Table I-2-11 (1) Crop Water Requirement of The Ariari Project Area

Crop Water Requirement of The Ariari Project Area (m3/s) CASE-I-1

ZONE (ha)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
UPPER ZONE	(4730)	8.354	6.885	6.743	7.310	7.228	7.126	7.333	6.404	6.399	7.456	7.523	7.304
	1/2	5.930	2.917	2.864	3.509	3.418	3.185	3.337	2.510	2.564	3.629	3.523	3.481
	1/5	6.342	3.270	2.939	3.508	3.418	3.185	3.378	2.551	2.606	3.629	3.587	3.901
	1/10	6.507	3.523	3.063	3.551	3.418	3.185	3.378	2.551	2.606	3.629	3.587	4.153
	1/20	6.674	3.778	3.165	3.551	3.459	3.227	3.378	2.572	2.627	3.670	3.651	4.363
MIDDLE ZONE	(9870)	20.560	16.955	16.702	18.838	18.665	18.342	18.389	15.893	16.354	18.973	20.167	16.415
	1/2	18.677	7.903	8.000	11.500	10.880	9.874	10.208	7.789	8.084	11.789	11.883	10.778
	1/5	18.935	7.979	8.509	11.500	10.880	9.874	10.208	7.789	8.279	11.789	12.013	11.503
	1/10	19.116	8.132	8.727	11.630	11.005	9.874	10.208	7.789	8.279	11.789	12.272	11.806
	1/20	19.197	8.132	8.956	11.630	11.068	10.103	10.208	7.915	8.279	11.914	12.486	12.147
LOWER ZONE	(9115)	20.996	16.587	15.953	18.231	18.028	17.356	17.564	14.971	15.388	19.079	19.395	16.448
	1/2	17.520	8.436	8.102	10.833	10.556	8.648	8.987	7.572	7.879	11.614	11.688	10.003
	1/5	17.882	8.744	8.525	10.995	10.556	8.835	8.987	7.652	8.004	11.674	11.688	10.510
	1/10	18.100	8.981	8.738	11.120	10.815	8.835	8.987	7.752	8.004	11.674	11.750	10.800
	1/20	18.244	9.218	8.951	11.244	10.675	8.835	8.987	7.752	8.004	11.735	11.812	11.017
Ground Total	(23815)	49.916	40.337	39.398	45.379	44.121	42.825	43.305	37.270	38.352	46.503	47.085	40.168
	1/2	42.084	19.255	20.966	25.842	24.854	22.807	23.532	17.871	18.527	27.032	27.094	24.262
	1/5	43.180	19.993	21.973	26.004	24.854	22.893	23.573	18.032	18.888	27.092	27.287	25.914
	1/10	43.723	20.636	22.528	26.301	25.039	22.893	23.573	18.093	18.888	27.092	27.609	26.658
	1/20	44.115	21.129	23.072	26.425	25.203	23.165	23.573	18.239	18.910	27.319	27.929	27.527

Table I-2-11 (2) Crop Water Requirement of The Ariari Project Area

Crop Water Requirement of The Ariari Project Area (m3/s) CASE-1-2

ZONE (ha)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
UPPER ZONE	(4730)	7.081	5.611	6.822	7.310	7.228	7.126	7.353	6.404	5.048	5.126	6.448	6.722
	1/2	4.541	2.031	2.984	3.509	3.418	3.183	3.227	2.510	1.756	2.486	3.414	3.660
	1/5	4.936	2.320	2.979	3.509	3.418	3.185	3.378	2.551	1.705	2.486	3.457	3.107
	1/10	5.122	2.501	3.060	3.551	3.418	3.185	3.378	2.551	1.785	2.486	3.457	3.370
	1/20	5.294	2.776	3.165	3.551	3.458	3.227	3.378	2.572	1.800	2.514	3.501	3.598
MIDDLE ZONE	(9970)	18.001	14.216	16.760	19.838	18.860	18.042	18.389	15.985	13.740	17.424	16.186	15.279
	1/2	15.996	6.342	9.000	11.500	10.880	9.874	10.208	7.789	6.487	9.458	9.533	9.285
	1/5	16.338	6.404	8.908	11.500	10.880	9.874	10.208	7.788	6.642	9.458	9.678	10.056
	1/10	16.710	6.550	8.727	11.650	11.005	9.874	10.208	7.788	6.642	9.458	9.847	10.484
	1/20	16.996	6.550	8.956	11.650	11.068	10.103	10.208	7.845	6.642	9.560	10.060	10.741
LOWER ZONE	(9140)	18.705	14.261	16.033	18.231	18.028	17.356	17.964	14.971	13.310	16.844	17.686	15.491
	1/2	15.048	6.964	9.102	10.875	10.556	9.848	9.987	7.572	6.471	9.033	9.098	8.851
	1/5	15.471	7.030	9.035	10.893	10.556	9.835	9.987	7.632	6.574	9.038	9.038	9.189
	1/10	15.861	7.441	8.730	11.120	10.616	9.835	9.987	7.702	6.574	9.038	9.601	9.486
	1/20	16.210	7.648	8.951	11.244	10.676	9.835	9.987	7.702	6.574	9.638	9.702	9.725
Ground Total	(23840)	43.868	34.088	39.622	45.379	44.121	42.823	43.305	37.370	32.100	40.395	42.278	37.492
	1/2	35.585	15.337	20.966	25.942	24.854	22.907	23.532	17.871	14.714	21.484	21.948	20.585
	1/5	36.725	15.360	21.973	26.004	24.854	22.895	23.573	18.032	15.002	21.534	21.806	22.351
	1/10	37.293	16.521	22.328	26.301	25.079	22.995	23.573	18.082	15.002	21.534	21.905	23.554
	1/20	37.795	16.954	23.072	26.425	25.203	23.165	23.573	18.259	15.016	21.712	22.206	24.063

Table I-2-11 (3) Crop Water Requirement of The Ariari Project Area

Crop Water Requirement of The Ariari Project Area (m3/s) CASE-II-1

ZONE (ha)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
UPPER ZONE	(9010)	7.423	5.345	5.713	6.114	6.316	6.365	6.562	5.520	5.329	6.364	6.711	7.066
	1/2	4.737	2.050	1.867	2.404	2.342	2.182	2.286	1.720	1.756	2.486	2.414	2.725
	1/3	3.152	2.379	2.029	2.404	2.342	2.182	2.314	1.748	1.782	2.486	2.457	3.202
	1/10	2.330	2.822	2.102	2.403	2.342	2.182	2.314	1.748	1.785	2.486	2.457	3.486
	1/20	2.515	2.868	2.217	2.403	2.370	2.211	2.314	1.762	1.800	2.514	2.501	3.727
MIDDLE ZONE	(9940)	16.122	14.341	14.127	17.035	16.672	16.462	16.397	13.730	13.819	17.460	16.181	15.303
	1/2	16.075	6.342	7.244	9.228	8.730	8.003	8.191	6.250	6.487	9.459	9.535	9.331
	1/3	16.416	6.403	7.682	9.228	8.730	8.003	8.191	6.250	6.643	9.459	9.639	10.088
	1/10	16.587	6.534	7.870	9.332	8.831	8.003	8.191	6.250	6.643	9.459	9.860	10.523
	1/20	16.672	6.534	8.065	9.332	8.881	8.107	8.191	6.251	6.643	9.560	10.027	10.781
LOWER ZONE	(9860)	10.515	14.179	13.588	15.681	15.905	15.484	15.613	12.963	13.293	16.686	17.403	15.183
	1/2	14.957	6.971	7.479	8.978	8.670	7.824	8.203	6.219	6.471	9.539	9.099	8.585
	1/3	15.328	7.207	7.841	9.030	8.670	8.078	8.203	6.318	6.574	9.588	9.599	9.104
	1/10	15.550	7.443	8.020	9.133	8.719	8.078	8.203	6.367	6.574	9.588	9.651	9.401
	1/20	15.698	7.648	8.205	9.205	8.769	8.078	8.203	6.367	6.574	9.638	9.702	9.623
Ground Total	(28810)	44.061	34.465	33.428	38.830	38.893	38.311	38.572	32.214	32.441	40.541	42.295	37.552
	1/2	35.769	15.363	16.691	20.611	19.741	18.109	18.680	14.188	14.714	21.484	21.048	20.641
	1/3	36.896	16.021	17.552	20.662	19.741	18.262	18.708	14.315	15.002	21.534	21.696	22.405
	1/10	37.467	16.598	18.024	20.868	19.892	18.262	18.708	14.365	15.002	21.534	21.968	23.414
	1/20	37.885	17.050	18.485	21.000	20.020	18.385	18.708	14.480	15.016	21.712	22.228	24.131

Table I-2-11 (4) Crop Water Requirement of The Ariari Project Area

Crop Water Requirement of The Ariari Project Area (m3/s) CASE-11-2

ZONE (ha)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
UPPER ZONE	(5010)	5.452	3.985	5.710	6.114	6.316	6.065	6.582	5.520	3.311	4.406	5.110	6.197
	1/2	2.612	.770	1.367	2.404	2.242	2.182	2.286	1.720	.557	.769	.766	1.481
	1/5	5.033	.987	2.005	2.404	2.242	2.182	2.314	1.748	.566	.769	.779	2.008
	1/10	3.201	1.146	2.132	2.402	2.242	2.182	2.314	1.748	.566	.769	.779	2.318
	1/20	3.380	1.223	2.217	2.403	2.270	2.211	2.314	1.762	.571	.796	.785	2.576
MIDDLE ZONE	(9540)	14.279	10.250	14.072	16.980	16.627	16.421	16.055	15.663	9.984	13.737	15.261	13.575
	1/2	12.051	4.086	7.222	8.228	8.730	8.003	8.191	6.250	4.178	6.093	6.142	7.087
	1/5	12.421	4.129	7.632	8.228	8.730	8.003	8.191	6.250	4.278	6.093	6.209	7.921
	1/10	12.607	4.218	7.810	8.352	8.831	8.003	8.191	6.250	4.278	6.093	6.343	8.385
	1/20	12.698	4.216	8.008	8.352	8.881	8.107	8.191	6.351	4.278	6.158	6.443	8.663
LOWER ZONE	(8660)	16.146	11.670	15.988	15.881	15.905	15.484	15.610	12.963	11.000	14.467	15.682	14.212
	1/2	12.377	5.487	7.472	8.873	8.670	7.924	8.203	6.218	5.058	7.456	7.504	7.218
	1/5	12.770	5.705	7.841	9.000	8.670	8.078	8.203	6.318	5.138	7.485	7.504	7.768
	1/10	13.006	5.875	8.025	9.133	8.719	8.078	8.203	6.367	5.138	7.485	7.544	8.083
	1/20	13.163	6.045	8.205	9.233	8.769	8.078	8.203	6.367	5.138	7.534	7.584	8.318
Ground Total	(23810)	35.881	26.780	35.770	38.776	38.848	38.270	38.529	32.167	24.296	32.610	36.055	33.980
	1/2	27.040	10.209	16.688	20.811	19.741	18.109	18.680	14.188	9.794	14.338	14.411	15.797
	1/5	30.224	10.821	17.501	20.882	19.741	18.262	18.708	14.316	9.984	14.377	14.492	17.698
	1/10	28.812	11.238	17.969	20.888	19.892	18.262	18.708	14.365	9.984	14.377	14.666	18.785
	1/20	29.239	11.380	18.430	21.000	20.020	18.395	18.708	14.480	9.988	14.489	14.820	19.558

Table I-2-12 Total Expectation of Water Insufficiency (%)

Zone	Crop	Without System	With System for 1/2	With System for 1/5	With System for 1/10
UPPER ZONE	Paddy Rice	55.82	.27	.09	.02
	Paddy Rice	62.63	1.05	.20	.05
	Maize (1)	0.00	0.00	0.00	0.00
	Soy beans (2)	10.72	2.76	.52	.10
	Sorghum	4.27	1.74	.39	.09
	Cotton	0.00	0.00	0.00	0.00
	Cotton	17.38	2.58	.61	.12
	Plantain	8.66	1.38	.28	.05
	Cacao	5.00	1.15	.30	.06
	Papaya	8.13	1.50	.35	.06
	Oil Parm	5.00	1.15	.30	.06
	Pastuer	4.17	1.05	.24	.06
MIDDLE ZONE	Paddy Rice	56.73	.29	.09	.02
	Paddy Rice	65.36	.61	.14	.02
	Maize (1)	0.00	0.00	0.00	0.00
	Soy beans (2)	22.03	1.73	.32	.04
	Sorghum	14.61	2.06	.39	.05
	Cotton	0.00	0.00	0.00	0.00
	Cotton	24.98	1.27	.24	.03
	Plantain	12.36	.73	.19	.02
	Cacao	8.22	.66	.15	.03
	Papaya	11.36	.94	.22	.03
	Oil Parm	8.22	.66	.15	.03
	Pastuer	8.66	.69	.13	.02
LOWER ZONE	Paddy Rice	57.49	.39	.08	.01
	Paddy Rice	64.03	.57	.12	.02
	Maize (1)	0.00	0.00	0.00	0.00
	Soy beans (2)	16.39	1.48	.30	.05
	Sorghum	7.38	1.77	.36	.05
	Cotton	0.00	0.00	0.00	0.00
	Cotton	22.22	1.46	.32	.05
	Plantain	13.13	.95	.20	.04
	Cacao	7.89	.92	.23	.04
	Papaya	12.25	.92	.21	.04
	Oil Parm	7.89	.92	.23	.04
	Pastuer	6.85	.67	.18	.04

Table I-2-13 EXPECTED PRODUCTION VALUE WITH IRRGATION SYSTEM

ITEM / CROP	WITHOUT AREA (ha)	WITHOUT BNEFIT (1000Col$)	WITH 1/2 AREA (ha)	WITH 1/2 BNEFIT (1000Col$)	WITH 1/5 AREA (ha)	WITH 1/5 BNEFIT (1000Col$)	WITH 1/10 AREA (ha)	WITH 1/10 BNEFIT (1000Col$)
PADDY	13539	5857253	33800	14816003	34023	14970033	34053	14983908
	20521	6730819	160	52478	37	12201	7	2156
	34060	12688072	34060	14968481	34060	14982234	34060	14985664
MAIZE	1297	168870	1323	171969	1325	172198	1325	172243
	28	2864	2	225	0	42	0	5
	1325	171534	1325	172194	1325	172240	1325	172248
SOY BEEN	2271	511038	2697	606870	2740	616493	2748	618388
	479	95743	53	10560	10	2006	2	321
	2750	606782	2750	617430	2750	618499	2750	618710
SORGHUM	1176	222309	1276	241084	1286	244891	1300	245605
	124	20272	24	3992	4	614	1	82
	1300	242581	1300	245086	1300	245605	1300	245687
OTHERS	574	180666	698	220012	707	222844	710	223511
	136	28656	12	2425	3	537	0	93
	710	209322	710	222437	710	223381	710	223604
PLANTAIN(E)	2045	1022276	2285	1142612	2305	1152335	2309	1154549
	265	78634	25	7433	5	1599	1	271
	2310	1101910	2310	1150045	2310	1153934	2310	1154820
CACAO	804	220792	862	238859	868	238455	870	238872
	66	13274	8	1542	2	377	0	73
	870	234066	870	238402	870	238832	870	238945
PAPAYA	377	331467	404	355388	409	359537	410	360584
	33	28666	6	4920	1	1148	0	197
	410	358133	410	360308	410	360685	410	360780
OILPALM	290	252790	318	276570	320	278046	320	278380
	30	12162	2	897	0	198	0	40
	320	264951	320	277467	320	278244	320	278420
MARACUYA	19	12723	20	13459	20	13564	20	13583
	1	103	0	17	0	4	0	1
	20	12827	20	13476	20	13568	20	13584
TOTAL	22392	8879985	43783	18160837	44012	18268498	44064	18288235
	21683	7010193	292	84488	63	18726	11	3237
	44075	15890179	44075	18265325	44075	18287224	44075	18292472

Table I-2-14 TOTAL EXPECTED PRODUCTION VALUE

ITEM / CROP	WITHOUT AREA (ha)	WITHOUT BNEFIT (1000Col$)	WITH 1/2 AREA (ha)	WITH 1/2 BNEFIT (1000Col$)	WITH 1/5 AREA (ha)	WITH 1/5 BNEFIT (1000Col$)	WITH 1/10 AREA (ha)	WITH 1/10 BNEFIT (1000Col$)
SUB-TOTAL	44075	15890179	44075	18265325	44075	18267224	44075	18232472
CATTLE	10200	556308	10200	556308	10200	556308	10200	556308
MAIZE	375	39000	375	39000	375	39000	375	39000
PLANTAIN(E	60	18000	60	18000	60	18000	60	18000
PAPAYA	430	344000	430	344000	430	344000	430	344000
MARACUYA	10	800	10	800	10	800	10	800
	55150	16848287	55150	19223433	55150	19245332	55150	19250580

Table I-2-15 (1) Comparison of Topography and Geology for the Proposed Diversion Site (Sheet 1)

Site	Location	Topography	Rivers	Geology			Remarks
				Petrology	Bearing Capacity	Permeability	
A	Right Downstream from Angostura Bridge	- V shaped Valley - Gorge with both steep banks - Elevation: 780m A.S.L. - Slope: Left Bank 1: 0.87 Right Bank 1: 3.96	Width: approx. 40m River Bed Slope: approx. 1/50 Stability: stable Velocity: large Catchment Area: 775km^2	Left Bank: Unconsolidated Sediments (gravel, sand, silt, clay) with 3.8m in thickness and Metamorphic Rocks Right Bank: Heterogeneous colluvial sediment of more than 30m in thickness	Unconsolidated Sediment: firm Metamorphic Rocks: solid	Unconsolidated Sediment: high Metamorphic Rocks: low	- Unconsolidated sediment is instable so as to cause land slide. - Large gravel is carried away in time of high water level. - Surrounding area is forest and pasture. - There are collapsible steep slopes and small river terraces in the right bank of downstream. - The site recommended by HIMAT.
B	1.5km Downstream from Angostura Bridge	- Eroded Valley - Both Banks: River terrace with 2 - 20m height from river bed. - Elevation: 750m A.S.L. - Slope: Left Bank 1: 22.44 - 1: 3.56 Right Bank 1: 11.31 - 1: 4.3	Width: approx. 150m River Bed Slope: approx. 1/55 Stability: instable Velocity: large Thalweg: Left Bank Joining Tributary: Right Bank Catchment Area: 780km^2	Left Bank: Fluvial Sediment (gravel, sand, and silt) Right Bank: Fluvial Sediment with 4.3m thickness and Sedimentary Rocks (sandstone, mudstone)	Fluvial Sediment: firm Sedimentary Rocks: solid to relatively soft	Fluvial Sediment: high Sedimentary Rocks: low	- Approx. 600m downstream from the end of gorge. - At high water time, it occurrs that change of sediment distribution and a lateral movement of river course. - At right bank, river terrace is well developed. - Surrounding area is covered with pasture.

Table I-2-15 (2) Comparison of Topography and Geology for the Proposed Diversion Site (Sheet 2)

Site	Location	Topography	Rivers	Geology			Remarks
				Petrology	Bearing Capacity	Permeability	
C	4km Downstream from Lejanias	- Eroded and Sedimented Valley - Left Bank: Foot Clift and River Terrace - Right Bank: River Terraces (1, 2 and 5m height from river bed) - Elevation: 594m A.S.L. - Slope: Left Bank 1: 0.72 Right Bank 1: 14.72	Width: approx. 230m River Bed Slope: approx.1/80 Stability: instable Velocity: moderate Thalweg: Left Bank Catchment Area: 815km^2	Left Bank: Fluvial Sediment with 1m in thickness and Sedimentary Rocks (mudstone, slate and sandstone) Right Bank: Fluvial Sediment	Fluvial Sediment: firm Sedimentary Rocks: solid to relatively soft	Fluvial Sediment: high Sedimentary Rocks: low	- Relatively narrow to downstream and upstream. - At high water stage, it occurrs that change of sediment distribution and a lateral movement of river course. - At right bank, river terrace is well developed. - Left bank is unused land, and Right bank is used for papaya plantation.

Table I-2-16 (1) Comparison of Diversion Facilities (Sheet 1)

Item	Site A	Site B	Site C
River Condition			
- Longitudinal Slope	1/50	1/55	1/80
- Design Flood Discharge(m^3/s)	440	440	460
- High Water Depth(m)	2.3	1.0	0.9
- Flood Water Velocity(m/s)	4.6	2.6	2.1
- Design Droughty Discharge(m^3/s)	17	17	17
Head Works			
- Fixed Weir (Concrete Gravity)			
Weir Length (L m)	25	155	255
Width of Top (B m)	2.5	2.0	2.0
Weir Hight/Check Water Depth (H/Ha)	2.0/1.5	2.0/1.5	2.0/1.5
Slope of Down Side (1:m)	1 : 1.5	1 : 1.0	1 : 1.0
Apron Length(law m)	10.5	9.5	9.5
Maximum Apron Thickness (ta m)	1.0	1.0	1.0
Riprap Length(lrs m)	35	15	15
- Scouring Sluice			
Width (Bs m)	5.0×2 Gate	5.0×2 Gate	5.0×2 Gate
Apron Length (las m)	25	20	20
Riprap Length(lrs m)	40	20	20
- Intake Works			
Width of Works(Bi m) (for 36.8 m^3/s)	5.0×5 Gate	5.0×5 Gate	5.0×5 Gate

Table I-2-16 (2) Comparison of Diversion Facilities (Sheet 2)

Item	Site A	Site B	Site C
Head Race			
- Tunnel	r=2.0 Standard Horseshoe Shape	Unnecessary	Unnecessary
Tunnel Length	1.5 km	---	---
Chute(H=30m,L=60m)	1 unit	---	---
- Open Canal (Wet Masonry lining, Bottom Width 5.0m, Canal Depth 3.0m, Longitudinal Slope 1/700)			
Canal Length	9.0 km	9.0 km	2.0 km
Drops (H=2.0m)	65 unit	65 unit	5 unit
Syphon (D=4.0m,L=20m)	1 unit	---	---
Cross Culvert	3.0(H)X3.0(B)X2 L=10.0m 1 unit	3.0(H)X3.0(B)X2 L=10.0m 1 unit	---
Pump Irrigation Facilities			
- Irrigated Area	A_1 =260ha, A_2 =170ha, Total 430ha		
- Pump			
Q=0.18m³/s,H=30m, P=90kw	---	---	2 unit
Q=0.14m³/s,H=10m, P=18kw	---	---	1 unit
- Chloride vinyl pipe			
D=500mm	---	---	1.7 km
D=350mm	---	---	0.9 km
- Farm Pond			
3,300 m³	---	---	1 unit
2,200 m³	---	---	1 unit
- Required Energy	---	---	460,000kwh/year

Table I-2-17 (1) Comparison of Cost and Consideration (sheet 1)

(Unit : Million Col$)

Item	Site A	Site B	Site C
Construction Cost - Head Works - Head Race Works (Tunnel) (Open Canal) (Others) - Pumping Facilities	 912 3,533 (1,200) (750) (1,583) ---	 1,577 2,311 (---) (750) (1,561) ---	 1,735 285 (---) (167) (119) 110
Total	4,445	3,889	2,130
Yearly Repayment Maintenance Cost Operation cost of Pump	535 111 ---	468 97 ---	259 53 7
Total Yearly Cost	646	565	319
Consideration - Stability of Water Intake	-The water route is stable due to narrow width.	-It is necessary to change and maintain the river route to right side for water intake.	-The same condition as the Site B can be seen.
-Solid Material	-Maintenance of facilities (sluiceway,diversion works) will be significance by reason of flowing of boulders in flood time.	-Almost same condition as the Site A can be seen.	-Flow velocity of solid materials is reduced because of wide river course.

Table I-2-17 (2) Comparison of Cost and Consideration (sheet 2)

Item	Site A	Site B	Site C
Consideration -The condition of Construction	-The scale of diversion weir is the smallest	-The scale of diversion weir is middle.	-The scale of diversion weir is the largest.
	-Head race of tunnel is required.	-Most of construction is cutting workes and no geological problem can be expected.	-Most of construction is cutting workes and no geological problem can be expected.
	-There is a collapse land near the site and geological unstable place can be seen.	-The site is located newer the main road and the problem of the access road is small.	-Comparing with other site, the land is flat topogrphicaly and the problem of the access road is the smallest.
	-Land slope is steep and problem of access to site is expected.		
-Maintenance	-The distance of head race is the longest and maintenance of the canal facilities such as tunnel, drop works is increased.	-The same condition as the Site A except tunnel can be expected	-The operation and maintenance of pumping system is required

Table I-2-17 (3) Comparison of Cost and Consideration (sheet 3)

Item	Site A	Site B	Site C
Consideration -Adjustment to the dam plan for hydro-electric power plant at the upper stream of the site	-Dam for hydro-electric power plant is planed at the upper stream of the site and it is necessary to adjust to wast-eway of the dam and diversion weir.	-No problem can be expected.	-No problem can be expected.

Note : 1) This table is to compare with each Site and common items are excluded.

2) Construction cost is estimated based on the unit price in Colombia, December, 1988 and following exchange rate is used.
Col$ 332.56=US$ 1

3) Maintenance Cost of head race and pumping facilities is excluded in this comparison.

4) Yearly repayment is calculated from equation below:

$$C = I \times \left(i + \frac{i}{(1+i)^n - 1} \right)$$

Where C : Yearly Repayment
i : Interest 12%
n : Durable year 50 years for civil works
20 years for pumping facilities

Table I-2-18 Comparison of Division Structures No.1

Item	System With Diversion Weir (Type A)	System Without Diversion Weir (Type B)
Stability of Water Intake	-Even in the dry season, a stable water intake is possible with diversion weir.	-It is expected that a stable water intake is difficult because of the reasons mentioned below: 1. River width is as large as 200 meters. 2. River discharge is so little as nearly equal to the maximum water intake in the dry season. 3. High amount of water will be infiltrated since the river bed consists of conglomerate and sand.
Maintenance	-Bottom of intake works canal can be designed as 1.0 m higher than the existing river bed. Therefore, the sedimentation which flows into the head race will be reduced.	-Large sedimentation flow will be expected since the bottom of intake works will be designed at the same level as the river bed. And the frequency of the sedimentation removal will be increased. -More than two times per year of maintenance will be necessary for the control of water route.

Table I-2-18 Comparison of Division Structures No.2

(Col$ 1,000)

Item	System With Diversion Weir (Type A)	System Without Diversion Weir (Type B)
Construction Cost		
1. Earth Works	76,400	52,000
2. Concrete Works	687,442	348,442
3. Riprap	31,382	2,988
4. Gabion	8,126	8,126
5. Gate	851,513	632,931
6. Temporary works	79,700	35,000
Sub-total	1,734,563	1,079,133
Maintenance Cost for a year		
a) Sedimentation Removal	7,000	10,500
b) Control of Water Route	1,620	16,308
Sub-total	8,620	26,808
Maintenance cost for 50 years	431,000	1,340,400
Grand Total of System Cost	2,165,563	2,419,533

Table I-2-19 Comparison of Irrigation Canal System

Item	Plan I Quantity	Plan I Construction Cost (1,000 Col$)	Plan II Quantity	Plan II Construction Cost (1,000 Col$)
Earth Works				
Excavation	435,000 m³	235	319,000 m³	172
Embankment	319,000 m³	131	203,000 m³	83
Removal of Surplus Soil	83,000 m³	104	93,000 m³	116
Sub-Total		470		371
Concrete Lining	174,000 m³	418	162,000 m³	388
Related Structure				
Drop	324 units	1,220	106 units	908
Siphon	19 units	52	118 units	222
Bridge	68 units	111	28 units	96
Sub-Total		1,383		1,226
Grand Total		2,271		1,985

Note : Construction cost is estimated considering the upper part of the irrigation system

Table I-2-20 Comparison of Construction Cost between Canal System

Item	Drop Type (Col$ 1,000)	Chute Type (Col$ 1,000)
1. Canal Works		
Earth Works	1,532,919	1,096,107
Lining	1,467,155	6,388,980
Sub-Total	3,000,074	7,485,085
2. Related Structure		
Drop	2,950,212	---
Siphon	103,116	103,116
Bridge	120,747	104,614
Division Works	216,539	216,539
Waste Way	904,184	904,184
Fence	58,272	58,272
Sub-Total	4,353,070	1,386,725
3. Land Acquisition	77,206	38,713
Grand Total	7,430,350	8,916,525

Note : Construction cost is estimated considering the upper part of the irrigation system.

Table I-2-21 Main Canal NO.1

NO	L (Km)	Q (m^3/s)	B (m)	I	h (m)	V (m/s)	H_1 (m)	H_2 (m)	TYPE
1	2.3	36.725	2.5	1/4050	3.30	1.50	3.70	3.40	C-a
2	3.8	36.725	2.5	1/4050	3.30	1.50	3.70	3.40	C-c
3	9.0	17.705	1.5	1/2500	2.36	1.49	2.70	2.45	C-a
4	8.0	16.904	1.5	1/2400	2.29	1.50	2.70	2.40	C-a
5	5.6	15.463	1.5	1/2250	2.16	1.50	2.50	2.25	C-a
6	4.8	14.745	1.5	1/2200	2.11	1.50	2.50	2.20	C-a
7	4.5	8.647	1.0	1/1550	1.65	1.49	2.00	1.75	C-a
8	4.1	6.113	1.0	1/1250	1.36	1.49	1.70	1.45	C-a
9	2.2	5.340	1.0	1/1500	1.25	1.48	1.60	1.35	C-a
10	4.3	4.785	1.0	1/4300	2.00	0.60	2.30	—	So-a
11	4.7	4.066	1.0	1/3850	1.82	0.60	2.10	—	So-a
12	3.8	2.209	1.0	1/2600	1.27	0.60	1.50	—	So-a

Note
L : Canal Length
Q : Design Discharge
B : Canal Bottom Width
I : Longitudinal Slope
h : Water Depth
V : Velocity
H_1: Canal Hight
H_2: Lining Hight

Table I-2-21 Main Canal NO.2

NO	L (Km)	Q (m^3/s)	B (m)	I	h (m)	V (m/s)	H_1 (m)	H_2 (m)	TYPE
1	4.7	17.008	1.5	1/2450	2.30	1.49	2.70	2.40	C-c
2	4.8	15.077	1.5	1/2250	2.14	1.49	2.50	2.25	C-c
3	5.4	12.597	1.5	1/2000	1.93	1.49	2.30	2.05	C-c
4	4.2	9.639	1.0	1/1650	1.76	1.50	2.10	1.85	C-b
5	2.3	3.676	1.0	1/3750	1.77	0.60	2.00	—	C-b
6	3.6	1.790	1.0	1/2300	1.13	0.59	1.30	—	C-b

Table I-2-21 Main Canal NO.3

NO	L (Km)	Q (m^3/s)	B (m)	I	h (m)	V (m/s)	H_1 (m)	H_2 (m)	TYPE
1	4.1	3.001	1.0	1/3150	1.52	0.60	1.80	—	So-a
2	3.8	2.158	1.0	1/2550	1.25	0.60	1.50	—	So-a
3	3.4	1.233	1.0	1/1750	0.89	0.60	1.10	—	So-a
4	1.5	0.461	0.5	1/ 950	0.62	0.59	0.80	—	So-b

Table I-2-22 Secandary Canal NO.1

NO	L (Km)	Q (m^3/s)	B (m)	I	h (m)	V (m/s)	H_1 (m)	H_2 (m)	TYPE
1	1.2	0.102	0.5	1/ 700	0.28	0.46	0.50	—	So-b
2	1.2	0.132	0.5	1/ 900	0.35	0.45	0.50	—	So-b
3	1.4	0.266	0.5	1/1200	0.47	0.46	0.60	—	So-b
4	3.2	0.450	0.5	1/1000	0.66	0.59	0.80	—	So-b
5	1.5	5.001	1.0	1/1100	1.20	1.48	1.50	1.30	C-b
	4.6	3.388	1.0	1/3400	1.64	0.60	1.90	—	So-a
	4.0	2.697	1.0	1/2950	1.43	0.60	1.70	—	So-a
	3.9	1.789	1.0	1/2250	1.12	0.60	1.30	—	So-a
	5.3	1.328	1.0	1/1800	0.92	0.60	1.10	—	So-a
	2.2	0.136	0.5	1/1000	0.43	0.44	0.60	—	So-b
6	2.2	1.098	1.0	1/1600	0.82	0.60	1.00	—	So-a
	4.1	0.732	1.0	1/1350	0.72	0.60	0.90	—	So-b
7	3.8	1.694	1.0	1/2150	1.08	0.60	1.30	—	So-a
	3.5	1.030	1.0	1/1550	0.79	0.60	1.00	—	So-a
	4.3	0.569	1.0	1/1150	0.60	0.59	0.80	—	So-b
8	1.8	0.813	1.0	1/2000	0.84	0.53	1.00	—	So-b
	3.0	0.421	0.5	1/2000	0.75	0.45	0.90	—	So-b
9	1.5	1.320	1.0	1/1800	0.97	0.60	1.20	—	So-a
	4.3	0.989	1.0	1/1800	0.90	0.58	1.10	—	So-b
	1.8	0.190	0.5	1/1500	0.47	0.41	0.70	—	So-b
10	2.5	0.461	0.5	1/2000	0.78	0.46	1.00	—	So-b

Table I-2-22 Secandary Canal NO.2

NO	L (Km)	Q (m^3/s)	B (m)	I	h (m)	V (m/s)	H_1 (m)	H_2 (m)	TYPE
1	1.8	0.296	0.5	1/1500	0.59	0.46	0.80	—	So-b
2	1.8	0.401	0.5	1/1900	0.72	0.45	0.90	—	So-b
3	3.0	0.296	0.5	1/1600	0.60	0.45	0.80	—	So-b
4	2.0	0.417	0.5	1/2000	0.75	0.45	0.90	—	So-b
5	2.2	0.449	0.5	1/2100	0.78	0.45	1.00	—	So-b
6	2.7	0.417	0.5	1/2000	0.75	0.45	0.90	—	So-b
7	2.0	0.372	0.5	1/1800	0.69	0.45	0.90	—	So-b
8	2.6	0.369	0.5	1/1800	0.69	0.45	0.90	—	So-b
9	1.8	0.266	0.5	1/1500	0.56	0.45	0.70	—	So-b
10	2.1	0.704	1.0	1/2800	0.85	0.45	1.00	—	So-b
	0.8	0.226	0.5	1/1300	0.50	0.45	0.70	—	So-b
11	1.1	0.731	1.0	1/2800	0.86	0.46	1.10	—	So-b
	2.3	0.465	0.5	1/2100	0.79	0.45	1.00	—	So-b
12	0.5	0.585	1.0	1/2400	0.74	0.46	0.90	—	So-b
	0.9	0.452	0.5	1/1600	0.74	0.50	0.90	—	So-b
13	1.8	0.558	1.0	1/2300	0.71	0.46	0.90	—	So-b
	1.6	0.425	0.5	1/1500	0.70	0.50	0.90	—	So-b
14	2.4	0.425	0.5	1/1900	0.74	0.46	0.90	—	So-b
15	2.0	1.010	1.0	1/2000	0.83	0.54	1.00	—	So-a
	1.4	0.452	0.5	1/2000	0.77	0.46	1.00	—	So-b
16	3.1	1.727	1.0	1/2200	1.10	0.60	1.30	—	So-a
	0.8	0.731	1.0	1/2200	0.81	0.50	1.00	—	So-b
	2.9	0.399	0.5	1/1900	0.72	0.45	0.90	—	So-b
17	2.9	0.384	0.5	1/1800	0.70	0.46	0.90	—	So-b
18	2.8	0.390	0.5	1/1800	0.70	0.46	0.90	—	So-b
19	2.5	0.348	0.5	1/1700	0.66	0.46	0.90	—	So-b

Table I-3-1 Peak Runoff Discharge(m3/sec)

		Return Period											
		1/2			1/5			1/10			1/20		
	A (km^2)	t(hour)	RI(mm/hr)	PQ(m3/s)	t(hour)	RI(mm/hr)	PQ(m3/s)	t(hour)	RI(mm/hr)	PQ(m3/s)	t(hour)	RI(mm/hr)	PQ(m3/s)
Avichule-1 *	4.40	1.93	3.38	14.86	1.66	5.14	22.62	1.54	6.41	28.20	1.45	7.68	33.77
Avichule-2 *	8.50	2.33	2.98	25.31	2.01	4.53	38.53	1.86	5.65	48.04	1.75	6.77	57.52
Cano Seco-1	15.60	2.76	2.69	41.96	2.38	4.07	63.56	2.21	5.06	78.98	2.07	6.05	94.42
Cano Seco-2	6.90	2.19	3.10	21.38	1.89	4.72	32.55	1.75	5.88	40.58	1.64	7.04	48.59
Cano Guanayas-1	10.43	2.47	2.86	29.87	2.13	4.36	45.47	1.97	5.43	56.68	1.85	6.51	67.87
Cano Guanayas-2	20.40	2.98	2.56	52.12	2.57	3.87	78.95	2.39	4.81	98.11	2.24	5.75	117.29
Cano Guanayas-3	13.57	2.42	3.57	48.40	2.16	4.97	67.48	2.03	5.92	80.31	1.93	6.83	92.64
Cano Guanayas-4	23.93	2.85	3.20	76.57	2.54	4.46	106.76	2.39	5.31	127.05	2.27	6.12	146.57
Cano Upin-1	22.27	3.05	2.51	55.95	2.64	3.81	84.76	2.45	4.73	105.32	2.30	5.65	125.91
Cano Upin-2	50.00	3.87	2.12	106.09	3.34	3.23	161.49	3.09	4.03	201.33	2.90	4.82	241.06
Cano Urichare-1	23.82	2.98	2.81	66.86	2.61	4.08	97.18	2.44	4.97	118.29	2.31	5.84	138.99
Cano Urichare-2	16.29	2.79	2.67	43.45	2.41	4.04	65.82	2.24	5.02	81.79	2.10	6.00	97.78
Cano Urichare-3	9.82	2.31	3.33	32.66	2.03	4.83	47.46	1.89	5.88	57.78	1.79	6.91	67.89
Cano Urichare-4	34.31	3.16	5.72	102.47	2.81	4.96	142.87	2.65	4.16	170.03	2.52	2.99	196.15
Cano Venado-1	16.50	2.68	3.01	49.77	2.35	4.38	72.34	2.20	5.33	88.05	2.08	6.26	103.46
Cano Venado-2	10.01	2.32	3.32	33.07	2.04	4.82	48.07	1.90	5.87	58.51	1.80	6.89	68.75
Cano Mucuya-1	4.30	1.90	3.44	14.80	1.65	5.21	22.42	1.53	6.48	27.86	1.43	7.74	33.30
Cano Mucuya-2	18.40	2.77	2.95	54.26	2.43	4.29	78.87	2.27	5.22	96.00	2.14	6.13	112.80
Cano Mucuya-3	11.50	2.42	3.23	37.11	2.12	4.69	53.93	1.98	5.71	65.65	1.87	6.71	77.13
Cano Mucuya-4	15.60	2.52	3.47	54.17	2.24	4.84	75.53	2.11	5.76	89.89	2.01	6.65	103.70
Cano Sardinata-1	2.30	1.59	3.88	8.92	1.38	5.88	13.52	1.28	7.30	16.79	1.20	8.73	20.08
Cano Sardinata-2	25.25	3.03	2.78	70.09	2.66	4.03	101.87	2.48	4.91	124.00	2.35	5.77	145.70
Cano Sardinata-3	11.45	2.31	3.68	42.19	2.05	5.14	58.82	1.93	6.11	70.00	1.84	7.05	80.75
Cano Taparo	13.98	2.44	3.55	49.29	2.17	4.95	68.72	2.04	5.89	81.79	1.94	6.80	94.35

note : * Exeisting Drainage Canal A=Catchment Area (km2)

t=Lag Time of Flood(hour) RI=Rainfall Intensity(mm/hr)

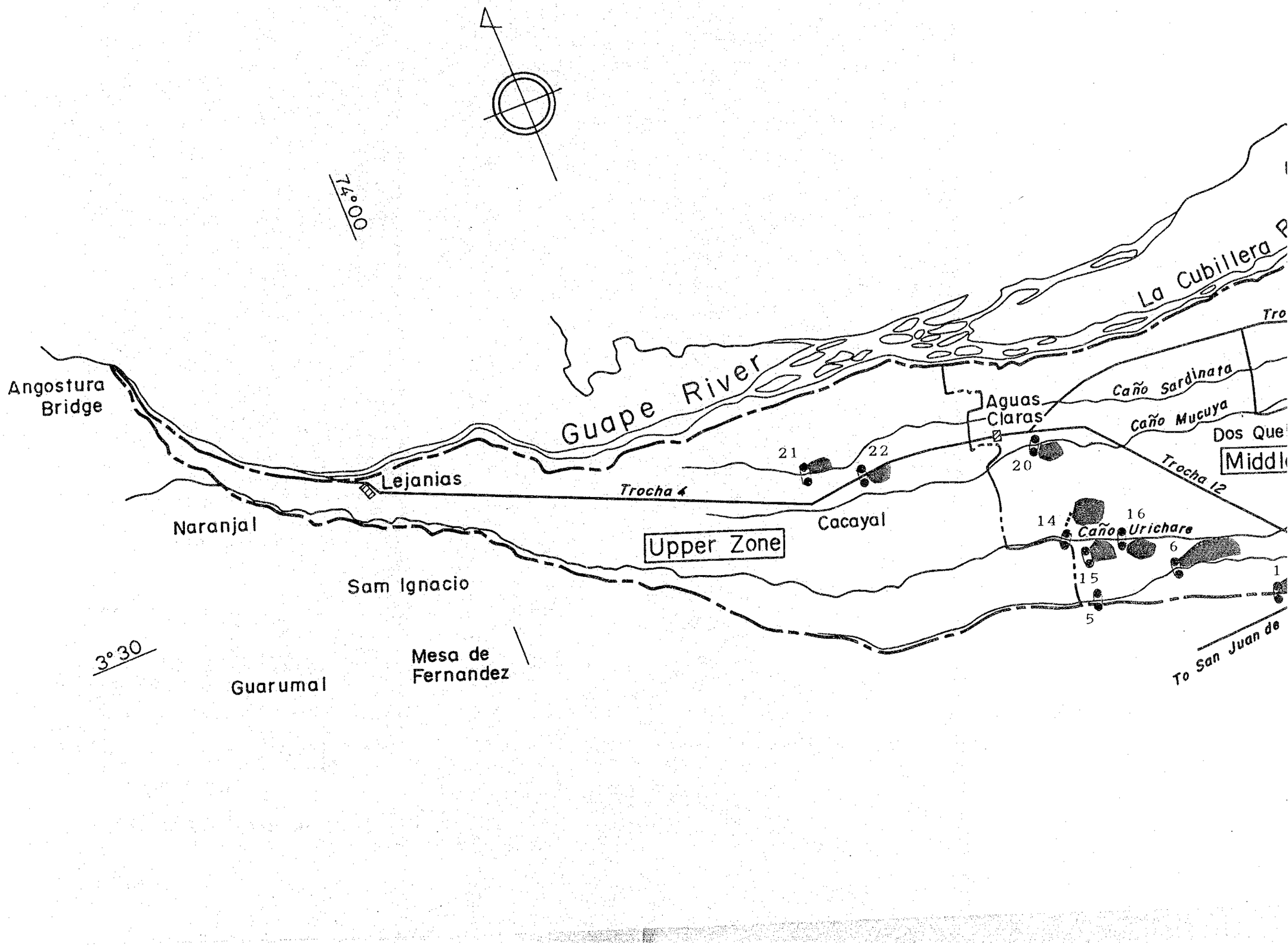
PQ=Peak Flood Dischage(m3/sec)

Table I-3-2 Summary of Inundation Time

Name of Cano	Return Period 1/2			Return Period 1/5			Return Period 1/10			Return Period 1/20		
	T (hr)	Q (m3/s)	H (m)	T (hr)	Q (m3/s)	H (m)	T (hr)	Q (m3/s)	H (m)	T (hr)	Q (m3/s)	H (m)
Avichure 2	1.8	19.22	0.13	3.0	23.11	0.44	3.4	25.49	0.62	3.7	27.61	0.78
Avichure 1	3.6	14.87	0.12	6.0	16.58	0.25	6.9	17.61	0.33	7.7	18.78	0.41
Avichure 2	1.8	19.22	0.13	3.0	23.11	0.44	3.4	25.49	0.62	3.7	27.61	0.78
Avichure 1 ★	---	18.49	-0.01	5.8	20.13	0.09	5.1	21.43	0.16	5.8	22.92	0.23
Caño Seco	2.3	12.18	0.11	3.5	13.79	0.28	4.1	14.73	0.38	4.7	15.54	0.46
Caño Hogotes	2.9	36.84	0.42	3.6	52.94	0.92	3.8	81.68	1.25	4.0	89.87	1.57
Caño Upin 2	---	84.37	-0.28	2.5	84.00	0.66	3.1	88.30	1.03	3.3	110.66	1.15
Caño Upin 1	---	104.28	-0.44	5.3	142.10	0.28	4.3	158.48	0.61	4.9	192.18	0.88
Caño Guanayas 4	1.1	70.23	0.25	2.4	81.67	0.99	2.8	104.97	1.44	3.0	116.72	1.82
Caño Guanayas 3	---	68.54	-0.09	3.6	84.19	0.39	4.6	94.40	0.70	4.9	103.31	0.96
Caño Guanayas 1	.5	57.12	0.02	3.9	80.78	0.48	5.4	89.78	0.77	5.2	97.45	1.01
Caño Guanayas 2	---	142.94	-1.25	3.6	206.89	0.46	5.2	239.20	0.77	5.1	267.96	1.03
Caño Urichare 4	1.1	98.06	0.25	2.4	134.26	0.87	2.8	158.38	1.23	3.0	180.92	1.53
Caño Urichare 3	2.2	88.50	0.33	3.8	114.65	0.63	4.4	127.97	1.15	4.7	140.03	1.44
Caño Urichare 1	1.9	86.87	0.25	3.6	111.85	0.73	4.2	123.57	1.01	7.4	134.12	1.26
Caño Urichare 2	---	86.81	-0.51	1.7	108.80	0.16	2.2	120.12	0.34	3.1	128.73	0.51
Caño Venado 2	8.0	8.82	0.90	10.5	8.99	1.23	12.0	9.23	1.40	13.3	9.43	1.56
Caño Venado 1	---	48.61	-0.53	1.7	66.29	0.09	4.2	78.53	0.42	5.3	80.94	0.75
Caño Venado 2 ★	1.7	26.27	0.14	2.7	32.05	0.45	3.0	34.83	0.64	3.3	37.32	0.82
Caño Venado 1	---	48.62	-0.53	3.4	70.10	0.19	5.5	85.57	0.61	7.1	100.16	0.98
Caño Mucuya 4	2.8	38.61	0.40	3.6	45.67	0.79	4.0	49.66	1.00	4.2	53.15	1.18
Caño Mucuya 3	---	43.25	-0.33	2.2	50.50	0.10	4.7	56.36	0.32	5.3	61.19	0.50
Caño Mucuya 2	---	50.73	-0.08	3.4	64.47	0.12	5.5	71.86	0.28	7.3	77.42	0.41
Caño Mucuya 1	---	50.09	-0.35	3.2	63.40	0.08	5.7	69.13	0.21	7.3	73.91	0.31
Caño Sardinata 3	2.9	31.12	0.48	3.2	37.57	0.94	3.5	41.31	1.20	3.7	44.52	1.42
Caño Sardinata 2	---	63.33	-0.38	3.9	71.33	0.14	4.9	75.88	0.23	5.6	79.54	0.31
Caño Sardinata 1	1.7	99.80	0.26	2.7	117.65	0.73	3.2	127.29	0.91	3.5	135.72	1.09
Caño Taparo	2.9	41.52	0.37	2.8	51.66	0.31	3.1	57.75	1.11	3.2	63.08	1.36

Note T : Inundation Time (hr)
Q : Peak Flow for Lower Basin (m³/s)
H : Maximum Water Level (m)

FIGURES


74°00
La Cubillera
River
Guape River
Caño Sardinata
Caño Mucuya
Aguas Claras
Angostura Bridge
Lejanias
Trocha 4
Trocha 12
Naranjal
Cacayal
Upper Zone
Caño Urichare
Sam Ignacio
3°30
Mesa de Fernandez
Guarumal
To San Juan de
Dos Que
Middl
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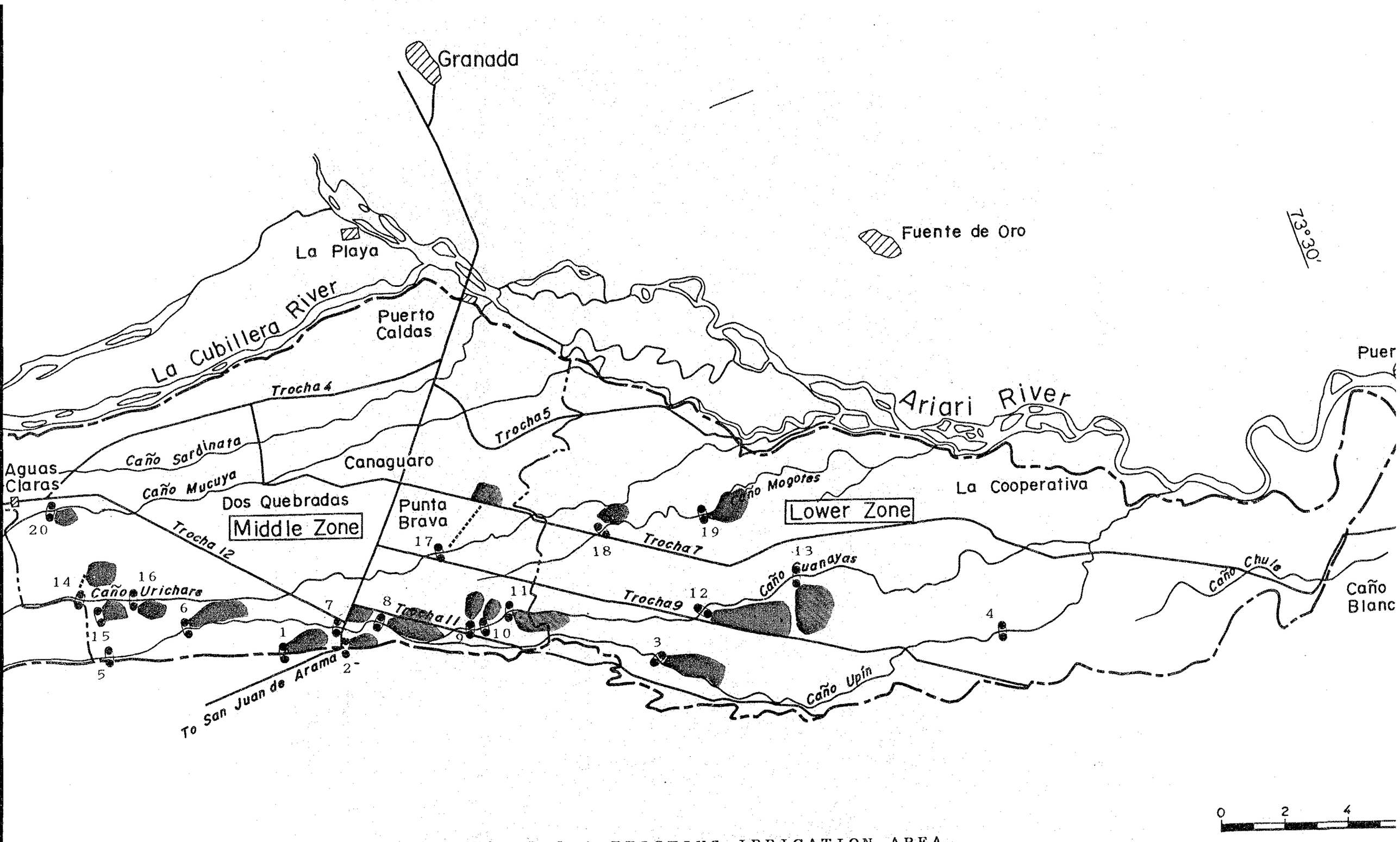
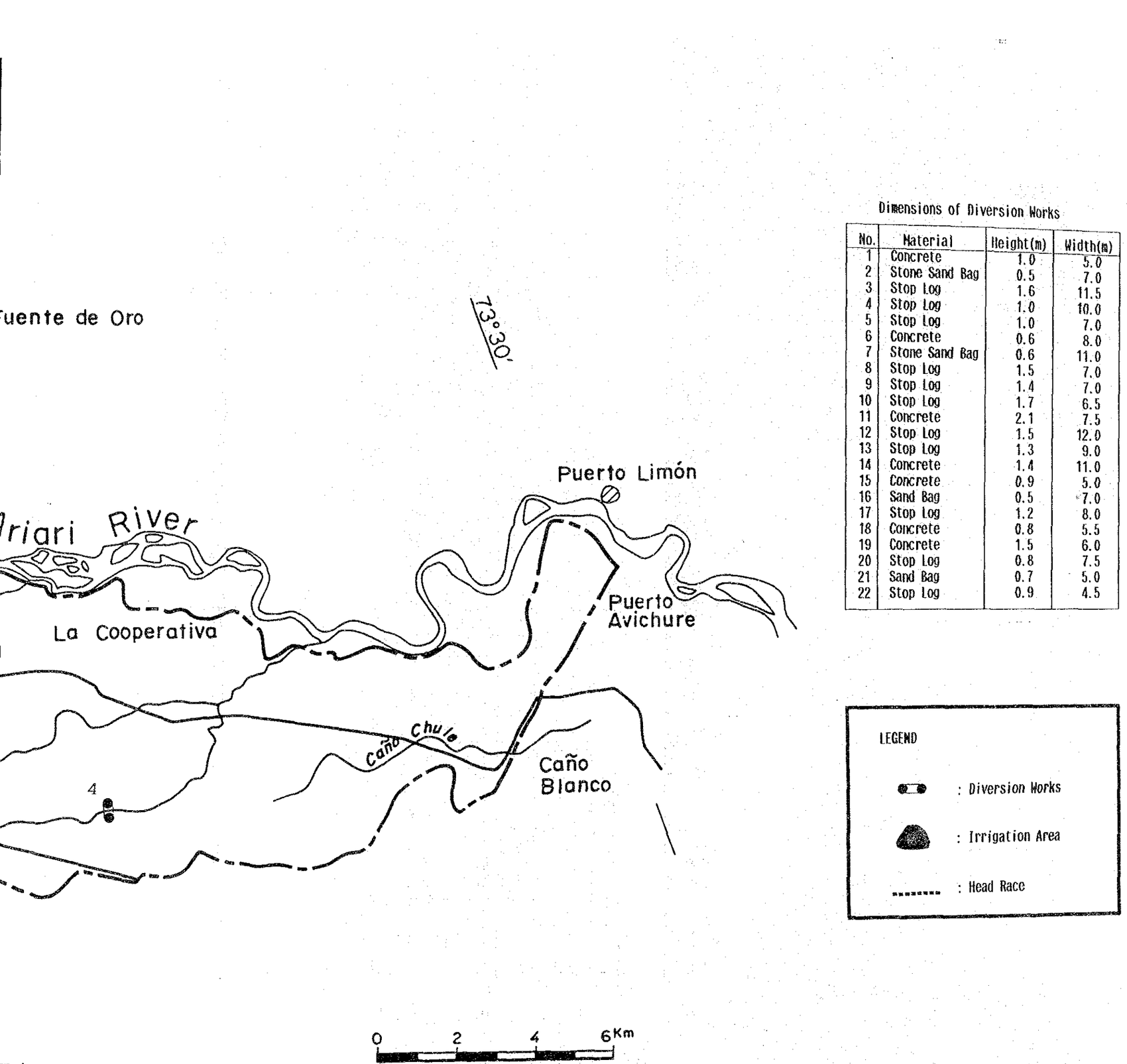


Fig. I-2-1 EXISTING IRRIGATION AREA

Dimensions of Diversion Works

No.	Material	Height(m)	Width(m)
1	Concrete	1.0	5.0
2	Stone Sand Bag	0.5	7.0
3	Stop Log	1.6	11.5
4	Stop Log	1.0	10.0
5	Stop Log	1.0	7.0
6	Concrete	0.6	8.0
7	Stone Sand Bag	0.6	11.0
8	Stop Log	1.5	7.0
9	Stop Log	1.4	7.0
10	Stop Log	1.7	6.5
11	Concrete	2.1	7.5
12	Stop Log	1.5	12.0
13	Stop Log	1.3	9.0
14	Concrete	1.4	11.0
15	Concrete	0.9	5.0
16	Sand Bag	0.5	7.0
17	Stop Log	1.2	8.0
18	Concrete	0.8	5.5
19	Concrete	1.5	6.0
20	Stop Log	0.8	7.5
21	Sand Bag	0.7	5.0
22	Stop Log	0.9	4.5



E A

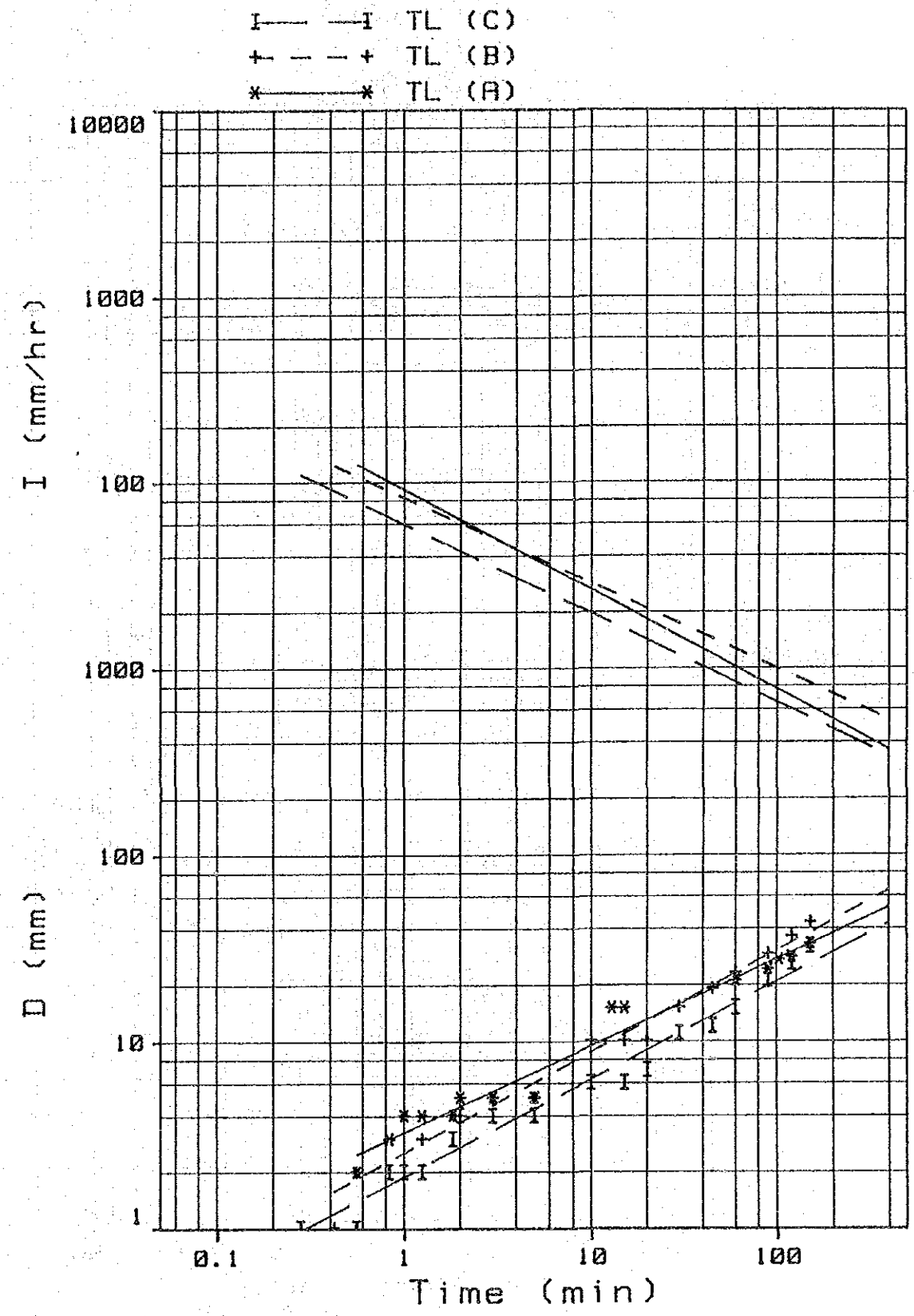


Fig. I-2-3 (1) INTAKE RATE OF TL

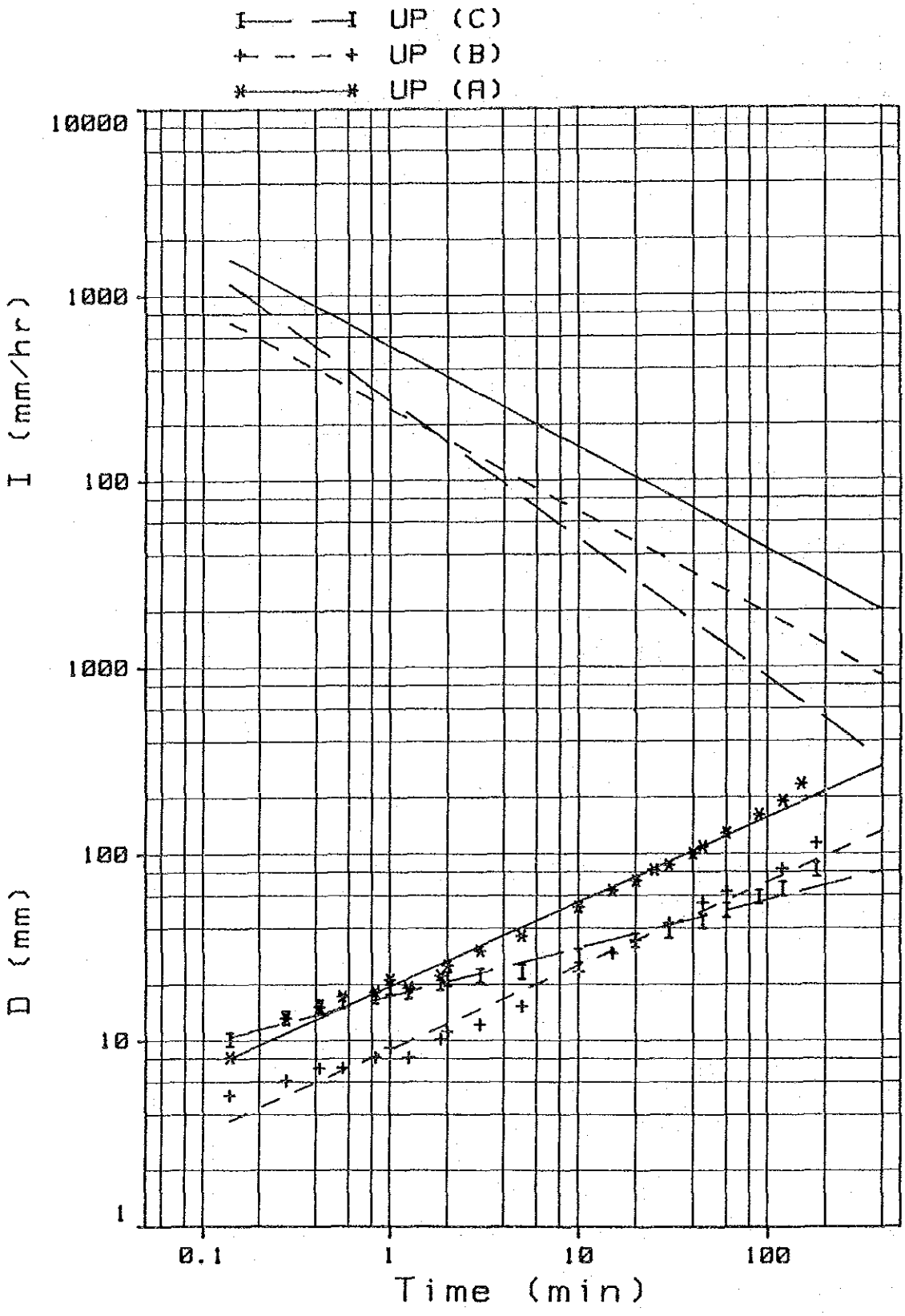


Fig. I-2-3 (2) INTAKE RATE OF UP

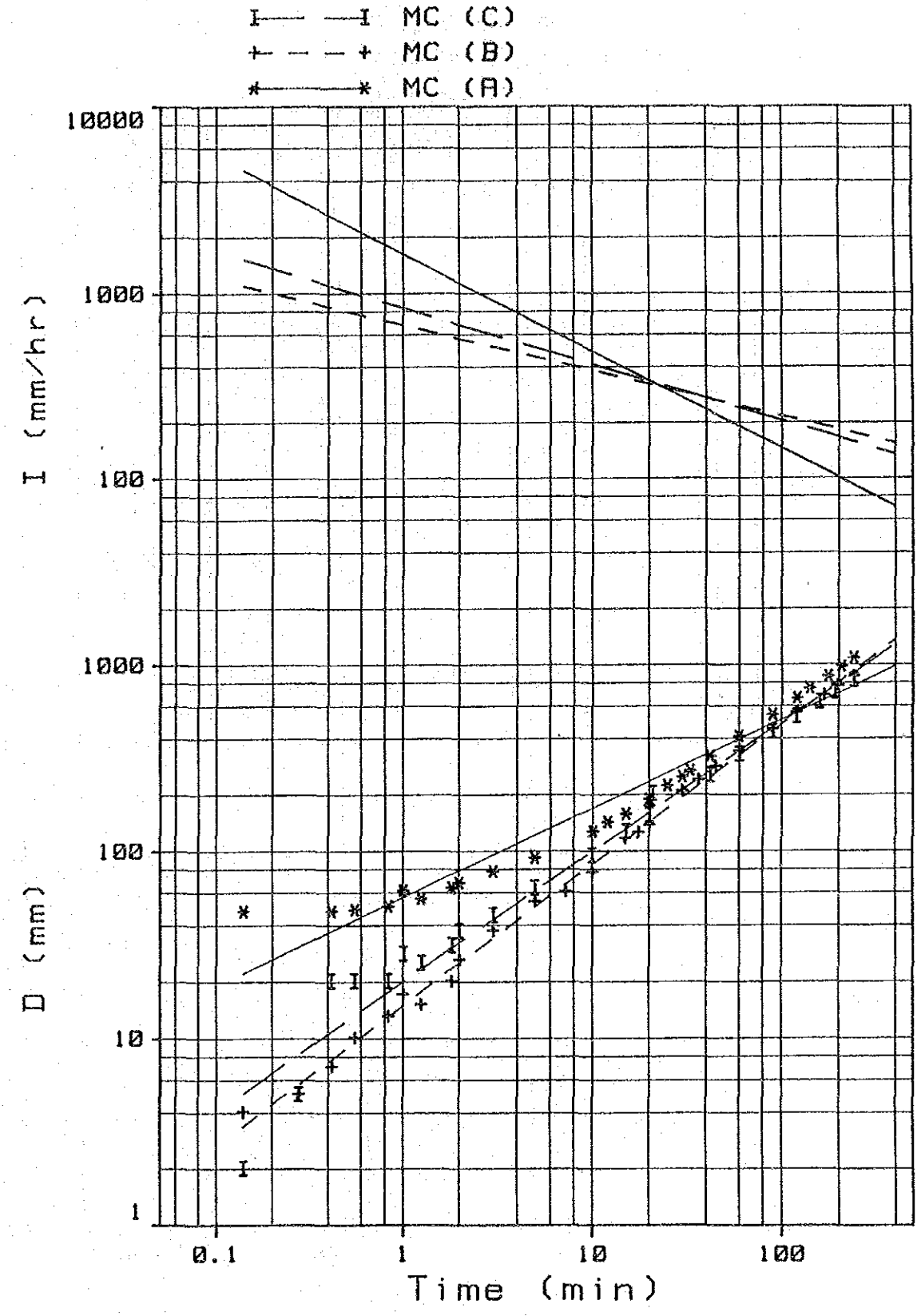


Fig. I-2-3 (3) INTAKE RATE OF MC

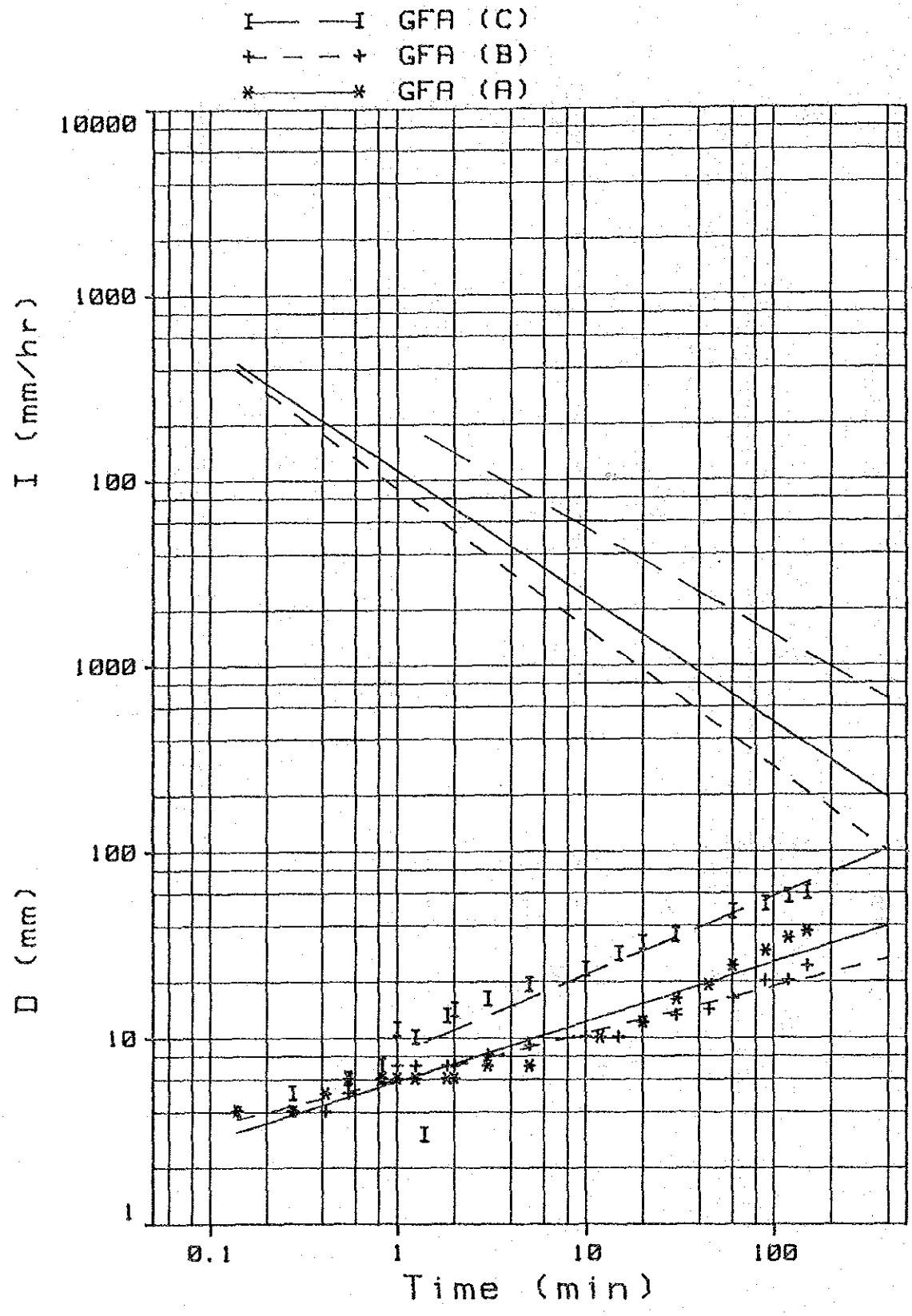


Fig. I-2-3 (4) INTAKE RATE OF GFA

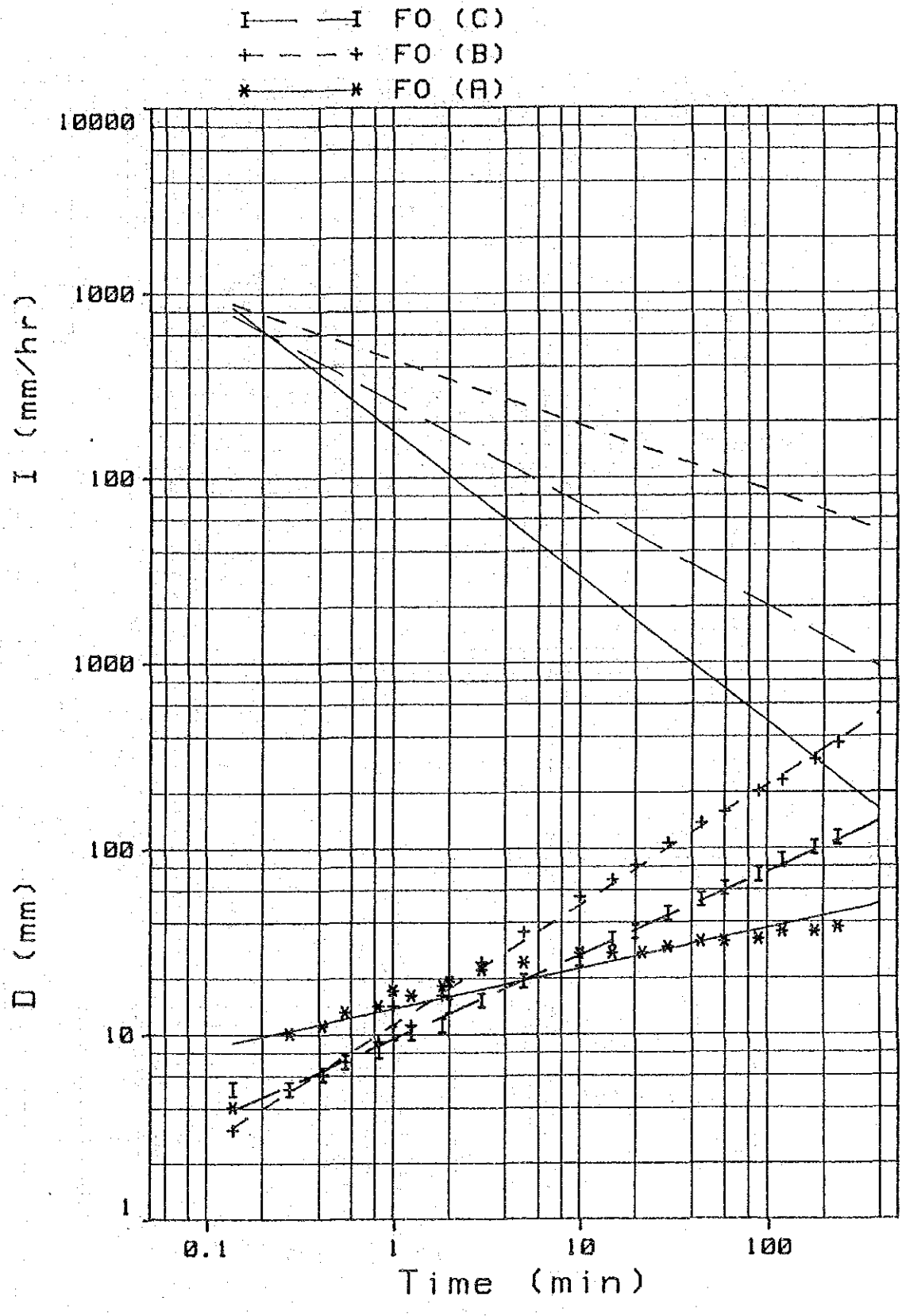


Fig. I-2-3 (5) INTAKE RATE OF FO

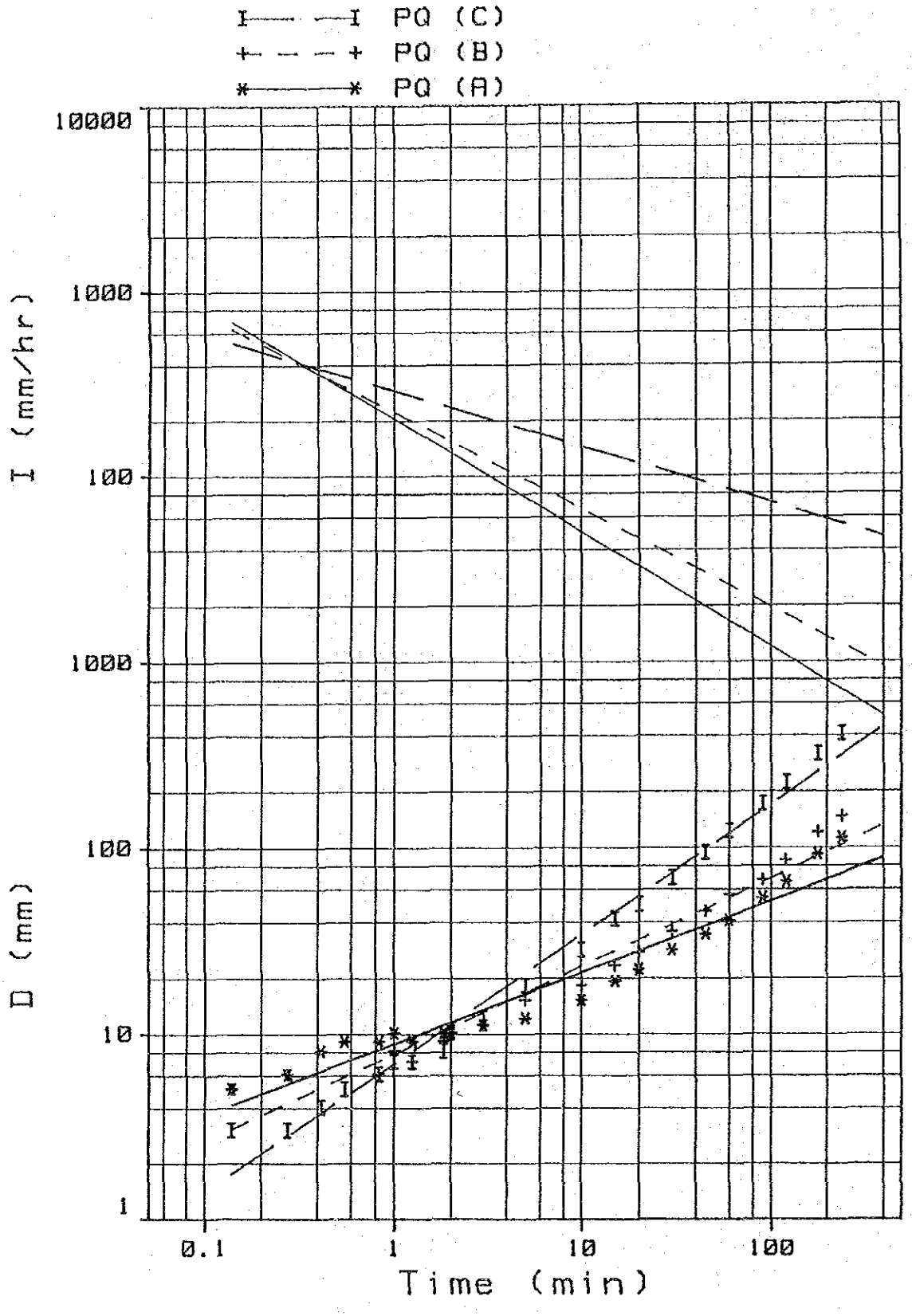


Fig. I-2-3 (6) INTAKE RATE OF PQ

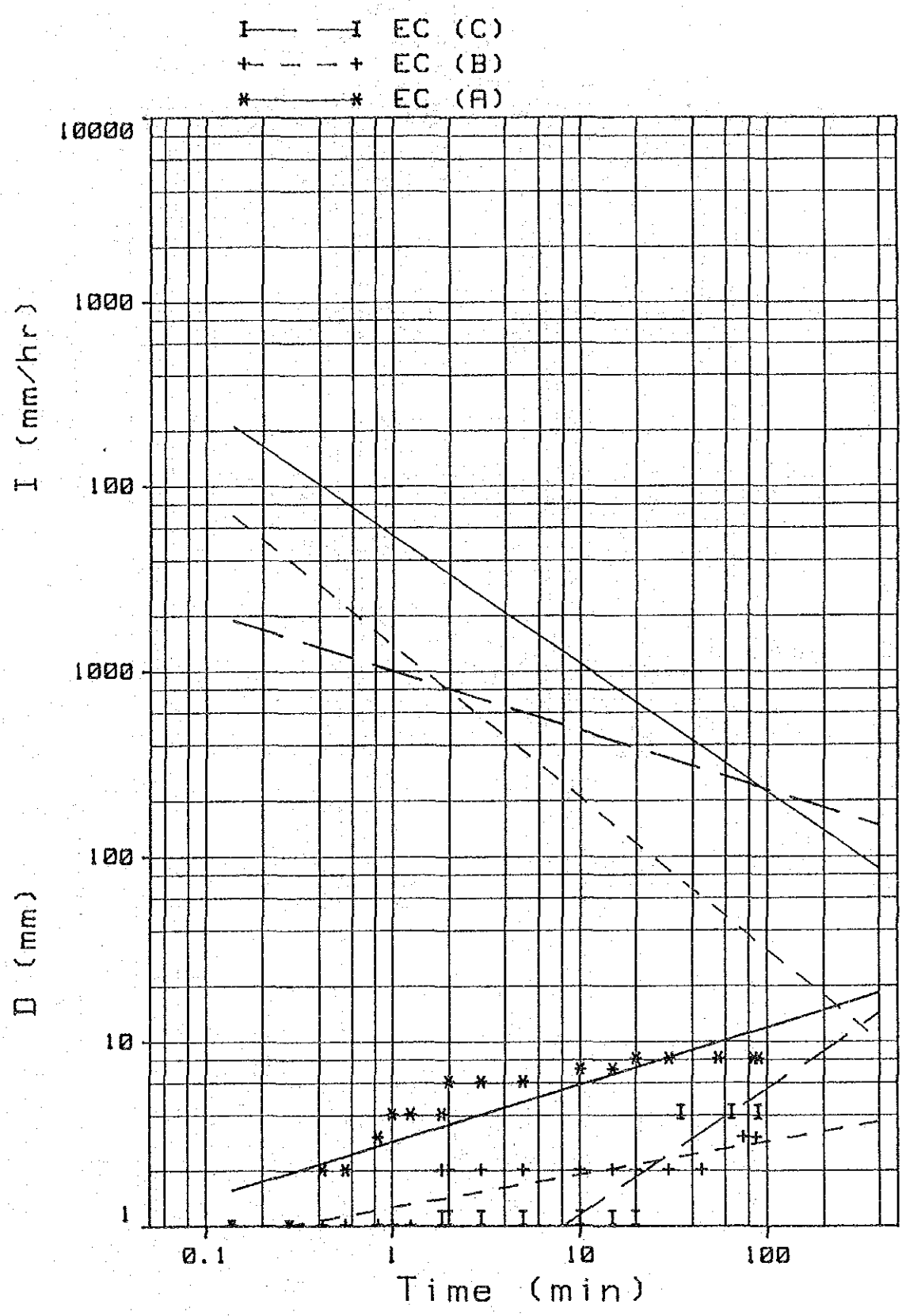


Fig. I-2-3 (7) INTAKE RATE OF EC

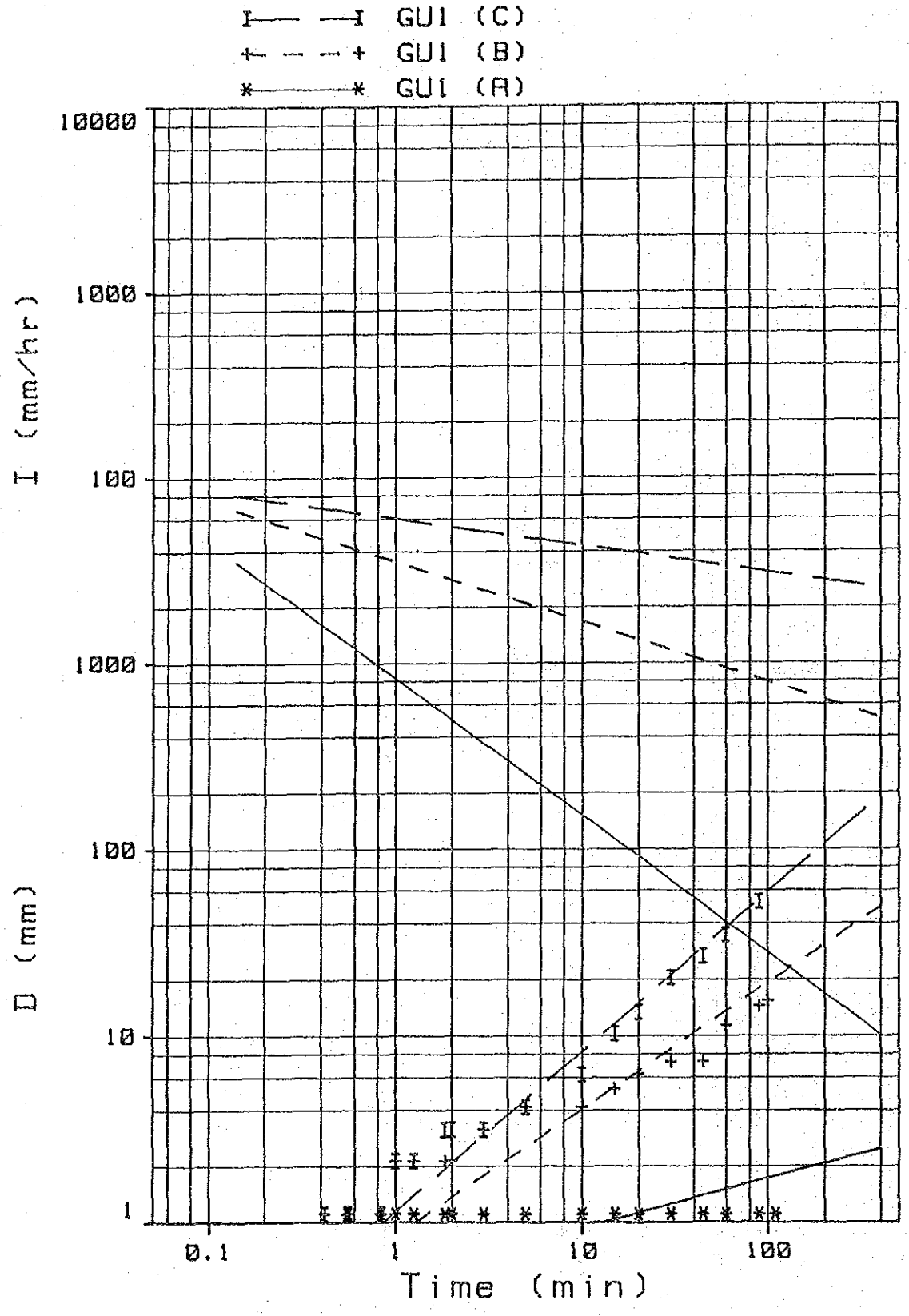


Fig. I-2-3 (8) INTAKE RATE OF GU1

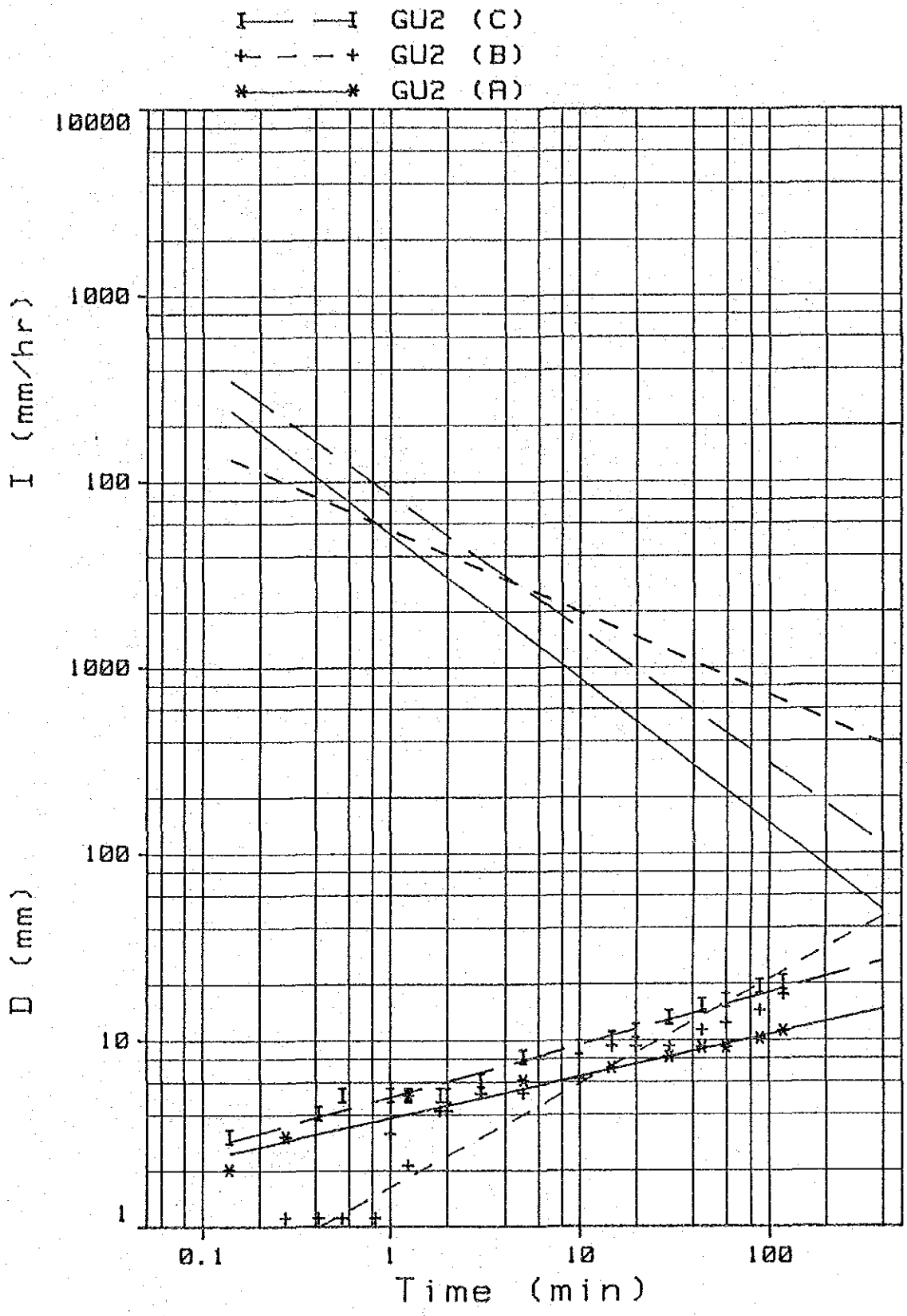
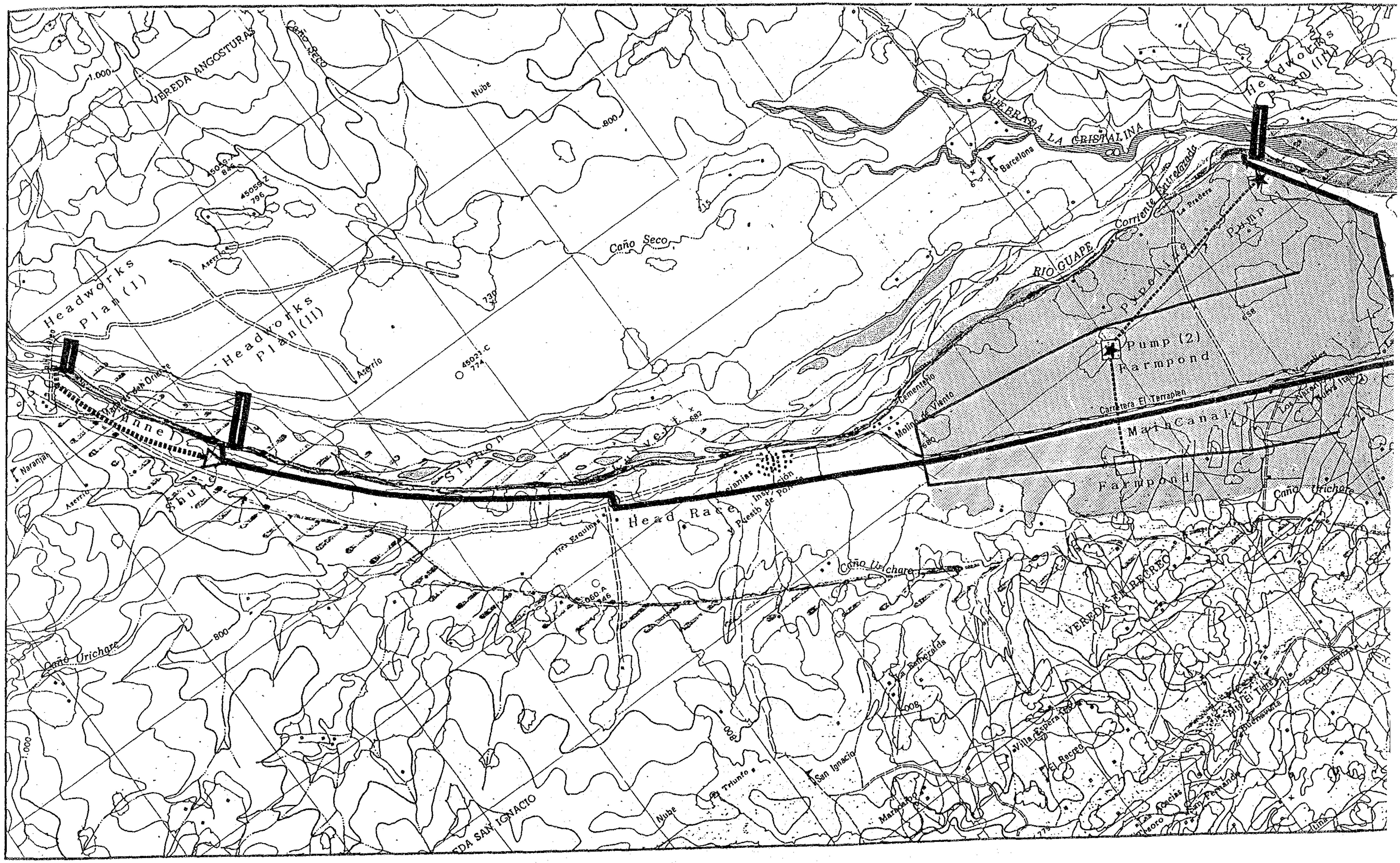


Fig. I-2-3 (9) INTAKE RATE OF GU2


VEREDA ANGOSTURAS
Caño Seco
1.000
Nube
800
QUEBRADA LA CRISTALINA
Barcelona
Headworks
Caño Seco
RIO GUAPE
Corriente Entrelazada
La Pradera
Pump
Headworks Plan (I)
Headworks Plan (II)
Aserrio
Pump (2)
Farmpond
Cementerio
Molino de Viento
Carretera El Terraplen
Main Canal
Siphon
Head Race
Farmpond
Caño Urichare
Naranjal
Caño Urichare
VEREDA EL RECREO
La Esmeralda
Villa Esperanza
El Recreo
Alto El Tigre
San Ignacio
El Triunfo
VEREDA SAN IGNACIO

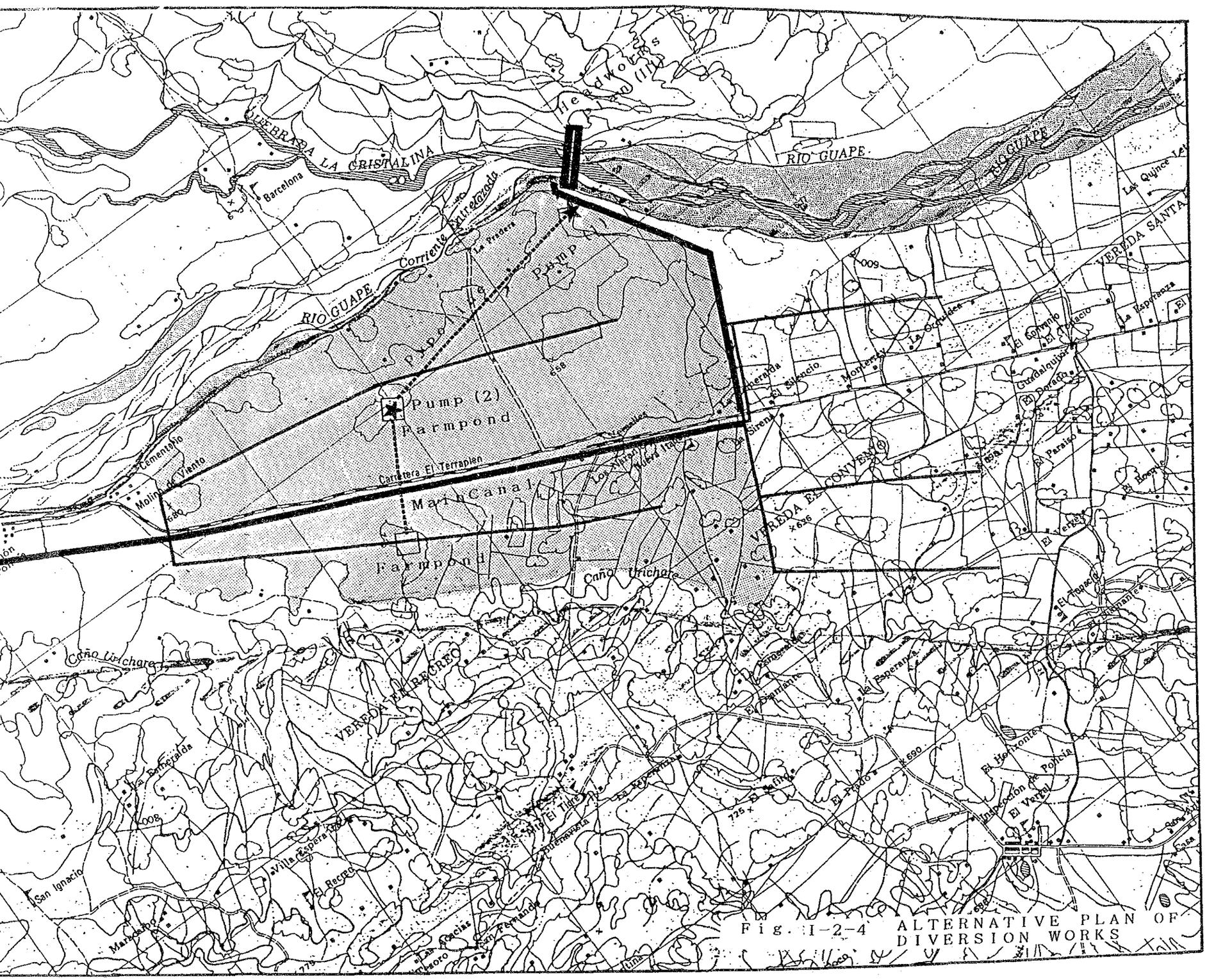


Fig. I-2-4 ALTERNATIVE PLAN OF DIVERSION WORKS

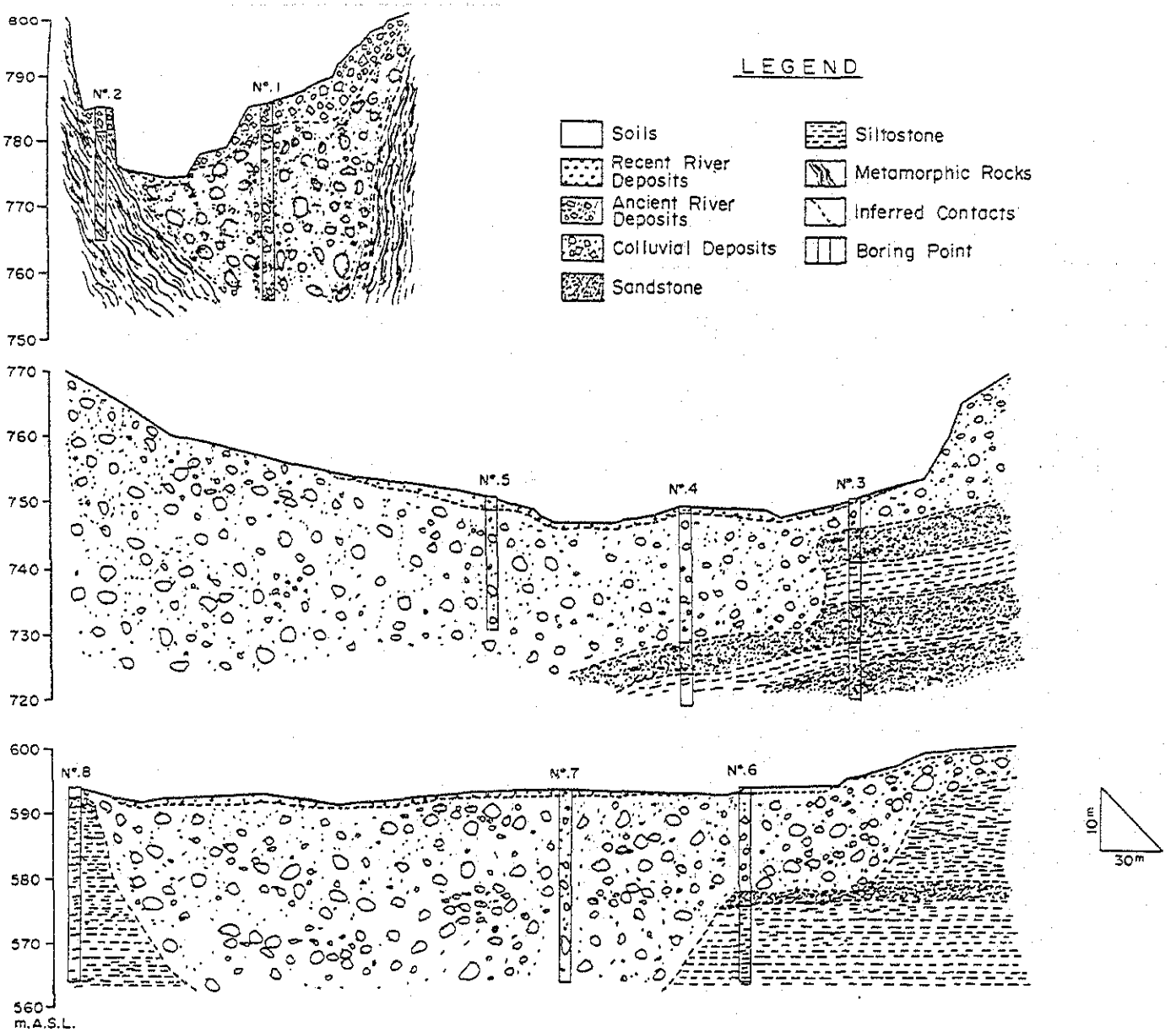


Fig.I-2-5 Geological Profile at Proposed Site of Head Works

BORING LOG

Boring No. 1 (Alt.I-1)　　Elevation 785.54 m A.S.L.　　Inclination Vertical

Location Right Margin of the Guape River at Angostura Bridge　　Total Depth 30 m　　Date Oct. 1988

Scale (m)	Elevation (m)	Depth (m)	Thickness (m)	Columnar Section	Colour	Lithology	Observation	Sampling Depth (m)	Sampling %	Sampling RQD	N-Value
							Angular - sub-angular pebbles and gravels of metamorphic, plutonic and volcanic origins medium compacted. Layers of coarse sand with fragments of shell	0.00-0.50	SS		
1					Light beige			0.50-1.00	100	0	
2								1.00-1.90	48	24	
					Reddish			1.90-2.40	SS		
3	782.54	3.00	3.00					2.40-3.00	38	0	
	782.04	3.50	0.50		Light beige	Medium - fine Pebbles and Coarse - medium - fine gravels in matrix of coarse, medium and fine sand and some portion of silt & clay		3.00-3.50			
4								3.50-4.20	77	0	
								4.20-5.00	33	0	
5								5.00-5.30			
					Reddish		Silt layer	5.30-5.70	63	0	
6								5.70-6.20	SS		
7								6.20-7.45	92	0	
8								7.45-8.00	62	0	
								8.00-8.70	72	0	
9								8.70-9.60	82	26	
					Grayish beige			9.60-10.00	68	0	
10								10.00-10.30	100	52	
								10.30-11.00	70	0	
11							Round and sub-round pebbles and gravels of metamorphic, plutonic and volcanic origins	11.00-11.90	74	0	
12											
13								11.90-13.30	79	70	
								13.30-13.70	90	0	
14								13.70-14.10	100	38	
15								14.10-15.50	34	0	
16								15.50-16.30	42	0	
17					Grayish beige			16.30-17.80	29	0	
18								17.80-19.30	46	0	
19								19.30-19.70	45	0	
20								19.70-21.00	26	0	
21											
22								21.00-22.50	38	8	
23								22.50-23.00	100	44	
24								23.00-24.00	16	0	
25					Grayish beige			24.00-25.50	24	0	
26								25.50-26.00	76	0	
27								26.00-27.50	27	0	
28								27.50-29.00	20	8	
29								29.00-30.00	38	0	
30	755.54	30.00									

Fig.I-2-6 (1) BORING LOG

BORING LOG

Boring No 2(Alt.I-2) Elevation 785.10 m A.S.L. Inclination Vertical

Location Left Margin of the Guape River at Angostura Bridge Total Depth 20m Date Oct.1988

Scale (m)	Elevation (m)	Depth (m)	Thickness (m)	Columnar Section	Colour	Lithology	Observation	Sampling Depth (m)	%	RQD	N-Value
1					Grayish beige.	Coarse - fine pebbles and gravels in matrix of sandy silt	Angular-sub-angular pebbles and gravels of metamorphic, plutonic and volcanic origins. Medium compacted	0.00-1.50	hand	dua	
2	782.50	2.60	2.60					1.50-2.00	55		
								2.00-2.50	55		
3					Gary	Sandy silt with coarse - fine gravels	Sub-round-sub-angular gravels	2.50-3.00	55		
	781.30	3.80	1.20					3.00-3.80	37	0	
4								3.80-4.30	100	15	
								4.30-5.00	100	12	
5								5.00-6.00	100	18	
6								6.00-7.50	77	35	
7											
8								7.50-8.25	100	15	
							Clear schistosity	8.25-8.40	100	0	
9					Dark green and Black	Phyllite	Gentle folding	8.40-9.00	95	10	
								9.00-19.99	83	26	
10							Many fractures	10.00-10.80	95	20	
11							Moderately weathered	10.80-12.00	90	25	
12								12.00-13.50	88	32	
13											
14								13.50-14.50	100	23	
15								14.50-16.00	95	26	
16								16.00-17.00	93	15	
17								17.00-18.00	97	22	
18								18.00-19.50	100	12	
19											
20	765.10	20.00						19.50-20.00	98	10	
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

Fig.I-2-6 (2) BORING LOG

BORING LOG

Boring No 3(Alt.11-1) Elevation 750.64m A.S.L. Inclination Vertical

Location Right Margin of the Guape River at Alvaro Ordoñez Farm Total Depth 30 m Date Oct. 1988

Scale (m)	Elevation (m)	Depth (m)	Thickness (m)	Columnar Section	Colour	Lithology	Observation	Sampling Depth (m)	Sampling %	Sampling RQD	N-Value
0	750.34	0.30	0.30		Dark brown	Soil	Contain roots	0.00-0.30	83	0	
1						N.-f. Pebbles and C.-f. gravles in matrix of sand and some silt	Moderately compacted Round-sub-round pebbles and gravels of metamorphic, plutonic and volcanic orlgins.	0.30-1.10	88	0	
2								1.10-2.00	78	73	
3					Light gray			2.00-3.50	51	0	
4	746.44	4.20	3.90					3.50-4.30	63	0	
5					Grayish blue	Fine sandstone and partially coarse sandstone	Moderately hard rock Fractured with calcite veins Some alternation of silt and gravel layers Partially weathered with beige colour	4.30-5.80	97	36	
6								5.80-6.80	51	10	
7								6.80-7.30	50	0	
8								7.30-8.80	56	0	
9	741.34	9.30	5.10					8.80-10.30	74	0	
10					Dark gray	Siltstone	Bland-moderately hard Very fractured Some alternation of clay and sandstone layers				
11								10.30-11.85	63	7	
12											
13								11.85-14.00	82	13	
14											
15	735.44	15.20	5.90					14.00-15.30	78	11	
16					Grayish beige	Fine sandstone	Moderatley hard-hard A little fractured with veins of calcite Some alternation of silt layer Some layers of coarse sandstone	15.30-16.70	88	28	
17								16.70-18.00	81	30	
18											
19								18.00-19.40	72	21	
20								19.40-21.60	68	18	
21	729.04	21.60	6.40								
22					Dark gray	Siltstone	Bland-moderately hard Fractured	21.60-22.90	75	9	
23								22.90-24.45	77	14	
24	726.34	24.30	2.70								
25					Grayish beige	Fine sandstone	Hard rock Some alternation of silt and gravel layers	24.45-26.00	69	17	
26								26.00-27.30	72	23	
27											
28								27.30-28.80	70	18	
29											
30	720.64	30.00						28.80-30.00	86	29	

Fig.I-2-6 (3) BORING LOG

BORING LOG

Boring No 4(Alt.II-2) Elevation 749.59 m A.S.L Inclination Vertical

Location River Bed of the Guape River at Alvaro Ordoñez's Farm Total Depth 30 m Date Oct. 1988

Scale (m)	Elevation (m)	Depth (m)	Thickness (m)	Columnar Section	Colour	Lithology	Observation	Sampling Depth (m)	Sampling %	Sampling RQD	N-Value
1					Light-dark gray	c.-f. pebbles and gravels in matrix of sand, and some portion of silt	Round-sub-round pebbles and gravels of metamorphic, plutonic and volcanic origins. Medium compacted. Some alternation of silt layers	0.00-1.30	Hand dug		
2								1.30-2.00	86	0	
3								2.00-2.60	95	0	
4								2.60-3.00	100	0	
5								3.00-4.30	31	0	
6								4.30-4.80	30	0	
7								4.80-5.80	38	0	
8								5.80-6.50	72	0	
9								6.50-7.50	50	0	
10								7.50-8.00	80	0	
11								8.00-9.00	67	0	
12								9.00-10.10	51	0	
13								10.10-11.50	41	0	
14								11.50-12.00	43	0	
15								12.00-12.90	32	0	
16								12.90-14.00	16	0	
17								14.00-15.30	20	0	
18								15.30-16.00	14	0	
19								16.00-16.70	23	0	
20	729.09	20.50	20.50					16.70-18.00	65	0	
21					Greyish blue	Fine sandstone	Moderately hard rock. Fracture with calcite veins. Some alternation of thin silt layers	18.00-18.80	52	0	
22								18.80-19.50	72	0	
23								19.50-20.50	43	0	
24								20.50-21.80	60	15	
25	724.39	25.20	4.70					21.80-23.20	51	12	
26					Dark gray	Silt-stone	Bland-moderately bland very fracturated. Some alternation of clay layers	23.20-24.00	78	30	
27								24.00-25.00	86	38	
28								25.00-25.60	86	16	
29								25.60-27.10	77	15	
30	719.59	30.00						27.10-27.90	71	11	
								27.90-29.00	85	9	
								29.00-30.00	82	10	

Fig.I-2-6 (4) BORING LOG

BORING LOG

Boring No S(Ali.II-3)　　Elevation 750.73 m A.S.L.　　Inclination Vertical

Location Left Margin of the Guape River at Alvaro Ordoñez's Farm　　Total Depth 20 m　　Date Oct. 1988

Scale (m)	Elevation (m)	Depth (m)	Thickness (m)	Columnar Section	Colour	Lithology	Observation	Sampling Depth (m)	%	RQD	N-Value
	750.23	0.50	0.50		Dark brown	Soil	Contain root	0.00-0.50	SS		
								0.50-1.00	SS		
1					Dark beige	C.-f. silty sand and gravels		1.00-2.00	50	0	
	748.73	2.00	1.50								
2								2.00-4.00	40	6	
3											
4								4.00-6.00	34	0	
5							Moderately compacted				
6						C.-f. pebbles and gravels in matrix of sand and some silt	Round-sub-round pebbles and gravels of plutonic metamorphic and volcanic origins	6.00-6.80	43	0	
7								6.80-8.00	62	0	
8					Light gray		Some alternation of silt and coarse sand layers	8.00-9.50	36	0	
9											
10								9.50-10.40	52	0	
11								10.40-11.50	65	0	
12								11.50-12.80	43	0	
13								12.80-13.50	49	0	
14								13.50-14.80	56	0	
15								14.80-16.00	68	0	
16								16.00-17.40	40	0	
17											
18								17.40-18.80	51	0	
19								18.80-21.00	56	0	
20	730.73	20.00									
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

Fig.I-2-6 (5) BORING LOG

BORING LOG

Boring No 6(Alt.III-1) Elevation 594.88 m A.S.L. Inclination Vertical

Location Right Margin of the Guape River at Finca La Pradera Total Depth 30 m Date Nov. 1988

Scale (m)	Elevation (m)	Depth (m)	Thickness (m)	Columnar Section	Colour	Lithology	Observation	Sampling Depth (m)	Sampling %	Sampling RQD	N-Value
1	593.88	1.00	1.00		Dark brown	Soil	Contain roots	0.00-1.30	Hand dug		
2								1.30-2.50	75	0	
								2.50-2.60	100	0	
3								2.60-3.00	68	0	
							Fragments of shell	3.00-3.30	87	0	
								3.30-3.60	70	0	
4						C.-f. pebbles and gravels in matrix of sand and a little portion of silt		3.60-4.60	60	0	
5							Moderately compacted	4.60-5.70	61	0	
6					Light gray		Round-sub-round pebbles and gravels of plutonic, volcanic and metamorphic origins	5.70-6.10	55	0	
								6.10-6.40	67	0	
7								6.40-7.10	57	0	
8								7.10-8.20	80	0	
9								8.20-10.05	19	0	
10											
11								10.05-11.90	68	0	
12											
13								11.90-13.30	55	0	
14								13.30-14.70	79	0	
15								14.70-15.80	72	0	
16	579.08	15.80	14.80								
17					Ligth beige	M. sandstone	Compacted clear stratification	15.80-17.10	96	28	
18	596.88	18.00	2.20					17.10-18.20	88	32	
19							Moderately compacted	18.20-19.20	67	0	
20							Carbon layers	19.20-21.00	64	5	
21							f.sandstone layer				
22					Light-dark gray	Siltstone and partially sandy siltstone	Clear stratification	21.00-22.30	82	12	
23								22.30-23.20	77	7	
24								23.20-24.00	68	10	
25								24.00-25.40	82	16	
26								25.40-26.30	60	7	
27							Gravel contained zone	26.30-27.00	51	0	
28							f. sandstone layer	27.00-28.15	56	0	
29								28.15-28.80	64	5	
30	564.88	30.00						28.80-30.00	71	11	

Fig.I-2-6 (6) BORING LOG

BORING LOG

Boring No. 7(A.t.III-2) Elevation 594.42 m A.S.L. Inclination Vertical

Location River Bed of the Guape River at Finca la Pradera Total Depth 30 m Date Nov. 1988

Scale (m)	Elevation (m)	Depth (m)	Thickness (m)	Columnar Section	Colour	Lithology	Observation	Sampling Depth (m)	Sampling %	Sampling RQD	N-Value
1								0.00-1.30	Hand	dug	
2								1.30-2.00	68	0	
3								2.00-2.90	72	0	
4								2.90-3.60	47	0	
5								3.60-5.10	63	0	
6								5.10-5.80	55	0	
7								5.80-6.70	40	0	
8							Moderately compacted	6.70-8.00	57	0	
9							Round-sub-round pebbles	8.00-9.20	83	0	
10						C.-f. Pebbles	and gravels of plutonic	9.20-10.10	61	0	All values show
11						and gravels	volcanic and metamorphic origins	10.10-11.40	43	0	more than 50
12					Light gray	in matrix of sand and	Some silt layer	11.40-12.00	70	0	
13						some portion of silt		12.00-13.20	55	0	
14							Some coarse sand layer	13.20-14.10	67	0	
15							and pockets	14.10-15.20	43	0	
16								15.20-16.40	41	0	
17								16.40-17.50	57	0	
18								17.50-18.70	66	0	
19								18.70-19.50	55	0	
20								19.50-20.10	45	0	
21								20.10-20.80	41	0	
22								20.80-21.90	36	0	
23								21.90-23.00	80	0	
24								23.00-23.70	55	0	
25								23.70-25.10	47	0	
26								25.10-25.80	40	0	
27								25.80-26.70	32	0	
28								26.70-27.40	58	0	
29								27.40-28.50	64	0	
30	564.42	30.00						28.50-29.20	78	0	
								29.20-30.00	58	0	

Fig.I-2-6 (7) BORING LOG

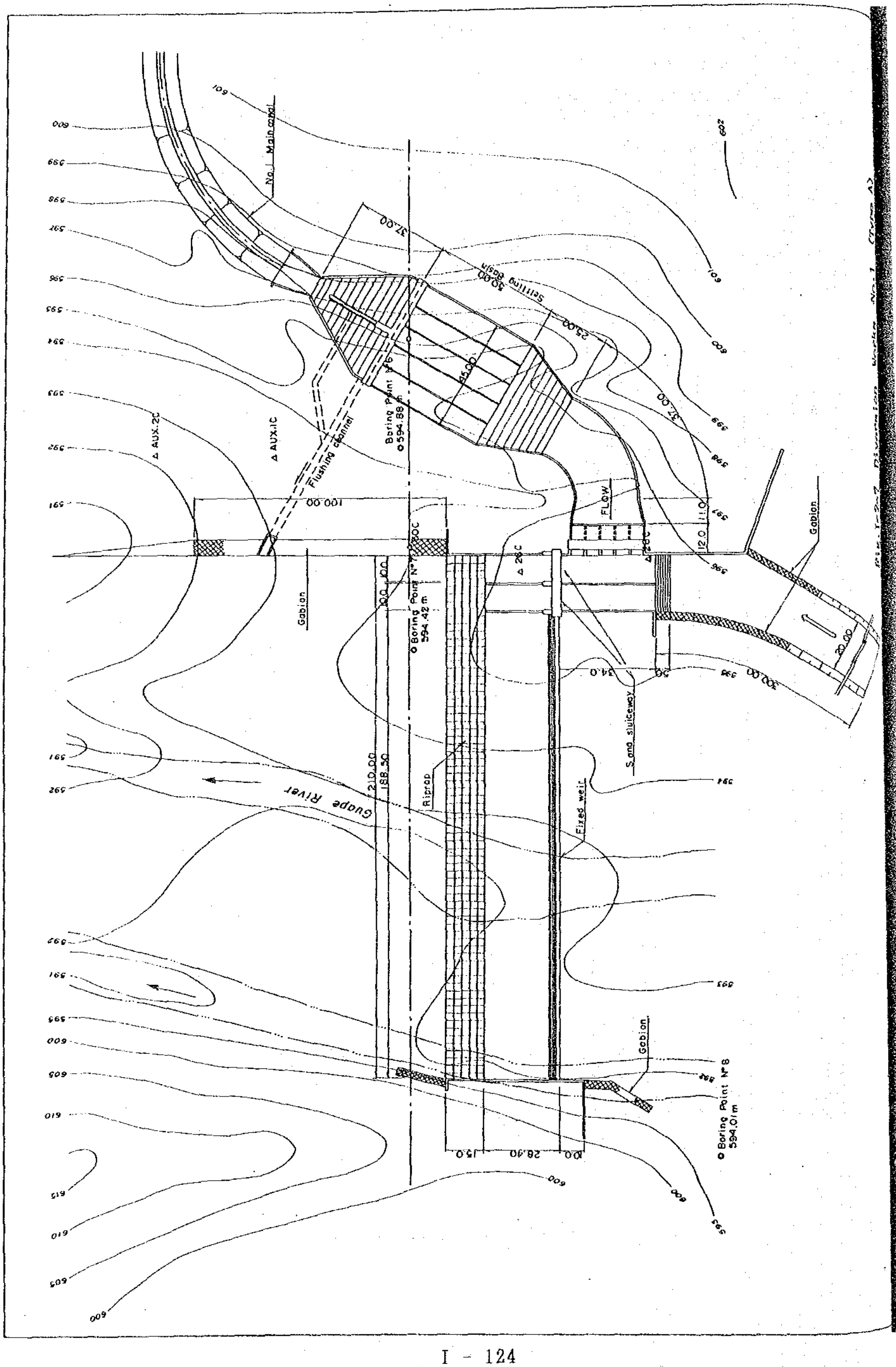
BORING LOG

Boring No 8(Alt.III-3) Elevation 596.01 m A.S.L. Inclination Vertical

Location Left Margin of the Guape River at Finca la Pradera Total Depth 30 m Date Nov. 1988

Scale (m)	Elevation (m)	Depth (m)	Thickness (m)	Columnar Section	Colour	Lithology	Observation	Sampling Depth (m)	Sampling %	Sampling RQD	N-Value
	593.71	0.30	0.30		brown	Soil	Contain roots				
1	592.51	1.50	1.20		Light beige	Pebbles and gravels	Moderately compacted.	0.00-1.00	Hand	dug	
								1.00-1.60	83	0	
2					Light beige	M. sandstone	Compacted Clear stratification Gravel layer	1.60-2.50	95	7	
3	590.81	3.20	1.70					2.50-3.20	88	16	
4							Moderately compacted	3.20-5.00	72	5	
5							Carbon layers				
6							Sandy Siltstone	5.00-6.80	80	32	
7							Clear stratification with slight dip tocard the east	6.80-8.15	64	12	
8								8.15-9.40	85	8	
9											
10					Light-dark gray, Partially light beige	Siltstone and Partially sandy siltstone	F.sandstone layer Partially weathered	9.40-10.80	60	3	
11							Gravel contained zone	10.80-12.30	78	13	
12								12.30-13.30	73	4	
13								13.30-14.90	60	5	
14								14.90-16.30	77	15	
15								16.30-17.70	84	14	
16							F.sandstone layer	17.70-19.40	63	10	
17								19.40-20.70	60	8	
18								20.70-22.00	83	11	
19								22.00-23.30	88	21	
20								23.30-24.70	80	27	
21								24.70-26.20	69	19	
22								26.20-26.90	74	17	
23								26.90-27.70	70	2	
24							Gravel layer	27.70-29.00	82	14	
25											
26								29.00-30.00	86	22	
27											
28											
29											
30	564.01	30.00									

Fig.I-2-6 (8) BORING LOG



No.1 Main canal
Settling Basin
Flushing channel
Boring Point No 6 594.88 m
Δ AUX.1C
Δ AUX.2C
FLOW
Gabion
Boring Point 594.42 m
Guape River
Riprap
Fixed weir
Sand sluiceway
Boring Point No 8 594.01m

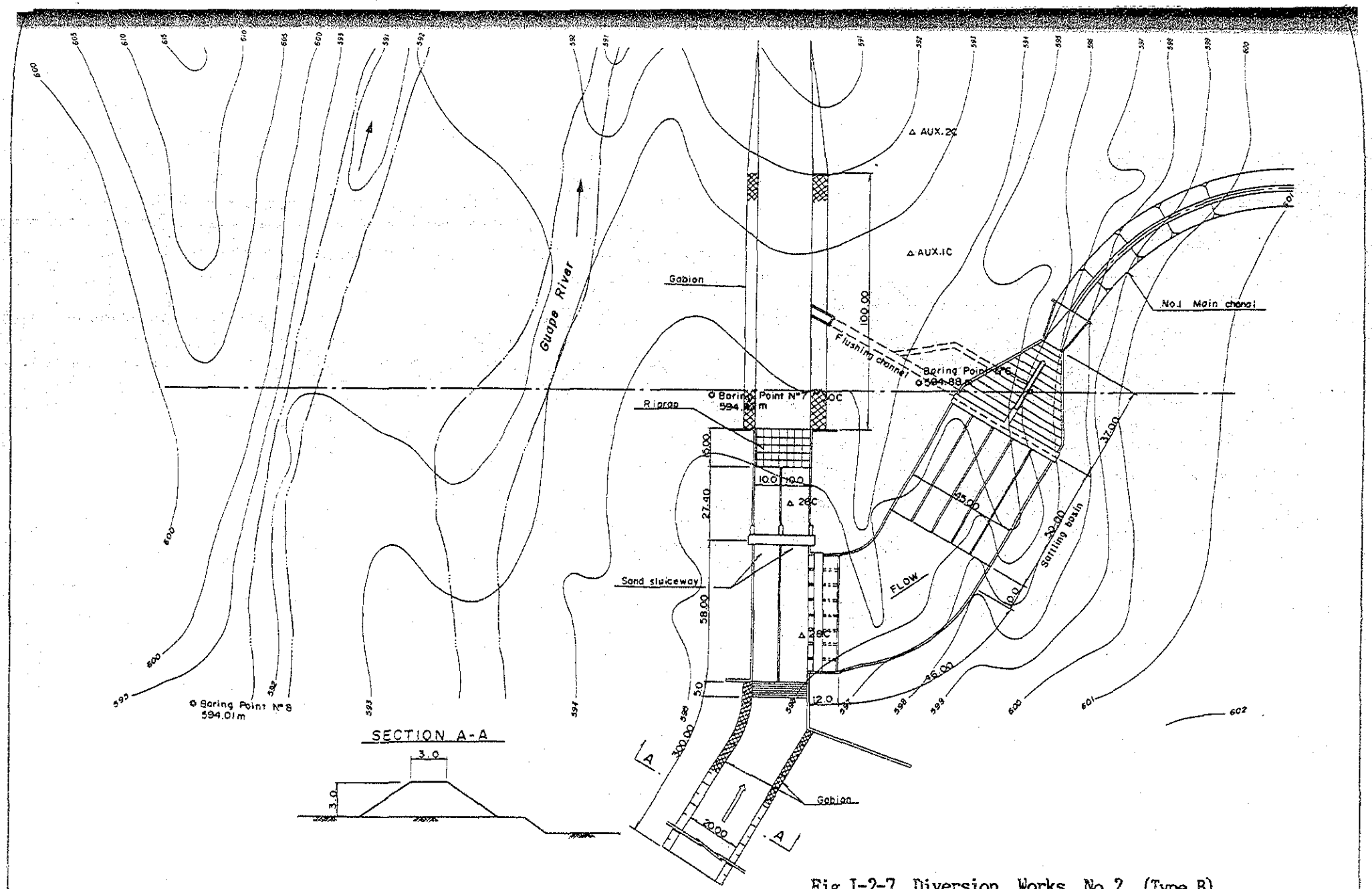


Fig.I-2-7 Diversion Works No.2 (Type B)

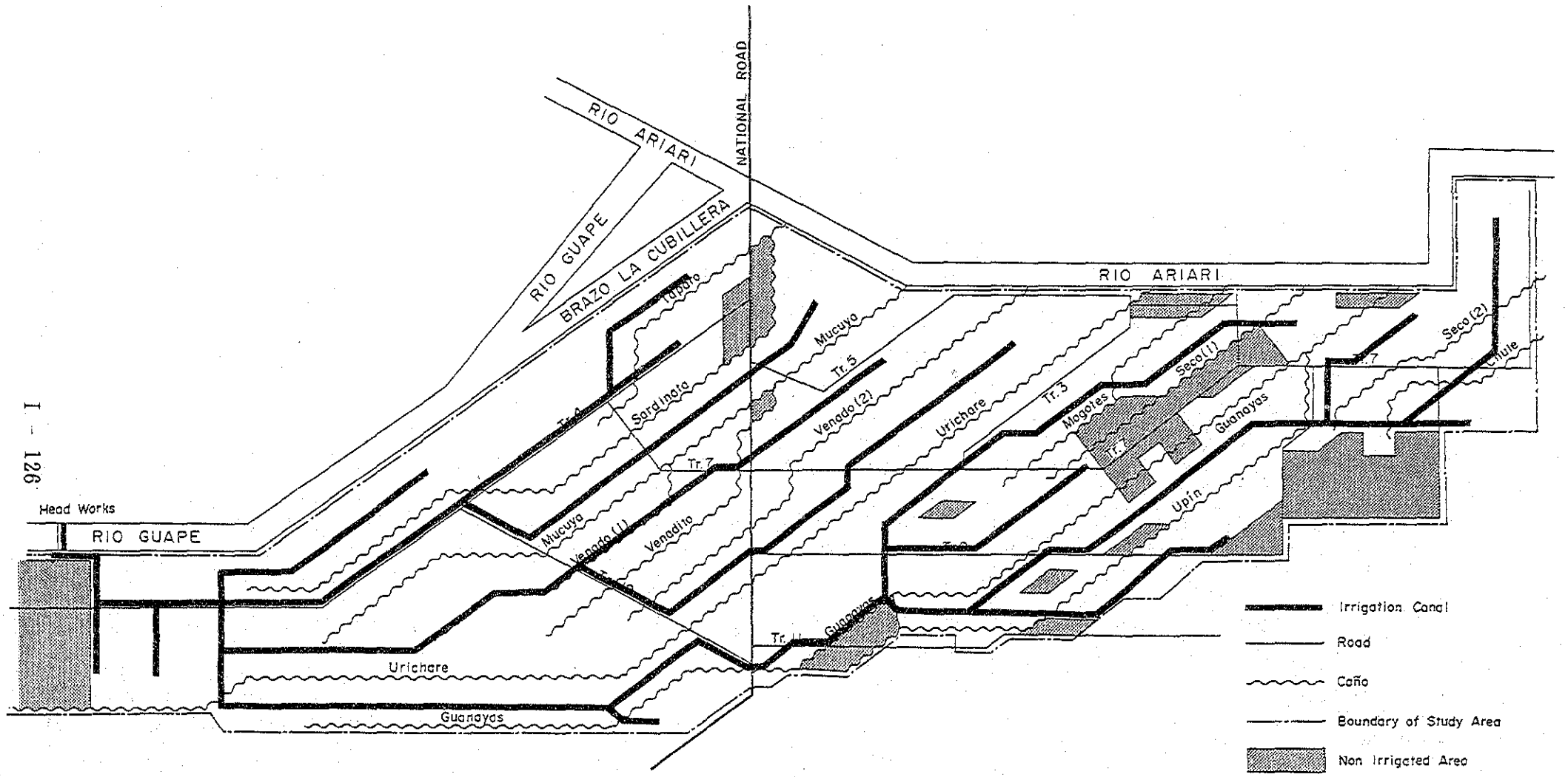


Fig. I-2-8 IRRIGATION CANAL SYSTEM PLAN I

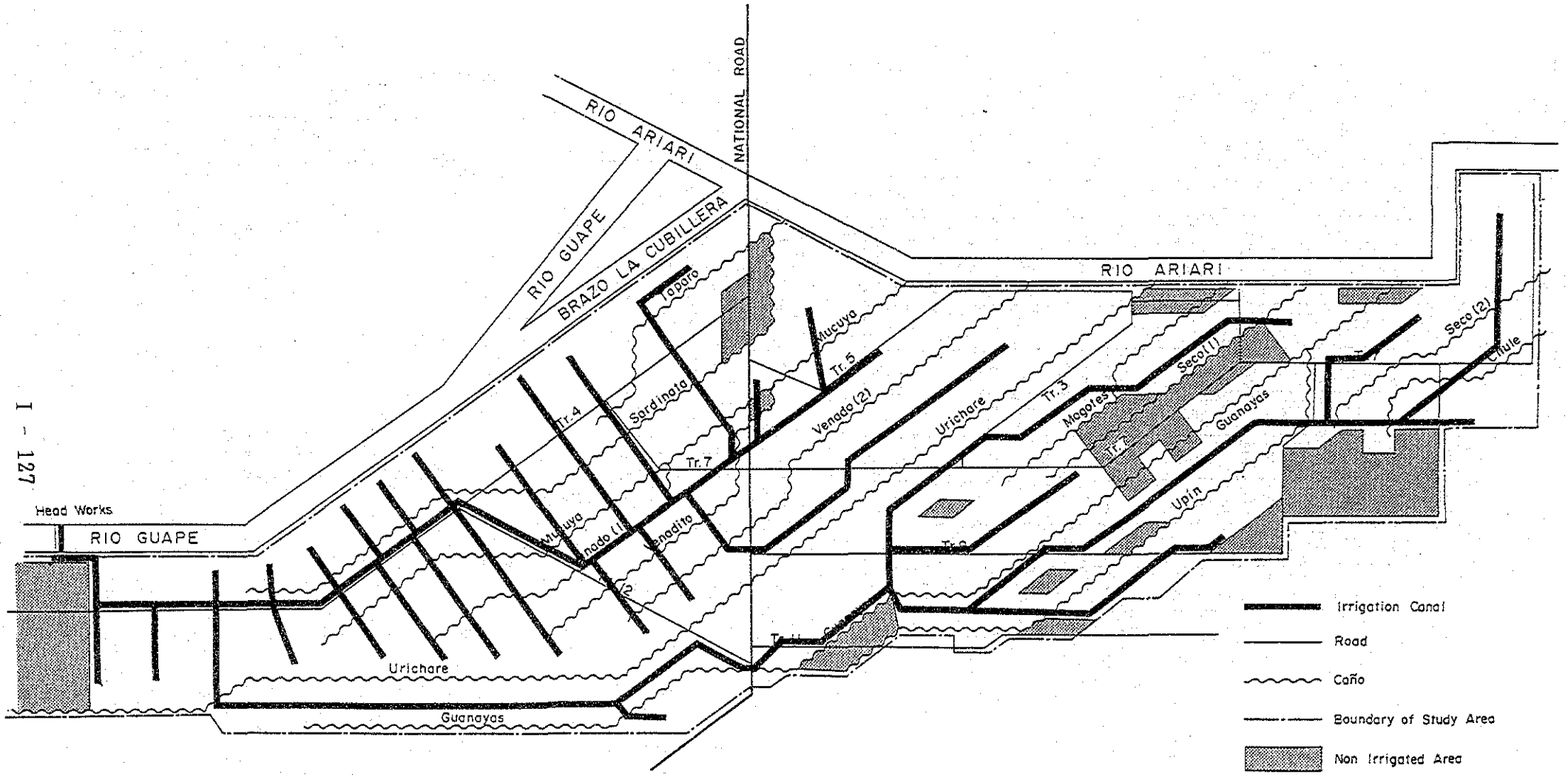
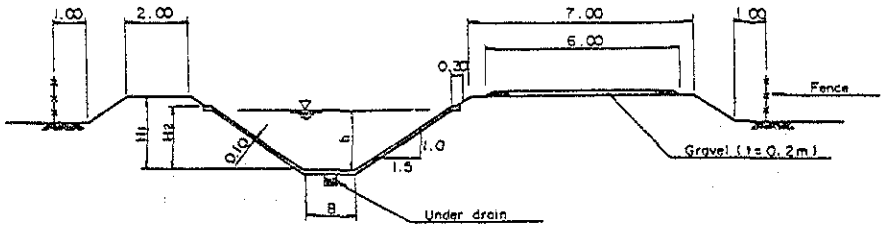
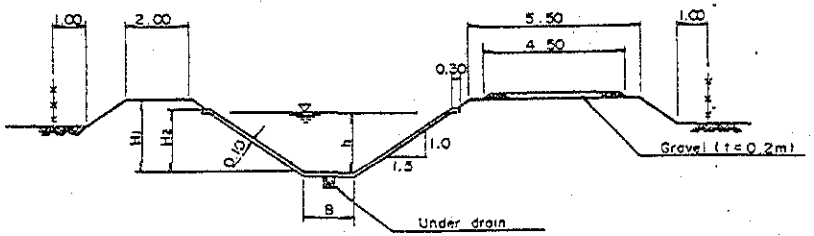


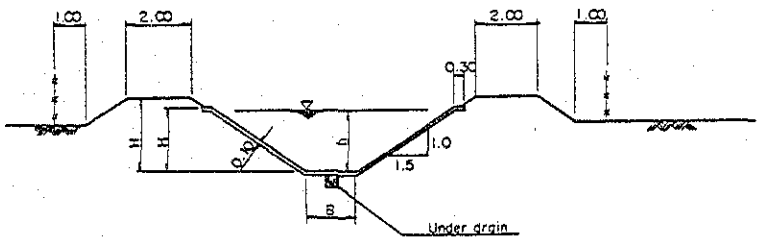
Fig. I-2-9 IRRIGATION CANAL SYSTEM PLAN II



C-a TYPE STANDARD SECTION



C-b TYPE STANDARD SECTION



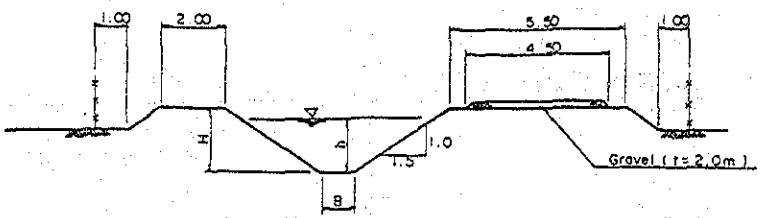
C-c TYPE STANDARD SECTION

Canal Dimensions

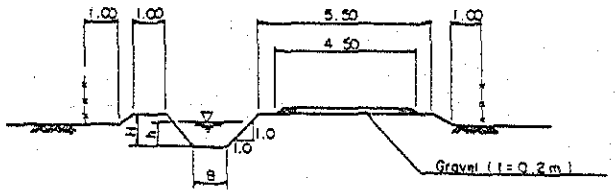
Type	B	H_1	H_2	n	Q
C-1	2.5	3.7	3.4	1.5	36.725 ~35.509
C-2	1.5	2.7	2.5	1.5	17.672 ~17.034
C-3	1.5	2.7	2.4	1.5	16.872 ~16.018
C-4	1.5	2.5	2.3	1.5	15.424 ~14.897
C-5	1.5	2.5	2.1	1.5	14.717 ~14.209
C-6	1.0	2.0	1.8	1.5	8.631 ~ 8.225
C-7	1.0	1.7	1.5	1.5	6.102 ~ 5.428
C-8	1.0	1.6	1.4	1.5	5.330 ~ 5.032

note B :Width Of Bottom(m)
H_1 :Height Of Canal(m)
H_2 :Height Of Lining(m)
n :Side Slope
Q :Design Discharge(m^3/sec)

Fig. I-2-10 Standard Section of Irrigation Canal (Concrete Lined)



So-a TYPE STANDARD SECTION



So-b TYPE STANDARD SECTION

Canal Dimensions

Type	B	H	h	n	Q
So-1	1.0	2.3	2.0	1.5	4.776~4.329
So-2	1.0	2.1	1.8	1.5	4.058~3.558
So-3	1.0	1.9	1.7	1.5	3.382~2.962
So-4	1.0	1.8	1.5	1.5	3.004~2.531
So-5	1.0	1.7	1.4	1.5	2.692~2.124
So-6	1.0	1.5	1.3	1.5	2.205~1.934
So-7	1.0	1.5	1.3	1.5	2.205~1.717
So-8	1.0	1.3	1.1	1.5	1.786~1.154
So-9	1.0	1.1	0.9	1.5	1.326~0.541
So-10	1.0	1.0	0.8	1.5	1.096~0.730
So-11	1.0	0.9	0.7	1.5	0.731~0.257
So-12	1.0 0.5	1.1 0.9	0.9 0.6	1.0	Under 0.723

note B:Width Of Bottom(m)
H:Height Of Canal(m)
h:Height Of Lining(m)
n:Side Slope
Q:Design Discharge(m^3 /sec)

Fig. I-2-11 Standard Section of Irrigation Canal (Unlined)

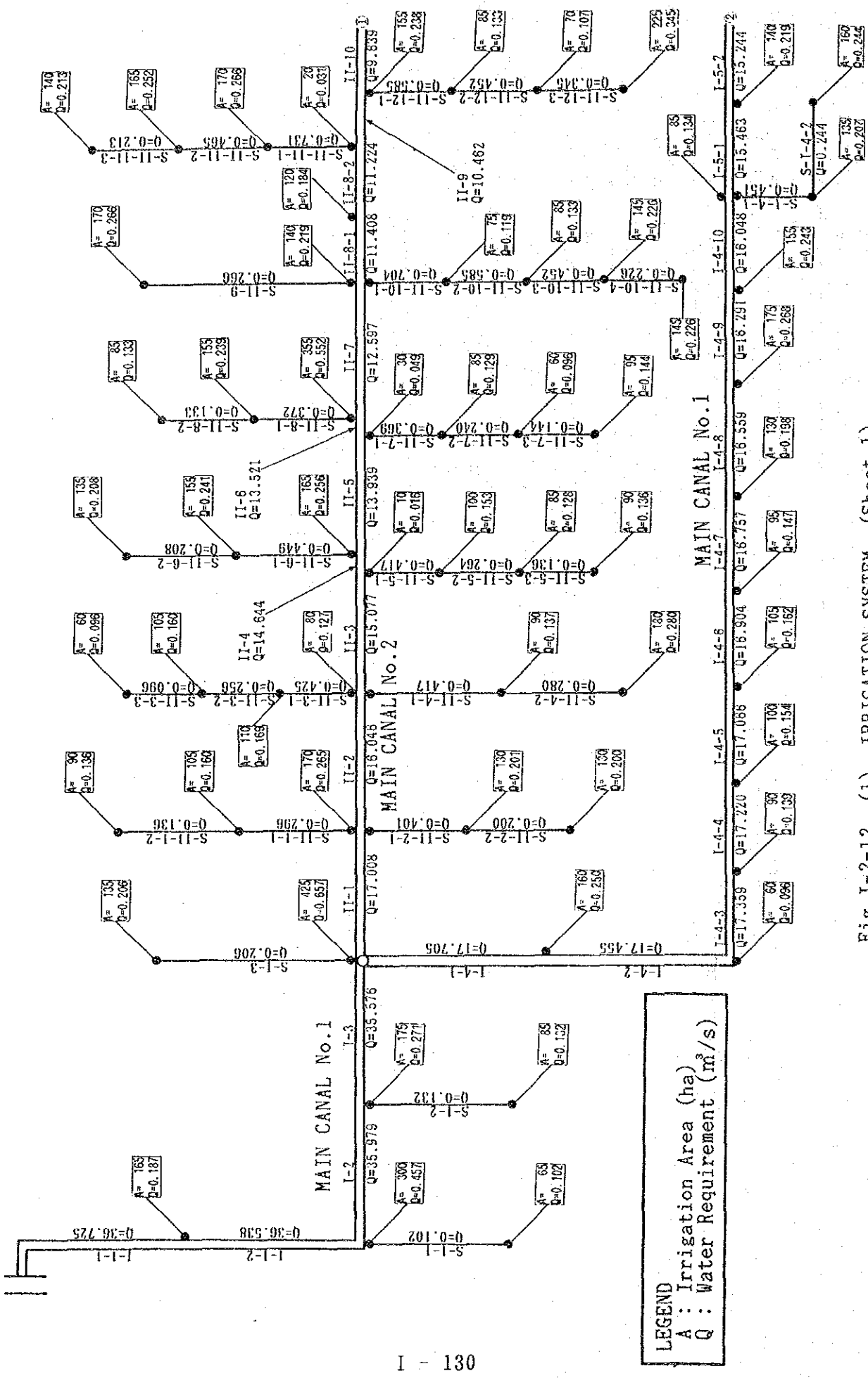


Fig.I-2-12 (1) IRRIGATION SYSTEM (Sheet 1)

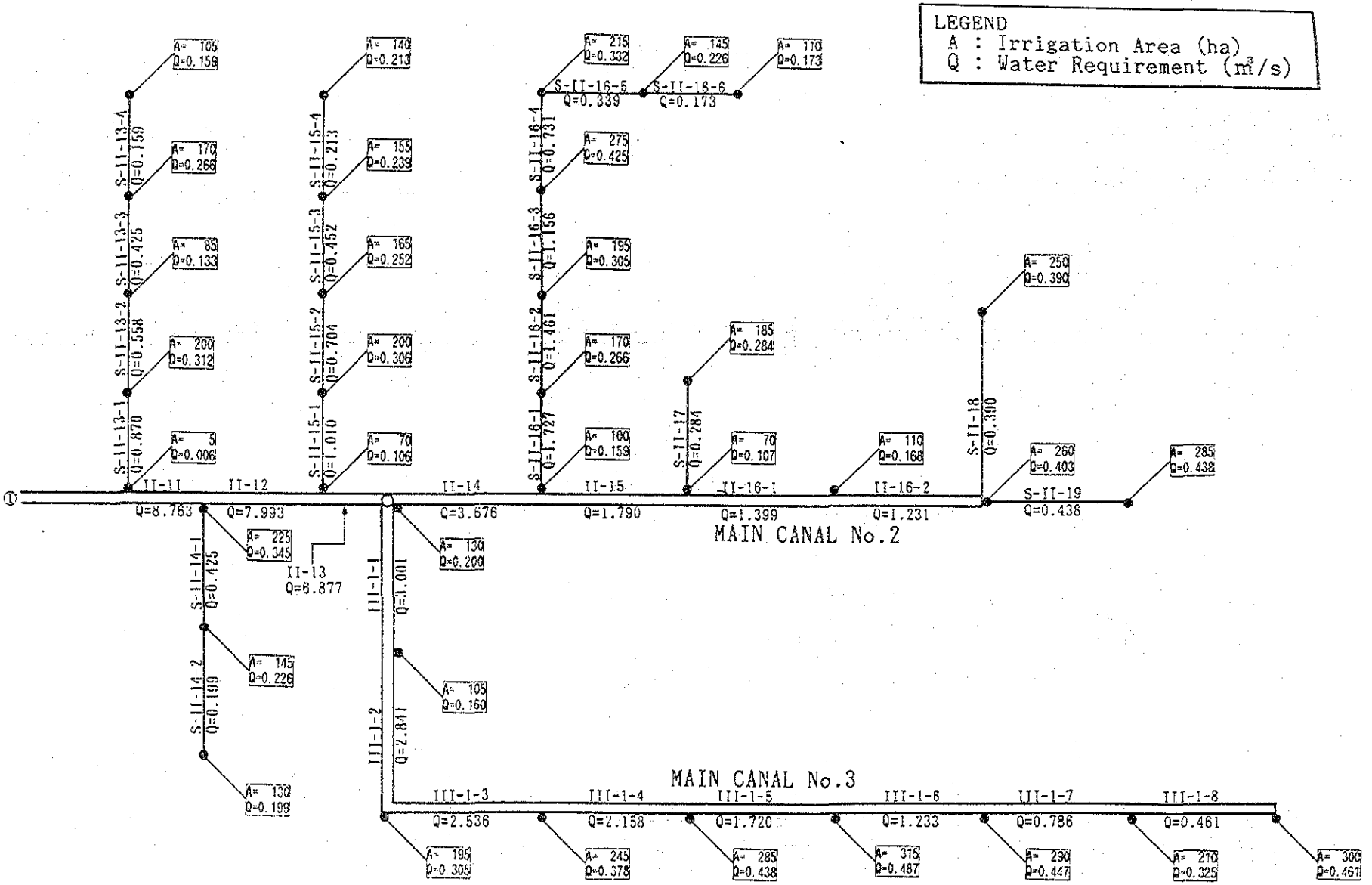


Fig.I-2-12 (2) IRRIGATION SYSTEM (Sheet 2)

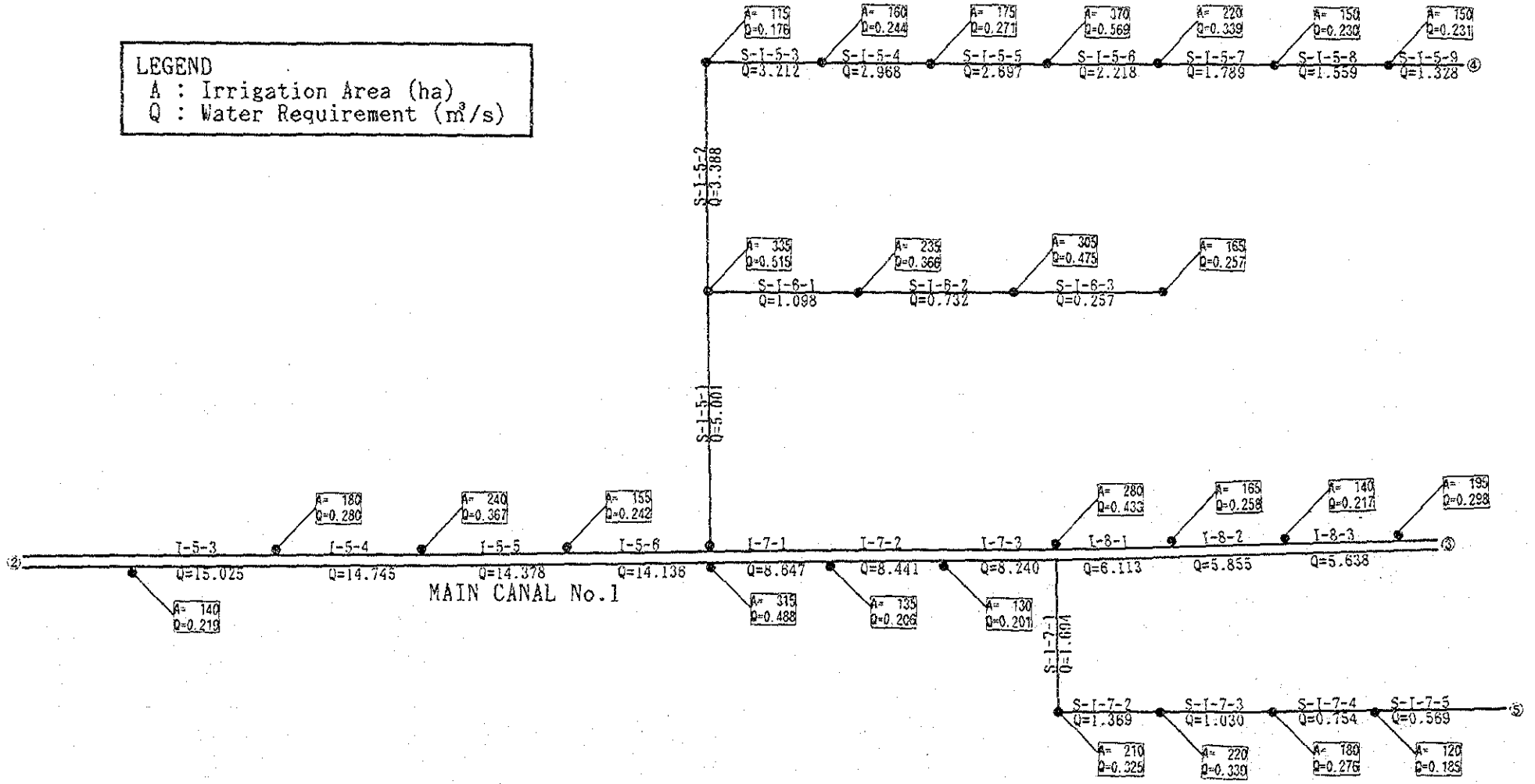


Fig.I-2-12 (3) IRRIGATION SYSTEM (Sheet 3)

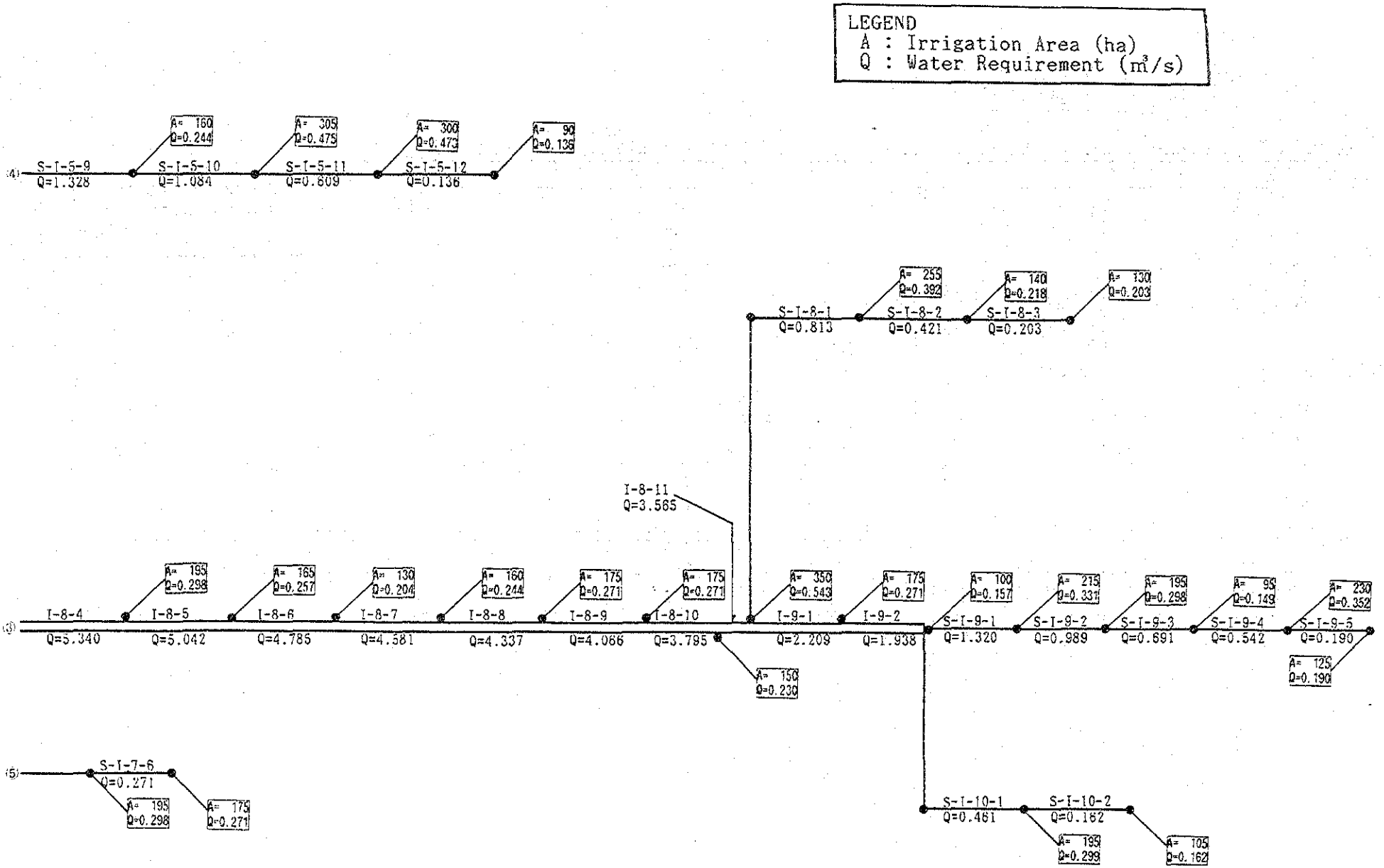


Fig.I-2-12 (4) IRRIGATION SYSTEM (Sheet 4)

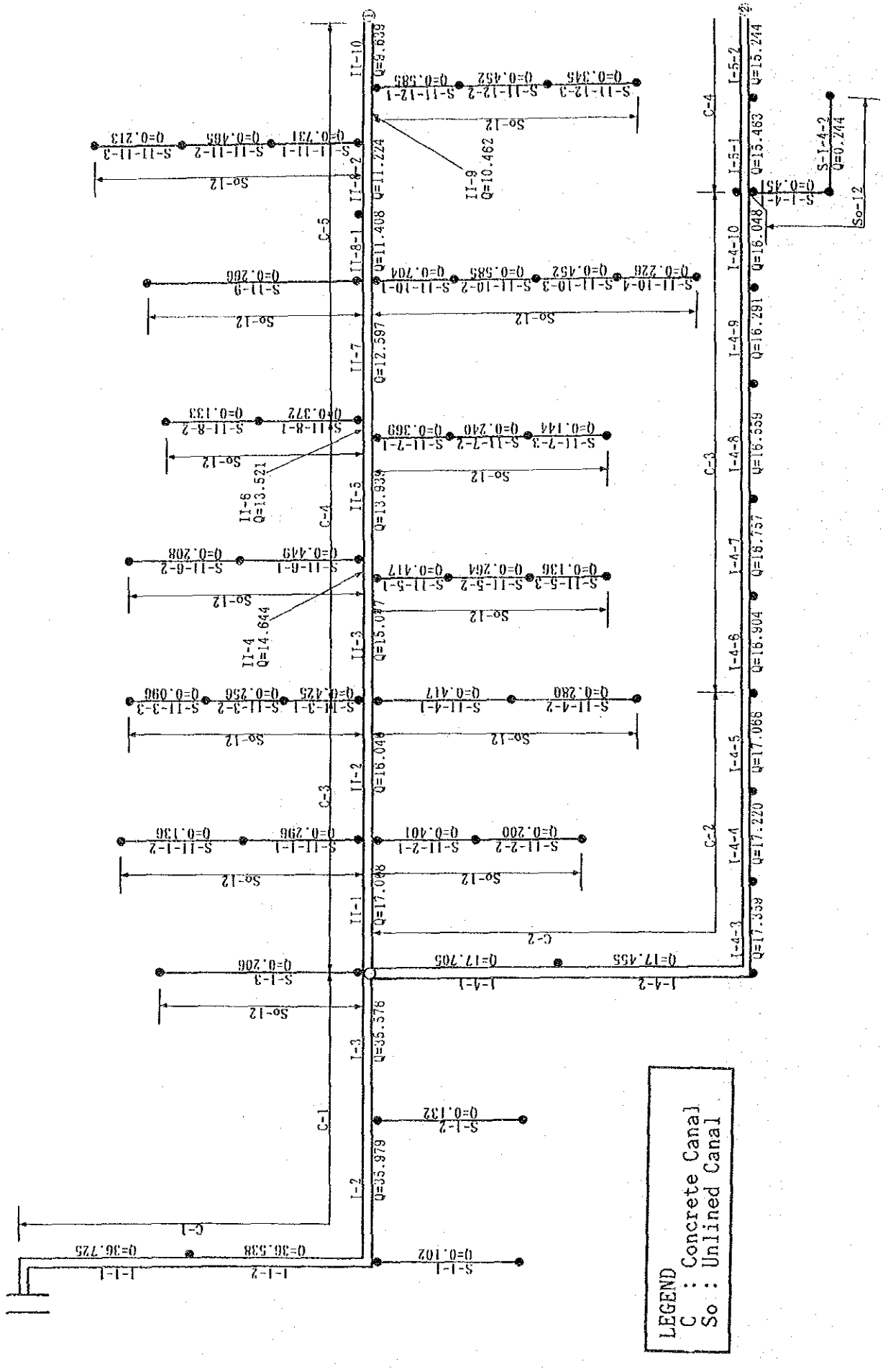


Fig.I-2-12 (5) IRRIGATION SYSTEM (Sheet 5)

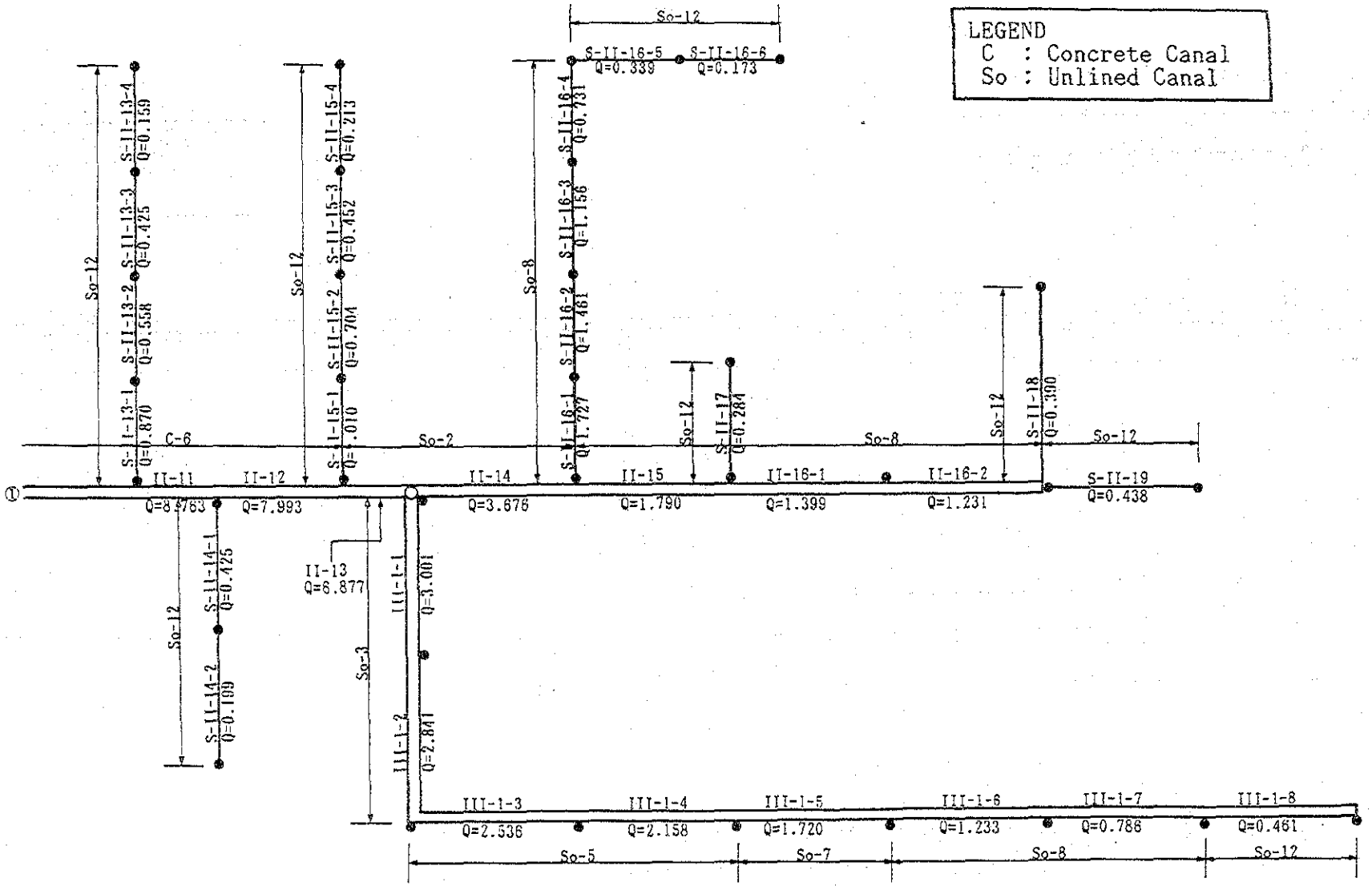


Fig.I-2-12 (6) IRRIGATION SYSTEM (Sheet 6)

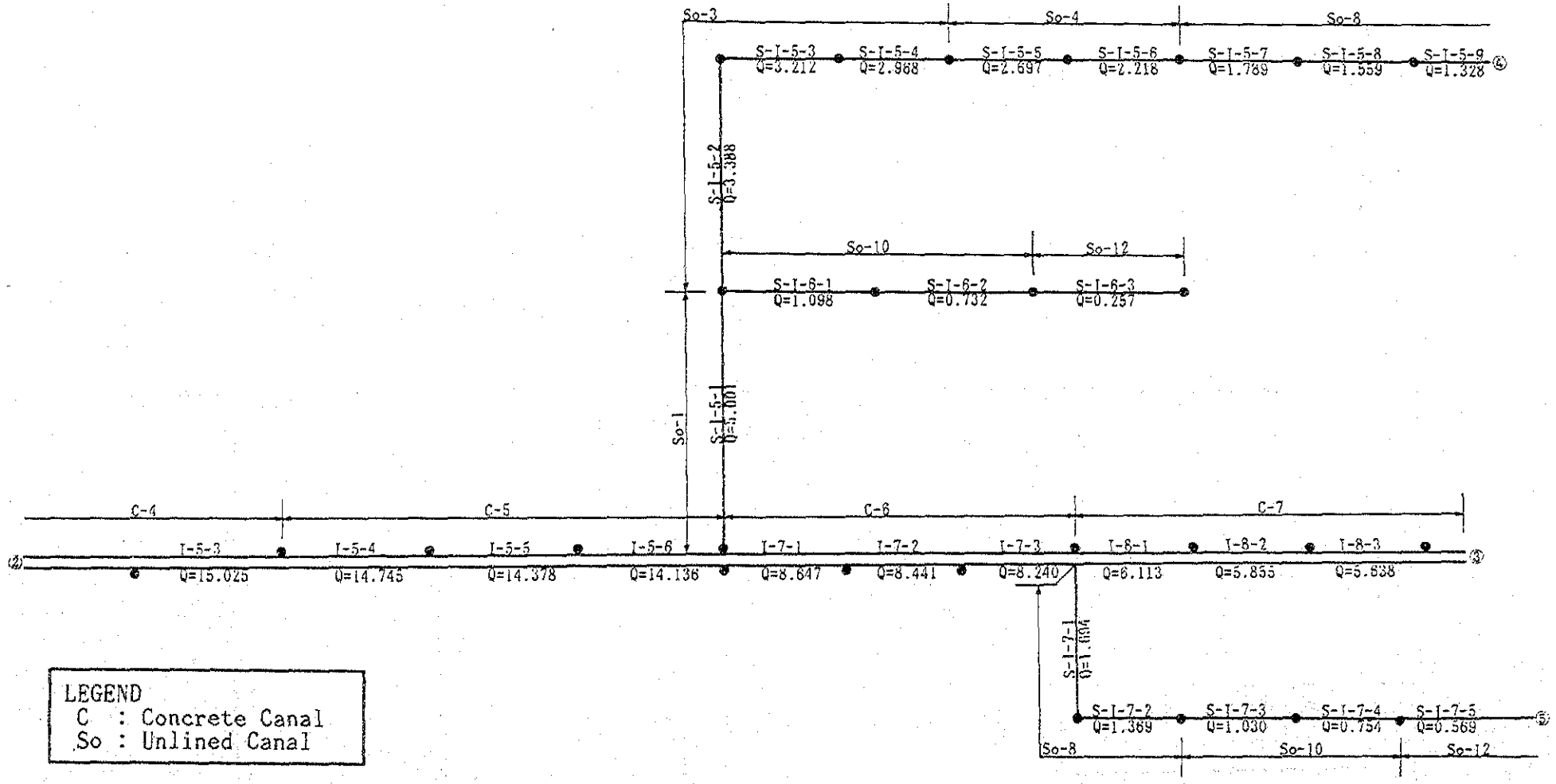


Fig.I-2-12 (7) IRRIGATION SYSTEM (Sheet 7)

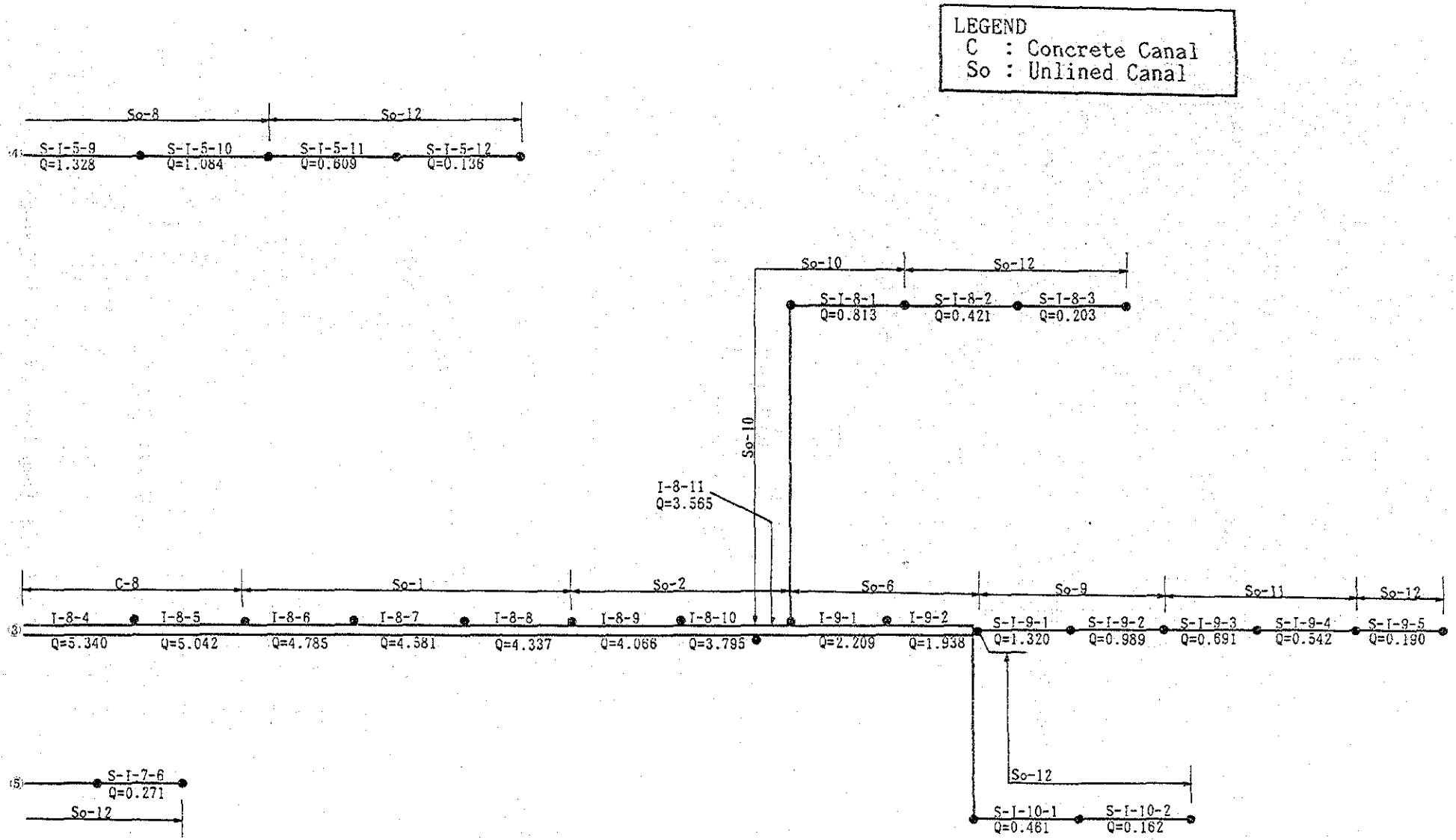
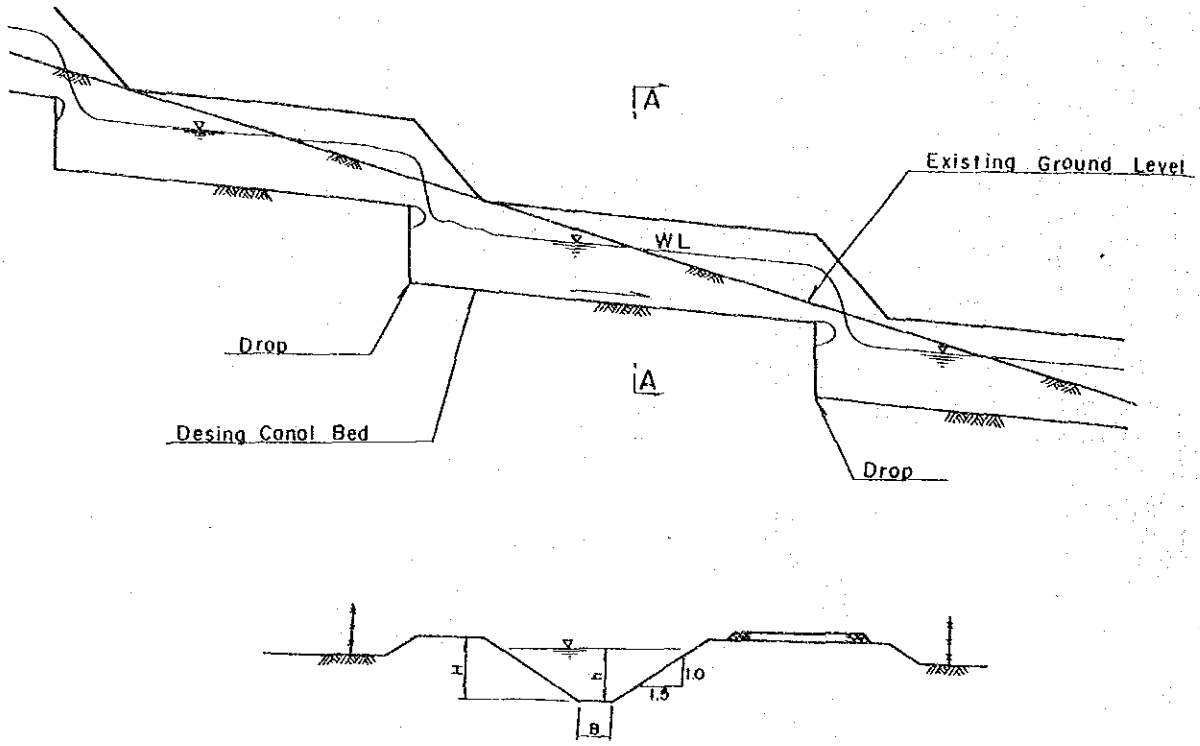
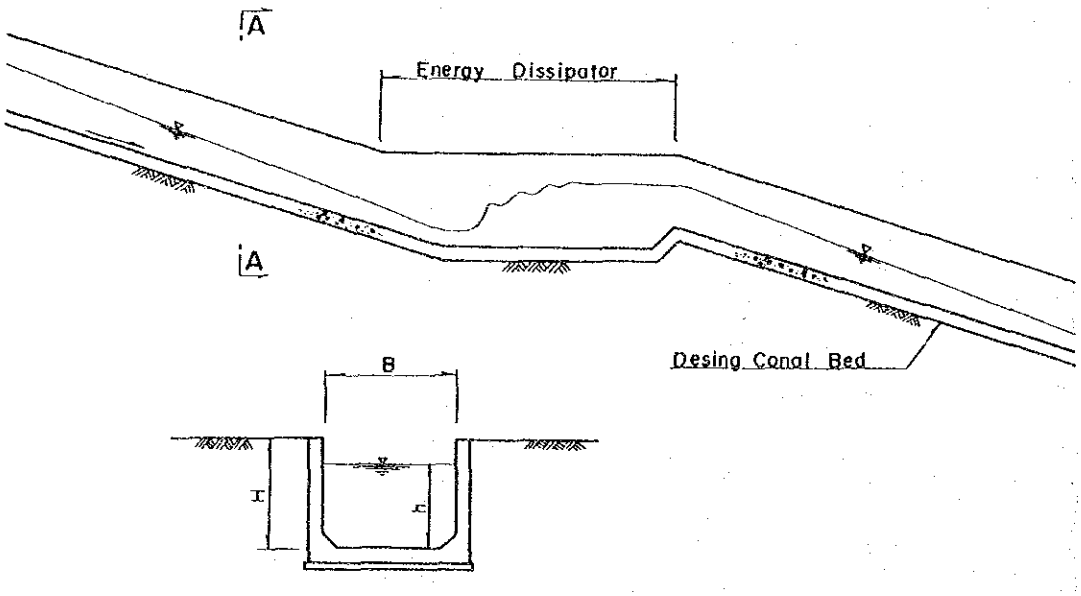


Fig.I-2-12 (8) IRRIGATION SYSTEM (Sheet 8)



SECTION A--A

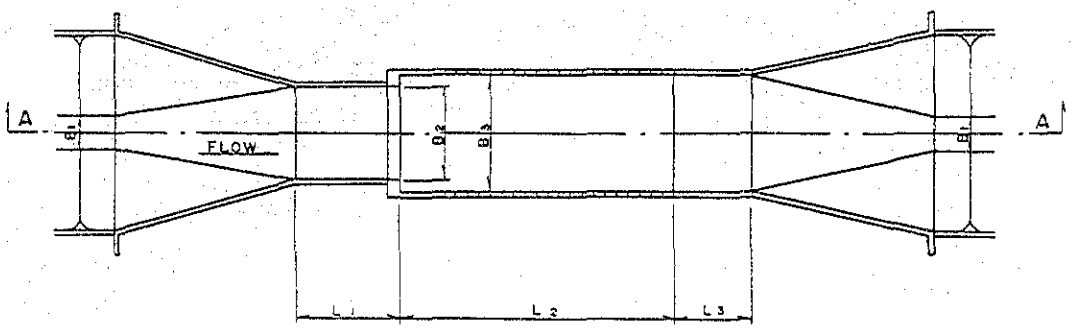
DROP TYPE



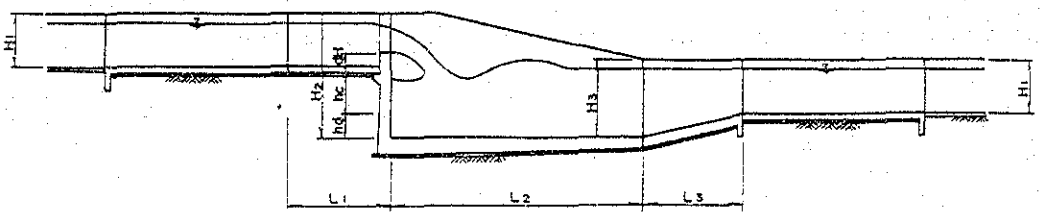
SECTION A-A

CHUTE TYPE

Fig.I-2-13 Camprison of Canal System



PLAN



SECTION A-A

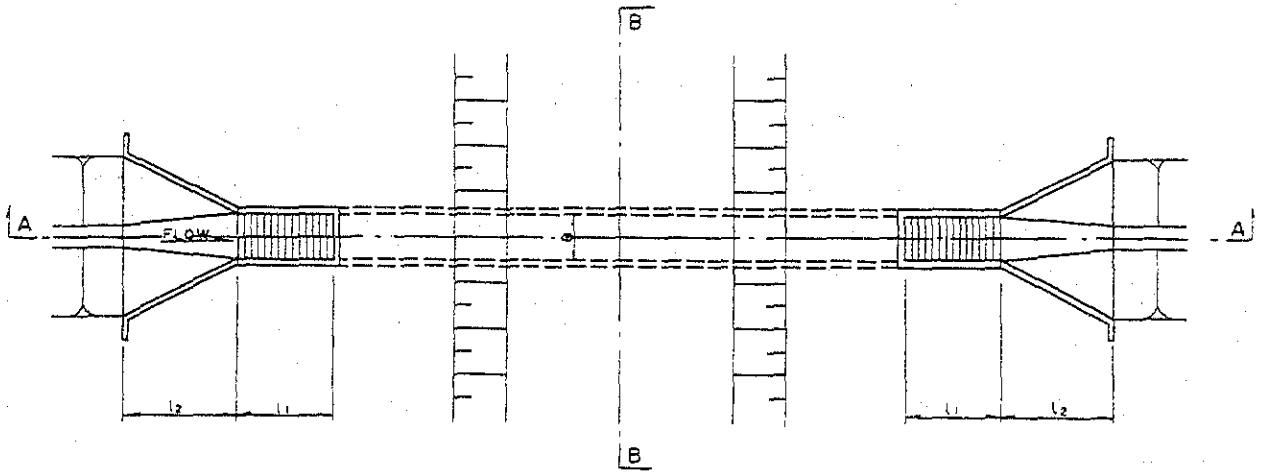
DIMENSIONS

(m)

TYPE	Q (m³/sec) max	Q (m³/sec) min	H1	H2	dH	hc	hd	B1	B2	B3	L1	L2	L3
1	37	36	3.8	7.0	0.6	2.0	1.2	2.5	4.6	5.6	5.5	17	4.8
2	18	17	2.7	5.9	0.6	2.0	1.2	1.5	4.1	5.1	4.9	14	4.8
3	17	14	2.5	5.6	0.6	2.0	1.1	1.5	4.1	5.1	4.6	12	4.4
4	14	11	2.3	5.4	0.6	2.0	1.1	1.5	4.0	5.0	4.5	11	4.4
5	11	9	2.1	5.1	0.6	2.0	1.0	1.0	3.7	4.7	4.4	9.5	4.0
6	9	6	2.0	4.9	0.6	2.0	0.9	1.0	3.6	4.6	4.3	9	3.6
7	6	3.8	2.0	4.8	0.6	2.0	0.8	1.0	2.7	3.7	4.3	8.5	3.2
8	3.8	3.3	1.9	4.7	0.6	2.0	0.8	1.0	2.3	3.3	4.3	8	3.2
9	3.3	2.5	1.8	4.5	0.5	2.0	0.7	1.0	2.2	3.2	4.2	7.5	2.8
10	2.5	2.2	1.6	4.3	0.4	2.0	0.7	1.0	2.0	3.0	4.2	7	2.8
11	2.2	1.7	1.5	4.2	0.35	2.0	0.7	1.0	1.9	2.9	4.2	6.5	2.8
12	1.7	1.3	1.3	3.9	0.25	2.0	0.6	1.0	1.7	2.7	4.1	6	2.4
13	1.3	1.0	1.0	3.6	0.2	2.0	0.6	1.0	1.5	2.5	4.1	5.5	2.4
14	1.0	0.1	0.9	3.5	0.2	2.0	0.6	1.0	1.2	2.2	4.0	5	2.0
15	2.0	1.7	1.3	2.8	0.35	1.0	0.5	1.0	1.8	2.8	3.4	5	2.0
16	1.7	1.3	1.1	2.6	0.25	1.0	0.5	1.0	1.6	2.6	3.4	4.5	1.6
17	1.2	0.1	1.0	2.4	0.2	1.0	0.4	1.0	1.5	2.5	3.2	4	1.6

Fig.I-2-14 Related Structure No.1 (Drop)

SIPHON-1



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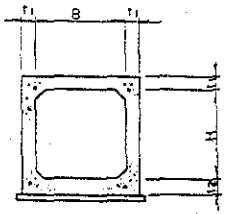
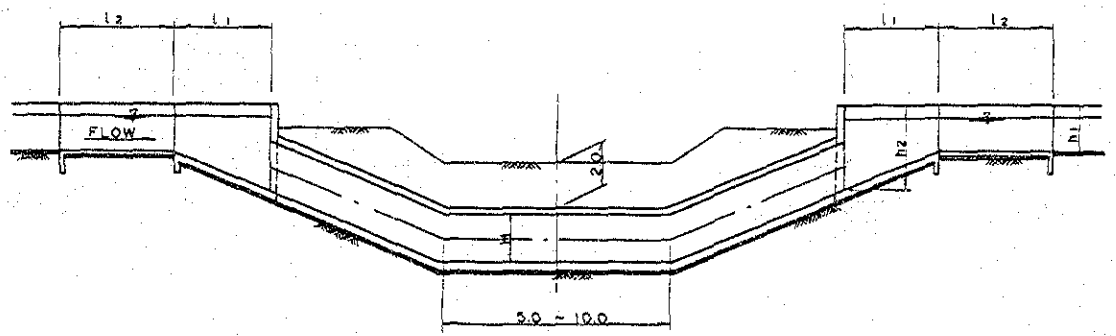


SECTION B-B

DIMENSIONS

(m)

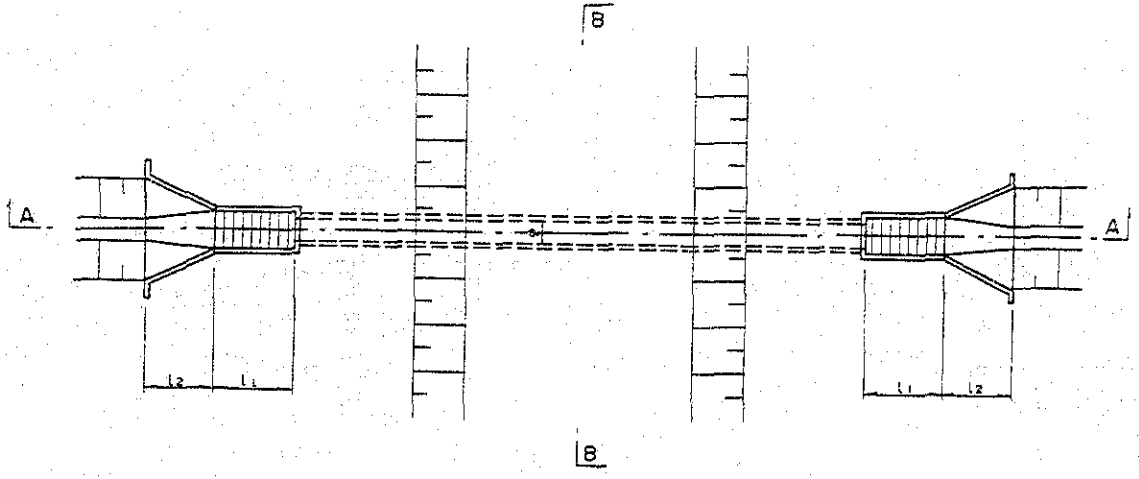
TYPE	Q (m³/sec) max	Q (m³/sec) min	B	H	h1	h2	l1	l2	t1	t2
1	37	36	3.5	3.5	3.7	6.0	6.0	5.0	0.4	0.45
2	18	15	2.5	2.5	2.7	4.5	4.5	5.0	0.3	0.35
3	13	8	2.0	2.0	2.1	3.5	3.5	5.0	0.3	0.35
4	6	2.5	1.5	1.5	2.1	3.0	2.5	5.0	0.3	0.35



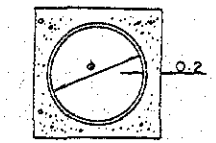
SECTION A-A

Fig. I-2-14 Related Structure No.2 (Siphon-1)

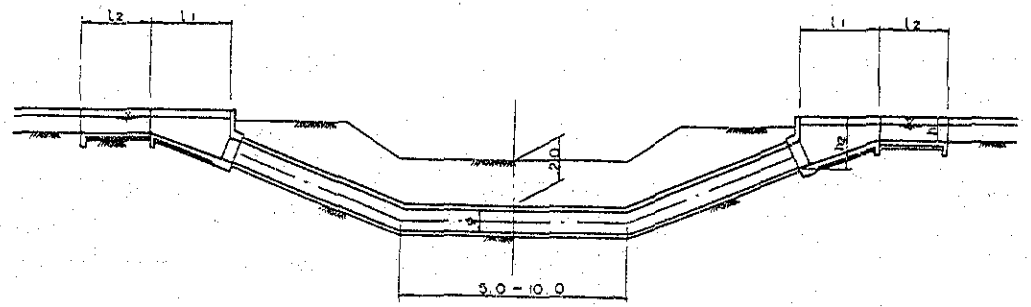
SIPHON-2



PLAN



SECTION B-B



SECTION A-A

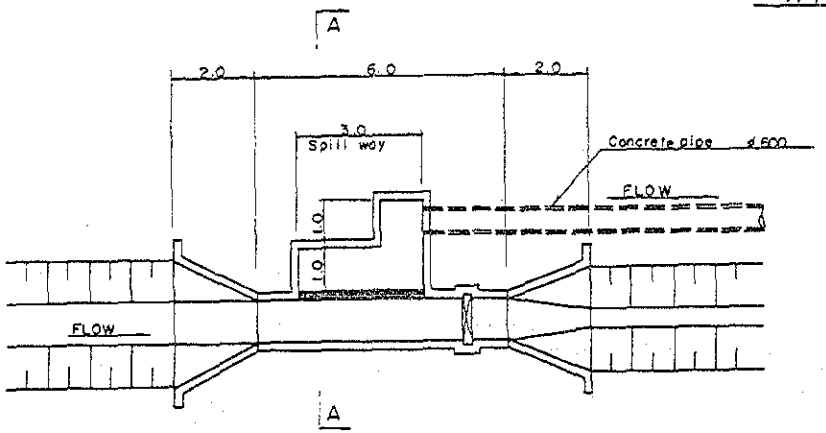
DIMENSIONS

(m)

TYPE	Q (m³/sec) max	Q (m³/sec) min	φ mm	h1	h2	l1	l2
1	2.5	1.5	1200	1.5	2.8	3.5	3.0
2	1.5	1.0	1000	1.2	2.4	3.0	3.0
3	1.0	0.5	800	0.9	2.1	3.0	2.0
4	0.5	0.1	600	0.9	1.8	2.5	2.0

Fig.I-2-14 Related Structure No.3 (Siphon-2)

WASTE WAY - 2



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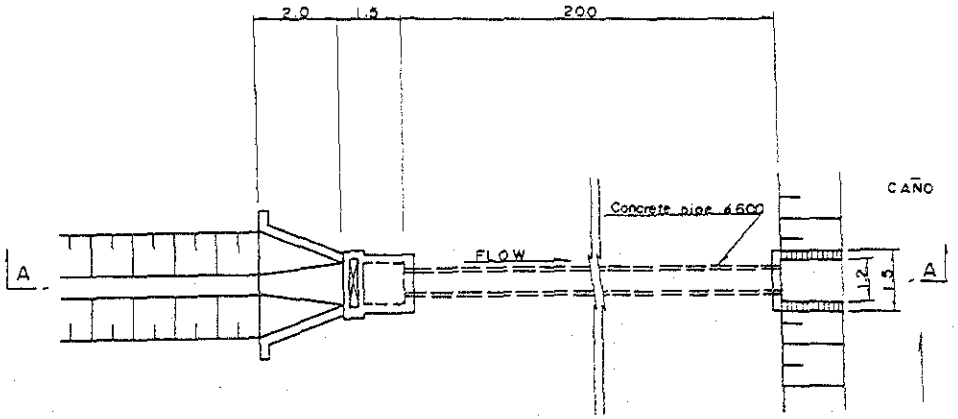
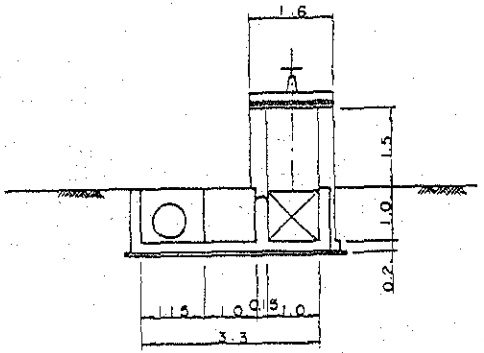
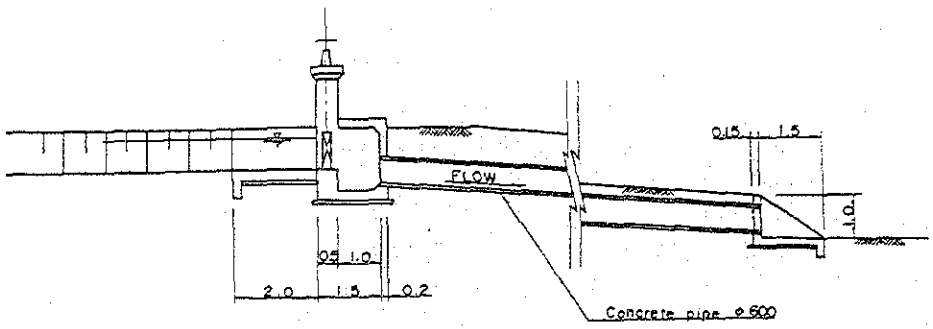


PLAN



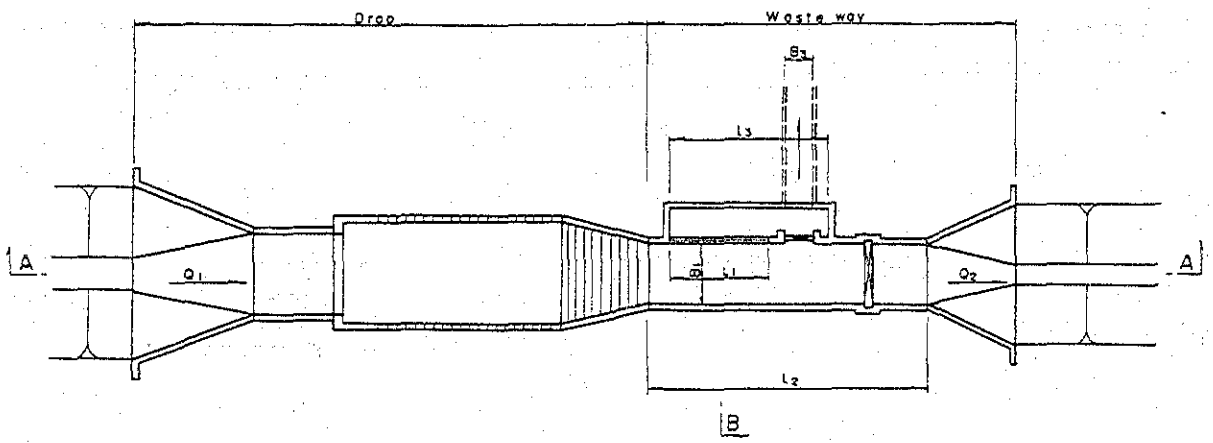
SECTION A-A



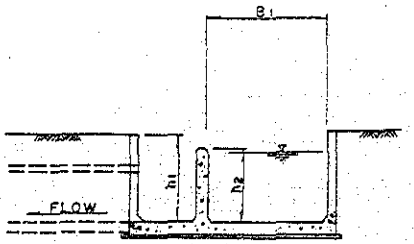
SECTION A-A

Fig. I-2-14 Related Structure No.5 (Wasteway-2)

WASTE WAY - 1



PLAN

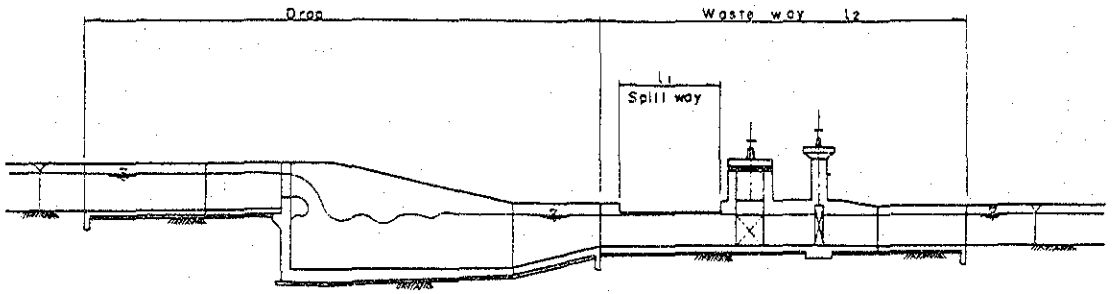


SECTION B-B

DIMENSIONS

(m)

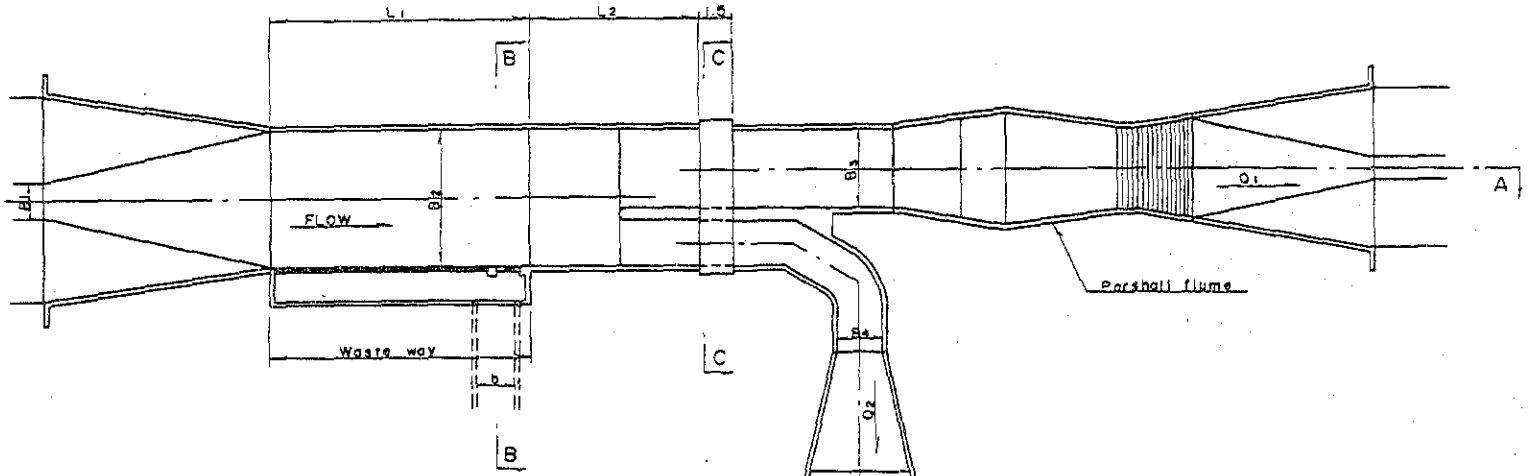
TYPE	Q_1 (m³/sec)	Q_2 (m³/sec)	B_1	B_2	h_1	h_2	l_1	l_2
1	15~18	12~17	4.5	2.0	2.7	2.25	5.0	15.0
2	12~13	9~10	3.5	2.0	2.3	1.85	7.0	15.0
3	5~7	3~6	2.5	1.5	1.7	1.35	4.0	12.0
4	3~5	2~5	2.5	φ1200 mm	2.1	1.40	3.0	8.0
5	1~3	0.5~2	1.5	φ1000	1.2	0.95	3.0	8.0

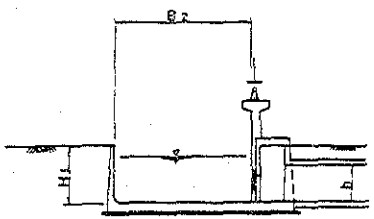


SECTION A-A

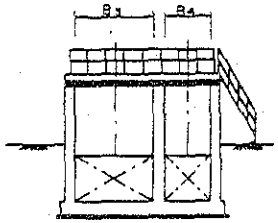
Fig.I-2-14 Related Structure No.4 (Wasteway-1)

DIVISION WORKS-I (LONGITUDINAL TYPE)





SECTION B-B



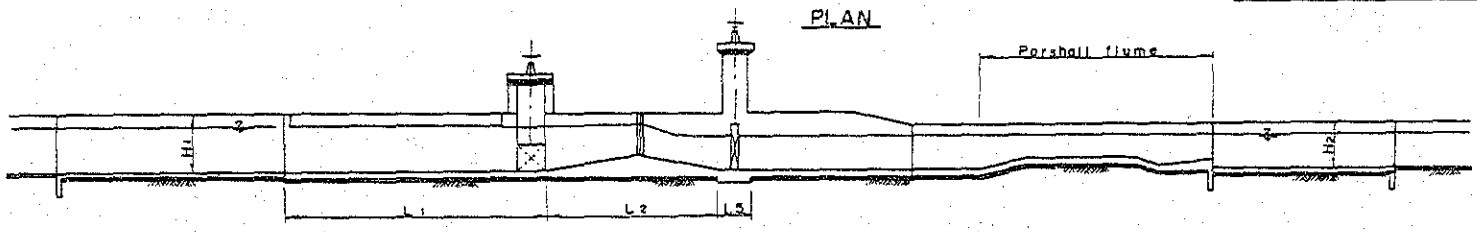
SECTION C-C

PLAN

DIMENSIONS

(m)

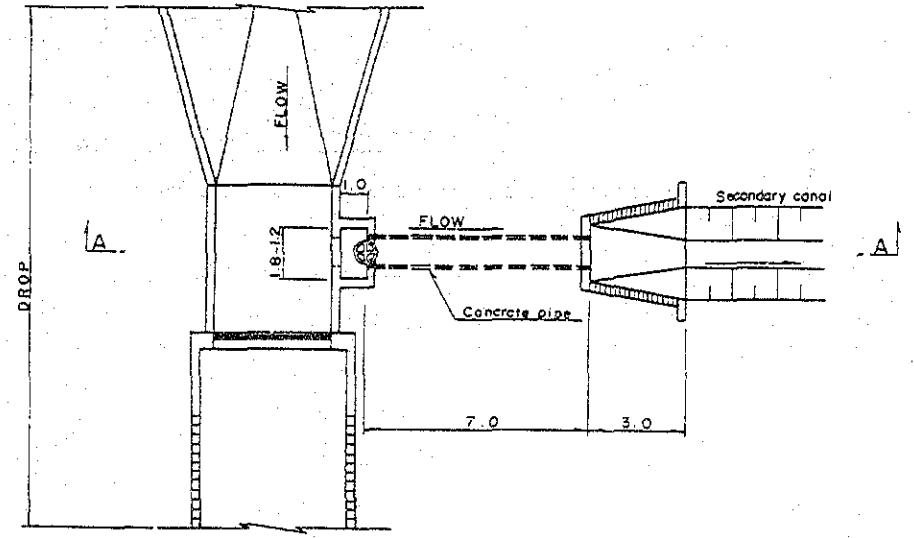
TYPE	Q (m³/sec) 1	Q (m³/sec) 2	b	h	L1	L2	H1	H2	B1	B2	B3	B4
1	17.705	17.008	2.2	2.2	19	16.5	3.7	2.7	2.5	10.4	5.0	4.9
2	8.647	5.001	1.6	1.6	15	8.5	2.5	1.5	1.5	6.0	3.5	2.0
3	6.113	1.694	1.4	1.4	10	7.0	2.0	1.7	1.0	5.3	3.0	1.8
4	3.388	1.098	1.2	1.2	9	4.5	1.5	1.9	1.0	4.4	2.4	1.5
5	1.790	1.727	0.9	0.9	8	9.5	2.0	1.3	1.0	4.1	1.8	1.8
6	3.676	3.001	1.2	1.2	11	7.5	2.1	2.0	1.0	5.2	2.4	2.3



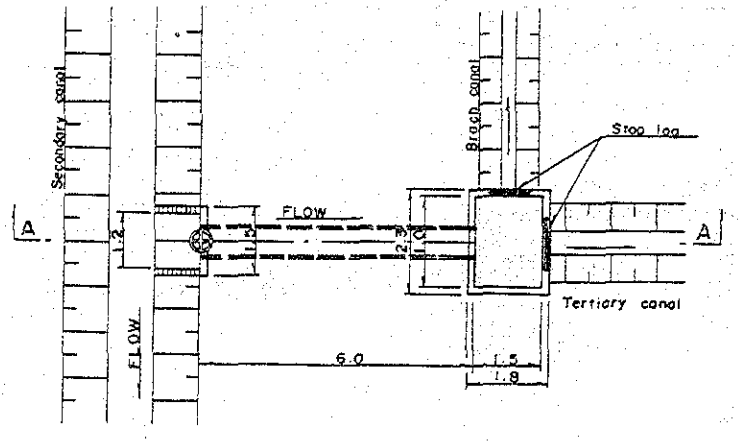
SECTION A-A

Fig-I-2-14 Related Structure No.6 (Division Works-1)

DIVISION WORKS-2 (GATE-CONTROLLED TYPED)



PLAN



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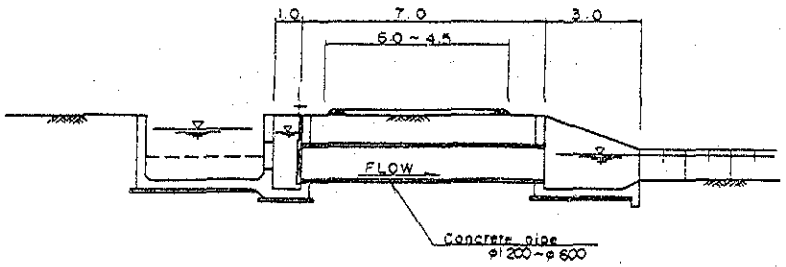
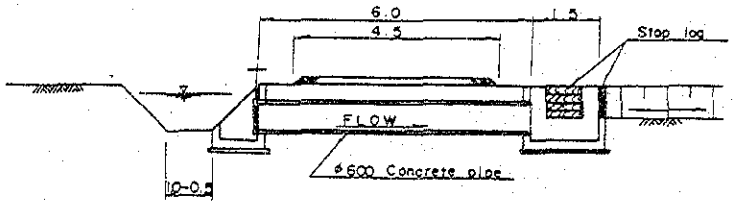


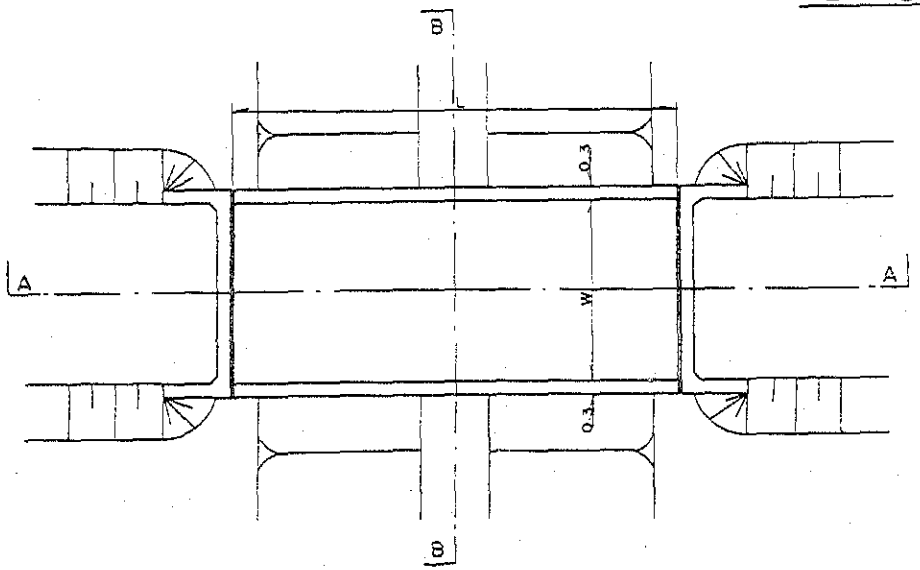
SECTION A-A



SECTION A-A

Fig.I-2-14 Related Structure No.7 (Division Works-2)

BRIDGE



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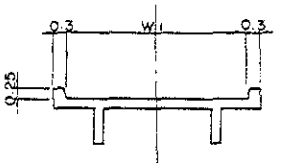
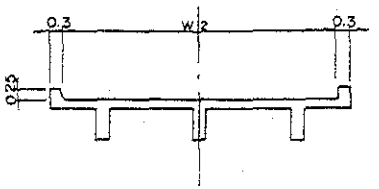
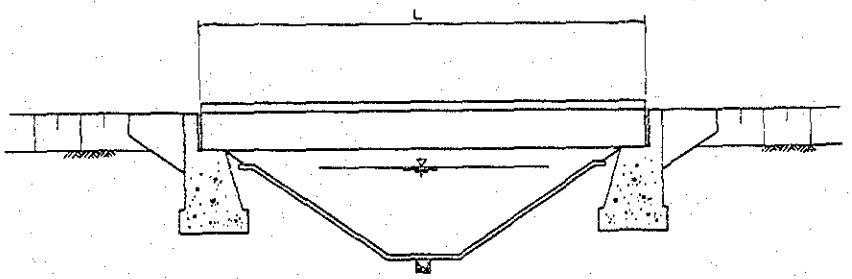




SECTION 8-8



SECTON A-A

DIMENSIONS

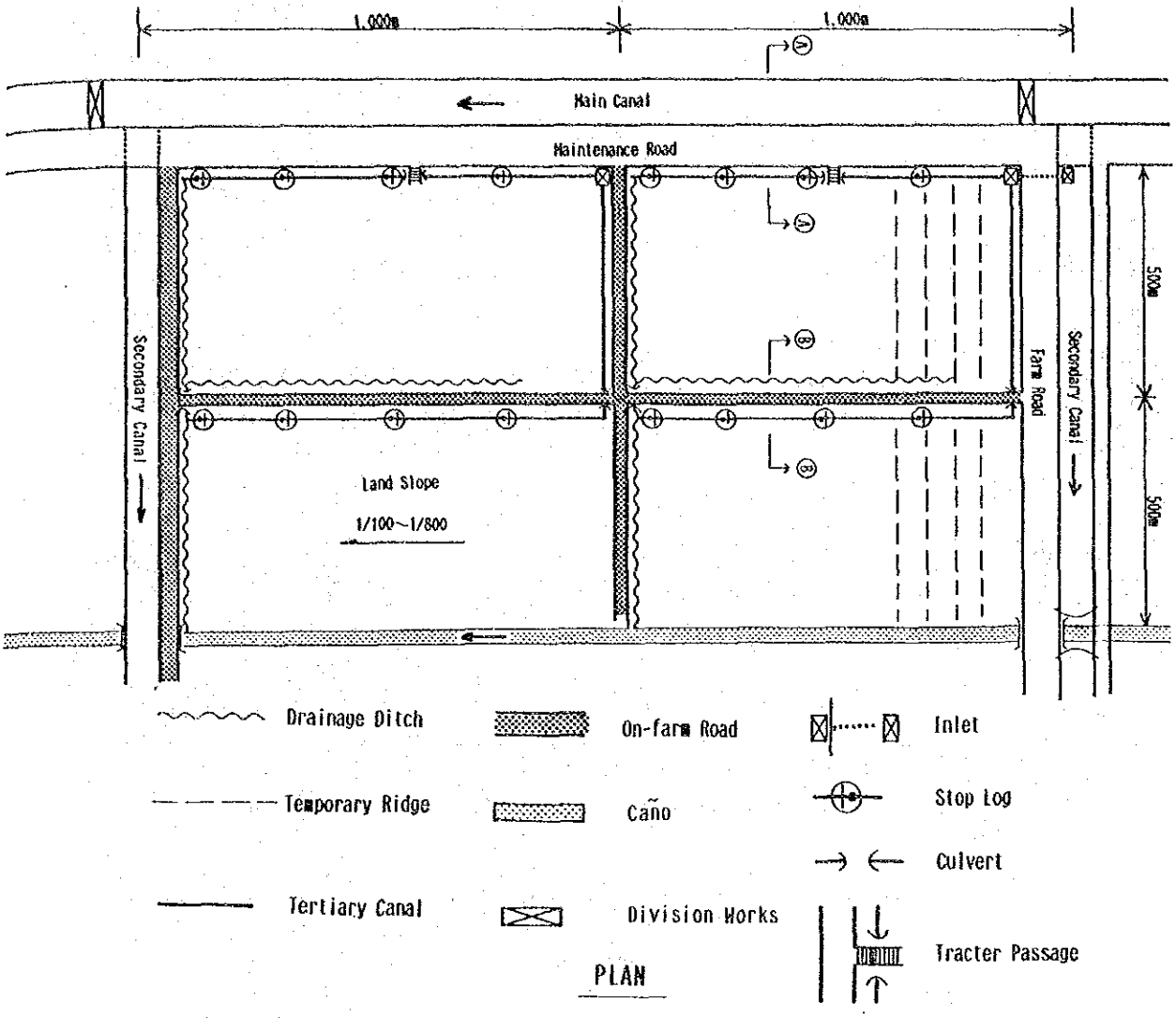
UNIT : (m)

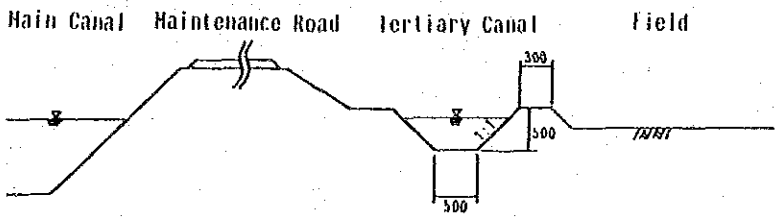
TYPE	Q (m³/sec) max	Q (m³/sec) min	L	W W1	W W2	
1	37	36	14.8	4.0	6.0	8.0
2	17	16	10.8	4.0	6.0	8.0
3	16	12	10.2	4.0	6.0	8.0
4	11	9	8.7	4.0	6.0	8.0
5	9	8	8.2	4.0	6.0	8.0
6	6	5	7.2	4.0	6.0	8.0
7	2	0.1	6.2	4.0	6.0	8.0

REMARK

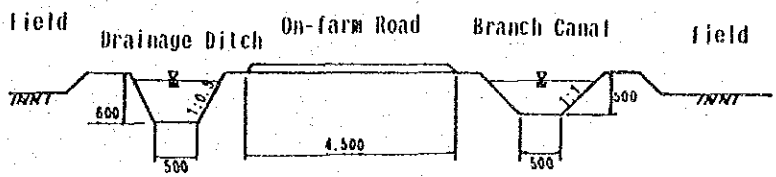
W = 4.0 : ON-FARM ROAD
W = 6.0, 8.0 : TROCHA

Fig.I-2-14 Related Structure No.8 (Bridge)





Section Ⓐ - Ⓐ



Section Ⓑ - Ⓑ

Fig. I-2-15 STANDARD FARM LOT

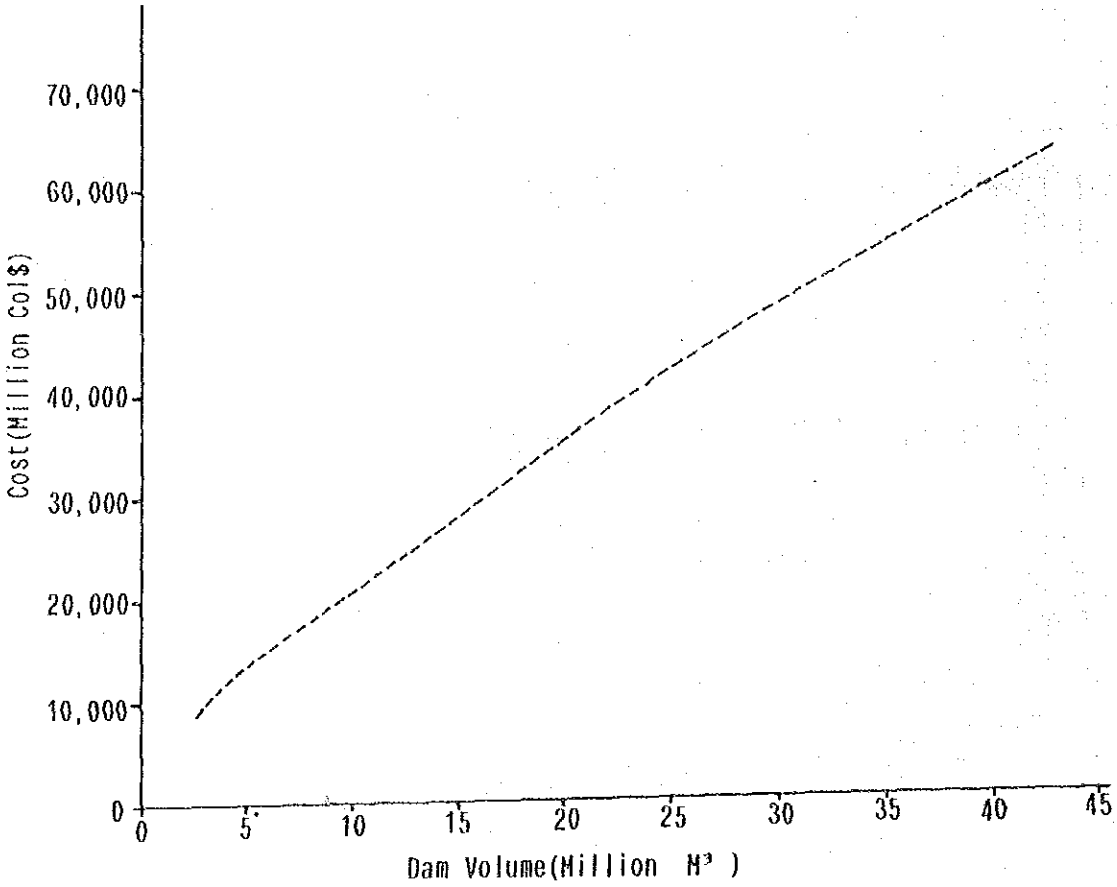


Fig. I-2-16 RELATION BETWEEN WATER STORAGE VOLUME AND COST OF DAM

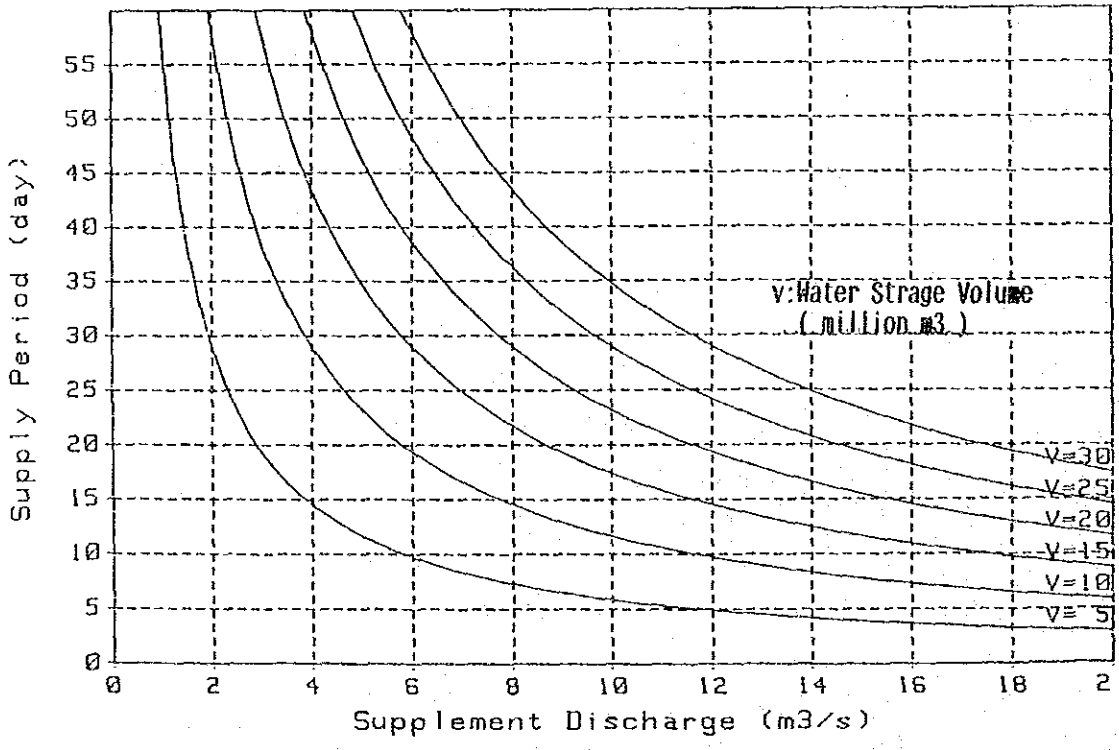


Fig. I-2-17 RELATION BETWEEN WATER STORAGE VOLUME AND WATER SUPPLY

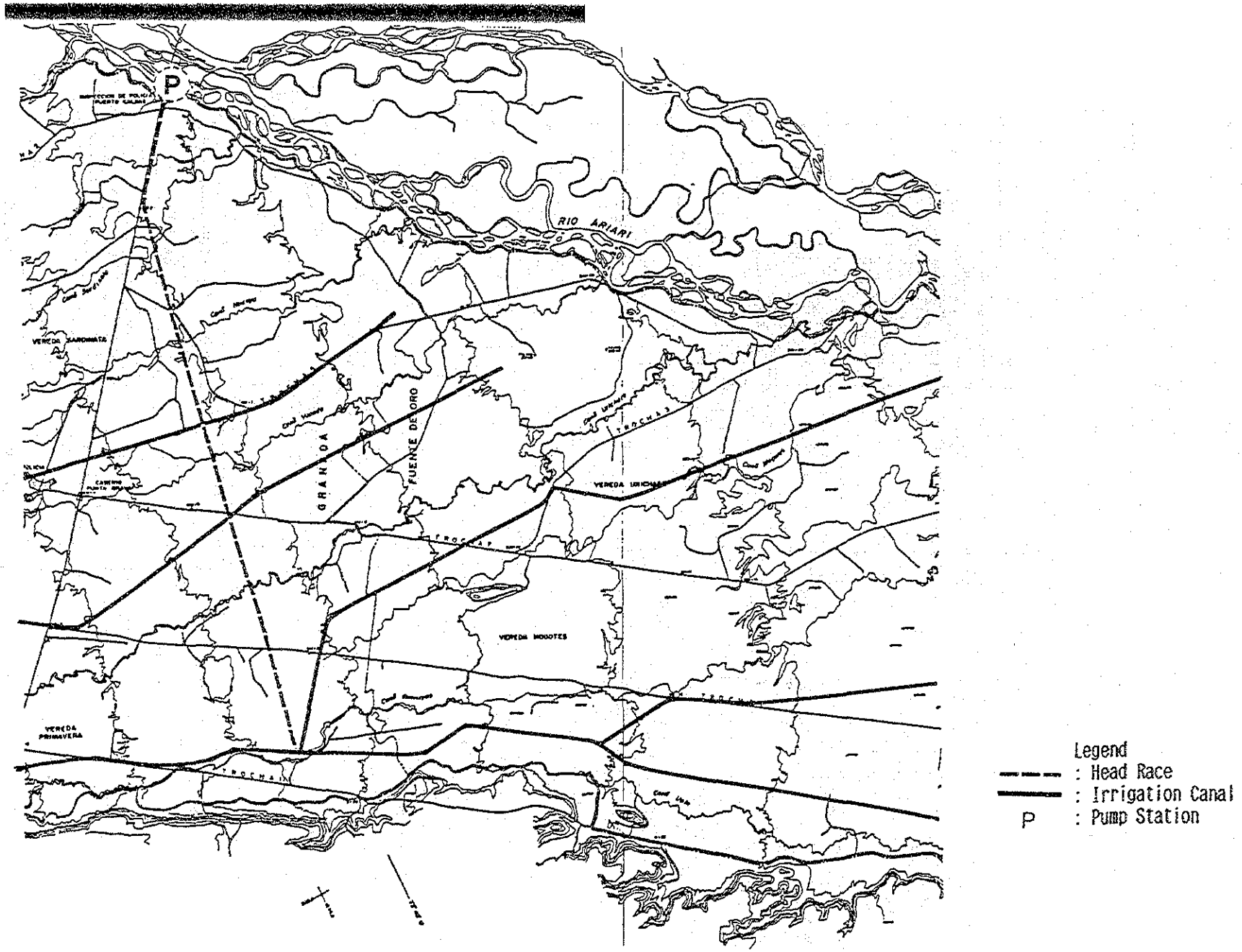
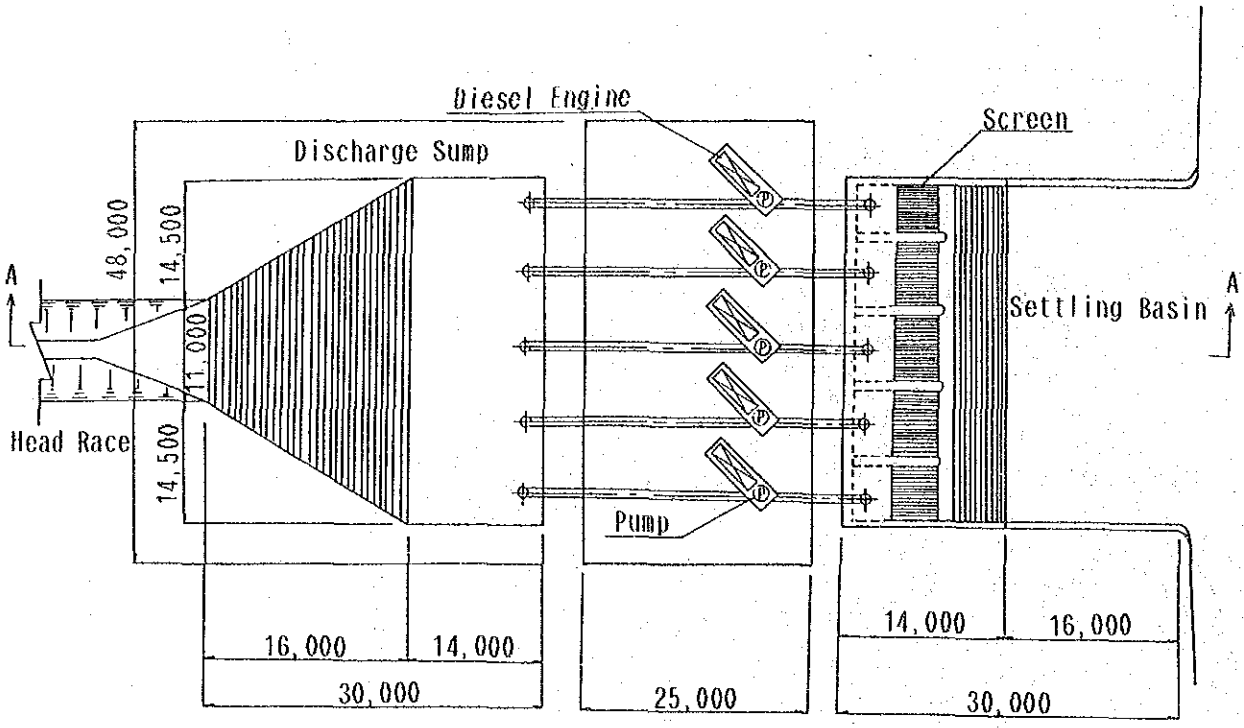
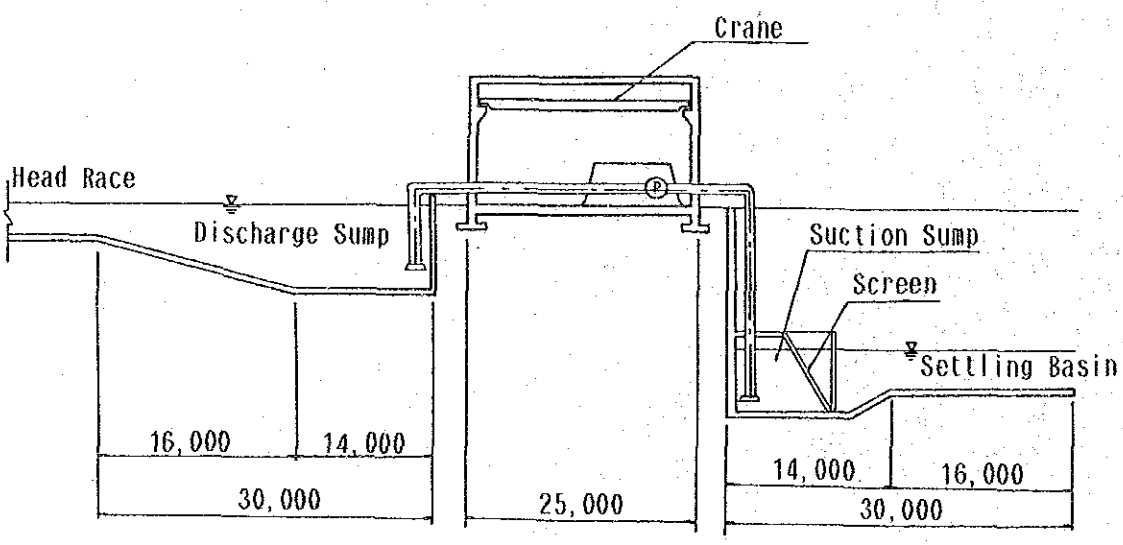


Fig. I-2-18 Preliminary Layout of Pumping System



Plan



Section A-A

Fig. I-2-19 PLAN OF PUMP STATION

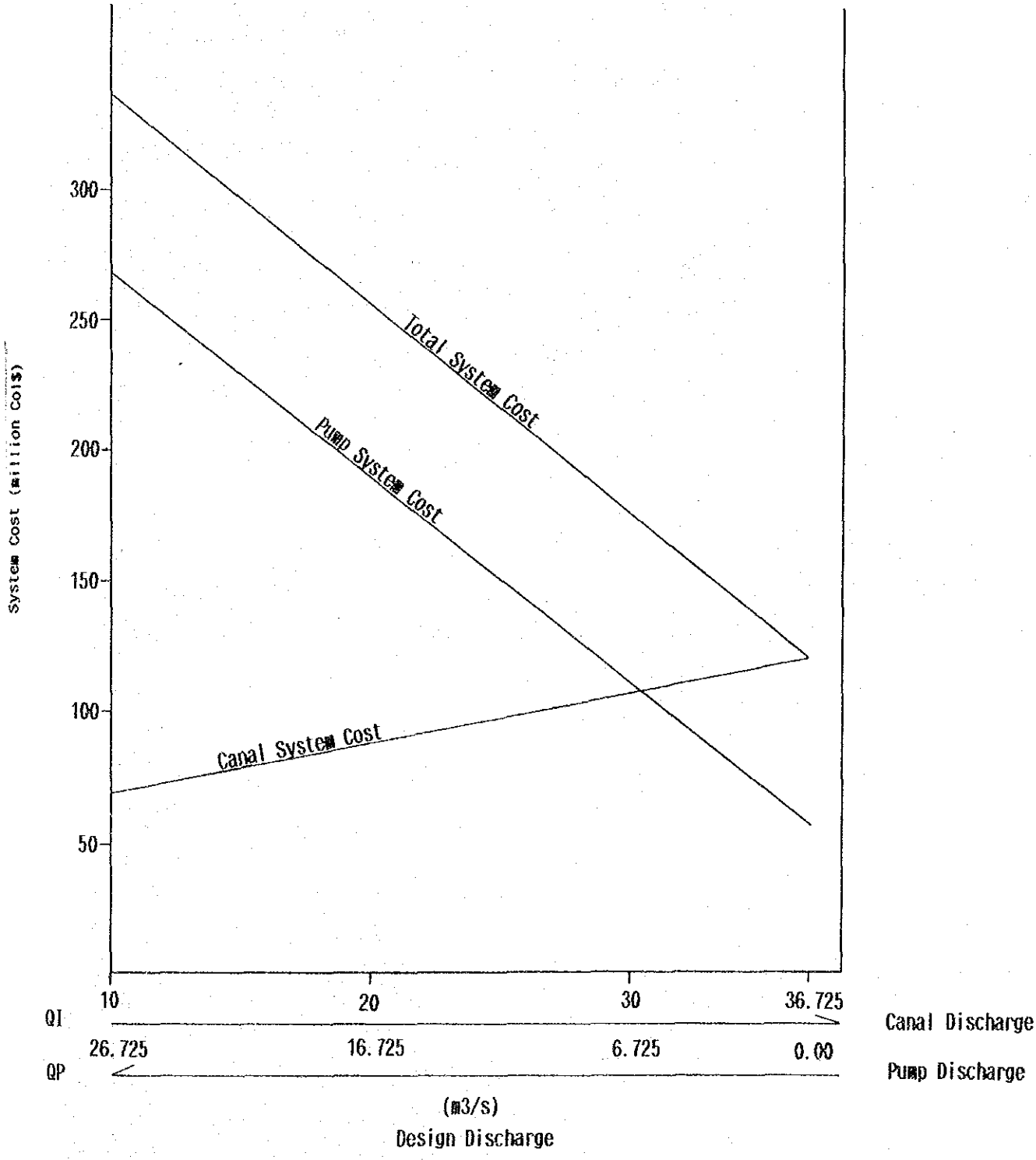


Fig. I-2-20 Relationship between System Cost and Water Distribution

Granada

La Playa

La Cubillera River

Puerto Caldas

Guape River

74°00

Angostura Bridge

Lejanias

Trocha 4

Aguas Claras

Caño Sardinata

Caño Mucuya

Dos Quebradas

Middle Zone

Canaguaro

Punta Brava

Trocha 12

Trocha 1

Trocha 3

Caño M

Trocha 4

Trocha 9

Caño Urichare

Trocha 11

Cacayal

Upper Zone

Naranjal

Sam Ignacio

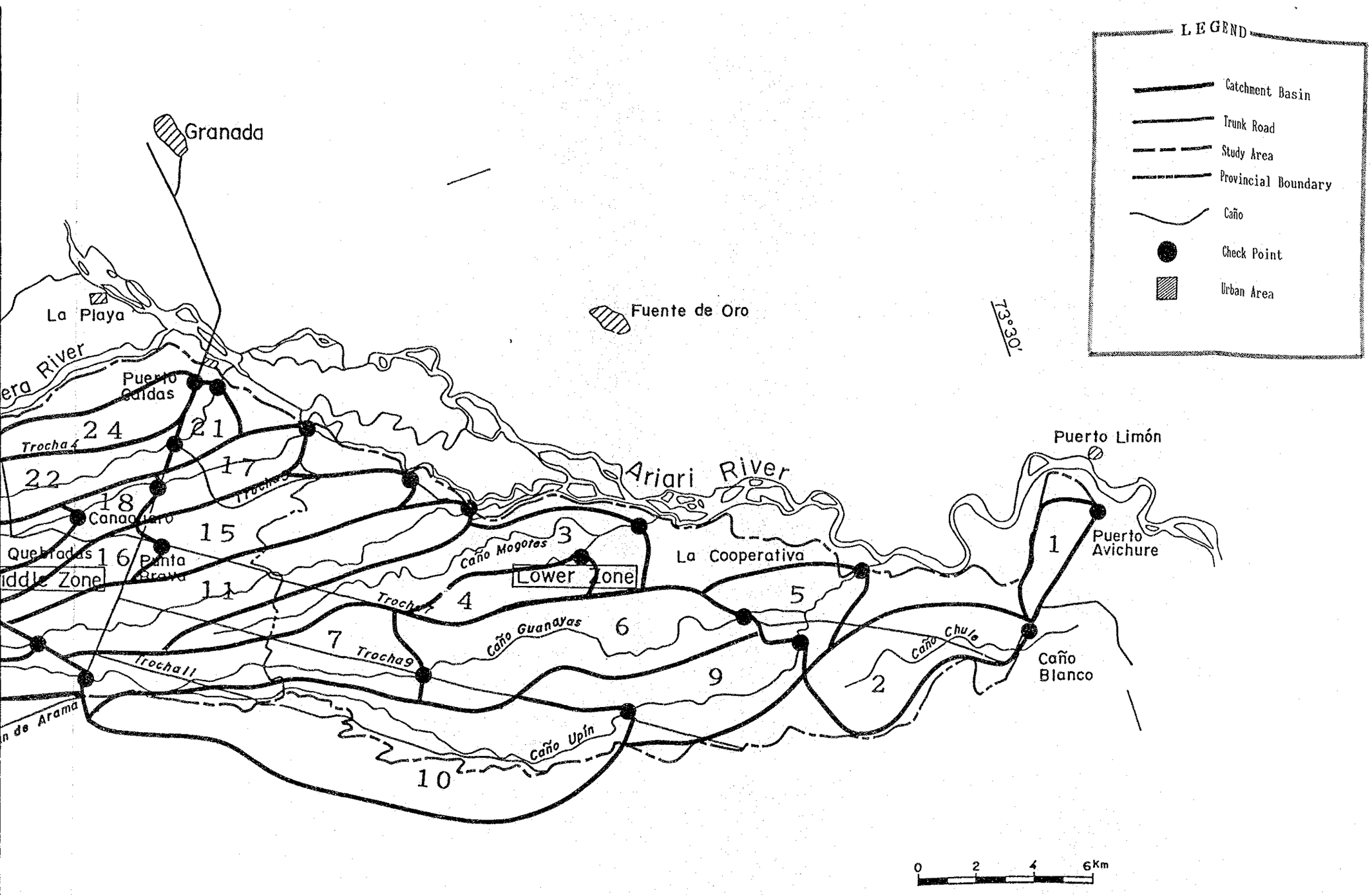
To San Juan de Arama

3°30

Guarumal

Mesa de Fernandez

24 21 17 22 18 15 19 16 11 23 20 12 7 4 14 13 8 10

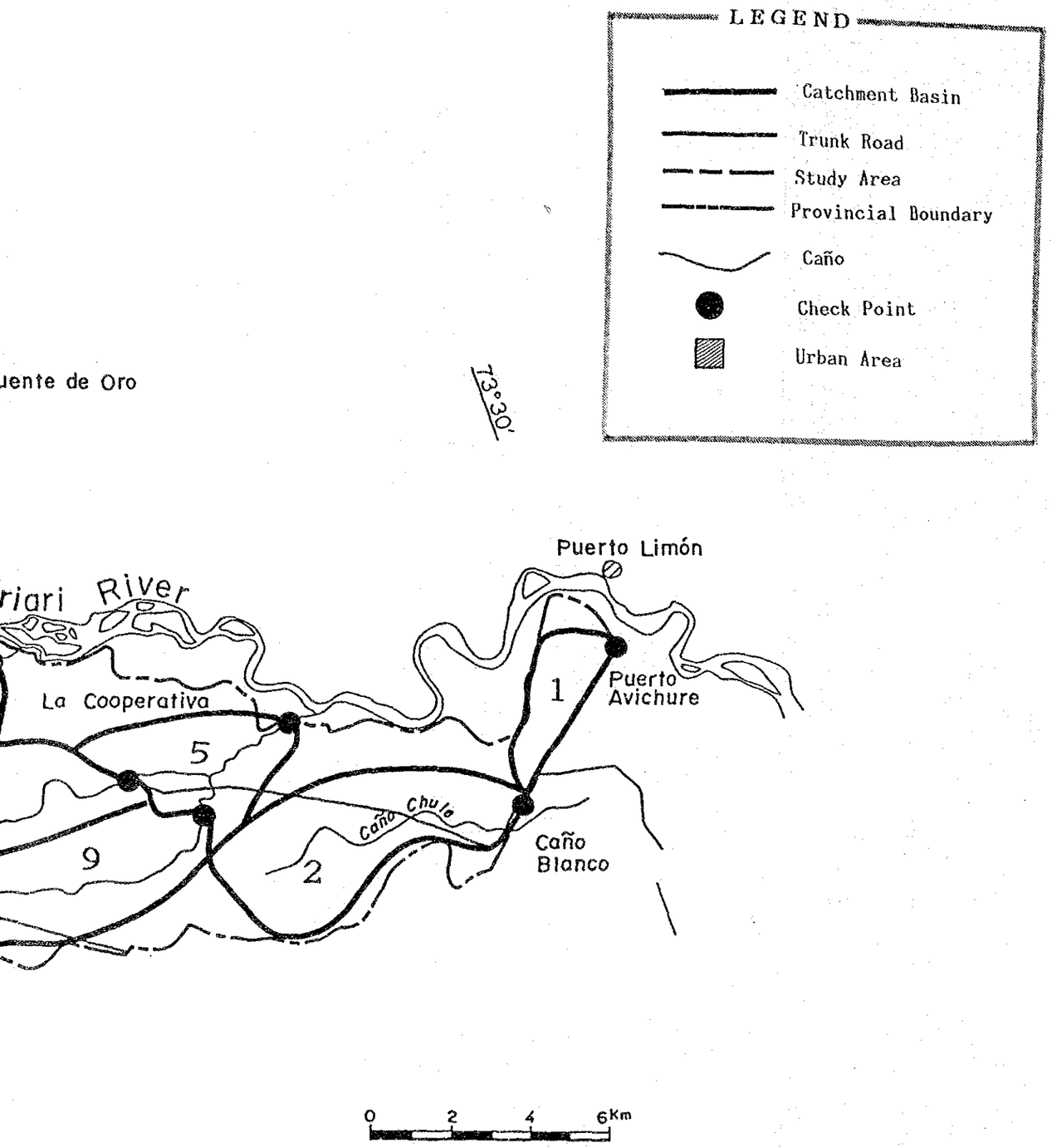


LEGEND

- Catchment Basin
- Trunk Road
- Study Area
- Provincial Boundary
- Caño
- Check Point
- Urban Area

Number	Caño	Area(
1	Avichure	4
2	Avichure	8
3	Caño Mogotes	15
4	Caño Seco	6
5	Caño Guanayas	10
6	Caño Guanayas	20
7	Caño Guanayas	13
8	Caño Guanayas	23
9	Caño Upín	22
10	Caño Upín	50
11	Caño Urichare	23
12	Caño Urichare	16
13	Caño Urichare	9
14	Caño Urichare	34
15	Caño Venado(2)	16
16	Caño Venado(2)	10
17	Caño Mucuya	4
18	Caño Mucuya	18
19	Caño Mucuya	11
20	Caño Mucuya	15
21	Caño Sardinata	2
22	Caño Sardinata	25
23	Caño Sardinata	11
24	Caño Taparo	13

Fig. I-3-1 Drainage System in the Study Area



Number	Caño	Area(km2)
1	Avichure	4.40
2	Avichure	8.50
3	Caño Mogotes	15.60
4	Caño Seco	6.90
5	Caño Guanayas	10.43
6	Caño Guanayas	20.40
7	Caño Guanayas	13.57
8	Caño Guanayas	23.93
9	Caño Upín	22.27
10	Caño Upín	50.00
11	Caño Urichare	23.82
12	Caño Urichare	16.29
13	Caño Urichare	9.82
14	Caño Urichare	34.31
15	Caño Venado(2)	16.50
16	Caño Venado(2)	10.01
17	Caño Mucuya	4.30
18	Caño Mucuya	18.40
19	Caño Mucuya	11.50
20	Caño Mucuya	15.60
21	Caño Sardinata	2.30
22	Caño Sardinata	25.25
23	Caño Sardinata	11.45
24	Caño Taparo	13.88

Fig. I-3-1 Drainage System in the Study Area

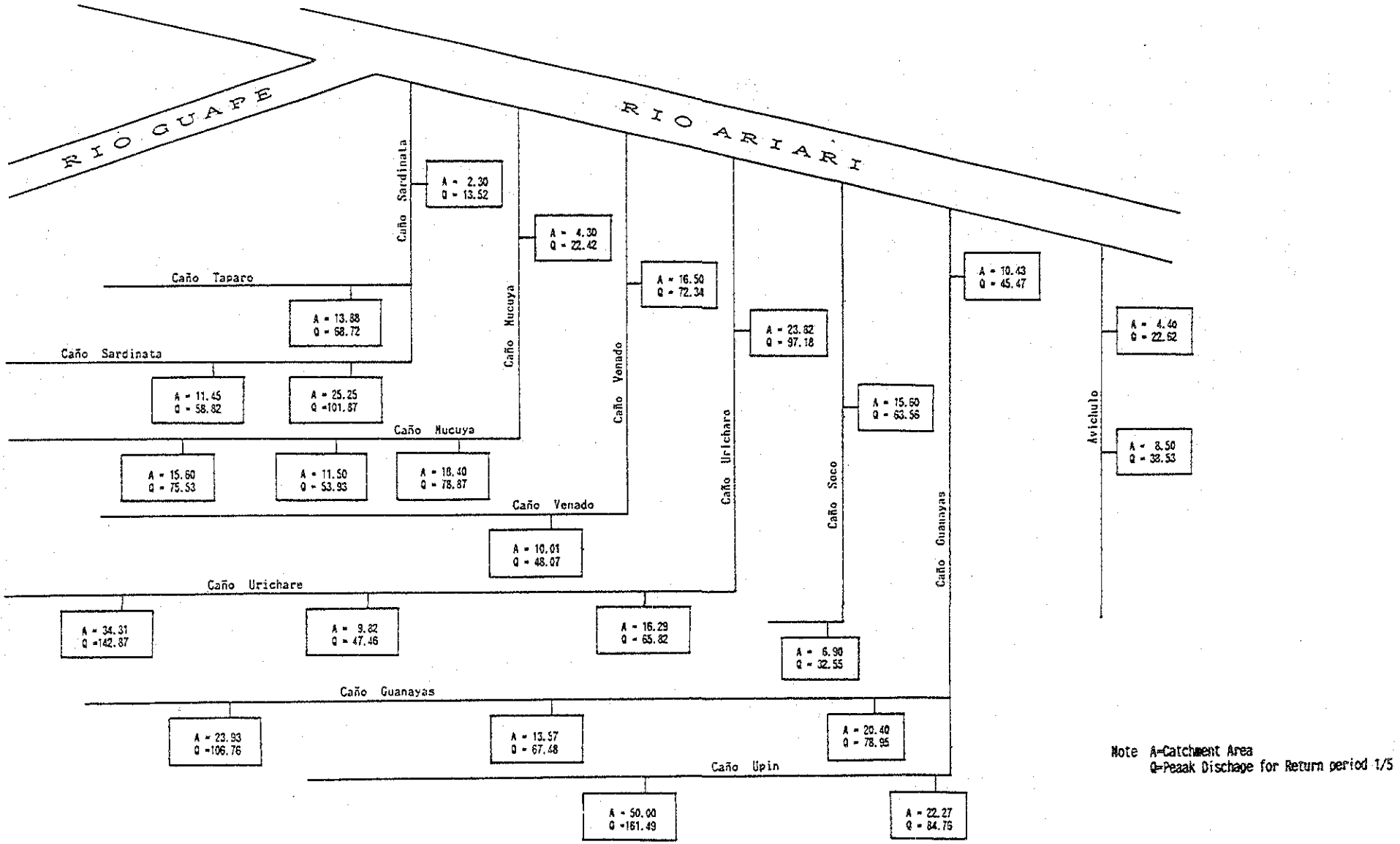


Fig. I-3-2 Drainage System and Runoff Peak Discharge