(US\$/ha)			98,675.7	71,298.3	65,048.8	
49	Cost per m3		(US\$/m3)			5.1	3.6	3.1	3.7
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)			77.4	87.9	92.3	
53	Capital Costs		(US\$'000)			159.4	181.0	190.1	
54	Total Annual Cost		(US\$'000)			236.8	268.8	282.4	
55	Unit Cost per m3		(US\$/m3)			2.1	1.5	1.3	
56	-----								
57	Remarks:	Water source : Extension of existing pipeline from Malindi							
58									
59									
60									
61									
62									
63	-----								



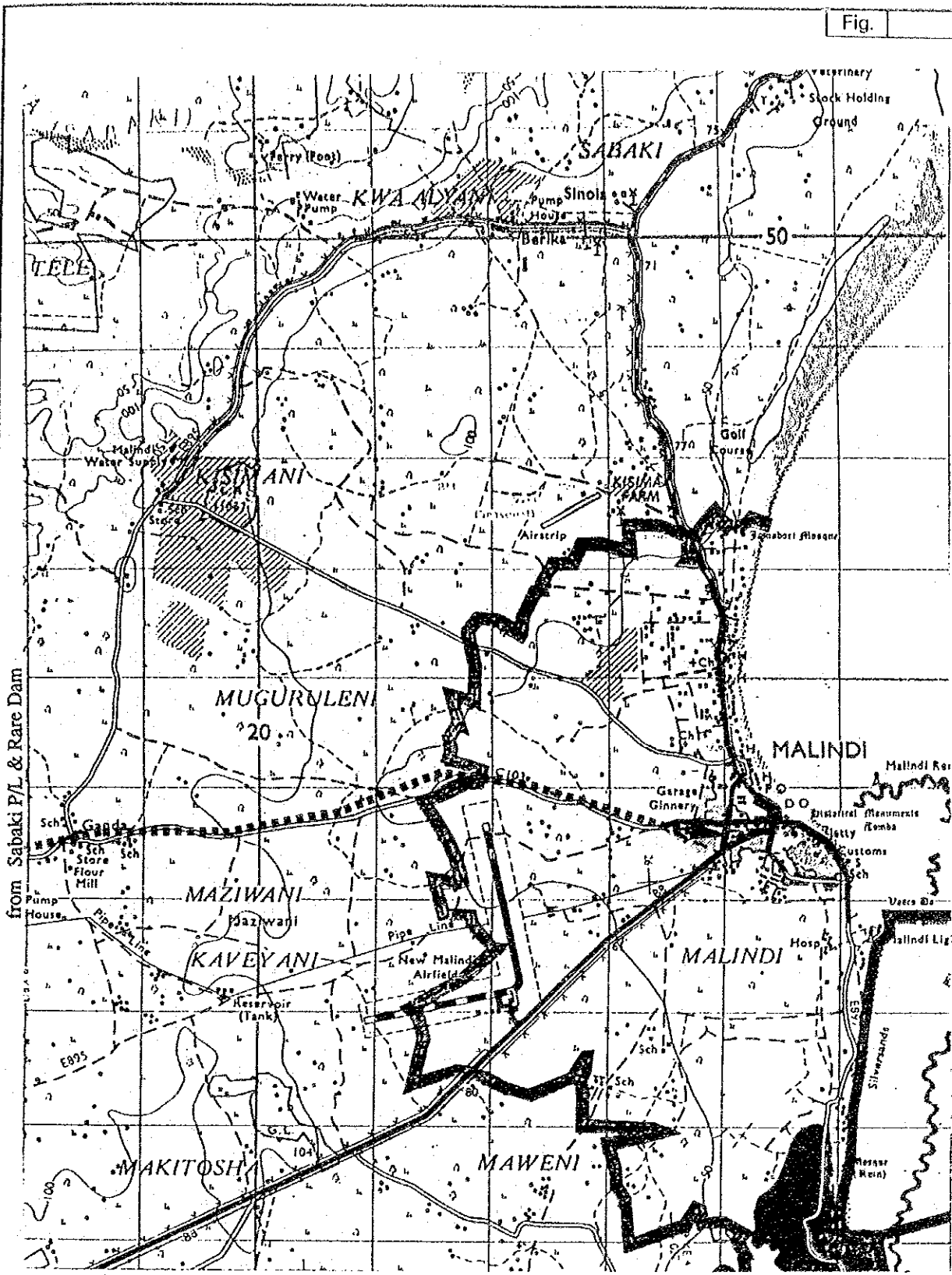
U- 25 Watamu

314.3 193/3



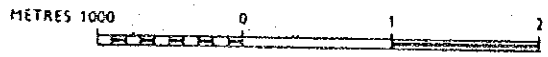
THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i	
2						National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92	
4	Code No.	310	U- 26			Rate		25.2	
5	-----								
6	Name of Urban:		Malindi		LGL Notice No:				
7	Organization:								
8	Per Capita GRDP in 1988 (guess):								
9	District:		Kilifi	Locataion :		314.4 Malindi Town			
10	Map (1/50,000):		193/1	Coordinates X:		40°06'	Y:	S 03°15'	
11	Sub-basin Code:		3LB	Elevation (El. m):					
12	-----								
13	Existing Facilities								
14	Raw Water Source:		Sabaki Pipeline			River No			
15	Raw Water System:		H (m)=	L (m)=					
16	Treatment:			Capacity (m3/d)		7000			
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population		(no)		36,700	93,900	159,800		
22	Residential Demand		(m3/d)		4,546	11,890	20,674		
23	Non-residential Demand		(m3/d)		761	1,945	3,311		
24	Livestock Demand		(m3/d)		43	104	177		
25	Industrial Demand		(m3/d)		468	866	1,246		
26	Total Demand		(m3/d)		5,818	14,805	25,408		
27	Area Served (estimated net)		(ha)		274	701	1,193		
28	-----								
29	Future Development Plan								
30	Raw Water Source:		Sabaki Pipeline & Rare Dam			River No:			
31	Raw Water System:		H (m)=	0 L (m)=		49,000			
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		0.0	7,805.1	10,603.0	18,408.1	
37	Source Works		(US\$'000)		0.0	49.4	62.2	111.6	
38	Pump Cost		(US\$'000)		0.0	0.0	0.0	0.0	
39	Raw Water Main		(US\$'000)		0.0	3,964.9	4,455.7	8,420.7	
40	Treatment		(US\$'000)		0.0	1,094.1	1,186.6	2,280.7	
41	Storage		(US\$'000)		0.0	153.6	146.1	299.7	
42	Distribution		(US\$'000)		0.0	3,417.3	3,937.1	7,354.4	
43	Miscellaneous (20%)		(US\$'000)		0.0	1,735.9	1,957.5	3,693.4	
44	Admi. & Engineering		(US\$'000)		0.0	1,041.5	1,174.5	2,216.0	
45	Contingency		(US\$'000)		0.0	2,291.4	2,583.9	4,875.3	
46	Total Cost		(US\$'000)		0.0	13,748.2	15,503.7	29,251.8	
47	Cost per Capita		(US\$/c)		0.0	240.4	235.3		
48	Cost per ha		(US\$/ha)		0.0	32,184.6	31,502.7		
49	Cost per m3		(US\$/m3)		0.0	1.8	1.5	1.6	
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		0.0	637.4	775.2		
53	Capital Costs		(US\$'000)		0.0	1,416.1	1,596.9		
54	Total Annual Cost		(US\$'000)		0.0	2,103.5	2,372.1		
55	Unit Cost per m3		(US\$/m3)		0.0	0.7	0.6		
56	-----								
57	Remarks:	Source works does not include the cost of Rare dam, which should be added separately							
58		(see Sectoral Report M).							
59		Augmentation of Sabaki pipeline capacity (extension of Baricho intake)							
60		will be an alternative to the Rare dam.							
61									
62									
63	-----								



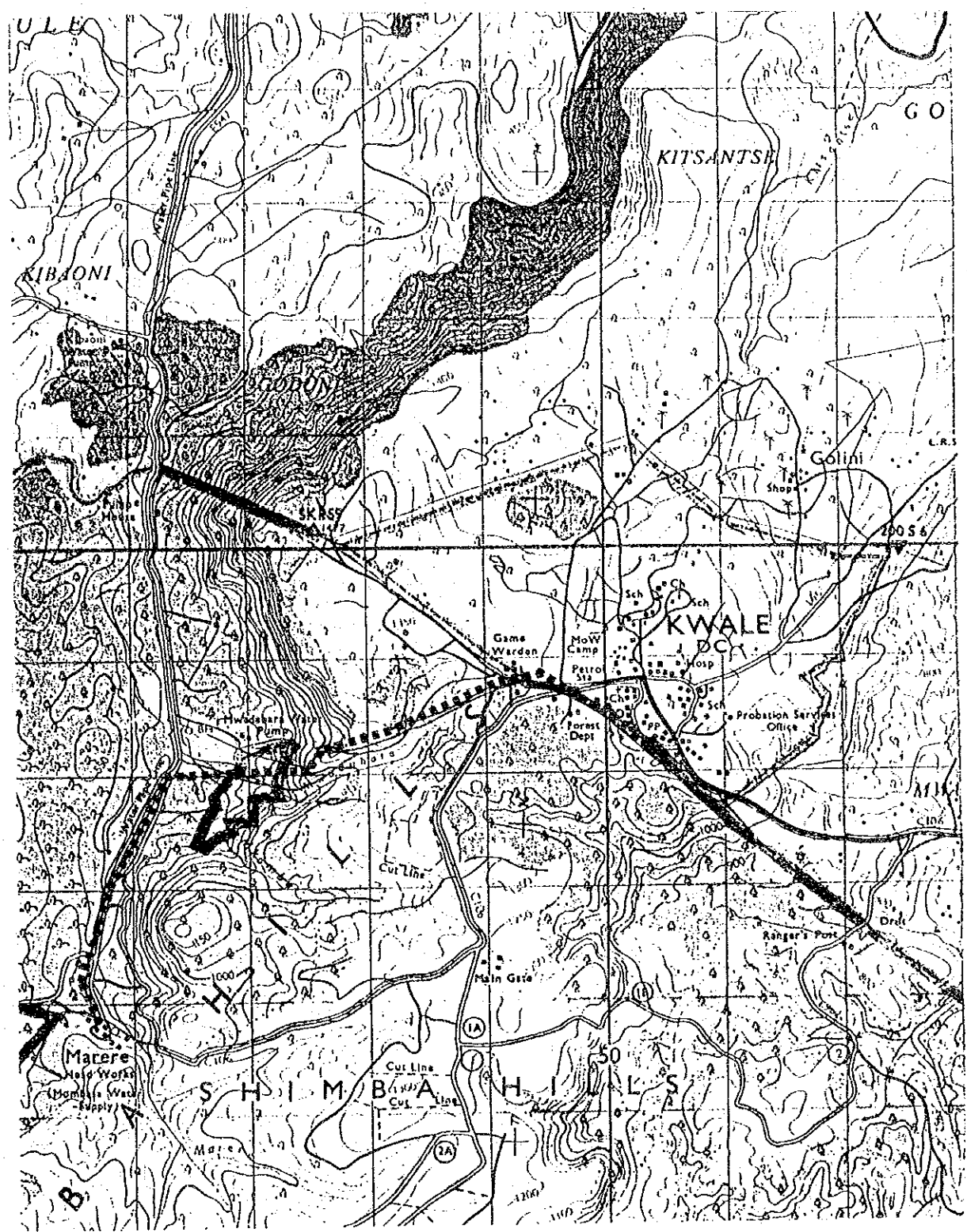
U- 26 Malindi

G 314.4 193/1 3LB



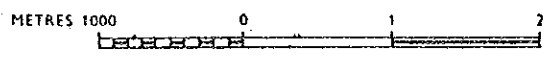
THE STUDY
ON
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a	b	c	d	e	f	g	h	i
2					National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92
4	Code No. 320		U- 27			Rate		25.2
5	-----							
6	Name of Urban:		Kwale		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 (guess):							
9	District:		Kwale	Locataion :	321.1	Shimba North		
10	Map (1/50,000) :		200/2	Coordinates X:		39°26'	Y:	S 04°11'
11	Sub-basin Code:		3MC	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Marere spring			River No		
15	Raw Water System:		H (m)=	L (m)=		24000		
16	Treatment:			Capacity (m3/d)		470		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		3,700	9,700	15,200	
22	Residential Demand		(m3/d)		458	1,228	1,967	
23	Non-residential Demand		(m3/d)		77	199	315	
24	Livestock Demand		(m3/d)		12	28	43	
25	Industrial Demand		(m3/d)		0	0	0	
26	Total Demand		(m3/d)		547	1,455	2,325	
27	Area Served (estimated net)		(ha)		28	72	114	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Marere pipeline			River No:		
31	Raw Water System:		H (m)=	200 L (m)=		7,800		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		77.3	907.9	869.2	1,854.5
37	Source Works		(US\$'000)		1.6	9.8	9.5	20.9
38	Pump Cost		(US\$'000)		5.7	7.6	7.6	20.9
39	Raw Water Main		(US\$'000)		282.8	363.4	360.8	1,007.0
40	Treatment		(US\$'000)		93.2	404.5	394.8	892.4
41	Storage		(US\$'000)		15.0	69.7	68.0	152.7
42	Distribution		(US\$'000)		221.1	358.5	328.6	908.1
43	Miscellaneous (20%)		(US\$'000)		123.9	242.7	233.9	600.4
44	Admi. & Engineering		(US\$'000)		74.3	145.6	140.3	360.2
45	Contingency		(US\$'000)		163.5	320.3	308.7	792.5
46	Total Cost		(US\$'000)		980.9	1,922.1	1,852.2	4,755.3
47	Cost per Capita		(US\$/c)		265.1	320.3	336.8	
48	Cost per ha		(US\$/ha)		35,499.8	42,896.5	45,095.6	
49	Cost per m3		(US\$/m3)		12.7	2.1	2.1	2.6
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		49.0	96.1	92.6	
53	Capital Costs		(US\$'000)		101.0	198.0	190.8	
54	Total Annual Cost		(US\$'000)		150.1	294.1	283.4	
55	Unit Cost per m3		(US\$/m3)		5.3	0.9	0.9	
56	-----							
57	Remarks: Augmentation of capacity of supply from Marere springs.							
58								
59								
60								
61								
62								
63	-----							



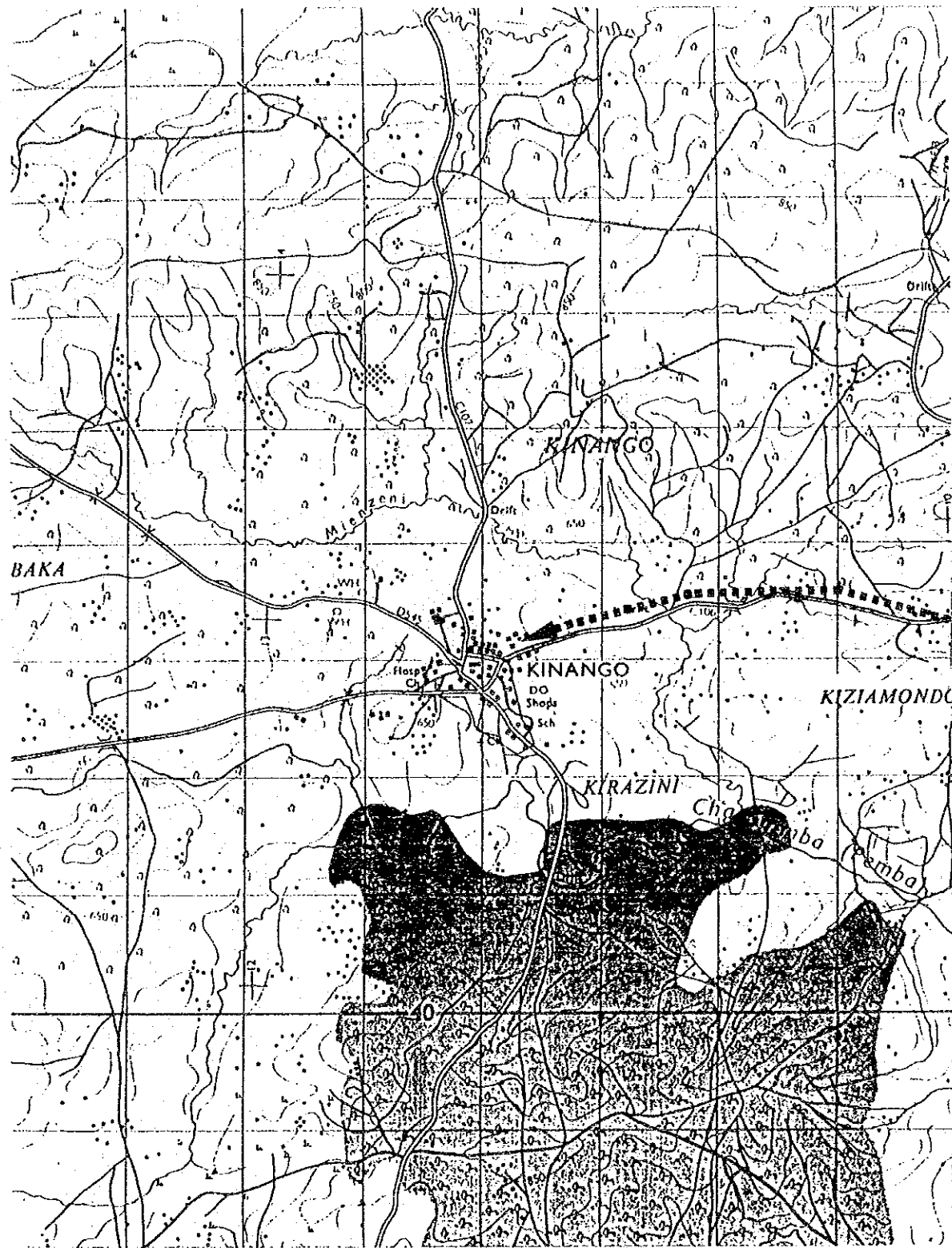
U- 27 Kwale

U 321.1 200/2 3MC



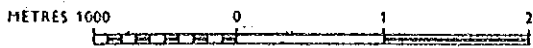
THE STUDY
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a	b	c	d	e	f	g	h	i	
2						National Water Master Plan			
3			URBAN WATER SUPPLY					Jul-92	
4	Code No. 320		U- 28			Rate		25.2	
5	-----								
6	Name of Urban:		Kinango		LGL Notice No:				
7	Organization:								
8	Per Capita GRDP in 1988 (guess):					323.1	Kinango South		
9	District:		Kwale	Locataion :				Y: S 04°09'	
10	Map (1/50,000) :		200/2	Coordinates X:			39°17'		
11	Sub-basin Code:		3MC	Elevation (El. m):					
12	-----								
13	Existing Facilities								
14	Raw Water Source:		Marere pipeline			River No			
15	Raw Water System:		H (m)=	L (m)=					
16	Treatment:			Capacity (m3/d)		300			
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population			(no)		2,500	4,400	5,800	
22	Residential Demand			(m3/d)		310	557	750	
23	Non-residential Demand			(m3/d)		0	90	119	
24	Livestock Demand			(m3/d)		0	13	16	
25	Industrial Demand			(m3/d)		0	0	0	
26	Total Demand			(m3/d)		310	660	885	
27	Area Served (estimated net)			(ha)		19	33	43	
28	-----								
29	Future Development Plan								
30	Raw Water Source:		Marere pipeline			River No:			
31	Raw Water System:		H (m)=	130 L (m)=		18,700			
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity			(m3/d)		9.7	360.2	225.2	595.1
37	Source Works			(US\$'000)		0.3	4.9	3.5	8.7
38	Pump Cost			(US\$'000)		3.3	4.3	3.9	11.5
39	Raw Water Main			(US\$'000)		630.5	767.4	731.9	2,129.8
40	Treatment			(US\$'000)		24.8	238.0	179.8	442.6
41	Storage			(US\$'000)		3.5	40.5	30.2	74.2
42	Distribution			(US\$'000)		149.4	113.5	83.6	346.5
43	Miscellaneous (20%)			(US\$'000)		162.4	233.7	206.6	602.7
44	Admii. & Engineering			(US\$'000)		97.4	140.2	123.9	361.6
45	Contingency			(US\$'000)		214.3	308.5	272.7	795.5
46	Total Cost			(US\$'000)		1,285.9	1,851.1	1,636.1	4,773.1
47	Cost per Capita			(US\$/c)		514.4	974.2	1,168.7	
48	Cost per ha			(US\$/ha)		68,877.6	130,456.5	156,490.6	
49	Cost per m3			(US\$/m3)		132.7	5.1	7.3	8.0
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs			(US\$'000)		64.3	92.6	81.8	
53	Capital Costs			(US\$'000)		132.5	190.7	168.5	
54	Total Annual Cost			(US\$'000)		196.7	283.2	250.3	
55	Unit Cost per m3			(US\$/m3)		55.6	2.2	3.0	
56	-----								
57	Remarks:	The plan proposed herein is the extension of existing Marere pipeline. An alternative may be							
58		the construction of small dam(s) on Cha Simba river, which would be subject to further survey.							
59									
60									
61									
62									
63	-----								



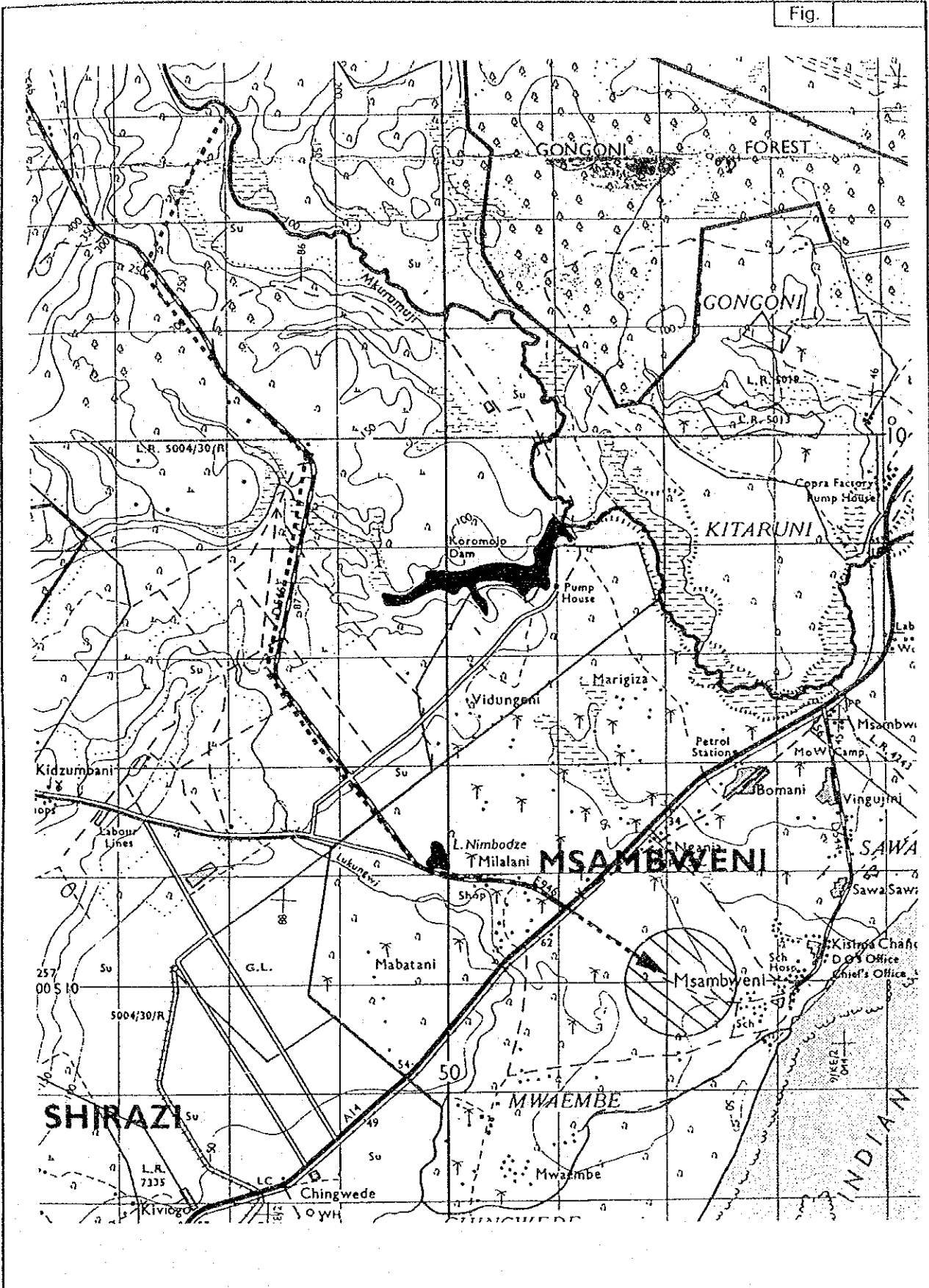
U- 28 Kinango

U 323.1 200/2 3MC



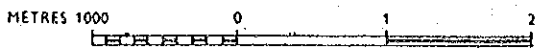
THE STUDY
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a	b	c	d	e	f	g	h	i
2	National Water Master Plan							
3	URBAN WATER SUPPLY							
4	Code No. 320	U- 29				Rate		Jul-92 25.2
5	-----							
6	Name of Urban:	Msambweni	LGL Notice No:					
7	Organization:							
8	Per Capita GRDP in 1988 (guess):							
9	District:	Kwale	Locataion :	324.1	Msambweni			
10	Map (1/50,000) :	200/4	Coordinates X:	39°27'	Y:	S 04°30'		
11	Sub-basin Code:	3K	Elevation (El. m):					
12	-----							
13	Existing Facilities							
14	Raw Water Source:	Boreholes	River No:					
15	Raw Water System:	H (m)=	40	L (m)=				
16	Treatment:	Capacity (m ³ /d)		600				
17	Distribution System:							
18	-----							
19			1990	2000	2010			
20	-----							
21	Projected Population	(no)	8,400	21,900	34,500			
22	Residential Demand	(m ³ /d)	1,041	2,773	4,463			
23	Non-residential Demand	(m ³ /d)	174	452	715			
24	Livestock Demand	(m ³ /d)	26	64	97			
25	Industrial Demand	(m ³ /d)	57	105	152			
26	Total Demand	(m ³ /d)	1,298	3,394	5,427			
27	Area Served (estimated net)	(ha)	63	164	258			
28	-----							
29	Future Development Plan							
30	Raw Water Source:	Boreholes + Mkurumuji river	River No:					
31	Raw Water System:	H (m)=	40	L (m)=	375,000	11,000		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost		1990	2000	2010	Total		
36	Incremental Capacity	(m ³ /d)	697.6	2,096.5	2,033.4	4,827.4		
37	Source Works	(US\$'000)	1,401.4	4,208.6	4,081.9	9,691.9		
38	Pump Cost	(US\$'000)	1.5	2.0	2.0	5.5		
39	Raw Water Main	(US\$'000)	2,331.5	6,471.6	6,279.3	15,082.4		
40	Treatment	(US\$'000)	349.0	629.5	620.0	1,598.5		
41	Storage	(US\$'000)	60.1	106.6	105.1	271.8		
42	Distribution	(US\$'000)	501.8	806.5	752.8	2,061.2		
43	Miscellaneous (20%)	(US\$'000)	929.1	2,445.0	2,368.2	5,742.3		
44	Admi. & Engineering	(US\$'000)	557.4	1,467.0	1,420.9	3,445.4		
45	Contingency	(US\$'000)	1,226.4	3,227.4	3,126.0	7,579.8		
46	Total Cost	(US\$'000)	7,358.1	19,364.3	18,756.3	45,478.6		
47	Cost per Capita	(US\$/c)	876.0	1,434.4	1,488.6			
48	Cost per ha	(US\$/ha)	117,296.9	192,072.7	199,330.9			
49	Cost per m ³	(US\$/m ³)	10.5	9.2	9.2	9.4		
50	-----							
51	Present Value of Water at DF=10 %		1990	2000	2010	Total		
52	Direct O & M Costs	(US\$'000)	367.9	968.2	937.8			
53	Capital Costs	(US\$'000)	757.9	1,994.5	1,931.9			
54	Total Annual Cost	(US\$'000)	1,125.8	2,962.7	2,869.7			
55	Unit Cost per m ³	(US\$/m ³)	4.4	3.9	3.9			
56	-----							
57	Remarks:	A great constraint is that the Ramisi River water is said to be salty. The proposed plan is to exploit groundwater at a maximum extent. The water abstraction from the Mukurumuji river is another solution for the area. In this study, it was assumed that 50 % of the demand is supplied by the groundwater and the remaining is served by the surface water taken from the Mukurumuji river.						
58								
59								
60								
61								
62								
63	-----							



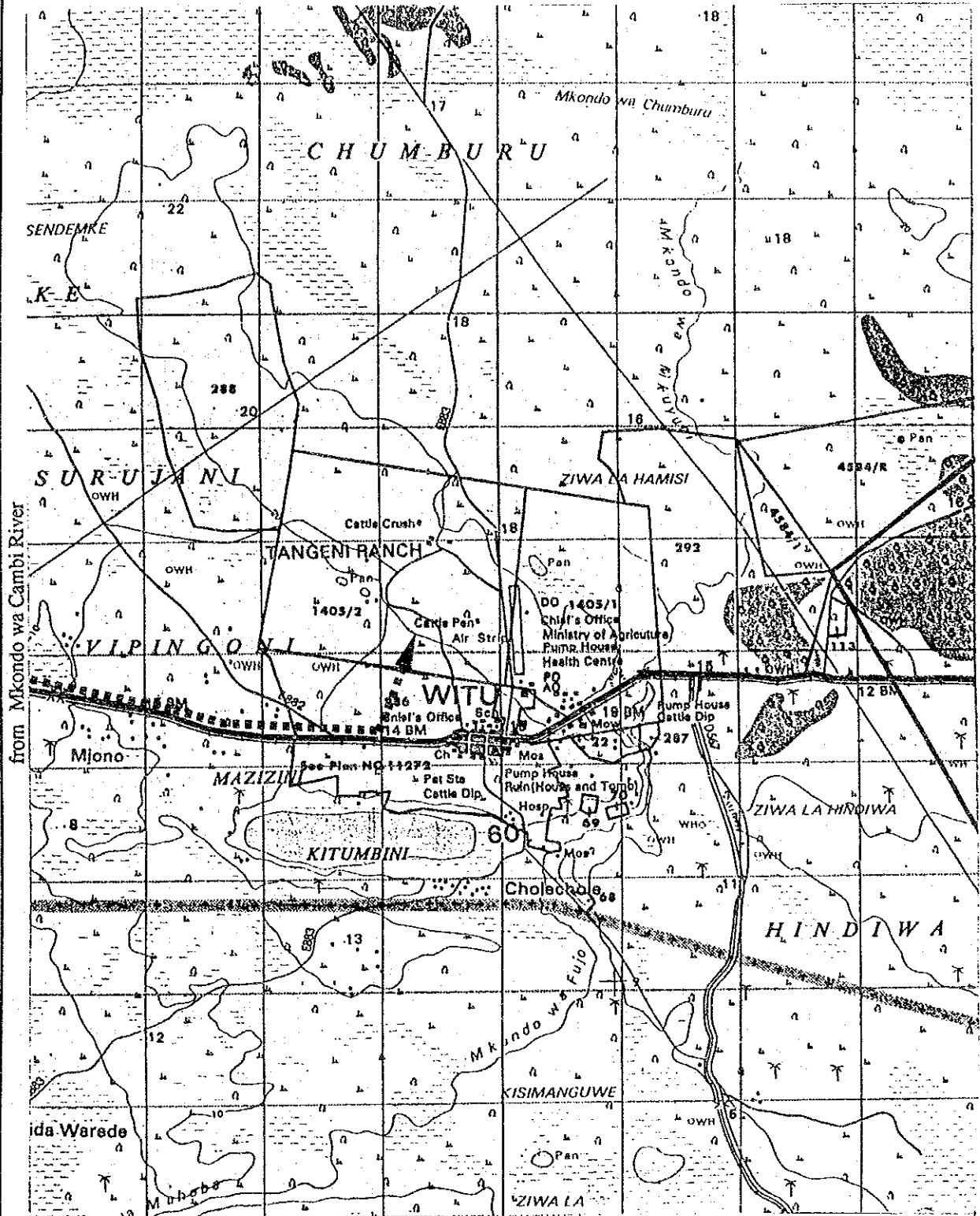
U- 29 Msambweni

R 324.1 200/4 3K



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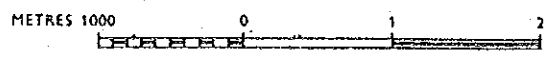
a	b	c	d	e	f	g	h	i	
2	National Water Master Plan								
3	URBAN WATER SUPPLY								
4	Code No. 330	U- 30	Rate			Feb-92 25.2			
5	-----								
6	Name of Urban:	Witu	LGL Notice No:						
7	Organization:								
8	Per Capita GRDP in 1988 (guess):								
9	District:	Lamu	Locataion :	331 Witu					
10	Map (1/50,000) :	179/4	Coordinates X:	40°25'		Y:	S 02°24'		
11	Sub-basin Code:	4GG	Elevation (El. m):						
12	-----								
13	Existing Facilities								
14	Raw Water Source:	1 no shallow well			River No				
15	Raw Water System:	H (m)=	L (m)=						
16	Treatment:	Capacity (m3/d)			150				
17	Distribution System:								
18	-----								
19				1990	2000	2010			
20	-----								
21	Projected Population	(no)		3,300	7,500	12,500			
22	Residential Demand	(m3/d)		409	950	1,617			
23	Non-residential Demand	(m3/d)		68	154	258			
24	Livestock Demand	(m3/d)		17	42	112			
25	Industrial Demand	(m3/d)		0	0	0			
26	Total Demand	(m3/d)		494	1,146	1,987			
27	Area Served (estimated net)	(ha)		25	56	93			
28	-----								
29	Future Development Plan								
30	Raw Water Source:	Mkondo wa Cambi river			River No:				
31	Raw Water System:	H (m)=	10 L (m)=		11,600				
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost			1990	2000	2010		Total	
36	Incremental Capacity	(m3/d)		343.8	651.9	841.5		1,837.2	
37	Source Works	(US\$'000)		4.8	7.7	9.3		21.7	
38	Pump Cost	(US\$'000)		0.8	1.0	1.1		2.8	
39	Raw Water Main	(US\$'000)		473.6	513.4	533.8		1,520.8	
40	Treatment	(US\$'000)		231.5	335.8	387.7		955.1	
41	Storage	(US\$'000)		39.3	57.8	66.8		163.9	
42	Distribution	(US\$'000)		197.2	250.9	298.7		746.8	
43	Miscellaneous (20%)	(US\$'000)		189.4	233.3	259.5		682.2	
44	Admi. & Engineering	(US\$'000)		113.7	140.0	155.7		409.3	
45	Contingency	(US\$'000)		250.0	308.0	342.5		900.5	
46	Total Cost	(US\$'000)		1,500.3	1,847.8	2,055.2		5,403.2	
47	Cost per Capita	(US\$/c)		454.6	439.9	411.0			
48	Cost per ha	(US\$/ha)		60,876.7	58,910.9	55,039.9			
49	Cost per m3	(US\$/m3)		4.4	2.8	2.4		2.9	
50	-----								
51	Present Value of Water at DF=10 %			1990	2000	2010		Total	
52	Direct O & M Costs	(US\$'000)		75.0	92.4	102.8			
53	Capital Costs	(US\$'000)		154.5	190.3	211.7			
54	Total Annual Cost	(US\$'000)		229.5	282.7	314.4			
55	Unit Cost per m3	(US\$/m3)		1.8	1.2	1.0			
56	-----								
57	Remarks: Alternatively, supply by Tana-Lamu pipeline.								
58									
59									
60									
61									
62									
63	-----								



from Mkombozi wa Cambi River

U- 30 Witu

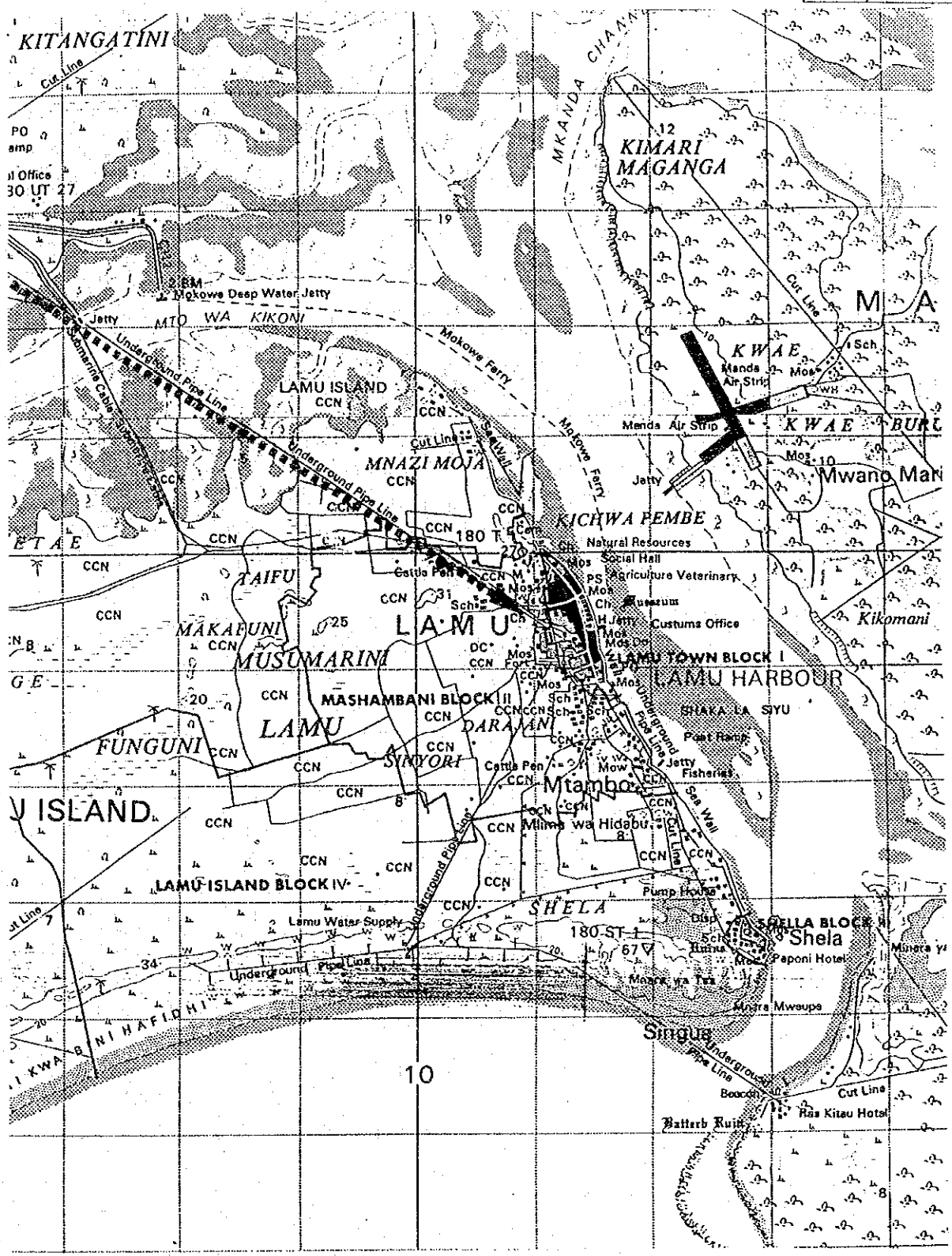
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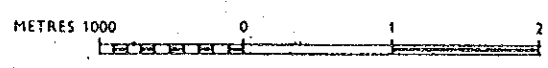
a	b	c	d	e	f	g	h	i
2					National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92
4	Code No.	330	U- 31			Rate		25.2
5	-----							
6	Name of Urban:		Lamu		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 (guess):				333.2	Lamu Town		
9	District:		Lamu	Locataion :		40°53'	Y:	S 02°17'
10	Map (1/50,000):		180/4	Coordinates X:				
11	Sub-basin Code:		4KB	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		20 shallow wells			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)		500		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		9,000	20,400	34,000	
22	Residential Demand		(m3/d)		1,115	2,583	4,399	
23	Non-residential Demand		(m3/d)		187	421	703	
24	Livestock Demand		(m3/d)		48	115	305	
25	Industrial Demand		(m3/d)		341	632	910	
26	Total Demand		(m3/d)		1,691	3,751	6,317	
27	Area Served (estimated net)		(ha)		67	152	254	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		P/L from Tana River + B/H			River No:		
31	Raw Water System:		H (m)=	40 L (m)=		121,000		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		1,190.9	2,060.3	2,565.6	5,816.8
37	Source Works		(US\$'000)		12.1	18.2	21.5	51.7
38	Pump Cost		(US\$'000)		2.5	3.4	4.2	10.1
39	Raw Water Main		(US\$'000)		5,911.9	6,621.4	6,978.1	19,511.3
40	Treatment		(US\$'000)		469.1	624.1	695.0	1,788.2
41	Storage		(US\$'000)		80.7	105.8	116.4	302.9
42	Distribution		(US\$'000)		537.7	681.1	812.5	2,031.3
43	Miscellaneous (20%)		(US\$'000)		1,402.8	1,610.8	1,725.5	4,739.1
44	Admi. & Engineering		(US\$'000)		841.7	966.5	1,035.3	2,843.5
45	Contingency		(US\$'000)		1,851.7	2,126.2	2,277.7	6,255.6
46	Total Cost		(US\$'000)		11,110.1	12,757.4	13,666.2	37,533.7
47	Cost per Capita		(US\$/c)		1,234.5	1,119.1	1,004.9	
48	Cost per ha		(US\$/ha)		165,300.2	149,849.4	134,557.8	
49	Cost per m3		(US\$/m3)		9.3	6.2	5.3	6.5
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		555.5	637.9	683.3	
53	Capital Costs		(US\$'000)		1,144.3	1,314.0	1,407.6	
54	Total Annual Cost		(US\$'000)		1,699.8	1,951.9	2,090.9	
55	Unit Cost per m3		(US\$/m3)		3.9	2.6	2.2	
56	-----							
57	Remarks:	Tentatively, cost of pipeline from Tana river is shown above. However, the first effort may be the						
58		maximum exploitation of groundwater resources in the Lamu island.						
59								
60								
61								
62								
63	-----							

from P/L from Tana + B/H



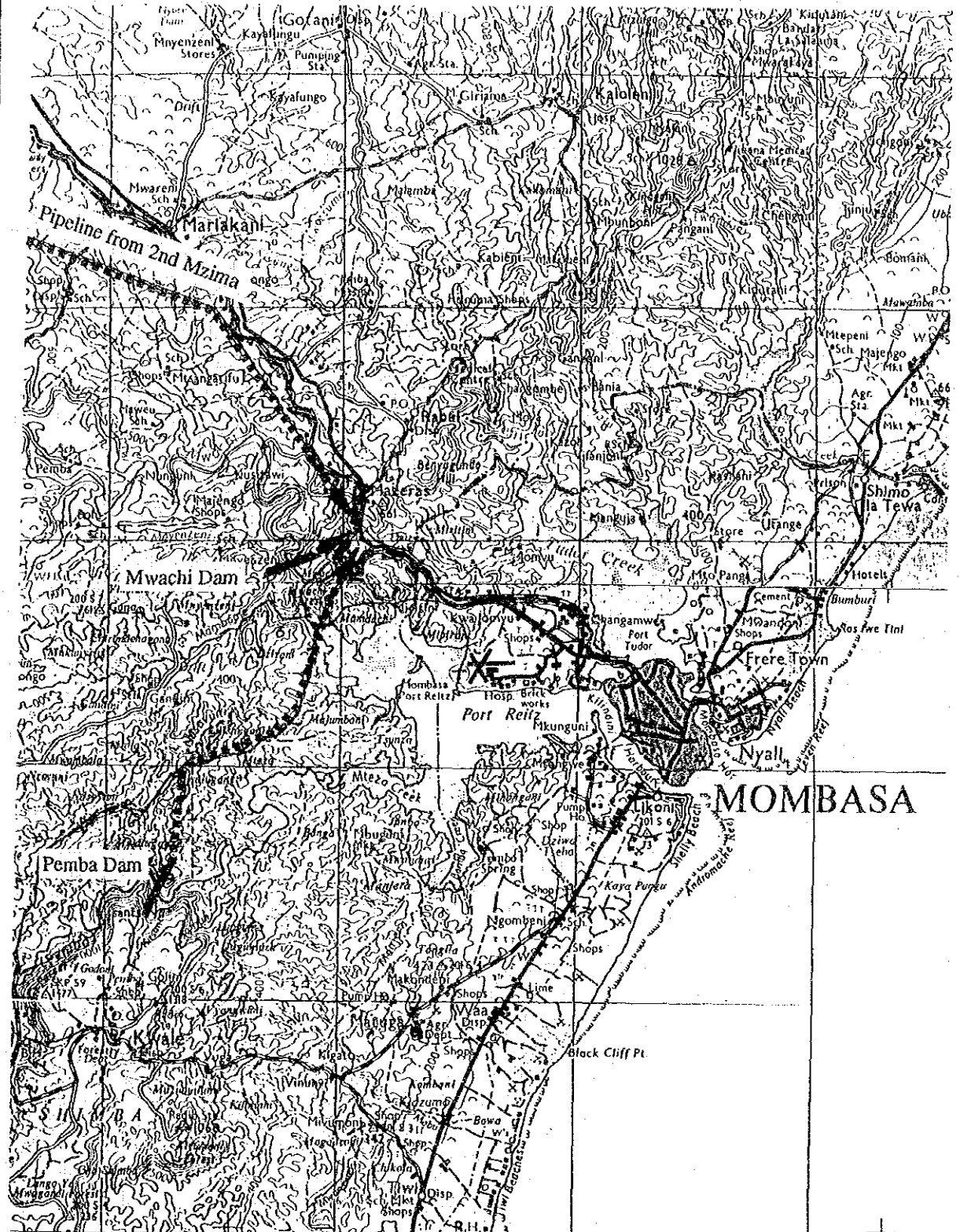
U- 31 Lamu

U 333.2 180/4 4HB

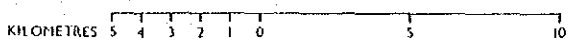


THE STUDY
ON
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a	b	c	d	e	f	g	h	i	
2						National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92	
4	Code No.	340	U- 32			Rate		25.2	
5	-----								
6	Name of Urban:		Mombasa		LGL Notice No:				
7	Organization:								
8	Per Capita GRDP in 1988 (guess):					340 Mombasa			
9	District:		Mombasa	Locataion :					
10	Map (1/50,000) :		201/1	Coordinates X:		39°40'	Y:	S 04°00'	
11	Sub-basin Code:		3MD1	Elevation (El. m):					
12	-----								
13	Existing Facilities								
14	Raw Water Source:		Mzima P/L /Sabaki P/L /Marere P/L		River No				
15	Raw Water System:		H (m)=		L (m)=				
16	Treatment:			Capacity (m3/d)		68600			
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population		(no)			479,600	673,000	904,400	
22	Residential Demand		(m3/d)			59,410	85,219	117,007	
23	Non-residential Demand		(m3/d)			9,940	13,947	18,743	
24	Livestock Demand		(m3/d)			138	182	239	
25	Industrial Demand		(m3/d)			30,768	52,286	66,834	
26	Total Demand		(m3/d)			100,256	151,634	202,823	
27	Area Served (estimated net)		(ha)			3,582	5,026	6,754	
28	-----								
29	Future Development Plan								
30	Raw Water Source:		2nd Mzima/Mwachi Dam, Pemba Dam		River No:				
31	Raw Water System:		H (m)=	0	L (m)=		261,900		
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity		(m3/d)			31,656.5	51,377.2	51,189.1	134,222.8
37	Source Works		(US\$'000)			141.3	203.1	202.6	547.0
38	Pump Cost		(US\$'000)			0.0	0.0	0.0	0.0
39	Raw Water Main		(US\$'000)			39,510.7	51,707.4	51,597.0	142,815.0
40	Treatment		(US\$'000)			3,221.0	5,227.6	5,208.5	13,657.2
41	Storage		(US\$'000)			1,363.3	2,212.6	2,204.5	5,780.5
42	Distribution		(US\$'000)			28,653.0	11,554.4	13,824.7	54,032.1
43	Miscellaneous (20%)		(US\$'000)			14,577.9	14,181.0	14,607.5	43,366.4
44	Admi. & Engineering		(US\$'000)			8,746.7	8,508.6	8,764.5	26,019.8
45	Contingency		(US\$'000)			19,242.8	18,719.0	19,281.8	57,243.6
46	Total Cost		(US\$'000)			115,456.7	112,313.9	115,691.0	343,461.6
47	Cost per Capita		(US\$/c)			240.7	580.7	500.0	
48	Cost per ha		(US\$/ha)			32,235.8	77,763.5	66,947.6	
49	Cost per m3		(US\$/m3)			3.6	2.2	2.3	2.6
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)			5,772.8	5,615.7	5,784.6	
53	Capital Costs		(US\$'000)			11,892.0	11,568.3	11,916.2	
54	Total Annual Cost		(US\$'000)			17,664.9	17,184.0	17,700.7	
55	Unit Cost per m3		(US\$/m3)			1.5	0.9	0.9	
56	-----								
57	Remarks:	Source works cost does not include the cost of Mwachi and Pemba dams, which should be added separately							
58		(see Sectoral Report M). Pipeline length assumed as 230km (Mzima), 2.3km (Mwachi) and 28.6km (Pemba).							
59		Also, a possible alternative plan will be water transfer from Njoro spring and/or Lake Jipe.							
60									
61									
62									
63	-----								



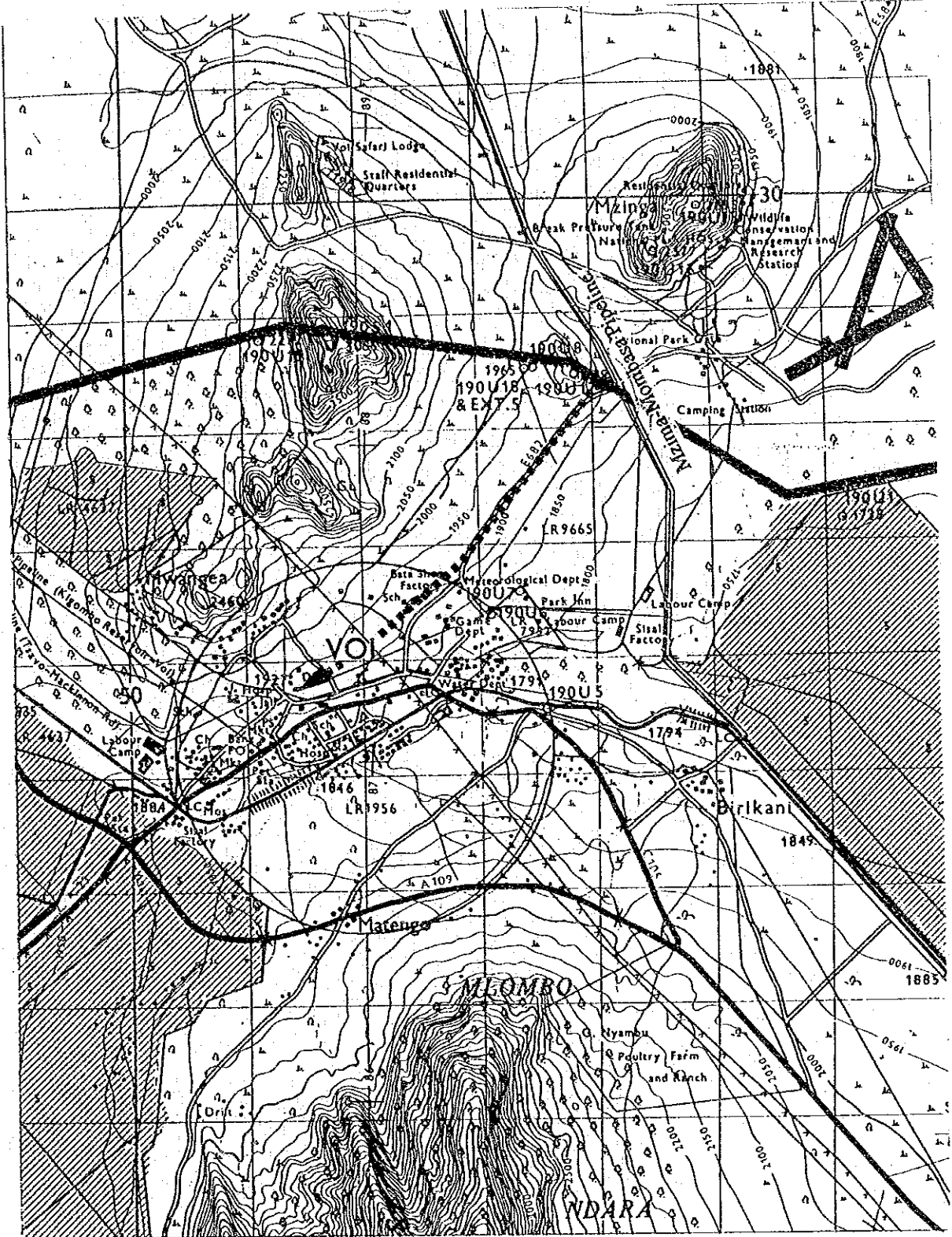
U-32 Mombasa G 340.0 201/1 3MD1



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a	b	c	d	e	f	g	h	i
2						National Water Master Plan		
3			URBAN WATER SUPPLY					Feb-92
4	Code No. 350		U- 33			Rate		25.2
5	-----							
6	Name of Urban:		Voi		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 (guess):							
9	District:		T.Taveta	Locataion :	352.4	Voi		
10	Map (1/50,000):		190/3	Coordinates X:		38°33'	Y:	S 03°24'
11	Sub-basin Code:		3LA	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Mzima P/L			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)		1230		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		12,200	23,600	36,000	
22	Residential Demand		(m3/d)		1,511	2,988	4,658	
23	Non-residential Demand		(m3/d)		253	488	745	
24	Livestock Demand		(m3/d)		59	109	166	
25	Industrial Demand		(m3/d)		354	672	996	
26	Total Demand		(m3/d)		2,177	4,257	6,565	
27	Area Served (estimated net)		(ha)		91	176	269	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		2nd Mzim pipeline			River No:		
31	Raw Water System:		H (m)=	10 L (m)=		4,100		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		947.3	2,080.1	2,307.2	5,334.5
37	Source Works		(US\$'000)		10.2	18.3	19.8	48.3
38	Pump Cost		(US\$'000)		1.4	1.5	1.7	4.6
39	Raw Water Main		(US\$'000)		192.4	224.9	230.4	647.6
40	Treatment		(US\$'000)		414.1	627.1	660.1	1,701.2
41	Storage		(US\$'000)		71.3	106.2	111.2	288.8
42	Distribution		(US\$'000)		728.9	681.1	740.8	2,150.8
43	Miscellaneous (20%)		(US\$'000)		283.6	331.8	352.8	968.3
44	Admi. & Engineering		(US\$'000)		170.2	199.1	211.7	581.0
45	Contingency		(US\$'000)		374.4	438.0	465.7	1,278.1
46	Total Cost		(US\$'000)		2,246.5	2,628.0	2,794.3	7,668.7
47	Cost per Capita		(US\$/c)		184.1	230.5	225.3	
48	Cost per ha		(US\$/ha)		24,656.8	30,868.5	30,175.0	
49	Cost per m3		(US\$/m3)		2.4	1.3	1.2	1.4
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		112.3	131.4	139.7	
53	Capital Costs		(US\$'000)		231.4	270.7	287.8	
54	Total Annual Cost		(US\$'000)		343.7	402.1	427.5	
55	Unit Cost per m3		(US\$/m3)		1.0	0.5	0.5	
56	-----							
57	Remarks:							
58								
59								
60								
61								
62								
63	-----							

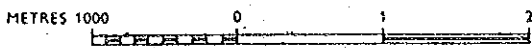
To Mzima



To Mombasa

U- 33 Voi

U 352.4 190/3 3LA

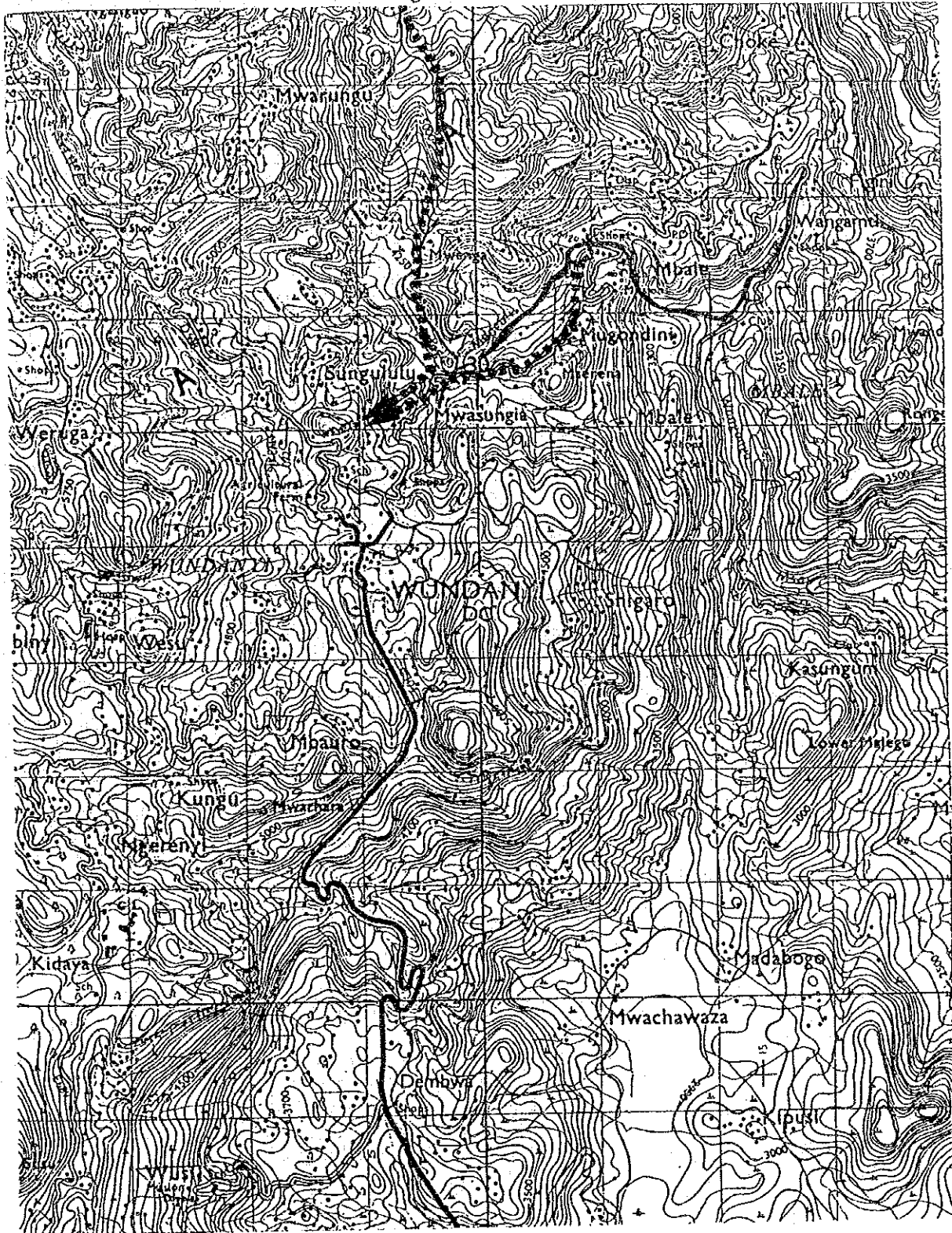


THE STUDY
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a	b	c	d	e	f	g	h	i
2					National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92
4	Code No.	350	U- 34			Rate		25.2
5	-----							
6	Name of Urban:		Wundanyi		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 (guess):				353.2	Werugha		
9	District:		T.Taveta	Locataion :				
10	Map (1/50,000):		189/4	Coordinates X:		38°21'	Y:	S 03°25'
11	Sub-basin Code:		3LA	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Taita Hills streams			River No		
15	Raw Water System:		H (m)=		L (m)=			
16	Treatment:			Capacity (m3/d)		1100		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population			(no)	2,700	5,300	8,000	
22	Residential Demand			(m3/d)	334	671	1,035	
23	Non-residential Demand			(m3/d)	56	108	165	
24	Livestock Demand			(m3/d)	13	24	37	
25	Industrial Demand			(m3/d)	0	0	0	
26	Total Demand			(m3/d)	403	803	1,237	
27	Area Served (estimated net)			(ha)	20	40	60	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Sigaso/Manguri River			River No:		
31	Raw Water System:		H (m)= 80		L (m)=	7,200		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity			(m3/d)	0.0	0.0	137.0	137.0
37	Source Works			(US\$'000)	0.0	0.0	2.4	2.4
38	Pump Cost			(US\$'000)	0.0	0.0	1.3	1.3
39	Raw Water Main			(US\$'000)	0.0	0.0	270.7	270.7
40	Treatment			(US\$'000)	0.0	0.0	132.8	132.8
41	Storage			(US\$'000)	0.0	0.0	21.9	21.9
42	Distribution			(US\$'000)	0.0	0.0	161.3	161.3
43	Miscellaneous (20%)			(US\$'000)	0.0	0.0	118.1	118.1
44	Admi. & Engineering			(US\$'000)	0.0	0.0	70.8	70.8
45	Contingency			(US\$'000)	0.0	0.0	155.9	155.9
46	Total Cost			(US\$'000)	0.0	0.0	935.2	935.2
47	Cost per Capita			(US\$/c)	0.0	0.0	346.4	
48	Cost per ha			(US\$/ha)	0.0	0.0	46,379.8	
49	Cost per m3			(US\$/m3)	0.0	0.0	6.8	6.8
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs			(US\$'000)	0.0	0.0	46.8	
53	Capital Costs			(US\$'000)	0.0	0.0	96.3	
54	Total Annual Cost			(US\$'000)	0.0	0.0	143.1	
55	Unit Cost per m3			(US\$/m3)	0.0	0.0	2.9	
56	-----							
57	Remarks:	Water source will be Taita Hill streams, of which Sigaso/Manguri rivers are tentatively listed above						
58		for cost estimate.						
59								
60								
61								
62								
63	-----							

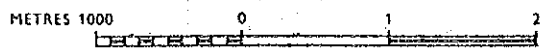
from Sigaso River

Fig.



U- 34 Wundanyi

U 353.2 189/4 3LA



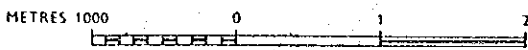
THE STUDY
ON
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JAPAN INTERNATIONAL COOPERATION AGENCY

a	b	c	d	e	f	g	h	i
2					National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92
4	Code No. 360		U- 35			Rate		25.2
5	-----							
6	Name of Urban:		Bura & Madogo		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 (guess):							
9	District:		T.River	Locataion :	362.3	Bura		
10	Map (1/50,000):		154/2	Coordinates X:		39°53'	Y:	S 01°13'
11	Sub-basin Code:		4GE	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Tana River			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)		120		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		1,200	2,100	2,800	
22	Residential Demand		(m3/d)		149	266	362	
23	Non-residential Demand		(m3/d)		0	43	58	
24	Livestock Demand		(m3/d)		0	25	30	
25	Industrial Demand		(m3/d)		0	0	0	
26	Total Demand		(m3/d)		149	334	450	
27	Area Served (estimated net)		(ha)		9	16	21	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Tana River			River No:		
31	Raw Water System:		H (m)=	20 L (m)=		200		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		28.7	213.9	116.3	358.9
37	Source Works		(US\$'000)		0.7	3.3	2.1	6.2
38	Pump Cost		(US\$'000)		0.0	1.0	1.0	2.0
39	Raw Water Main		(US\$'000)		6.9	7.8	7.4	22.2
40	Treatment		(US\$'000)		49.8	174.3	120.1	344.1
41	Storage		(US\$'000)		7.6	29.2	19.6	56.4
42	Distribution		(US\$'000)		71.7	53.8	41.8	167.3
43	Miscellaneous (20%)		(US\$'000)		27.3	53.9	38.4	119.6
44	Admi. & Engineering		(US\$'000)		16.4	32.3	23.0	71.8
45	Contingency		(US\$'000)		36.1	71.1	50.7	157.9
46	Total Cost		(US\$'000)		216.6	426.7	304.2	947.5
47	Cost per Capita		(US\$/c)		180.5	474.2	434.5	
48	Cost per ha		(US\$/ha)		24,165.5	63,492.6	58,188.2	
49	Cost per m3		(US\$/m3)		7.6	2.0	2.6	2.6
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		10.8	21.3	15.2	
53	Capital Costs		(US\$'000)		22.3	44.0	31.3	
54	Total Annual Cost		(US\$'000)		33.1	65.3	46.5	
55	Unit Cost per m3		(US\$/m3)		3.2	0.8	1.1	
56	-----							
57	Remarks:							
58								
59								
60								
61								
62								
63	-----							



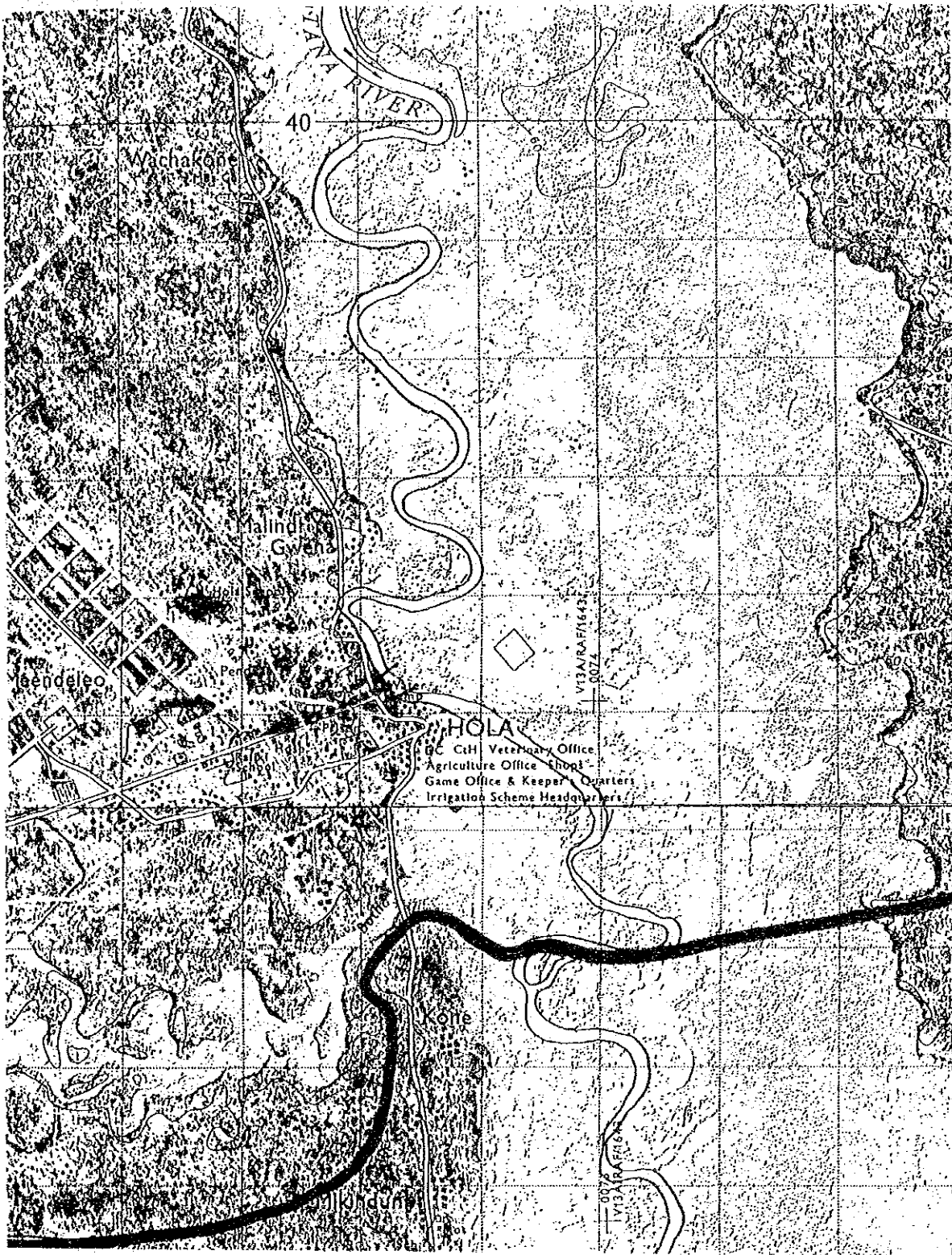
U- 35 Bura+Madogo

U 362.3 154/2 4GE



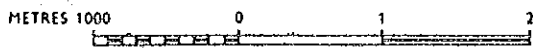
THE STUDY
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a	b	c	d	e	f	g	h	i
2					National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92
4	Code No. 360		U- 36			Rate		25.2
5	-----							
6	Name of Urban:		Hola		LGL Notice No:			
7	Organization:							
8	Per Capita GRDP in 1988 (guess):							
9	District:		T.River	Locataion :	363.3	Zabaki		
10	Map (1/50,000) :		155/3	Coordinates X:		40°04'	Y:	S 01°30'
11	Sub-basin Code:		4GF	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Tana River			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)		500		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population		(no)		8,100	21,600	34,800	
22	Residential Demand		(m3/d)		1,003	2,735	4,502	
23	Non-residential Demand		(m3/d)		168	447	721	
24	Livestock Demand		(m3/d)		109	255	375	
25	Industrial Demand		(m3/d)		94	178	264	
26	Total Demand		(m3/d)		1,374	3,615	5,862	
27	Area Served (estimated net)		(ha)		60	161	260	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Tana River			River No:		
31	Raw Water System:		H (m)=	20 L (m)=		1,300		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity		(m3/d)		874.4	2,240.7	2,247.2	5,362.3
37	Source Works		(US\$'000)		9.6	19.4	19.4	48.4
38	Pump Cost		(US\$'000)		1.3	1.9	1.9	5.0
39	Raw Water Main		(US\$'000)		60.2	72.5	72.6	205.3
40	Treatment		(US\$'000)		396.1	650.7	651.6	1,698.4
41	Storage		(US\$'000)		68.2	109.8	110.0	288.0
42	Distribution		(US\$'000)		483.9	806.5	788.6	2,079.1
43	Miscellaneous (20%)		(US\$'000)		203.9	332.2	328.8	864.8
44	Admi. & Engineering		(US\$'000)		122.3	199.3	197.3	518.9
45	Contingency		(US\$'000)		269.1	438.5	434.0	1,141.6
46	Total Cost		(US\$'000)		1,614.6	2,630.7	2,604.2	6,849.6
47	Cost per Capita		(US\$/c)		199.3	194.9	197.3	
48	Cost per ha		(US\$/ha)		26,692.3	26,094.1	26,418.3	
49	Cost per m3		(US\$/m3)		1.8	1.2	1.2	1.3
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)		80.7	131.5	130.2	
53	Capital Costs		(US\$'000)		166.3	271.0	268.2	
54	Total Annual Cost		(US\$'000)		247.0	402.5	398.4	
55	Unit Cost per m3		(US\$/m3)		0.8	0.5	0.5	
56	-----							
57	Remarks:							
58								
59								
60								
61								
62								
63	-----							



U- 36 Hola

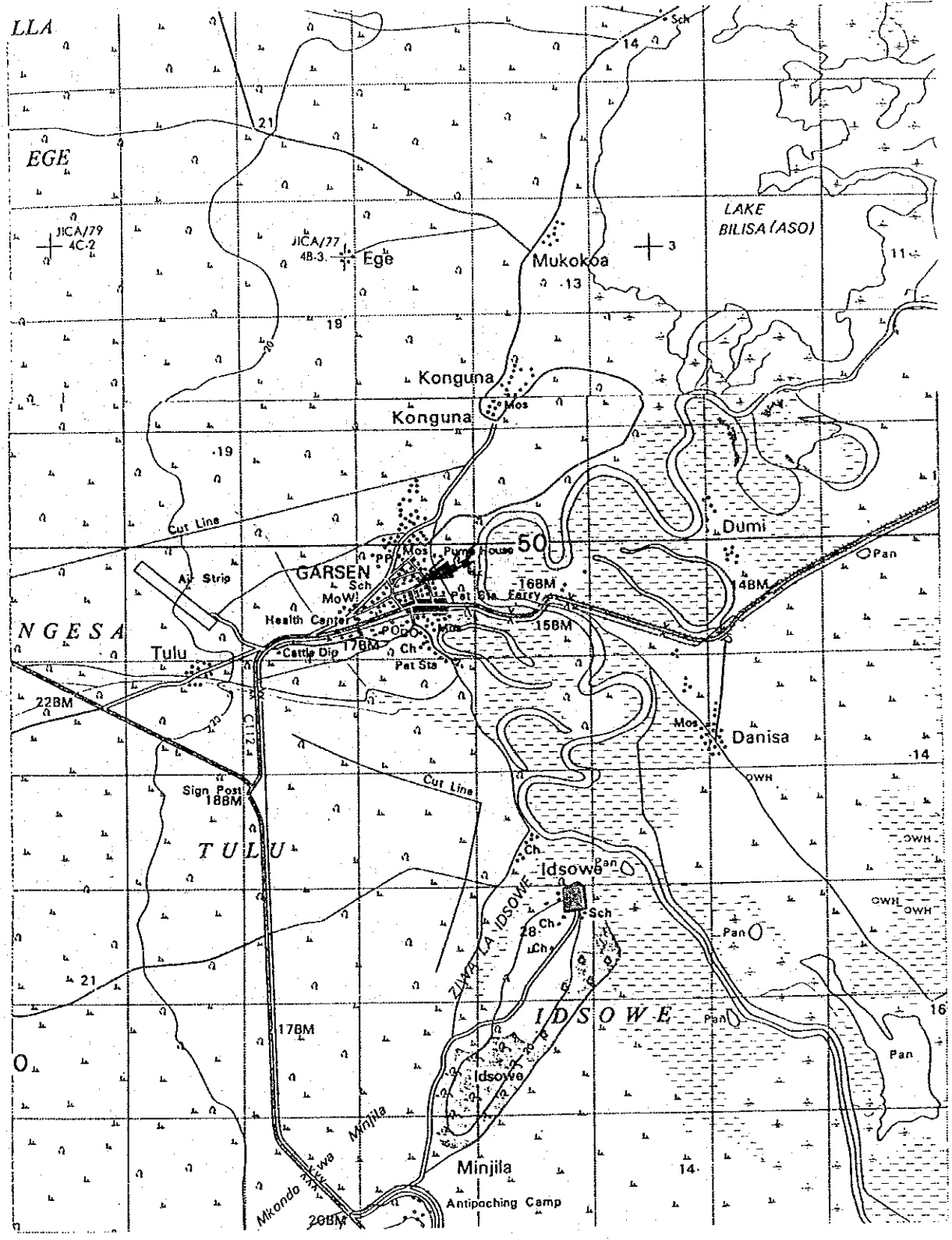
U 363.3 155/3 4GF



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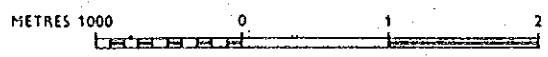
a	b	c	d	e	f	g	h	i	
2									
3			National Water Master Plan					Feb-92	
4	Code No. 360		URBAN WATER SUPPLY			Rate		25.2	
5									
6	Name of Urban:		Garsen			L.G.L Notice No:			
7	Organization:								
8	Per Capita GRDP in 1988 (guess):					364.1	Bilisa		
9	District:		T. River	Locataion :					
10	Map (1/50,000):		179/3	Coordinates X:			40°09'	Y: S 02°16'	
11	Sub-basin Code:		4GG	Elevation (El. m):					
12									
13	Existing Facilities								
14	Raw Water Source:		Tana River				River No		
15	Raw Water System:		H (m)=	L (m)=					
16	Treatment:			Capacity (m3/d)			170		
17	Distribution System:								
18									
19						1990	2000	2010	
20									
21	Projected Population			(no)		3,600	8,000	11,700	
22	Residential Demand			(m3/d)		446	1,013	1,514	
23	Non-residential Demand			(m3/d)		75	165	242	
24	Livestock Demand			(m3/d)		49	94	126	
25	Industrial Demand			(m3/d)		0	0	0	
26	Total Demand			(m3/d)		570	1,272	1,882	
27	Area Served (estimated net)			(ha)		27	60	87	
28									
29	Future Development Plan								
30	Raw Water Source:		Tana River				River No:		
31	Raw Water System:		H (m)=	20 L (m)=			600		
32	Treatment:								
33	Distribution System:								
34									
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity			(m3/d)		400.0	702.1	609.7	1,711.7
37	Source Works			(US\$'000)		5.3	8.1	7.3	20.7
38	Pump Cost			(US\$'000)		1.1	1.2	1.1	3.4
39	Raw Water Main			(US\$'000)		24.9	26.8	26.3	78.1
40	Treatment			(US\$'000)		253.1	350.2	323.2	926.6
41	Storage			(US\$'000)		43.2	60.3	55.5	159.0
42	Distribution			(US\$'000)		215.1	262.9	221.1	699.0
43	Miscellaneous (20%)			(US\$'000)		108.5	141.9	126.9	377.4
44	Admi. & Engineering			(US\$'000)		65.1	85.1	76.1	226.4
45	Contingency			(US\$'000)		143.3	187.3	167.5	498.1
46	Total Cost			(US\$'000)		859.7	1,123.9	1,005.2	2,988.7
47	Cost per Capita			(US\$/c)		238.8	255.4	271.7	
48	Cost per ha			(US\$/ha)		31,975.9	34,203.1	36,377.5	
49	Cost per m3			(US\$/m3)		2.1	1.6	1.6	1.7
50									
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs			(US\$'000)		43.0	56.2	50.3	
53	Capital Costs			(US\$'000)		88.5	115.8	103.5	
54	Total Annual Cost			(US\$'000)		131.5	172.0	153.8	
55	Unit Cost per m3			(US\$/m3)		0.9	0.7	0.7	
56									
57	Remarks:								
58									
59									
60									
61									
62									
63									

Fig.



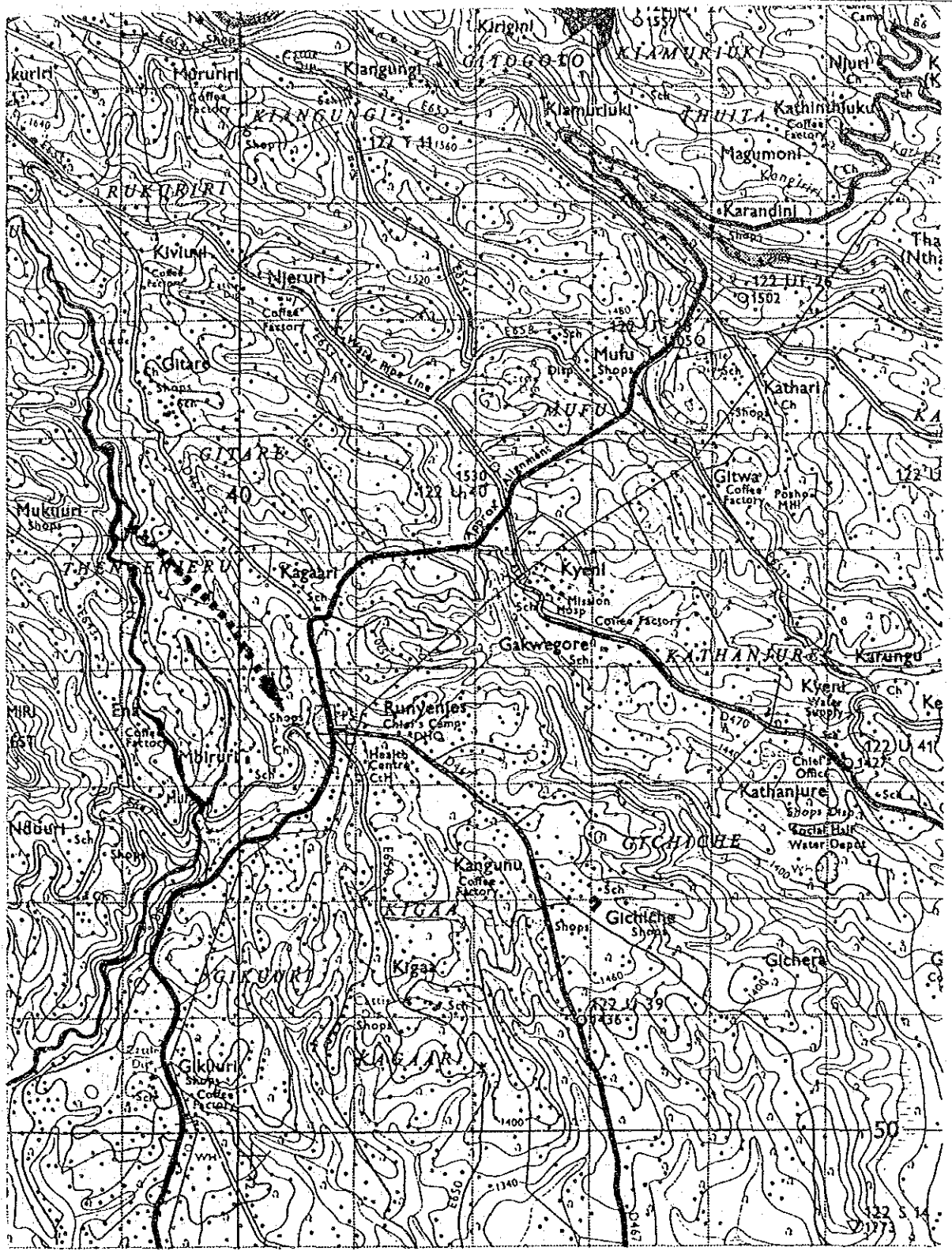
U- 37 Garsen

U 364.1 179/3 4GG



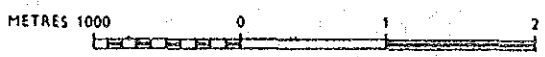
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a	b	c	d	e	f	g	h	i
2						National Water Master Plan		
3			URBAN WATER SUPPLY					Jul-92
4	Code No. 410		U- 38			Rate		25.2
5	-----							
6	Name of Urban:		Runyenjes			LGL Notice No:		
7	Organization:							
8	Per Capita GRDP in 1988 (guess):							
9	District:		Embu	Locataion :		411.8 Kangaari South		
10	Map (1/50,000):		122/3	Coordinates X:		37°34'	Y:	S 00°24'
11	Sub-basin Code:		4EC	Elevation (El. m):				
12	-----							
13	Existing Facilities							
14	Raw Water Source:		Ena River			River No		
15	Raw Water System:		H (m)=	L (m)=				
16	Treatment:			Capacity (m3/d)		135		
17	Distribution System:							
18	-----							
19					1990	2000	2010	
20	-----							
21	Projected Population			(no)	2,000	4,100	6,100	
22	Residential Demand			(m3/d)	248	519	789	
23	Non-residential Demand			(m3/d)	41	84	126	
24	Livestock Demand			(m3/d)	4	7	10	
25	Industrial Demand			(m3/d)	114	211	303	
26	Total Demand			(m3/d)	407	821	1,228	
27	Area Served (estimated net)			(ha)	15	31	46	
28	-----							
29	Future Development Plan							
30	Raw Water Source:		Ena river			River No:		
31	Raw Water System:		H (m)=	0 L (m)=		2,100		
32	Treatment:							
33	Distribution System:							
34	-----							
35	Incremental Capital Cost				1990	2000	2010	Total
36	Incremental Capacity			(m3/d)	271.8	414.4	407.0	1,093.2
37	Source Works			(US\$'000)	4.0	5.5	5.4	14.8
38	Pump Cost			(US\$'000)	0.0	0.0	0.0	0.0
39	Raw Water Main			(US\$'000)	83.7	87.6	87.4	258.6
40	Treatment			(US\$'000)	201.3	258.5	255.8	715.5
41	Storage			(US\$'000)	34.0	44.1	43.6	121.7
42	Distribution			(US\$'000)	119.5	125.5	119.5	364.4
43	Miscellaneous (20%)			(US\$'000)	88.5	104.2	102.3	295.0
44	Admi. & Engineering			(US\$'000)	53.1	62.5	61.4	177.0
45	Contingency			(US\$'000)	116.8	137.6	135.1	389.4
46	Total Cost			(US\$'000)	700.8	825.4	810.5	2,336.7
47	Cost per Capita			(US\$/c)	350.4	393.1	405.2	
48	Cost per ha			(US\$/ha)	46,918.3	52,632.6	54,264.7	
49	Cost per m3			(US\$/m3)	2.6	2.0	2.0	2.1
50	-----							
51	Present Value of Water at DF=10 %				1990	2000	2010	Total
52	Direct O & M Costs			(US\$'000)	35.0	41.3	40.5	
53	Capital Costs			(US\$'000)	72.2	85.0	83.5	
54	Total Annual Cost			(US\$'000)	107.2	126.3	124.0	
55	Unit Cost per m3			(US\$/m3)	1.1	0.8	0.8	
56	-----							
57	Remarks:							
58								
59								
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62								
63	-----							



U- 38 Runyenjes

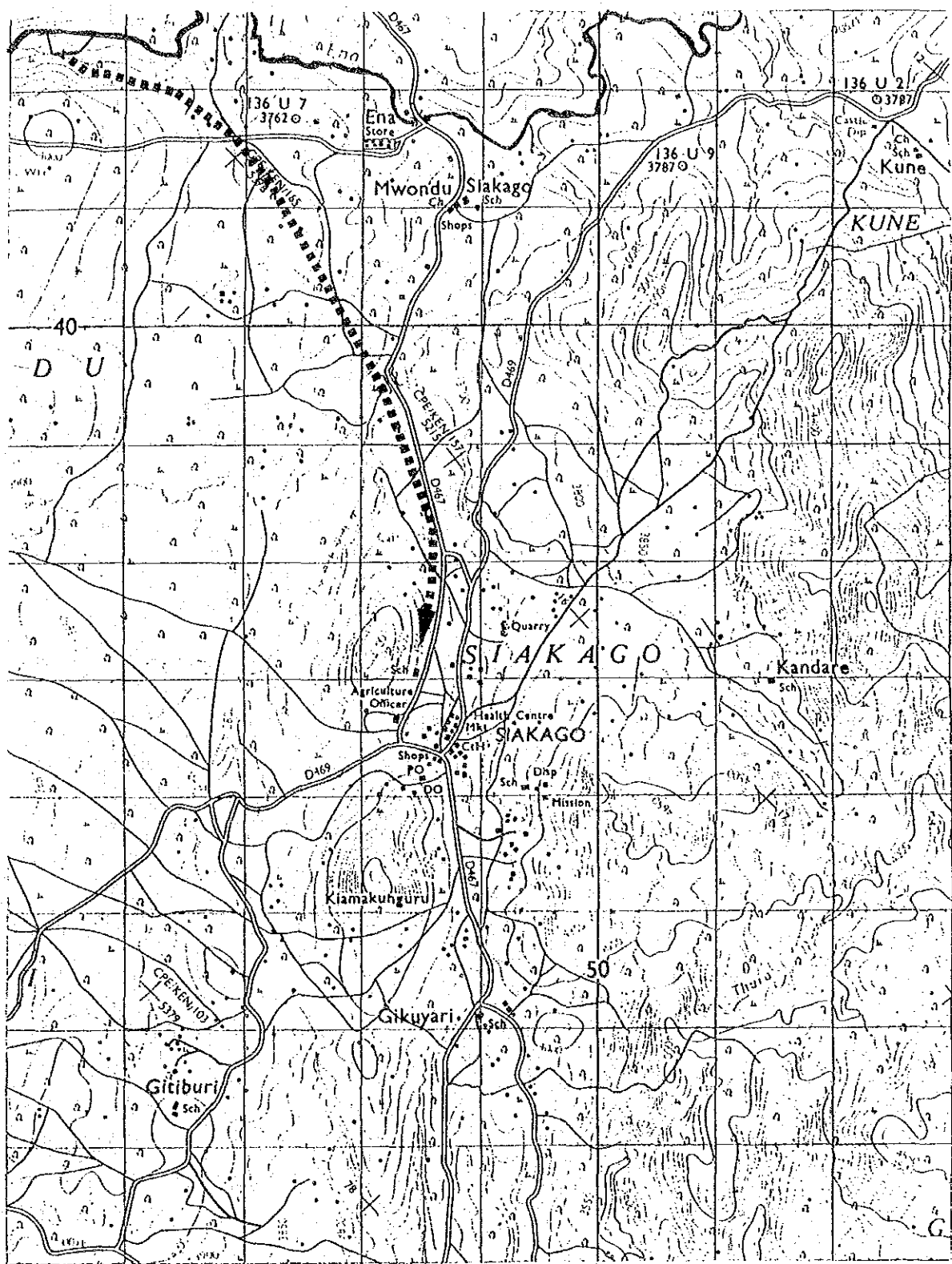
U 411.8 122/3 4EC



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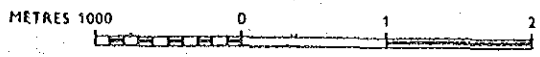
a	b	c	d	e	f	g	h	i	
2						National Water Master Plan			
3			URBAN WATER SUPPLY					Feb-92	
4	Code No. 410		U- 39			Rate		25.2	
5	-----								
6	Name of Urban:		Siakago		LGL Notice No:				
7	Organization:								
8	Per Capita GRDP in 1988 (guess):					412.1 Nthawa			
9	District:		Embu	Locataion :					
10	Map (1/50,000) :		136/1	Coordinates X:		37°38'	Y:	S 00°34'	
11	Sub-basin Code:		4EC	Elevation (El. m):					
12	-----								
13	Existing Facilities								
14	Raw Water Source:		Ena River			River No			
15	Raw Water System:		H (m)=	L (m)=					
16	Treatment:			Capacity (m3/d)		228			
17	Distribution System:								
18	-----								
19						1990	2000	2010	
20	-----								
21	Projected Population		(no)			400	600	800	
22	Residential Demand		(m3/d)			50	76	104	
23	Non-residential Demand		(m3/d)			0	11	15	
24	Livestock Demand		(m3/d)			0	1	1	
25	Industrial Demand		(m3/d)			0	0	0	
26	Total Demand		(m3/d)			50	88	120	
27	Area Served (estimated net)		(ha)			3	4	6	
28	-----								
29	Future Development Plan								
30	Raw Water Source:		Ena River			River No:			
31	Raw Water System:		H (m)=	70 L (m)=		7,000			
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost					1990	2000	2010	Total
36	Incremental Capacity		(m3/d)			0.0	0.0	0.0	0.0
37	Source Works		(US\$'000)			0.0	0.0	0.0	0.0
38	Pump Cost		(US\$'000)			0.0	0.0	0.0	0.0
39	Raw Water Main		(US\$'000)			0.0	0.0	0.0	0.0
40	Treatment		(US\$'000)			0.0	0.0	0.0	0.0
41	Storage		(US\$'000)			0.0	0.0	0.0	0.0
42	Distribution		(US\$'000)			0.0	0.0	0.0	0.0
43	Miscellaneous (20%)		(US\$'000)			0.0	0.0	0.0	0.0
44	Admi. & Engineering		(US\$'000)			0.0	0.0	0.0	0.0
45	Contingency		(US\$'000)			0.0	0.0	0.0	0.0
46	Total Cost		(US\$'000)			0.0	0.0	0.0	0.0
47	Cost per Capita		(US\$/c)			0.0	0.0	0.0	
48	Cost per ha		(US\$/ha)			0.0	0.0	0.0	
49	Cost per m3		(US\$/m3)			0.0	0.0	0.0	0.0
50	-----								
51	Present Value of Water at DF=10 %					1990	2000	2010	Total
52	Direct O & M Costs		(US\$'000)			0.0	0.0	0.0	
53	Capital Costs		(US\$'000)			0.0	0.0	0.0	
54	Total Annual Cost		(US\$'000)			0.0	0.0	0.0	
55	Unit Cost per m3		(US\$/m3)			0.0	0.0	0.0	
56	-----								
57	Remarks:	It appears that existing facility could meet the demand up to year 2010.							
58									
59									
60									
61									
62									
63	-----								

Fig.



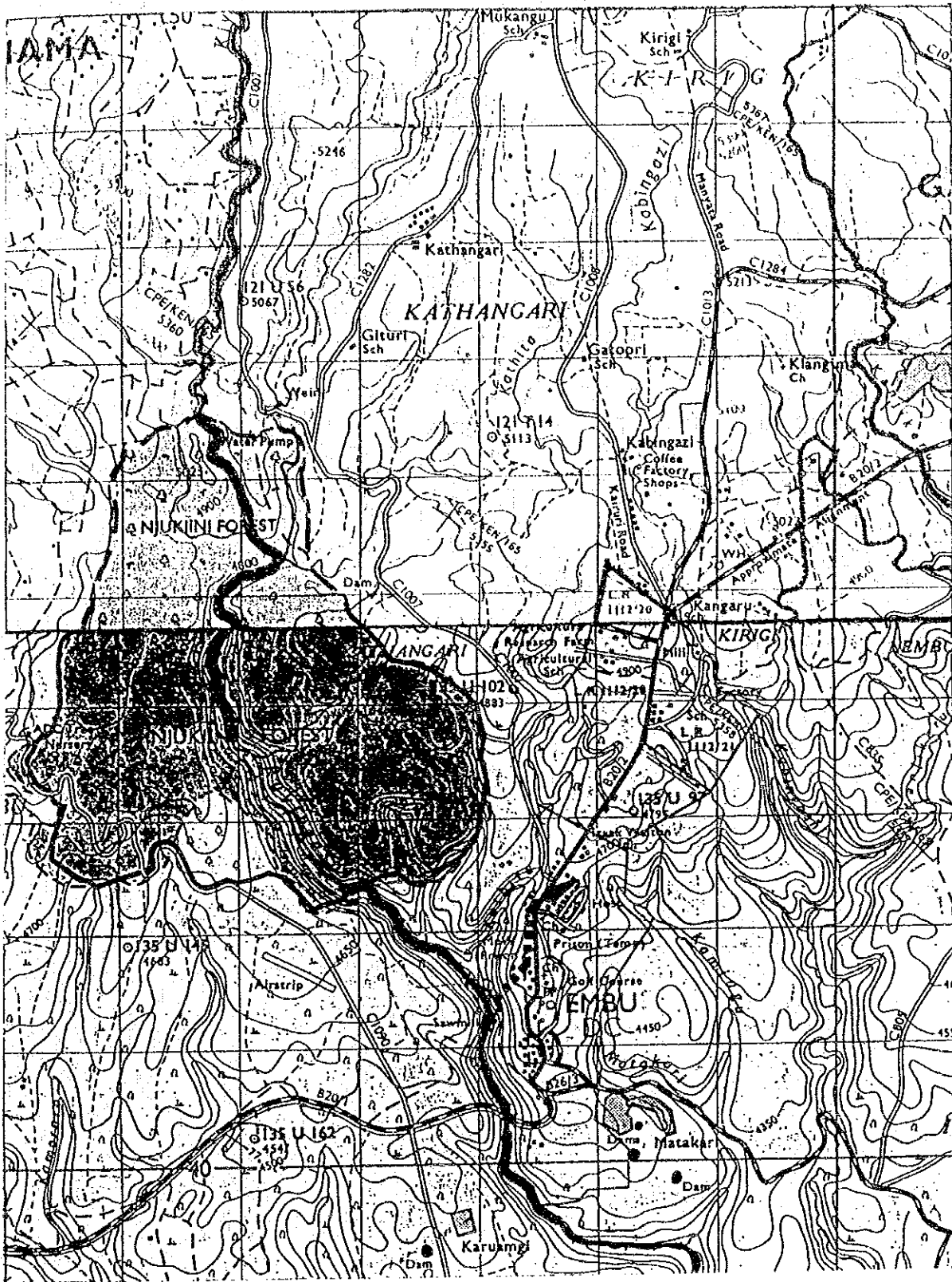
U- 39 Siakago

U 412.1 136/1 4EC



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a	b	c	d	e	f	g	h	i	
2	National Water Master Plan							Jul-92	
3	URBAN WATER SUPPLY							25.2	
4	Code No. 410		U- 40			Rate			
5	-----								
6	Name of Urban:		Embu		LGL Notice No:				
7	Organization:								
8	Per Capita GRDP in 1988 (guess):								
9	District:		Embu	Locataion :	413.7	Embu Municipality			
10	Map (1/50,000) :		135/2	Coordinates X:		37°27'	Y:	S 00°31'	
11	Sub-basin Code:		4DC	Elevation (El. m):					
12	-----								
13	Existing Facilities								
14	Raw Water Source:		Kapingazi River + Rupingazi River			River No			
15	Raw Water System:		H (m)=	L (m)=					
16	Treatment:		Capacity (m3/d)			3200			
17	Distribution System:								
18	-----								
19					1990	2000	2010		
20	-----								
21	Projected Population		(no)		18,400	44,400	72,900		
22	Residential Demand		(m3/d)		2,279	5,622	9,431		
23	Non-residential Demand		(m3/d)		381	919	1,510		
24	Livestock Demand		(m3/d)		33	76	123		
25	Industrial Demand		(m3/d)		317	584	835		
26	Total Demand		(m3/d)		3,010	7,201	11,899		
27	Area Served (estimated net)		(ha)		137	332	544		
28	-----								
29	Future Development Plan								
30	Raw Water Source:		Lower Kapingazi River + Upper Rupingazi River						
31	Raw Water System:		H (m)=	130	L (m)=	1,500			
32	Treatment:								
33	Distribution System:								
34	-----								
35	Incremental Capital Cost				1990	2000	2010	Total	
36	Incremental Capacity		(m3/d)		0.0	4,001.2	4,698.3	8,699.4	
37	Source Works		(US\$'000)		0.0	29.9	33.8	63.7	
38	Pump Cost		(US\$'000)		0.0	11.4	12.9	24.3	
39	Raw Water Main		(US\$'000)		0.0	97.5	102.4	199.9	
40	Treatment		(US\$'000)		0.0	851.5	910.8	1,762.3	
41	Storage		(US\$'000)		0.0	137.0	143.4	280.4	
42	Distribution		(US\$'000)		0.0	1,553.3	1,702.7	3,256.0	
43	Miscellaneous (20%)		(US\$'000)		0.0	536.2	581.2	1,117.3	
44	Admi. & Engineering		(US\$'000)		0.0	321.7	348.7	670.4	
45	Contingency		(US\$'000)		0.0	707.7	767.2	1,474.9	
46	Total Cost		(US\$'000)		0.0	4,246.3	4,603.0	8,849.3	
47	Cost per Capita		(US\$/c)		0.0	163.3	161.5		
48	Cost per ha		(US\$/ha)		0.0	21,869.6	21,626.7		
49	Cost per m3		(US\$/m3)		0.0	1.1	1.0	1.0	
50	-----								
51	Present Value of Water at DF=10 %				1990	2000	2010	Total	
52	Direct O & M Costs		(US\$'000)		0.0	212.3	230.1		
53	Capital Costs		(US\$'000)		0.0	437.4	474.1		
54	Total Annual Cost		(US\$'000)		0.0	649.7	704.3		
55	Unit Cost per m3		(US\$/m3)		0.0	0.4	0.4		
56	-----								
57	Remarks:								
58									
59									
60									
61									
62									
63	-----								



U- 40 Embu

G 413.7 135/2 4DC

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