

Table 6.8.2 Economic Efficiency of Urban Water Supply Projects (2/3)

(Continuation)

Urban Code	Urban Name	Loc. Code	Location Name	NPV*1 (US\$1000)	B/C*1	IRR*2 (%)
U-55	Marsabit	454.1	Mountain	-136676	0.02	---
U-56	Sololo	455.2	Sololo	-48977	0.02	---
U-57	Moyale	456.1	Moyale	-51440	0.04	---
U-58	Meru	461.4	Ntima	-10119	0.71	5.7%
U-59	Nkubu	463.1	Nkuene	-2348	0.37	-2.7%
U-60	Chogoria	464.1	Chogoria	-1243	0.17	---
U-61	Chuka	464.3	Karingani	-2675	0.22	---
U-62	Maua	467.2	Maua	-2270	0.29	---
U-63	Mudo Gashe	513.1	Madogashe	-15931	0.03	---
U-64	Ijara	515.2	Ijara	-9223	0.02	---
U-65	Kotile	515.3	Kotile	-13588	0.02	---
U-66	Masalani	515.4	Masalani	-1842	0.10	---
U-67	Garissa	519.1	Sankuri	-4984	0.49	1.5%
U-68	Mandera	521.1	Mandera	-1355	0.40	-0.6%
U-69	Elwak	523.1	Elwak	-61203	0.04	---
U-70	Rhamu	524.2	Rhamu	-1736	0.27	---
U-71	Wajir	532.4	Wajir Township	-136338	0.02	---
U-72	Buna	536.2	Buna	-78413	0.01	---
U-73	Bute	537.2	Bute	-15082	0.01	---
U-74	Manga	611.2	Erange	-2595	0.08	---
U-75	Keroka	611.5	East Kitutu	-3639	0.18	---
U-76	Kisii	615.0	Kisii Municipality	-10620	0.55	3.2%
U-77	Ogembo	617.5	Majoge Chache	-1171	0.21	---
U-78	Maseno	622.1	West Kisumu	-3895	0.70	5.8%
U-79	Kisumu + Kiboswa	622.3	East Kisumu	-38724	0.57	3.7%
U-80	Ahero	623.2	South East Kano	-1436	0.71	5.7%
U-81	Muhoroni	625.2	Muhoroni	-3076	0.51	1.9%
U-82	Yala	633.2	East Gem	-1040	0.51	2.6%
U-83	Siaya	634.1	East Alego	-5872	0.56	3.7%
U-84	Ukwala	635.4	North Agenya	-1259	0.22	---
U-85	Homa Bay	641.1	Kanyada West	-2229	0.79	7.1%
U-86	Migori	644.3	Suna East	-1586	0.65	4.8%
U-87	Kendu Bay	648.1	Central Karachuonyo	-1317	0.47	1.1%
U-88	Oloitokitok	711.1	Odomongi	-4532	0.18	---
U-89	Ngong	712.1	Ngong	-7984	0.30	-8.8%
U-90	Kajiado	713.1	Ildamat	-14457	0.09	---
U-91	Namanga	713.5	Namanga	-3260	0.26	---
U-92	Magadi	714.1	Magadi	-7951	0.07	---
U-93	Sotik	723.1	Kepletudo	-1212	0.68	5.2%
U-94	Kericho	725.5	Kericho Township	-1889	0.90	8.7%
U-95	Kipkelion	726.1	Kipkelion	-792	0.53	2.3%
U-96	Londiani	727.1	Londiani	-57652	0.02	---
U-97	Nanyuki	731.5	Nanyuki	-5238	0.64	4.7%
U-98	Nyahururu	733.9	Nyahururu Township	-11033	0.28	---
U-99	Gilgil	743.2	Gilgil	-36507	0.12	---
U-100	Naivasha	744.1	Naivasha	-27760	0.32	-5.7%
U-101	Njoro	746.1	Njoro	-19071	0.14	---
U-102	Elburgon	747.3	El Burgon	-17083	0.20	---
U-103	Molo	747.5	Molo South	-13523	0.22	---
U-104	Nakuru	749.0	Nakuru Municipality	-113003	0.33	-4.7%
U-105	Narok	752.1	Lower Melili	-22828	0.16	---
U-106	Nairagie Ngare	752.5	Keekonyoike	-1305	0.08	---
U-107	Kitale	762.3	Kitale	-11281	0.59	3.6%

(To be continued)

Table 6.8.2 Economic Efficiency of Urban Water Supply Projects (3/3)

(Conclusion)

Urban Code	Urban Name	Loc. Code	Location Name	NPV*1 (US\$1000)	B/C*1	IRR*2 (%)
U-108	Kiminini/Saboti+Spr.Kita	762.4	Kiminini	-2670	0.12	---
U-109	Endebess/Kwanza	763.5	Endebess	-1482	0.28	---
U-110	Eldoret	772.5	Eldoret Municipality	-79400	0.27	-11.7%
U-111	Burnt Forest	774.6	Olare	-1168	0.31	-8.2%
U-112	Kabarnet	812.5	Kabarnet Mosop	-24366	0.07	---
U-113	Maji Mazuri	814.3	Maji Mazuri	-2763	0.34	-5.3%
U-114	Eldama Ravine	814.5	Eldama Ravine	-23223	0.05	---
U-115	Mogotio	815.1	Lembus Soi	-4900	0.10	---
U-116	Iten+Tambach	822.4	Kiptuilong	-9772	0.08	---
U-117	Nandi Hills	831.3	Chemelil	-2314	0.31	-6.9%
U-118	Kapsabet+Baraton	832.2	Chemundu	-4350	0.54	2.6%
U-119	Maralal	841.4	Maralal	-6897	0.46	1.0%
U-120	Wamba	842.4	Wamba	-61173	0.02	---
U-121	Baragoi	843.6	Elbarta	-93885	0.01	---
U-122	Lodwar	853.5	Lodwar	-95585	0.03	---
U-123	Kapenguria/Makutano	861.1	Kapenguria	-3950	0.45	-0.2%
U-124	Bungoma	912.4	Musikoma	-11836	0.45	0.3%
U-125	Kimilili	913.1	Kimilili	-3658	0.38	-2.7%
U-126	Webuye	914.2	Webuye	-7189	0.55	2.7%
U-127	Busia	921.5	South Teso	-5629	0.49	2.6%
U-128	Luanda	931.3	West Bunyore	-690	0.17	---
U-129	Vihiga+Majengo	932.5	Central Maragoli	-2811	0.34	-5.1%
U-130	Kaimosi	933.1	Shamakhokho	0	***	***
U-131	Khayega	934.3	West Isukha	-1236	0.18	---
U-132	Kakamega	935.4	Kakamega Municipality	-7030	0.71	5.9%
U-133	Butere	939.2	Central Marama	-1204	0.34	-4.5%
U-134	Mumias	93A.4	Central Wanga	-4077	0.64	4.6%
U-135	Mamburi	314.6	Magarini	-2491	0.29	---
U-136	Lungalunga	324.5	Lungalunga	-1253	0.36	-3.0%
U-137	Taveta	351.1	Taveta	-1913	0.69	5.5%
U-138	Garbatula	422.1	Garbatula	-30182	0.02	---
U-139	Merti	423.1	Merti	-2816	0.36	-3.2%
U-140	Tala	445.2	Matungulu	-6237	0.12	---
U-141	Wote	448.1	Makuoni	-2004	0.24	---
U-142	North Horr	451.1	North Horr	-17578	0.03	---
U-143	Korr	453.1	Korr	-44094	0.02	---
U-144	Nyamira + Kebirigo	612.2	East Mugirango	-6446	0.33	-5.3%
U-145	Bondo	632.4	West Sakwa	-2204	0.37	-1.4%
U-146	Kehancha + Tarang'anya	646.3	Bukira East	-2839	0.30	---
U-147	Nyabikaye	646.8	Bugembe West	-21987	0.05	---
U-148	Oyugis	647.4	Central Kasipul	-3119	0.26	---
U-149	Awendo/Sare	649.4	South Sakwa	-2653	0.41	-1.1%
U-150	Rumuruti	733.4	Rumuruti	-3094	0.22	---
U-151	Kilgoris	754.4	Uasin Gishu East	-2554	0.26	---
U-152	Lolkorian	755.1	Siria East	-2553	0.15	---
U-153	Moi's Bridge	771.2	Moi's Bridge	-1610	0.33	-6.0%
U-154	Turbo	772.4	Turbo West	-3476	0.23	---
U-155	Marigat	816.2	Marigat	-1513	0.28	---
U-156	Mawalie + Malakisi	911.4	Malakisi	-1755	0.37	-3.6%
U-157	Chaptais	916.1	Cheptais	-1394	0.38	-3.3%
U-158	Nambale	922.2	Central Bukhayo	-1063	0.41	-0.2%
All Urban Schemes in Kenya (158 schemes)				-2622013	0.43	-0.1%

Remark : *1 Discounted at 10%.

*2 "----" means that IRR marks less than zero percent. "****" means not applicable.

Table 6.8.3 List of Urban Water Supply Schemes Resulted in Positive Economic Efficiency

Urban No	Urban Code	Urban Name	Loc. Code	Location Name	NPV*1 (US\$1000)	B/C*1	IRR (%)
1	U-040	Embu	413.7	Embu Municipality	3496	1.54	16.1%
2	U-007	Thika	214.4	Thika Municipality	5985	1.38	14.4%
3	U-023	Mariakani	311.3	Mariakani	698	1.19	12.3%
4	U-001	Nairobi	110.0	Nairobi	115304	1.13	11.5%
5	U-094	Kericho	725.5	Kericho Township	-1889	0.90	8.7%
6	U-022	Nyeri	257.0	Nyeri Municipality	-5134	0.87	8.2%
7	U-006	Ruiru	214.1	Ruiru	-1583	0.81	7.3%
8	U-085	Homa Bay	641.1	Kanyada West	-2229	0.79	7.1%
9	U-002	Karuri	211.1	Kiambaa	-3071	0.71	5.9%
10	U-132	Kakamega	935.4	Kakamega Municipality	-7030	0.71	5.9%
11	U-078	Maseno	622.1	West Kisumu	-3895	0.70	5.8%
12	U-058	Meru	461.4	Ntira	-10119	0.71	5.7%
13	U-080	Ahero	623.2	South East Kano	-1436	0.71	5.7%
14	U-137	Taveta	351.1	Taveta	-1913	0.69	5.5%
15	U-093	Sotik	723.1	Kepletudo	-1212	0.68	5.2%
16	U-033	Voi	352.4	Voi	-2228	0.65	5.0%
17	U-086	Migori	644.3	Suna East	-1586	0.65	4.8%
18	U-038	Runyenjes	411.8	Kangaari South	-672	0.65	4.8%
19	U-097	Nanyuki	731.5	Nanyuki	-5238	0.64	4.7%
20	U-134	Mumias	93A.4	Central Wanga	-4077	0.64	4.6%
21	U-015	Maragua	232.7	Nginda	-4802	0.63	4.5%
22	U-032	Mombasa	340.0	Mombasa	-169313	0.56	3.8%
23	U-079	Kisumu & + Kiboswa	622.3	East Kisumu	-38724	0.57	3.7%
24	U-083	Siaya	634.1	East Alego	-5872	0.56	3.7%
25	U-107	Kitale	762.3	Kitale	-11281	0.59	3.6%
26	U-076	Kisii	615.0	Kisii Municipality	-10620	0.55	3.2%
27	U-126	Webuye	914.2	Webuye	-7189	0.55	2.7%
28	U-127	Busia	921.5	South Teso	-5629	0.49	2.6%
29	U-082	Yala	633.2	East Gem	-1040	0.51	2.6%
30	U-118	Kapsabet+Baraton	832.2	Chemundu	-4350	0.54	2.6%
31	U-017	Murang'a	234.3	Mbiri	-4722	0.49	2.4%
32	U-095	Kipkelion	726.1	Kipkelion	-792	0.53	2.3%
33	U-081	Muhoroni	625.2	Muhoroni	-3076	0.51	1.9%
34	U-008	Githunguri	215.1	Githunguri	-2026	0.50	1.8%
35	U-067	Garissa	519.1	Sankuri	-4984	0.49	1.5%
36	U-047	Mitaboni	441.2	Mitaboni	-8331	0.49	1.2%
37	U-087	Kendu Bay	648.1	Central Karachuonyo	-1317	0.47	1.1%
38	U-119	Maralal	841.4	Maralal	-6897	0.46	1.0%
39	U-019	Oi Kalou	241.3	Oi Kalou	-5140	0.41	0.7%
40	U-124	Bungoma	912.4	Musikoma	-11836	0.45	0.3%

Remark : *1 Discounted at 10%.

Table 6.8.4 Economic Efficiency of Rural Water Supply Sector by District

Code	District	Number of Location	NPV*1 (US\$ million)	B/C*	IRR*2 (%)
110	Nairobi	-	***	***	***
210	Kiambu	29	-73.2	0.034	---
220	Kirinyaga	12	-29.0	0.038	---
230	Murang'a	26	-62.8	0.038	---
240	Nyandarua	21	-57.3	0.021	---
250	Nyeri	28	-37.2	0.036	---
310	Kilifi	32	-85.4	0.021	---
320	Kwale	26	-68.9	0.016	---
330	Lamu	12	-9.1	0.016	---
340	Mombasa	-	***	***	***
350	Taita Taveta	12	-21.6	0.024	---
360	Tana River	17	-18.7	0.019	---
410	Embu	19	-44.1	0.024	---
420	Isiolo	10	-8.4	0.016	---
430	Kitui	32	-114.5	0.017	---
440	Machakos/Makueni	42	-189.9	0.020	---
450	Marsabit	15	-20.0	0.014	---
460	Meru	41	-170.0	0.019	---
510	Garissa	21	-15.7	0.016	---
520	Mandera	14	-16.9	0.016	---
530	Wajir	19	-16.4	0.015	---
610	Kisii/Nyamira	27	-110.3	0.027	---
620	Kisumu	19	-67.7	0.020	---
630	Siaya	28	-92.3	0.020	---
640	South Nyanza	51	-222.3	0.014	---
710	Kajiado	18	-46.3	0.019	---
720	Kericho	28	-79.3	0.031	---
730	Laikipia	21	-38.5	0.016	---
740	Nakuru	28	-131.2	0.017	---
750	Narok	28	-93.1	0.017	---
760	Trans Nzoia	17	-24.2	0.045	---
770	Uasin Gishu	23	-20.2	0.045	---
810	Baringo	37	-41.0	0.020	---
820	Elgeyo Marakwet	25	-29.3	0.023	---
830	Nandi	23	-37.9	0.037	---
840	Samburu	20	-19.8	0.015	---
850	Turkana	20	-31.4	0.016	---
860	West Pokot	20	-34.5	0.020	---
910	Bungoma	19	-71.8	0.030	---
920	Busia	16	-70.8	0.020	---
930	Kakamega/Vihiga	42	-129.8	0.030	---
	Kenya	938 *3	-2450.9	0.023	---

Remark : *1 Discounted at 10%

*2 "****" means that no schemes exist in the District.

"---" means that IRR marks less than zero percent.

*3 Locations in both Nairobi and Mombasa were not counted in this table.

Table 6.8.5 Economic Efficiency of Irrigation Schemes

No.	Name of Scheme	Initial	Annual	Index of Economic Efficiency		
		Cost *1 (US\$1000)	Benefit *2 (US\$1000)	NPV (US\$1000)	B/C	IRR (%)
1.	Kunati	3,497	2,342	6,943	2.39	23.4%
2.	Lower Rupigazi	5,994	4,015	11,902	2.39	23.4%
3.	Bunyala Extension	12,423	10,964	24,487	1.78	23.2%
4.	Lower Kuja	5,578	956	3,043	1.72	18.4%
5.	Taita Taveta	11,914	5,173	8,951	1.51	16.3%
6.	Kano Plain	232,490	43,741	49,732	1.44	16.3%
7.	Mwea Extension	63,678	17,996	83,118	2.51	15.5%
8.	Tana Delta	141,341	15,076	-41,924	0.65	14.0%
9.	Kanzalu	38,097	9,045	13,593	1.42	12.1%
10.	Lower Ewaso Ngiro	56,993	13,686	2,817	1.04	10.5%
11.	Kimira	18,131	3,412	-1,516	0.92	9.1%
12.	Thanantu	17,322	3,449	-1,714	0.91	8.9%
13.	Kibwezi Extention	227,129	29,445	56,199	1.6	6.7%
14.	Turkwel	1,750	233	-528	0.69	6.4%
15.	Sabaki Extension	19,831	6,692	11,779	1.53	4.7%
16.	Arror	6,324	1,406	-722	0.91	3.0%
17.	Upper Nzoia	87,998	7,899	-47,106	0.46	2.3%
18.	Yala Swamp	65,000	2,311	-27,951	0.19	-2.9%
	Proposed 18 Schemes	1,015,490	177,844	-696	0.97	9.6%

Remark : *1 Refer the economic values to Table E2.20 in Sectoral Report "E".
*2 Refer to Section 2.5.5 in Sectoral Report "E"

**Table 6.8.6 Total Long Run Marginal Costs (LRMC) of Power Supply in Kenya
(All Costs in US\$ at 10 % Interest Rate)*1**

(1) Marginal Capacity Costs

Cost at	Peak Power Losses	Generation Costs (US\$/KW/Year)	Transmission (US\$/KW/Year)	Total Marginal Capacity Cost (US\$/KW/Year)
Generation		110.60		110.60 *2
	4.0%			
High Voltage Transmission (66 - 132 KV)		115.21	32.90	148.11 *3

(2) Marginal Energy Costs and Average Intergated Costs of Supply

Cost at	Average Energy Losses	Energy Cost (US\$/KWh)	Average Load Factor	Average Cost *5 (US\$/KWh)	Average Integrated Cost (LRMC) (US\$/KWh)
Generation		0.0340 *4	62.1%	0.0203	0.054
	3.0%				
High Voltage Transmission (66 - 132 KV)		0.0351	85.0%	0.0199	0.055 =====

Source : 1990 Interim Update of National Power Development Plan 1991 to 2010,
Draft Final Report, April 1991, ACRES

Remark : *1 Table 10.9 in the above source.
*2 Table 10.3 in the above source.
*3 Table 10.7 in the above source.
*4 Refer to Section 10.2.3 in the above source.
*5 (Total Marginal Capacity Cost)/(8,760 hr X Average load Factor)

Table 6.8.7 Economic Efficiency of Hydropower Schemes

No.	Name of Scheme	Initial	Annual	Index of Economic Efficiency		
		Cost *1 (US\$1000)	Benefit *2 (US\$1000)	NPV (US\$1000)	B/C	IRR (%)
1.	Sondu/Miriu	118,407	25,671	76,375	1.94	18.3%
2.	Low Grand Falls	290,821	57,173	151,382	1.75	16.9%
3.	Oldorko	70,806	13,712	35,562	1.73	16.7%
4.	Magwagwa	340,045 (561,350) *3	34,695 (111,420) *3	-20,925 (135,000) *3	0.91 (1.40) *3	9.1% (14.6%) *3
5.	Mutonga	148,914	24,948	24,948	1.50	14.6%
	Proposed Above Schemes	968,993	156,199	156,199	1.44	14.1%

Remark : *1 Refer the financial costs to Table L6.2 in Sectoral Report "L"

*2 Calculated as a product of Output in Table L6.2 and LRMC (US\$0.055/KWh).

*3 Figures quoted from "Feasibility Study on Magwagwa Hydroelectric Power Development Project, Final Report, October 1991, JICA"

Note : (1) Evaluation was made on five projects (excluding Gitaru #3 Extension)

(2) Evaluation is based on the cost estimated in the NPDP study to compare the relative merit of each scheme on a uniform basis.

Table 6.8.8 Unit Values of Damageable Properties in Flood Prone Areas

Item	1990 Condition		2010 Condition	
1. Agricultural Product	Unit Yield (mt/ha)	Value (US\$/mt)	Unit Yield (mt/ha)	Value *1 (US\$/mt)
Mize Production	2.8	120	4.0	135
2. Housing Unit	Unit Density (Units/ha)	Value (US\$/Unit)	Unit Density (Units/ha)	Value *2 (US\$/Unit)
Urban Area (Nairobi)	20.0	8,000	20.0	13,100
Rural Area (Other Areas)	1.2	1,500	1.2	2,460
3. Infrastructure :	50 % of Damage on Road, Railway, Irrigation Channel, Utilities (Power, Water Supply, Telephone) Public Buildings		50 % of Damage on Housing Unit	
4. Indirect Damage	30 % of Total Damage of the above three items		30 % of Total Damage of the above three items	
1) Losses of Business Opportunity, Wages, Trade, Manufacturing, Transportation, Utility Services				
2) Costs for Rescue and Relief Activities				

Remark : *1 Refer to "Price Prospects of World Bank".

*2 Average growth Rate of 2.5 % per annum was applied.

Table 6.8.9 Economic Efficiency of Flood Control Schemes

No.	Name of Scheme	Initial Cost *1 (US\$1000)	Benefit *1 (US\$1000/year)		Under 1990 Conditions			Under Conditions Considering Land Enhancement Effects		
			1990 Condition	2010 Condition	NPV (US\$1000)	B/C	IRR (%)	NPV (US\$1000)	B/C	IRR (%)
			1.	Kano Plain	20,650	1,516	4,147	-5,737	0.59	5.9
2.	Nairobi City	10,800	718	1,683	-3,415	0.54	5.2	205	1.03	10.2
3.	Yala Swamp	17,660	572	3,448	-8,921	0.26	1.2	827	1.07	10.5
4.	Kuja Rivermouth	5,034	96	520	-2,914	0.15	-1.2	-1,460	0.58	6.4
5.	Lumi Rivermouth	8,322	309	727	-3,985	0.30	1.9	-3,190	0.44	5.0
	Proposed Above 5 Schemes Five Schemes	62,466	3,211	10,525	-24,972	0.42	3.6	344	1.01	10.1

Remark : *1 Refer to Table G6.1 in Sectoral Report "G".

Table 7.2.1 Potential Dam Schemes as Alternative Scheme or for Additional Development (1/2)

Item No.	Prospective Site proposed in the Study		Alternative Site Future Dev't Potentials		Purpose	Water Supply	Irrigation	Hydropower	Remarks
	Damsite	Sub-basin	Damsite	Sub-basin		Service Urban Centre	Large Irri. Scheme	Hydropower Scheme	
L. Victoria Drainage Area									
1	*1 Moiben	1BA			W	Eldoret/Iten	-	-	
2			Moi's Bridge	1BE	P, I, W			Moi's Bridge	inter-basin/transfer
3			Hemsted Brg.	1BD	W, I, P	Great Rift W/S	Upper Nzoia	Hemsted Brg.	inter-basin/transfer
4			Kibolo	1CE	W	-	-	-	
5			Webuye Falls	1DA	P	-	-	Webuye Falls	
6			Teremi	1DB	P	-	-	Teremi	rural hydro-electricity
7	Mukulusi	1EA			W	Kakamega	-	-	small dam
8			Kimondi	1FC	W, I	Great Rift W/S	-	-	inter-basin/transfer
9			Nandi Forest	1FD	I, P, W	-	Yala Swamp/ Kano Plain	Nandi Forest	multipurpose
10			Mushangumbo	1FE	P	-	-	Mushangumbo	
11	Londiani	1GC			W	Londiani	-	-	
12			Nyando	1GD1	W, I, P	Great Rift W/S	Kano Plain	-	inter-basin w/transfer
13	Kibos	1HA			W	Kisumu/Maseno	-	-	
14	Itare	1JA			W	Nakuru/Molo/Njoro /Elburugon/Rongai /Mogotio	-	-	
15			Timbilli	1JC	W	Kericho	-	-	
16			Sisei	1JF	W	-	-	-	
17	*1 (Sundu/Miriu)	1JG			P, I	-	(Kano Plain)	Sundu/Miriu	run-of-river type weir detailed design stage
18	Magwagwa	1JG			P, I	-	Kano Plain	Magwagwa	multipurpose
19	Bunyuny	1KB			W	Kisii	-	-	
20			Katieno	1KB	W	-	-	-	
21			Namba Kodero	1KC	W, P	-	-	Namba Kodero	
22			Amala	1LB1	W	Nakuru	-	-	
Rift Valley Drainage Area									
23			Kimwarer	2CB	W, P, I	-	Kimwarer	Kimwarer	multipurpose
24			Kipsang	2CB	W	-	-	-	
25			Arror	2CC	W	-	-	-	
26			Sererwa	2CC	P, I, W	-	Arror	Arror	multipurpose
27			Wasages	2CC	W	-	-	-	
28			Kamukuny	2CC	W, I	-	-	-	flow augment,
29	*1 (Chemususu)	2ED			W	Eldama Ravine	-	-	detailed design stage
30			Aram	2EE	W	-	-	-	run-of-river type weir
31			Ratat	2EE	W	-	-	-	
32	*1 (Kirandich)	2EH			W	Kabarnet	-	-	detailed design stage
33	Malewa	2GB			W	Nakuru/Gilgil/ Naivasha	-	-	
34	Upper Narok	2KA			W	Narok	-	-	
35	Oldorko	2KB			P, I, W	Magadi	Lower E.Ngiro	Oldorko	multipurpose
36			Leshota	2KB	P, W	-	-	Leshota	
Athi River Drainage Area									
37	Upper Athi	3AA			W	Athi River	-	-	
38	Ruiru- A	3BC			W	Nairobi	-	-	
39	Kikuyu	3BA			W	Kikuyu	-	-	
40	Ndarugu	3CB			W, I	Nairobi, Ruiru, Kiambu	Kanzalu	-	multipurpose
41			Munyu	3DA	W, I, P	Nairobi	-	Munyu	multipurpose
42			Mbuuni	3EA	W	Machakos	-	-	
43			Kiteta	3EB	W	rural	-	-	
44			Thwake	3FA	I, W	-	-	-	
45	Yatta	3FB			I	-	Kibwezi Ext.	-	
46			Tsavo	3G	W	Tsavo	-	-	
47			Bar-icho	3HD	W	-	-	-	
48	Rare	3LA			W	Malindi	-	-	off-stream reservoir
49	Mwachi	3MB			W	Mombasa	-	-	
50	Pemba	3HC			W	Mombasa	-	-	run-off-river type weir

.... continued

Table 7.2.1 Potential Dam Schemes as Alternative Scheme or for Additional Development (2/2)

Item No.	Prospective Site proposed in the Study		Alternative Site Future Dev't Potentials		Purpose	Water Supply	Irrigation	Hydropower	Remarks
	Damsite	Sub-basin	Damsite	Sub-basin		Service Urban Centre	Large Irri. Scheme	Hydropower Scheme	
Tana River Drainage Area									
51			Maragua 8	4BE	W	-			
52	Chania- B	4CA			W, I	Nairobi	(small iri.)	-	multipurpose
53			Ndiara	4CA	W	-	-	-	
54	Thiba	4DA			I, W	-	Mwea Ext.	-	
55	Mutonga	4PA			P	-	-	Mutonga	
56	Low Grand Falls	4FB			P	-	-	L. Grand Falls	
57			High Grand Falls	4FB	P, W, I	-	-	H. Grand Falls	multipurpose
58			Adamson Falls	4GA	P, W, I	-	-	Adamson Falls	multipurpose
59			Kora	4GB	P, W, I	-	-	Kora	multipurpose
60			Umaa	4HA	W	-	-	-	
61			Mutuni	4HA	W	-	-	-	
62			Kitimui	4HA	W	-	-	-	
Ewaso Nigro North River Drainage Area									
63	Rumuruti	5AA			W	Rumuruti	-	-	
64	Nyuhururu	5AA			W	Nyuhururu	-	-	small dam
65			Archers Post	5DA	W, I, P	-	-	-	flow augment.
66			Crocodile Jaw	5DC	P, W, I	-	-	Crocodile Jaw	flow augment.
			Kirium	5DC	P	-	-	Kirium	
67			Kihoto	5BC	W, I	-	-	-	flow augment.
68			Nundoto	5CA	W	Maralal	-	-	small dam
69			Lag-Bor	5EA	W	-	-	-	*2
70			Buna	5EA	W	Buna	-	-	*2
71			Habaswein	5EC	W	Habaswein	-	-	*2
72			Meri	5EC	W	Meri	-	-	*2
73			Modogashe	5FA	W	-	-	-	*2
74			Dadab	5FA	W	-	-	Oldorko	*2
75			Kutulo-Biwak	5GA	W	-	-	Leshota	*2
76			Takaba	5GA	W	-	-	-	*2
77			Mandera	5GB	W	Mandera	-	-	*2
78			Neboi-Mandera	5GB	W	-	-	-	*2
79			Rham Mandera	5GB	W	-	-	-	*2
80			Arabic	5GB	W	-	-	-	*2
81			Pino	5GB	W	-	-	-	*2
82			Kalatiyo	5H	W	-	-	-	*2
83			Markamari	5H	W	-	-	-	*2

Note: *1 shows a dam scheme in detailed design stage.

*2 potential sites proposed by MOWD. No detailed information available.

**Table 7.2.2 Potential Damsites for Domestic Water Supply
(For Future Development)**

No.	Damsite	River	Purpose	Alternative to	Service center
1	Kiboro	Sosiani	D	Miben dam	Eldoret and environs
2	Timbilil	Timbilil	D	Intake Weir	Kericho and environs
3	Sisei	Sisei	D	Intake Weir	Sotik and environs
4	Katieno	Kuja	D	Bunyonyu dam	Kisii and environs
5	Amala	Amala	D	Itare dam	Nakuru and environs
6	Kipsang	Kipsang	D	groundwater	Rural center in 2CB
7	Arror	Sererwa	D, P, I	groundwater	Rural center in 2CC
8	Waseges	Waseges	D	groundwater	Rural center in 2EB
9	Kamukuny	Kerio	D	groundwater	Rural center in 2CC
10	Aram	Perkerra	D	Chemususu dam	Marigat and environs
11	Ratat	Perkerra	D	Chemususu dam	Marigat and environs
12	Mubuuni	Thwake	D	Athi river P/L	Machakos and environs
13	Kiteta	Ngaa	D	groundwater	Rural center in 3EB
14	Thwake	Thwake	D, I	Yatta dam	Kibwezi Irri, scheme and rural center
15	Tsavo	Tsavo	D	2nd Mzima P/L	Flow augmentation to downstream areas
16	Baricho	Sabaki	D	Sabaki intake/ Rare dam	Malindi, Mombasa and environs
17	Maragua-8	Maragua	D	Surface water source	Maragua and environs
18	Ndiara	Ndiara	D	Surface water source	Rural center
19	Nundoto	Nundoto	D	existing intake weir	Mararal and environs

Note on purpose : D; Domestic P; Hydropower I; Irrigation

FIGURES

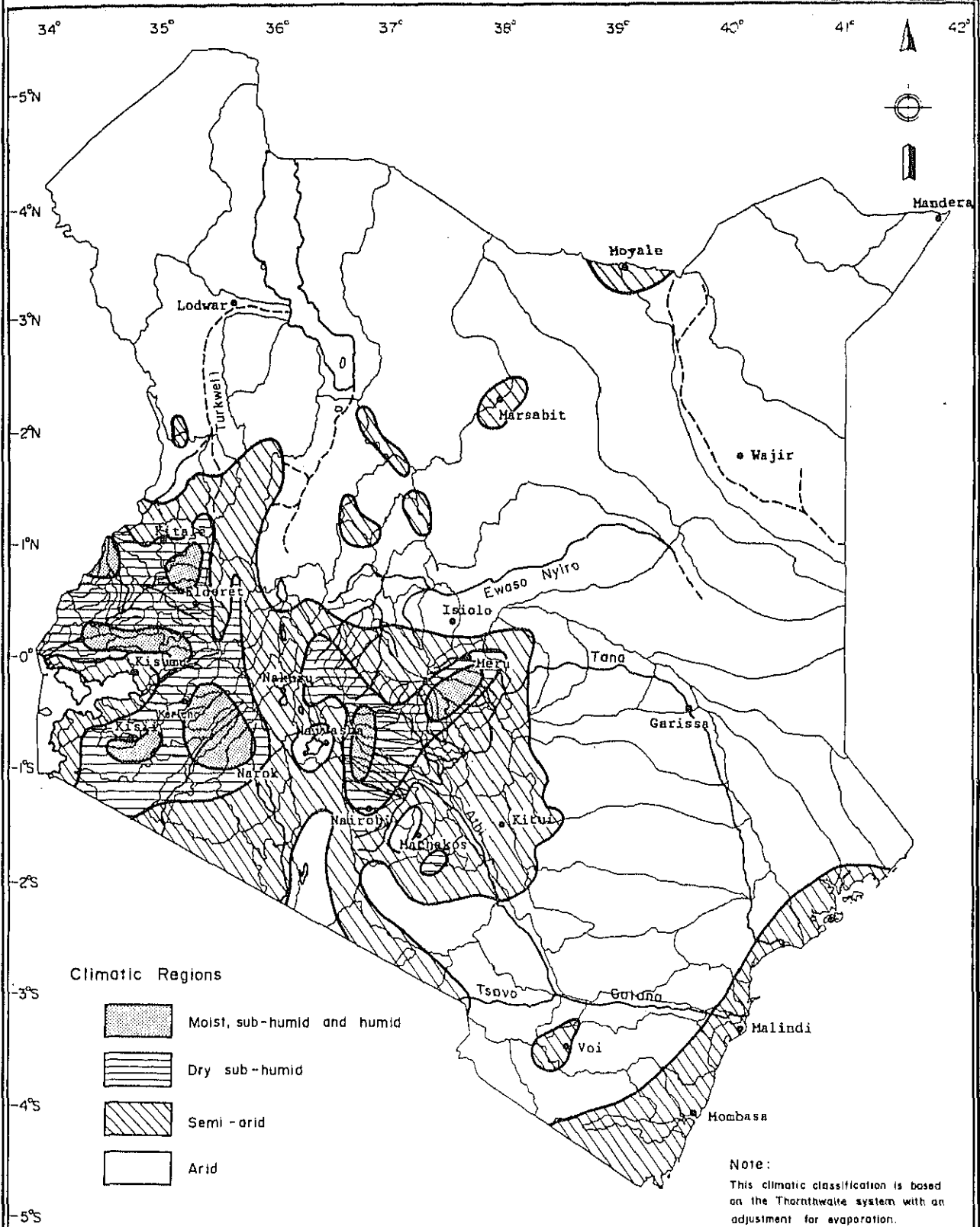
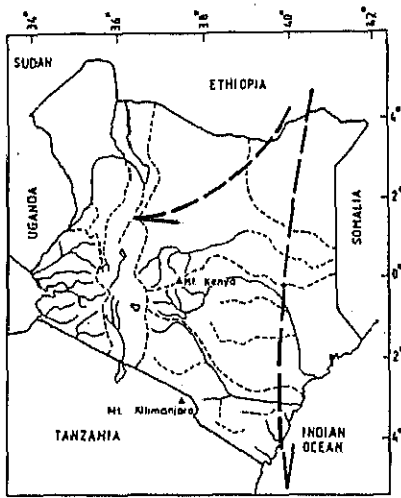
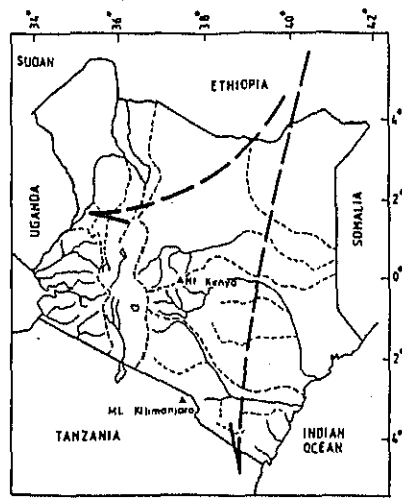


Figure 2.2.1 Climatic Regions

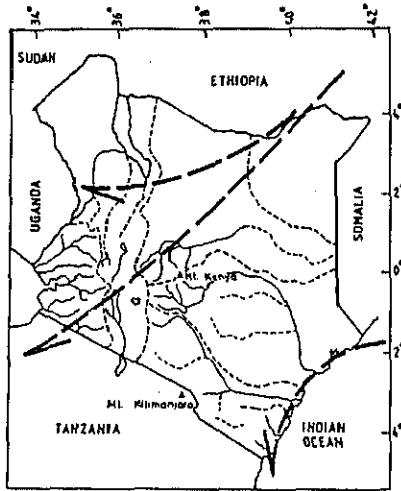
THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY



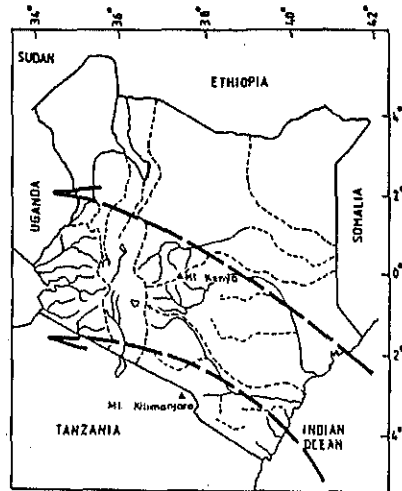
JANUARY



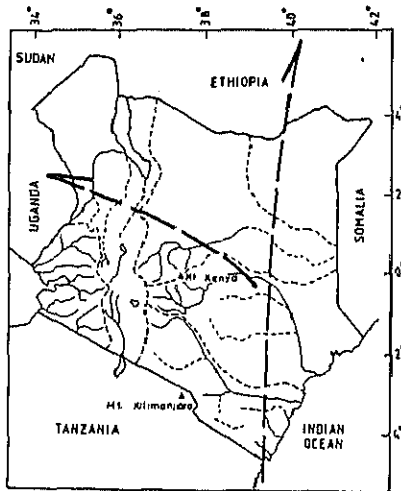
FEBRUARY



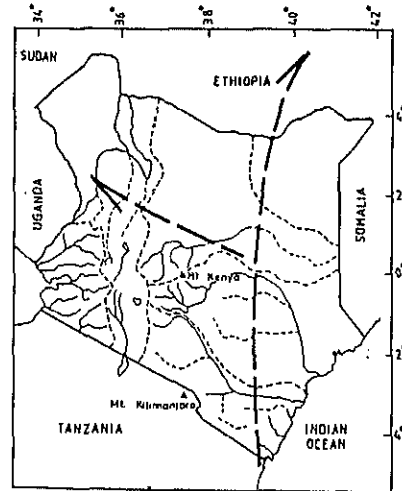
MARCH



APRIL



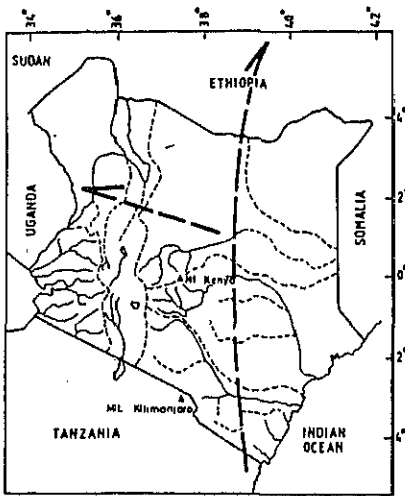
MAY



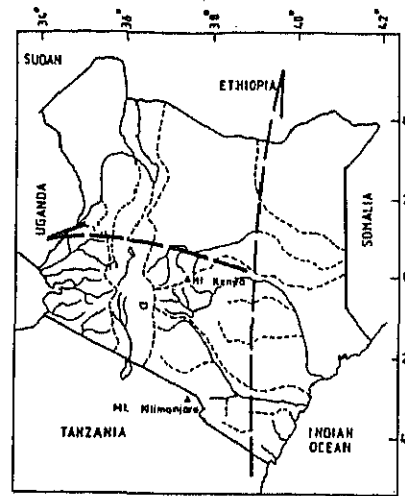
JUNE

Figure 2.2.2 Surface Wind Movement (1/2)

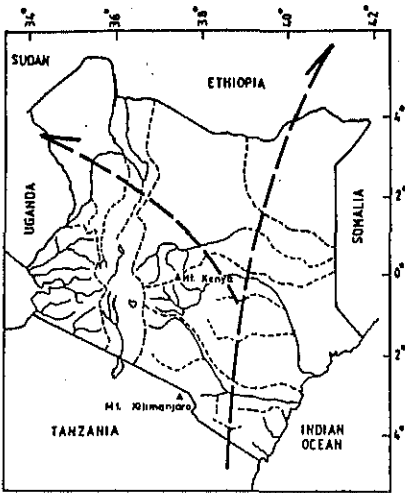
THE STUDY
ON
THE NATIONAL WATER MASTER PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY



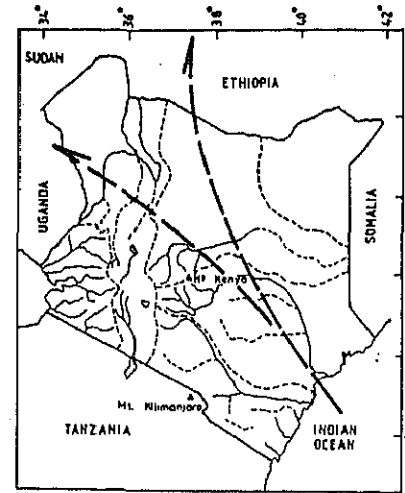
JULY



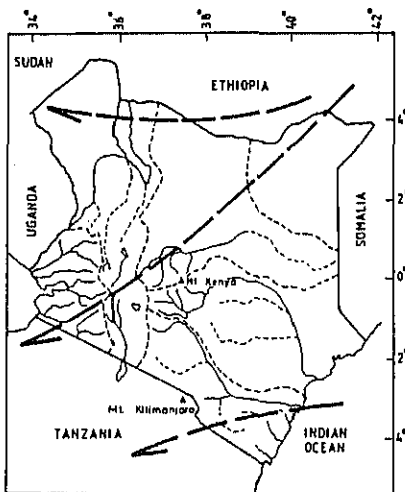
AUGUST



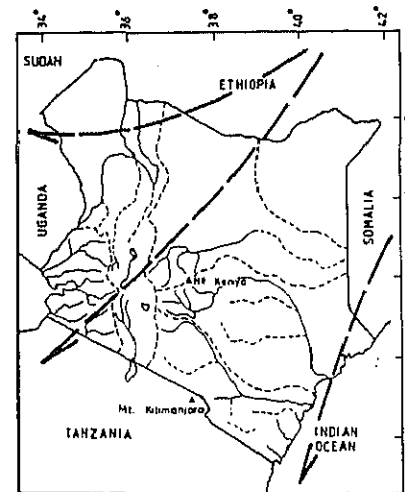
SEPTEMBER



OCTOBER



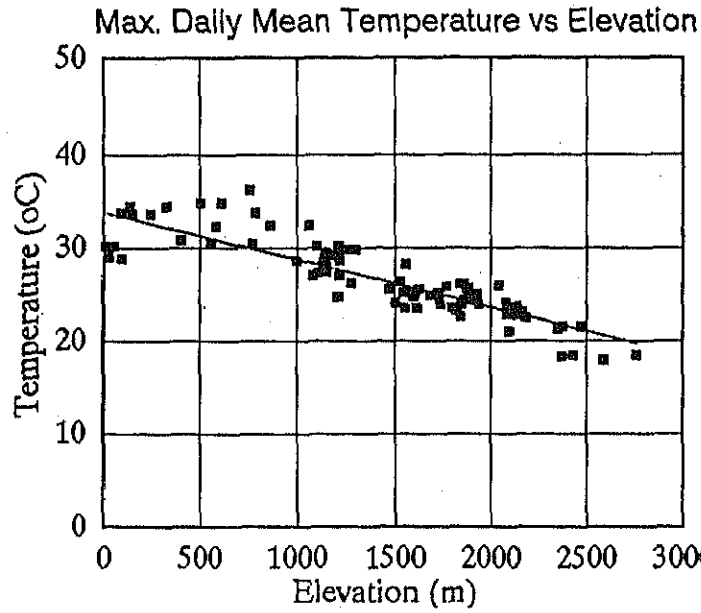
NOVEMBER



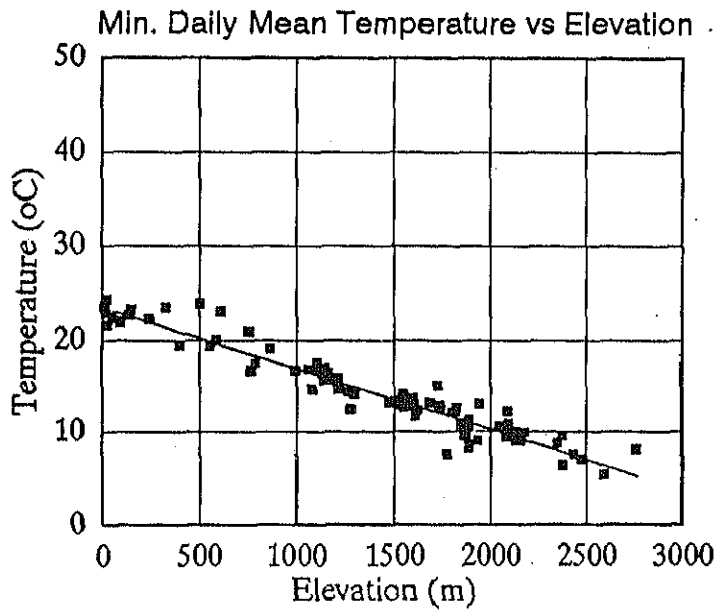
DECEMBER

Figure 2.2.2 Surface Wind Movement (2/2)

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

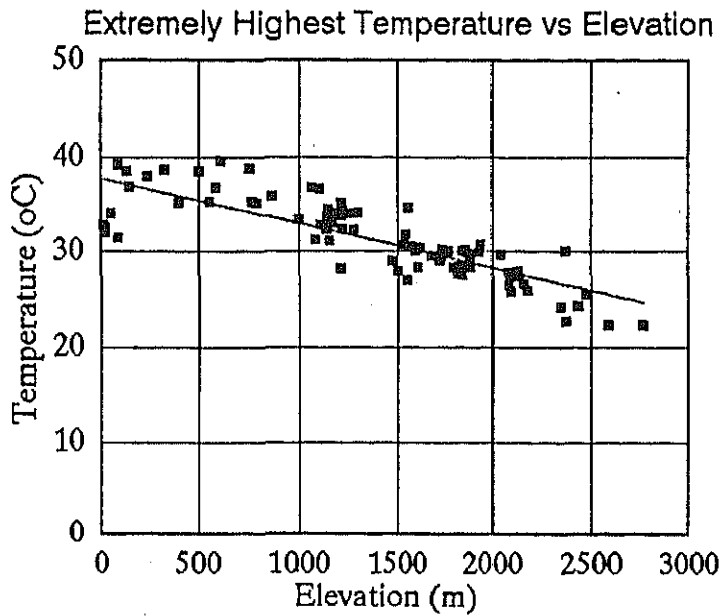


$T = 33.926 - 0.00517 * H$
 Nos. of samples : 89
 Std. dev. : 2.03
 Applicable range : El.16 - El.2,762

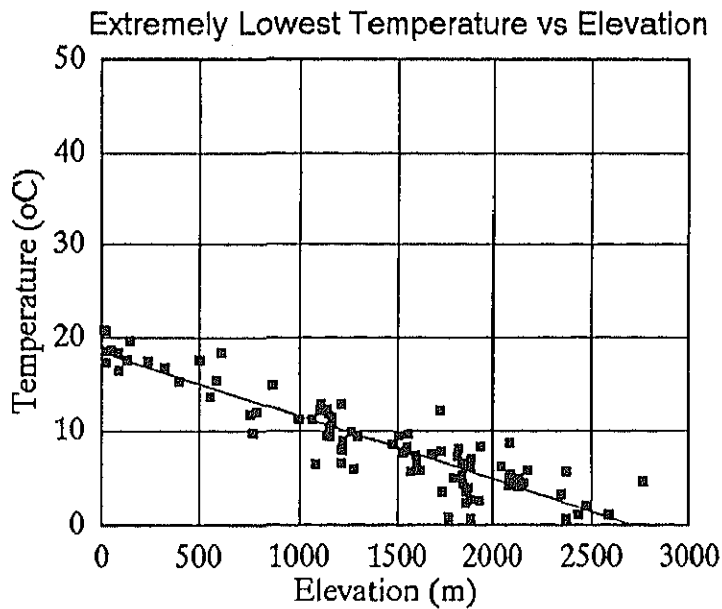


$T = 23.529 - 0.00663 * H$
 Nos. of samples : 89
 Std. dev. : 1.335
 Applicable range : El.16 - El.2,762

Figure 2.2.3 Relationship between Temperature and Elevation (1/2)



$T = 37.804 - 0.00475 * H$
 Nos. of samples : 89
 Std. dev. : 2.276
 Applicable range : El.16 - El.2,762



$T = 18.475 - 0.00680 * H$
 Nos. of samples : 89
 Std. dev. : 2.13
 Applicable range : El.16 - El.2,762

Figure 2.2.3 Relationship between Temperature and Elevation (2/2)

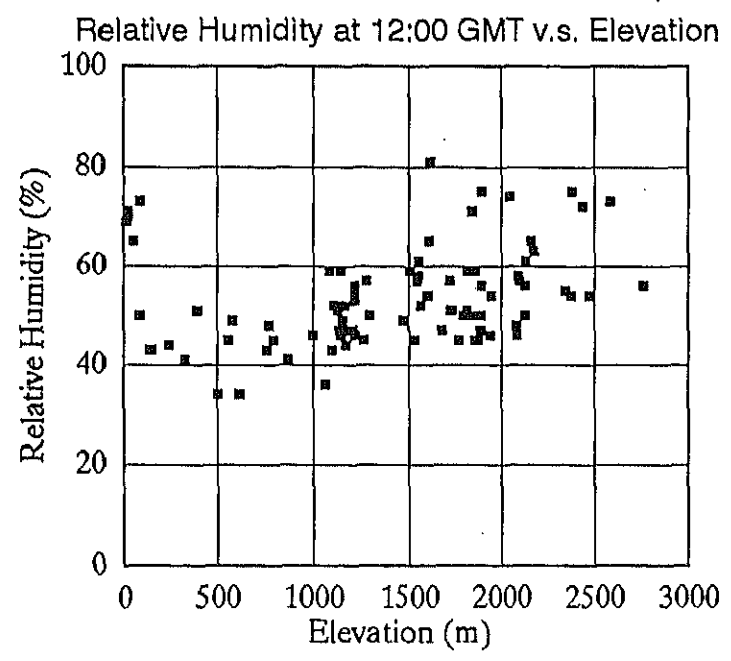
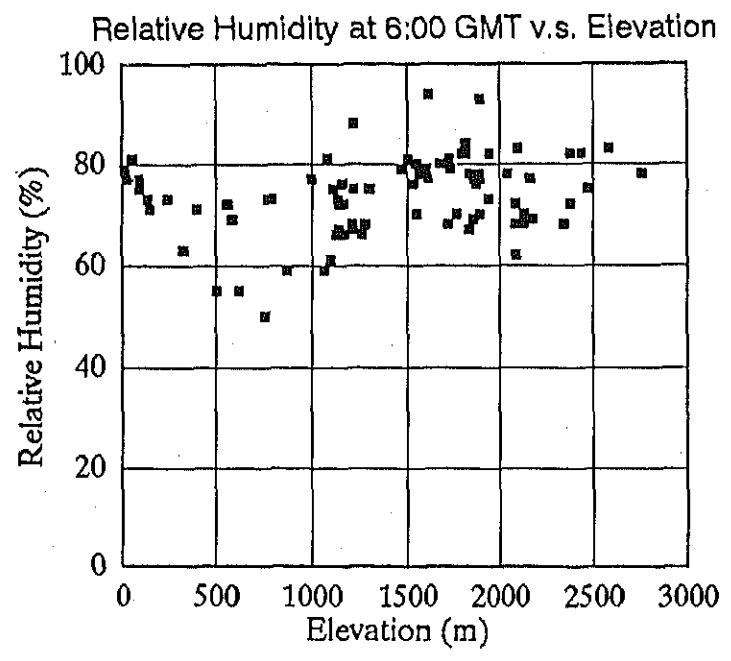
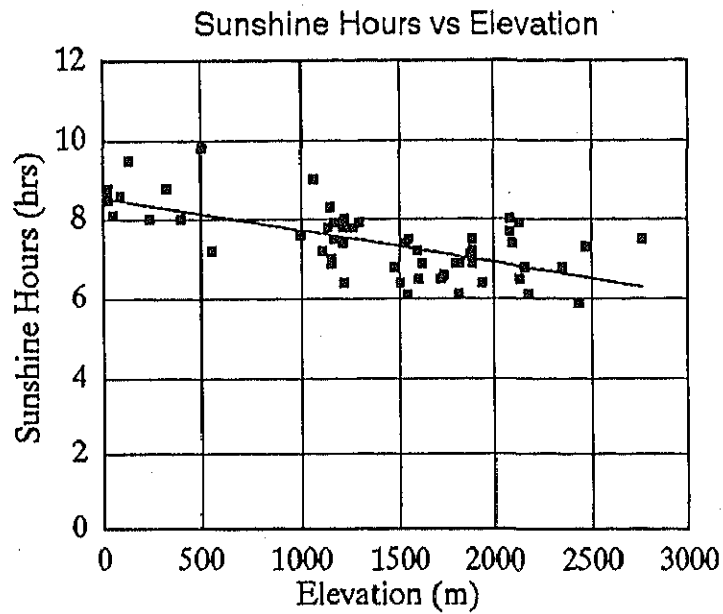
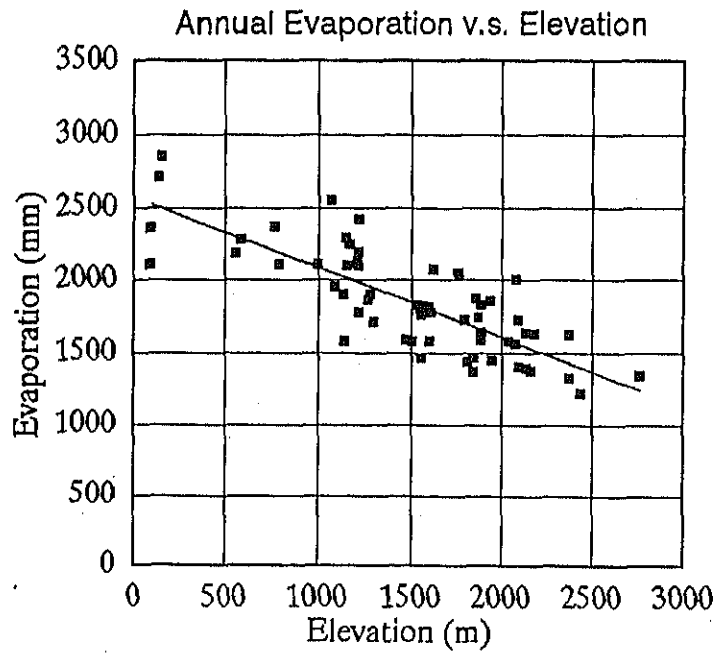


Figure 2.2.4 Relationship between Relative Humidity and Elevation

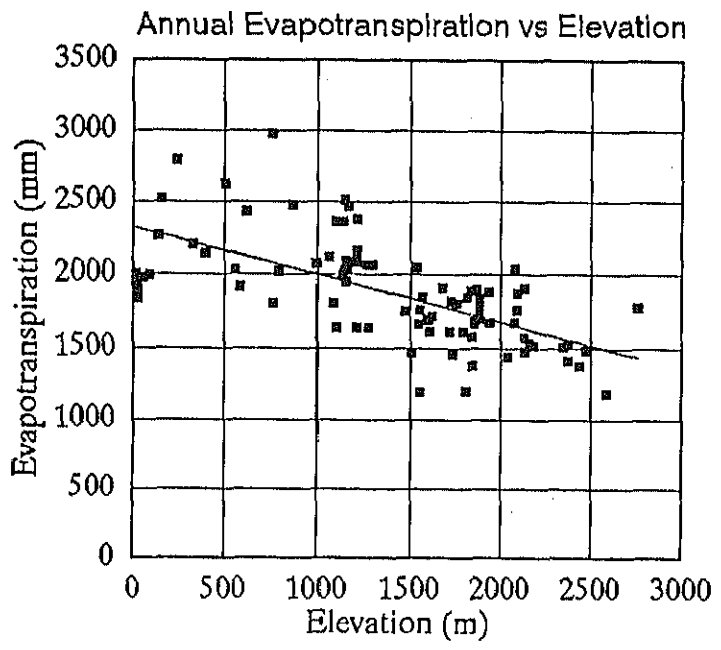


$SH = 8.557 - 0.00081 * H$
 Nos. of samples : 56
 Std. dev. : 0.650
 Applicable range : El.20 - El.2,762

Figure 2.2.5 Relationship between Sunshine Hours and Elevation



$E_o = 2,575 - 0.4838 * H$
 Nos. of samples : 60
 Std. dev. : 216
 Applicable range : El.91 - El.2,762



$E_{To} = 2,330 - 0.03235 * H$
 Nos. of samples : 88
 Std. dev. : 272
 Applicable range : El.16 - El.2,762

Figure 2.2.6 Relationship between Evaporation and Elevation

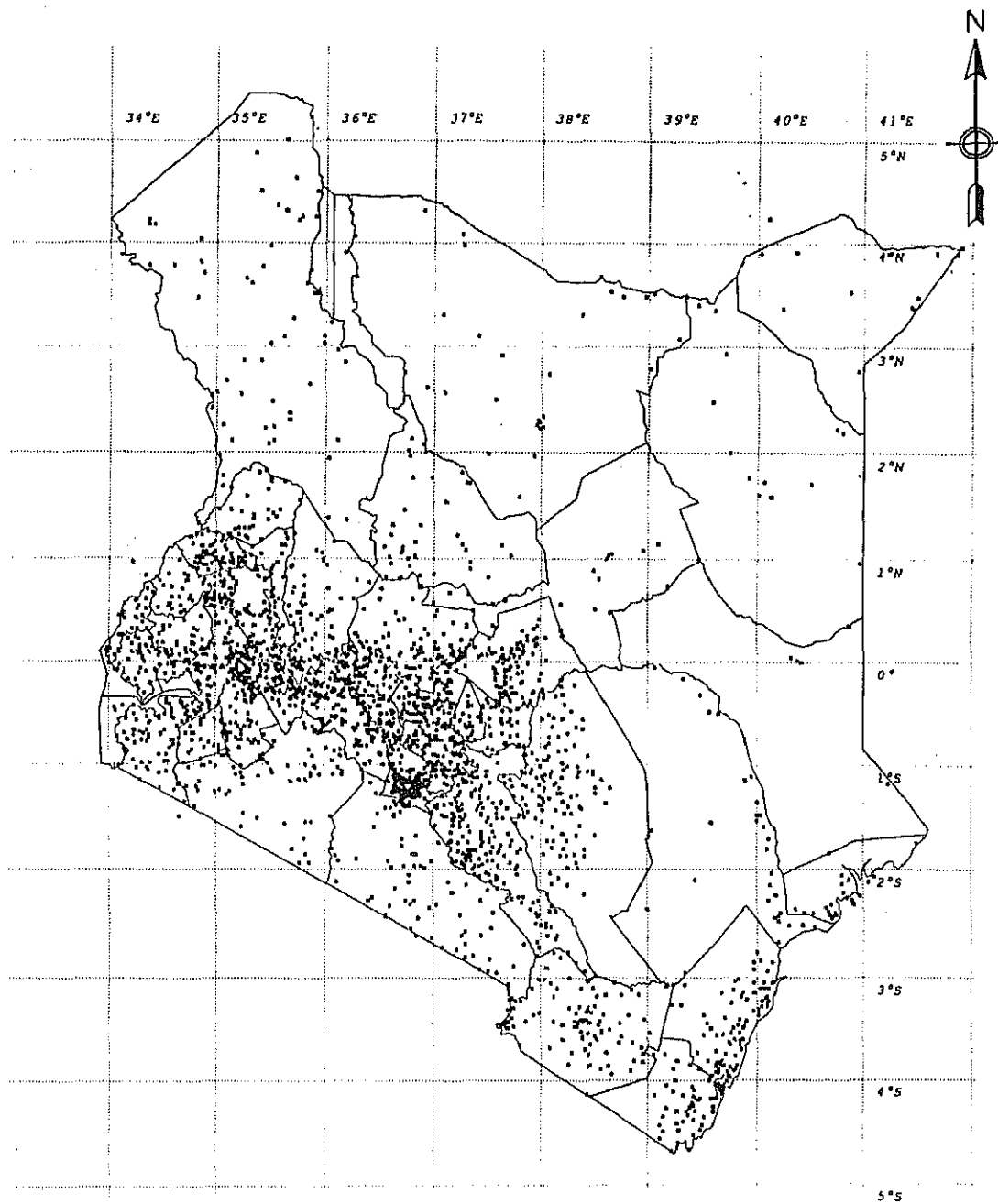
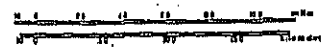


Figure 2.2.7 Registered Rainfall Gauging Stations



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

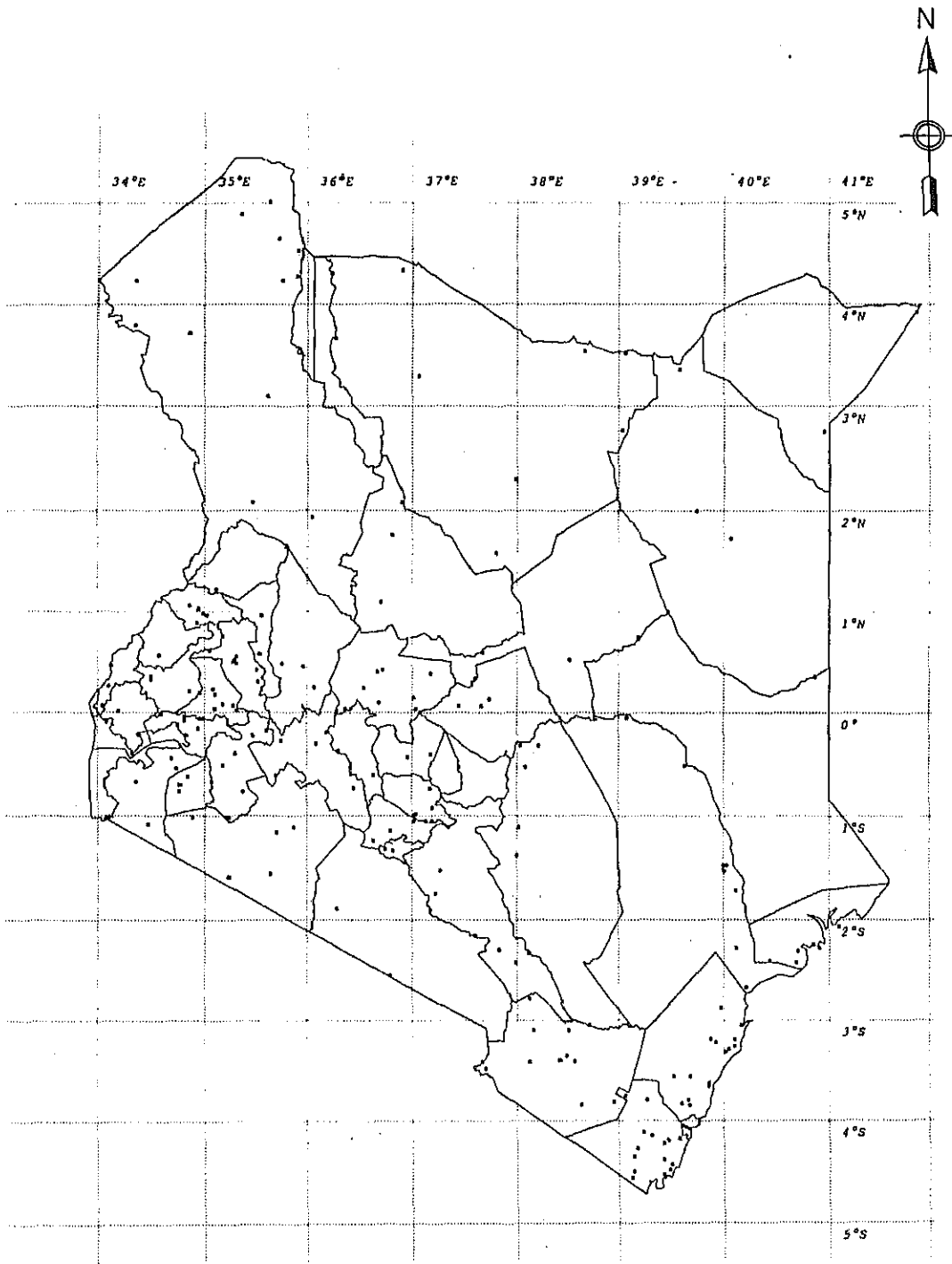
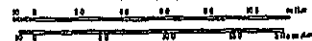


Figure 2.2.8 Selected 212 Rainfall Gauging Stations



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

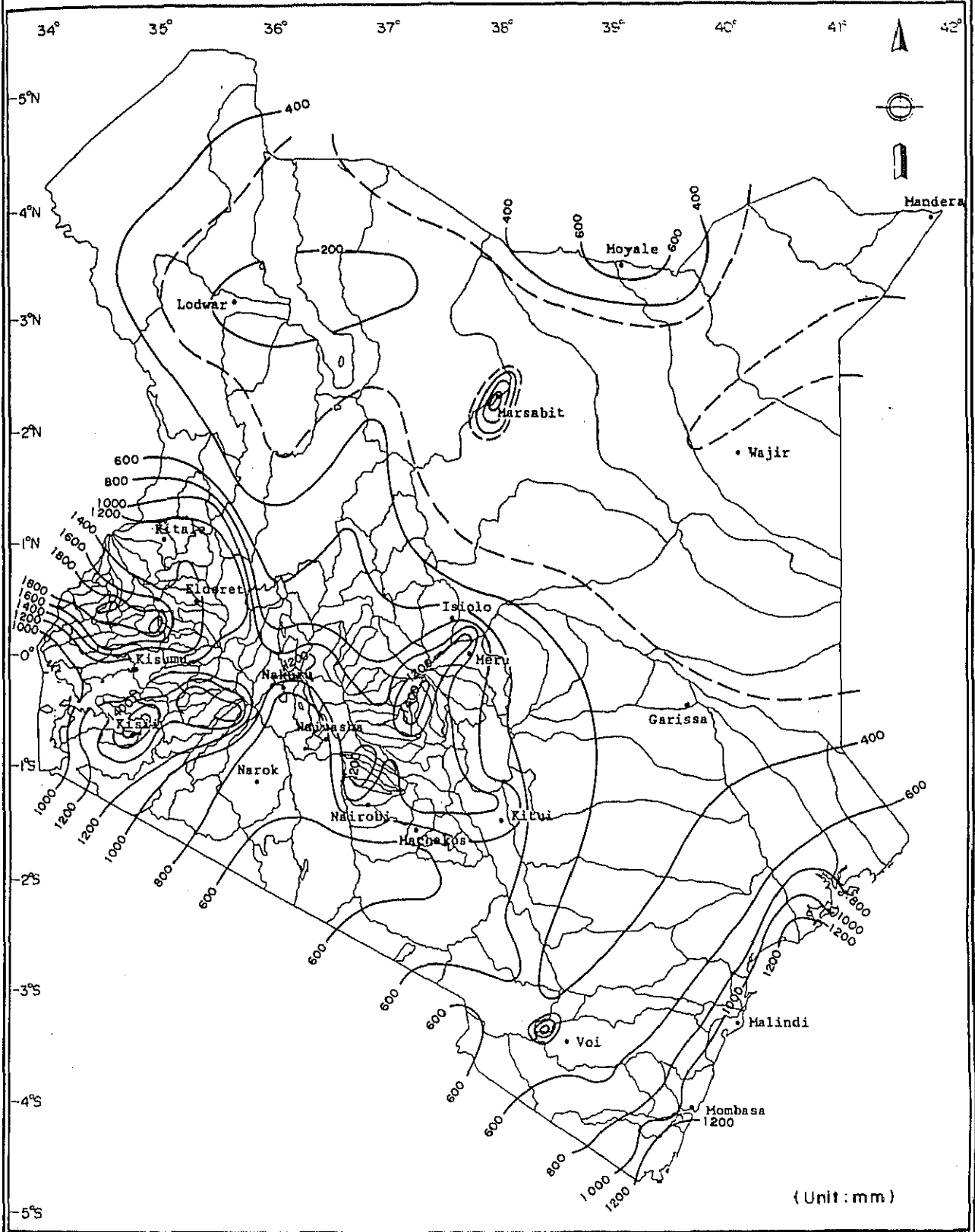


Figure 2.2.9 Isohyetal Map of Annual Rainfall Depth

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

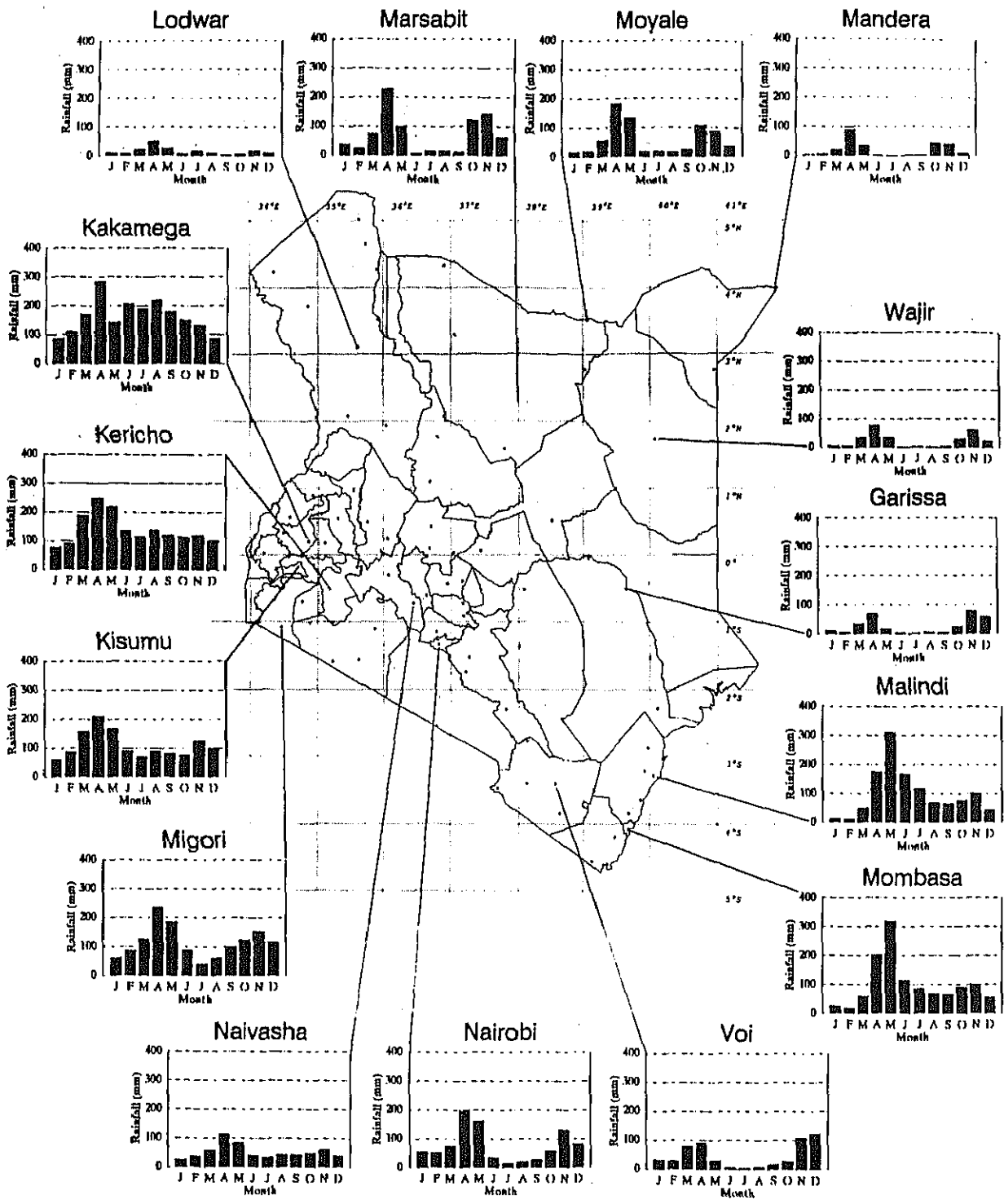


Figure 2.2.10 Variation of Monthly Rainfall Depth at Representative Rainfall Gauging Station

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

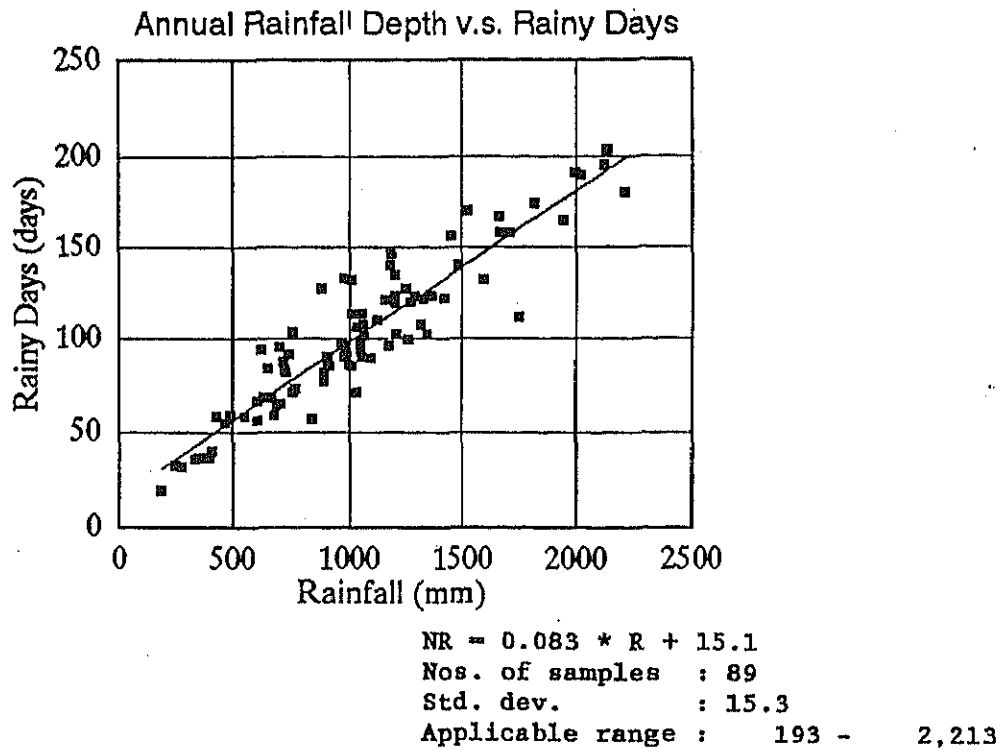
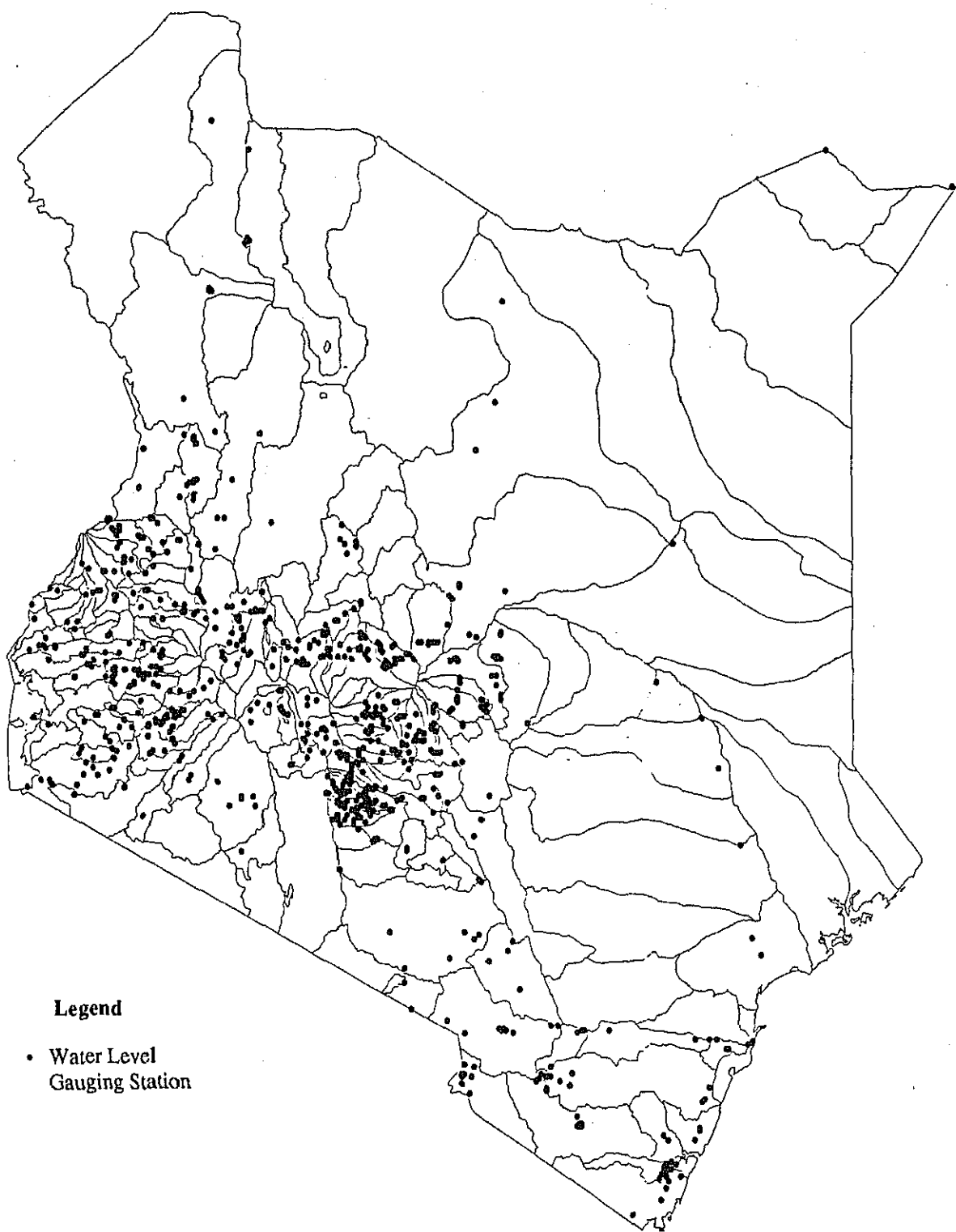


Figure 2.2.11 Relationship between Annual Rainy Days and Annual Rainfall Depth



Legend

- Water Level Gauging Station

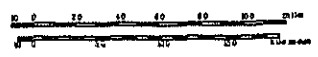


Figure 2.3.1 Registered Water Level Gauging Station

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

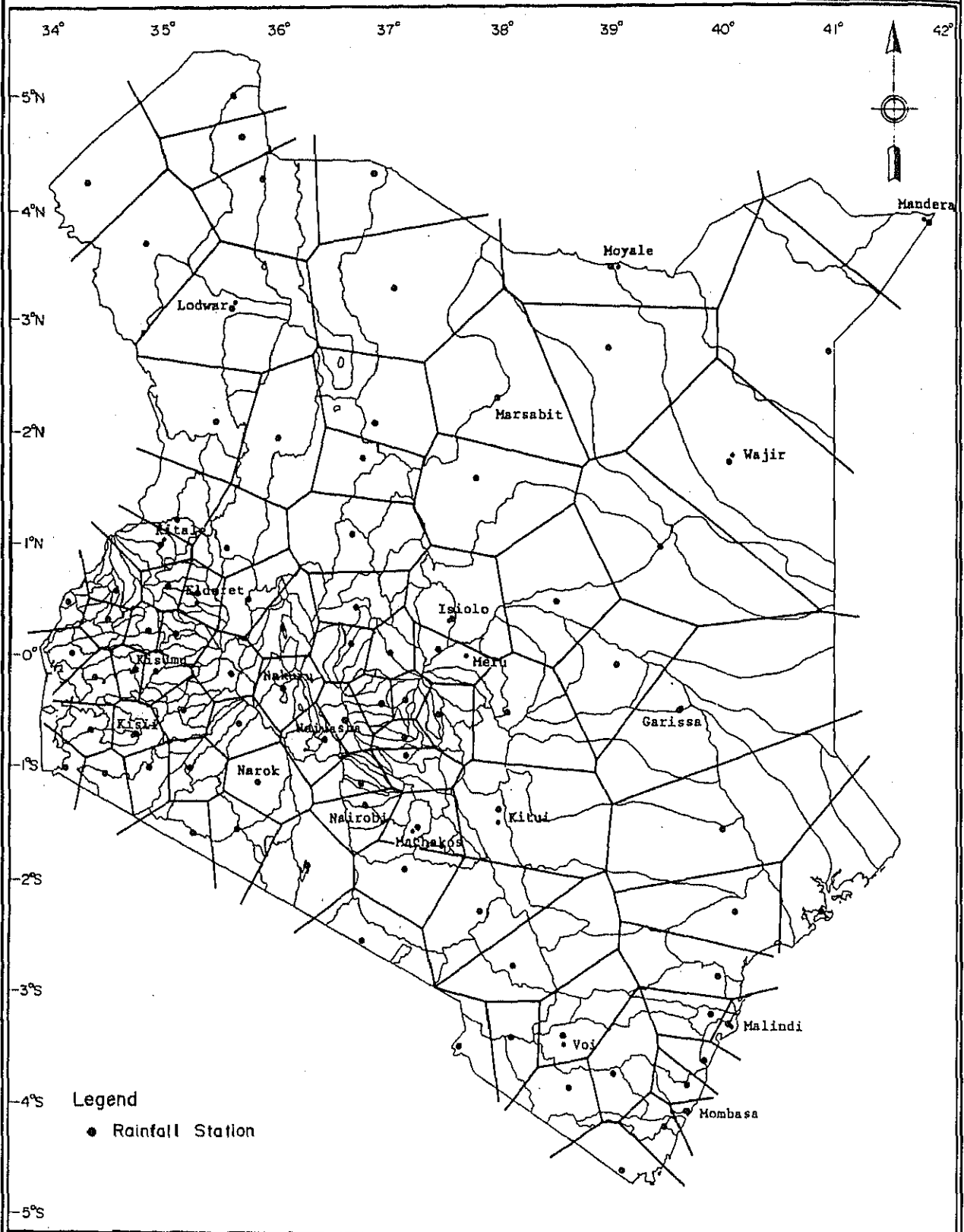


Figure 2.3.3 Thiessen's Polygon

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

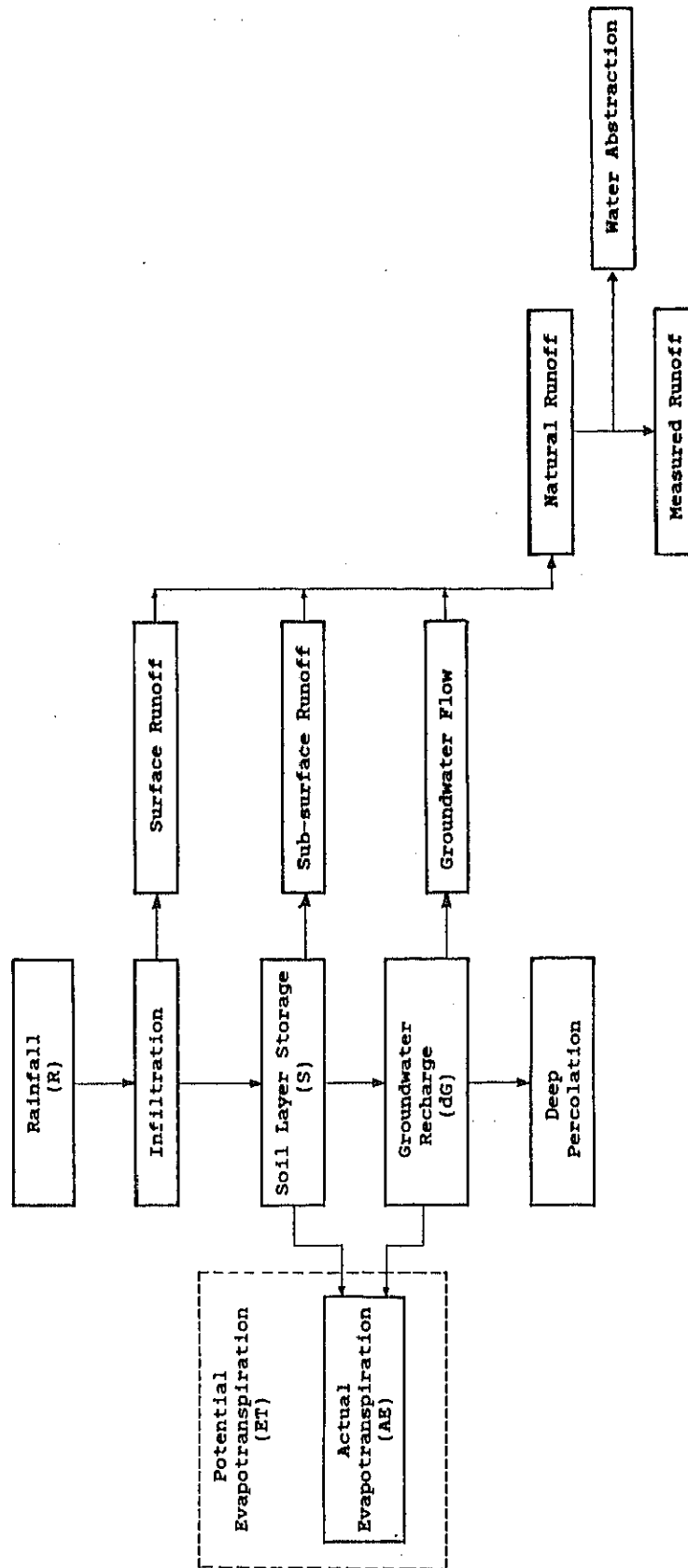


Figure 2.3.4 Flowchart of Preliminary Rainfall-Runoff Balance Calculation

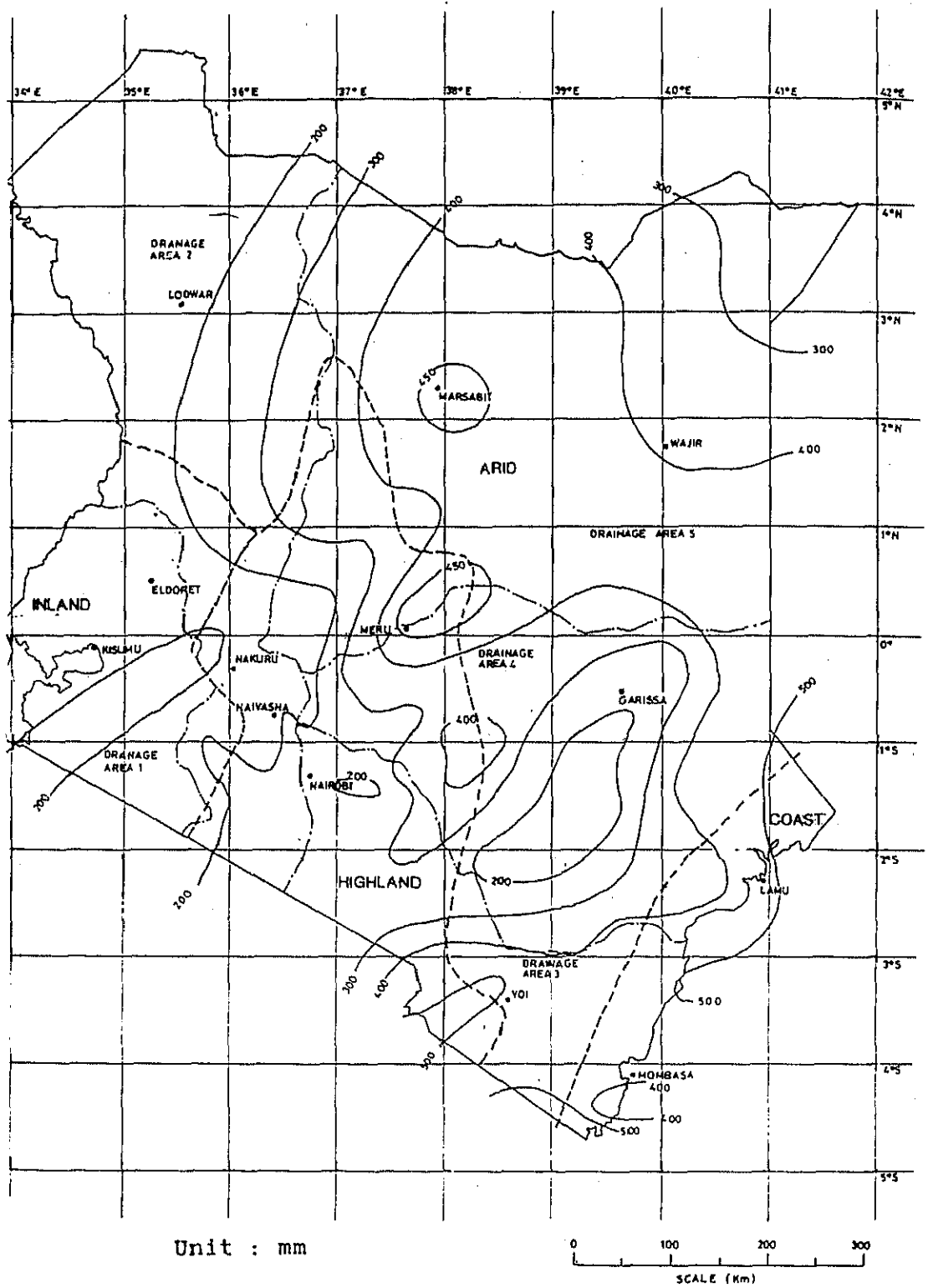
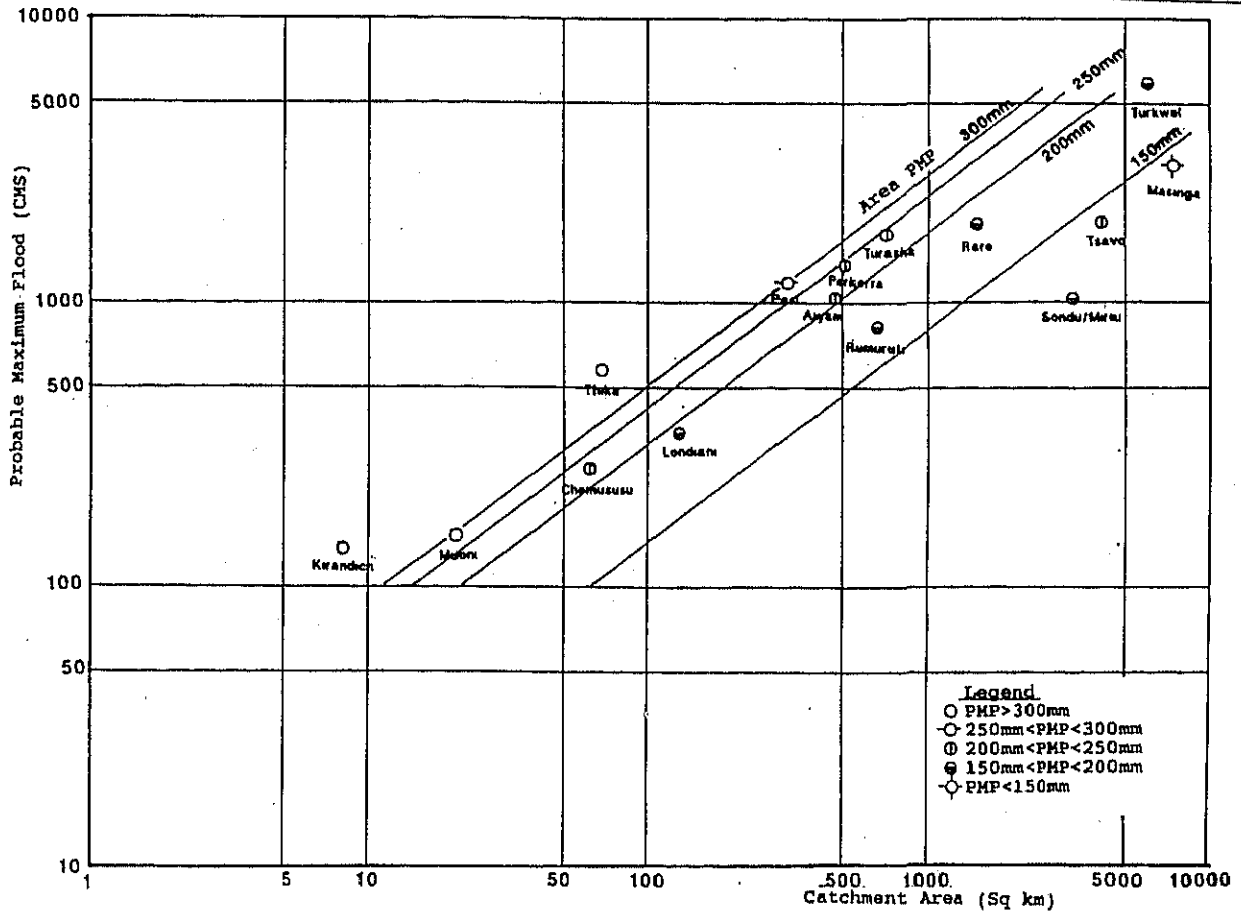


Figure 2.3.5 Isohyetal Map of Probable Maximum Precipitation

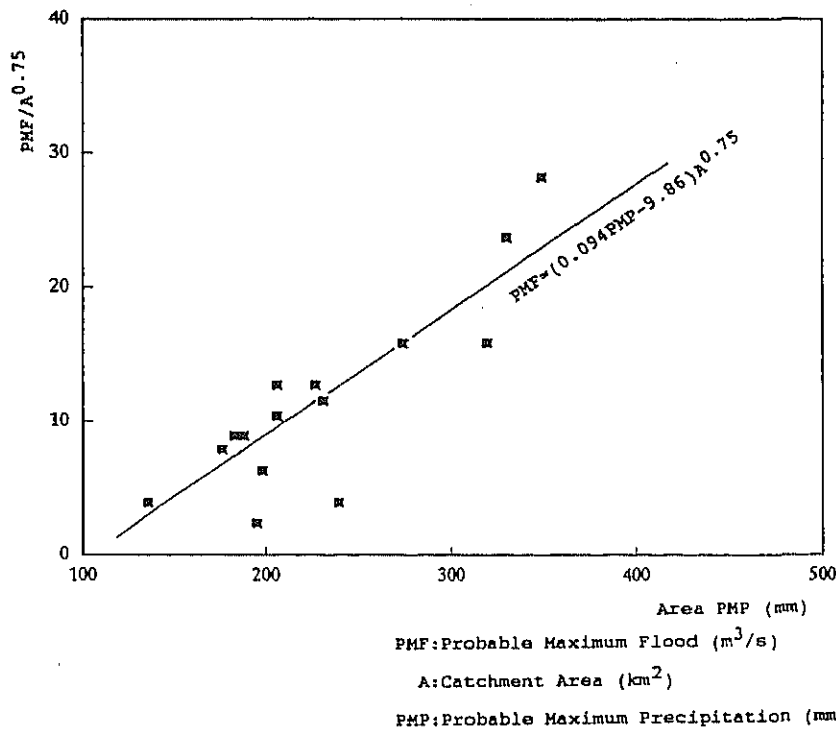
Source: Isohyetal Map: Obasi and Nimira (1977)

Geographic Zone (-----): TRRL Laboratory Report 623 (1974)

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



Relationship between PMF, PMP and Catchment Area



Regression Curve for the relationship between PMF, PMP and Catchment Area

Figure 2.3.6 Relationship Between PMF and PMP

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

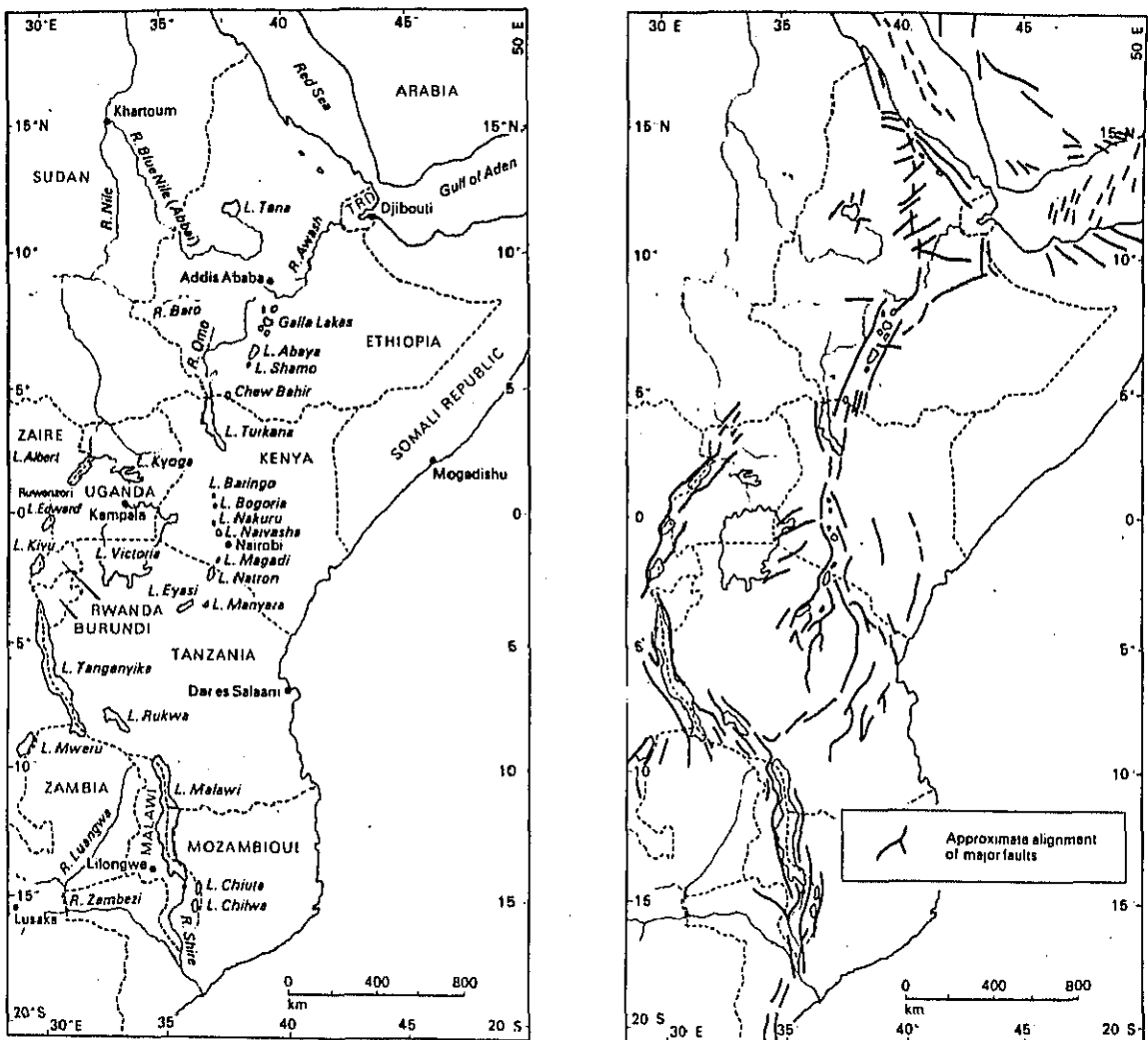
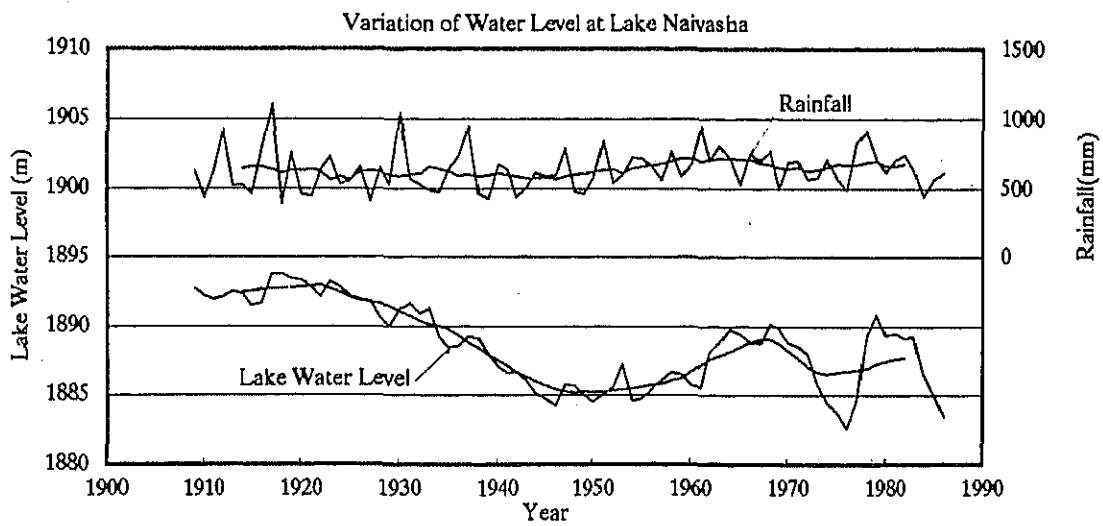
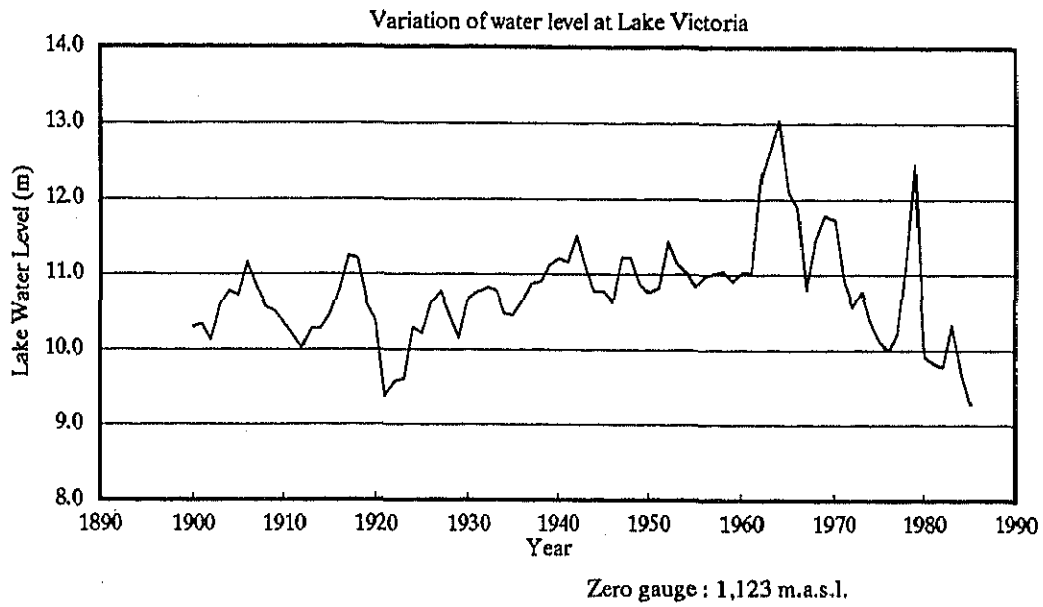


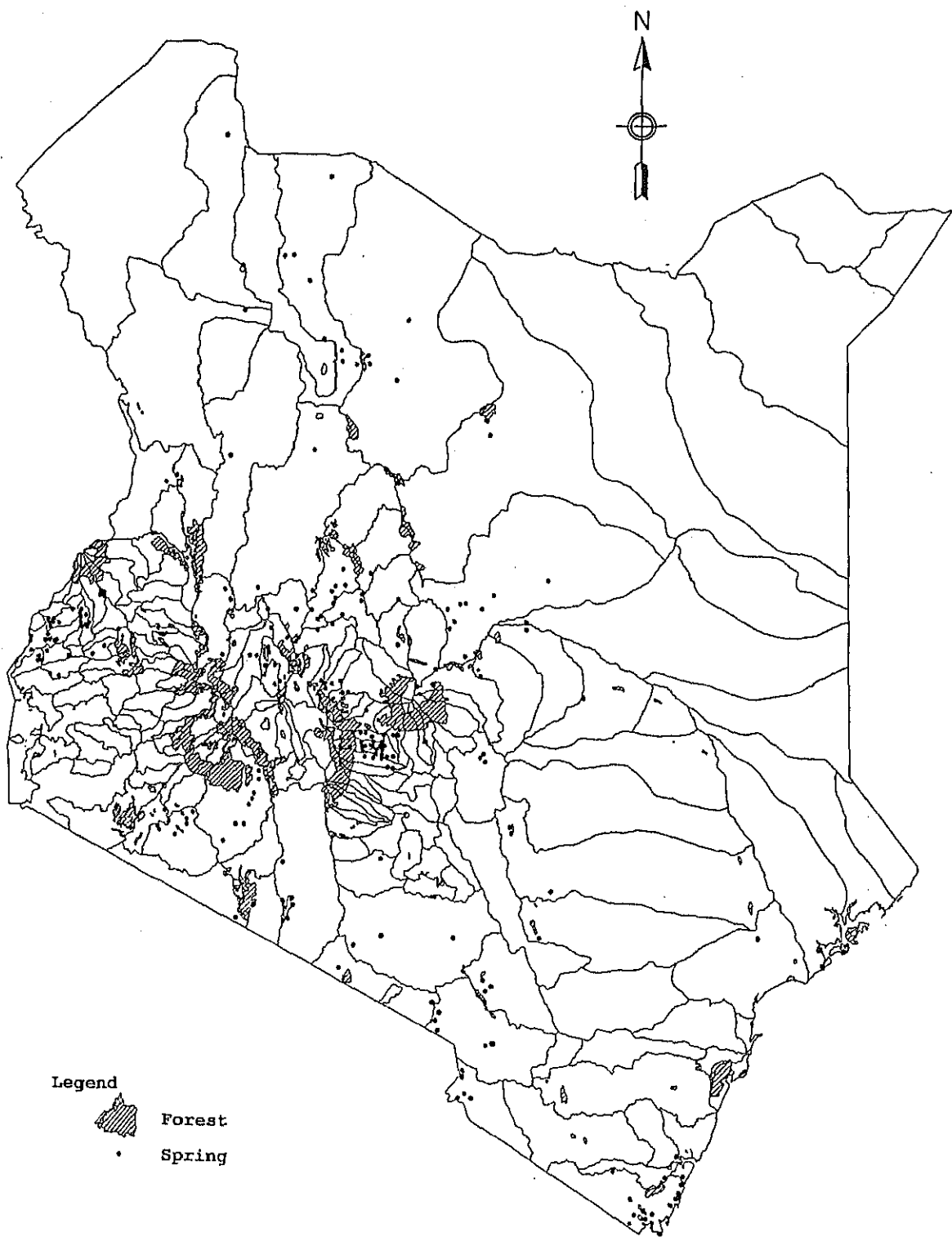
Figure 2.3.7 Lakes in Eastern Africa

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



Note : Water level indicates in m.a.s.l.

Figure 2.3.8 Variation of Water Level at Lake Victoria and Lake Naivasha



Legend
Forest
Spring

Note : Springs shown here are only those the information of location (coordinates) is available.

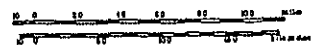
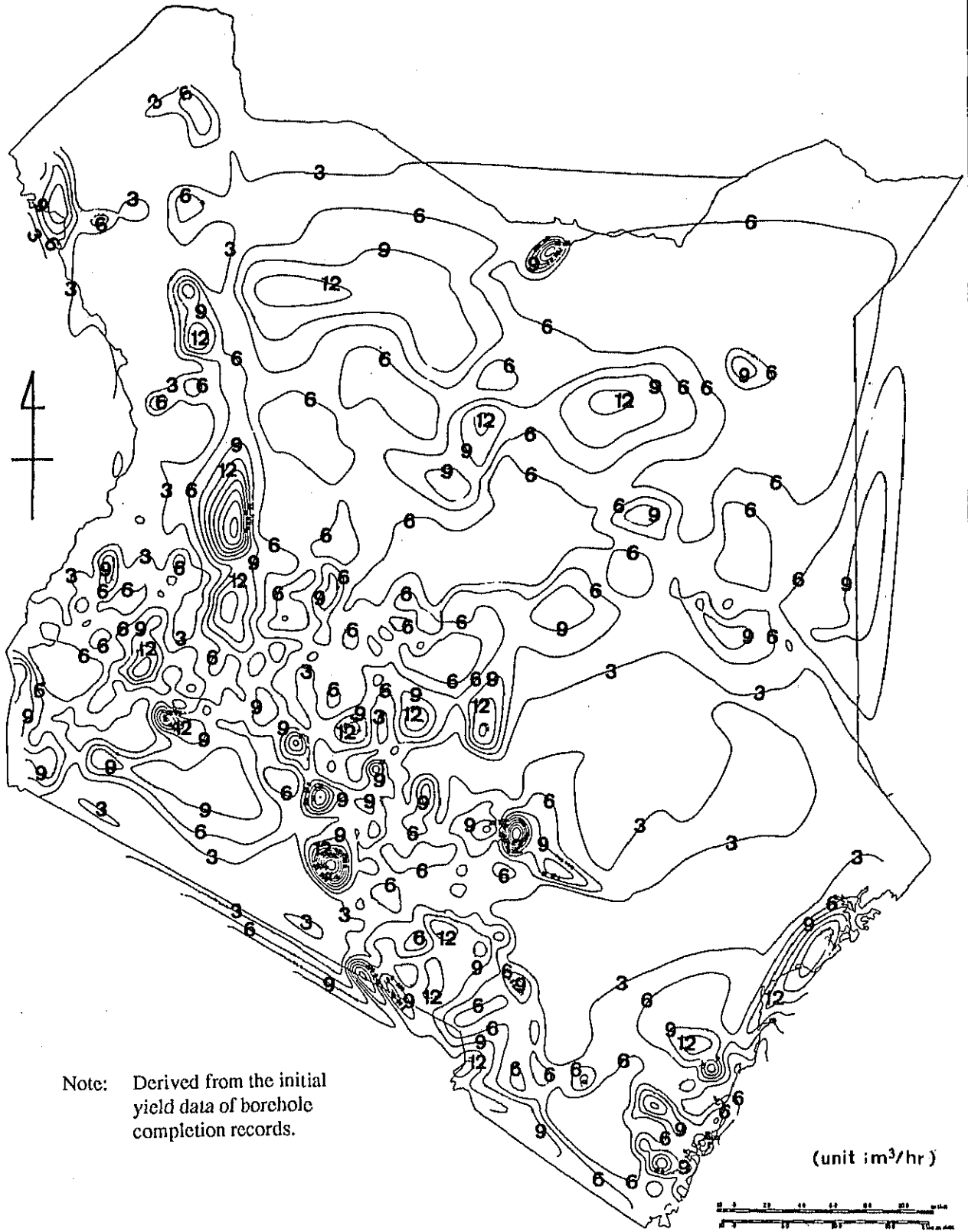


Figure 2.3.9 Location Map of Springs

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

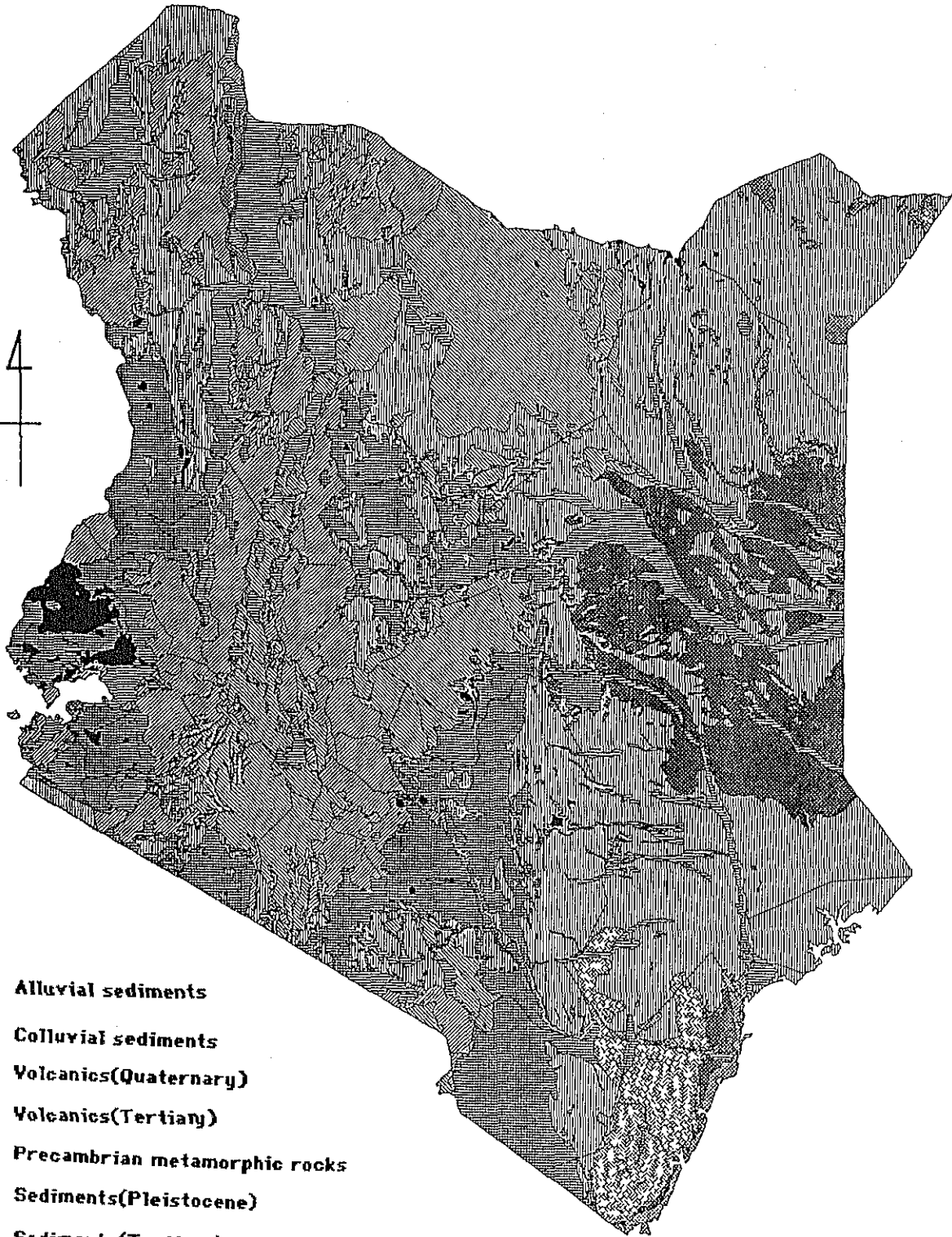


Note: Derived from the initial yield data of borehole completion records.

(unit : m³/hr)

Figure 2.4.1 Groundwater Yield

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



- 1 Alluvial sediments
- 2 Colluvial sediments
- 3 Volcanics(Quaternary)
- 4 Volcanics(Tertiary)
- 5 Precambrian metamorphic rocks
- 6 Sediments(Pleistocene)
- 7 Sediments(Tertiary)
- 8 Sediments(Mesozoic)
- 9 Intrusives

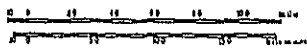
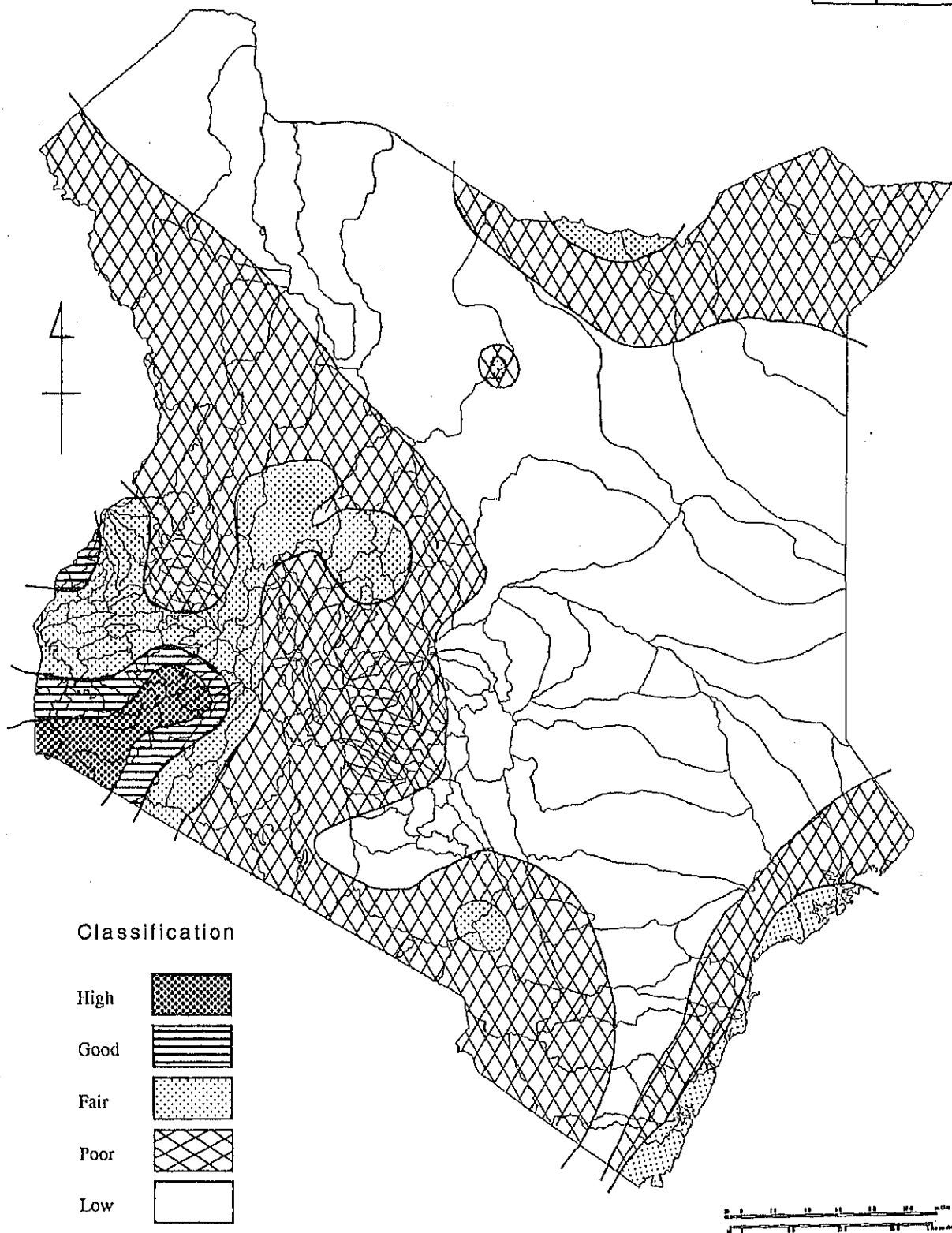


Figure 2.4.2 (1/2) Hydrogeological Map (Geological Potential)

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



Classification

High

Good

Fair

Poor

Low

Cf. Appendix C.6

This map is based on a limited number of data and hence is of limited use only for providing general information.

Figure 2.4.2 (2/2) Hydrogeological Map (Groundwater Potential)

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

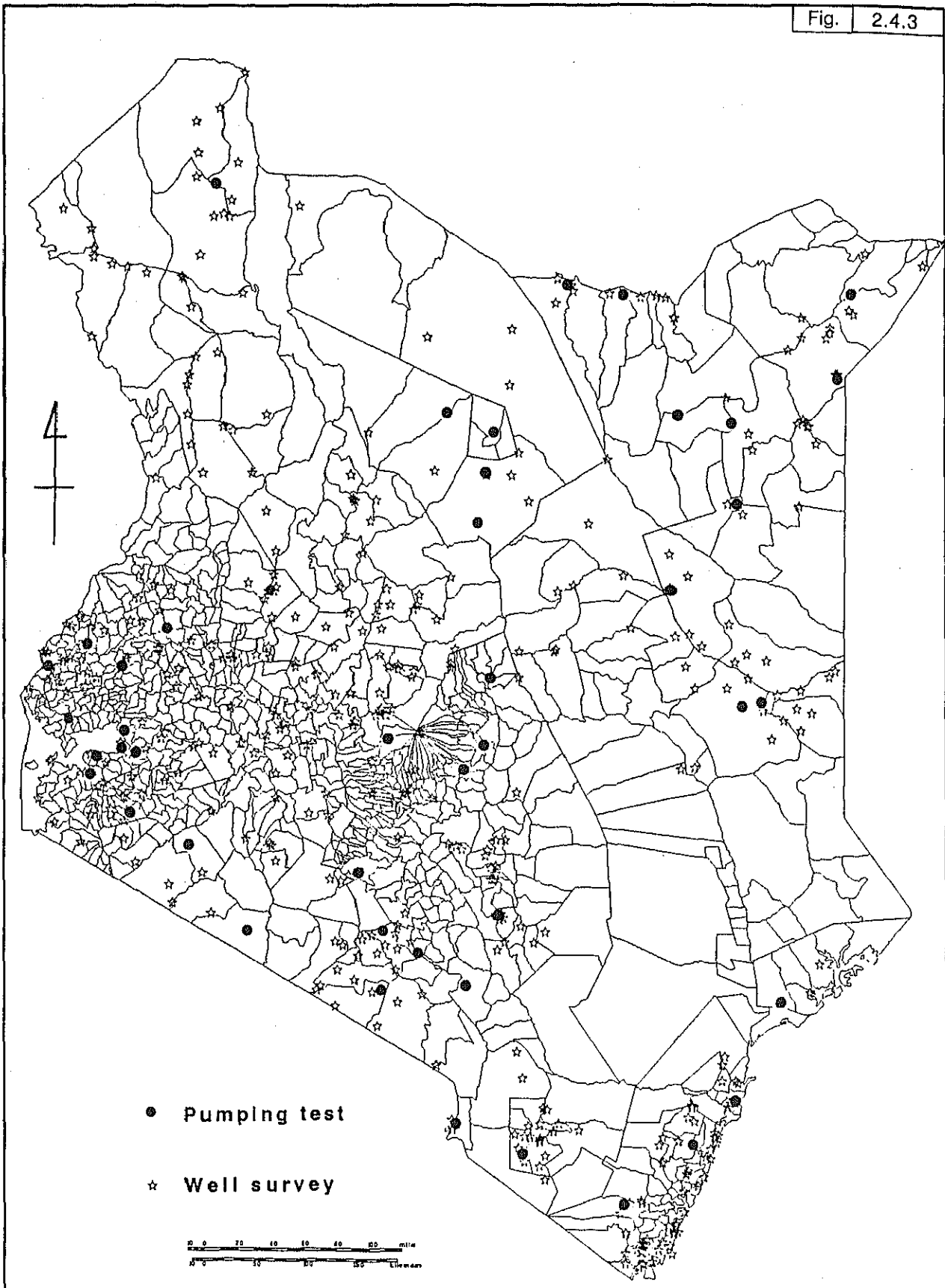


Figure 2.4.3 Location Map of Boreholes served for Pumping Test and Well Survey

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

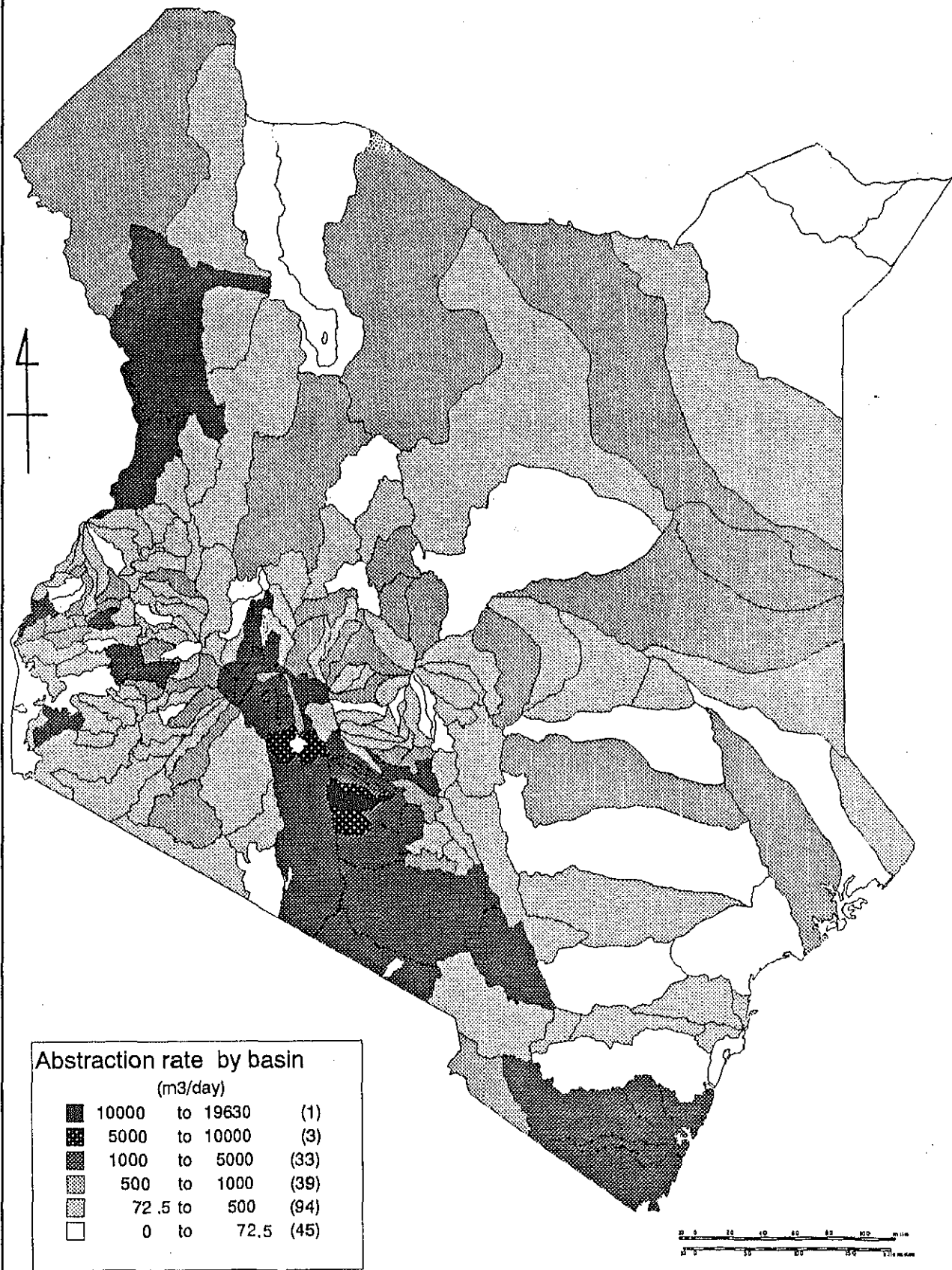


Figure 2.4.4 Present Groundwater Abstraction Rates by Basin

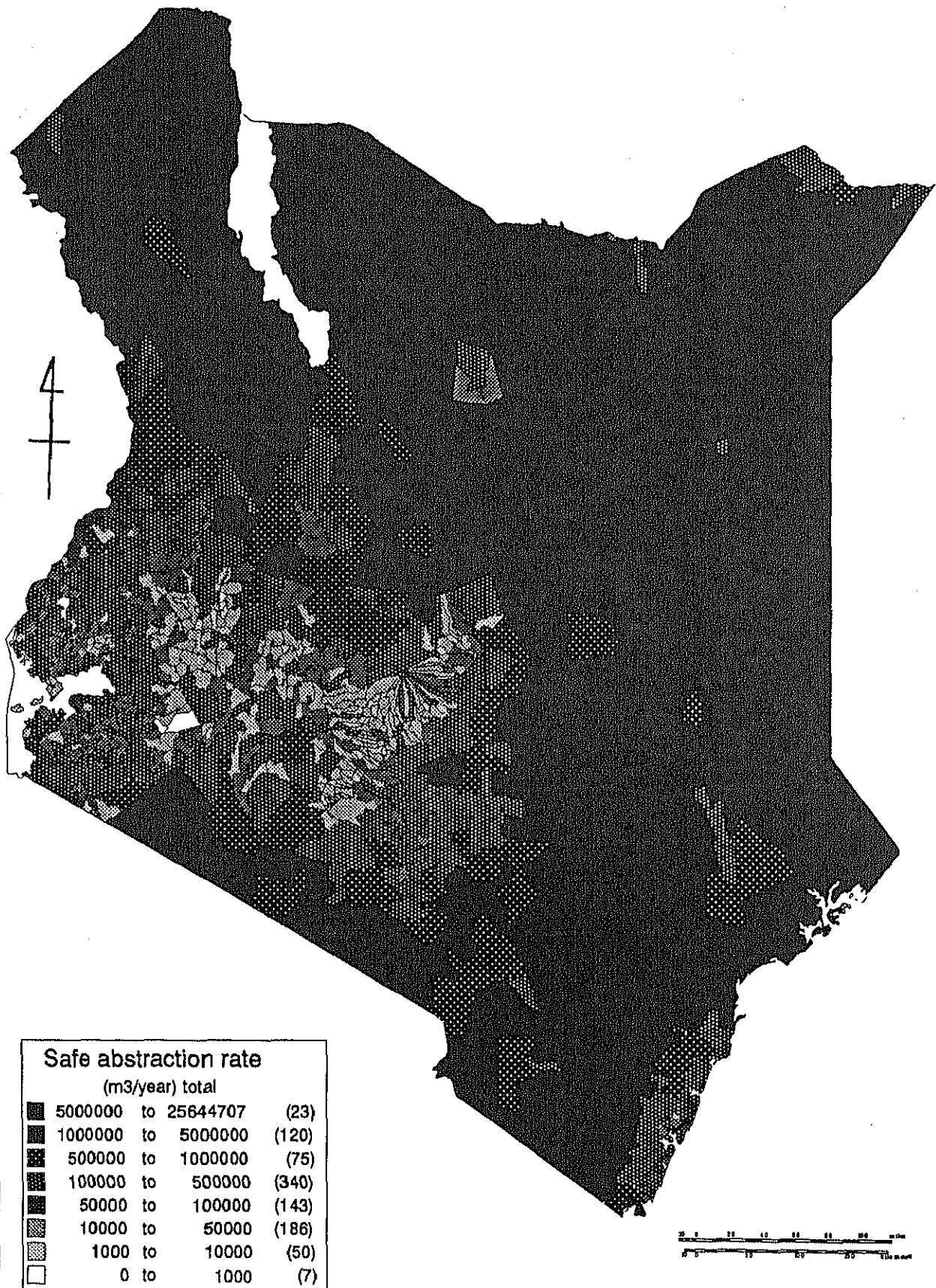


Figure 2.4.5 Safe Abstraction Rates of Boreholes (by Location)

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

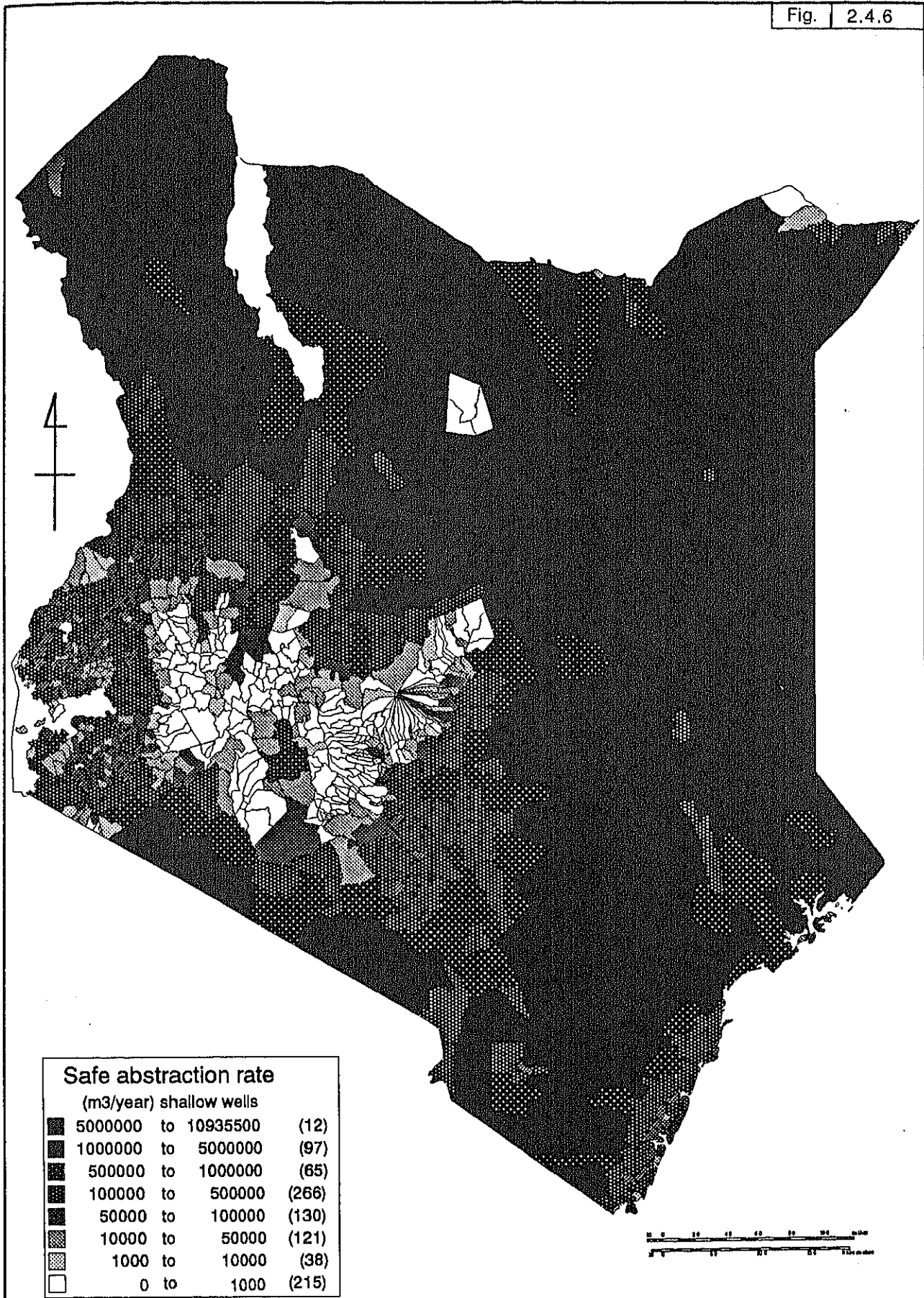


Figure 2.4.6 Safe Abstraction Rates of Shallow Wells (by Location)

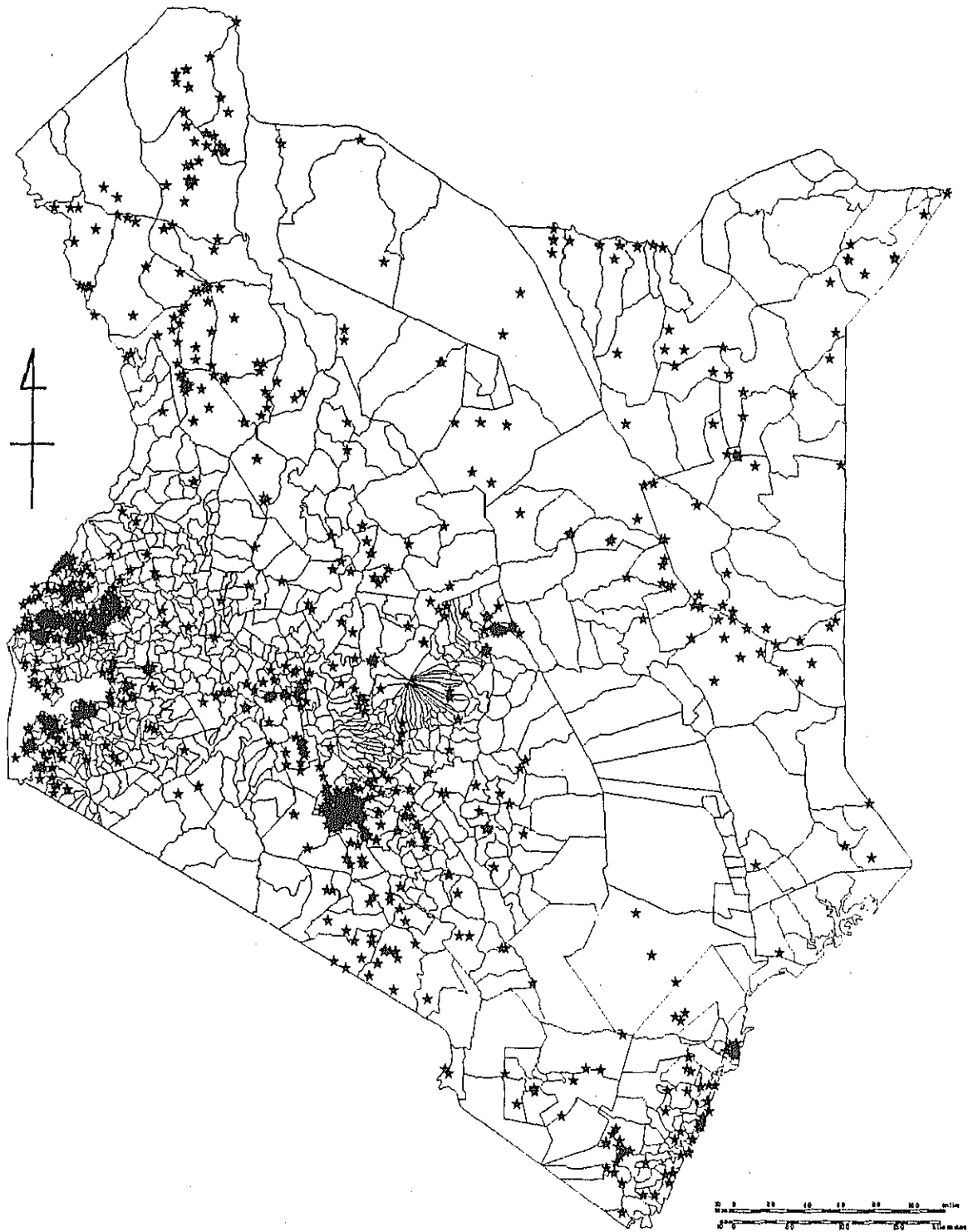


Figure 2.4.7 Location Map of Boreholes with Electrical Conductivity Data

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

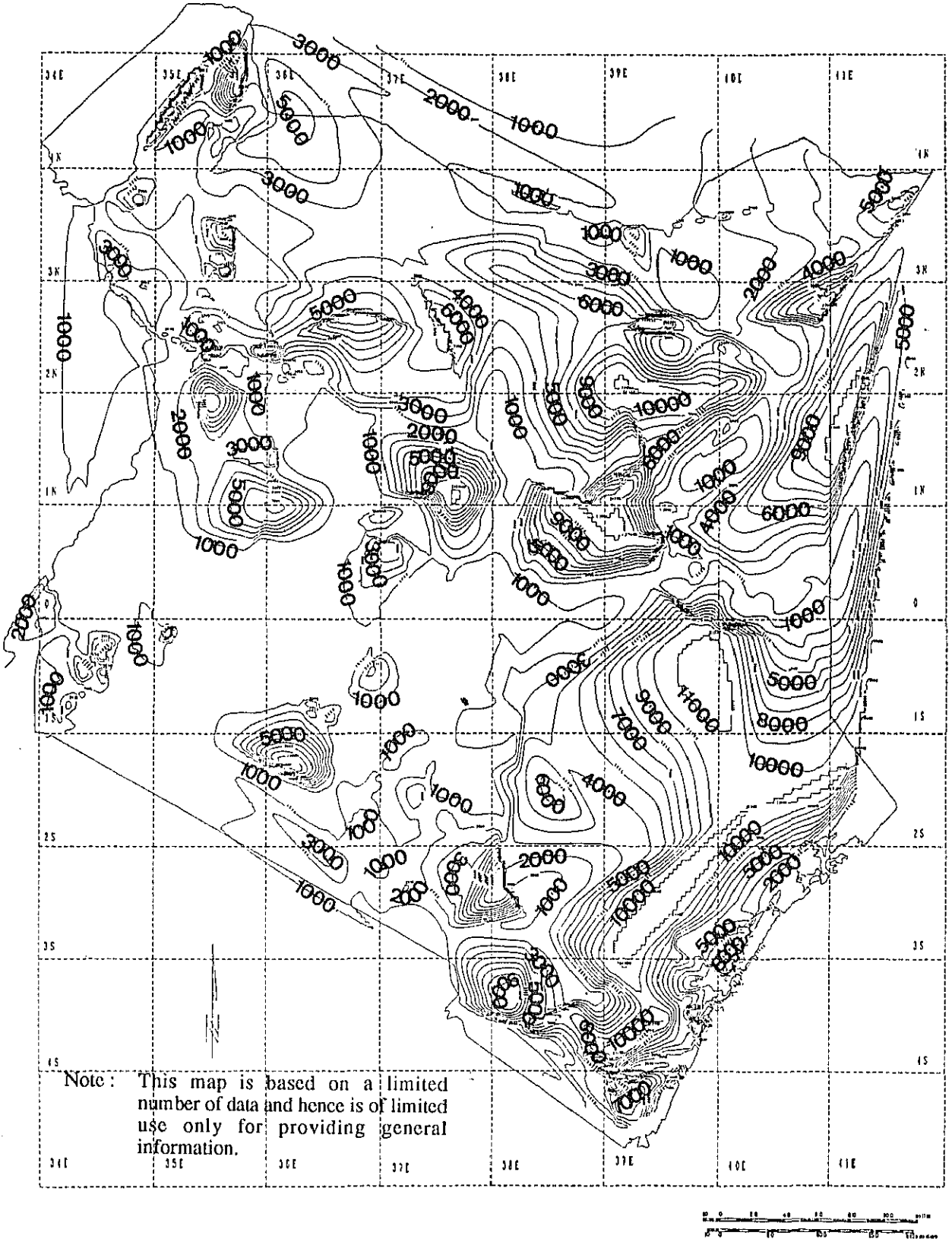


Figure 2.4.8 Contour Map of Electrical Conductivity (micro s/cm)

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

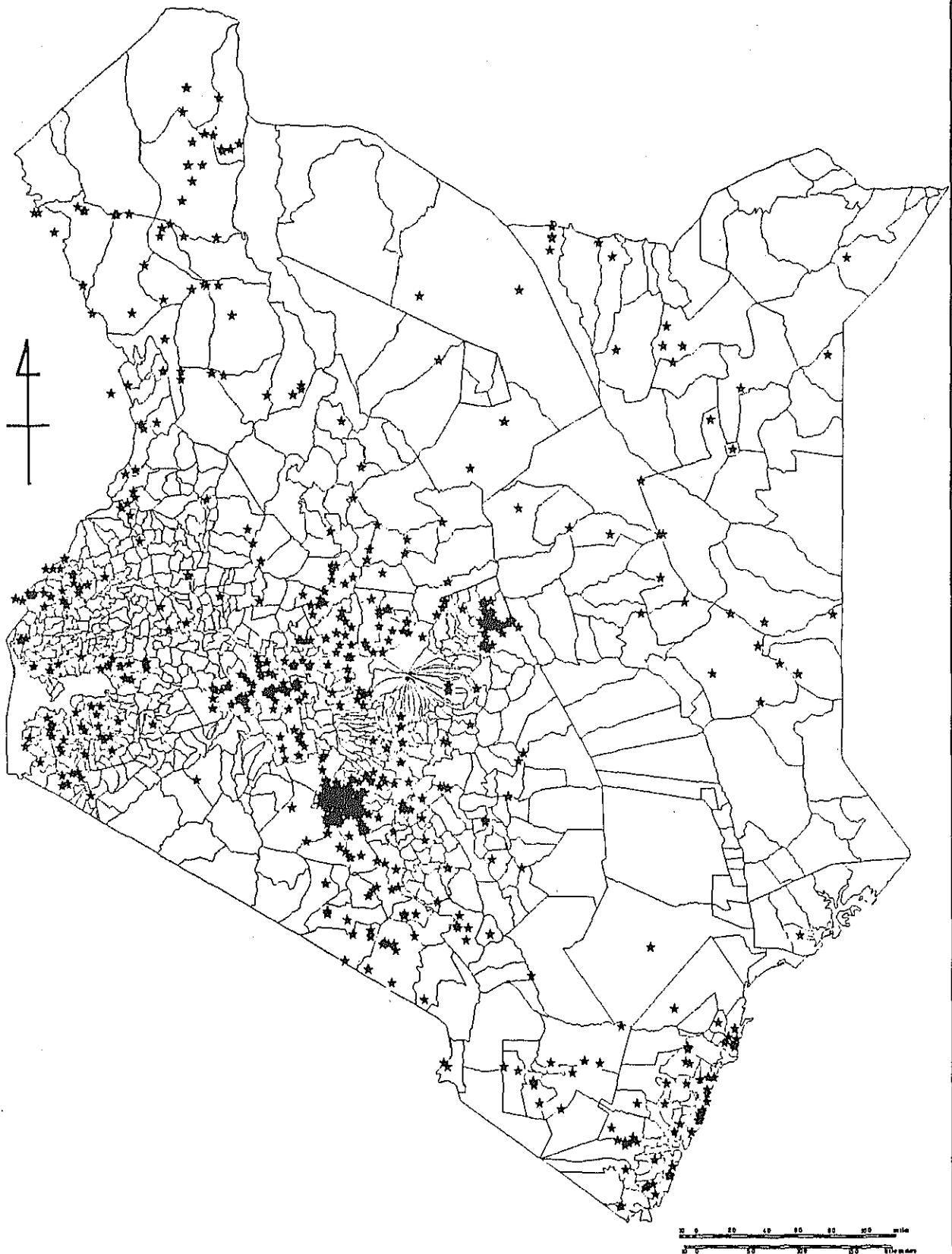


Figure 2.4.9 Location Map of Boreholes with Fluoride Data

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

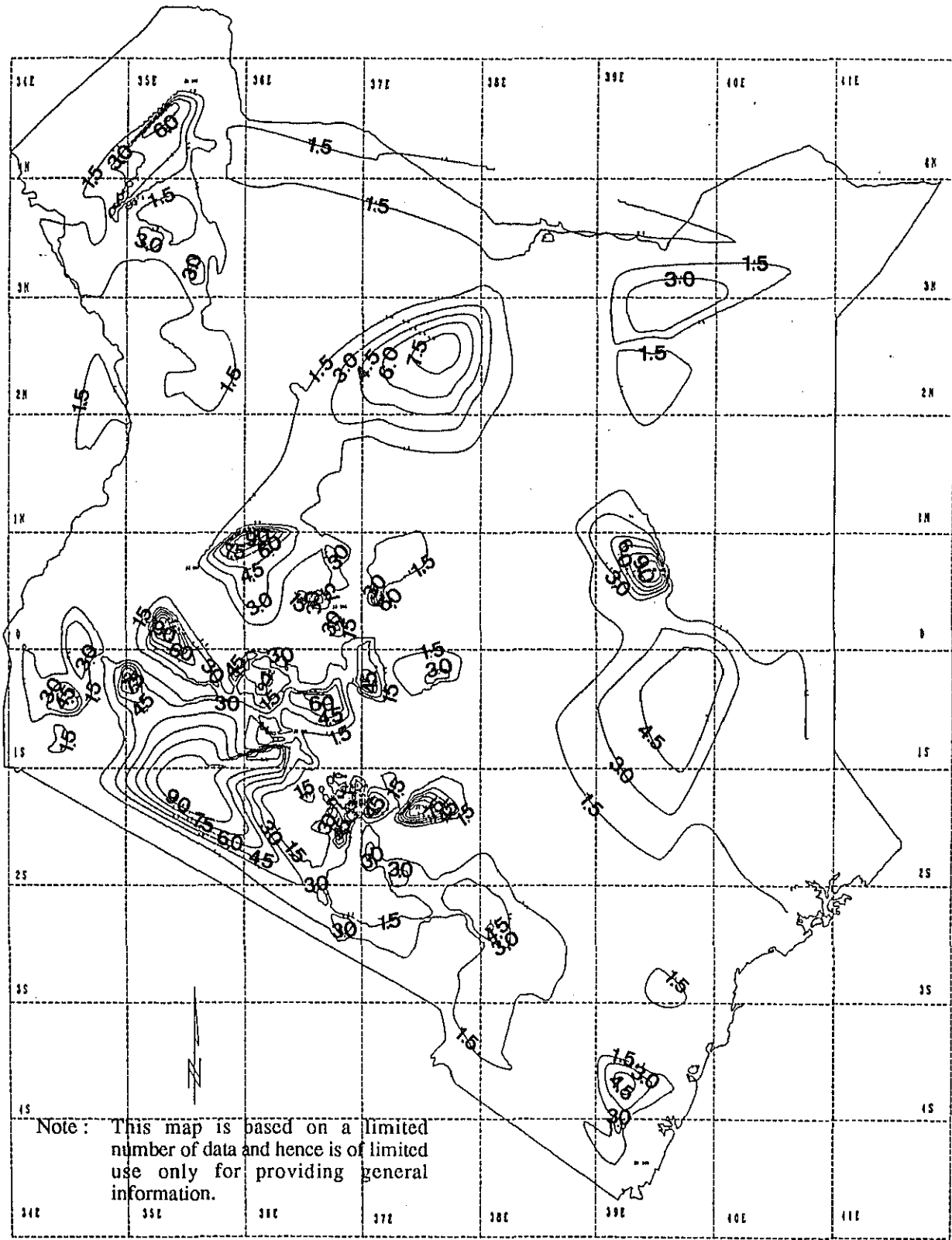


Figure 2.4.10 Contour Map of Fluoride (mg/l)

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

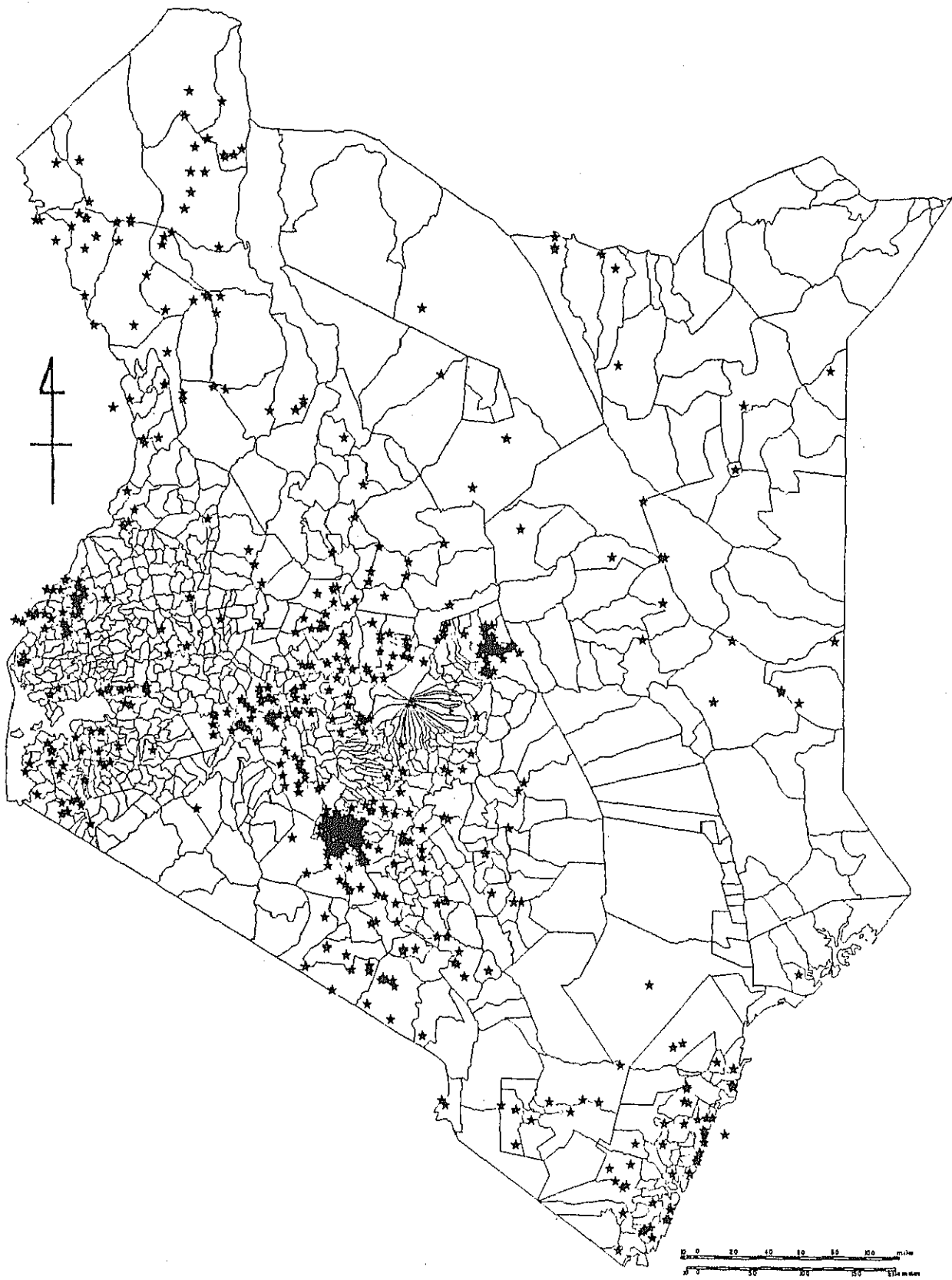


Figure 2.4.11 Location Map of Boreholes with Iron Data

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

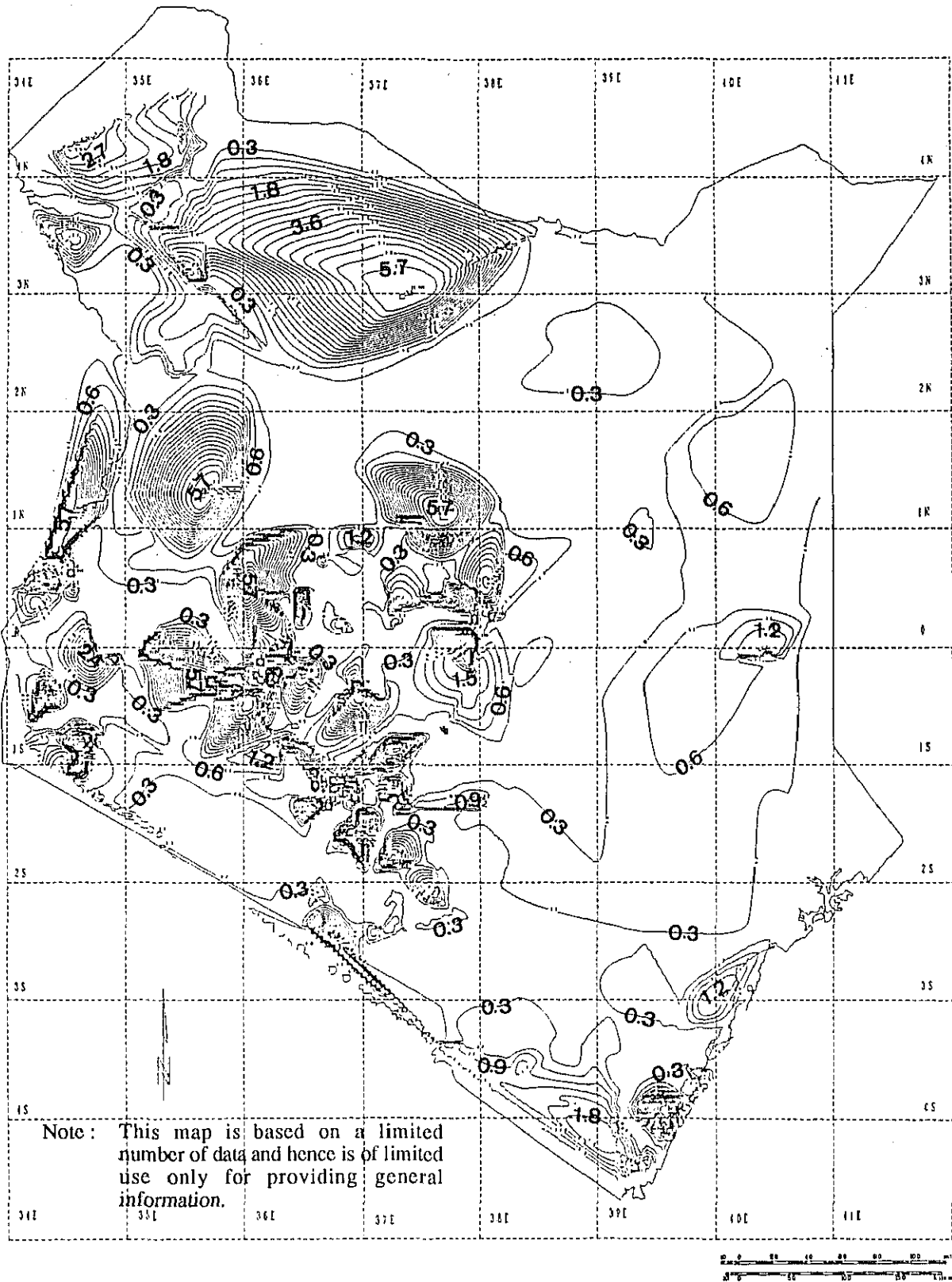


Figure 2.4.12 Contour Map of Iron (mg/l)

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

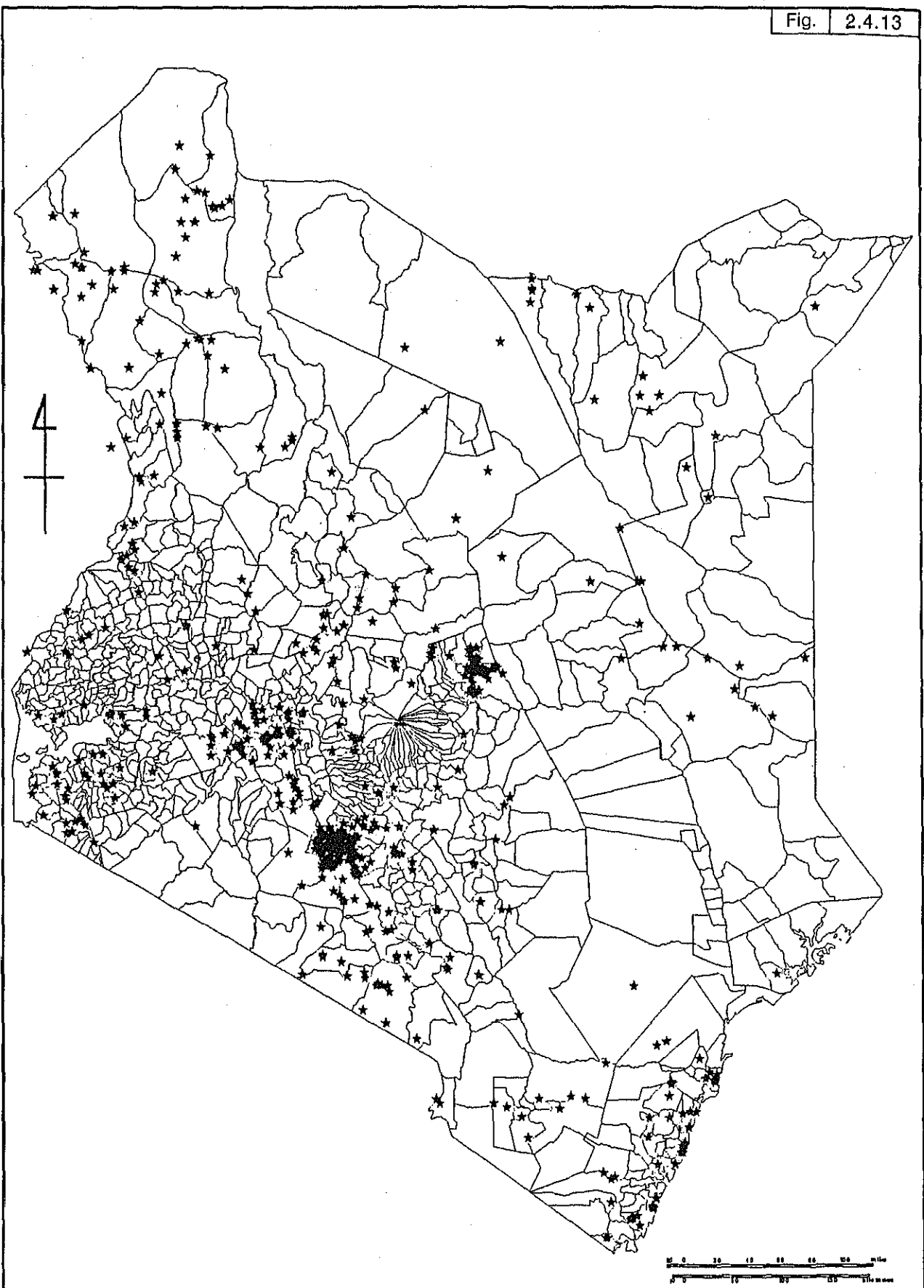
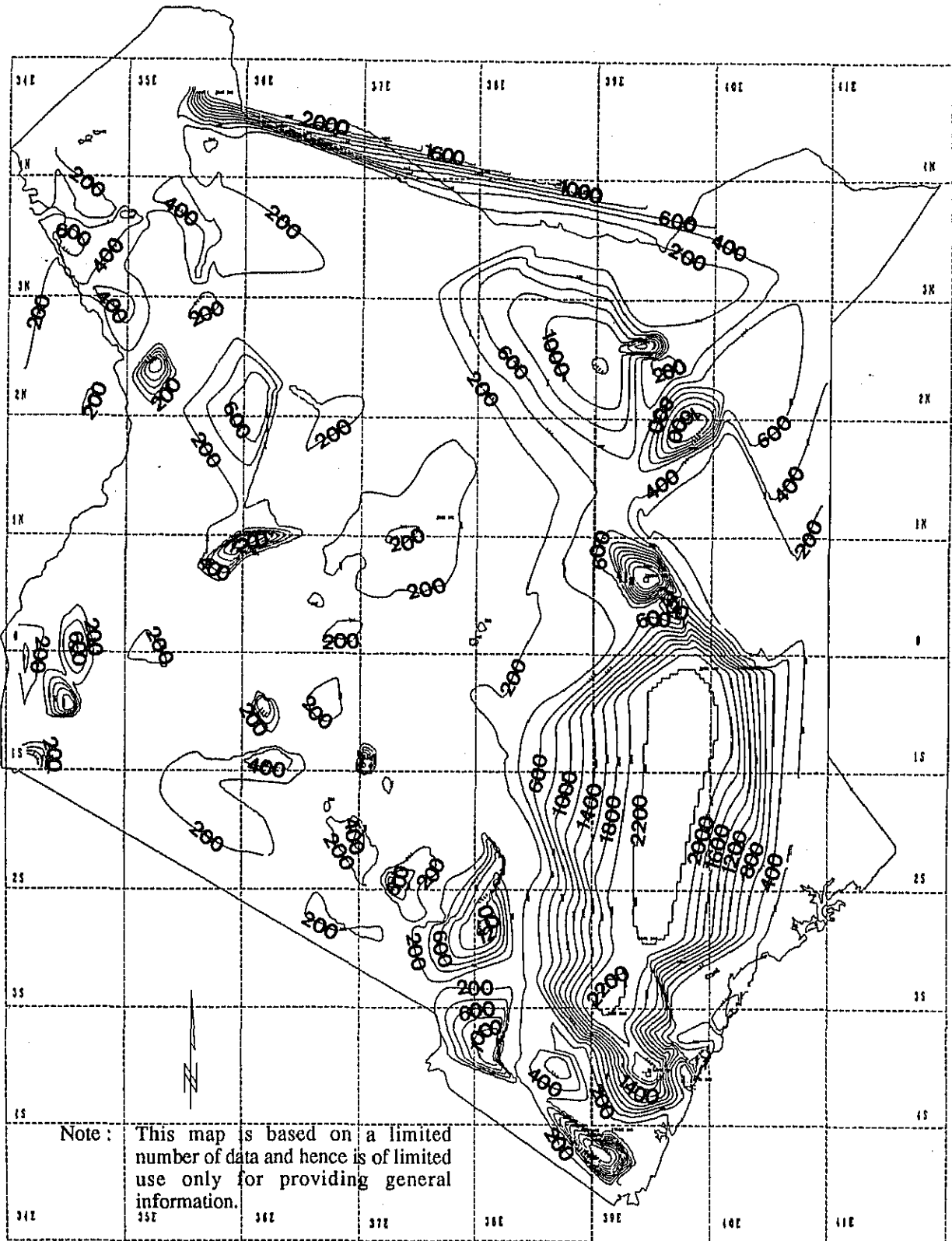


Figure 2.4.13 Location Map of Boreholes with Sodium Data

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



Note : This map is based on a limited number of data and hence is of limited use only for providing general information.

Figure 2.4.14 Contour Map of Sodium (mg/l)

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

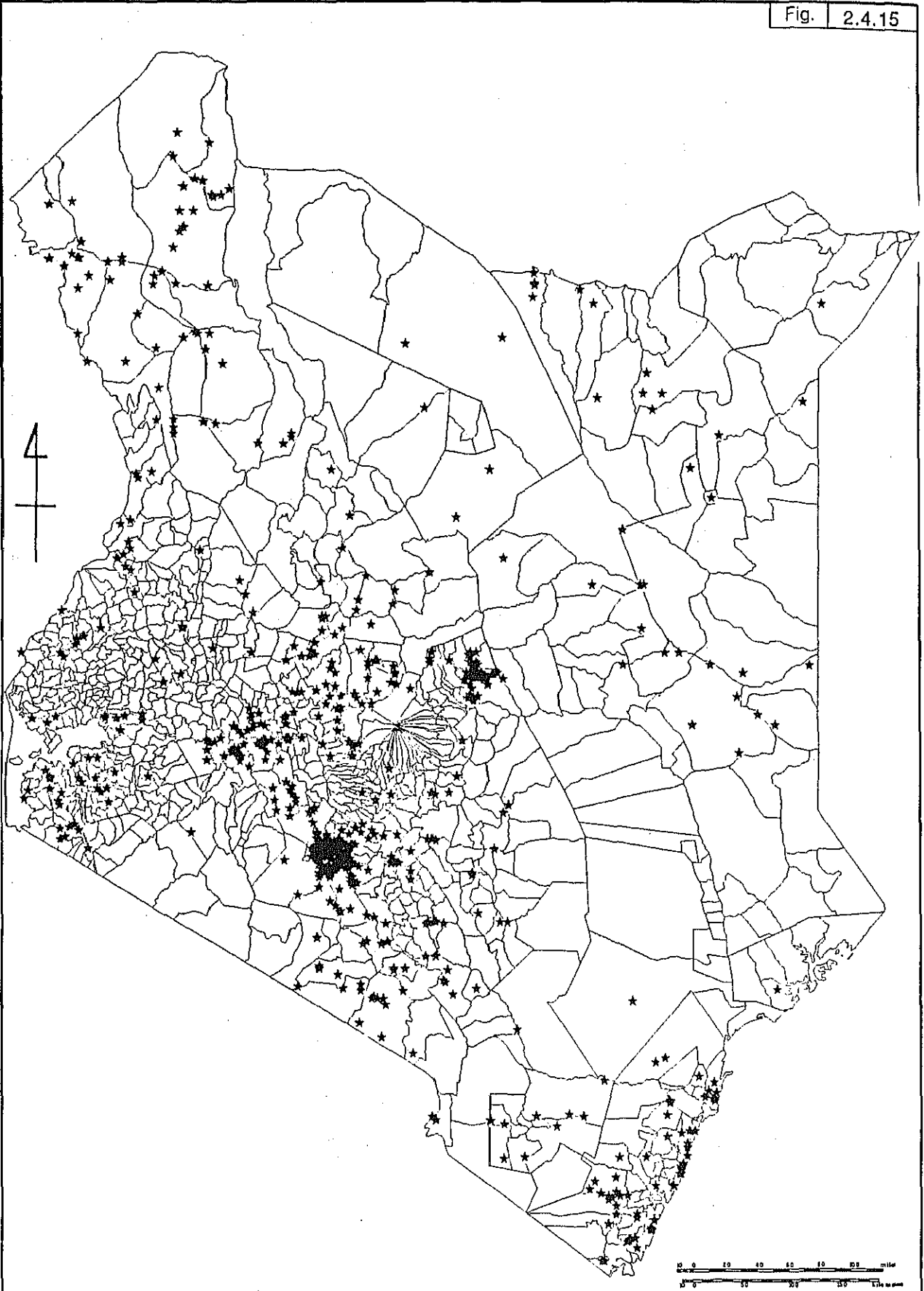


Figure 2.4.15 Location Map of Boreholes with Calcium Data

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

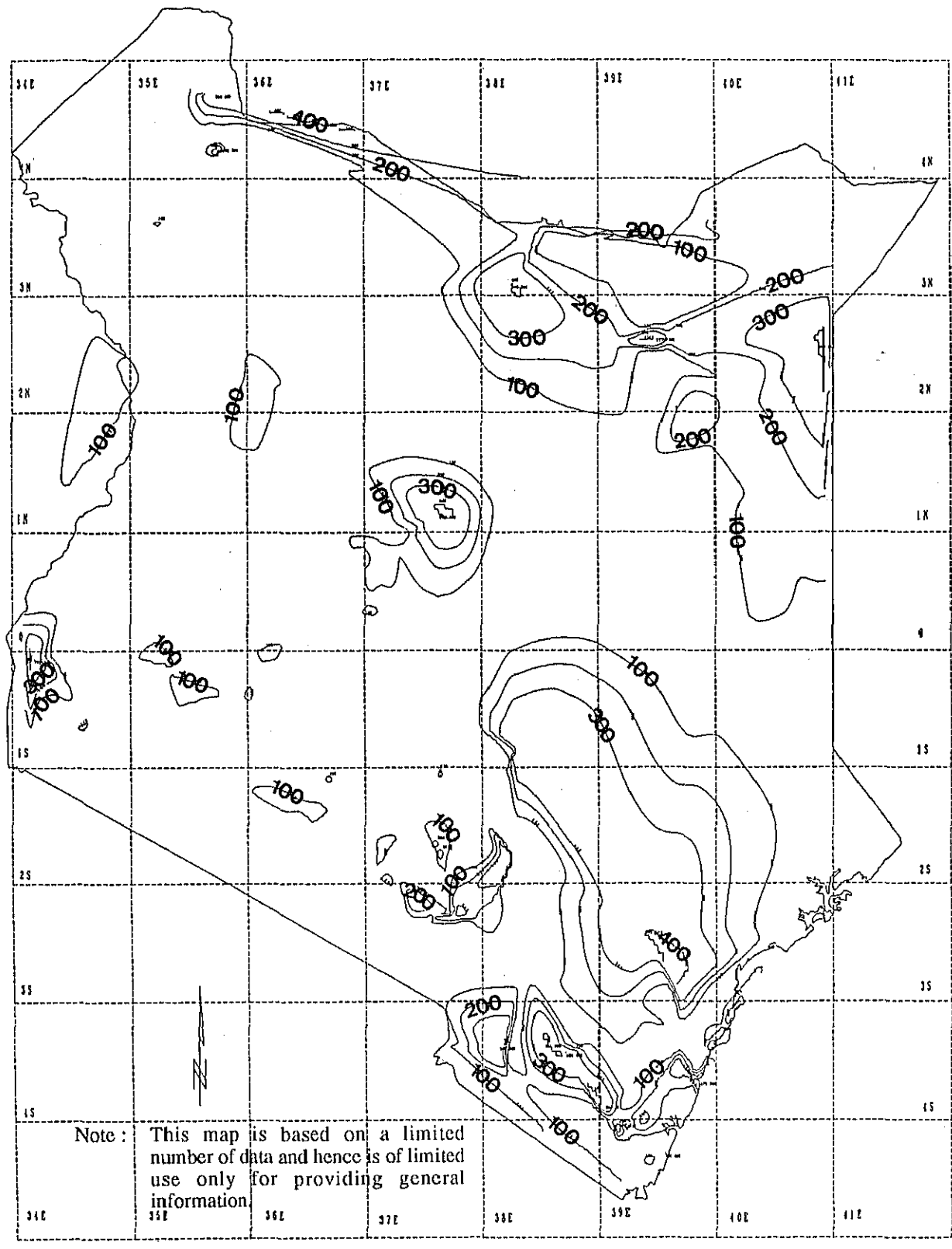


Figure 2.4.16 Contour Map of Calcium (mg/l)

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

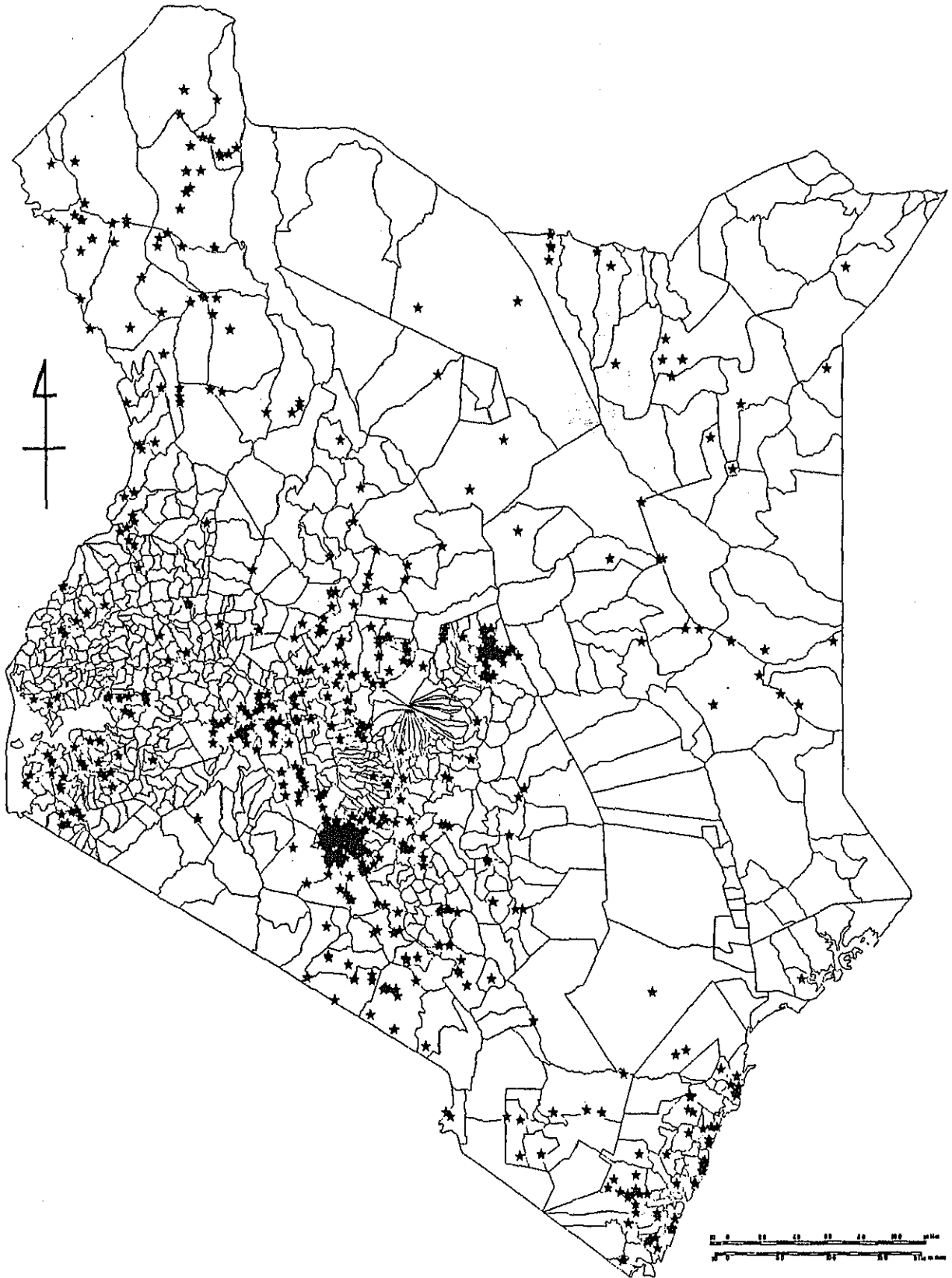


Figure 2.4.17 Location Map of Boreholes with Magnesium Data

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

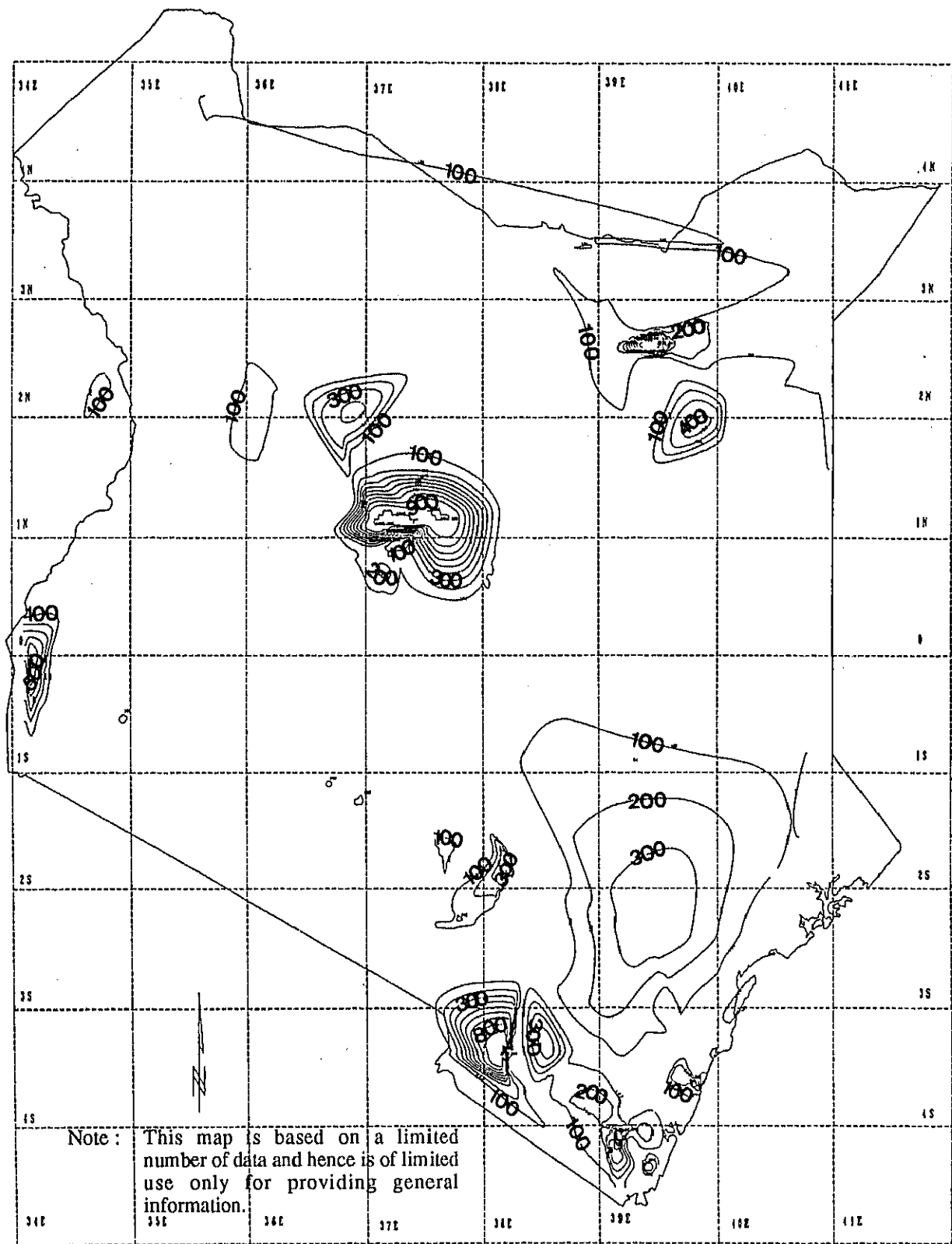


Figure 2.4.18 Contour Map of Magnesium (mg/l)

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

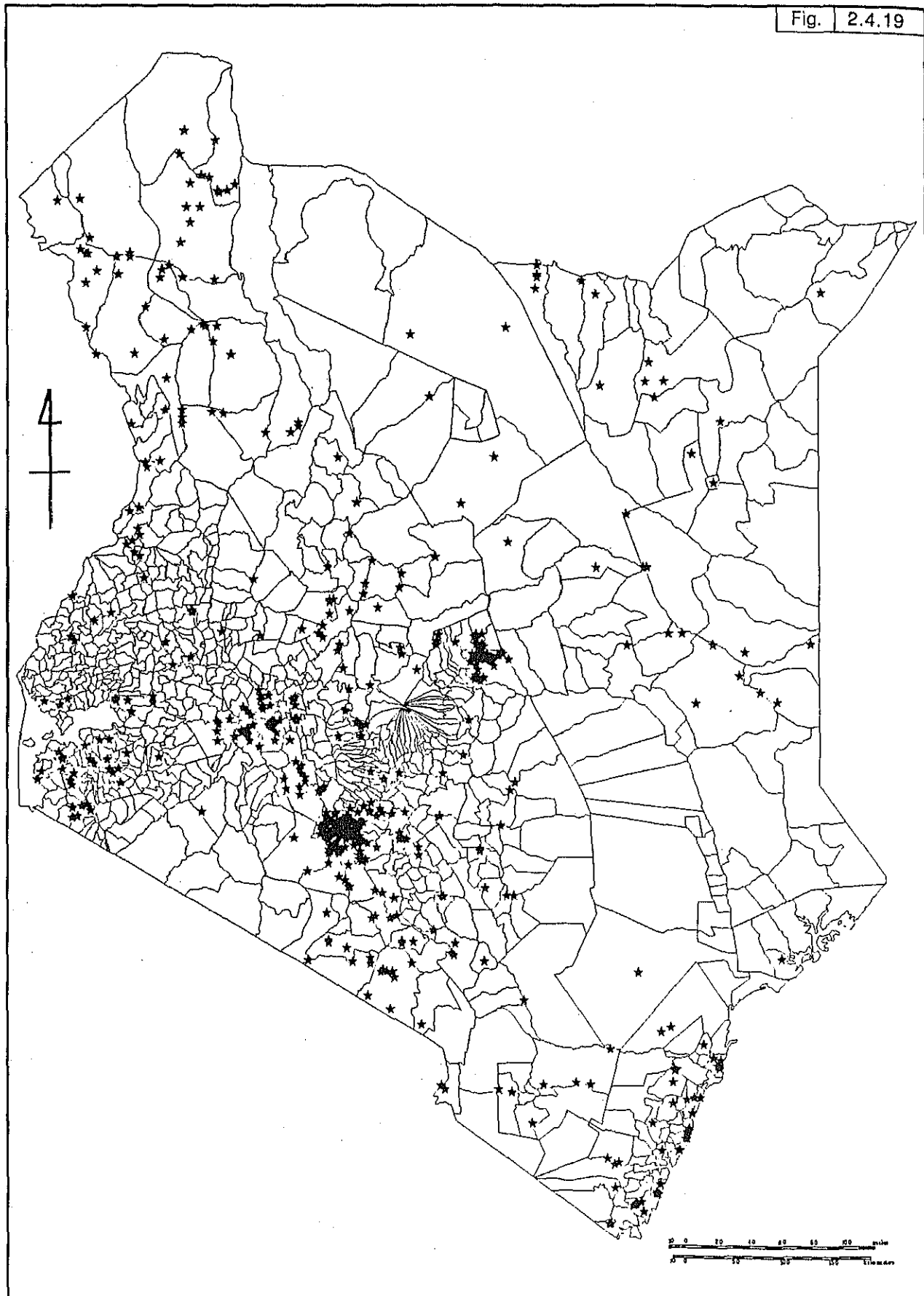
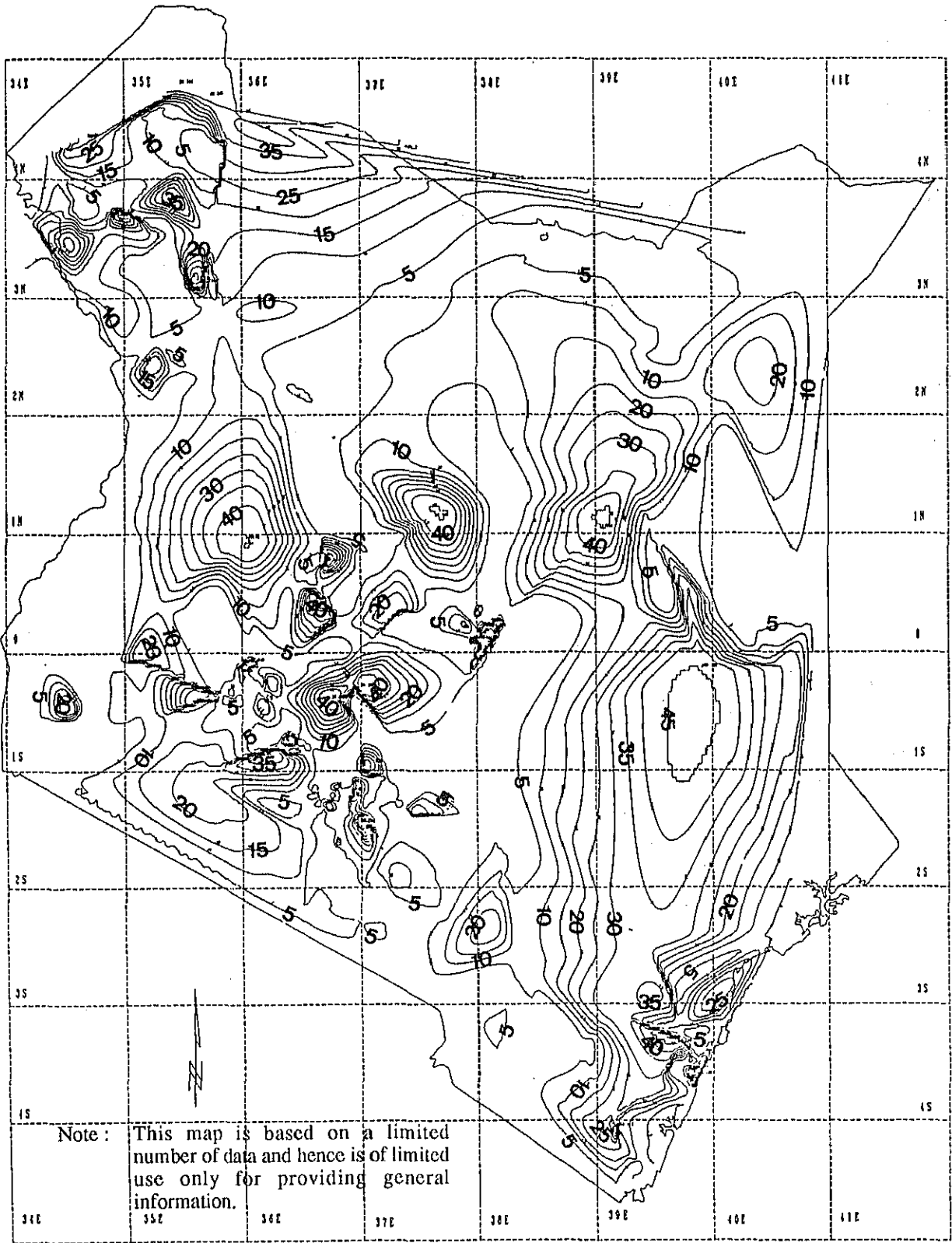


Figure 2.4.19 Location Map of Boreholes with Sodium Absorption Ratio Data

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



Note: This map is based on a limited number of data and hence is of limited use only for providing general information.

Figure 2.4.20 Contour Map of Sodium Absorption Ratio

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

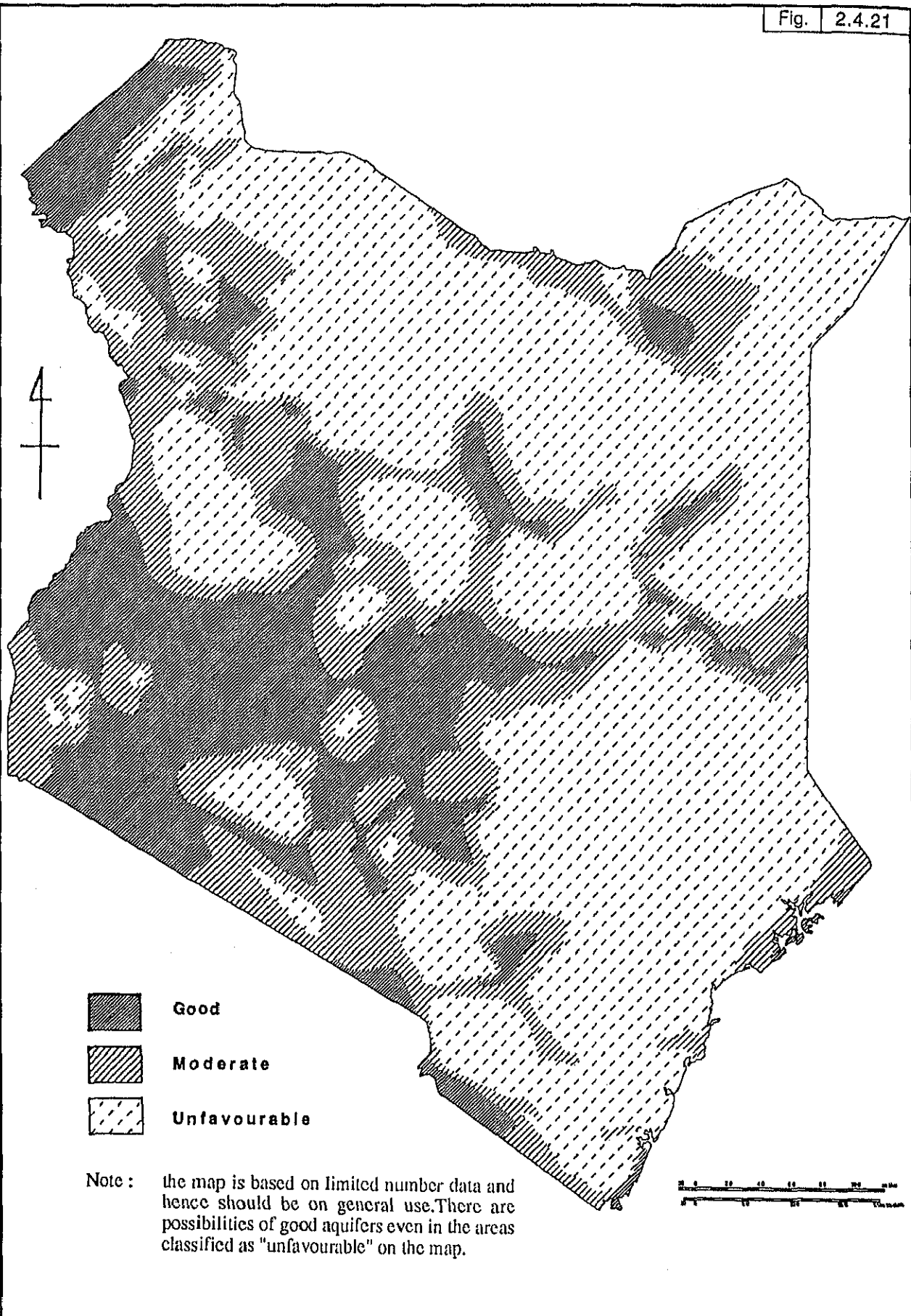


Figure 2.4.21 Groundwater-Drinking Water Risk (electrical conductivity)

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

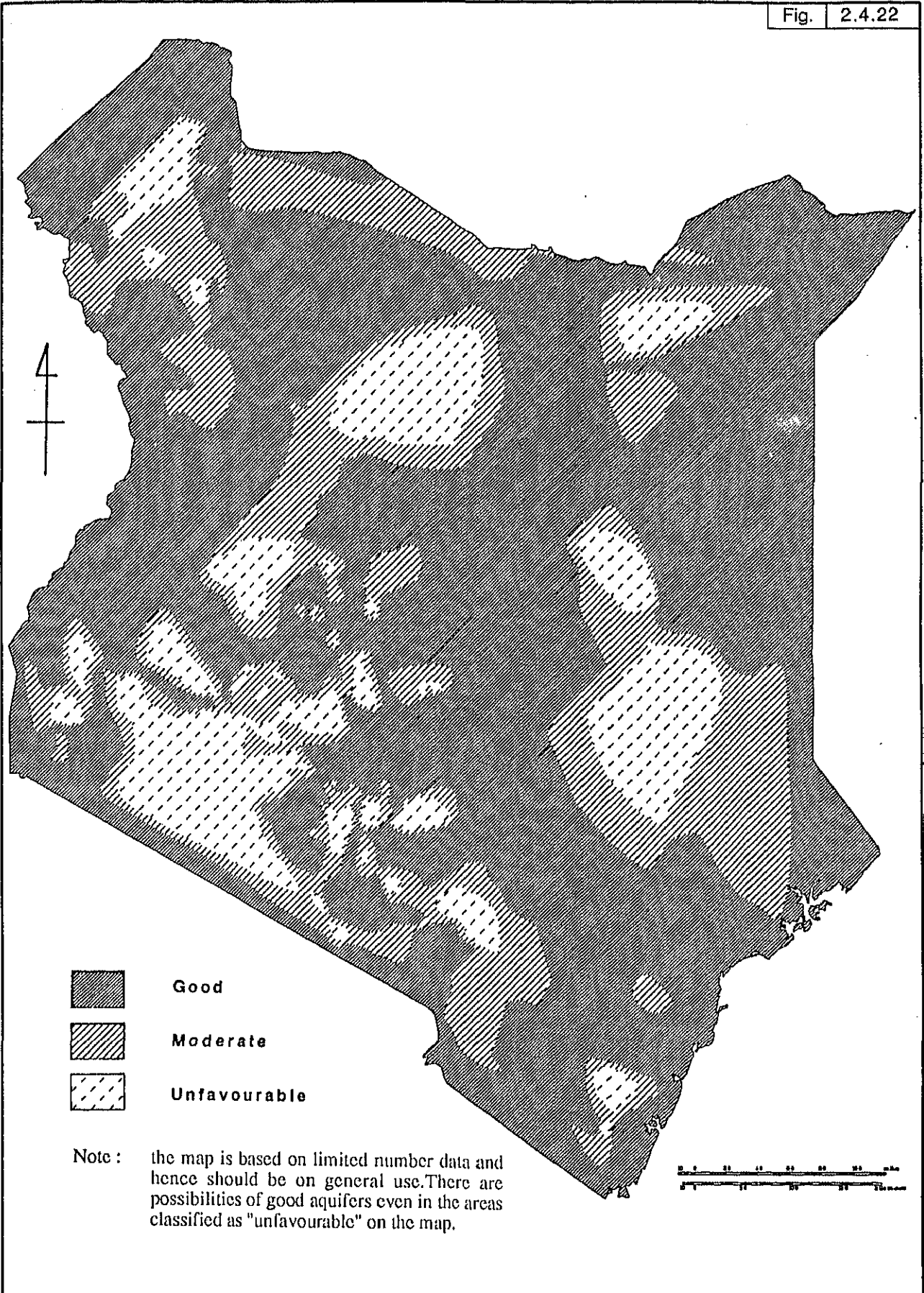


Figure 2.4.22 Groundwater-Drinking Water Risk (Fluoride)

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