

TABLES

Table 2.1 Real Growth Rates of GDP

(Unit: % in real terms)

Period/Year	Growth rate	Year	Growth rate
1964 - 69	Average 5.8	1980	3.3
1970	6.8	1981	5.3
1971	7.0	1982	3.4
1972	6.8	1983	3.9
1973	4.3	1984	0.9
1974	1.1		
1975	4.1		
1976	2.4		
1977	8.8		
1978	6.6		
1979	3.3		

Average 5.1

- Sources: (1) Economic Survey 1980 (1970 - 79)
 (2) Economic Survey 1983 (1980 - 83)
 (3) Figure for 1964 - 69 calculated from the figures for 1964 - 72 in (2)
 (4) EIU, Quarterly Economic Review of Kenya, No.3, 1985 (1984)

Table 2.2 GDP by Sector at Current Prices, 1970, 1979 and 1983

(Unit: 10^3 k£, % shares in parentheses)

Sector	1970	1979	1983
Agriculture, forestry and fishery	173.0 (33.1)	679.0 (34.4)	1,091.6 (33.2)
Mining and quarrying	2.4 (0.5)	5.0 (0.3)	6.2 (0.2)
Manufacturing	62.2 (11.9)	249.8 (12.6)	408.3 (12.4)
Electricity and water	12.0 (2.3)	42.3 (2.2)	76.8 (2.3)
Construction	62.4 (5.1)	117.5 (5.9)	180.2 (5.5)
Wholesale and retail trade, hotels and restaurants	55.8 (10.7)	209.2 (10.6)	346.3 (10.5)
Transport & communications	40.8 (7.8)	114.7 (5.8)	195.3 (5.9)
Government services	76.5 (14.7)	290.3 (14.7)	481.4 (14.6)
Other services	72.8 (13.9)	267.2 (13.5)	505.2 (15.4)
Total GDP at factor cost	521.9	1,975.0	3,291.2

Sources: Statistical Abstracts 1970, 1979 and 1983

Table 2.3 Commodity Composition of External Trade

	1964	1970	1979	Year 1980	1981	1982	1983*/
<u>Exports</u>							
Coffee	32.7	21.6	28.7	22.2	21.3	26.5	25.4
Tea	12.9	12.8	16.3	17.9	11.9	14.2	19.6
Petroleum products	4.6	13.4	17.7	31.1	30.7	27.4	18.8
Others	49.8	52.2	37.3	34.8	36.1	31.9	36.2
<u>Imports</u>							
Consumer goods	30.1	23.2	11.8	10.4	9.8	10.7	13.5
Industrial supplies	34.7	36.0	29.0	27.3	24.9	24.9	27.3
Fuels & lubricants	9.9	9.3	23.7	33.6	38.7	37.2	36.6
Machinery, capital & transport equipment	25.3	31.4	35.5	28.7	26.5	27.1	22.6

* Provisional

Sources: Development Plan 1984 - 88 (1964, 1970, 1979 - 81)
 Statistical Abstract 1983 (1982)
 Economic Survey 1984 (1983, Imports)
 EIU, op. cit. (1983, Exports)

Table 2.4 Current Account Balance

(Unit: 10⁶ K£)

	1964	1969	1979	Year 1980	1981	1982*/	1983*/
Trade balance	-9.4	-31.6	-299.4	-526.6	-495.4	-430.4	-335.6
Net services	14.4	20.1	79.0	143.2	126.3	140.2	143.5
Net transfer	12.5	8.1	34.1	54.7	42.9	36.8	76.5
Current account balance	17.5	-2.9	-186.3	-328.7	-326.2	-253.4	-115.6

* Provisional

Sources: Development Plan 1984 - 88 (1964, 1969, 1979 - 81)
 EIU, op. cit. (1982, 1983)

Table 3.1 Population by Tribe, Race and Nationality (1979 Census) (1/2)

Tribe or Nationality	Male	Female	Total
Kenyans			
Kikuyu	1,582,145	1,620,676	3,202,821
Embu	89,471	90,929	180,400
Meru	416,800	423,704	840,504
Mbere	29,242	32,483	61,725
Kamba	852,360	873,209	1,725,569
Tharaka	4,763	4,919	9,682
Luhya	1,048,914	1,070,794	2,119,708
Kisii	469,629	474,458	944,087
Kuria	46,388	42,781	89,169
Mijikenda	357,116	375,714	732,830
Pokomo	19,835	19,906	39,741
Taita	74,068	79,051	153,119
Taveta	3,850	3,826	7,676
Swahili/Shirazi	2,903	2,743	5,646
Bajun	18,304	18,667	36,971
Boni/Sanye	2,108	2,062	4,170
Luo	966,548	989,297	1,955,845
Kalenjin	820,749	831,494	1,652,243
Masai	120,838	120,557	241,395
Samburu	36,168	37,457	73,625
Turkana	106,009	101,240	207,249
Teso	66,192	66,295	123,487
Nderobo	3,698	3,502	7,200
Njemps	3,668	3,878	7,546
Rendille	10,940	10,854	21,794
Boran	35,306	33,588	68,894
Gabbra	15,467	15,086	30,553
Sakuye	926	893	1,824
Orma	16,134	15,993	32,127
Gosha	917	935	1,852
Hawiyah	811	793	1,604
Ogaden	13,584	12,058	25,642
Ajuran	11,309	10,697	22,006
Gurreh	41,901	41,182	83,083
Degodia	49,227	43,808	93,035
Somali (so stated)	83,119	72,575	155,695
Basuba	29,889	29,779	59,668
El Molo	277	261	538
Asian	17,402	15,152	32,554
European	2,200	2,245	4,445
Arab	9,486	9,375	18,861
Other Kenyans	29,711	27,708	57,318
Total Kenyans	7,510,372	7,632,528	15,142,900

Table 3.1 Population by Tribe, Race and Nationality (1979 Census) (2/2)

Tribe or Nationality	Male	Female	Total
Non-Kenyans			
Africans	39,744	32,074	71,818
Asians	23,755	22,291	46,046
Europeans	17,409	18,047	35,456
Arabs	10,562	9,723	20,285
Others	5,102	5,111	10,213
Total Non-Kenyans	96,572	87,246	183,818
Not stated	169	174	343
Total	7,607,113	7,719,948	15,327,061

Source: Statistical Abstract 1983.

Table 3.2 Population, Density, Growth Rates and Projections of Project Area

	Kenya	Western Province	Nyanza Province	Kisumu	Siaya	S.Nyanza	Kisii	Kericho, Rift Valley Province
Total Land Area (km ²)	571,416	8,223	12,526	2,093	2,523	5,714	2,196	4,890
Population (10 ³ persons) 1969 census	10,943	1,328	2,122	401	383	663	675	479
Population (10 ³ persons) 1979 census	15,327	1,833	2,644	482	475	818	870	633
Population Density per km ² 1979	27	223	211	230	188	143	395	161
Population Growth Rate % per annum	3.4	3.3	2.2	1.9	2.2	2.1	2.6	2.8
Projected Population 1985	20,241	2,355	3,632	635	651	1,120	1,206	816
Projected Population 1990	24,397	2,837	4,323	773	773	1,329	1,447	984
Projected Population 2000	34,792							

Source: Census 1969, Census 1979; CBS, Population Projection for Kenya 1980 - 2000, March, 1983.

Table 3.3 Planted Area and Production by Crop (1982) (1/2)

i) Cereals

District	Maize		Finger Millet		Sorghum		Rice	
	ha	10 ³ ton	ha	10 ³ ton	ha	10 ³ ton	ha	ton
Kisumu	13,000	29.3	750	0.4	10,000	10.8	283	401
Siaya	42,112	75.8	678	0.4	22,540	20.3	14	16
S. Nyanza	86,909	234.7	8,034	4.9	12,540	13.5	685	668
Kisii	64,820	192.1	2,386	1.7	564	0.6	-	-
Kericho	70,232	221.1	4,335	3.9	-	-	-	-

ii) Root Crop and Pulses

District	Cassava		Sweet Potatoes		Irish Potatoes		Beans	
	ha	10 ³ ton	ha	10 ³ ton	ha	-	ha	10 ³ ton
Kisumu	618	4.9	1,170	1.3	-	-	1,765	1.0
Siaya	6,830	47.8	2,590	2.8	-	-	12,121	6.0
S. Nyanza	16,836	117.9	18,818	3.2	52	na	15,459	11.1
Kisii	160	1.9	2,570	15.2	1,300	na	18,208	13.9
Kericho	-	-	1,455	19.6	-	-	4,767	4.3

Table 3.3 Planted Area and Production by Crop (1982) (2/2)

iii) Cash Crops

District	Coffee		Tea		Cotton		Pyrethrum		Sugar Cane	
	ha	ton	ha	10 ³ ton	ha	10 ³ ton	ha	ton	ha	10 ³ ton
Kisumu	75	3.1	-	-	7,200	2.0	-	-	30,750	1045.4
Siaya	44	4.9	-	-	10,531	1.3	-	-	1,055	26.4
S.Nyanza	1,266	645	-	-	27,990	2.3	-	-	8,539	298.9
Kisii	7,000	2,402	7,974	na	-	-	8,429	na	-	-
Kericho	221	11	7,120	21.1	-	-	-	-	5,022	52.0

Source: "Annual Report 1982 Nyanza Province MOA
 "Annual Report 1981 Rift Valley Province MOA

Remarks: na - data not available.

Table 3.4 Total Catch of Lake Victoria Fisheries

(Unit: ton)

Year	Catch	Year	Catch
1968	16,357	1976	18,680
69	17,442	77	19,332
70	16,400	78	23,856
71	14,918	79	30,592
72	15,980	80	26,914
73	16,797	81	38,179
74	17,175	82	60,958
75	16,581	83	77,328

Source: Zonneveld 1984 (1982 - 83)

Statistical Abstract 1983 (1979 - 81)

Univ. of Nairobi, IDS Occasional Paper
No. 34 (1968 - 77)

Economic Survey 1980 (1978)

Table 4.1 Probable Rainfall (1/2)

1-day Rainfall

Recurrence Interval	Probability Distribution		
	Pearson III	Extremal I	Lognormal
2	46.5	46.3	46.5
5	60.7	59.8	60.3
10	69.8	68.7	69.1
20	78.3	77.3	77.3
25	80.9	80.0	83.2
50	89.1	88.4	87.8
100	97.1	96.7	95.6
200	105.1	105.0	103.4
500	115.6	115.9	113.7
1000	123.7	124.1	121.0

3-day Rainfall

Recurrence Interval	Probability Distribution		
	Pearson III	Extremal I	Lognormal
2	78.4	77.6	78.3
5	99.4	98.3	99.4
10	112.6	112.1	112.7
20	124.8	125.2	124.9
25	128.5	129.4	133.6
50	140.0	142.2	140.3
100	151.3	155.0	151.6
200	162.3	167.7	162.7
500	176.8	184.4	177.3
1000	187.7	197.1	187.7

5-day Rainfall

Recurrence Interval	Probability Distribution		
	Pearson III	Extremal I	Lognormal
2	102.8	102.0	102.7
5	131.5	129.6	130.9
10	149.6	147.9	148.7
20	166.4	165.4	165.2
25	171.6	170.9	176.8
50	187.5	188.0	185.9
100	203.1	205.0	201.2
200	218.5	222.0	216.3
500	238.8	244.3	236.3
1000	254.1	261.2	250.5

Table 4.1 Probable Rainfall (2/2)

7-day Rainfall

Recurrence Interval	Probability Distribution		
	Pearson III	Extremal I	Lognormal
2	126.8	126.0	126.2
5	160.0	158.0	159.8
10	180.9	179.2	180.9
20	200.1	199.6	200.4
25	206.1	206.0	214.2
50	224.3	225.9	225.0
100	242.0	245.7	243.1
200	259.6	265.3	260.9
500	282.6	291.3	284.5
1000	300.0	310.9	301.1

15-day Rainfall

Recurrence Interval	Probability Distribution		
	Pearson III	Extremal I	Lognormal
2	196.4	194.8	196.5
5	246.5	240.4	243.1
10	277.5	270.5	272.0
20	306.1	299.5	298.5
25	315.0	308.7	306.8
50	341.8	337.0	331.8
100	367.8	365.1	356.0
200	393.4	373.0	379.9
500	426.8	430.0	411.0
1000	451.9	457.9	434.4

Table 4.2 Monthly Mean Discharge at LJGI (1/2)

Unit : m³/sec

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1946	4.50	4.67	4.23	110.48	92.02	87.55	(35.21)	45.12	28.54	31.42	45.78	123.48	51.28
1947	13.16	11.83	15.58	99.60	264.97	79.78	52.07	56.27	59.93	53.99	13.44	8.50	61.13
1948	5.30	(3.46)	(2.79)	(5.17)	9.61	25.33	26.59	57.29	64.40	19.03	10.30	2.78	19.35
1949	3.49	2.78	1.74	4.15	5.53	13.46	15.77	36.09	57.62	23.48	10.85	(9.31)	15.39
1950	6.58	3.89	5.72	14.07	20.89	22.62	35.44	44.78	57.90	24.23	10.47	6.96	21.21
1951	4.50	4.67	4.23	110.48	92.02	87.55	(35.21)	45.12	28.54	31.42	45.78	123.48	51.28
1952	60.32	14.73	8.72	44.83	201.45	65.52	29.04	52.92	46.56	25.71	15.73	10.62	48.33
1953	5.49	3.17	2.31	6.16	9.86	10.75	9.85	11.96	9.73	7.05	6.65	6.45	7.48
1954	(3.32)	1.72	1.58	5.89	45.75	75.33	39.00	34.10	56.07	26.91	13.32	11.00	26.16
1955	5.92	5.55	3.10	6.81	16.26	10.25	16.51	45.16	86.04	(63.39)	25.04	(19.21)	25.36
1956	41.62	31.56	14.51	36.77	104.10	75.25	48.16	54.04	86.63	40.64	27.72	16.73	48.14
1957	8.58	6.95	6.57	47.67	113.96	149.81	63.26	53.37	45.54	15.27	10.62	9.40	44.35
1958	6.47	(9.71)	9.70	9.76	66.99	33.78	34.66	32.82	45.29	27.77	13.87	11.52	25.32
1959	8.64	6.64	11.68	37.04	69.75	35.22	16.09	18.29	28.56	22.84	23.27	14.49	24.44
1960	9.74	6.20	17.90	70.06	62.60	55.34	36.56	40.10	78.78	43.50	23.21	13.08	38.06
1961	(6.76)	4.54	4.32	9.72	24.06	15.55	(12.92)	(33.03)	46.28	56.62	258.81	(227.19)	58.49
1962	(85.56)	26.66	12.65	32.71	182.56	111.75	88.55	(45.75)	(86.22)	(73.18)	(31.11)	(18.04)	66.56
1963	31.95	24.98	21.17	74.05	264.96	118.43	34.96	51.32	37.63	10.98	12.69	88.08	64.63
1964	33.83	13.38	25.37	183.64	108.52	49.04	69.10	71.89	60.73	75.29	22.12	11.40	60.41
1965	10.03	6.37	4.01	32.45	72.74	23.59	15.38	16.38	17.01	11.81	31.57	22.14	22.04
1966	11.02	11.29	32.36	89.45	80.88	33.29	26.36	24.60	71.05	24.10	22.88	11.86	36.61
1967	6.55	4.35	3.64	19.93	(99.09)	64.22	(75.48)	(40.09)	30.81	17.02	(21.22)	(57.12)	36.92
1968	15.32	17.18	51.35	122.92	160.99	92.59	57.35	93.56	46.83	17.75	29.27	93.28	66.73
1969	22.83	48.94	39.46	29.85	37.70	23.70	14.16	16.94	34.87	14.15	9.58	6.89	24.71
1970	14.33	22.60	66.73	126.23	115.65	82.58	42.54	79.93	79.54	59.12	27.14	(11.90)	60.80

Table 4.2 Monthly Mean Discharge at LJGI (2/2)

Unit : m³/sec

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1971	10.54	6.86	4.61	11.21	41.77	(66.50)	64.14	(100.38)	(93.93)	46.17	16.84	10.38	39.63
1972	10.25	9.19	7.44	7.66	32.37	(41.38)	45.88	44.40	26.74	19.83	74.83	47.23	30.62
1973	43.61	32.63	20.06	12.45	33.23	80.71	(31.40)	48.67	62.91	36.59	30.01	13.36	37.07
1974	7.11	4.50	5.71	71.24	51.20	56.58	130.91	67.00	55.03	42.84	24.24	11.02	44.27
1975	6.21	(4.42)	5.50	28.79	33.33	50.50	42.40	94.43	136.64	81.90	36.79	14.41	44.74
1976	8.89	6.17	5.39	8.42	22.84	41.59	58.00	50.89	73.24	21.65	11.29	9.07	26.49
1977	11.65	24.01	13.92	89.55	163.96	81.02	109.92	78.33	53.35	26.12	109.91	78.31	70.40
1978	(31.26)	28.15	168.06	198.19	(153.49)	46.46	58.52	55.92	70.46	73.79	40.71	28.57	79.78
1979	21.22	69.63	48.07	69.45	92.72	75.23	56.32	63.41	35.35	(15.33)	(10.08)	7.65	46.85
1980	5.87	5.22	7.70	(14.76)	39.42	55.90	64.56	33.42	32.28	14.00	13.23	(10.36)	24.79
1981	(5.69)	6.26	12.53	142.07	93.51	33.41	40.33	79.29	62.33	(56.68)	22.00	(13.11)	47.41
1982	(7.57)	(4.48)	(2.66)	(4.82)	(44.02)	72.24	36.89	65.10	50.18	35.82	122.30	163.90	51.09
1983	26.80	11.74	7.50	16.96	48.94	50.50	42.83	55.15	107.71	80.22	51.82	24.52	43.84
Mean	16.70	13.69	17.86	49.99	81.46	56.74	45.12	51.98	58.09	36.01	34.14	32.98	41.59

Note: Parentheses show the data substantially interpolated.

Table 4.3 Monthly Mean Discharge of the Nyando (1/4)

Unit : m³/sec

Station : IGD1

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1948				9.32	12.75	25.11	18.32	21.17	18.27	6.12	4.05	2.29	13.30
1949	2.39	2.62	0.69	5.95	8.33	9.50	9.27	20.11	23.19	6.45	2.80	2.78	7.87
1950	1.86	1.06	5.30	5.29	4.17	5.36	19.25	28.09	22.04	8.30	2.92	1.98	8.71
1951	1.46	1.49	1.66	87.73	38.90	21.09	7.99	17.96	8.31	8.40	13.49	38.92	20.48
1952	10.98	4.65	3.03	25.92	79.78	16.95	11.39	17.85	31.06	8.84	6.88	2.02	18.37
1953	2.01	1.33	0.96	4.32	5.98	5.84	4.56	9.80	3.20	2.24	1.91	1.89	3.66
1954	1.06	0.75	0.77	3.99	27.74	13.04	23.09	30.18	33.59	7.94	2.93	2.84	12.30
1955	1.58	2.83	3.49	9.07	12.56	2.81	4.23	24.51	34.32	20.68	5.54	4.94	10.54
1956	14.52	7.53	4.53	13.48	22.47	14.20	20.61	41.15	28.60	15.29	5.04	3.58	15.73
1957	2.48	2.73	2.51	16.06	21.77	41.19	15.63	19.85	10.84	3.79	3.36	2.63	11.39
1958	1.89	4.86	5.09	2.45	20.00	10.83	22.82	18.59	18.17	8.93	3.20	3.59	10.07
1959	2.72	2.04	4.87	12.35	16.45	4.20	3.47	5.11	11.38	7.65	12.88	4.73	7.41
1960	2.60	1.84	10.95	29.96	49.73	16.63	8.13	13.44	19.86	8.01	9.04	3.07	14.59
1961	7.05	-	-	5.05	6.37	-	3.85	19.39	23.85	-	87.95	96.57	28.05
1962	53.10	-	9.10	33.43	47.17	27.80	17.53	22.51	21.68	15.17	7.84	8.25	23.21
Mean	7.55	2.81	4.09	17.60	24.95	15.32	12.68	20.65	20.56	9.13	11.32	12.00	13.71

Table 4.3 Monthly Mean Discharge of the Nyando (2/4)

Unit : m³/sec

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1967	6.56	11.30	16.72	27.61	16.51	5.29	4.24	14.49	19.64	14.22	21.60	3.51	4.85
1968	6.20	15.07	11.43	6.39	12.36	6.74	6.52	10.13	13.75	8.35	12.42	19.77	13.36
1969	7.33	9.69	11.28	33.32	39.16	24.14	16.04	45.28	39.71	20.51	6.92	10.15	9.53
1970	6.98	3.63	2.71	28.27	27.14	27.14	34.00	43.69	41.39	18.92	8.54	13.10	20.87
1971	4.80	6.52	3.13	3.59	18.08	20.33	20.11	16.09	10.24	25.43	47.32	17.02	16.06
1972	15.08	17.59	6.90	5.69	14.43	14.58	8.64	25.88	27.73	17.82	9.36	8.99	14.36
1973	3.42	2.23	3.27	56.92	14.28	18.40	45.34	17.32	18.18	13.59	7.79	7.93	17.42
1974	2.30	2.04	5.61	16.39	10.16	14.84	26.29	58.76	69.20	38.01	10.85	11.06	22.23
1975	5.29	3.72	2.89	5.33	8.43	8.30	18.15	15.59	17.59	6.56	4.16	6.07	8.53
1976	3.92	6.36	3.66	27.11	61.89	36.23	42.77	38.55	23.15	12.58	72.42	26.89	29.69
1977	14.63	16.98	48.82	43.75	48.41	19.76	29.97	37.44	31.34	26.33	13.65	17.05	29.09
1978	7.99	69.32	27.47	21.95	25.92	30.99	21.64	37.93	15.54	9.15	8.76	6.94	23.31
1979	7.45	5.24	5.17	23.61	27.72	17.19	16.97	11.29	9.49	5.63	5.55	4.57	11.67
1980	3.79	3.48	6.48	45.55	32.85	9.60	17.86	44.76					20.65
1981	9.54	6.82	5.31	10.88	12.62	12.75	12.57	29.13	32.34	10.29	31.26	43.32	26.51
1982	7.16	5.33								37.84	15.51	9.51	15.65
1983													6.24
1984													
Mean	7.03	11.58	10.72	23.44	24.74	17.75	20.48	29.76	26.38	17.68	17.87	13.69	17.36

Table 4.3 Monthly Mean Discharge of the Nyando (3/4)

Unit : m³/sec

Station : IGD4

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1955	3.56	3.77	5.80	11.87	42.27	19.77	31.04	73.19	83.15	54.35	27.79	30.27	41.76
1956	17.97	10.25	12.18	20.60	36.05	46.44	57.39	82.70	62.44	42.91	26.52	24.87	37.03
1957	5.47	4.43	5.63	19.30	36.86	79.70	45.30	52.75	36.93	20.89	17.61	16.71	29.30
1958	4.35	7.74	7.86	5.38	31.81	34.63	57.12	57.34	22.54	6.72	3.53		24.92
1959	3.18	2.57	3.59	5.89	12.31	6.76	2.50		6.94	5.61	27.93		5.50
1960	4.78	3.50	15.30	25.59	34.01	34.61	28.95	38.07	49.62	29.93	28.35	13.20	25.42
1961	2.46	2.28	4.39	6.38	15.04	17.28	16.95	62.02	59.58	43.60	147.45	98.50	36.37
1962			11.67	29.71	71.03	64.29	53.92	62.86	63.58	42.03	30.49	21.79	45.19
1963	9.44		13.12	23.65	85.88		31.23	49.89	33.71	13.58	18.63	53.33	32.15
1964	6.77	5.05	6.03	56.98	31.84	29.47	46.89	62.19	55.76	45.69	17.00	11.60	31.61
1965	6.41	4.49	4.03	6.62	8.58	5.99	6.24	6.76	5.66	5.84	9.52	6.96	6.48
1966	2.20	5.00	9.56	23.50	11.10	10.27	11.29	13.67	27.01	6.18	6.86	7.41	11.14
1967	2.09	1.86	2.03	9.74	30.89	17.84	52.45	35.04	19.96	7.91	23.85	30.48	20.23
1968	6.98	23.92	23.10	66.54	44.56	36.18	29.69	50.64	15.80	8.71	7.41	13.44	26.65
1969	8.22	11.36	8.90	4.24	11.38	5.34	5.13	7.92	8.28	4.45	3.78	2.63	6.89
1970	15.74	6.89	9.99	22.29	19.75	13.75	12.79	25.68	20.25	11.06	6.15	4.45	14.04
1971	3.57	2.28	2.44	10.64	17.46	14.64	20.12	25.30	22.13	13.15	6.90	5.76	12.23
1972	4.68	6.37	3.36	3.24	12.33	12.14	12.79	12.22	7.71	10.23	21.64	10.09	9.58
1973	8.69	8.76	4.72	4.62	10.47	11.15	7.18	16.47	17.55	9.31	7.09	3.90	9.11
1974	3.21	2.36	3.23	22.70	9.68	10.30	24.39	12.15	12.34	8.26	5.08	3.51	9.96
1975	2.41	2.87	4.55	9.40	7.61	12.41	15.20	28.77	36.13	20.55	7.85	6.75	13.40
1976	3.56	3.06	2.42	3.74	1.89	7.50	10.80	10.98	11.13	4.11	3.67	3.07	5.56
1977	3.21	4.99	3.14	11.47	32.47	21.66	20.43	21.00	15.06	9.22	35.18	15.91	16.14
1978	10.84	1.89	18.11	24.26	23.73	10.41	15.93	17.72	18.27	14.38	8.41	9.06	14.46
1979	6.65	40.78	12.28	14.61	12.84	17.12	13.71	21.37	1.89	6.59	6.03	4.29	13.16
1980	8.93	3.54	2.91	7.07	15.32	10.43	10.59	7.42	6.41	3.81		2.73	7.18

Table 4.3 Monthly Mean Discharge of the Nyando (4/4)

Unit : m³/sec

Station : IGD4

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1981	2.30	2.43	4.66	23.10	17.01	5.92	10.85	19.56	16.45	11.34	5.64	45.48	14.60
1982	2.50	3.08	2.22	6.55	14.73	10.46	6.29	14.77	7.85	6.74	16.46	26.10	9.66
1983	6.28	4.45	3.01	5.75	6.51	8.70	7.48	17.79	20.52	17.84	9.04		9.48
Mean	5.94	6.67	7.25	16.74	24.33	20.54	22.92	32.37	26.37	16.72	19.14	18.17	18.59

Table 4.4 Summary of Rock Material Test

Site Marking	Depth (m)	Specific gravity	Water Absorption (%)	Los Angeles Abrasion (%)	Sulphate Soundness (%)		Unconfined Compressive Strength	
					+No.4 Sieve	-No.4 Sieve	Bulk Density (kg/m ³)	Compressive Strength (kg/cm ²)
BQ-1	24.30 - 26.50	2.66	0.4	17	1.7	5.0	2,679	1,297
BQ-1	26.50 - 29.40	2.60	0.3	18	1.7	5.7	2,678	1,441
BQ-1	34.70 - 37.20	2.67	0.4	18	3.4	7.9	2,639	1,115
BQ-1	37.40 - 40.00	2.67	0.4	16	3.1	4.4	2,471	1,376
BD-3	21.26 - 24.00	2.66	0.1	16	1.1	3.7	2,678	1,039
BD-3	43.41 - 45.40	2.67	0.3	16	0.9	2.6	2,678	1,431
BD-9	25.50 - 31.00	2.67	0.5	17	2.9	5.9	2,681	1,388
BD-9	31.00 - 35.00	2.61	0.7	17	2.6	3.6	2,660	808
BD-9	35.50 - 39.30	2.67	0.5	16	1.1	3.1	2,671	1,164
BD-9	43.00 - 45.00	2.69	0.4	14	0.9	2.7	2,678	1,039

Table 5.1 Summary of Electric Power Supply Facilities (1/2)

(A) Generating Plant

As of end of 1983

Plant	Installed Capacity		Effective Capacity	
	(MW)	(%)	(MW)	(%)
a) Hydro ^{1/}	348.5	66.2	339	69.7
b) Oil-fired steam	98	18.6	86	17.7
c) Gas-turbine	30.1	5.7	18.8	3.9
d) Diesel ^{2/}	20.1	3.8	12.4	2.5
e) Geothermal	30	5.7	30	6.2
Total	526.7	100.0	486.2	100.0

Note: ^{1/} Import of UEB hydro power (30MW) is not included.

^{2/} Small isolated diesel is not included.

(B) Transmission & Distribution Lines

	Total Circuit Length (KM)	
	As at 31st December 1982	As at 31st December 1983
<u>Transmission Lines</u>		
220 kV	217 (4.8%)	633 (11.6%)
132 kV	1,635 (35.9%)	1,959 (36.0%)
66 kV	368 (8.1%)	385 (7.1%)
40 kV	113 (2.5%)	113 (2.1%)
33 kV	2,215 (48.7%)	2,356 (43.2%)
Sub-total	4,548 (100%)	5,446 (100%)
<u>Distribution Lines</u>		
11 kV	6,029	6,306
Total	10,577	11,752

Table 5.1 Summary of Electric Power Supply Facilities (2/2)

(C) Transformers in Service

Voltage Rating	As at 31st December 1982		As at 31st December 1983	
	Number	Capacity (MVA)	Number	Capacity (MVA)
<u>Generating Substation</u>				
11/132 kV	10	397 (68.0%)	10	397 (46.5%)
11/66 kV	6	30 (5.1%)	6	30 (3.5%)
11/33 kV	8	137 (23.5%)	8	137 (16.0%)
11/40 kV	4	5 (0.9%)	4	5 (0.6%)
3.3/11/40kV	2	8 (1.4%)	2	8 (0.9%)
3.3/40 kV	2	4 (0.7%)	2	4 (0.5%)
3.3/33 kV	1	2.3 (0.4%)	2	3 (0.4%)
132/220 kV	-	-	1	270 (31.6%)
Sub-total	33	583.3 (100 %)	35	854 (100 %)
<u>Distribution Substations</u>				
220/132 kV	-	-	2	180 (14.4%)
132/66 kV	6	195 (19.5%)	6	195 (15.5%)
132/33 kV	11	180 (18.0%)	13	239 (19.1%)
66/11 kV	26	323 (32.3%)	26	323 (25.8%)
66/40 kV	2	15 (1.5%)	2	15 (1.2%)
40/11 kV	6	15.5 (1.5%)	6	15.5 (1.2%)
33/11 kV	97	272 (27.2%)	103	286 (22.8%)
Sub-total	148	1,000.5 (100 %)	158	1,253.5 (100 %)
<u>Distribution Transformers</u>				
33/.415 kV, 11/.415 kV	6,095	871	6,330	931
Total	6,276	2,454.8	6,523	3,038.5

(Source: KP&L statistics)

Table 5.2 Existing Generating Plants on Interconnecting System (1/2)

Plant	No. and Capacity of Generator (No. x MW)	Gross Head (m)	Steam Pressure	Total installed Capacity (MW)	Effective Capacity (MW)	Annual average		Year of Commissioning
						Energy 1979 - 1983 (GWh)	Energy 1979 - 1983 (GWh)	
(A) Hydro Power Plants								
(I) Upper Tana								
1) Tana (KPC)	-	56.5-62.0	-	14.4	12.4	69.8	1953	
2) Manjii (KPC)	-	-	-	7.4	7.4	43.6	1952	
Sub-total (I)				21.8	19.8	113.4		
(II) Seven Forks								
3) Kindaruma (TRDC)	2 x 22	34.0	-	44.0	44.0	170.4	1968	
4) Kamburu (")	2 x 30.5	66.6-81.5	-	91.5	84.0	342.2	1974	
	1 x 30.5	-	-				1976	
5) Gitaru (")	2 x 72.5	142.0	-	145.0	145.0	638.8	1978	
6) Masinga (TARDA)	2 x 20	25.8-49.8	-	40.0	40.0	(59.7)	1981	
Sub-total (II)				320.5	313.0	(1,193.1)		
(III) Small Hydro								
7) Ngula	-	-	-	2.0	2.0	-	-	
8) Mesco	-	-	-	0.4	0.4	-	-	
9) Sagana Falls	-	-	-	1.5	1.5	22.4	-	
10) Selby Falls	-	-	-	0.3	0.3	-	-	
11) Gogo Falls	2 x 1.0	-	-	2.0	2.0*	22.4	-	
Sub-total (III)				6.2	6.2			
Total Capacity of Hydro (I+II+III)				348.5	339.0	(1328.9)		
(B) Thermal Power Plants								
(I) Oil-Fired Steam								
1) Mombasa-Kipevu	1 x 5	-	-	5	4	-	1958	
	"	-	-	5	4	-	1958	
	1 x 12.5	-	-	12.5	10*	239.0	1961	
	"	-	-	12.5	10	-	1962	
	1 x 30	-	-	30	27	-	1973	
	1 x 33	-	-	33	30	-	1976	
Sub-total (I)				98.0	85	239.0		

Table 5.2 Existing Generating Plants on Interconnecting System (2/2)

Plant	No. and Capacity of Generator (No. x MW)	Cross Head (m)	Steam Pressure	Total installed Capacity (MW)	Effective Capacity (MW)	Annual average Energy 1979 - 1983 (GWh)		Year of Commissioning
						1979 - 1983	1983	
(II) Gas-turbine								
2) Nairobi South	1 x 13.5	-	-	13.5	14	(13.0)		1972
	2 x 2.2	-	-	4.4	8*			-
3) Mombasa-Kipevu	1 x 12.2	-	-	12.2	22	(13.0)		1972
Sub-total (II)				30.1				
(III) Diesel								
4) Nairobi South	-	-	-		8	(6.3)		before 1955
5) Mombasa-Ruiru	-	-	-	20.1	2			"
6) Mombasa-Mbaraki	-	-	-		2			
Sub-total (III)				20.1	12	(6.3)		
(IV) Geo-thermal								
7) Olkaria (KPC)	1 x 15	5 bars	press. (152°C)	15	15	(132.3)		1981
	"	"	"	15	15	(132.3)		1982
Sub-total (IV)				30.0	30.0			
Total Capacity of Thermal (I+II+III+IV)				178.2	149.0	(390.6)		
(C) Import from Uganda (UEB)				30.0	30.0	212.0		Since 1958
Grand Total (A+B+C)				556.7	518.0	(1931.5)		

Source: KP&L statistics & Turkwell Report by PCR

- Note: 1) Small isolated stations are not included herein.
 2) UEB hydropower is considered to be non-firm power from 1988 onward.
 3) Annual average energy is worked out based on actual generation for 5 years. Figures in parenthesis means data being not available for 5 years.
 4) Asterisked figures mean the effective capacity after duly repair in due time.

Table 5.3 GDP and Energy Consumption (1974 - 1983)

	Year									
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
GDP at factor cost (K£ million at 1975 const. price)	1,028	1,050	1,109	1,205	1,283	1,339	1,383	1,437	1,507	1,566
Total energy consumption	925	1,001	1,082	1,203	1,301	1,409	1,468	1,593	1,631	1,677

	Period		
	1974 - 79	1974 - 83	1979 - 83
Growth rates (% p.a.)			
(A) GDP	5.8	4.8	4.0
(B) Energy consump.	8.8	6.8	4.4
Elasticity (B)/(A)	1.52	1.42	1.10

Source: Statistical Abstract 1979 and 1983 for GDP, KP&L for energy consumption.

Table 5.4 Electric Power Forecast in Kenya

Year	Demand (MW Sent Out)			Energy (GWh Sent Out)		
	Low	Median	High	Low	Median	High
1983	328	328*	328	1,984	1,984*	1,984
1984	341	341	341	2,060	2,060	2,060
1985	355	355	355	2,148	2,148	2,148
1986	371	371	371	2,240	2,240	2,240
1987	382	387	393	2,314	2,340	2,379
1988	395	406	420	2,392	2,457	2,542
1989	409	429	452	2,473	2,592	2,730
1990	424	454	487	2,564	2,747	2,945
1991	447	482	519	2,705	2,912	3,136
1992	472	511	553	2,853	3,087	3,340
1993	498	541	589	3,010	3,272	3,557
1994	525	574	627	3,176	3,489	3,789
1995	554	608	668	3,351	3,677	4,035
1996	584	645	711	3,535	3,898	4,297
1997	617	683	757	3,729	4,131	4,576
1998	650	724	807	3,934	4,379	4,874
1999	686	768	859	4,151	4,642	5,191
2000	724	814	915	4,379	4,920	5,528
2002		915			5,528	

Source: Generation and Economic Study for the Turkwell Gorge Project, Preece, Cardew and Rider, July 1984

* Actual values

Table 5.5 Geographical Distribution of Energy Sales and Maximum Demand

(1) Energy Sales (GWh)

Power supply region	Year							
	1976	1977	1978	1979	1980	1981	1982	1983
Nairobi	637	684	732	791	827	900	909	930
Coast	268	301	331	344	357	390	392	400
Western	89	116	134	167	172	180	195	206
Rift Valley	59	63	70	71	72	79	87	85
Mt. Kenya	29	39	34	36	40	44	48	55
Total	1,082	1,203	1,301	1,409	1,468	1,593	1,631	1,676

(2) Maximum Demand (MW)

Power supply region	Year							
	1976	1977	1978	1979	1980	1981	1982	1983
Nairobi	108	124	147	156	165	182	180	191
Coast	48	50	58	58	61	66	69	69
Western	20	23	27	31	35	38	39	41
Rift Valley	12	13	17	15	17	18	18	19
Mt. Kenya	6	9	9	9	10	12	14	16
Total (simultaneous)	107	223	256	269	290	313	317	334

Source: KP&L

Table 5.6 Comparison of Demand Structure (1983)

(Unit: %)

	Power Supply Region					Whole Country
	W. Kenya	R. Valley	Coast	Mt. Kenya	Nairobi	
Domestic & small commercial (+off-peak domestic)	19.2 (21.1)	36.5 (38.8)	20.7 (21.8)	40.1 (43.6)	32.7 (43.1)	28.6
Industrial & large commercial	78.2	59.8	77.5	55.5	56.1	64.1
Public & other	2.6	3.6	1.8	4.6	11.3	7.3

Source: KP&L

Table 5.7 Estimation of Household Electrification Ratio

	Power Supply Region					Whole Country
	W. Kenya	R. Valley	Coast	Mt. Kenya	Nairobi	
Population 1979 census	6,118,423	733,015	1,342,794	3,257,534	4,362,194	
Assumed growth rate % p.a. '79-'83	3.5	5.0	4.0	4.0	5.0	
1983 Population	7,021,000	891,000	1,571,000	3,811,000	5,302,000	
1979 # of households	1,120,707	152,371	269,199	662,431	880,661	
1979 Avg. household size	5.46	4.81	4.99	4.92	4.95	
1983 # of h.h. estimated	1,285,900	185,200	314,800	774,600	1,071,100	3,631,600
1983 # of domestic consumers */	18,878	11,040	35,460	10,188	72,476	148,042
Household electri- fication ratio(%)	1.5	6.0	11.3	1.3	6.8	4.1

*/ The number of consumers in the domestic and small commercial category; off-peak domestic consumers not included to avoid double-counting.

Source: 1979 Census for the population and household data.

Table 5.8 Electric Power Uses in Western Kenya

	Year							
	1976	1977	1978	1979	1980	1981	1982	1983
<u>Total Sales</u> (GWh)	89	116	134	167.7	171.9	179.8	195.2	206.1
Domestic & Small commercial				35.1	33.1	35.4	38.2	39.5
Large commercial & industrial				127.5	133.8	139.3	152.0	161.3
Off-peak				3.9	3.7	3.8	3.7	3.9
Street lighting				1.3	1.3	1.3	1.4	1.4
<u>Max. Demand</u> (MW)	20	23	28	31	35	38	39	41

Source: KP&L

Table 5.9 New Major Loads Expected by 1987 in Western Kenya

Scheme	Loads in 1987	
	MVA	MWh
1. Kenya Breweries, Kisumu	3.0	17,000
2. Rai Plywood, Eldoret	1.8	4,500
3. Ken Chemicals Foods Ltd., Kisumu	6.0	35,000
4. Pan African Paper Mills, Webuye (expansion)	9.0	18,000
5. Agro Chemical & Food Corp., Muhoroni	1.2	2,000
6. Soy-Militisa/Army Barracks	2.5	4,000
Total	23.5	80,500

19 MW (power factor = 0.8)

Source: KP&L

Table 5.10 Prospective Industries with a High Probability of Realization by mid-1990's in Western Kenya

Category of power demand by each industry	Industries	Power demand by category
Over 1 MW	Cement	
	Edible oil (including refining and meal treatment)	6 MW
0.5 - 1 MW	Fish processing (several establishments, including ice-making and cold storage)	
	Ceramics (one or two establishments)	
	Tannery (a few establishments)	4 MW
	Bricks & tiles (a few establishments)	
Less than 0.5 MW	Maize milling (several establishments)	
	Wood products (quality furniture etc.)	
	Fruits/vegetable processing (a variety of establishments)	3 MW
	Others	
Total Power Demand		13 MW

* Prepared by the Study Team in consultation with LBDA staff.

Table 5.11 Projected Power Demand in Western Kenya

	Year		
	1983 ^{*/}	1993	2000
Domestic & small commercial	48 GWh (19.0%)	127 GWh (26.5%)	2969 GWh (34.1%)
Public	8 (3.2%)	17 (3.5%)	35 (4.6%)
Industrial & large commercial	197 (77.9%)	335 (69.9%)	486 (61.5%)
Total	253 GWh	479 GWh	790 GWh
Maximum	41 MW	78 MW	129 MW
Turkwell forecasts ^{**/}		74 MW	123 MW

^{*/} Actual converted to value on sent-out basis

^{**/} "Sent-out" basis

Table 6.1 Plan Optimization

Work Item	Combination-A		Combination-B		Combination-C		Combination-D		Combination-E	
	Sondu /Miriu R-O-R	Maraboi R-O-R	Sondu /Miriu R-O-R	Maraboi R-O-R	Sondu /Miriu R-O-R	Maraboi R-O-R	Sondu /Miriu R-O-R	Maraboi R-O-R	Sondu /Miriu R-O-R	Maraboi R-O-R
1. Firm Discharge (m ³ /sec)	3.30	3.30	17.10	24.10	24.10	16.00	25.60	24.10	24.10	24.10
2. Plant Discharge (m ³ /sec)	29.60	29.60	28.40	72.30	39.90	48.00	42.70	72.30	72.30	39.90
3. Optimum Power Scale										
Installed Capacity (MW)	32.83	50.49	46.90	94.60	48.60	54.90	72.90	50.70	69.22	69.22
Firm Energy (GWh/yr)	32.01	49.23	246.30	276.20	237.48	160.20	383.30	147.90	364.05	364.05
Secondary Energy (GWh/yr)	155.55	239.21	54.60	57.90	14.91	87.50	36.20	32.70	22.86	22.86
Dump Energy (GWh/yr)	14.45	22.22	-	-	46.08	-	-	-	-	70.63
4. Economic Scale on Power Sector										
Benefit (mil. US\$) *	79.23	121.85	174.40	351.19	305.85	386.00	450.60	300.93	345.18	345.18
Cost (mil. US\$) *	72.14	113.70	202.30	276.20	237.48	160.20	383.30	147.90	364.05	364.05
B - C (mil. US\$) *	7.09	8.15	-27.90	45.34	11.36	8.63	8.63	11.36	11.36	11.36
EIRR	10.95	10.70	8.69	11.36	5.49	7.36	7.36	5.49	5.49	5.49
Cost per Energy (US\$/KWh)	5.74	5.88	7.31	5.49	5.49	7.36	7.36	5.49	5.49	5.49
5. Economic Scale on Irrigation Sector										
Irrigation Area (ha)	15,610	15,610	25,610	25,610	25,610	25,610	25,610	25,610	25,610	25,610
Benefit (mil. US\$) *	94.16	94.16	121.88	121.88	121.88	121.88	121.88	121.88	121.88	121.88
Cost (mil. US\$) *	52.08	52.08	78.64	78.64	78.64	78.64	78.64	78.64	78.64	78.64
B - C (mil. US\$) *	42.08	42.08	43.24	43.24	43.24	43.24	43.24	43.24	43.24	43.24
6. Total Economic Scale										
Benefit (mil. US\$) *	173.39	216.01	296.28	473.07	384.49	507.88	529.24	379.57	467.06	467.06
Cost (mil. US\$) *	124.22	165.78	280.94	384.49	384.49	529.24	379.57	379.57	379.57	379.57
B - C (mil. US\$) *	49.17	50.23	15.34	88.58	88.58	-21.36	-21.36	87.49	87.49	87.49

* Discounted value at 10 %

Table 6.2 Construction and O&M Costs of Thermal Candidates
for KP&L System Planting-up

Type	Installed Capacity MW	Annual Max. Operation Rate %	Lead Time Year	Construction Time Period Year	Construction Disbursement	Life Time Year	Construction Cost US\$/kW	O&M Cost %	Fuel Price US\$/t	Calorific Value Kcal/kg	Fuel Cost US\$/kwh
<u>Oil-fired</u>	60 ^{1/}	70	2	5	0.05/0.25/0.40/0.20/0.10	30	1,055	2	220	10,300	6.80
	120	"	"	"	"	"	"	"	"	"	"
<u>Coal-fired</u>	60 ^{1/}	70	2	5	0.05/0.25/0.40/0.20/0.10	30	1,815	2	52	6,200	2.67
	120	"	"	"	"	"	"	"	"	"	"
	180	"	"	"	"	"	"	"	"	"	"
<u>Gas-turbine</u>	20	50	0	2	0.40/0.60	25	565	2.5	340	10,800	11.27
	40	"	"	"	"	"	460	"	"	"	"
<u>Diesel</u>	2	60	0	1	1.0	20	1,300	3	340	10,800	7.96
	5	"	"	"	"	"	990	"	"	"	"
	10 ^{2/}	"	"	"	"	"	800	"	"	"	"
	20	"	"	"	"	"	"	"	"	"	"
	30	"	"	"	"	"	"	"	"	"	"

Notes : 1/ Maximum unit capacity is set at 60 MW considering the system reliability as recommended by WLPJ, and it is confirmed by the PCR reconnaissance that plant construction sites are available including coal handling facilities at Fort Reitz, Mombasa.

2/ Maximum unit capacity is set at 10 MW.

Table 6.3 Construction and O&M Costs of Hydro and Geothermal Candidates
for KP&L System Planting-up

Project	Installed Capacity MW	Firm Energy GWh/year	Lead ^{1/} Time Year	Construction Time Period Year	Construction Disbursement	Life Time Year	Construction Cost Million US\$	O&M ^{2/} Cost %	Fuel Cost US\$/kwh
<u>Hydro</u>									
Sondu/Miriu-1 ^{4/}	48.6	32	3	4	0.20/0.30/0.30/0.20	50	61.4	1	-
Sondu/Miriu-2	94.6	482 ^{5/}	5	5	0.15/0.25/0.30/0.20/0.10	"	150.7	"	-
Mutonga	70.0	153	"	"	"	"	173.7	"	-
Grand Falls	120.0	321	"	"	"	"	450.0	"	-
Adamson's Falls	50.0	200	"	6	0.15/0.20/0.25/0.20/0.15/0.05	"	520.0	"	-
Munyu	38.0	133	"	5	0.15/0.25/0.30/0.20/0.10	"	223.9	"	-
<u>Geothermal</u>									
Oikaria IV	15.0	105	3	4	0.10/0.45/0.35/0.10	30	33.1 ^{6/}	2	0.5
" IV	30.0	210	"	"	"	"	66.3	"	"
Eburru	15.0	105	5	"	"	"	33.1	"	"
"	30.0	210	5	"	"	"	66.3	"	"
Lake Bogoria	15.0	105	5	"	"	"	40.6 ^{7/}	"	"
"	30.0	210	5	"	"	"	72.7	"	"

Notes : 1/ Presumable lead time before construction is set forth as follows; 2 years for feasibility study, 1 year for finance and tendering, and 2 years for detailed design. Lead time is reduced based on the project maturity.
2/ Price level is set at December 1984.
3/ Annual O&M costs are expressed with percentage for construction cost.
4/ Sondu/Miriu-1 is the first stage of Combination-C, Sondu/Miriu run-of-river, whilst Sondu/Miriu-2 corresponds to the second stage of Combination-C, Magwaga reservoir plan.
5/ Incremental firm energy from Sondu/Miriu-1 by the installation of Sondu/Miriu-2 is counted in the second stage.
6/ Construction Cost is estimated at US\$2,209/kw, in which a half of drilling cost (US\$427/kw + 2 = US\$214/kw) is included, namely a remaining half of drilling cost is assumed to have been invested and is treated as sunk cost.
7/ Full drilling cost (US\$427/kw) and transmission line cost (US\$4.25 million for 85 km long) are included in the construction cost.

Table 6.4 Optimal Planting-up Sequence in the KP&L System
(1986 to 2005)

Plant	Type	Capacity MW	Installation Year	Notes
Kiambere	Hydro	144	1988	Under Construction
Turkwell	Hydro	100	1992	Committed (the first date of 1993)
Sondu/Miriu 1	Hydro	48.6	1992	
Olkaria IV	Geothermal	30	1993	
Coal-1	Coal	60	1993	
Sondu/Miriu 2	Hydro	94.6	1996	
Eburru	Geothermal	15	1998	
Coal-2	Coal	120	1998	
Coal-3	Coal	60	2001	
Coal-4	Coal	60	2002	
Coal-5	Coal	120	2003	
Coal-6	Coal	60	2004	

Table 8.1 Major Construction Plant and Equipment

Item No.	Description	Spec.	Total Required Number
1	Bulldozer w/ripper	21 ton	7
2	Bulldozer	11 ton	5
3	Tractor shovel	2.3 m ³	6
4	Tractor shovel	1.6 m ³	3
5	Backhoe	0.6 m ³	2
6	Backhoe	0.3 m ³	1
7	Dump truck	11 ton	30
8	Dump truck	6 ton	10
9	Vibrating roller	5 ton	3
10	Crawler drill	7 m ³ /min	12
11	Air compressor	10 m ³ /min	12
12	Concrete plant	1.0 m ³	2
13	Crushing plant	100 ton/h	1
14	Agitator truck	3.2 m ³	8
15	Concrete bucket	1.0 m ³	2
16	Concrete pump car	45 m ³ /h	2
17	Boring machine	5.5 kw	3
18	Grout pump	7.5 kw	6
19	Grout mixer	200 lit x 2	6
20	Truck crane	32 ton	2
21	Truck crane	20 ton	2
22	Trailer	20 ton	2
23	Motor grader	3.7 m	1
24	Sprinkler truck	6 klit	1
25	Leg hammer	30 kg	5
26	Sinker	24 kg	5
27	Raise climber		1
28	Muck loader	0.6 m ³	2
29	Train loader	200 t/h	2
30	Muck car	4.5 m ³	26
31	Battery locomotive	10 ton	4
32	Ventilation fan	300 m ³	24
33	Ventilation fan	100 m ³	4
34	Air compressor	27 m ³ /min	4
35	Drill jumbo	7-boom	2
36	Battery locomotive	4 ton	6
37	Concrete placer	3.0 m ³	6
38	Agitator car	3 m ³	4
39	Sliding form	12 m	2
40	Grout pump	11 kw	2
41	Grout mixer	300 lit x 2	2
42	Winch	100 kw	1

Table 8.2 Land Acquisition

(Unit: KShs.)

Description	Quantity (ha)	Unit Rate	Total
1. Reservoir and Intake	3.6 14.4	11,000/ha 7,500/ha	39,600 108,000
2. Surge Tank	0.3	7,500/ha	2,250
3. Penstock Line	1.0	7,500/ha	7,500
4. Tailrace, Powerhouse and Switchyard	2.4	7,500/ha	18,000
5. Substation	0.1	7,500/ha	750
6. Temporary Facilities	2.4	7,500/ha	18,000
Total	<u>24.2</u>		<u>194,100</u>

Table 8.3 Construction Cost

Description	Foreign Currency (1,000 US\$)	Local Currency (1,000 KShs.)	Total (1,000 KShs.)
1. Preparatory works	4,005.0	14,631.6	74,706.6
2. Civil works	14,009.8	106,884.5	317,031.5
3. Metal works	8,338.0	11,815.4	136,885.4
4. Generating equipment & substation equipment	15,928.0	22,152.0	261,072.0
5. Transmission line	1,774.0	5,464.0	32,074.0
Total (1 - 5)	<u>44,054.8</u>	<u>160,947.5</u>	<u>821,769.5</u>
6. Land acquisition & compensation	-	194.1	194.1
7. Administration expenses	-	16,435.4	16,435.4
8. Engineering services	6,030.0	-	90,450.0
Total (1 - 8)	<u>50,084.8</u>	<u>177,577.0</u>	<u>928,849.0</u>
9. Physical contingency	3,706.5	15,786.2	71,383.7
10. Price escalation	10,144.4	123,510.7	275,676.7
Grand total	<u>63,935.7</u>	<u>316,873.9</u>	<u>1,275,909.4</u>

Note: A cost of US\$ 3 million (KShs 45 million) is necessary for detailed design and preparation of tender document on the pre-construction stage besides the above costs.

Table 8.4 Detailed Construction Cost (1/2)

Description	Foreign Currency (1,000 US\$)	Local Currency (1,000 KShs.)	Total (1,000 KShs.)
1. Preparatory works	4,005.0	14,631.6	74,706.6
2. Civil works			
2.1 River diversion	401.8	2,254.4	8,281.4
2.2 Waterway	1,579.9	12,331.4	36,029.9
2.2.1 Intake weir			
2.2.2 Intake and desilting basin	1,887.7	14,266.2	42,581.7
2.2.3 Headrace tunnel	6,209.1	51,223.6	144,360.1
2.2.4 Surge tank	438.5	2,883.4	9,460.9
2.2.5 Penstock	879.9	5,886.1	19,084.6
Sub-total (2.2)	10,995.1	86,590.7	251,517.2
2.3 Power station			
2.3.1 Tailrace	501.3	3,545.0	11,064.5
2.3.2 Powerhouse	814.9	5,385.1	17,608.6
2.3.3 Switchyard	136.4	732.1	2,778.1
2.3.4 Building works	474.5	4,107.5	11,225.0
Sub-total (2.3)	1,927.1	13,769.7	42,676.2
2.4 Outlet channel	101.6	514.0	2,038.0
2.5 Road construction	584.2	3,755.7	12,518.7
Total (2)	14,009.8	106,884.5	317,031.5
3. Metal works			
3.1 Weir metal work	758.5	1,211.4	12,588.9
3.2 Intake metal work	1,600.3	2,553.8	26,558.3
3.3 Penstock metal work	5,979.2	8,050.2	97,738.2
Total (3)	8,338.0	11,815.4	136,885.4
4. Generating equipment & substation equipment			
4.1 Generating equipment	11,908.0	16,001.0	194,621.0
4.2 Substation equipment	4,020.0	6,151.0	66,451.0
Total (4)	15,928.0	22,152.0	261,072.0
5. Transmission line	1,774.0	5,464.0	32,074.0
Total (1 - 5)	<u>44,054.8</u>	<u>160,947.5</u>	<u>821,769.5</u>

Table 8.4 Detailed Construction Cost (2/2)

Description	Foreign Currency (1,000 US\$)	Local Currency (1,000 KShs.)	Total (1,000 KShs.)
6. Land acquisition & compensation	-	194.1	194.1
7. Administration expenses	-	16,435.4	16,435.4
8. Engineering services	6,030.0	-	90,450.0
Total (1 - 8)	<u>50,084.8</u>	<u>177,577.0</u>	<u>928,849.0</u>
9. Physical contingency	3,706.5	15,786.2	71,383.7
10. Price escalation	10,144.4	123,510.7	275,676.7
Grand total	<u>63,935.7</u>	<u>316,873.9</u>	<u>1,275,909.4</u>

Note: A cost of US\$ 3 million (KShs 45 million) is necessary for detailed design and preparation of tender document on the pre-construction stage besides the above costs.

Table 8.5 Disbursement Schedule

(Unit: F.C. 1000 US\$, L.C. 1000 KShs)

Description	1989		1990		1991		1992	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Preparatory Works	4,005.0	14,631.6	4,005.0	14,631.6	-	-	-	-
2. Civil Works								
2.1 River Diversion	401.8	2,254.4	395.4	2,233.7	-	-	6.4	20.7
2.2 Waterway	10,995.1	86,590.7	2,946.0	23,861.9	6,068.8	46,507.8	1,282.8	10,102.0
2.3 Power Station	1,927.1	13,769.7	192.7	1,377.0	1,013.0	6,933.0	699.6	5,236.7
2.4 Outlet Channel	101.6	514.0	10.1	51.4	-	-	67.7	227.4
2.5 Road Construction	584.2	3,755.7	584.2	3,755.7	-	-	-	-
Sub-total (2)	14,009.8	106,884.5	4,128.4	31,279.7	7,081.8	53,440.8	2,056.5	15,586.8
3. Metal Works								
3.1 Weir Metal Work	758.5	1,211.4	118.4	-	209.6	476.5	430.5	734.9
3.2 Intake Metal Work	1,600.3	2,533.8	249.7	-	394.7	699.1	955.9	1,854.7
3.3 Penstock Metal Work	5,979.2	8,050.2	703.0	-	1,205.2	1,712.9	2,511.6	3,692.1
Sub-total (3)	8,338.0	11,815.4	1,071.1	-	1,809.5	2,888.5	3,898.0	6,281.7
4. Generating Equipment and Substation Equipment								
4.1 Generating Equipment	11,908.0	16,001.0	1,765.0	-	1,474.0	1,668.1	6,924.4	10,611.6
4.2 Substation Equipment	4,002.0	6,151.0	586.6	-	-	-	2,449.1	2,772.9
Sub-total (4)	15,928.0	22,152.0	2,351.6	-	1,474.0	1,668.1	9,373.5	13,383.6
5. Transmission Line	1,774.0	5,464.0	235.0	-	490.5	555.3	737.9	3,029.9
Total (1 - 5)	44,054.8	160,947.5	11,791.1	45,911.3	10,855.8	58,552.7	16,065.9	38,282.0
6. Land Acquisition and Compensation	-	194.1	-	194.1	-	-	-	-
7. Administration Expenses	-	16,435.4	-	4,455.6	-	4,427.8	-	5,585.4
8. Engineering Services	6,030.0	-	1,634.7	-	1,624.5	-	2,049.3	-
Total (1 - 8)	50,084.8	177,577.0	13,425.8	50,561.0	12,480.3	62,980.5	18,115.2	43,867.4
9. Physical Contingency	3,706.5	15,786.2	1,159.7	5,056.1	1,059.3	6,042.5	1,111.1	3,252.0
10. Price Escalation	10,144.4	123,510.7	2,077.0	26,423.7	2,392.4	41,959.1	4,076.0	35,462.1
Grand Total	63,935.7	316,873.9	16,662.5	82,040.8	15,932.0	110,982.1	25,902.3	82,581.5

Note: A cost of US\$ 3 million (KShs 45 million) is necessary for detailed design and preparation of tender document on the pre-construction stage besides the above costs in 1987.

Table 9.1 Benefit and Cost Streams of the Sondu River Multipurpose Project
(Standard case) (1/2)

(Unit: 10³ KShs)

NO.	Year	Project Costs			Project Benefits					
		Investment Costs		O & M Costs		Hydro- power	Irriga- tion	Total		
		Hydro- power	Irriga- tion	Total	Hydro- power				Irriga- tion	
1.	1988		4,795			7,057	121,728		121,728	
2.	89	252,153	16,873	269,026	13,406	7,057	20,463	121,728	37,914	159,642
3.	90	244,508	62,064	306,572	14,827	7,057	21,884	121,728	93,755	215,483
4.	91	316,666	292,302	608,968	16,249	7,057	23,306	121,728	157,850	279,578
5.	92	109,561	277,841	387,402	16,249	7,057	23,306	121,728	227,634	349,362
6.	93		179,952	179,952	16,249	7,057	23,306	121,728	267,632	383,360
7.	94		109,519	109,519	16,249	7,057	23,306	121,728	293,523	415,251
8.	95		109,519	109,519	16,249	7,057	23,306	121,728	311,160	432,888
9.	96		109,519	109,519	16,249	7,057	23,306	121,728	320,544	442,272
10.	97				16,249	7,057	23,306	121,728	322,101	443,829
11.	98				16,249	7,057	23,306	121,728	322,101	443,829
12.	99				16,249	7,057	23,306	121,728	322,101	443,829
13.	2000				16,249	7,057	23,306	121,728	322,101	443,829
14.	01				16,249	7,057	23,306	121,728	322,101	443,829
15.	02				16,249	7,057	23,306	121,728	322,101	443,829
16.	03				16,249	7,057	23,306	121,728	322,101	443,829
17.	04				16,249	7,057	23,306	121,728	322,101	443,829
18.	05				16,249	7,057	23,306	121,728	322,101	443,829
19.	06				16,249	7,057	23,306	121,728	322,101	443,829
20.	07				16,249	7,057	23,306	121,728	322,101	443,829
21.	08				16,249	7,057	23,306	121,728	322,101	443,829
22.	09				16,249	7,057	23,306	121,728	322,101	443,829
23.	10				16,249	7,057	23,306	121,728	322,101	443,829
24.	11				16,249	7,057	23,306	121,728	322,101	443,829
25.	12				16,249	7,057	23,306	121,728	322,101	443,829

Table 9.1 Benefit and Cost Streams of the Sondu River Multipurpose Project
(Standard case) (2/2)

(Unit: 10³ KShs)

NO.	Year	Project Costs			Project Benefits				
		Investment Costs		O & M Costs		Hydro- power	Irriga- tion	Total	
		Hydro- power	Irriga- tion	Total	Hydro- power				Irriga- tion
26.	2013			7,057	16,249	23,306	121,728	322,101	443,829
27.	14			7,057	16,249	23,306	121,728	322,101	443,829
28.	15			7,057	16,249	23,306	121,728	322,101	443,829
29.	16			7,057	16,249	23,306	121,728	322,101	443,829
30.	17			7,057	16,249	23,306	121,728	322,101	443,829
31.	18			7,057	16,249	23,306	121,728	322,101	443,829
32.	19			7,057	16,249	23,306	121,728	322,101	443,829
33.	20			7,057	16,249	23,306	121,728	322,101	443,829
34.	21			7,057	16,249	23,306	121,728	322,101	443,829
35.	22			7,057	16,249	23,306	121,728	322,101	443,829
36.	23			7,057	16,249	23,306	121,728	322,101	443,829
37.	24			7,057	16,249	23,306	121,728	322,101	443,829
38.	25			7,057	16,249	23,306	121,728	322,101	443,829
39.	26			7,057	16,249	23,306	121,728	322,101	443,829
40.	27			7,057	16,249	23,306	121,728	322,101	443,829
41.	28			7,057	16,249	23,306	121,728	322,101	443,829
42.	29			7,057	16,249	23,306	121,728	322,101	443,829
43.	30			7,057	16,249	23,306	121,728	322,101	443,829
44.	31			7,057	16,249	23,306	121,728	322,101	443,829
45.	32			7,057	16,249	23,306	121,728	322,101	443,829
46.	33			7,057	16,249	23,306	121,728	322,101	443,829
47.	34			7,057	16,249	23,306	121,728	322,101	443,829
48.	35			7,057	16,249	23,306	121,728	322,101	443,829
49.	36			7,057	16,249	23,306	121,728	322,101	443,829
50.	37			7,057	16,249	23,306	121,728	322,101	443,829
51.	38			7,057	16,249	23,306	121,728	322,101	443,829

Table 9.2 Benefit and Cost Streams of the Sondu River Hydropower Development, According to the Kenyan Evaluation Method (1/2)

(Unit: 10³ KShs)

No.	Year	Project Cost		Cost of Subtrans- mission and Distribution	Project Benefits
		Investment costs	O & M costs		
1.	1989	252,513			
2.	90	244,508			
3.	91	316,666			
4.	92	109,561			
5.	93	0	7,057	30,391	131,695
6.	94	0	7,057	30,391	131,695
7.	95	0	7,057	30,391	131,695
8.	96	0	7,057	30,391	131,695
9.	97	0	7,057	30,391	131,695
10.	98	0	7,057	30,391	131,695
11.	99	0	7,057	30,391	131,695
12.	2000	0	7,057	30,391	131,695
13.	01	0	7,057	30,391	131,695
14.	02	0	7,057	30,391	131,695
15.	03	0	7,057	30,391	131,695
16.	04	0	7,057	30,391	131,695
17.	05	0	7,057	30,391	131,695
18.	06	0	7,057	30,391	131,695
19.	07	0	7,057	30,391	131,695
20.	08	0	7,057	30,391	131,695
21.	09	0	7,057	30,391	131,695
22.	10	0	7,057	30,391	131,695
23.	11	0	7,057	30,391	131,695
24.	12	0	7,057	30,391	131,695
25.	13	0	7,057	30,391	131,695
26.	14	0	7,057	30,391	131,695
27.	15	0	7,057	30,391	131,695
28.	16	0	7,057	30,391	131,695
29.	17	0	7,057	30,391	131,695
30.	18	0	7,057	30,391	131,695
31.	19	0	7,057	30,391	131,695
32.	20	0	7,057	30,391	131,695
33.	21	0	7,057	30,391	131,695
34.	22	0	7,057	30,391	131,695
35.	23	0	7,057	30,391	131,695
36.	24	0	7,057	30,391	131,695
37.	25	0	7,057	30,391	131,695
38.	26	0	7,057	30,391	131,695
39.	27	0	7,057	30,391	131,695
40.	28	0	7,057	30,391	131,695
41.	29	0	7,057	30,391	131,695
42.	30	0	7,057	30,391	131,695
43.	31	0	7,057	30,391	131,695

Table 9.2 Benefit and Cost Streams of the Sondu River Hydropower Development, According to the Kenyan Evaluation Method (2/2)

(Unit: 10^3 KShs)

No.	Year	Project Cost		Cost of Subtrans- mission and Distribution	Project Benefits
		Investment costs	O & M costs		
44.	2032	0	7,057	30,391	131,695
45.	33	0	7,057	30,391	131,695
46.	34	0	7,057	30,391	131,695
47.	35	0	7,057	30,391	131,695
48.	36	0	7,057	30,391	131,695
49.	37	0	7,057	30,391	131,695
50.	38	0	7,057	30,391	131,695

ERR = 8.6%

Table 9.3 Financial Cash Flow for the Sondu River Hydropower Development (Average tariff = 0.78 KShs/Kwh) (1/2)

(Unit: 10³ KShs)

No.	Year	Financial Costs		Subtransmission and distribu- tion costs	Revenue
		Investment costs	O & M costs		
1.	1989	274,400			
2.	90	272,119			
3.	91	335,514			
4.	92	118,202			
5.	93	0	8,302	27,893	89,003
6.	94	0	8,302	27,893	89,003
7.	95	0	8,302	27,893	89,003
8.	96	0	8,302	27,893	89,003
9.	97	0	8,302	27,893	89,003
10.	98	0	8,302	27,893	89,003
11.	99	0	8,302	27,893	89,003
12.	2000	0	8,302	27,893	89,003
13.	01	0	8,302	27,893	89,003
14.	02	0	8,302	27,893	89,003
15.	03	0	8,302	27,893	89,003
16.	04	0	8,302	27,893	89,003
17.	05	0	8,302	27,893	89,003
18.	06	0	8,302	27,893	89,003
19.	07	0	8,302	27,893	89,003
20.	08	0	8,302	27,893	89,003
21.	09	0	8,302	27,893	89,003
22.	10	0	8,302	27,893	89,003
23.	11	0	8,302	27,893	89,003
24.	12	0	8,302	27,893	89,003
25.	13	0	8,302	27,893	89,003
26.	14	0	8,302	27,893	89,003
27.	15	0	8,302	27,893	89,003
28.	16	0	8,302	27,893	89,003
29.	17	0	8,302	27,893	89,003
30.	18	0	8,302	27,893	89,003
31.	19	0	8,302	27,893	89,003
32.	20	0	8,302	27,893	89,003
33.	21	0	8,302	27,893	89,003
34.	22	0	8,302	27,893	89,003
35.	23	0	8,302	27,893	89,003
36.	24	0	8,302	27,893	89,003
37.	25	0	8,302	27,893	89,003
38.	26	0	8,302	27,893	89,003
39.	27	0	8,302	27,893	89,003

Table 9.3 Financial Cash Flow for the Sondu River Hydropower Development (Average tariff = 0.78 KShs/KWh) (2/2)

(Unit: 10³ KShs)

No.	Year	Financial Costs		Subtransmission and distribution costs	Revenue
		Investment costs	O & M costs		
40.	2028	0	8,302	27,893	89,003
41.	29	0	8,302	27,893	89,003
42.	30	0	8,302	27,893	89,003
43.	31	0	8,302	27,893	89,003
44.	32	0	8,302	27,893	89,003
45.	33	0	8,302	27,893	89,003
46.	34	0	8,302	27,893	89,003
47.	35	0	8,302	27,893	89,003
48.	36	0	8,302	27,893	89,003
49.	37	0	8,302	27,893	89,003
50.	38	0	8,302	27,893	89,003

Table 9.4 Financial Statement

(Unit: 10³ KShs)

No. Year	Local Cost Finance	Interest during Construction	O&M Costs	Loan Repayment	Gross Revenue	Annual Balance	Accumulated Surplus
1. 1987	0	-1,800				-1,800	-1,800
2. 88	0	-1,800				-1,800	-3,600
3. 89	-82,040	-21,795				-103,835	-107,435
4. 90	-110,980	-40,914				-151,894	-259,329
5. 91	-82,580	-68,877				-151,457	-410,786
6. 92	-41,270	-78,523				-119,793	-530,579
7. 93			-18,031	-62,956	142,633	61,646	-468,933
8. 94			-18,031	-62,956	142,633	61,646	-407,287
9. 95			-18,031	-62,956	142,633	61,646	-345,641
10. 96			-18,031	-62,956	142,633	61,646	-283,995
11. 97			-18,031	-62,956	142,633	61,646	-222,349
12. 98			-18,031	-62,956	142,633	61,646	-160,703
13. 99			-18,031	-62,956	142,633	61,646	-99,057
14. 2000			-18,031	-62,956	142,633	61,646	-37,411
15. 01			-18,031	-62,956	142,633	61,646	24,235
16. 02			-18,031	-62,956	142,633	61,646	85,881
17. 03			-18,031	-62,956	142,633	61,646	147,527
18. 04			-18,031	-62,956	142,633	61,646	209,173
19. 05			-18,031	-62,956	142,633	61,646	270,819
20. 06			-18,031	-62,956	142,633	61,646	332,465
21. 07			-18,031	-62,956	142,633	61,646	394,111
22. 08			-18,031	-62,956	142,633	61,646	455,757
23. 09			-18,031	-62,956	142,633	61,646	517,403
24. 10			-18,031	-62,956	142,633	61,646	579,049
25. 11			-18,031	-62,956	142,633	61,646	640,695
26. 12			-18,031	-62,956	142,633	61,646	702,341
27. 13			-18,031	-62,956	142,633	61,646	763,987
28. 14			-18,031	-62,956	142,633	61,646	825,633
29. 15			-18,031	-62,956	142,633	61,646	887,279
30. 16			-18,031	-62,956	142,633	61,646	948,925
31. 17			-18,031	-62,956	142,633	61,646	1,010,571
32. 18			-18,031	-62,956	142,633	61,646	1,072,217

Table 9.5 Results of Environmental Impact Assessment (1/2)

Item	Prediction	Evaluation
Settlement	No submergence is expected in the project area since it plans a run-of-river type power generation.	0
Land Issues and Compensation	About 50,000 m ² will have to be secured for the construction of such major facilities as intake, surge tank, powerstation and access road on the almost non-cultivated land. Land issues are not foreseen so far as it is properly compensated.	0
Economic Activity	A large construction labour demand is expected. Incremental agricultural production is also expected by introducing perennial irrigation.	+H
Recreation	The Odino Falls has been planned to be submerged according to the initial plan. It is, however, to be preserved since the proposed damsite have been shifted upstream. Flow in the downstream area will be decreased due to intake for power generation and, consequently, the potential value of Odino Falls as tourism resources would be dropped. Notwithstanding, the accessibility to the Odino Falls is so inferior and people are scarcely able to visit there at present that it will be less affected.	-L
Public Health	It is predicted that <i>Anopheles gambiae</i> , a vector of malaria will increase in the irrigated area. Also, it is predicted that snails which are host of miracidium will increase in the irrigation canals and schistosomiasis will become more popular than the present time in the irrigated area.	-H
Sedimentation	Sediment are deposited at the intake gate and/or in the sand stilling basin. It will be discharged into downstream by the gate opening during floods. Since sedimentation into Lake Victoria takes place almost during flood period, it will be less affected.	-L

Table 9.5 Results of Environmental Impact Assessment (2/2)

Item	Prediction	Evaluation
Vegetation	<p>Since the major structure sites such as intake, suge tank, powerstation and access road are merely covered by scattered shrubs and, further, ground modification is to be confined to a small area, vegetation will be less affected.</p> <p>The surge tank site, however, is located in the Koguta ungazetted forests, afforestation will be necessary at and arround the site after construction.</p>	-L
Wildlife	<p>Wildlife will not be affected because of no inundation in addition to tree fellings during construction.</p>	-L
Fishes and Fisheries	<p>Aquatic biology in the river channel between the damsite and Sangoro will be affected, because river flow in the lower reaches will be decreased due to intake for power generation. Local inhabitants presently catch fishes such as Labeo victoriunus (Ningu), Synodontis victoriana (Okoko) and etc. for feeding, and such catches would be decreased due to the implementation of the project.</p> <p>Some species in Lake Victoria which migrate upstream for spawning will not be affected because their migration takes place during the flood season.</p>	-L

Source: JICA Study Team

FIGURES

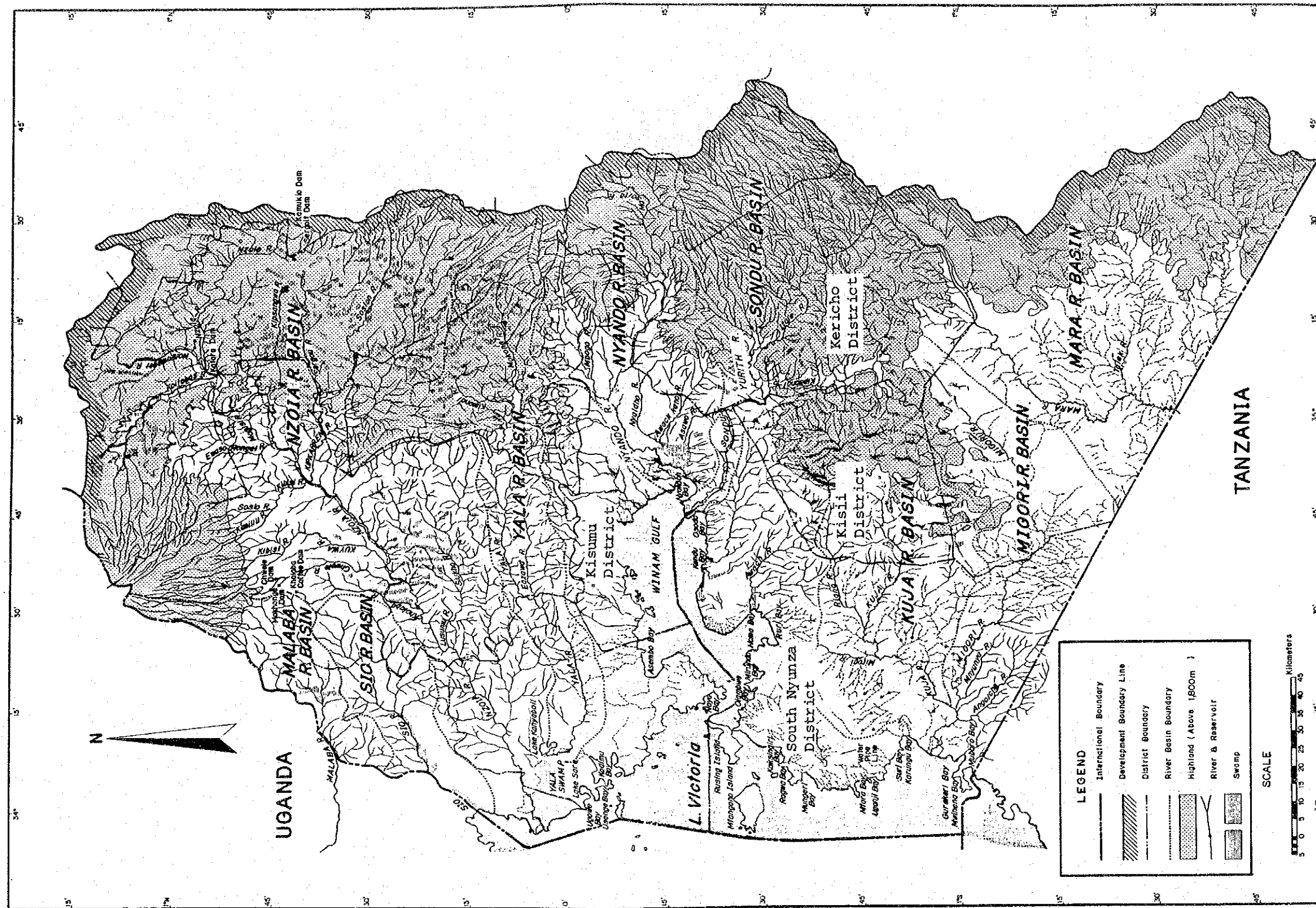
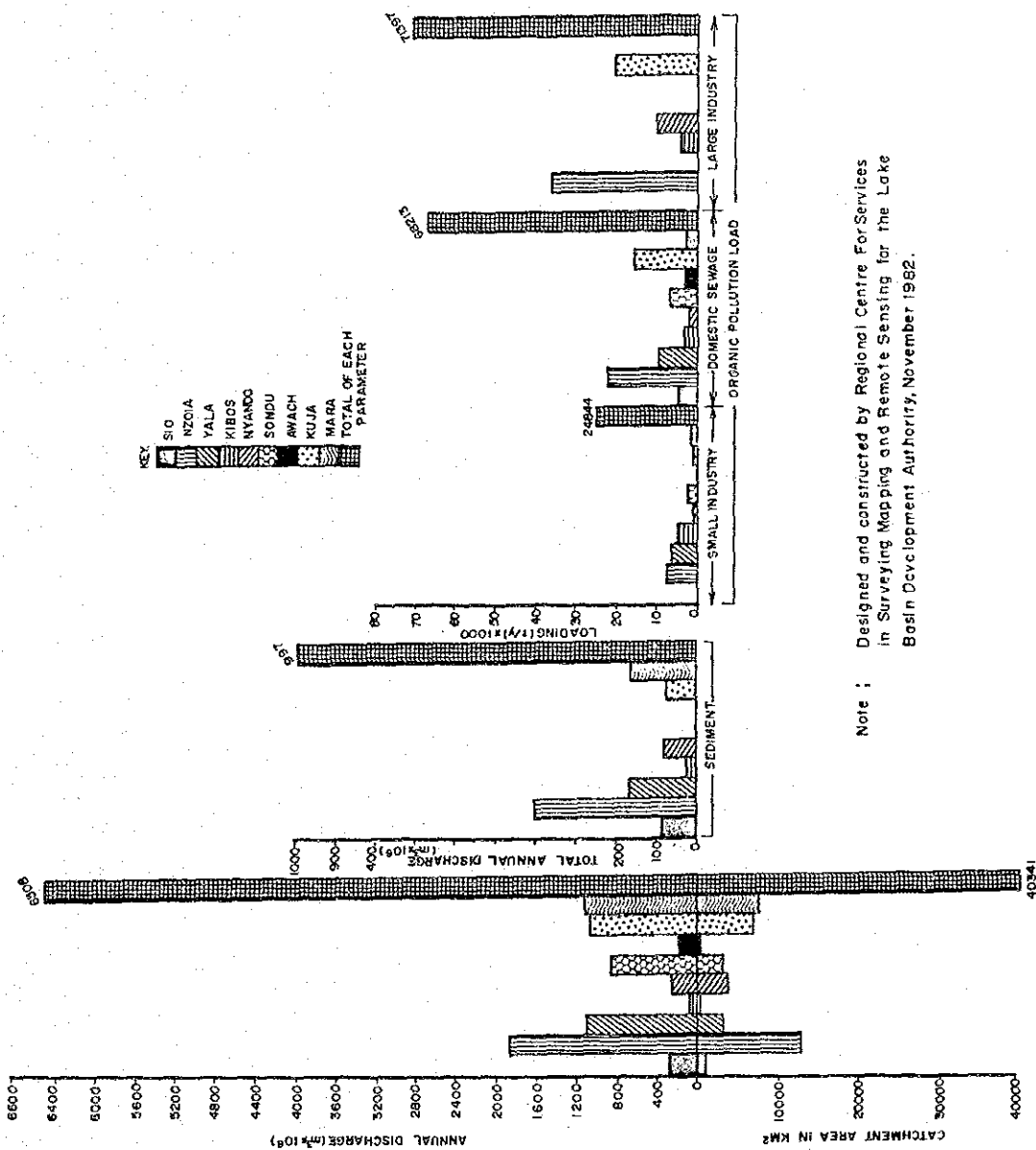


Figure 3.1
Administrative Division
and Sub-Catchment Areas

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Note : Designed and constructed by Regional Centre For Services in Surveying Mapping and Remote Sensing for the Lake Basin Development Authority, November 1982.

Figure 3.2
Macro Hydromorphologic Index

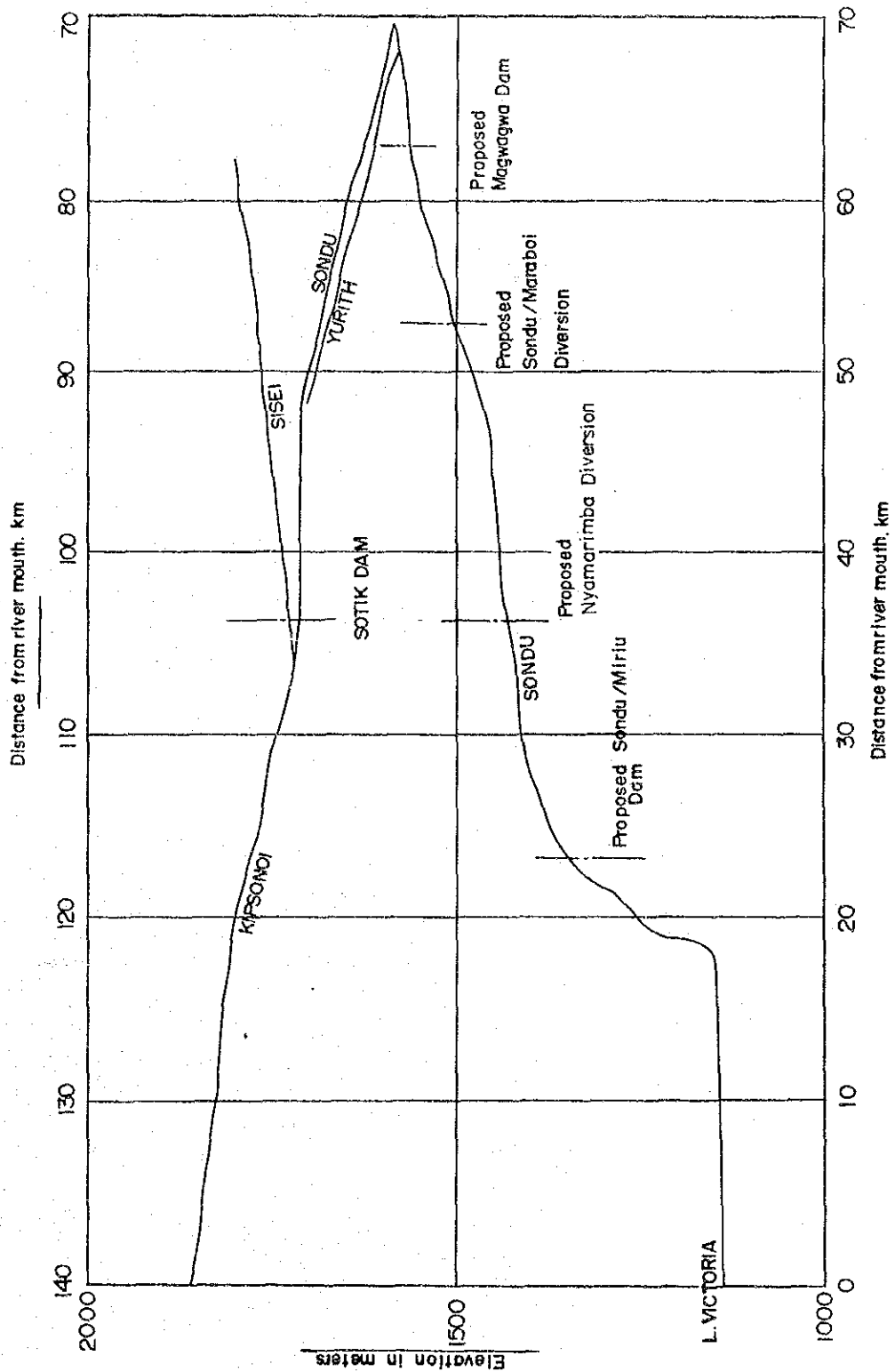


Figure 3.3
 Longitudinal Profile of the
 Sondu River

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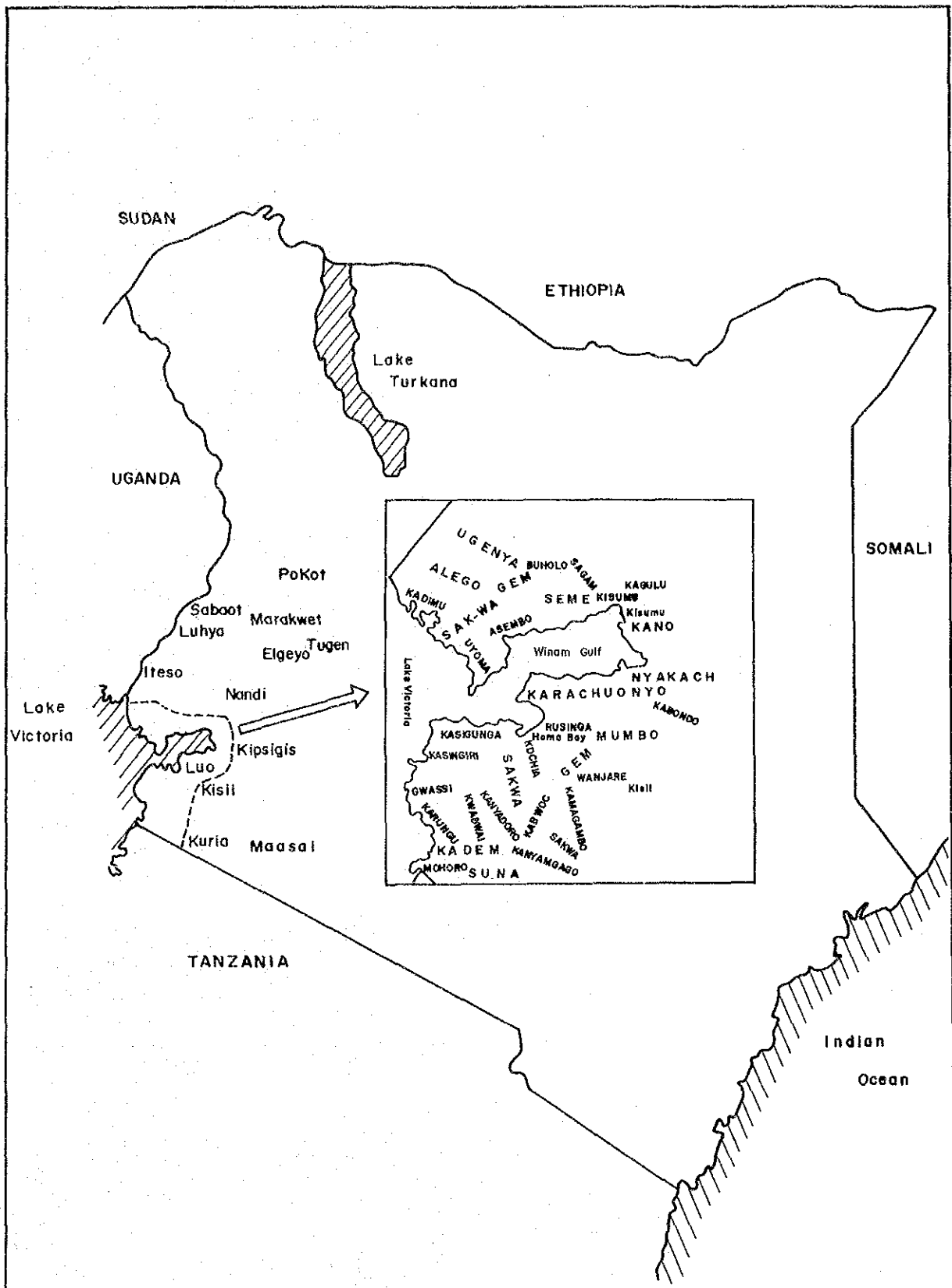


Figure 3.4
Relative Positions of Major Tribes
in the LBDA Area

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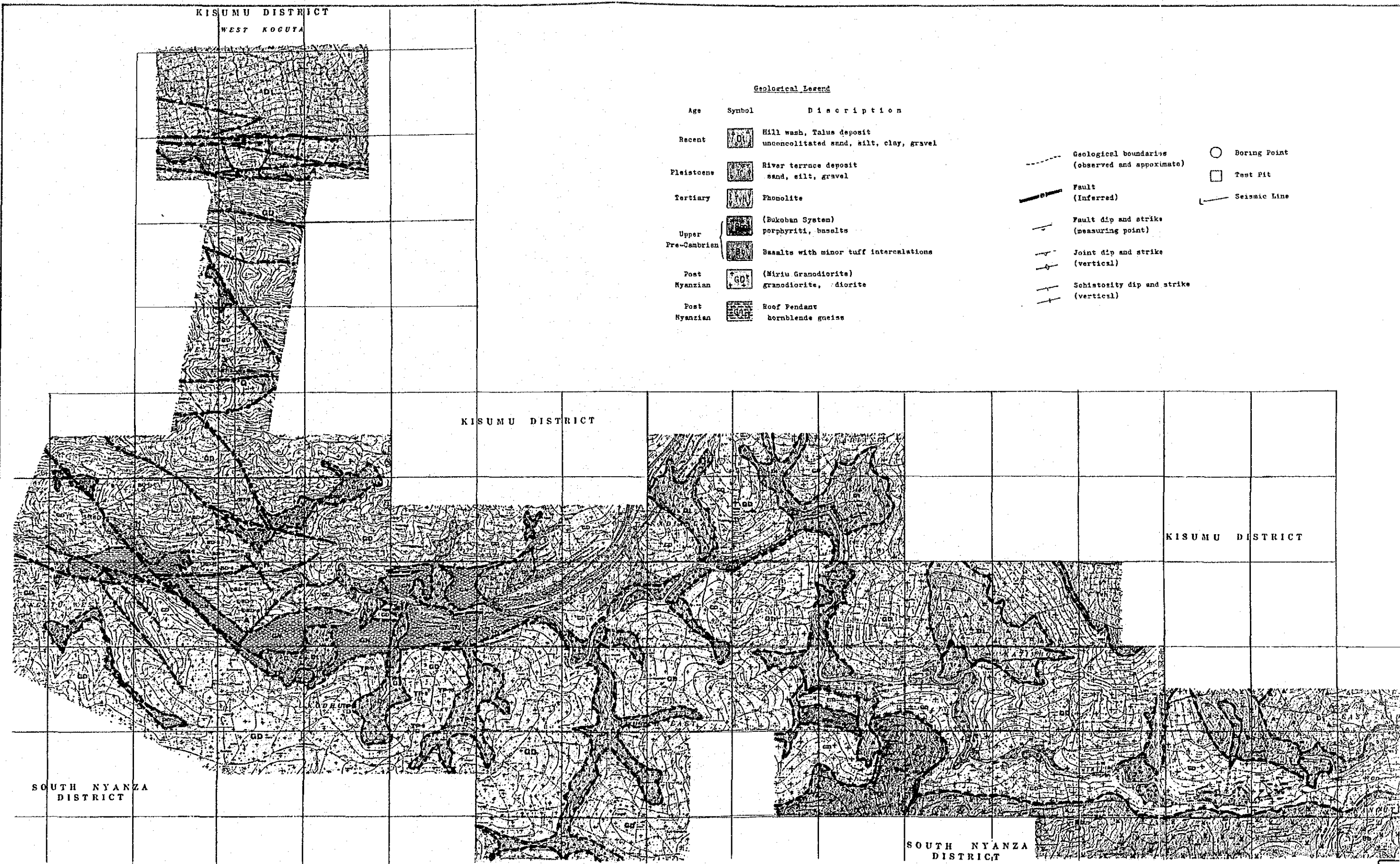
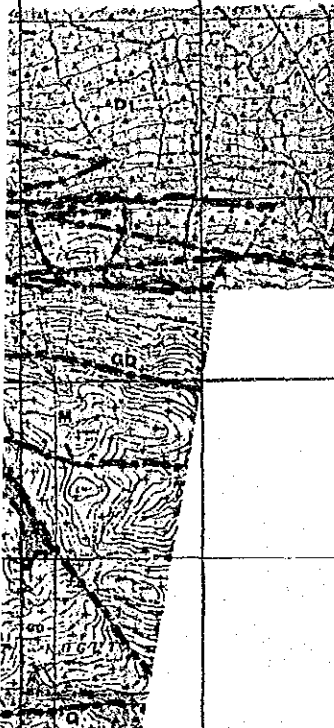


Figure 4.1 Geological Map for the Sondu/Miriu Reservoir

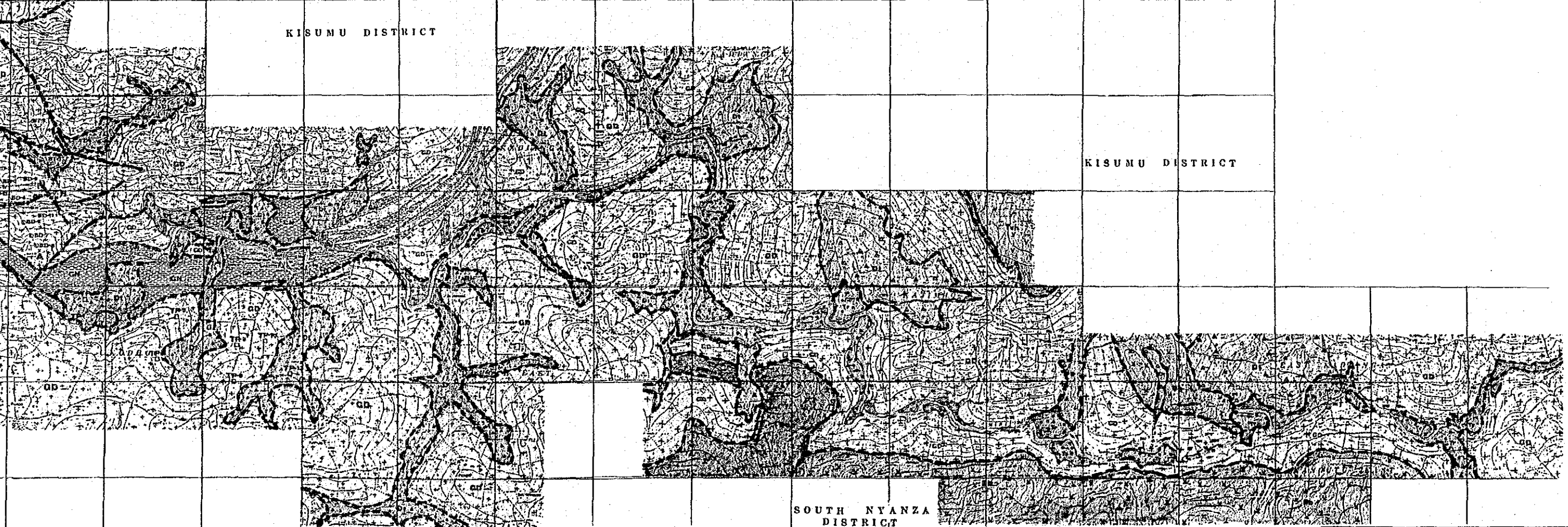
SUMU DISTRICT
WEST KOGUTA



Geological Legend

Age	Symbol	Description		
Recent		Hill wash, Talus deposit unconcolitated sand, silt, clay, gravel		Geological boundaries (observed and approximate)
Pleistocene		River terrace deposit sand, silt, gravel		Fault (Inferred)
Tertiary		Phonolite		Fault dip and strike (measuring point)
Upper Pre-Cambrian		(Bukoban System) porphyriti, basalte		Joint dip and strike (vertical)
		Basalts with minor tuff intercalations		Schistosity dip and strike (vertical)
Post Nyanzian		(Miriu Granodiorite) granodiorite, diorite		Boring Point
Post Nyanzian		Roof Pendant hornblende gneiss		Test Pit
				Seismic Line

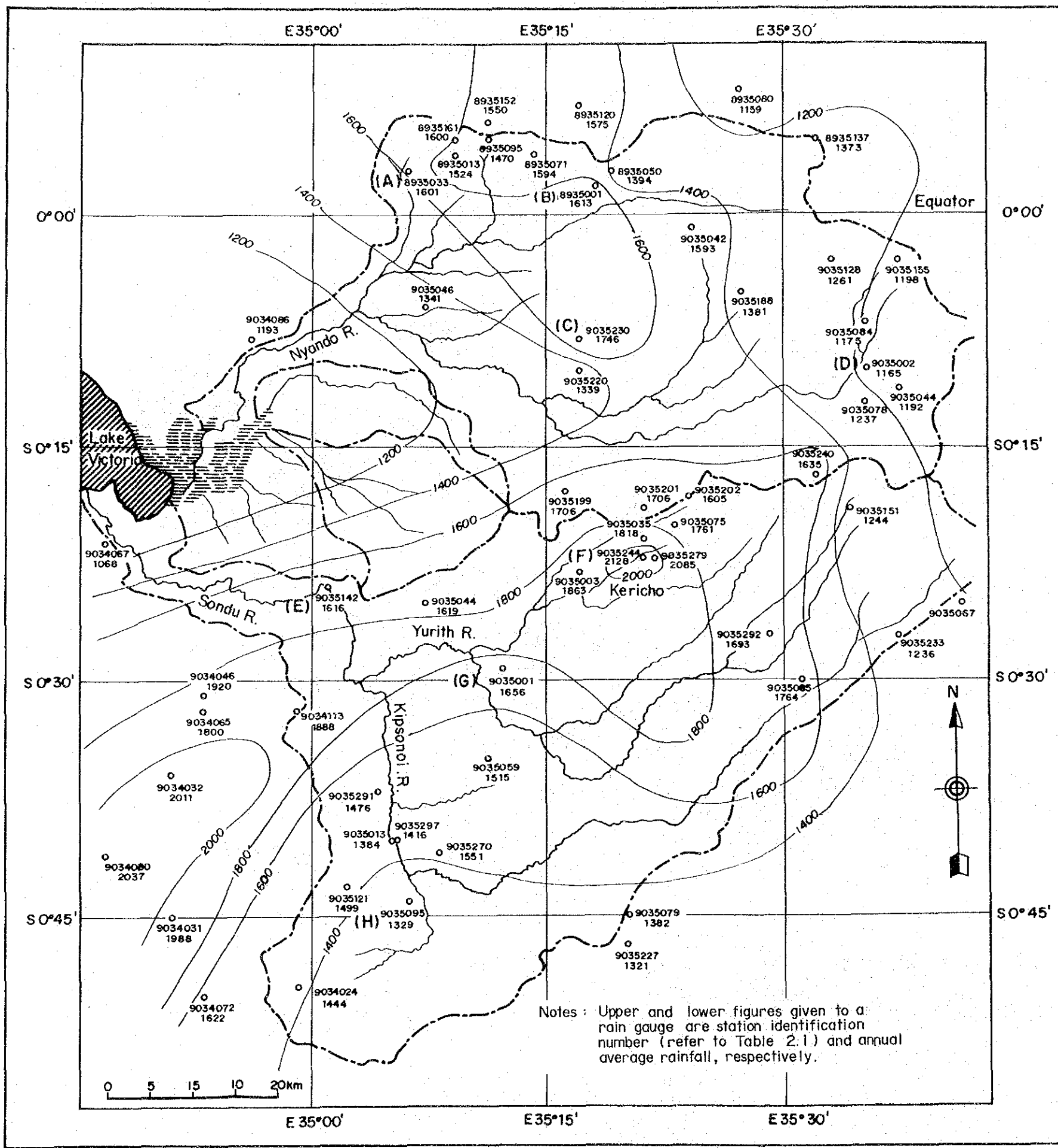
KISUMU DISTRICT



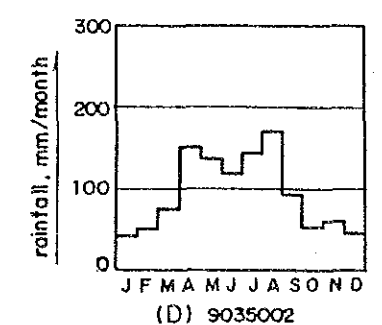
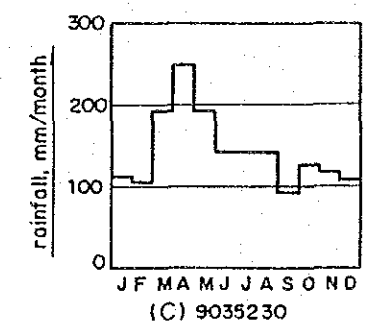
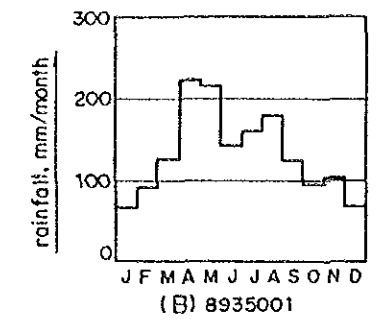
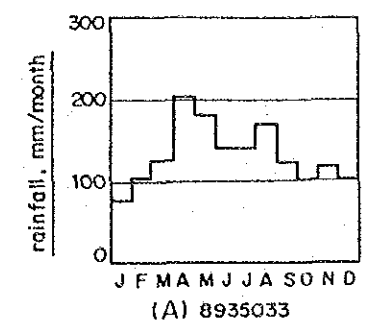
KISUMU DISTRICT

SOUTH NYANZA
DISTRICT

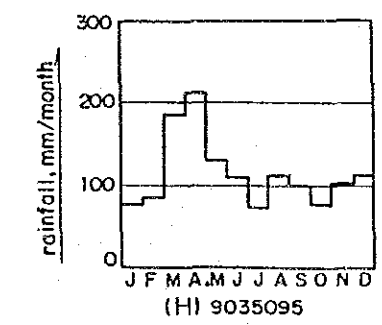
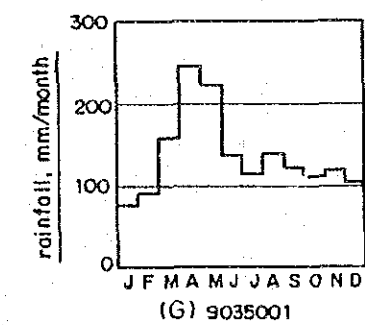
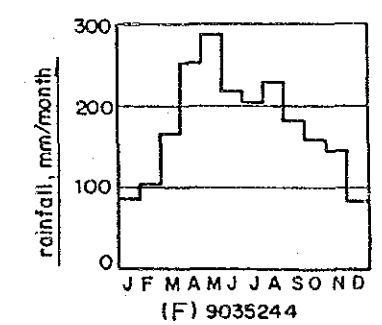
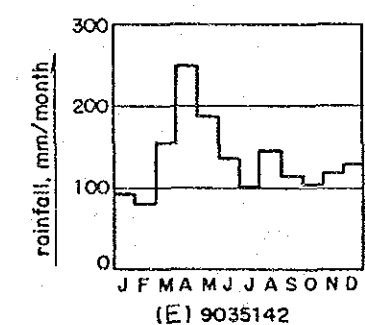
Figure 4.1 Geological Map for the Sondu/Miriu Reservoir



Nyando River Basin



Sondu River Basin



Monthly mean rainfall of selected rain gauges

Figure 4.2 Isohyetal Map in and around the Sondu River Basin

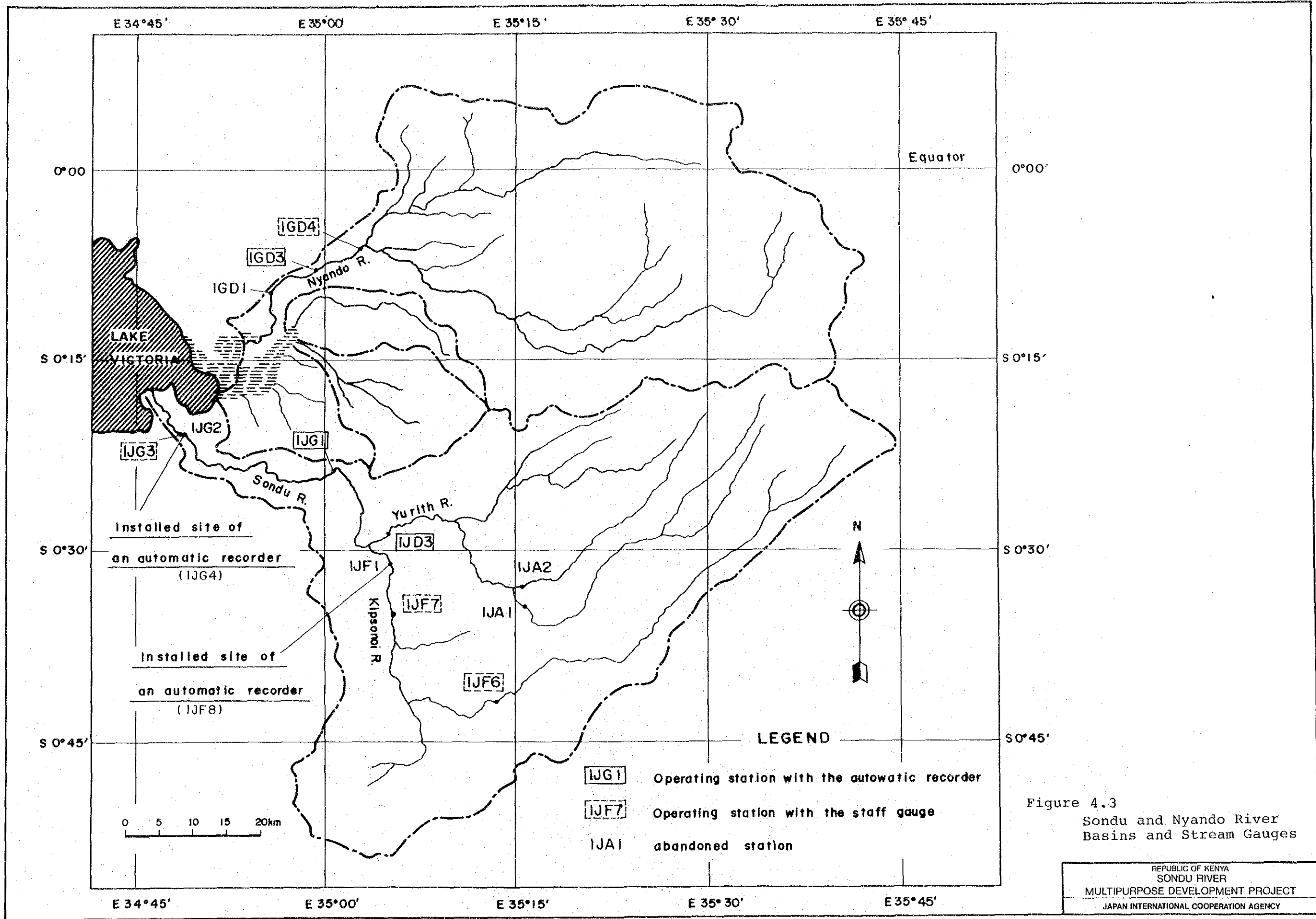


Figure 4.3
 Sondu and Nyando River
 Basins and Stream Gauges

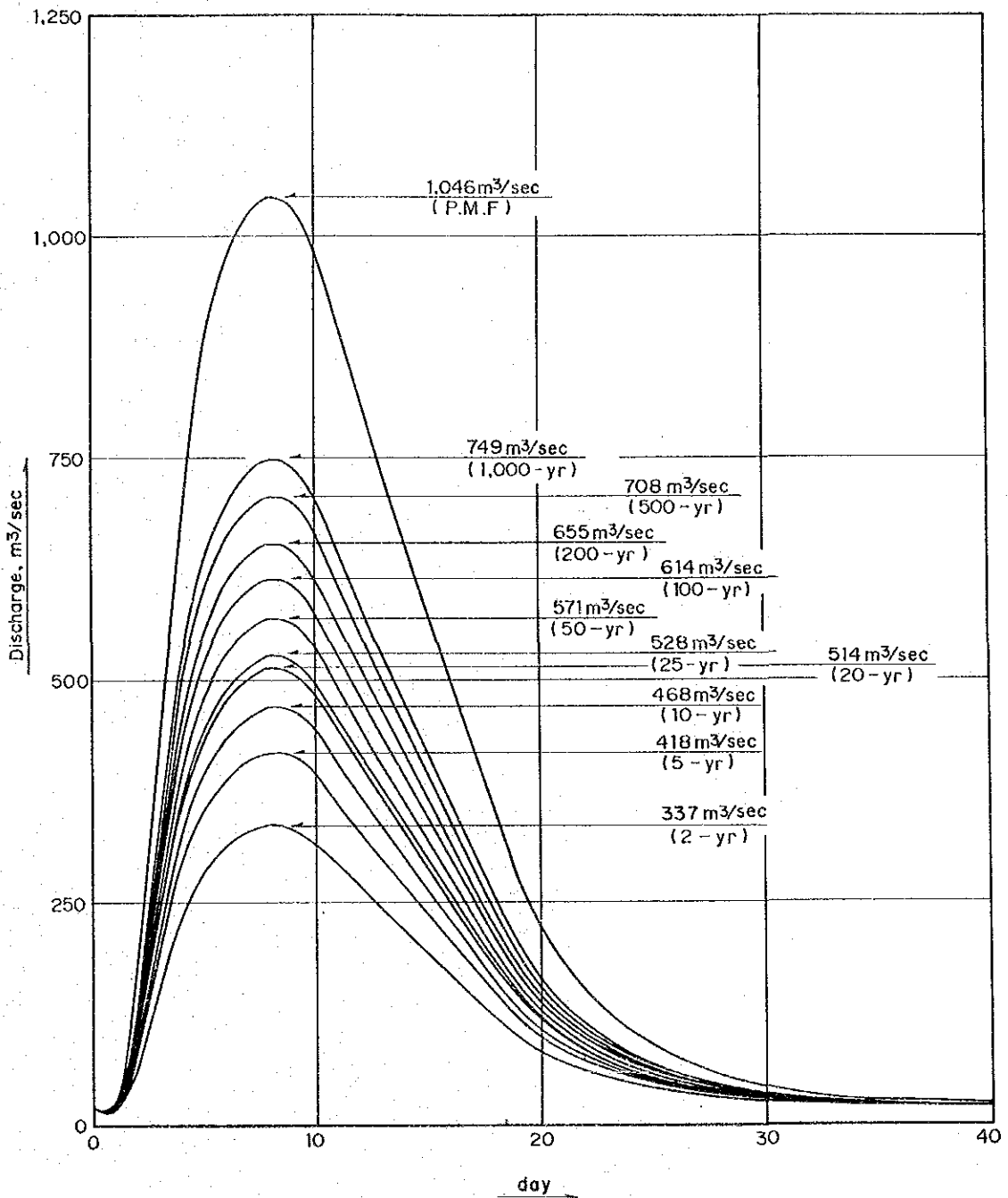


Figure 4.4
Probable Flood Hydrographs at 1JG1

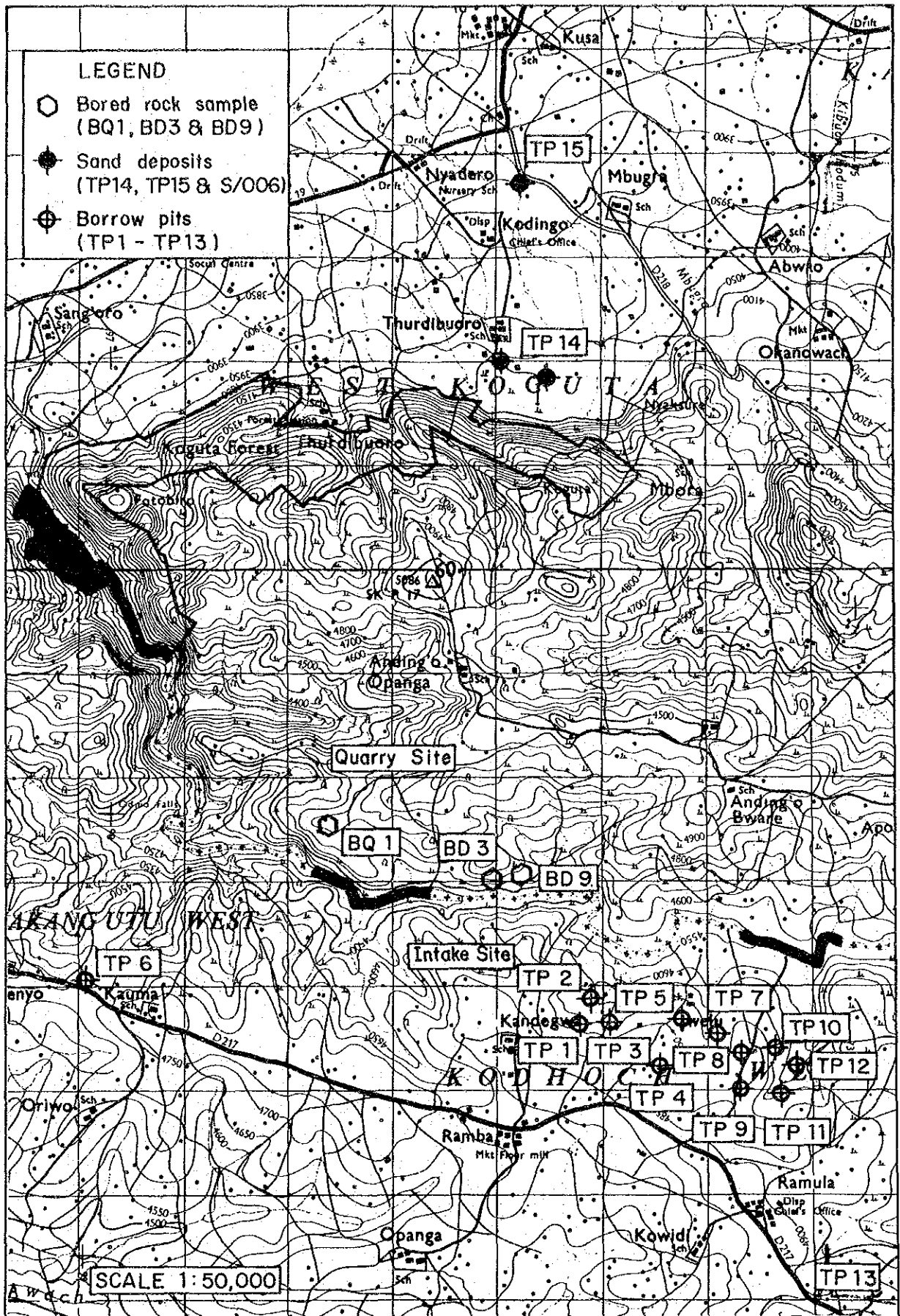


Figure 4.5 Location of Test Pits

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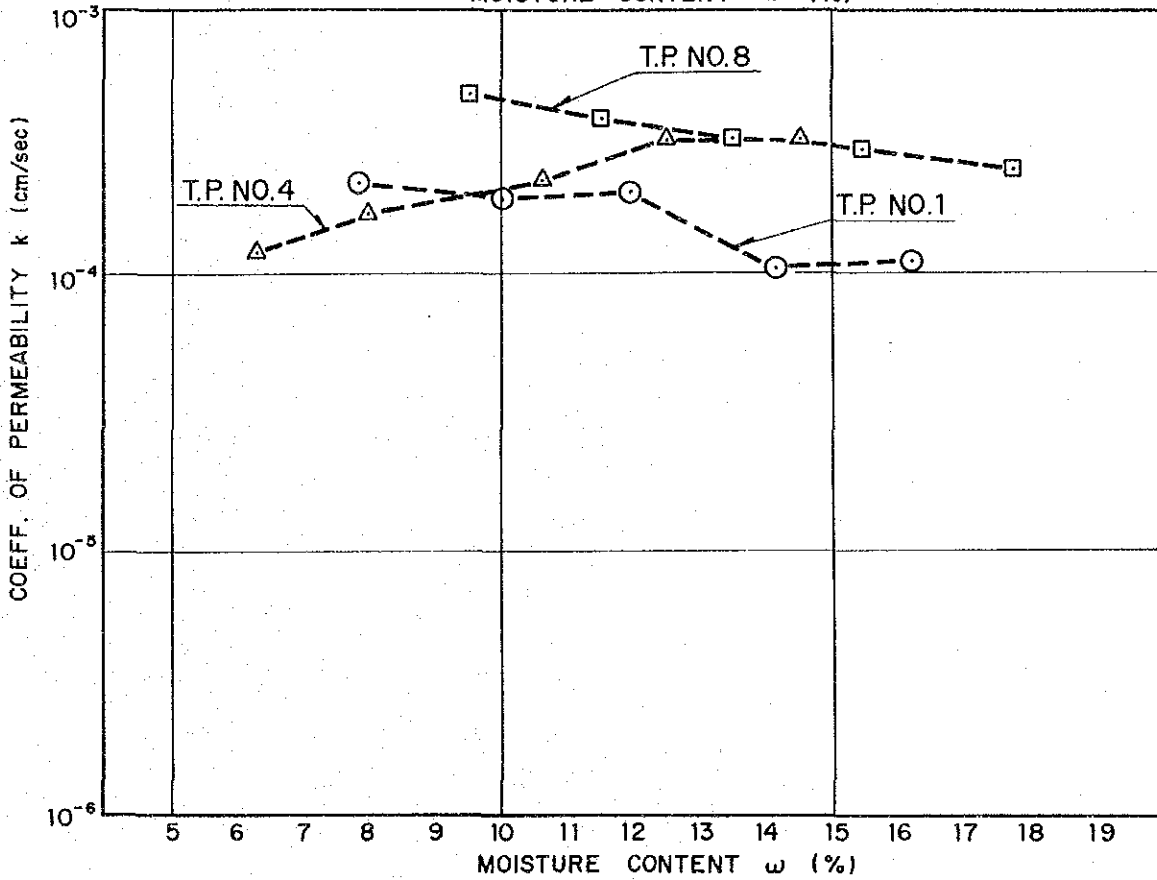
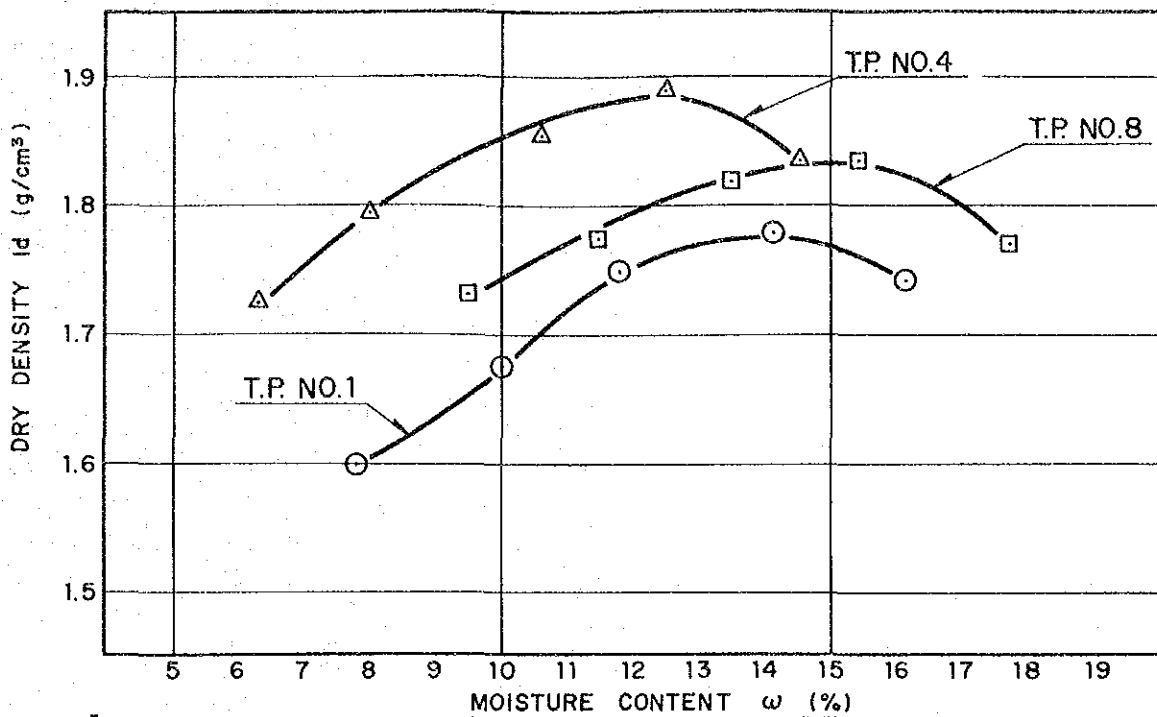


Figure 4.6
 Laboratory Permeability
 Characteristics for Weathered
 Granodiorite

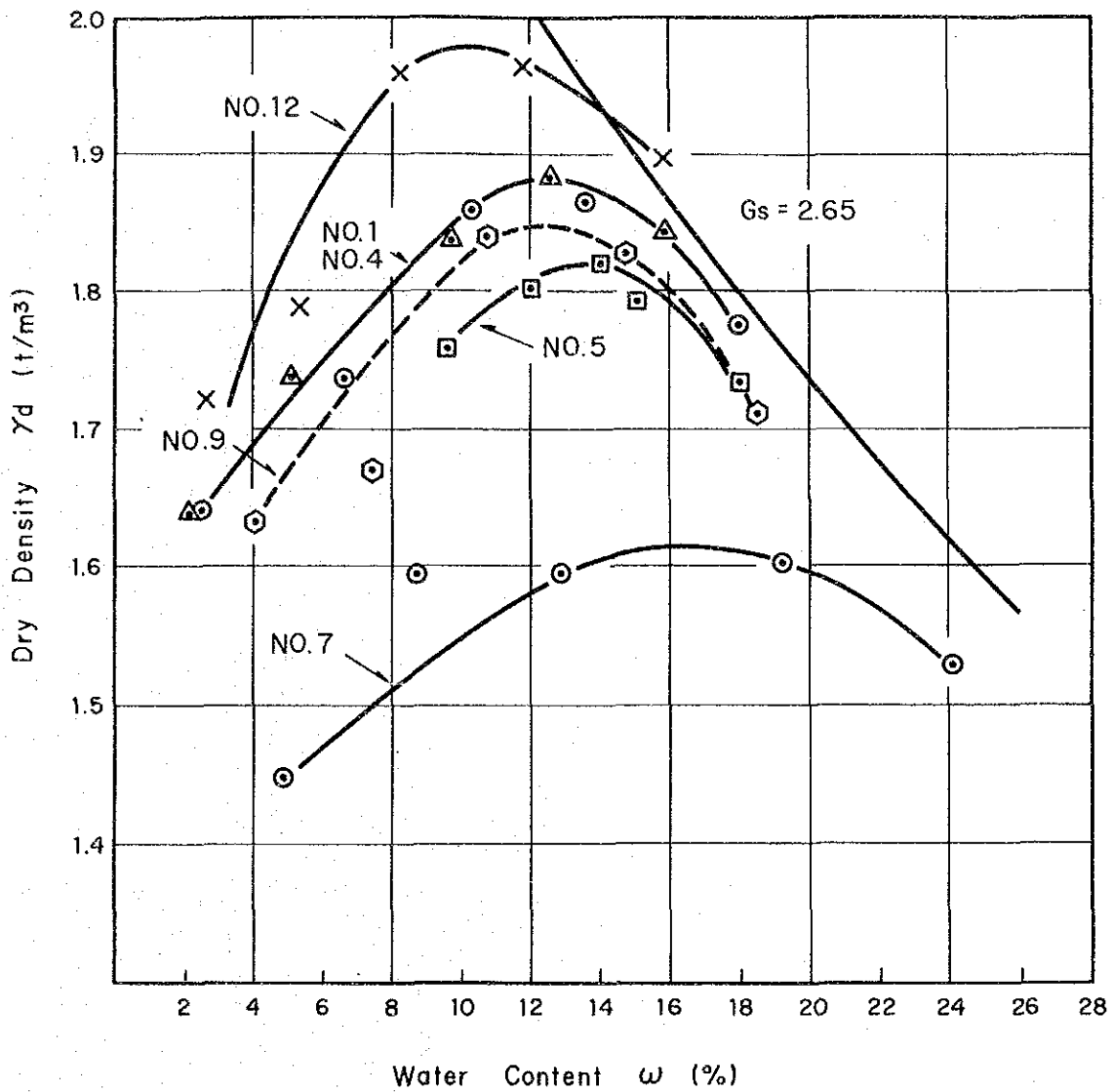


Figure 4.7
 Compaction Characteristics for
 Weathered Granodiorite

Lateritized red soil
Gs = 2.66

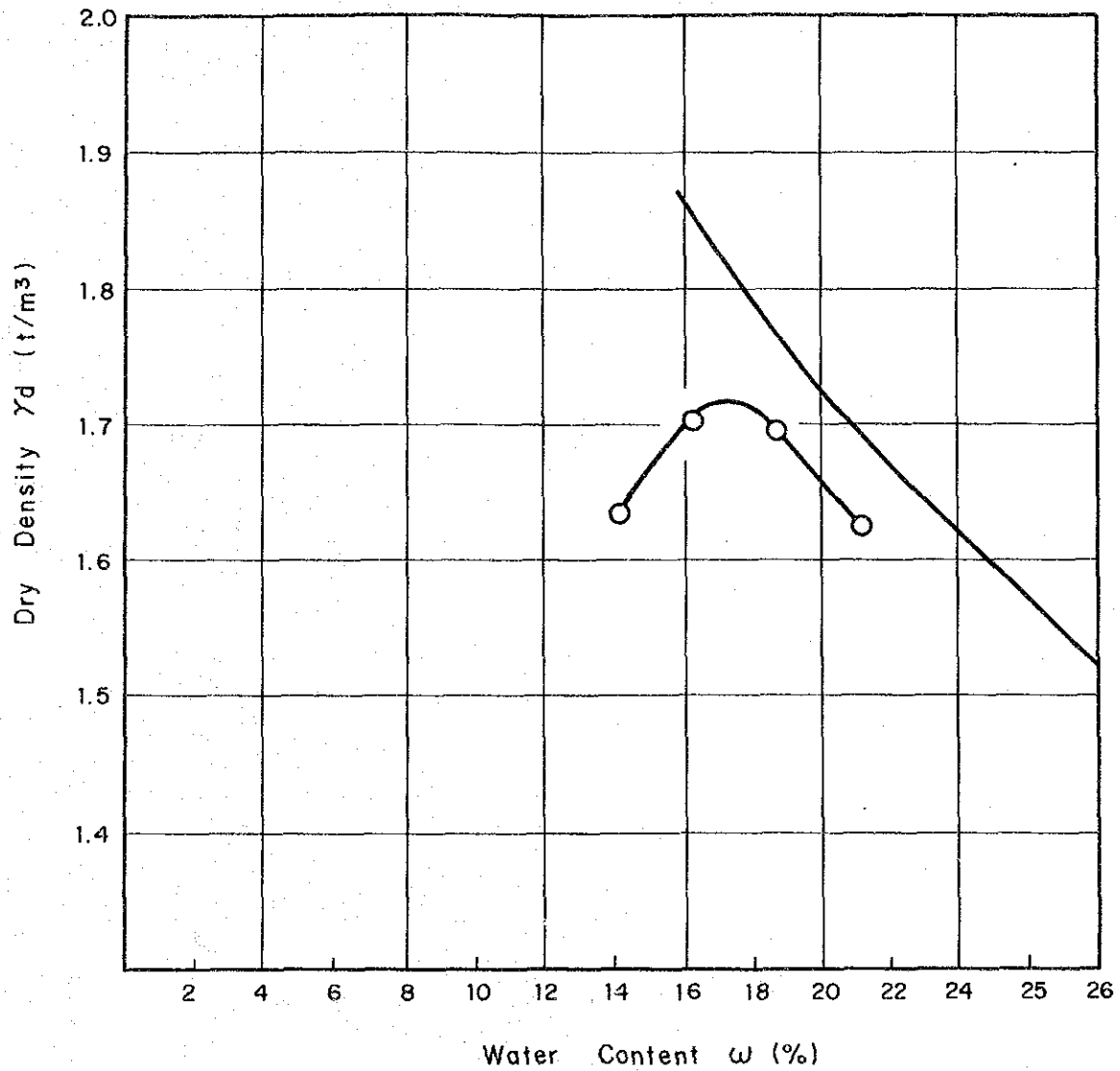


Figure 4.8
Compaction Characteristics for
Lateritized Red Soil

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JAPAN INTERNATIONAL COOPERATION AGENCY

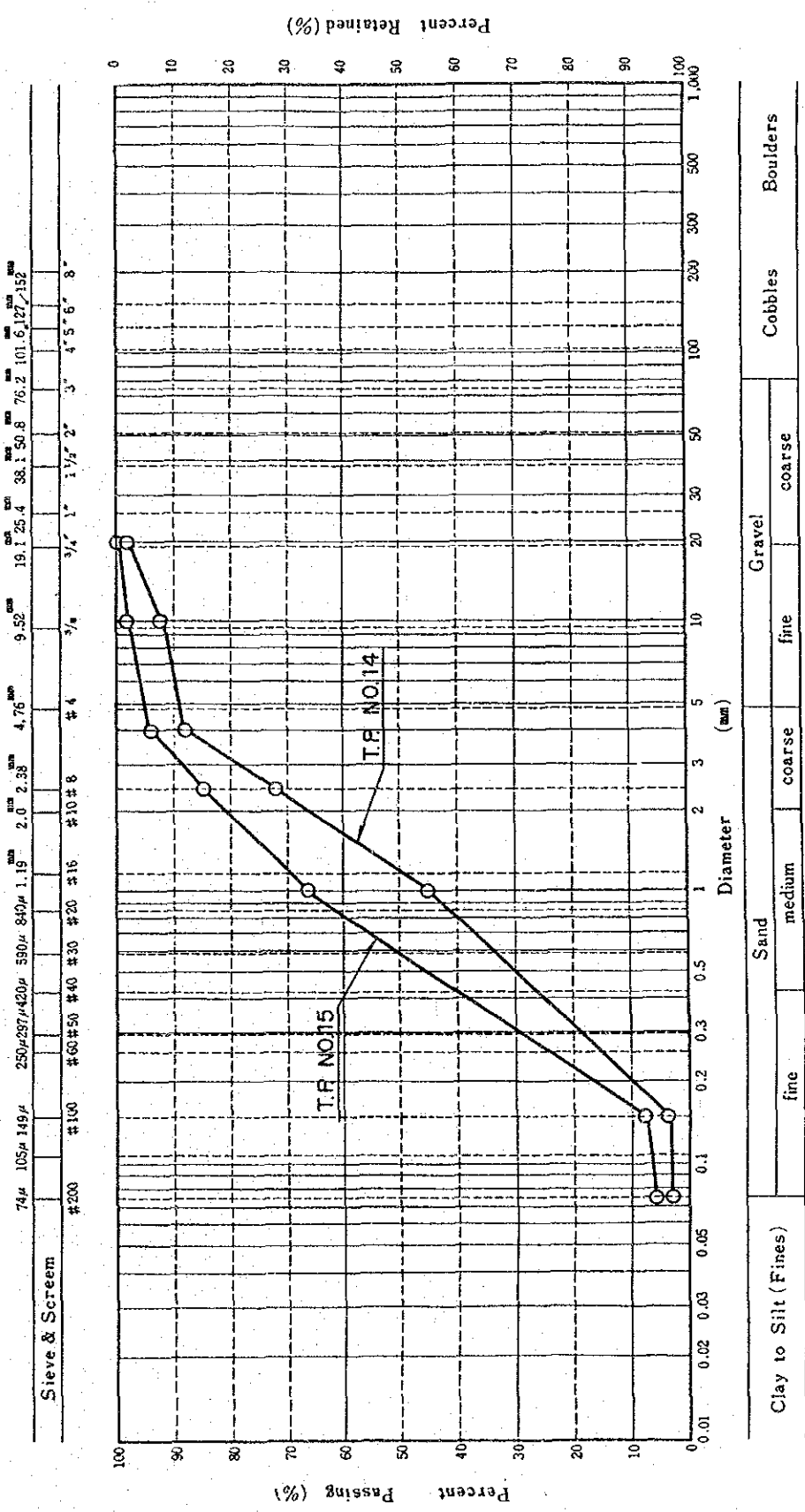
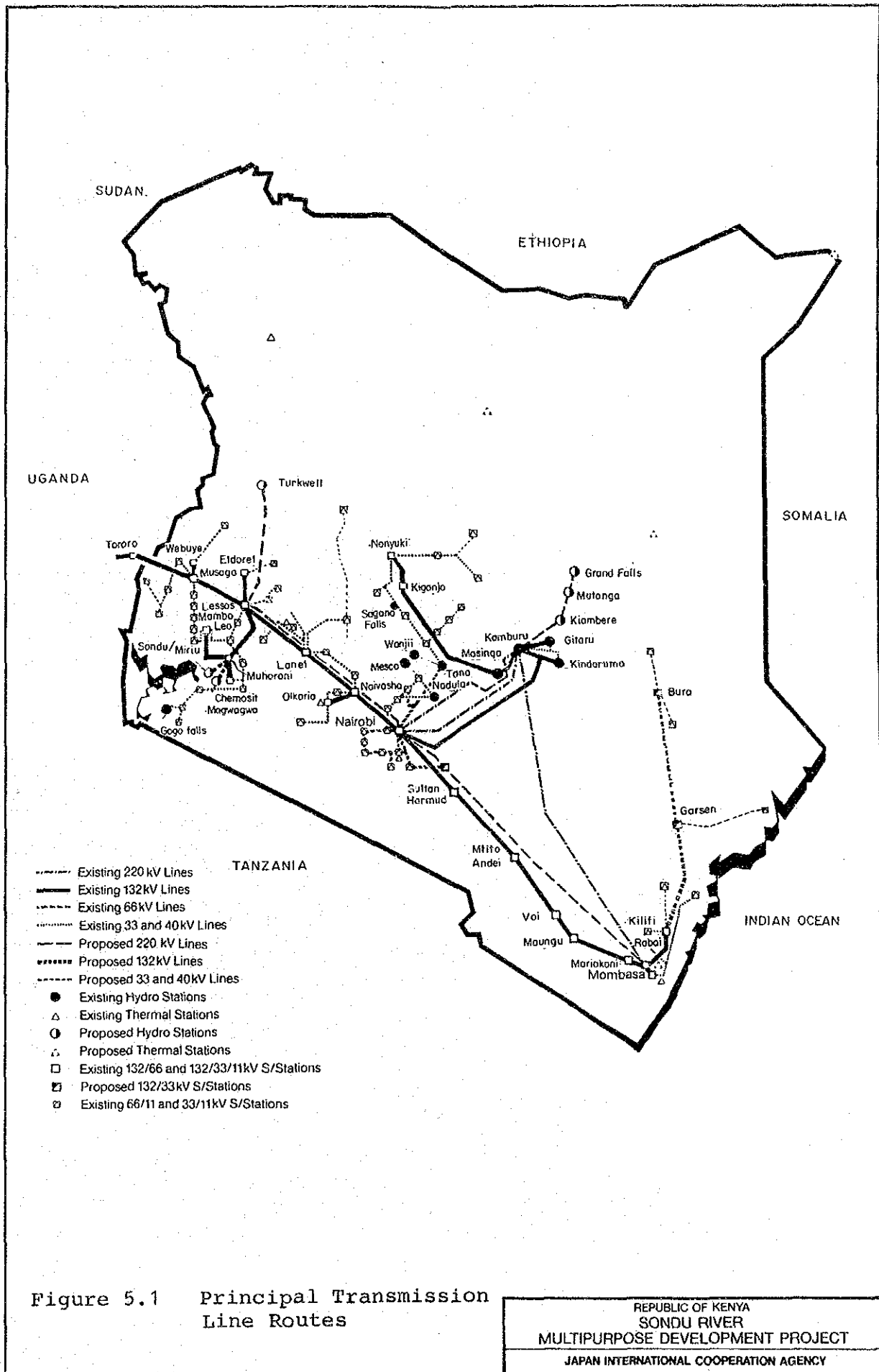


Figure 4.9 Gradation for Sands

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(Unit: % p.a.)

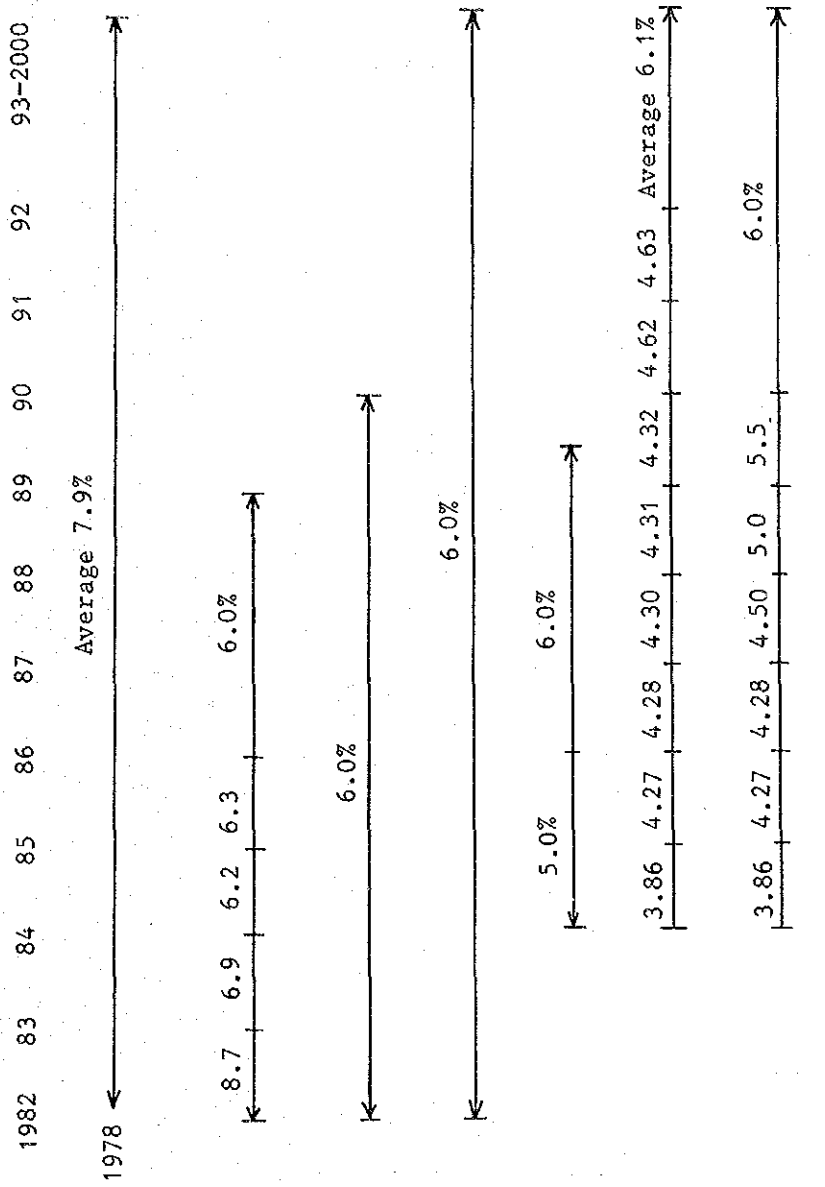


Figure 5.2
Comparison of Power Demand Growth Rates by Recent Studies

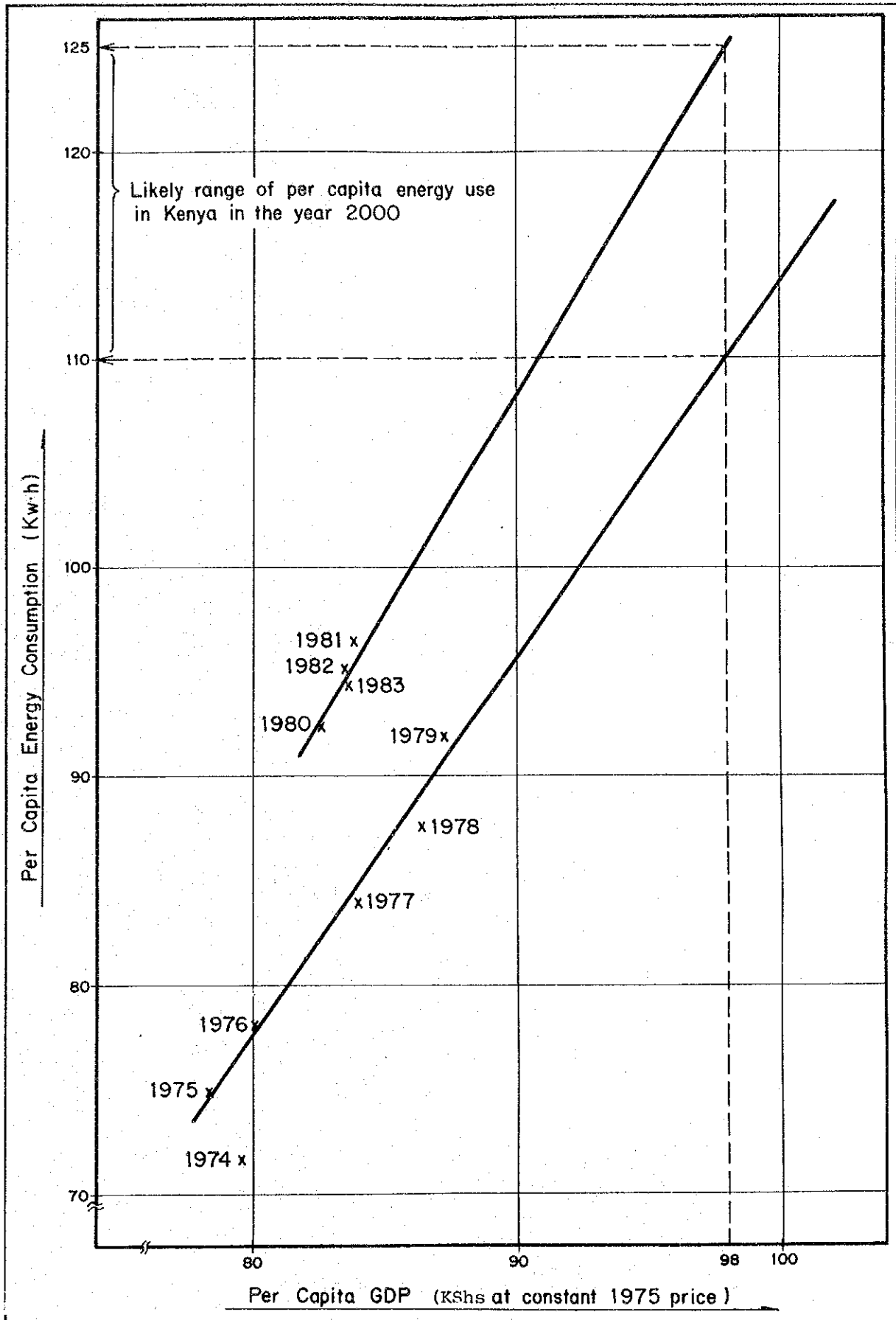


Figure 5.3 Relationship between per Capita GDP and per Capita Energy Consumption

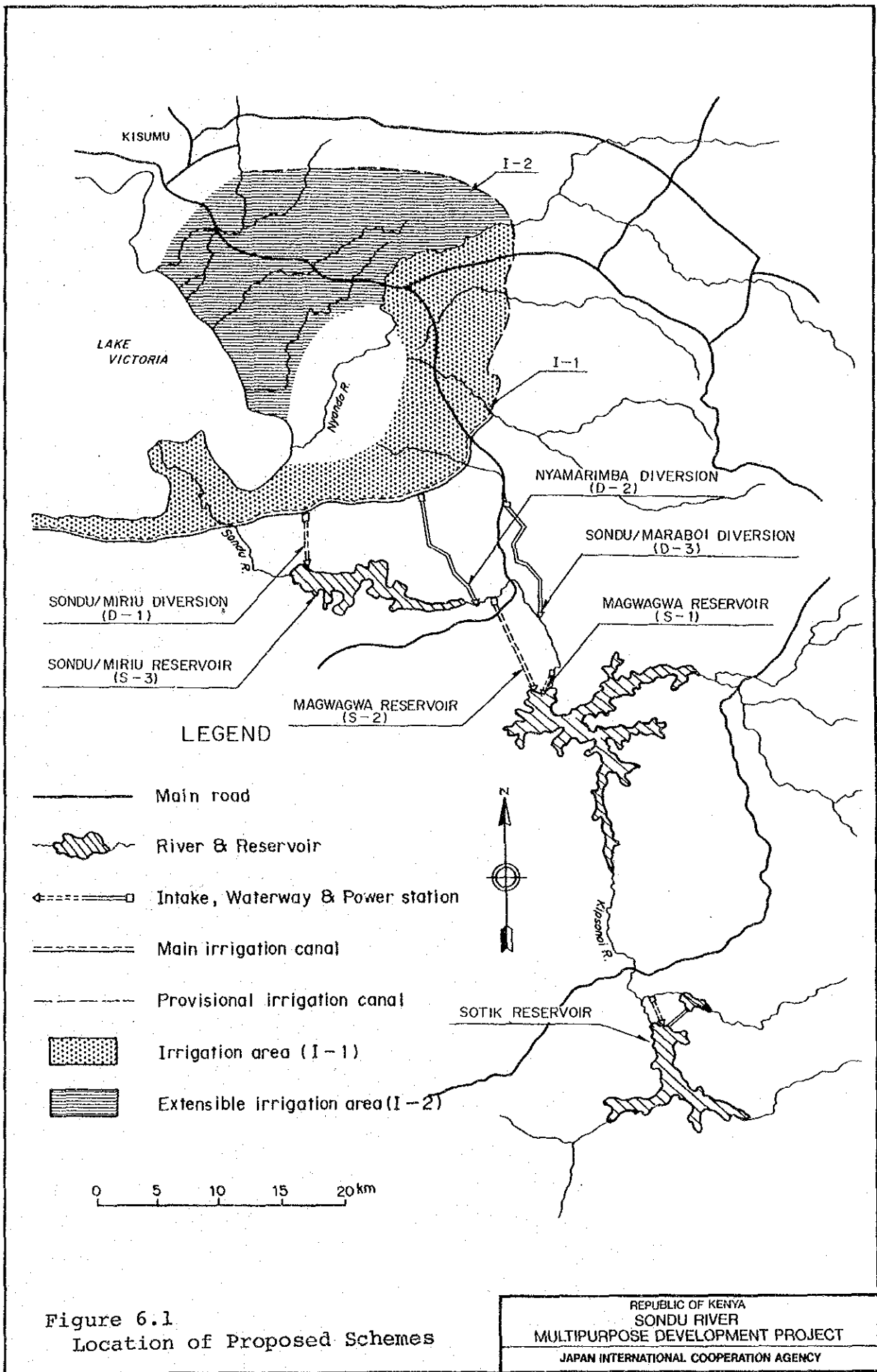
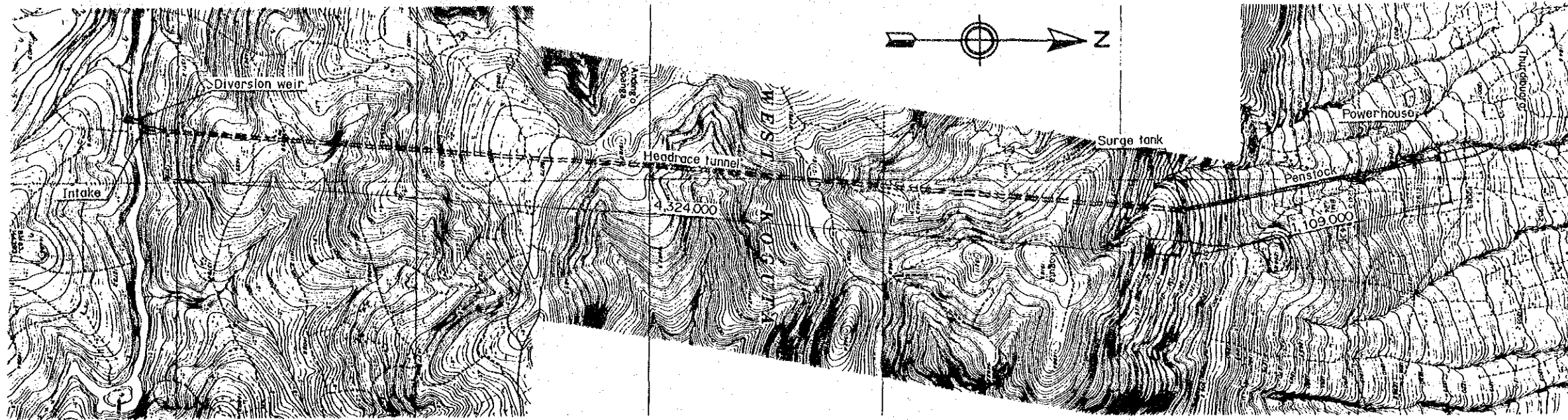
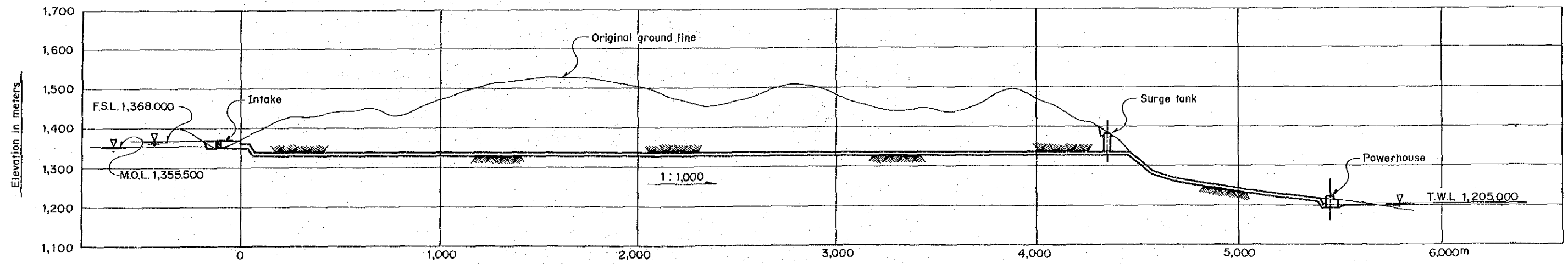


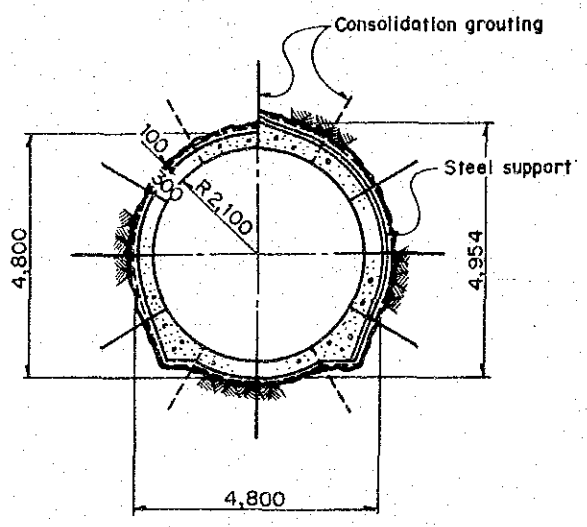
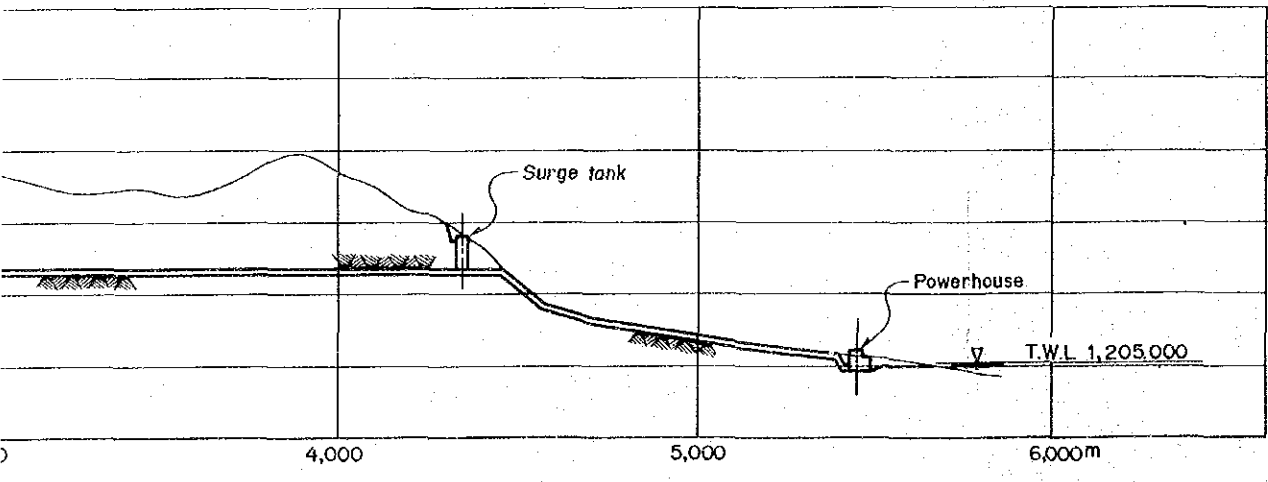
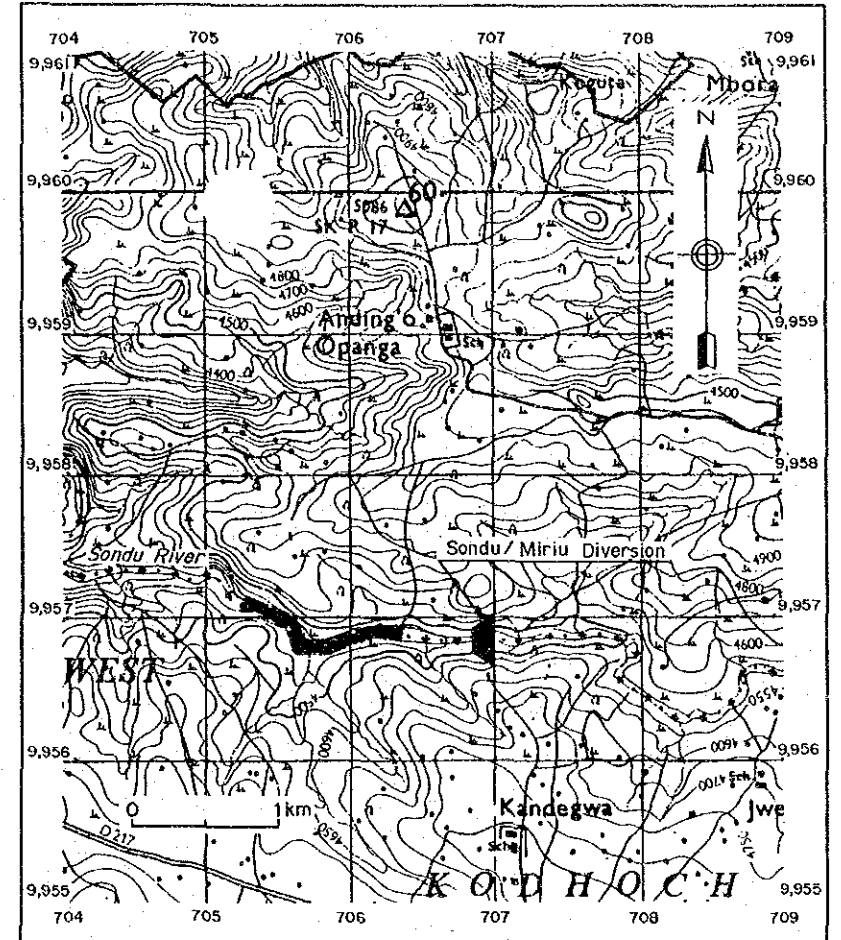
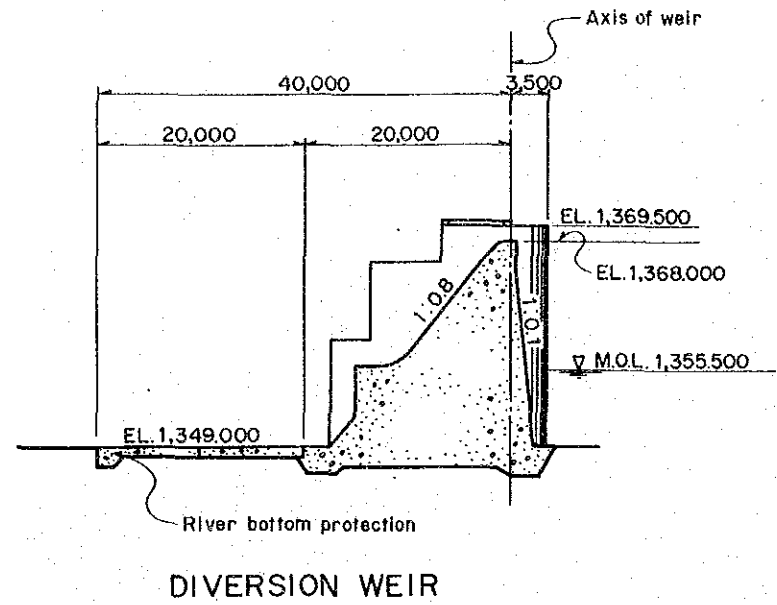
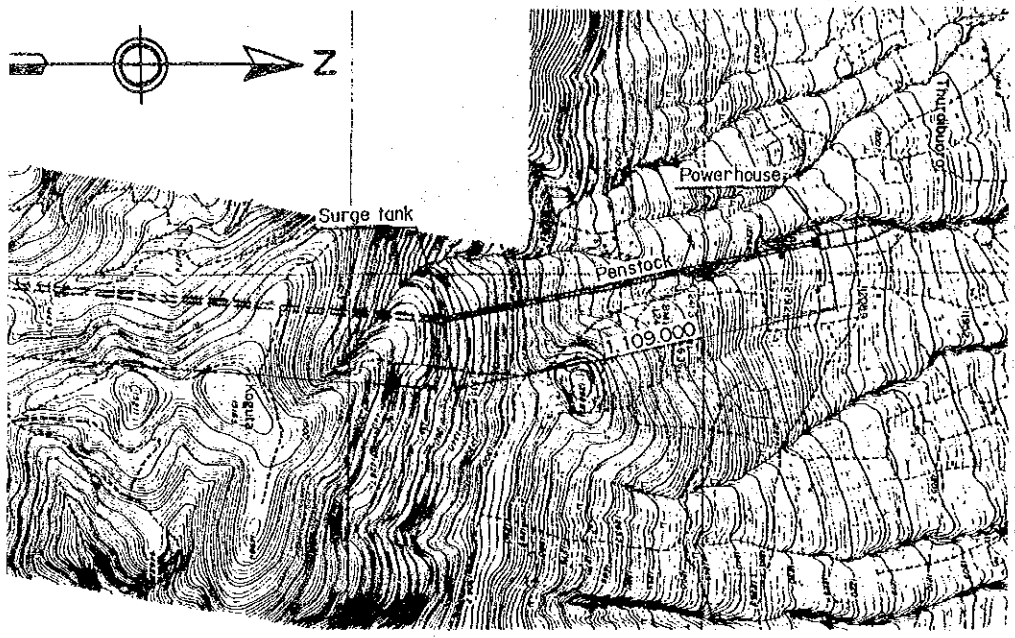
Figure 6.1
 Location of Proposed Schemes



PLAN



PROFILE



TYPE I TYPE II
**TYPICAL SECTION OF
HEADRACE TUNNEL**

Figure 6.2 Sondu/Miriu Run-of-river Plan