PROBABLE ANNUAL RAINFALL IN PROJECT AREA

Unit: mm

Return Period	Excessive Value		Non-excessive Value	
	Calendar Year	Hydrological Year	Calendar Year	Hydrological Year
2-year	1,798.9	1,773.2	1,798.9	1,773.2
5-year	2,158.9	2,184.7	1,492.1	1,432.9
10-year	2,371.2	2,433.0	1,350.2	1,279.1
20-year	2,560.4	2,657.3	1,241.7	1,163.2
50-year	2,789.4	2,932.7	1,128.2	1,043.5
100-year	2,952.6	3,131.3	1,057.2	969.6

MAXIMUM CONTINUOUS RAINFALL IN PROJECT AREA

Unit: mm

Year	1-Day	2-Day	3-Day	Year	1-Day	2-Day	3-Day
1964	121.3	133.9	160.5	1974	76.7	95.9	121.9
1965	98.2	176.7	177.0	1975	133.3	118.2	142.8
1966	79.0	144.5	209.7	1976	249.4	251.4	251.4
1967	87.1	136.8	136.8	1977	55.4	94.7	142.8
1968	82.8	125.1	170.4	1978	75.0	99.5	146.9
1969	67.0	106.3	118.4	1979	182.1	332.1	374.1
1970	88.0	155.6	160.5	1980	159.8	166.4	195.6
1971	128.2	203.9	211.0	1981	130.0	130.0	131.0
1972	174.3	198.8	202.8	1982	85.8	122.2	128.9
1973	151.3	233.8	249.1	1983	85.0	102.0	132.4

PROBABLE CONTINUOUS RAINFALL IN PROJECT AREA

unit: mm

Return Period	Excessive Value		
	1-Day	2-Day	3-Day
2-Year	103.8	140.8	165.4
3-Year	123.1	169.36	187.4
5-Year	145.9	202.4	213.6
10-Year	176.3	245.4	248.3
20-Year	207.2	288.0	283.4
50-Year	249.6	345.4	331.6
100-Year	283.2	390.1	369.8

PROBABLE RAINFALL AT ILOILO CITY

Unit:mm

Duration	Return Period (Years)									
	2	5	10	15	20	25	50	100	200[1/]	1000[1/]
5 min	11.2	14.2	16.2	17.4	18.1	18.8	20.6	22.5		
	134.4	170.4	194.4	208.8	217.2	225.6	247.2	270.0		
10 min	18.0	23.5	27.2	29.3	30.7	31.8	35.3	38.7		
	108.0	141.0	163.2	175.8	184.2	190.8	211.8	232.2		
15 min	24.1	30.3	34.4	36.8	38.4	39.7	43.5	47.3		
	96.4	121.2	137.6	147.2	153.6	158.8	174.0	189.2		
30 min	35.9	46.0	52.7	56.5	59.1	61.2	67.4	73.7	80.0	94.0
	71.8	92.0	105.4	113.0	118.2	122.4	134.8	147.4	160.0	188.0
60 min	45.8	59.3	68.2	73.2	76.8	79.5	87.8	96.1	105.0	123.0
	45.8	59.3	68.2	73.2	76.8	79.5	87.8	96.1	105.0	123.0
2 hrs	58.0	76.1	88.1	94.8	99.6	103.2	114.4	125.6	139.0	165.0
	29.0	38.0	44.0	47.4	49.8	51.6	57.2	62.8	69.5	82.5
3 hrs	64.7	81.3	92.3	98.5	102.8	106.2	116.5	126.7	142.0	168.0
	21.6	27.1	30.8	32.8	34.3	35.4	38.8	42.2	47.3	56.0
6 hrs	78.7	107.9	127.2	138.1	145.7	151.6	169.8	187.7	210.0	251.0
	13.1	18.0	21.1	23.0	24.3	25.3	28.3	31.3	35.0	41.8
12 hrs	92.1	140.6	172.7	190.8	203.5	213.3	243.3	273.2	319.0	400.0
	7.7	11.7	14.4	15.9	17.0	17.8	20.3	22.8	26.6	33.3
24 hrs	108.1	173.4	216.6	241.0	258.1	271.3	311.8	352.0	420.0	540.0
	4.5	7.2	9.0	10.0	10.8	11.3	13.0	14.7	17.5	22.5

Note: Upper column value is in mm.
Lower column value is in intensity of mm/hr.

1/ Estimate based on probability analysis.

DESIGN HYETOGRAPH FOR FLOOD ANALYSIS

Unit: mm

Hour	Return Period				
	10-Year	25-Year	50-Year	200-Year	1000-year
1	2.95	3.94	4.69	7.03	9.90
2	3.16	4.07	4.83	7.21	10.14
3	3.38	4.33	5.13	7.64	10.68
4	3.65	4.48	5.31	7.88	10.98
5	3.98	4.83	5.70	8.41	11.67
6	4.38	5.02	5.92	8.72	12.05
7	5.66	5.47	6.44	9.41	12.93
8	6.33	5.74	6.75	9.83	13.45
9	7.30	7.44	8.79	12.57	16.77
10	8.81	7.84	9.25	13.19	17.51
11	11.61	8.84	10.38	14.69	19.38
12	19.84	9.49	11.13	15.66	20.60
13	68.20	11.36	13.24	18.40	23.97
14	14.30	12.76	14.83	20.43	26.45
15	9.95	18.04	20.78	27.95	35.54
16	7.96	24.65	28.16	37.05	46.36
17	6.77	79.50	87.80	105.00	123.00
18	5.97	14.77	17.11	23.33	29.99
19	4.61	10.31	12.06	16.86	22.07
20	4.16	8.30	9.77	13.87	18.36
21	3.80	6.04	7.10	10.28	14.03
22	3.52	5.23	6.17	9.04	12.47
23	3.26	4.65	5.49	8.13	11.30
24	3.05	4.20	4.97	7.42	10.40
Total	216.60	271.30	311.80	420.00	540.00

OBSERVED MONTHLY MEAN DISCHARGE

Year	River	Observed Monthly Mean Discharge (CMS)													Annual (MCM)	Annual Rainfall (MCM)	Runoff Co-eff.
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean			
1979	Catipayan	0.12	0.13	0.06	0.06	0.05	10.12	4.43	1.49	(10.59)	1.27	2.33	2.14	2.73	86.172	102.73	0.84
	Asue	0.07	0.04	0.03	0.17	0.13	0.42	0.30	0.40	0.30	0.12	0.31	0.36	0.22	6.964	18.98	0.37
	Serruco	0.35	0.27	0.20	0.18	0.28	2.73	0.51	0.57	0.76	0.60	1.40	1.81	0.64	20.130	37.85	0.53
1980	Catipayan	2.40	(0.44)	3.02	1.45	0.14	(3.24)	(1.04)	7.02	2.52	2.08	4.58	1.14	2.42	76.396	119.59	0.64
	Asue	0.18	(0.07)	0.04	0.04	(0.05)	(0.20)	0.49	0.88	0.72	0.81	0.86	0.34	0.39	12.299	22.10	0.56
	Serruco	0.34	(0.39)	0.37	(0.27)	0.22	0.64	(0.85)	1.36	0.97	1.50	1.87	0.88	0.81	25.386	44.06	0.58
1981	Catipayan	0.44	0.61	0.39	0.31	0.26	0.44	0.85	2.59	5.60	5.45	0.71	2.53	1.68	53.033	62.65	0.85
	Asue	0.15	0.07	0.06	0.03	0.06	0.10	0.27	0.12	0.37	0.39	0.40	0.21	0.19	5.860	11.58	0.51
	Serruco	1.37	1.05	0.07	0.05	0.04	0.04	(0.20)	0.27	0.26	0.27	0.23	0.31	0.35	10.932	23.08	0.47
1982	Catipayan	1.41	0.45	1.09	0.60	0.50	0.97	1.61	7.81	2.43	2.29	0.61	(0.47)	1.69	53.191	63.64	0.84
	Asue	0.18	0.06	0.08	0.05	0.06	0.20	0.21	0.43	0.26	0.13	0.08	0.04	0.15	4.678	11.76	0.40
	Serruco	0.27	0.21	0.29	0.18	0.34	0.30	0.23	(1.93)	(0.80)	0.57	0.43	0.39	0.50	15.610	23.45	0.67
1983	Catipayan	0.33	0.16	0.09	0.03	0.01	0.41	2.87	3.06	7.72	3.34	3.27	1.66	1.91	60.313	95.95	0.63
	Asue	0.05	0.02	0	0	0	(0.10)	0.27	(0.40)	0.57	0.40	0.29	0.17	0.19	5.966	17.73	0.34
	Serruco	0.33	0.08	0.05	0.05	0.03	0.22	0.35	0.55	1.76	1.36	0.80	0.51	0.51	16.005	35.35	0.45

Note: Catchment Area: Catipayan (51.30 km^2), Asue (9.48 km^2), Serruco (18.90 km^2)
Estimated values are shown with ( )

ESTIMATED 10-DAY DISCHARGE OF CATIPAYAN RIVER

Catipayan st C site			Catipayan st C site			Catipayan st C site			Catipayan st C site			Catipayan st C site		
1964	MCM	CMS	1965	MCM	CMS	1966	MCM	CMS	1967	MCM	CMS	1968	MCM	CMS
1/1	0.85689	0.9918	1/1	0.76896	0.8900	1/1	1.15756	1.3398	1/1	2.13654	2.4728	1/1	0.58124	0.6727
1/2	0.73108	0.8462	1/2	0.84705	0.9804	1/2	1.05574	1.2219	1/2	2.57875	2.9847	1/2	0.50757	0.5875
1/3	0.69125	0.7273	1/3	0.78403	0.8249	1/3	0.97532	1.0262	1/3	1.94282	2.0442	1/3	0.49040	0.5160
1	2.27922	0.8510	1	2.40004	0.8961	1	3.18862	1.1905	1	6.65811	2.4859	1	1.57921	0.5896
2/1	0.73282	0.8482	2/1	0.67049	0.7760	2/1	0.62674	0.7254	2/1	0.74719	0.8648	2/1	0.39573	0.4580
2/2	0.76277	0.8828	2/2	0.52194	0.6041	2/2	0.55623	0.6438	2/2	1.15937	1.3419	2/2	0.35479	0.4106
2/3	0.44459	0.5718	2/3	0.37126	0.5371	2/3	0.39047	0.5649	2/3	0.57404	0.8305	2/3	0.40424	0.5199
2	1.94018	0.7743	2	1.56369	0.6464	2	1.57344	0.6504	2	2.48060	1.0254	2	1.15477	0.4609
3/1	0.44299	0.5127	3/1	0.45575	0.5275	3/1	0.49295	0.5705	3/1	0.71915	0.8324	3/1	0.33744	0.3906
3/2	0.38395	0.4444	3/2	0.37965	0.4394	3/2	0.40072	0.4638	3/2	0.63281	0.7324	3/2	0.30962	0.3584
3/3	0.44220	0.4653	3/3	1.79405	1.8877	3/3	0.38808	0.4083	3/3	0.54084	0.5691	3/3	0.30957	0.3257
3	1.26913	0.4738	3	2.62945	0.9817	3	1.28175	0.4786	3	1.89279	0.7067	3	0.95663	0.3572
4/1	0.31239	0.3616	4/1	0.52238	0.6046	4/1	0.31178	0.3609	4/1	0.42522	0.4921	4/1	0.25370	0.2936
4/2	0.28554	0.3305	4/2	0.45520	0.5269	4/2	0.32029	0.3707	4/2	0.37443	0.4334	4/2	0.23635	0.2736
4/3	0.40619	0.4701	4/3	0.37046	0.4289	4/3	0.26543	0.3072	4/3	0.33917	0.3926	4/3	0.22898	0.2650
4	1.00411	0.3874	4	1.34804	0.5201	4	0.89749	0.3463	4	1.13882	0.4394	4	0.71903	0.2774
5/1	0.37734	0.4367	5/1	0.34216	0.3960	5/1	0.24326	0.2816	5/1	0.31395	0.3634	5/1	0.22195	0.2569
5/2	2.81415	3.2571	5/2	0.30582	0.3540	5/2	7.34062	8.4961	5/2	0.32040	0.3708	5/2	0.25788	0.2985
5/3	3.52252	3.7064	5/3	1.25054	1.3158	5/3	5.46918	5.7546	5/3	1.27100	1.3373	5/3	0.23567	0.2480
5	6.71401	2.5067	5	1.89852	0.7088	5	13.05310	4.8735	5	1.90535	0.7114	5	0.71550	0.2671
6/1	0.89848	1.0399	6/1	0.57592	0.6666	6/1	2.48751	2.8791	6/1	3.40607	3.9422	6/1	1.50992	1.7475
6/2	1.29616	1.5002	6/2	1.68405	1.9491	6/2	1.80057	2.0840	6/2	2.27203	2.6297	6/2	0.97643	1.1301
6/3	3.58024	4.1438	6/3	3.31360	3.8352	6/3	3.90091	4.5149	6/3	1.48088	1.7140	6/3	1.10958	1.2842
6	5.77488	2.2280	6	5.57358	2.1503	6	8.18899	3.1593	6	7.15898	2.7620	6	3.59593	1.3873
7/1	4.77613	5.5279	7/1	1.81764	2.1038	7/1	2.24934	2.6034	7/1	5.17149	5.9855	7/1	3.77175	4.3655
7/2	1.28581	1.4882	7/2	2.38951	2.7656	7/2	5.07727	5.8765	7/2	2.49041	2.8824	7/2	2.51135	2.9067
7/3	0.90895	0.9564	7/3	6.49814	6.8373	7/3	3.42590	3.6047	7/3	2.33245	2.4542	7/3	1.76715	1.8594
7	6.97089	2.6026	7	10.70530	3.9969	7	10.75250	4.0145	7	9.99435	3.7315	7	8.05025	3.0056
8/1	2.98787	3.4582	8/1	1.71650	1.9867	8/1	2.15602	2.4954	8/1	3.52598	4.0810	8/1	1.82579	2.1132
8/2	2.04056	2.3618	8/2	1.43130	1.6566	8/2	1.37498	1.5914	8/2	4.38195	5.0717	8/2	8.77916	10.1611
8/3	3.50055	3.6832	8/3	4.81447	5.0657	8/3	1.89943	1.9986	8/3	4.47243	4.7058	8/3	2.94253	3.0961
8	8.52898	3.1844	8	7.96227	2.9728	8	5.43043	2.0275	8	12.38040	4.6223	8	13.54750	5.0581
9/1	1.80196	2.0856	9/1	3.36791	3.8980	9/1	2.81762	3.2611	9/1	2.74782	3.1803	9/1	1.10582	1.2799
9/2	1.82186	2.1086	9/2	3.97804	4.6042	9/2	2.86825	3.3197	9/2	1.69464	1.9614	9/2	2.61699	3.0289
9/3	3.01320	3.4875	9/3	1.54041	1.7829	9/3	3.12344	3.6151	9/3	0.90537	1.0481	9/3	1.43353	1.6592
9	6.63702	2.5606	9	8.88636	3.4284	9	8.80931	3.3987	9	5.34803	2.0633	9	5.15634	1.9893
10/1	2.87282	3.3250	10/1	1.78640	2.0676	10/1	1.79795	2.0810	10/1	2.50277	2.8967	10/1	1.41271	1.6351
10/2	2.37632	2.7504	10/2	2.71840	3.1463	10/2	2.21765	2.5667	10/2	2.94063	3.4035	10/2	8.51612	9.8566
10/3	2.25497	2.3727	10/3	2.46516	2.5938	10/3	3.11732	3.2800	10/3	4.03290	4.2434	10/3	3.26912	3.4397
10	7.50411	2.8017	10	6.96996	2.6023	10	7.13292	2.6631	10	9.47636	3.5381	10	13.19800	4.9276
11/1	2.76086	3.1954	11/1	1.21056	1.4011	11/1	1.59694	1.8482	11/1	3.61050	4.1788	11/1	0.99790	1.1550
11/2	4.83022	5.5905	11/2	0.82376	0.9534	11/2	2.29842	2.6602	11/2	3.38416	3.9169	11/2	2.57506	2.9804
11/3	5.99611	6.9399	11/3	6.08186	7.0392	11/3	2.09955	2.4300	11/3	1.07308	1.2420	11/3	4.70620	5.4470
11	13.58720	5.2420	11	8.11618	3.1312	11	5.99481	2.3128	11	8.06774	3.1126	11	8.27924	3.1942
12/1	2.05715	2.3810	12/1	2.34133	2.7099	12/1	3.23520	3.7444	12/1	0.86765	1.0042	12/1	1.13941	1.3188
12/2	1.21685	1.4084	12/2	1.88434	2.1809	12/2	1.41812	1.6413	12/2	0.92263	1.0679	12/2	0.81885	0.9478
12/3	1.01683	1.0699	12/3	1.62761	1.7126	12/3	1.02865	1.0823	12/3	0.74217	0.7809	12/3	0.75976	0.7994
12	4.29083	1.6020	12	5.85328	2.1854	12	5.68197	2.1214	12	2.53245	0.9455	12	2.71803	1.0148
Year	66.50060	2.1030	Year	63.90670	2.0265	Year	71.98530	2.2826	Year	69.03390	2.1891	Year	59.67030	1.8870

Catipayan st C site			Catipayan st C site			Catipayan st C site			Catipayan st C site			Catipayan st C site		
1969	MCM	CMS	1970	MCM	CMS	1971	MCM	CMS	1972	MCM	CMS	1973	MCM	CMS
1/1	0.61808	0.7154	1/1	1.01179	1.1709	1/1	3.34117	3.8671	1/1	6.74478	7.8064	1/1	0.74089	0.8575
1/2	0.64233	0.7434	1/2	0.68051	0.7876	1/2	1.14843	1.3292	1/2	5.16763	5.9811	1/2	0.63492	0.7349
1/3	0.54793	0.5765	1/3	0.62819	0.6609	1/3	1.10105	1.1585	1/3	2.11674	2.2272	1/3	0.59872	0.6300
1	1.80833	0.6752	1	2.32050	0.8663	1	5.59065	2.0873	1	14.02910	5.2379	1	1.97452	0.7372
2/1	0.67275	0.7786	2/1	0.73346	0.8489	2/1	0.98811	1.1436	2/1	1.17704	1.3623	2/1	0.47429	0.5489
2/2	0.43240	0.5005	2/2	0.92680	1.0727	2/2	1.53691	1.7788	2/2	0.92575	1.0715	2/2	0.45179	0.5229
2/3	0.31299	0.4528	2/3	1.34072	1.9397	2/3	0.59979	0.8677	2/3	0.72905	0.9376	2/3	0.32155	0.4652
2	1.41814	0.5862	2	3.00097	1.2405	2	3.12480	1.2917	2	2.83184	1.1302	2	1.24754	0.5157
3/1	0.42473	0.4916	3/1	0.94761	1.0969	3/1	0.66052	0.7645	3/1	0.70813	0.8196	3/1	0.36213	0.4191
3/2	0.35029	0.4054	3/2	1.37350	1.5897	3/2	5.34076	6.1814	3/2	1.24990	1.4466	3/2	0.32323	0.3741
3/3	0.31921	0.3359	3/3	0.91836	0.9663	3/3	0.87998	0.9259	3/3	0.74402	0.7829	3/3	0.51922	0.5463
3	1.09423	0.4085	3	3.23946	1.2095	3	6.88118	2.5691	3	2.70205	1.0088	3	1.20458	0.4497
4/1	0.25736	0.2979	4/1	0.49517	0.5731	4/1	0.63355	0.7333	4/1	0.67719	0.7838	4/1	0.30637	0.3546
4/2	0.23164	0.2681	4/2	0.42461	0.4914	4/2	0.54677	0.6328	4/2	0.52177	0.6039	4/2	0.28459	0.3294
4/3	0.21838	0.2528	4/3	0.36694	0.4247	4/3	1.95460	2.2623	4/3	0.46675	0.5402	4/3	0.25886	0.2996
4	0.70738	0.2729	4	1.28672	0.4964	4	3.13492	1.2095	4	1.66571	0.6426	4	0.84982	0.3279
5/1	0.21139	0.2447	5/1	0.48845	0.5653	5/1	3.87685	4.4871	5/1	0.49099	0.5683	5/1	0.23806	0.2755
5/2	0.50463	0.5841	5/2	2.31729	2.6820	5/2	1.24816	1.4446	5/2	0.40299	0.4664	5/2	0.22925	0.2653
5/3	2.50179	2.6323	5/3	1.41196	1.4856	5/3	4.10333	4.3175	5/3	0.42251	0.4446	5/3	0.24408	0.2568
5	3.21772	1.2014	5	4.21770	1.5747	5	9.22834	3.4455	5	1.31649	0.4915	5	0.71139	0.2656
6/1	4.61085	5.3366	6/1	0.55416	0.6414	6/1	4.70763	5.4486	6/1	2.11208	2.4445	6/1	0.22292	0.2580
6/2	1.04830	1.2133	6/2	1.24027	1.4355	6/2	7.01575	8.1201	6/2	2.68130	3.1034	6/2	1.05551	1.2217
6/3	1.27422	1.4748	6/3	7.30742	8.4577	6/3	10.37670	12.0101	6/3	3.05095	3.5312	6/3	0.79200	0.9167
6	6.93337	2.6749	6	9.10185	3.5115	6	22.10010	8.5263	6	7.84433	3.0264	6	2.07043	0.7988
7/1	4.03796	4.6736	7/1	4.75126	5.4991	7/1	9.55606	11.0603	7/1	1.33886	1.5496	7/1	4.34414	5.0279
7/2	6.06699	7.0220	7/2	4.05854	4.6974	7/2	6.36689	7.3690	7/2	0.78569	0.9094	7/2	2.89295	3.3483
7/3	2.90960	3.0614	7/3	3.01465	3.1720	7/3	3.61654	3.8053	7/3	0.67916	0.7146	7/3	1.77415	1.8667
7	13.01460	4.8591	7	11.82450	4.4147	7	19.53940	7.2952	7	2.80371	1.0468	7	9.01124	3.3644
8/1	1.34992	1.5624	8/1	1.55916	1.8046	8/1	2.49079	2.8829	8/1	0.53692	0.6213	8/1	1.68827	1.9540
8/2	2.68328	3.1056	8/2	2.75781	3.1919	8/2	2.60843	3.0190	8/2	0.81726	0.9459	8/2	2.34655	2.7159
8/3	4.64426	4.8866	8/3	1.45415	1.5300	8/3	2.70564	2.8468	8/3	1.72117	1.8110	8/3	6.29521	6.6237
8	8.67746	3.2398	8	5.77112	2.1547	8	7.80486	2.9140	8	3.07525	1.1482	8	10.33000	3.8568
9/1	3.83106	4.4341	9/1	2.60354	3.0134	9/1	1.94609	2.2524	9/1	4.03321	4.6681	9/1	5.55765	6.4325
9/2	1.75960	2.0366	9/2	3.27931	3.7955	9/2	1.09914	1.2722	9/2	2.38919	2.7653	9/2	8.79450	10.1788
9/3	1.38149	1.5989	9/3	3.75199	4.3426	9/3	3.84334	4.4483	9/3	2.15378	2.4928	9/3	6.55605	7.5880
9	6.97215	2.6899	9	9.63484	3.7171	9	6.88857	2.6576	9	8.57618	3.3087	9	20.90820	8.0664
10/1	1.22008	1.4121	10/1	1.67996	1.9444	10/1	8.44247	9.7714	10/1	2.30407	2.6667	10/1	9.68787	11.2128
10/2	2.58547	2.9924	10/2	4.55577	5.2729	10/2	5.17109	5.9850	10/2	1.00695	1.1655	10/2	2.02693	2.3460
10/3	1.34825	1.4186	10/3	2.82953	2.9772	10/3	3.87239	4.0745	10/3	1.09526	1.1524	10/3	2.60109	2.7367
10	5.15380	1.9242	10	9.06526	3.3846	10	17.48590	6.5285	10	4.40629	1.6451	10	14.31590	5.3449
11/1	1.02393	1.1851	11/1	2.81553	3.2587	11/1	5.60855	6.4914	11/1	8.32604	9.6366	11/1	6.25239	7.2366
11/2	0.79561	0.9208	11/2	7.98358	9.2403	11/2	4.85859	5.6234	11/2	1.71420	1.9840	11/2	6.06978	7.0252
11/3	1.15045	1.3315	11/3	3.97687	4.6029	11/3	3.73775	4.3261	11/3	0.98116	1.1356	11/3	8.85015	10.2432
11	2.96999	1.1458	11	14.77600	5.7006	11	14.20490	5.4803	11	11.02140	4.2521	11	21.17230	8.1683
12/1	0.86947	1.0063	12/1	2.65941	3.0780	12/1	1.71232	1.9819	12/1	3.47701	4.0243	12/1	10.45290	12.0983
12/2	2.18742	2.5317	12/2	2.58179	2.9882	12/2	1.46719	1.6981	12/2	1.61422	1.8683	12/2	2.37791	2.7522
12/3	1.87380	1.9716	12/3	1.48763	1.5653	12/3	1.18366	1.2454	12/3	1.15128	1.2114	12/3	4.45807	4.6907
12	4.93069	1.8409	12	6.72883	2.5123	12	4.36317	1.6290	12	6.24251	2.3307	12	17.28890	6.4549
Year	56.89780	1.8042	Year	80.96760	2.5675	Year	120.34700	3.8162	Year	66.51490	2.1034	Year	101.08500	3.2054

ESTIMATED 10-DAY DISCHARGE OF CATIPAYAN RIVER

Catipayan st C site			Catipayan st C site			Catipayan st C site			Catipayan st C site			Catipayan st C site		
1974	MCM	CMS	1975	MCM	CMS	1976	MCM	CMS	1977	MCM	CMS	1978	MCM	CMS
1/1	2.47910	2.8693	1/1	2.35618	2.7271	1/1	2.04372	2.3654	1/1	1.54637	1.7898	1/1	0.61541	0.7123
1/2	1.41751	1.6406	1/2	1.18088	1.3668	1/2	1.16093	1.3437	1/2	1.12698	1.3044	1/2	0.53062	0.6141
1/3	1.28181	1.3487	1/3	1.42353	1.4978	1/3	1.01069	1.0634	1/3	2.44737	2.5751	1/3	0.50416	0.5305
1	5.17842	1.9334	1	4.96059	1.8521	1	4.21534	1.5738	1	5.12072	1.9119	1	1.65020	0.6161
2/1	0.98082	1.1352	2/1	0.78034	0.9032	2/1	0.78763	0.9116	2/1	1.13049	1.3084	2/1	0.40365	0.4672
2/2	1.04057	1.2044	2/2	0.87628	1.0142	2/2	0.68153	0.7888	2/2	1.58151	1.8305	2/2	0.36110	0.4179
2/3	0.64813	0.9377	2/3	0.88076	1.2743	2/3	0.59652	0.7671	2/3	1.53856	2.2259	2/3	0.26570	0.3844
2	2.66952	1.1035	2	2.53738	1.0489	2	2.06567	0.8244	2	4.25056	1.7570	2	1.03044	0.4259
3/1	0.99815	1.1553	3/1	0.65807	0.7617	3/1	0.57374	0.6641	3/1	0.89117	1.0314	3/1	0.30336	0.3511
3/2	0.65726	0.7607	3/2	0.56189	0.6503	3/2	0.49938	0.5780	3/2	0.74051	0.8571	3/2	0.27335	0.3164
3/3	0.62804	0.6608	3/3	0.53924	0.5674	3/3	0.50050	0.5266	3/3	0.65360	0.6877	3/3	0.27185	0.2860
3	2.28346	0.8525	3	1.75919	0.6568	3	1.57362	0.5875	3	2.28528	0.8532	3	0.84856	0.3168
4/1	0.49895	0.5774	4/1	0.43982	0.5091	4/1	0.40661	0.4706	4/1	0.63363	0.7334	4/1	0.23194	0.2685
4/2	0.44334	0.5131	4/2	0.39233	0.4541	4/2	0.36692	0.4247	4/2	0.59740	0.6914	4/2	0.22482	0.2602
4/3	0.39782	0.4604	4/3	7.35072	8.5078	4/3	0.33644	0.3894	4/3	0.43944	0.5086	4/3	3.85306	4.4596
4	1.34002	0.5170	4	8.18287	3.1570	4	1.10996	0.4282	4	1.67046	0.6445	4	4.30962	1.6627
5/1	0.50407	0.5834	5/1	1.10393	1.2777	5/1	0.31021	0.3590	5/1	0.39082	0.4523	5/1	0.38736	0.4483
5/2	0.35991	0.4166	5/2	1.20583	1.3956	5/2	1.73652	2.0099	5/2	0.77950	0.9022	5/2	0.93782	1.0854
5/3	1.00771	1.0603	5/3	0.78092	0.8217	5/3	2.68126	2.8212	5/3	1.00978	1.0625	5/3	0.92231	0.9704
5	1.87170	0.6988	5	3.09068	1.1539	5	4.72799	1.7652	5	2.18010	0.8140	5	2.24749	0.8391
6/1	1.00042	1.1579	6/1	0.92399	1.0694	6/1	0.95227	1.1022	6/1	1.24633	1.4425	6/1	0.48419	0.5604
6/2	1.56871	1.8156	6/2	2.92668	3.3874	6/2	0.91374	1.0576	6/2	5.27645	6.1070	6/2	1.23107	1.4400
6/3	1.08584	1.2568	6/3	3.21149	3.7170	6/3	1.64143	1.8998	6/3	2.40038	2.7782	6/3	1.65342	1.9137
6	3.65497	1.4101	6	7.06216	2.7246	6	3.50743	1.3532	6	8.92316	3.4426	6	3.38868	1.3074
7/1	2.22547	2.5758	7/1	0.75759	0.8768	7/1	0.63446	0.7343	7/1	2.50066	2.8943	7/1	0.87033	1.0076
7/2	2.33055	2.7205	7/2	3.17763	3.6778	7/2	2.44527	2.8302	7/2	3.70434	4.2874	7/2	1.51620	1.7550
7/3	4.44946	4.6817	7/3	1.78516	1.8783	7/3	1.41544	1.4893	7/3	1.86229	1.9595	7/3	1.52745	1.6072
7	9.02548	3.3697	7	5.72038	2.1357	7	4.49517	1.6783	7	8.06729	3.0120	7	3.91426	1.4614
8/1	2.74597	3.1782	8/1	1.72624	1.9980	8/1	0.83340	0.9646	8/1	6.78180	7.8493	8/1	2.78602	3.2246
8/2	1.72064	1.9915	8/2	1.84231	2.1323	8/2	5.40675	6.2578	8/2	1.35185	1.5646	8/2	5.86823	6.7920
8/3	1.65338	1.7449	8/3	2.82512	2.9726	8/3	3.09823	3.2599	8/3	0.96738	1.0179	8/3	6.30158	6.6305
8	6.12499	2.2868	8	6.39367	2.3871	8	9.33839	3.4866	8	9.10103	3.3979	8	14.95590	5.5839
9/1	1.47414	1.7062	9/1	2.64686	3.0635	9/1	3.71697	4.3020	9/1	3.11790	3.6087	9/1	1.17952	1.3652
9/2	1.39491	1.6145	9/2	6.49759	7.5203	9/2	1.38658	1.6048	9/2	2.10574	2.4372	9/2	2.03052	2.3501
9/3	1.30921	1.5153	9/3	2.89437	3.3500	9/3	1.13338	1.3118	9/3	1.33241	1.5421	9/3	6.37035	7.3731
9	4.17826	1.6120	9	12.03870	4.6446	9	6.23693	2.4062	9	6.55605	2.5293	9	9.58040	3.6961
10/1	8.17787	9.4651	10/1	5.90377	6.8331	10/1	3.14160	3.6361	10/1	1.90745	2.2077	10/1	4.31737	4.9970
10/2	3.66801	4.2465	10/2	5.76463	6.6720	10/2	3.44320	3.9852	10/2	2.75820	3.1924	10/2	4.71204	5.4538
10/3	2.59105	2.7263	10/3	4.64098	4.8831	10/3	1.52928	1.6091	10/3	1.69319	1.7816	10/3	1.52239	1.6018
10	14.43790	5.3905	10	16.30938	6.0892	10	8.11408	3.0295	10	6.35884	2.3741	10	10.55180	3.9396
11/1	3.51937	4.0733	11/1	5.95865	6.8966	11/1	0.80875	0.9361	11/1	0.84263	0.9753	11/1	2.65187	3.0693
11/2	4.84308	5.6054	11/2	1.99737	2.3118	11/2	0.80002	0.9259	11/2	0.81003	0.9375	11/2	1.35001	1.5625
11/3	1.59289	1.8436	11/3	1.48056	1.7136	11/3	6.82226	7.8961	11/3	1.32520	1.5338	11/3	1.04643	1.2112
11	9.95533	3.8408	11	9.43658	3.6407	11	8.43104	3.2527	11	2.97786	1.1489	11	5.04834	1.9477
12/1	2.91117	3.3694	12/1	1.93180	2.2359	12/1	8.72608	10.0995	12/1	0.82320	0.9528	12/1	1.63249	1.8895
12/2	4.32549	5.0063	12/2	3.34082	3.8667	12/2	2.74594	3.1771	12/2	0.69488	0.8043	12/2	3.76286	4.3552
12/3	2.25971	2.3776	12/3	7.84155	8.2508	12/3	2.37719	2.5013	12/3	1.01780	1.0709	12/3	1.02567	1.0792
12	9.49636	3.5455	12	13.11420	4.8963	12	13.94839	5.1704	12	2.53588	0.9468	12	6.42102	2.3973
Year	70.21640	2.2265	Year	98.60570	2.8731	Year	67.66390	2.1397	Year	60.02720	1.9035	Year	63.94690	2.0277

Catipayan st C site			Catipayan st C site			Catipayan st C site			Catipayan st C site			Catipayan st C site		
1979	MCM	CMS	1980	MCM	CMS	1981	MCM	CMS	1982	MCM	CMS	1983	MCM	CMS
1/1	0.74555	0.8629	1/1	0.78769	0.9117	1/1	1.18159	1.3676	1/1	0.59628	0.6901	1/1	0.72272	0.8365
1/2	0.61649	0.7135	1/2	0.65849	0.7621	1/2	0.88518	1.0245	1/2	0.52446	0.6070	1/2	0.40518	0.4690
1/3	0.58321	0.6137	1/3	1.41666	1.4906	1/3	1.02022	1.0019	1/3	1.13797	1.1964	1/3	1.02165	1.0750
1	1.94524	0.7263	1	2.86283	1.0689	1	3.09499	1.1555	1	2.25781	0.8430	1	2.14947	0.8025
2/1	0.49668	0.5749	2/1	0.65372	0.7566	2/1	0.71146	0.8235	2/1	0.48552	0.5619	2/1	0.38549	0.4461
2/2	0.49836	0.5768	2/2	0.67227	0.7781	2/2	0.61190	0.7082	2/2	0.42321	0.4898	2/2	0.33623	0.3891
2/3	0.32107	0.4645	2/3	0.46558	0.5987	2/3	0.43799	0.6337	2/3	0.29942	0.4332	2/3	0.23853	0.3451
2	1.31612	0.5440	2	1.79156	0.7150	2	1.76135	0.7281	2	1.20815	0.4994	2	0.96017	0.3969
3/1	0.40244	0.4658	3/1	0.43415	0.5256	3/1	0.65729	0.7607	3/1	0.33210	0.3844	3/1	0.26474	0.3064
3/2	1.20807	1.3982	3/2	0.39739	0.4599	3/2	0.46447	0.5376	3/2	0.29275	0.3388	3/2	0.23262	0.2692
3/3	0.44000	0.4630	3/3	3.22210	3.3903	3/3	0.44962	0.4731	3/3	0.95493	1.0048	3/3	0.22557	0.2373
3	2.05051	0.7656	3	4.07364	1.5209	3	1.57136	0.5867	3	1.57983	0.5898	3	0.72293	0.2699
4/1	0.33349	0.3860	4/1	0.48939	0.5664	4/1	0.38406	0.4445	4/1	0.39315	0.4550	4/1	0.18724	0.2167
4/2	2.26539	2.6220	4/2	0.41653	0.4821	4/2	0.34122	0.3949	4/2	0.29972	0.3469	4/2	0.18122	0.2098
4/3	0.76291	0.8030	4/3	0.36336	0.4206	4/3	0.97558	1.1291	4/3	0.26257	0.3039	4/3	0.17557	0.2032
4	3.36179	1.2970	4	1.26933	0.4897	4	1.70086	0.6562	4	0.95544	0.3686	4	0.54404	0.2099
5/1	0.38436	0.4449	5/1	0.49055	0.5678	5/1	0.59895	0.6932	5/1	0.23392	0.2707	5/1	0.17012	0.1969
5/2	1.24155	1.4370	5/2	0.37547	0.4346	5/2	0.51975	0.6016	5/2	1.03635	1.1995	5/2	0.16485	0.1908
5/3	1.43044	1.5051	5/3	0.36540	0.3845	5/3	0.52985	0.5575	5/3	1.17452	1.2358	5/3	0.27511	0.2895
5	3.05635	1.1411	5	1.23142	0.4598	5	1.64855	0.6155	5	2.44479	0.9128	5	0.61008	0.2278
6/1	6.08646	7.0445	6/1	8.60122	9.9551	6/1	1.29928	1.5038	6/1	0.40315	0.4666	6/1	0.31887	0.3691
6/2	8.00023	9.2595	6/2	8.13575	9.4164	6/2	0.53315	0.6171	6/2	2.76419	3.1993	6/2	0.97207	1.1251
6/3	2.74527	3.1774	6/3	5.31539	6.1520	6/3	0.89368	1.0344	6/3	5.97433	6.9150	6/3	7.12229	8.2434
6	16.83200	6.4938	6	22.05230	8.5078	6	2.72611	1.0517	6	9.14188	3.5270	6	8.31323	3.2073
7/1	1.19760	1.3861	7/1	3.83890	4.4432	7/1	2.08670	2.4152	7/1	1.02982	1.1919	7/1	3.75541	4.3465
7/2	0.78490	0.9084	7/2	2.76259	3.1974	7/2	4.20554	4.8675	7/2	1.15909	1.3414	7/2	5.76983	6.6780
7/3	17.11350	18.0087	7/3	3.00916	3.1662	7/3	1.05557	1.1107	7/3	2.60973	2.7460	7/3	4.15801	4.3750
7	19.09800	7.1304	7	9.61065	3.5882	7	7.34781	2.7434	7	4.79860	1.7916	7	13.68330	5.1087
8/1	2.01206	2.3288	8/1	2.59595	3.0045	8/1	1.41926	1.6427	8/1	1.91751	2.2195	8/1	2.76716	3.2027
8/2	4.38823	5.0790	8/2	2.94423	3.4077	8/2	0.84333	0.9761	8/2	5.15191	5.9629	8/2	2.54159	2.9416
8/3	3.67810	3.8701	8/3	4.32343	4.5491	8/3	0.63897	0.6723	8/3	4.83677	5.0892	8/3	1.65891	1.7455
8	10.07840	3.7628	8	9.86351	3.6826	8	2.90163	1.0833	8	11.90630	4.4453	8	6.96765	2.6014
9/1	2.07415	2.4006	9/1	3.49810	4.0487	9/1	0.53776	0.6224	9/1	1.82281	2.1097	9/1	3.80924	4.4097
9/2	2.88252	3.3363	9/2	2.38131	2.7564	9/2	4.57692	5.2972	9/2	1.50162	1.7380	9/2	2.92315	3.3833
9/3	1.16279	1.3458	9/3	5.08044	5.8834	9/3	5.47572	6.3376	9/3	0.83114	0.9620	9/3	4.12791	4.7777
9	6.11946	2.3609	9	10.96010	4.2315	9	10.59039	4.0859	9	4.15557	1.6032	9	10.86100	4.1902
10/1	1.90833	2.2087	10/1	5.45883	6.3181	10/1	1.35303	1.5661	10/1	1.95921	2.2676	10/1	4.31772	4.9974
10/2	1.87422	2.1692	10/2	5.59373	6.4742	10/2	1.80581	2.0901	10/2	2.88122	3.3347	10/2	2.51251	2.9080
10/3	1.03078	1.0846	10/3	4.18099	4.3992	10/3	1.78161	1.8746	10/3	1.91772	1.9708	10/3	3.12559	3.2887
10	4.81333	1.7971	10	15.23360	5.6876	10	4.94059	1.8446	10	5.85815	2.1872	10	9.95579	3.7171
11/1	1.60235	1.8546	11/1	1.74089	2.0149	11/1	1.22253	1.4150	11/1	0.66170	0.7659	11/1	4.26593	3.6780
11/2	1.05715	1.2236	11/2	4.04215	4.6784	11/2	1.75426	2.0304	11/2	0.75839	0.8778	11/2	3.90181	4.5160
11/3	1.20766	1.3978	11/3	1.18975	1.3770	11/3	0.88849	0.9357	11/3	0.52520	0.6086	11/3	3.63259	4.2044
11	3.86736	1.4920	11	6.97279	2.6901	11	3.78527	1.4604	11	1.94529	0.7507	11	12.39940	4.7837
12/1	1.28383	1.4859	12/1	1.15966	1.3422	12/1	2.43697	2.8206	12/1	0.46927	0.5431	12/1	1.84097	2.1308
12/2	0.65369	0.7366	12/2	1.08518	1.2560	12/2	0.83767	0.9695	12/2	0.40169	0.4684	12/2	1.72356	1.9949
12/3	3.48539	3.6673	12/3	4.20302	4.4224	12/3	1.22771	1.2918	12/3	0.60178	0.6332	12/3	1.01692	1.0709
12	5.42291	2.0247	12	6.44786	2.4074	12	4.50235	1.6810	12	1.47574	0.5510	12	4.58145	1.7105
Year	77.96140	2.4721	Year	92.37750	2.9213	Year	46.57110	1.4768	Year	47.72810	1.5134	Year	71.74850	2.2751

ESTIMATED 10-DAY DISCHARGE OF ASUE RIVER

	Asue Discharge 1964 MCM	CMS	Asue Discharge 1965 MCM	CMS	Asue Discharge 1966 MCM	CMS	Asue Discharge 1967 MCM	CMS	Asue Discharge 1968 MCM	CMS	Asue Discharge 1969 MCM	CMS	Asue Discharge 1970 MCM	CMS	Asue Discharge 1971 MCM	CMS	Asue Discharge 1972 MCM	CMS	Asue Discharge 1973 MCM	CMS
1/1	0.19983	0.2313	0.20684	0.2394	0.22619	0.2618	0.28302	0.3276	0.13406	0.1552	0.13902	0.1609	0.16969	0.1964	0.46962	0.5435	0.94216	1.0905	0.18845	0.2181
1/2	0.15523	0.1797	0.17051	0.1973	0.19532	0.2261	0.29246	0.3385	0.10029	0.1161	0.12081	0.1398	0.13148	0.1522	0.30654	0.3548	0.64158	0.7426	0.13932	0.1613
1/3	0.13078	0.1376	0.15720	0.1654	0.18071	0.1901	0.30176	0.3175	0.09107	0.0958	0.10060	0.1059	0.11167	0.1175	0.27255	0.2868	0.46916	0.4936	0.10886	0.1145
1	0.48584	0.1814	0.53456	0.1996	0.60222	0.2248	0.87724	0.3275	0.32543	0.1215	0.36043	0.1346	0.41284	0.1541	1.04871	0.3915	2.05291	0.7665	0.43664	0.1630
2/1	0.10735	0.1242	0.11956	0.1384	0.12169	0.1408	0.17880	0.2069	0.07919	0.0917	0.08251	0.0955	0.08847	0.1024	0.21785	0.2521	0.35041	0.4056	0.08410	0.0973
2/2	0.09643	0.1116	0.08709	0.1008	0.09069	0.1050	0.16829	0.1948	0.07572	0.0876	0.07335	0.0849	0.10110	0.1170	0.21229	0.2457	0.28737	0.3326	0.08126	0.0940
2/3	0.06994	0.0899	0.06265	0.0906	0.06055	0.0876	0.11467	0.1659	0.06711	0.0863	0.05473	0.0792	0.11496	0.1663	0.14791	0.2140	0.20869	0.2684	0.06251	0.0904
2	0.27372	0.1092	0.26930	0.1113	0.27293	0.1128	0.46175	0.1909	0.22202	0.0886	0.21059	0.0870	0.30453	0.1259	0.57805	0.2389	0.84646	0.3378	0.22786	0.0942
3/1	0.07344	0.0850	0.07551	0.0874	0.07335	0.0849	0.11741	0.1359	0.07031	0.0814	0.06881	0.0796	0.09897	0.1145	0.14154	0.1638	0.17960	0.2079	0.07479	0.0866
3/2	0.06969	0.0807	0.07182	0.0831	0.06961	0.0806	0.09238	0.1069	0.06713	0.0777	0.06293	0.0729	0.12897	0.1493	0.54447	0.6302	0.18048	0.2089	0.07100	0.0822
3/3	0.07391	0.0778	0.18041	0.1898	0.07258	0.0764	0.08778	0.0924	0.07017	0.0738	0.06468	0.0681	0.09198	0.0968	0.19404	0.2042	0.15135	0.1592	0.07897	0.0831
3	0.21705	0.0810	0.32773	0.1224	0.21554	0.0805	0.29756	0.1111	0.20760	0.0775	0.19642	0.0733	0.31992	0.1194	0.88005	0.3286	0.51142	0.1909	0.22476	0.0839
4/1	0.06282	0.0727	0.08580	0.0993	0.06227	0.0721	0.07566	0.0876	0.06023	0.0697	0.05531	0.0640	0.05915	0.0685	0.12249	0.1418	0.12994	0.1504	0.06559	0.0759
4/2	0.05986	0.0693	0.06681	0.0773	0.05938	0.0687	0.07184	0.0831	0.05687	0.0658	0.05209	0.0603	0.05507	0.0637	0.08981	0.1039	0.12206	0.1413	0.06161	0.0713
4/3	0.06966	0.0806	0.06148	0.0712	0.05600	0.0648	0.06857	0.0794	0.05360	0.0620	0.04925	0.0570	0.05192	0.0601	0.18648	0.2158	0.11689	0.1353	0.05849	0.0676
4	0.19234	0.0742	0.21409	0.0826	0.17764	0.0685	0.21607	0.0834	0.17070	0.0659	0.15665	0.0604	0.16614	0.0641	0.39879	0.1539	0.36888	0.1423	0.18551	0.0716
5/1	0.05830	0.0675	0.05872	0.0690	0.05394	0.0614	0.06537	0.0757	0.05063	0.0586	0.04648	0.0538	0.06322	0.0732	0.33975	0.3932	0.11289	0.1306	0.05529	0.0640
5/2	0.25275	0.2925	0.05593	0.0647	0.74480	0.8620	0.06236	0.0722	0.04845	0.0561	0.06210	0.0719	0.17656	0.2043	0.19591	0.2267	0.10792	0.1249	0.05243	0.0607
5/3	0.31354	0.3299	0.12151	0.1279	0.58120	0.6115	0.12454	0.1310	0.05034	0.0530	0.21592	0.2272	0.14516	0.1527	0.41362	0.4352	0.11383	0.1198	0.05416	0.0573
5	0.62459	0.2332	0.23616	0.0882	1.37903	0.5149	0.25227	0.0942	0.14941	0.0558	0.32450	0.1212	0.38493	0.1437	0.94928	0.3544	0.33463	0.1249	0.16218	0.0606
6/1	0.15967	0.1848	0.07680	0.0888	0.35494	0.4108	0.38474	0.4453	0.11540	0.1336	0.39901	0.4618	0.09027	0.1045	0.48649	0.5631	0.21572	0.2497	0.04697	0.0544
6/2	0.16344	0.1892	0.13315	0.1541	0.29977	0.3470	0.23227	0.2688	0.09805	0.1135	0.19312	0.2235	0.13191	0.1527	0.73393	0.8495	0.26708	0.3091	0.10169	0.1177
6/3	0.30877	0.3574	0.26877	0.3111	0.42089	0.4870	0.17565	0.2033	0.10898	0.1261	0.17782	0.2058	0.62672	0.7254	1.27249	1.4728	0.32405	0.3751	0.08539	0.0989
6	0.63188	0.2438	0.47792	0.1844	1.07550	0.4149	0.79266	0.3058	0.32242	0.1244	0.76995	0.2970	0.84891	0.3275	2.49291	0.9618	0.80685	0.3113	0.23404	0.0903
7/1	0.50356	0.5828	0.21423	0.2479	0.32992	0.3818	0.49170	0.5691	0.30191	0.3494	0.37400	0.4329	0.48695	0.5636	1.23552	1.4300	0.23387	0.2707	0.36182	0.4188
7/2	0.26379	0.3053	0.24322	0.2815	0.56035	0.6486	0.34105	0.3947	0.26061	0.3016	0.61147	0.7077	0.50459	0.5840	0.94472	1.0934	0.19241	0.2227	0.30771	0.3561
7/3	0.23444	0.2467	0.67504	0.7103	0.48499	0.5103	0.31585	0.3323	0.26249	0.2762	0.42741	0.4497	0.45931	0.4833	0.75567	0.7951	0.16516	0.1738	0.26381	0.2776
7	1.00179	0.3740	1.13248	0.4228	1.37526	0.5135	1.14860	0.4288	0.82499	0.3080	1.41288	0.5275	1.45085	0.5417	2.93591	1.0961	0.59144	0.2208	0.93334	0.3485
8/1	0.32651	0.3779	0.29782	0.3447	0.37930	0.4390	0.44324	0.5130	0.22487	0.2603	0.30033	0.3476	0.30558	0.3537	0.55477	0.6421	0.11634	0.1347	0.23442	0.2713
8/2	0.27173	0.3145	0.27155	0.3143	0.30923	0.3579	0.46881	0.5426	0.81172	0.9395	0.36489	0.4223	0.38119	0.4411	0.51752	0.5990	0.10472	0.1212	0.26000	0.3009
8/3	0.39977	0.4206	0.49394	0.5197	0.35515	0.3737	0.57526	0.6053	0.48865	0.5141	0.52846	0.5560	0.30281	0.3186	0.50896	0.5355	0.18643	0.1962	0.61694	0.6490
8	0.99801	0.3726	1.06331	0.3970	1.04367	0.3897	1.48731	0.5553	1.52524	0.5695	1.19367	0.4457	0.98949	0.3694	1.58125	0.5904	0.40749	0.1521	1.11126	0.4149
9/1	0.26282	0.3042	0.42906	0.4966	0.35335	0.4090	0.42735	0.4946	0.30395	0.3518	0.49745	0.5758	0.32036	0.3708	0.42679	0.4940	0.37057	0.4289	0.61800	0.7153
9/2	0.27552	0.3189	0.50714	0.5870	0.37413	0.4330	0.33942	0.3929	0.36133	0.4182	0.34375	0.3979	0.38689	0.4478	0.34729	0.4019	0.29988	0.3471	1.01861	1.1789
9/3	0.34131	0.3950	0.32846	0.3802	0.42561	0.4926	0.27147	0.3142	0.26407	0.3056	0.30096	0.3483	0.44986	0.5207	0.52381	0.6063	0.29095	0.3368	0.86335	0.9992
9	0.87965	0.3394	1.26466	0.4879	1.15309	0.4449	1.03825	0.4006	0.92935	0.3585	1.14215	0.4406	1.15711	0.4464	1.29785	0.5007	0.96142	0.3709	2.49996	0.9645
10/1	0.36923	0.4274	0.30999	0.3588	0.31782	0.3678	0.33226	0.3846	0.26106	0.3021	0.26806	0.3103	0.32149	0.3721	0.95764	1.1084	0.31238	0.3615	1.29585	1.4998
10/2	0.32323	0.3741	0.36745	0.4253	0.34415	0.3983	0.35869	0.4152	0.90394	1.0461	0.30885	0.3575	0.57702	0.6678	0.69724	0.8070	0.22239	0.2574	0.58161	0.6732
10/3	0.33589	0.3534	0.37579	0.3954	0.40909	0.4303	0.47551	0.5003	0.50449	0.5308	0.26517	0.2790	0.42240	0.4444	0.66781	0.7027	0.21820	0.2295	0.57771	0.6079
10	1.02834	0.3839	1.05322	0.3932	1.07097	0.3999	1.16647	0.4355	1.66937	0.6233	0.84208	0.3144	1.32091	0.4932	2.32269	0.8672	0.75297	0.2811	2.45517	0.9167
11/1	0.35182	0.4072	0.25781	0.2984	0.30942	0.3581	0.46482	0.5380	0.31709	0.3670	0.20703	0.2396	0.39352	0.4555	0.81051	0.9381	0.90589	1.0485	0.82359	0.9532
11/2	0.66128	0.7654	0.21473	0.2485	0.30890	0.3575	0.47347	0.5480	0.39161	0.4533	0.17606	0.2038	0.96221	1.1137	0.71706	0.8299	0.31969	0.3700	0.84793	0.9814
11/3	0.63615	0.7363	0.75129	0.8695	0.29438	0.3407	0.32102	0.3716	0.53334	0.6173	0.17132	0.1983	0.56566	0.6547	0.64197	0.7430	0.26397	0.3055	1.30150	1.5064
11	1.64924	0.6363	1.22383	0.4722	0.91270	0.3521	1.25931	0.4858	1.24204	0.4792	0.55440	0.2139	1.92139	0.7413	2.16954	0.8370	1.48953	0.5747	2.97302	1.1470
12/1	0.40141	0.4646	0.32719	0.3787	0.41803	0.4838	0.25895	0.2997	0.30592	0.3541	0.14477	0.1676	0.46375	0.5367	0.47298	0.5474	0.41163	0.4764	1.50296	1.7395
12/2	0.33012	0.3821	0.30624	0.3544	0.27282	0.3158	0.21966	0.2542	0.24221	0.2803	0.21059	0.2437	0.45298	0.5232	0.41446	0.4797	0.28116	0.3258	0.62417	0.7224
12/3	0.29379	0.3091	0.29202	0.3073	0.24955	0.2626	0.19006	0.2000	0.20181	0.2123	0.22583	0.2376	0.39152	0.4129	0.38160	0.4015	0.26618	0.2801	0.75974	0.7994
12	1.02531	0.3828	0.92545	0.3455	0.94040	0.3511	0.66867	0.2497	0.74994	0.2800	0.58117	0.2170	1.30735	0.4881	1.26905	0.4738	0.95927	0.3582	2.88687	1.0778
Year	9.00776	0.2849	8.72271	0.2766	10.21900	0.3240	9.66617	0.3065	8.33850	0.2637	7.74490	0.2456	10.58440	0.3356	17.92410	0.5684	10.08330	0.3189	14.33060	0.4544

ESTIMATED 10-DAY DISCHARGE OF ASUE RIVER

Period	1974 Asue Discharge MCM	1974 CMS	1975 Asue Discharge MCM	1975 CMS	1976 Asue Discharge MCM	1976 CMS	1977 Asue Discharge MCM	1977 CMS	1978 Asue Discharge MCM	1978 CMS	1979 Asue Discharge MCM	1979 CMS	1980 Asue Discharge MCM	1980 CMS	1981 Asue Discharge MCM	1981 CMS	1982 Asue Discharge MCM	1982 CMS	1983 Asue Discharge MCM	1983 CMS
1/1	0.55658	0.6442	0.37923	0.4389	0.46358	0.5366	0.33887	0.3922	0.10205	0.1181	0.18518	0.2143	0.17118	0.1981	0.29316	0.3393	0.11817	0.1368	0.07416	0.0858
1/2	0.44408	0.5140	0.29706	0.3438	0.35857	0.4150	0.28029	0.3244	0.07659	0.0886	0.13913	0.1610	0.13920	0.1611	0.24093	0.2789	0.08716	0.1009	0.05179	0.0599
1/3	0.39855	0.4194	0.28616	0.3011	0.31698	0.3335	0.33594	0.3535	0.07658	0.0806	0.11489	0.1209	0.16363	0.1722	0.22605	0.2378	0.10913	0.1148	0.08987	0.0946
1	1.39922	0.5224	0.96245	0.3593	1.13914	0.4253	0.95510	0.3566	0.25522	0.0953	0.43911	0.1639	0.47402	0.1770	0.76013	0.2838	0.31446	0.1174	0.21582	0.0806
2/1	0.30122	0.3486	0.20497	0.2372	0.22529	0.2607	0.23438	0.2713	0.06638	0.0768	0.07936	0.0919	0.12196	0.1412	0.16849	0.1950	0.06899	0.0798	0.04553	0.0527
2/2	0.26014	0.3011	0.17303	0.2003	0.17710	0.2050	0.23803	0.2755	0.06345	0.0734	0.07161	0.0829	0.10408	0.1205	0.13841	0.1602	0.05800	0.0671	0.04232	0.0490
2/3	0.18179	0.2630	0.13536	0.1958	0.11709	0.1694	0.18504	0.2677	0.04883	0.0787	0.05443	0.0787	0.07193	0.0925	0.08693	0.1258	0.04434	0.0641	0.03212	0.0465
2	0.74315	0.3072	0.51336	0.2122	0.53406	0.2131	0.65745	0.2718	0.17867	0.0739	0.20540	0.0849	0.29796	0.1189	0.39383	0.1628	0.17133	0.0708	0.11996	0.0496
3/1	0.20803	0.2408	0.13473	0.1559	0.11854	0.1372	0.18579	0.2150	0.05828	0.0675	0.06551	0.0758	0.07215	0.0835	0.10716	0.1240	0.05267	0.0610	0.03781	0.0438
3/2	0.15116	0.1750	0.09847	0.1140	0.10566	0.1223	0.13651	0.1580	0.05506	0.0637	0.12236	0.1416	0.06857	0.0794	0.09615	0.1113	0.04957	0.0574	0.03510	0.0406
3/3	0.13362	0.1406	0.10191	0.1072	0.11119	0.1170	0.11059	0.1164	0.05694	0.0599	0.07357	0.0774	0.30682	0.3228	0.10065	0.1059	0.09024	0.0950	0.03559	0.0374
3	0.49280	0.1840	0.33512	0.1251	0.33539	0.1252	0.43290	0.1616	0.17028	0.0636	0.26144	0.0976	0.44754	0.1671	0.30396	0.1135	0.19248	0.0719	0.10850	0.0405
4/1	0.11527	0.1334	0.08830	0.1022	0.09665	0.1119	0.08866	0.1026	0.04850	0.0561	0.05701	0.0660	0.09762	0.1130	0.08751	0.1013	0.05062	0.0586	0.02969	0.0344
4/2	0.11029	0.1276	0.08449	0.0978	0.09226	0.1068	0.08470	0.0980	0.04551	0.0527	0.18496	0.2141	0.06407	0.0742	0.08349	0.0966	0.04269	0.0494	0.02723	0.0315
4/3	0.10543	0.1220	0.69751	0.8073	0.08817	0.1021	0.07709	0.0892	0.34269	0.3966	0.10432	0.1207	0.05922	0.0685	0.13028	0.1507	0.03994	0.0461	0.02484	0.0287
4	0.33099	0.1277	0.87029	0.3358	0.27709	0.1069	0.25045	0.0966	0.43669	0.1685	0.34629	0.1336	0.22091	0.0852	0.30128	0.1162	0.13315	0.0514	0.08176	0.0315
5/1	0.10759	0.1245	0.23099	0.2673	0.08424	0.0975	0.07356	0.0851	0.08468	0.0980	0.06417	0.0743	0.06236	0.0722	0.09240	0.1069	0.03728	0.0431	0.02272	0.0263
5/2	0.09750	0.1128	0.20721	0.2398	0.18574	0.2150	0.10522	0.1218	0.08912	0.1032	0.10004	0.1158	0.05616	0.0650	0.07717	0.0893	0.09066	0.1049	0.02082	0.0241
5/3	0.13493	0.1420	0.18024	0.1896	0.26362	0.2774	0.11342	0.1193	0.09327	0.0981	0.11454	0.1205	0.05722	0.0602	0.08040	0.0846	0.09263	0.0975	0.02462	0.0259
5	0.34002	0.1269	0.61844	0.2309	0.53359	0.1992	0.29220	0.1091	0.26707	0.0997	0.27875	0.1041	0.17573	0.0656	0.24998	0.0933	0.22057	0.0824	0.06816	0.0254
6/1	0.14070	0.1628	0.14708	0.1702	0.16441	0.1903	0.13421	0.1553	0.05771	0.0668	0.58975	0.6826	0.85038	0.9842	0.12955	0.1499	0.05346	0.0619	0.03170	0.0367
6/2	0.17609	0.2038	0.27390	0.3170	0.14635	0.1694	0.44990	0.5207	0.08371	0.0969	0.90857	1.0516	0.87625	1.0142	0.07266	0.0841	0.21067	0.2438	0.06069	0.0702
6/3	0.13463	0.1558	0.34035	0.3939	0.19159	0.2217	0.27814	0.3219	0.13431	0.1555	0.37616	0.4354	0.59323	0.6866	0.10167	0.1177	0.57042	0.6602	0.62537	0.7238
6	0.45142	0.1742	0.76134	0.2937	0.50234	0.1938	0.86225	0.3327	0.27574	0.1064	1.87448	0.7232	2.31986	0.8950	0.30388	0.1172	0.83455	0.3220	0.71777	0.2769
7/1	0.21557	0.2495	0.19040	0.2204	0.12847	0.1487	0.28446	0.3292	0.09525	0.1102	0.27792	0.3217	0.57224	0.6623	0.16889	0.1955	0.18961	0.2195	0.36851	0.4265
7/2	0.26617	0.3081	0.32666	0.3781	0.23267	0.2693	0.40188	0.4651	0.14569	0.1686	0.21845	0.2528	0.47496	0.5497	0.36699	0.4248	0.16738	0.1937	0.57775	0.6687
7/3	0.47737	0.5023	0.26771	0.2817	0.18592	0.1956	0.32650	0.3435	0.13075	0.1376	2.12291	2.2337	0.49307	0.5188	0.20069	0.2112	0.27923	0.2938	0.54542	0.5739
7	0.95911	0.3581	0.78477	0.2930	0.54706	0.2042	1.01284	0.3782	0.37169	0.1388	2.61928	0.9779	1.54027	0.5751	0.73657	0.2750	0.63621	0.2375	1.49168	0.5569
8/1	0.35074	0.4059	0.25202	0.2917	0.15064	0.1743	0.74618	0.8636	0.23364	0.2704	0.43716	0.5060	0.41972	0.4858	0.19717	0.2282	0.23648	0.2737	0.39449	0.4566
8/2	0.28715	0.3323	0.24474	0.2833	0.54034	0.6254	0.31043	0.3593	0.52773	0.6108	0.59736	0.6914	0.40569	0.4695	0.15075	0.1745	0.53290	0.6168	0.38345	0.4438
8/3	0.29323	0.3085	0.32977	0.3470	0.35997	0.3788	0.27870	0.2932	0.69815	0.7346	0.55553	0.5845	0.55393	0.5881	0.11978	0.1260	0.54638	0.5749	0.33735	0.3550
8	0.93111	0.3476	0.82654	0.3086	1.05095	0.3924	1.33530	0.4985	1.45951	0.5449	1.59005	0.5937	1.38434	0.5169	0.46770	0.1746	1.31575	0.4912	1.11528	0.4164
9/1	0.23125	0.2677	0.30587	0.3540	0.41729	0.4830	0.35186	0.4072	0.30941	0.3581	0.40494	0.4687	0.49085	0.5681	0.07612	0.0881	0.31593	0.3657	0.45509	0.5267
9/2	0.21299	0.2465	0.68310	0.7906	0.28613	0.3312	0.30985	0.3586	0.32453	0.3756	0.42227	0.4887	0.40873	0.4731	0.38580	0.4465	0.25710	0.2976	0.38758	0.4485
9/3	0.20885	0.2417	0.41814	0.4840	0.25000	0.2894	0.25060	0.2900	0.69135	0.8004	0.32005	0.3704	0.62676	0.7254	0.63011	0.7293	0.21625	0.2503	0.47254	0.5469
9	0.65309	0.2520	1.40712	0.5429	0.95342	0.3678	0.91231	0.3520	1.32549	0.5114	1.14726	0.4426	1.52634	0.5889	1.09204	0.4213	0.78927	0.3045	1.31513	0.5074
10/1	0.80972	0.9369	0.67081	0.7764	0.35866	0.4151	0.27924	0.3232	0.52967	0.6130	0.31505	0.3647	0.66365	0.7681	0.25620	0.2965	0.25529	0.2955	0.51673	0.5981
10/2	0.48130	0.5571	0.70685	0.8181	0.39367	0.4556	0.32442	0.3755	0.61271	0.7092	0.31171	0.3608	0.72815	0.8428	0.25268	0.2924	0.33949	0.3929	0.44891	0.5192
10/3	0.43664	0.4594	0.68575	0.7215	0.30579	0.3217	0.27094	0.2851	0.41325	0.4348	0.25909	0.2726	0.68037	0.7159	0.26054	0.2741	0.21551	0.2268	0.50620	0.5326
10	1.72666	0.6447	2.06340	0.7704	1.05812	0.3951	0.87460	0.3265	1.55564	0.5808	0.88586	0.3307	2.07218	0.7737	0.76941	0.2873	0.81030	0.3025	1.46375	0.5465
11/1	0.47983	0.5542	0.76220	0.8822	0.22424	0.2595	0.20410	0.2362	0.41806	0.4839	0.25047	0.2899	0.44438	0.5143	0.20995	0.2430	0.15373	0.1779	0.60691	0.7024
11/2	0.60745	0.7031	0.49438	0.5722	0.18624	0.2156	0.17394	0.2013	0.30444	0.3524	0.20397	0.2361	0.59879	0.6815	0.22699	0.2627	0.12743	0.1475	0.50767	0.5876
11/3	0.38642	0.4472	0.40766	0.4718	1.02226	1.1832	0.18086	0.2093	0.26101	0.3021	0.20506	0.2373	0.38041	0.4403	0.16538	0.1914	0.09439	0.1093	0.51795	0.5994
11	1.47270	0.5682	1.66423	0.6421	1.43274	0.5528	0.55890	0.2156	0.98351	0.3794	0.65950	0.2544	1.41356	0.5454	0.60232	0.2324	0.37556	0.1449	1.63164	0.6295
12/1	0.42930	0.4969	0.39533	0.4576	0.78690	0.9120	0.15108	0.1749	0.26047	0.3015	0.19649	0.2274	0.32273	0.3735	0.26149	0.3025	0.06717	0.0777	0.39222	0.4540
12/2	0.54915	0.6356	0.45434	0.5259	0.45378	0.5252	0.12278	0.1421	0.40273	0.4661	0.14402	0.1667	0.27985	0.3239	0.17098	0.1979	0.05393	0.0625	0.34094	0.3945
12/3	0.43855	0.4538	0.96312	1.0134	0.43582	0.4586	0.13201	0.1389	0.25721	0.2706	0.33726	0.3549	0.50901	0.5261	0.18795	0.1978	0.06865	0.0722	0.30522	0.3212
12	1.40999	0.5261	1.81279	0.6768	1.67761	0.6263	0.40587	0.1515	0.92041	0.3436	0.67777	0.2530	1.10179	0.4114	0.62032	0.2316	0.18980	0.0789	1.03928	0.3876
Year	10.90930	0.3459	12.61980	0.4002	10.04150	0.3175	8.55017	0.2711	8.19993	0.2600	10.98520	0.3483	12.97450	0.4103	6.60132	0.2093	5.98345	0.1897	9.36772	0.2970

ESTIMATED 10-DAY AVERAGE LOW WATER FLOW

	CATIPAYAN		ASUE	
YEAR OCCURRED	MONTH (m^3/s)	DISCHARGE OCCURRED	MONTH (m^3/s)	DISCHARGE
1964	APR	0.331	MAY	0.068
1965	MAY	0.335	MAY	0.065
1966	MAY	0.282	MAY	0.061
1967	MAY	0.363	MAY	0.072
1968	MAY	0.248	MAY	0.053
1969	MAY	0.245	MAY	0.054
1970	APR	0.245	APR	0.060
1971	APR	0.633	APR	0.104
1972	MAY	0.445	MAY	0.120
1973	MAY	0.257	JUN	0.054
1974	MAY	0.417	MAY	0.113
1975	APR	0.454	APR	0.102
1976	MAY	0.359	MAY	0.098
1977	MAY	0.452	MAY	0.085
1978	APR	0.260	APR	0.056
1979	APR	0.386	APR	0.066
1980	MAY	0.385	MAY	0.060
1981	APR	0.395	JUN	0.084
1982	MAY	0.271	APR	0.046
1983	MAY	0.191	MAY	0.024
Mean		0.348		0.072

PROBABLE 10-DAY AVERAGE LOW WATER FLOW

Unit m^3/s

Return Period	1/100	1/75	1/50	1/30	1/20	1/10	1/5	1/3	1/2
Catipayan	0.115	0.163	0.175	0.191	0.206	0.235	0.272	0.309	0.351
Asue	0.022	0.024	0.027	0.031	0.035	0.042	0.051	0.060	0.071

CATIPAYAN RIVER FLOOD RECORD

Unit: H: m
Q: CMS

1984	Jul.9		Jul.30		Aug.10		Aug.23		Sep.2		Sep.3	
	H	Q	H	Q	H	Q	H	Q	H	Q	H	Q
6:00 a.m											0.84	6.74
7:00											0.81	6.29
8:00												
9:00												
10:00												
11:00												
12:00 p.m.												
1:00												
2:00									0.83	6.59		
3:00									1.20	13.13		
4:00	0.83	6.59					0.89	7.53	1.29	15.00		
5:00	0.94	8.34					1.58	21.70	1.26	14.37		
6:00	0.97	8.85			0.86	7.05	1.33	15.86	1.31	15.43		
7:00	0.94	8.34	0.84	6.74	1.02	9.72	1.16	12.34	1.28	14.79		
8:00	0.88	7.37	0.96	8.68	1.18	12.73	1.02	9.72	1.22	13.54		
9:00	0.82	6.44	1.04	10.08	1.21	13.34	0.88	7.37	1.19	12.93		
10:00			0.94	8.34	1.17	12.54			1.14	11.95		

1984	Sep.16		Sep.17		Sep.18		Sep.19		Sep.20		Sep.21	
	H	Q	H	Q	H	Q	H	Q	H	Q	H	Q
6:00 a.m.					1.56	21.20	9.94	8.34	1.04	10.08	1.40	17.42
7:00					1.49	19.51	0.91	7.85	0.98	9.02	1.34	16.08
8:00					1.38	16.97	0.86	7.05	0.92	8.01	1.28	14.79
9:00					1.30	15.21	0.82	6.44	0.90	7.69	1.22	13.54
10:00					1.23	13.74			0.90	7.69	1.18	12.73
11:00					1.16	12.34			0.89	7.53	1.14	11.95
12:00 p.m.					1.10	11.19			0.88	7.37	1.17	12.54
1:00					1.05	10.26			0.87	7.21	1.19	12.93
2:00			1.64	23.21	1.02	9.72			0.85	6.90	1.09	11.00
3:00	2.42	46.30	3.98	115.09	0.99	9.19	0.94	8.34	0.84	6.74	1.02	9.72
4:00	1.96	32.03	3.30	81.04	0.97	8.85	2.04	34.37	0.83	6.59	0.96	8.68
5:00	1.55	20.96	2.10	36.14	1.01	9.54	2.76	58.52	0.82	6.44	0.92	8.01
6:00	1.48	19.27	1.80	27.47	1.04	10.08	2.96	66.41	0.80	6.14	0.87	7.21
7:00	1.23	13.74	1.58	21.70	1.02	9.72	3.34	82.87			0.82	6.44
8:00	0.98	9.02	1.32	15.64	1.11	11.37	3.99	115.64			0.91	7.85
9:00	0.82	6.44	1.12	11.56	0.98	9.02	3.83	107.02			0.99	9.19
10:00			0.94	8.34	0.97	8.85	3.76	103.36			1.19	12.93

CATIPAYAN RIVER FLOOD RECORD

Unit: H : m
Q : CMS

1984	Sep.22		Sep.23		Sep.30		Oct.7		Oct.8		Oct.9	
	H	Q	H	Q	H	Q	H	Q	H	Q	H	Q
6:00 a.m.	1.22	13.54	0.97	8.85	1.60	22.20	0.94	8.34				
7:00	1.20	13.13	0.94	8.34	1.59	21.95	0.93	8.18				
8:00	1.17	12.54	0.94	8.34	1.48	19.27	0.90	7.69				
9:00	1.11	11.37	0.93	8.18	1.38	16.97	0.89	7.53				
10:00	1.05	10.26	0.92	8.01	1.27	14.58	0.89	7.53				
11:00	1.01	9.54	0.90	7.69	1.15	12.14	0.87	7.21				
12:00 p.m.	0.96	8.68	0.89	7.53	1.05	10.26	0.84	6.74				
1:00	1.21	13.34	0.88	7.37	0.94	8.34	0.82	6.44	0.84	6.74		
2:00	2.20	39.18	0.87	7.21	0.91	7.85			0.88	7.37		
3:00	2.55	50.80	0.85	6.90	0.87	7.21			0.92	8.01	1.10	11.19
4:00	1.83	28.30	0.84	6.74	0.85	6.90			1.11	11.37	1.19	12.93
5:00	1.70	24.77	0.83	6.59	0.84	6.74			1.22	13.54	1.30	15.21
6:00	1.58	21.70	0.81	6.29	0.82	6.44			1.21	13.34	1.42	17.87
7:00	1.45	18.57	0.80	6.14	0.80	6.14			1.17	12.54	1.41	17.64
8:00	1.30	15.21	0.80	6.14					1.12	11.56	1.38	16.97
9:00	1.13	11.76							1.06	10.44	1.35	16.30
10:00	1.03	9.90							0.89	9.19	1.31	15.43

1984	Oct.14		Oct.19		Oct.20		Oct.21		Nov.5			
	H	Q	H	Q	H	Q	H	Q	H	Q	H	Q
6:00 a.m.	2.42	46.30	1.20	13.13	0.84	6.74	1.04	10.08				
7:00	3.38	84.71	1.20	13.13	0.82	6.44	1.02	9.72				
8:00	1.28	14.79	1.22	13.54	0.82	6.44	0.99	9.19				
9:00	1.25	14.16	1.28	14.79	0.81	6.29	0.97	8.85	0.84	6.74		
10:00	1.23	13.74	1.34	16.08	0.81	6.29	0.96	8.68	2.90	63.99		
11:00	1.19	12.93	1.41	17.64	0.80	6.14	0.96	8.68	3.99	115.64		
12:00 p.m.	1.16	12.34	1.44	18.33			0.95	8.51				
1:00	1.12	11.56	1.40	17.42			0.93	8.18				
2:00	1.10	11.19	1.70	24.77	0.80	6.14	0.91	7.85				
3:00	1.07	10.63	1.49	19.51	0.83	6.59	0.88	7.37				
4:00	1.03	9.90	1.38	16.97	1.48	19.27	0.85	6.90				
5:00	1.00	9.37	1.30	15.21	2.04	34.37	0.82	6.44				
6:00	1.00	9.37	1.22	13.54	2.40	45.63	1.23	13.74				
7:00	1.09	11.00	1.18	12.73	2.38	44.96	1.56	21.20				
8:00	1.07	10.63	1.12	11.56	2.32	42.99	1.53	20.47				
9:00	1.06	10.44	1.07	10.63	2.27	41.38	1.51	19.99				
10:00	1.06	10.44	1.01	9.54	2.23	40.11	1.49	19.51				

FLOOD HYDROGRAPH FOR DAM DESIGN

Hour	10-Year		200-Year		1000-Year	
	Rainfall	Drainage	Rainfall	Drainage	Rainfall	Drainage
1	3.0	6.0	7.0	6.0	9.9	6.1
2	3.2	6.1	7.2	6.4	10.1	7.0
3	3.4	6.2	7.6	7.7	10.7	9.9
4	3.7	6.5	7.9	10.0	11.0	15.3
5	4.0	7.0	8.4	13.4	11.7	23.3
6	4.4	7.8	8.7	18.4	12.1	34.7
7	5.7	9.0	9.4	24.9	12.9	49.4
8	6.3	11.2	9.8	33.6	13.5	68.9
9	7.3	14.3	12.6	45.6	16.8	95.7
10	8.8	19.1	13.2	66.2	17.5	138.0
11	11.6	27.5	14.7	91.5	19.4	171.9
12	19.8	46.0	15.7	125.0	20.6	200.5
13	68.2	130.8	18.4	156.2	24.0	226.0
14	14.3	358.7	20.4	187.4	26.5	258.2
15	10.0	269.6	28.0	221.1	35.5	295.8
16	8.0	202.8	37.1	281.2	46.4	365.6
17	6.8	166.1	105.0	414.6	123.0	519.7
18	6.0	138.9	23.3	703.7	30.0	847.1
19	4.6	117.7	16.9	512.6	22.1	628.0
20	4.2	100.0	13.9	307.8	18.4	476.0
21	3.8	87.1	10.3	246.8	14.0	387.6
22	3.5	76.9	9.0	174.2	12.5	314.9
23	3.3	68.5	8.1	145.5	11.3	263.1
24	3.1	62.3	7.4	174.2	10.4	227.7
25		54.7		145.5		191.4
26		36.5		95.6		124.3
27		25.6		65.7		84.5
28		18.2		48.0		61.0
29		14.3		35.8		44.9
30		11.7		26.6		33.0
31		10.0		19.7		24.0
32		8.7		13.6		16.4
33		7.9		11.0		12.8
34		7.2		9.2		10.4
35		6.8		8.0		8.8
36		6.5		7.2		7.7
37		6.3		6.6		6.9
38		6.1		6.2		6.3

REGISTERED WATER RIGHTS

NAME	ADDRESS	SOURCE	COORDINATES LATITUDE	COORDINATES LONGITUDE	PERMIT NO.	DATE GRANTED	METHOD OF DIVERSION	IRRIGABLE AREA (HAS.)	AMOUNT AVAILABLE (LPS)	AMOUNT GRANTED (LPS)
Andres Biclar	Ajuy	Gubatan R.	no coordinate		532	2-19-75	Pump	35	35	35
Estrella Borromeo	Ajuy	Lanuran R.	-	-	538	2-19-75		-	-	390 - disapprove-
Arturo Canicula	Ajuy	Gubatan R.	no coordinate		625	2-19-75	Pump	8	8	8
Primo Delfin	Ajuy	Pinangtan Creek	no coordinate		661	2-19-75	Pump	4	4	4
Virginia Capalla	Ajuy	Gubatan R.	no coordinate		954	2-19-75	Pump	30	30	30
Primo Delfin	Ajuy	Pinangtan Creek	no coordinate		1496	6-19-75	Pump	10	8	8
Perlita Illustrisimo	Ajuy	Balogo Creek	11°09' 13.77"	122°59' 41.87"	3581	2-23-78	Pump	5	75	5
Estrellina Padernal	Sara	Asue Creek	11°16'49"	122°59' 22"	7113	3-31-80	Gravity Dam	100	25	25
Imelda Isa Inc.	San Dionisio	Odiongan R.	11°21'38"	123°04'28'	9421	10-21-82	Concrete Dam	250	188	169
Serruco Isa Inc.	Sara (Ajuy)	Serruco R.	11°14'02"	123°00'00"	9564	2-24-83	Concrete Dam	700	444	400
Epifania Peñaflor	Sara	Asue Creek	no coordinate		1053	3-20-75	Pump	54	54	54

FIG. II - 1

METEOROLOGICAL STATION IN REGION VI

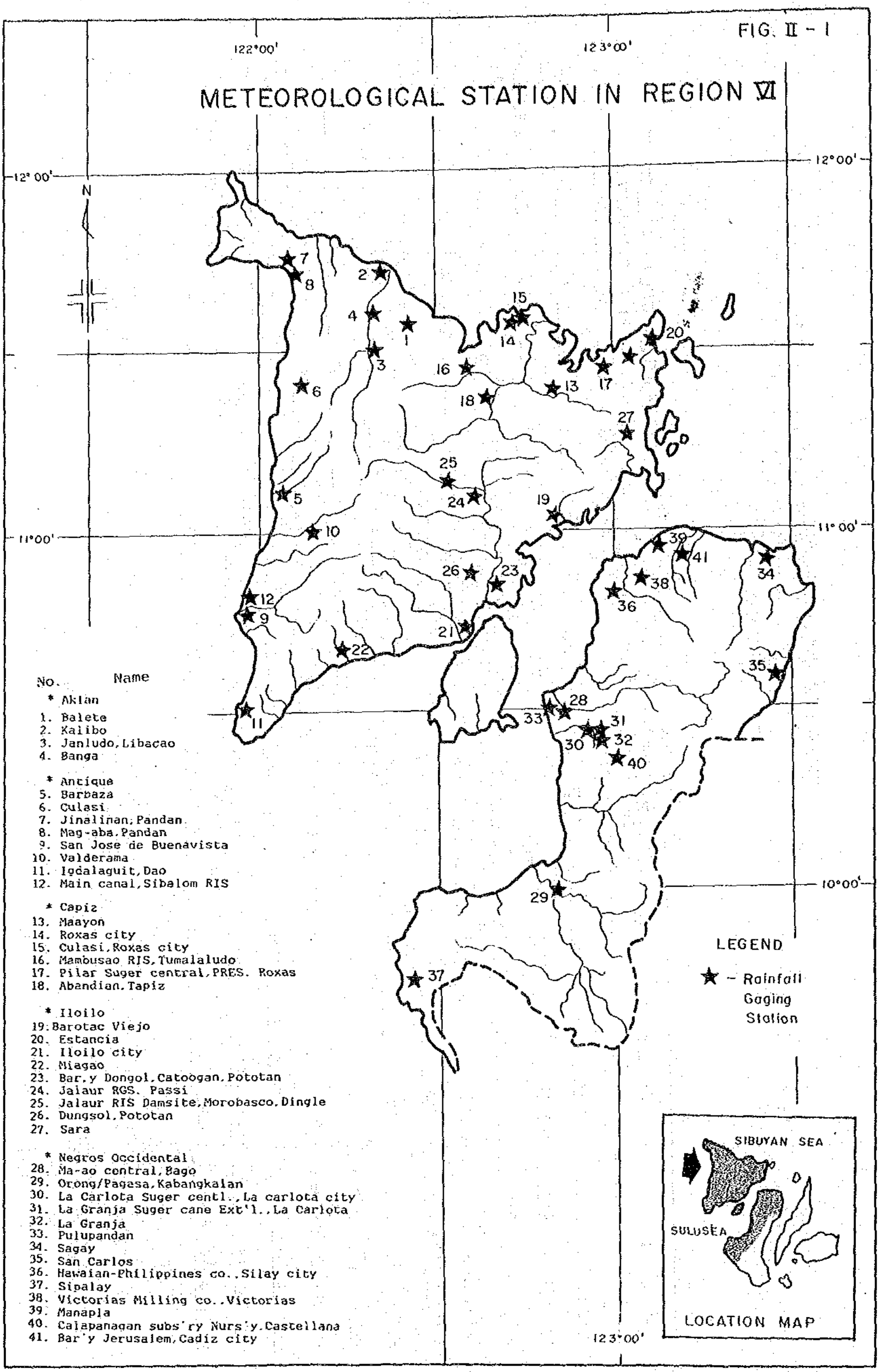


FIG. II - 2

AVAILABLE DATA PERIOD

Station	Location Lat	Location Long.	Elev. (m)	Year ('65 – '83)
-Rainfall-				
Brgy. Aguirre, Sara Iloilo	11° 16'	122° 59'	34.9	
Roxas City, Capiz	11° 35'	122° 45'	1.5	from Mar., 1949
Iloilo City	10° 42'	122° 34'	1.0	from Jan., 1949
Barotac Viejo, Iloilo	11° 03'	122° 51'	25.0	
Pilar Sugar Central, Pres. Roxas	11° 27'	122° 57'	15.0	from Jan., 1952
Estancia, Iloilo	11° 23'	123° 07'	9.0	
Dongsol, Pototan, Iloilo	10° 52'	122° 38'	20.0	from Mar., 1957
Jalaur RGS, Pass:	11° 09'	122° 27'	30.0	
Jalaur RIS Damsite, Dingle	11° 10'	122° 27'	40.0	
Abandian, Tapaz, Capiz	11° 14'	122° 30'	35.0	
-Meteorologicy-				
Brgy. Aguirre, Sara, Iloilo	11° 16'	122° 59'	34.9	(evaporation only)
Roxas City, Capiz	11° 35'	122° 45'	1.5	
Iloilo City	10° 42'	122° 34	1.0	from Jan., 1950

River, Station	Location Lat	Location Long	Catchment Area (km²)	Year ('65 – '83)
-River Water Gage-				
Asue River, Brgy. Aguirre	11° 17'	122° 59'	9.5	
Catipayan River, Armidel Sara	11° 10'	122° 59'	51.3	
Serruco River, Emprogo, Sara	11° 13'	122° 59'	18.9	

FIG. II - 3

LOCATION MAP OF NEWLY INSTALLED RAIN GAUGE

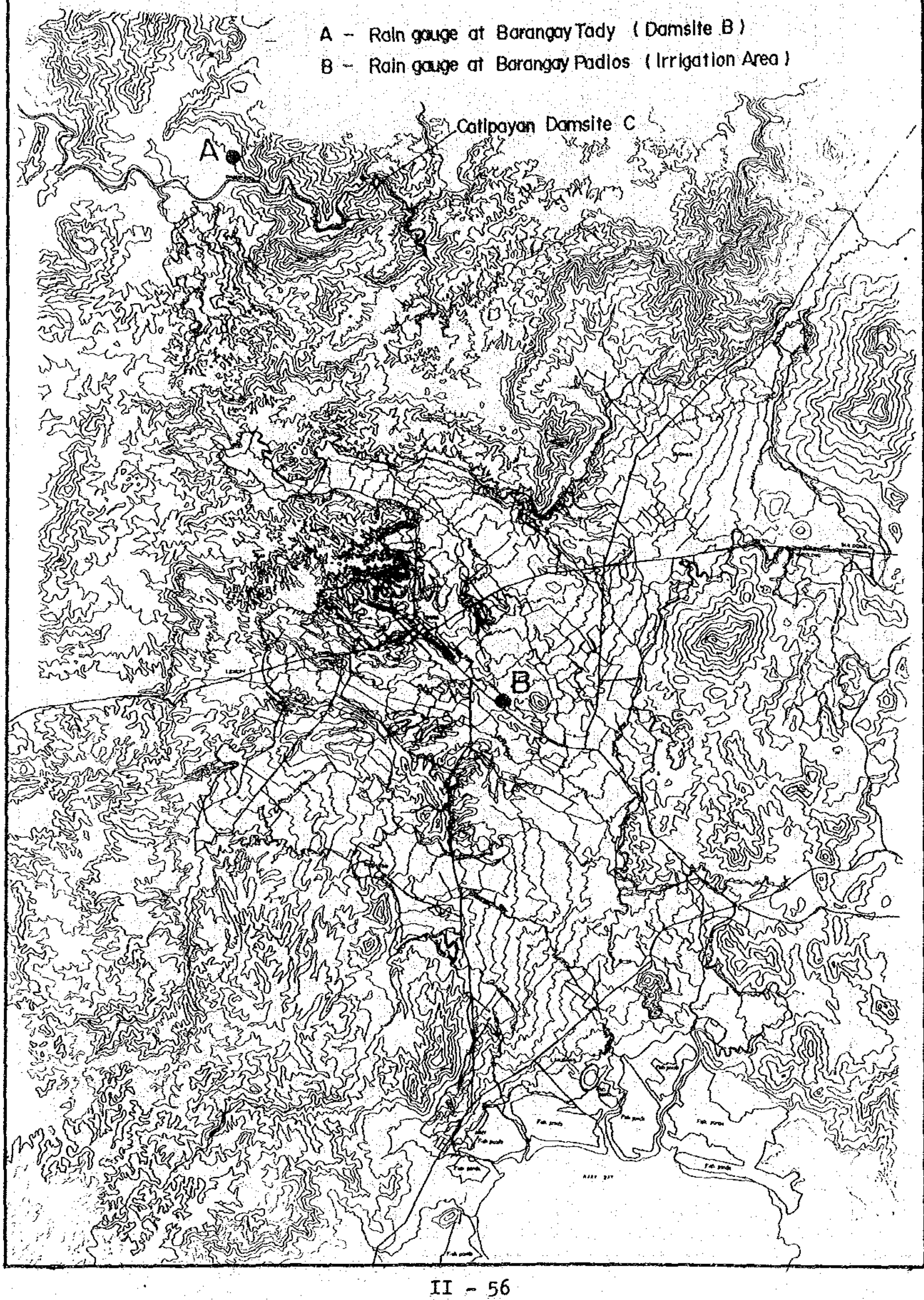


FIG. II-4

PHILIPPINES CLIMATE CLASSIFICATION BY CORONAS

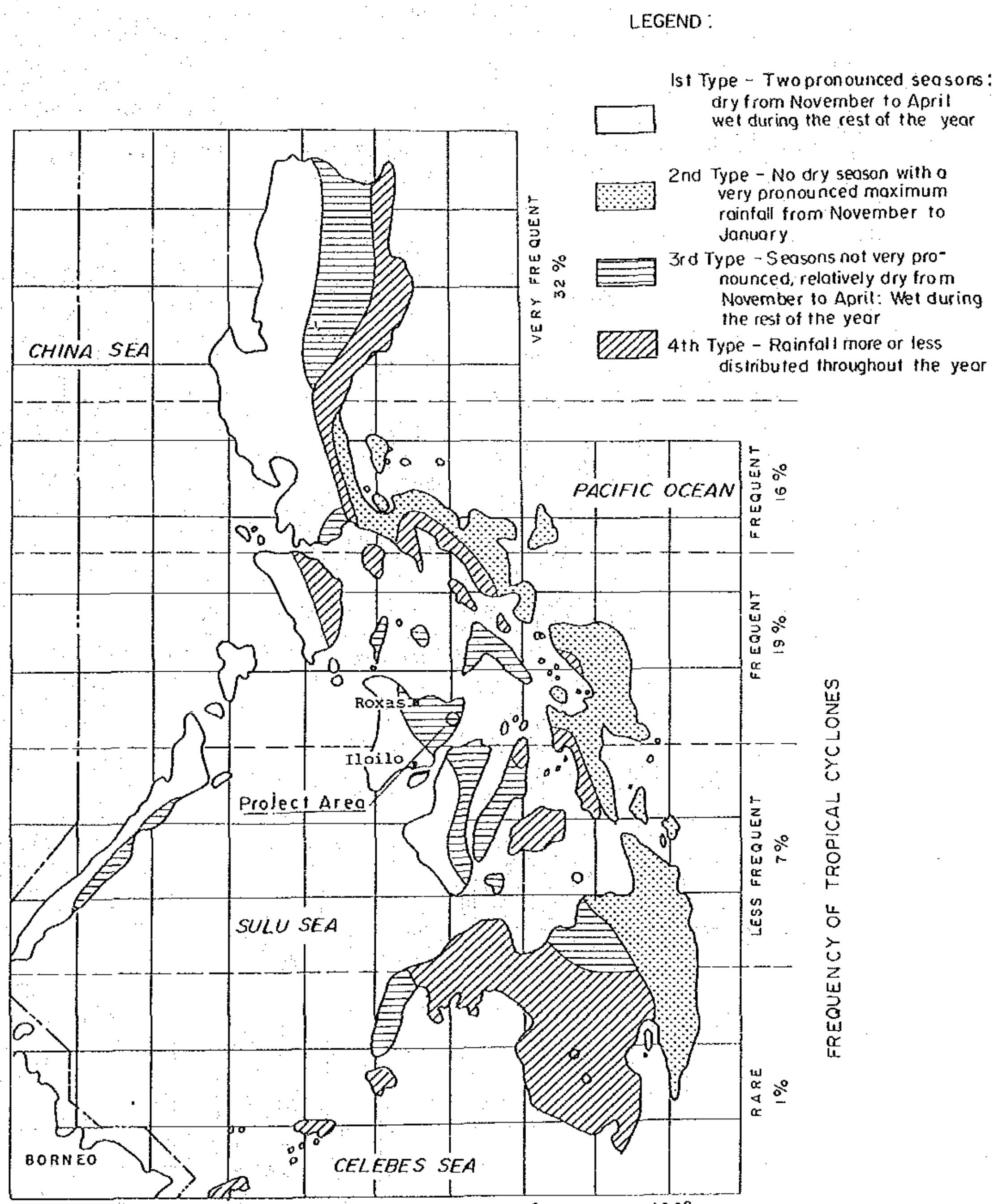


FIG. II-5

PHILIPPINES CLIMATE CLASSIFICATION BY HERNANDEZ

LEGEND :

- Wet : rainy throughout the year with at most 1½ dry months ;
- Humid : rain well or evenly distributed throughout the year with at most 3 dry months; (Q 0.14~0.33)
- Moist : rain sufficiently distributed with at most 4½ dry months ; (Q 0.33~0.60)
- Dry : rain not sufficiently distributed with at most 6 dry months; (Q 0.60~1.0)
- Arid : there are more dry than wet months ; at most there are 4½ wet months; (Q 1.00~1.67)

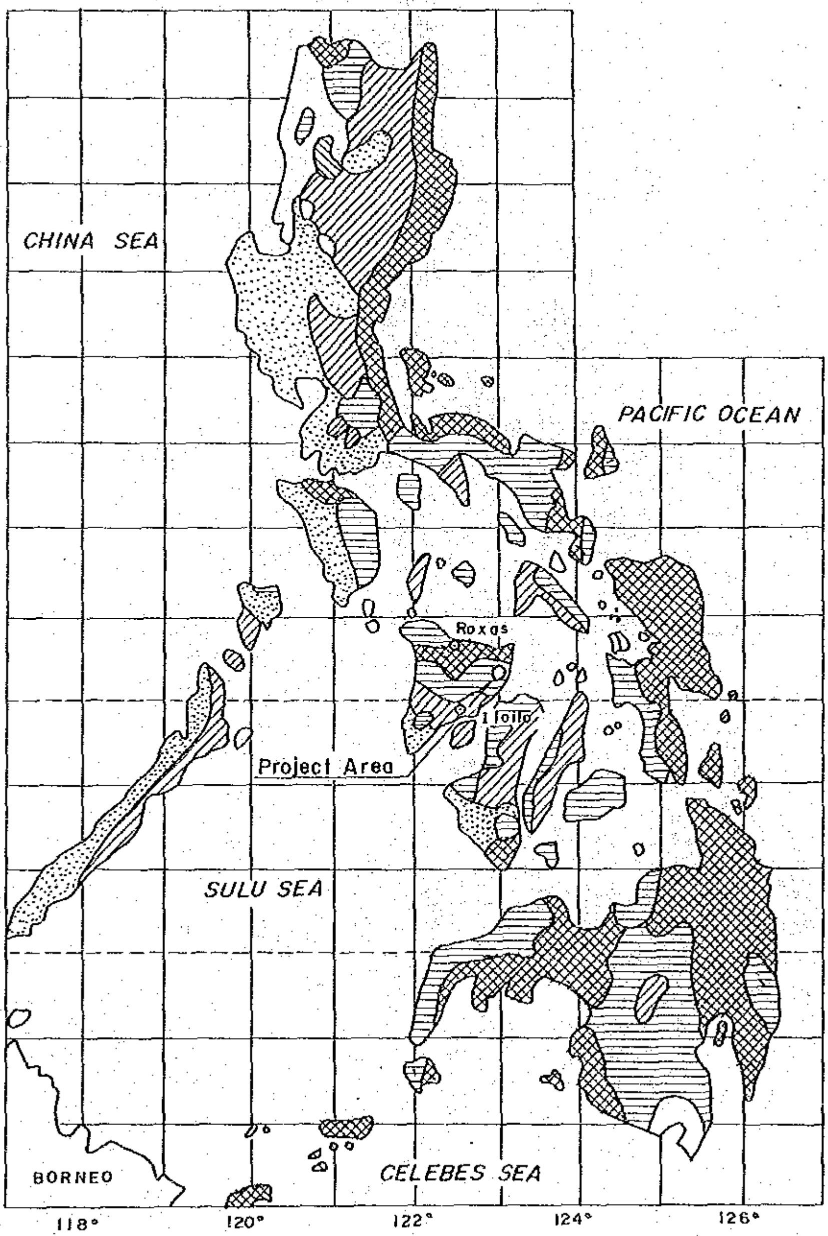


FIG. II - 6

1982 RAINFALL PATTERN IN SARA, ROXAS, ILOILO, BAROTAC VIEJO

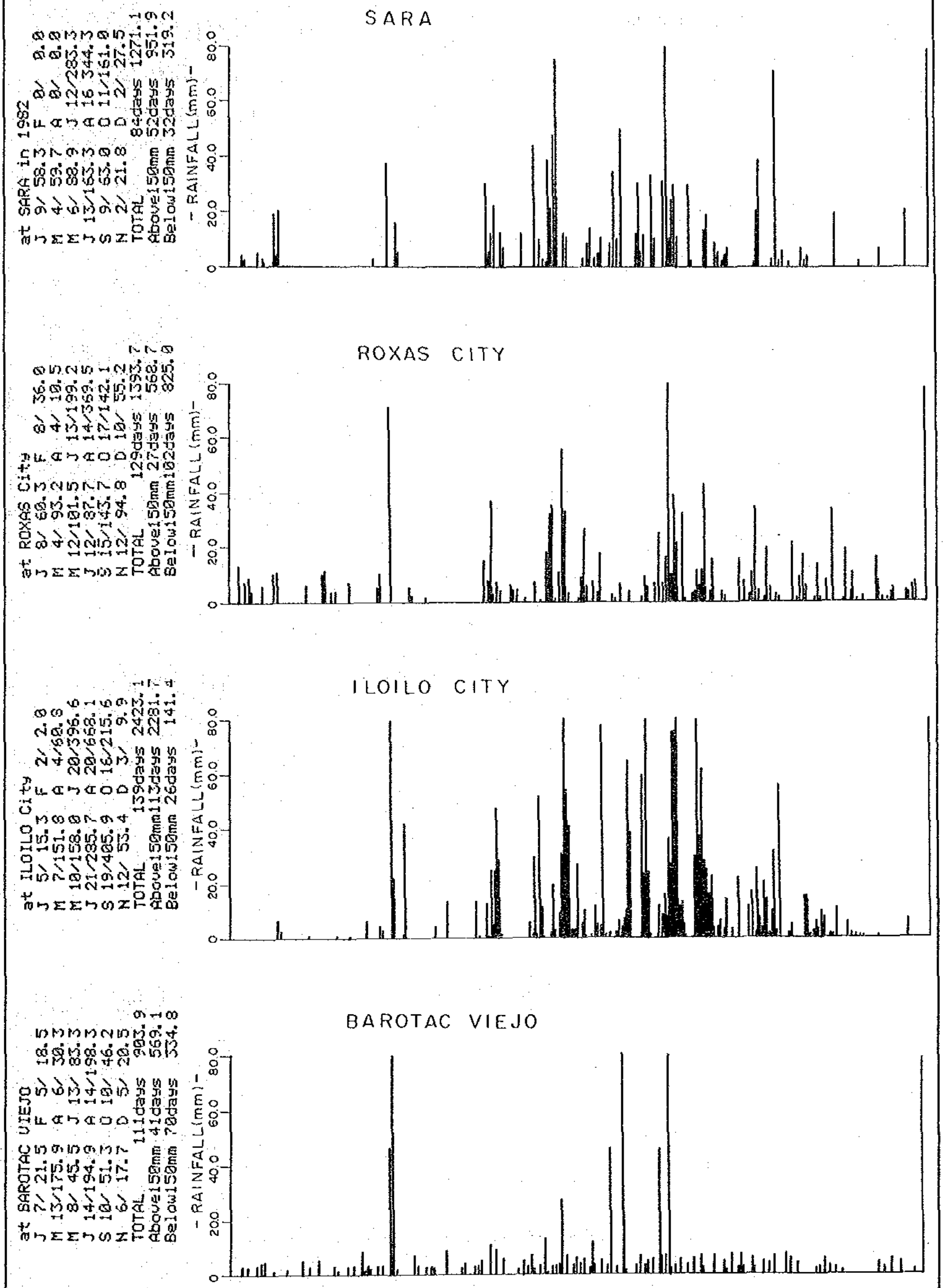


FIG. II-7

SARA-ROXAS CITY RAINFALL CORRELATION

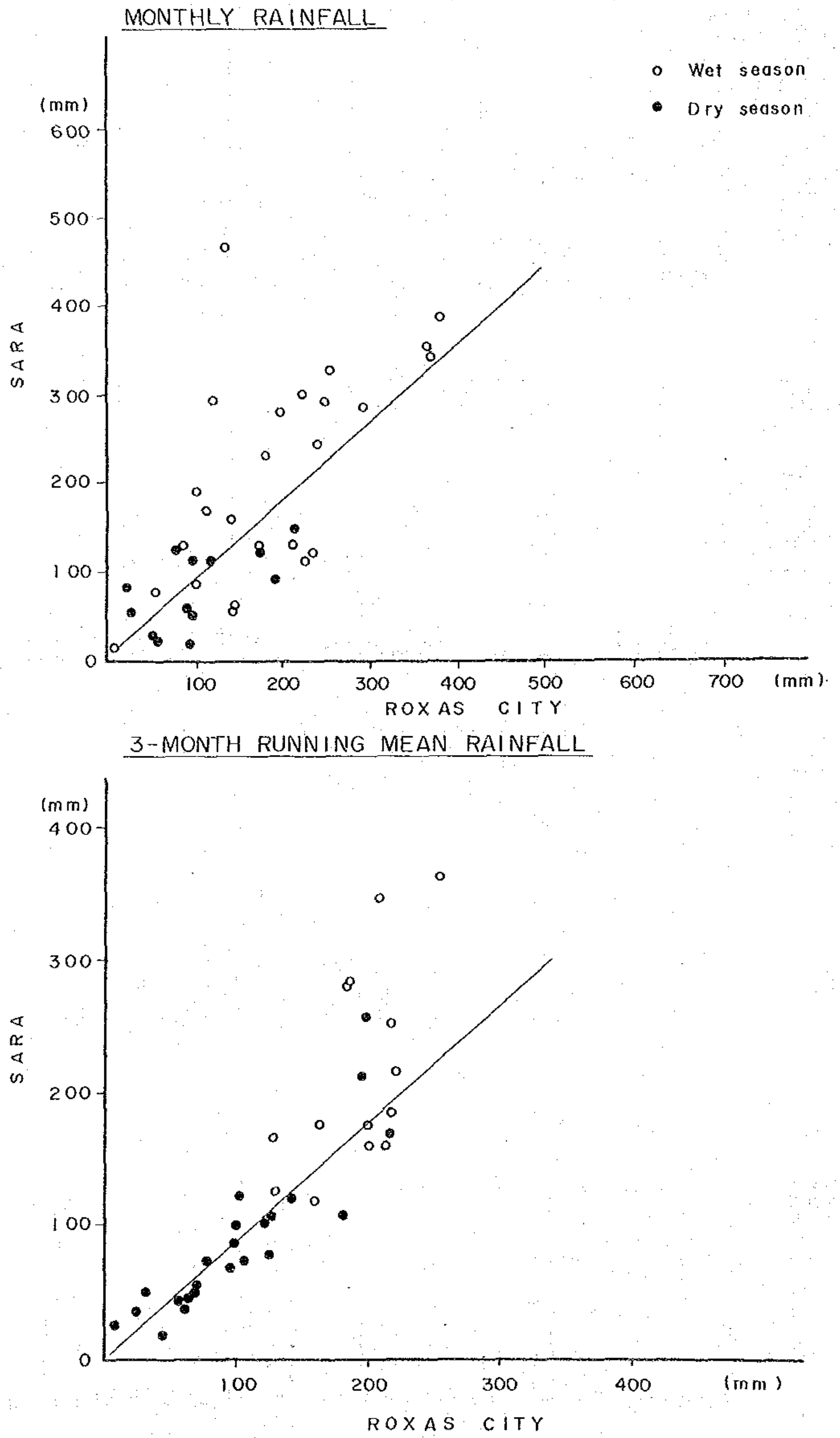
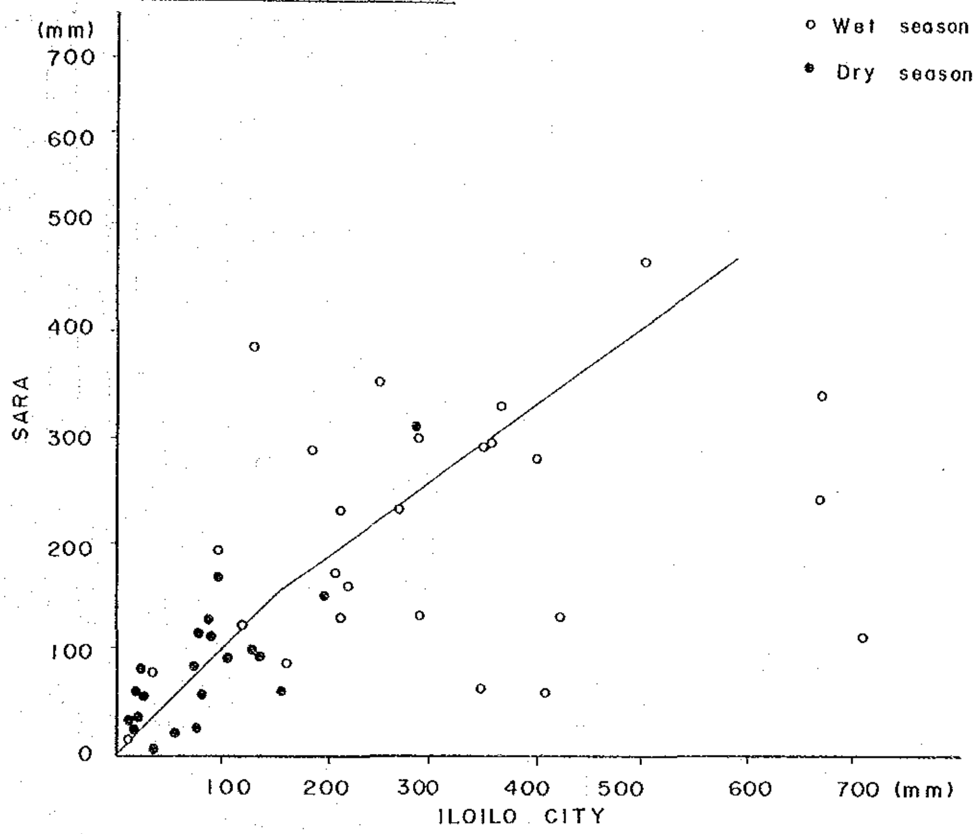


FIG. II - 8

SARA-ILOILO CITY RAINFALL CORRELATION

MONTHLY RAINFALL



3-MONTH RUNNING MEAN RAINFALL

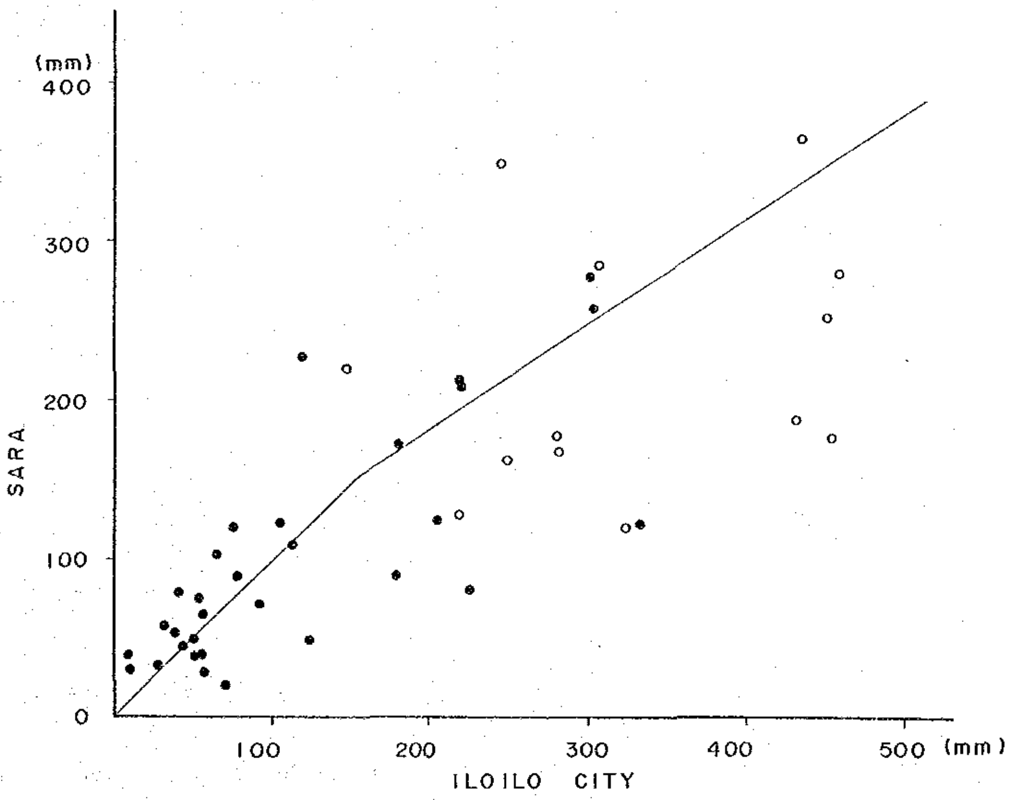


FIG. II – 9

10-DAY PERIOD HEAVY RAINFALL OCCURRENCE

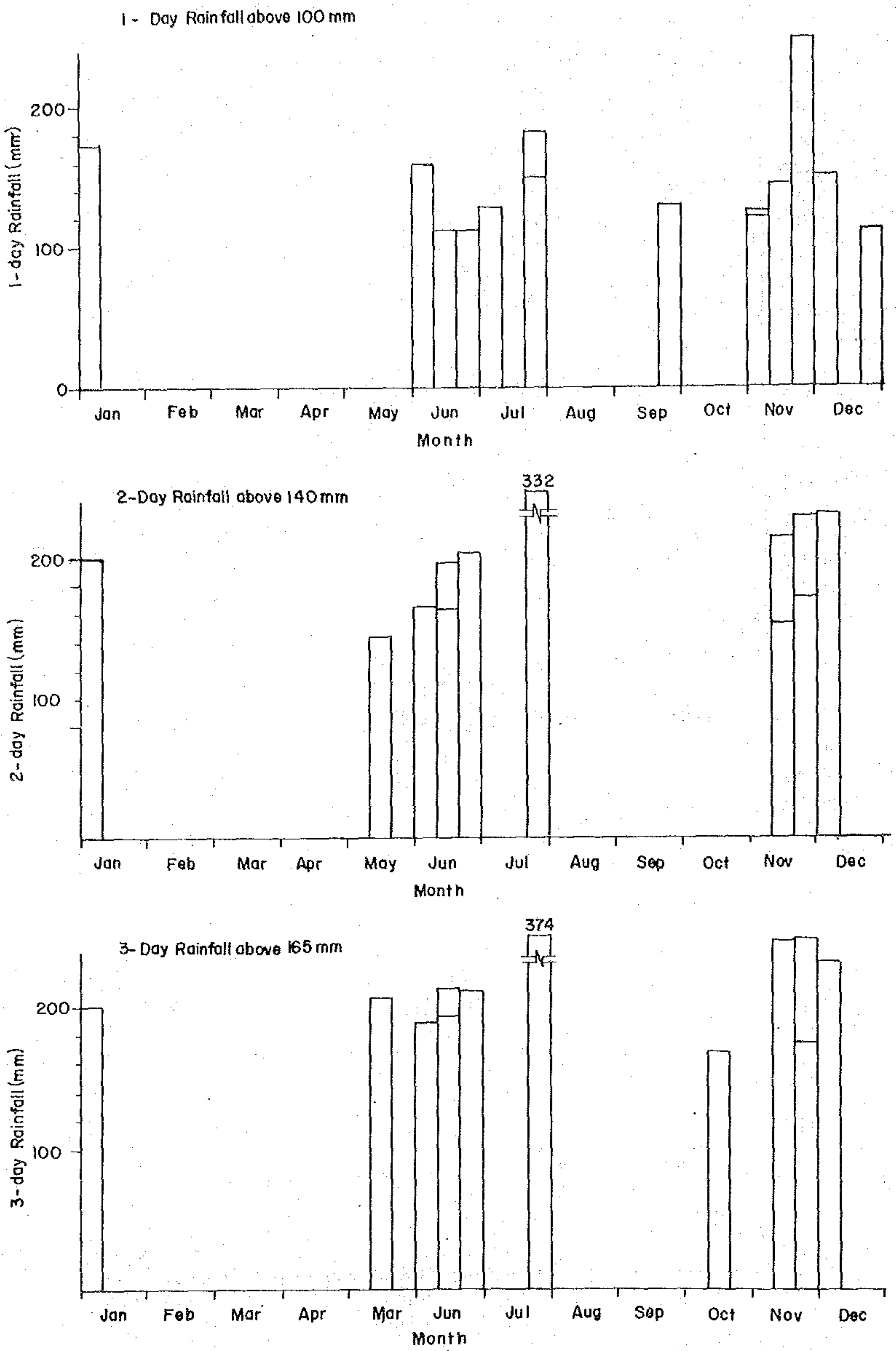


FIG. II - 10

OBSERVED HOURLY RAINFALL IN THE PROJECT AREA

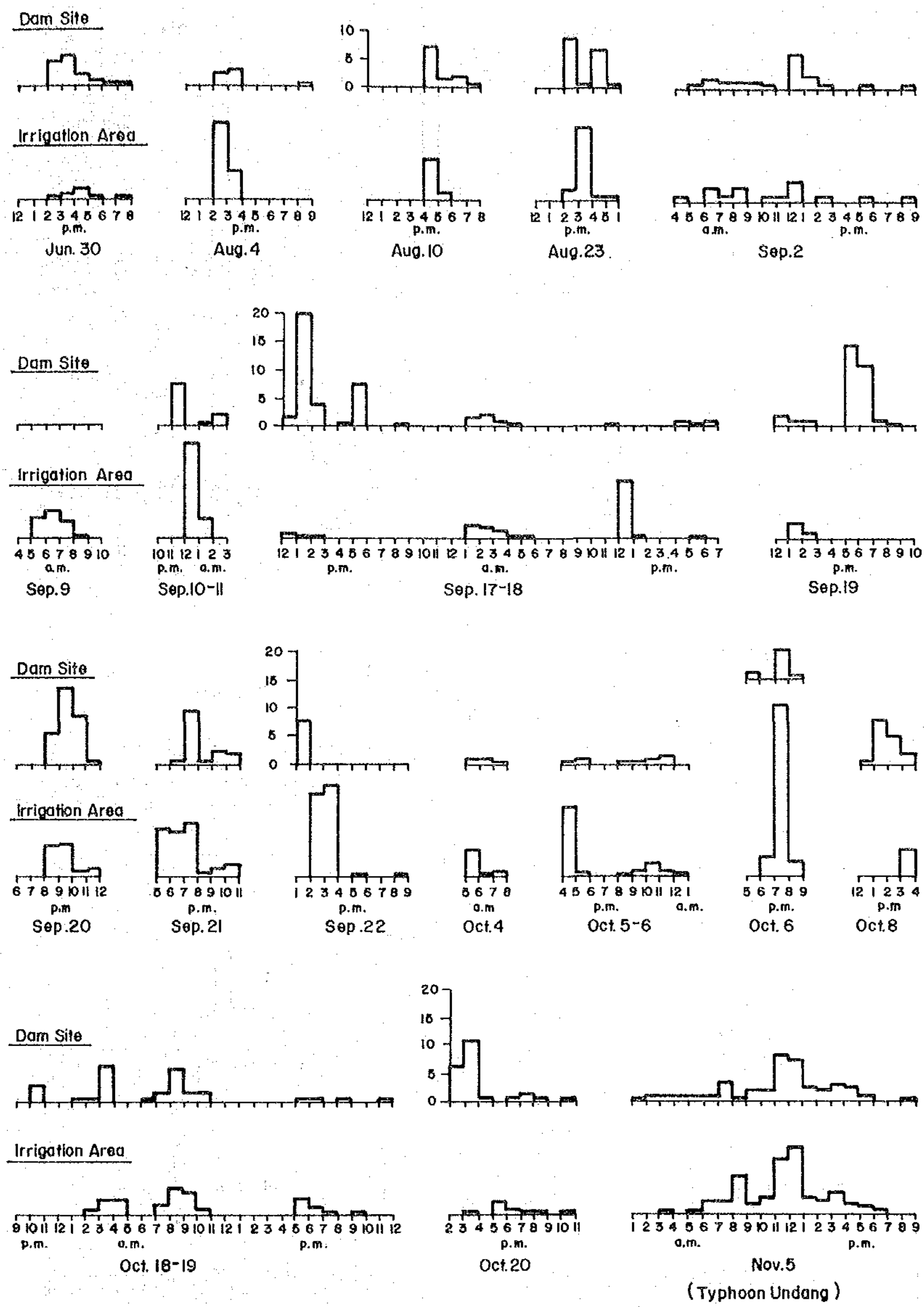


FIG. II - 11

OBSERVED HOURLY RAINFALL IN PANAY ISLAND

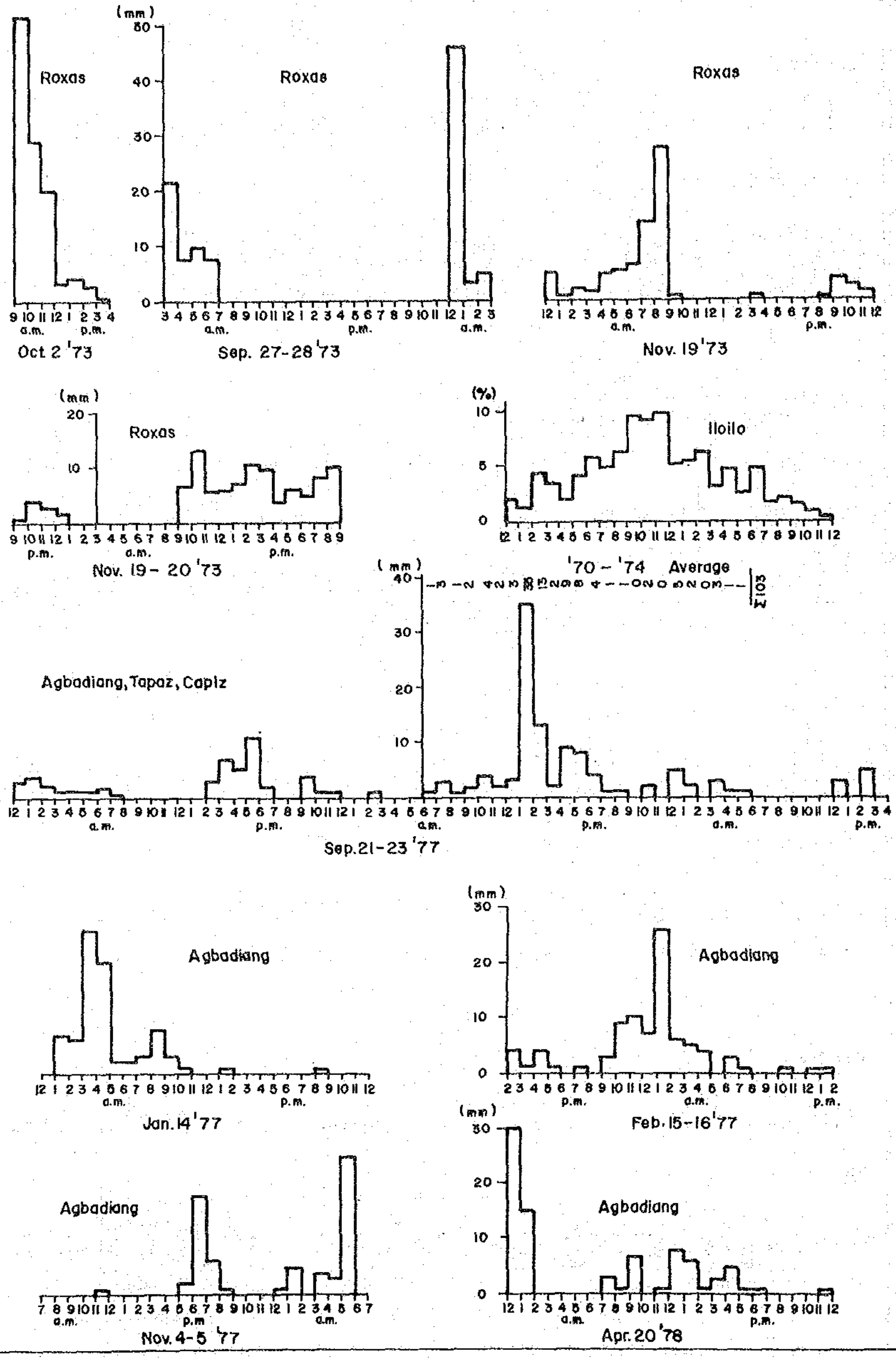
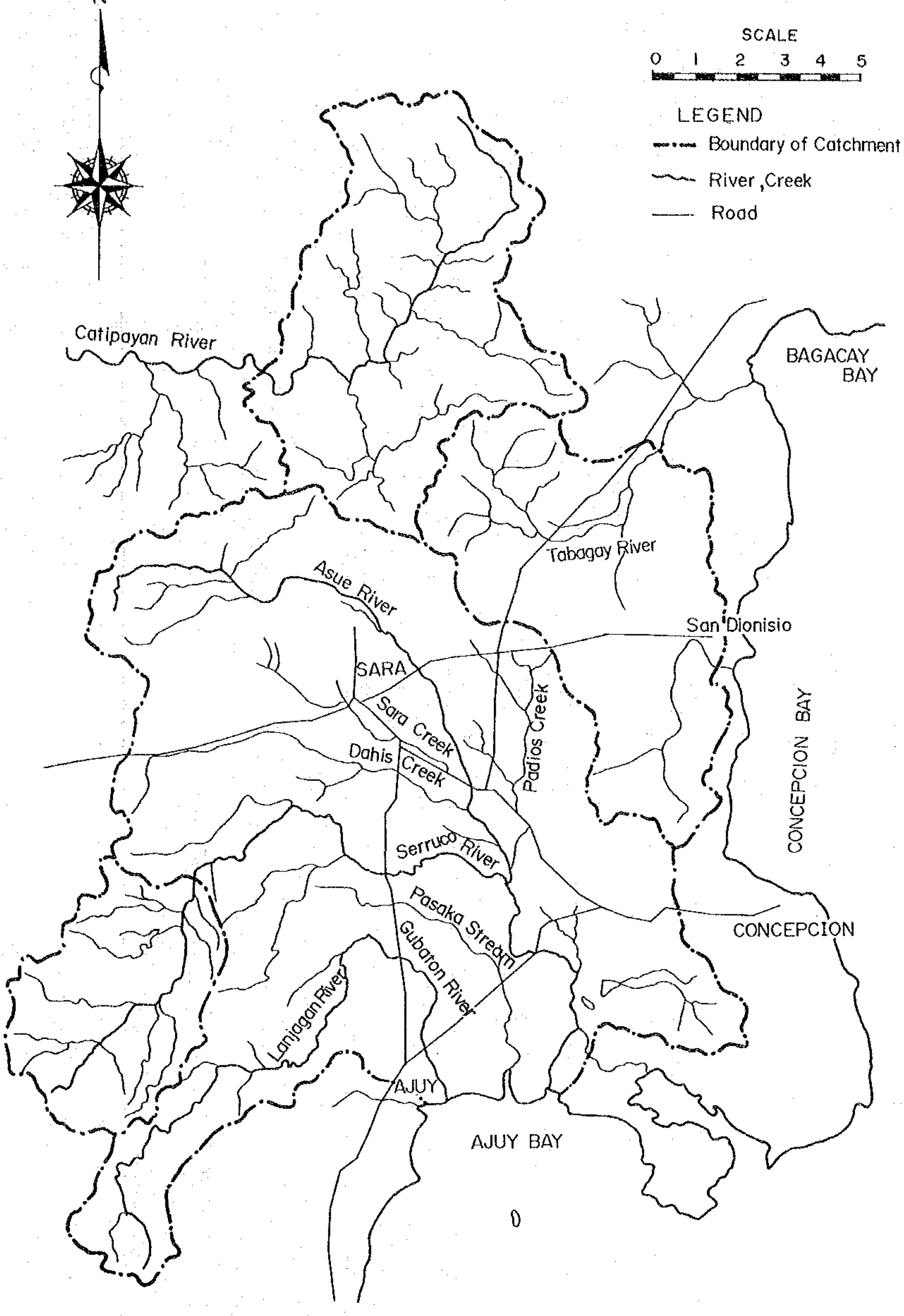


FIG. II-12

RIVERS AND CATCHMENT IN THE PROJECT AREA



PROFILE OF RIVERS

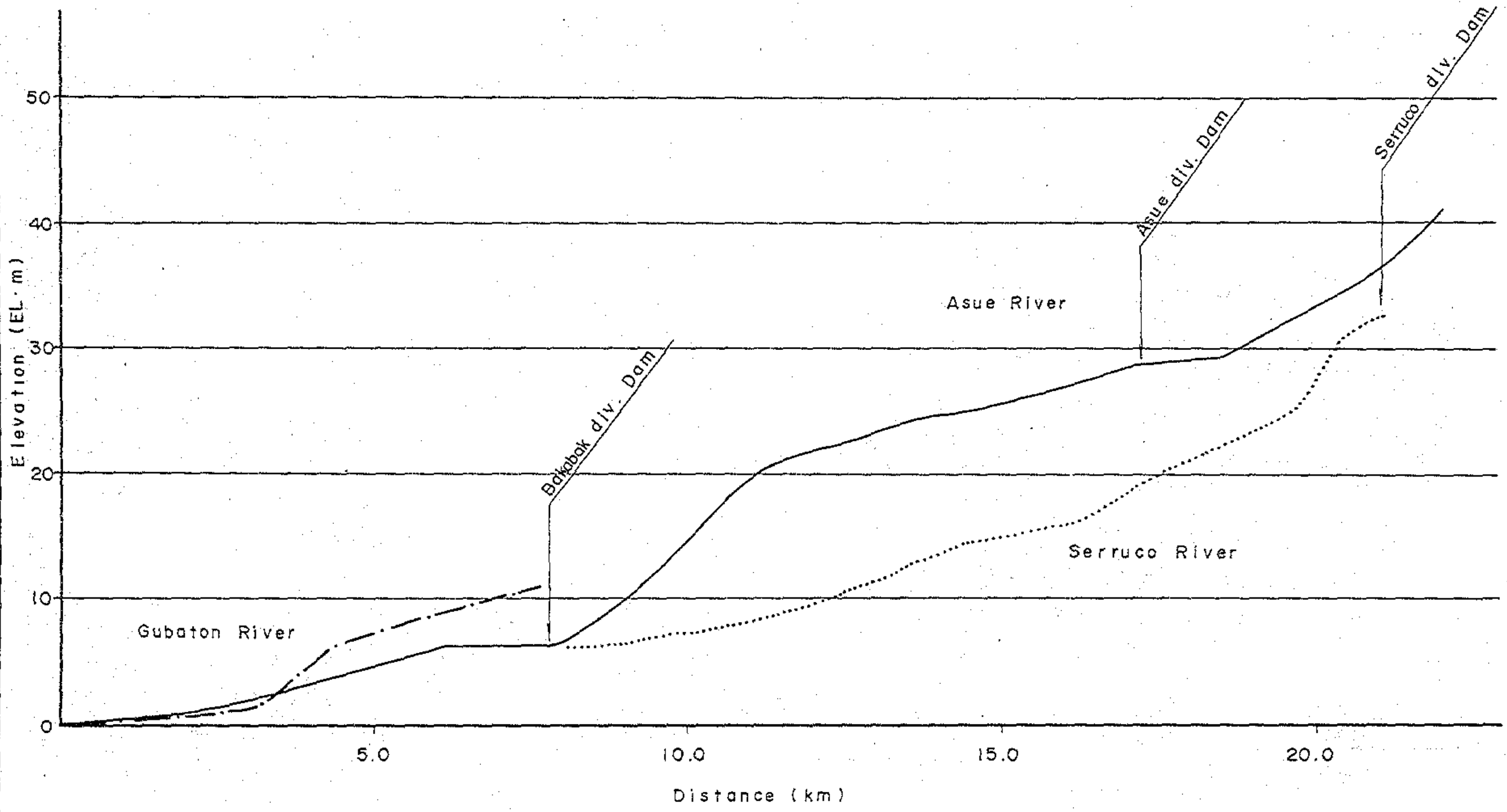


FIG. II - 13
(1 of 2)

PROFILE OF RIVERS

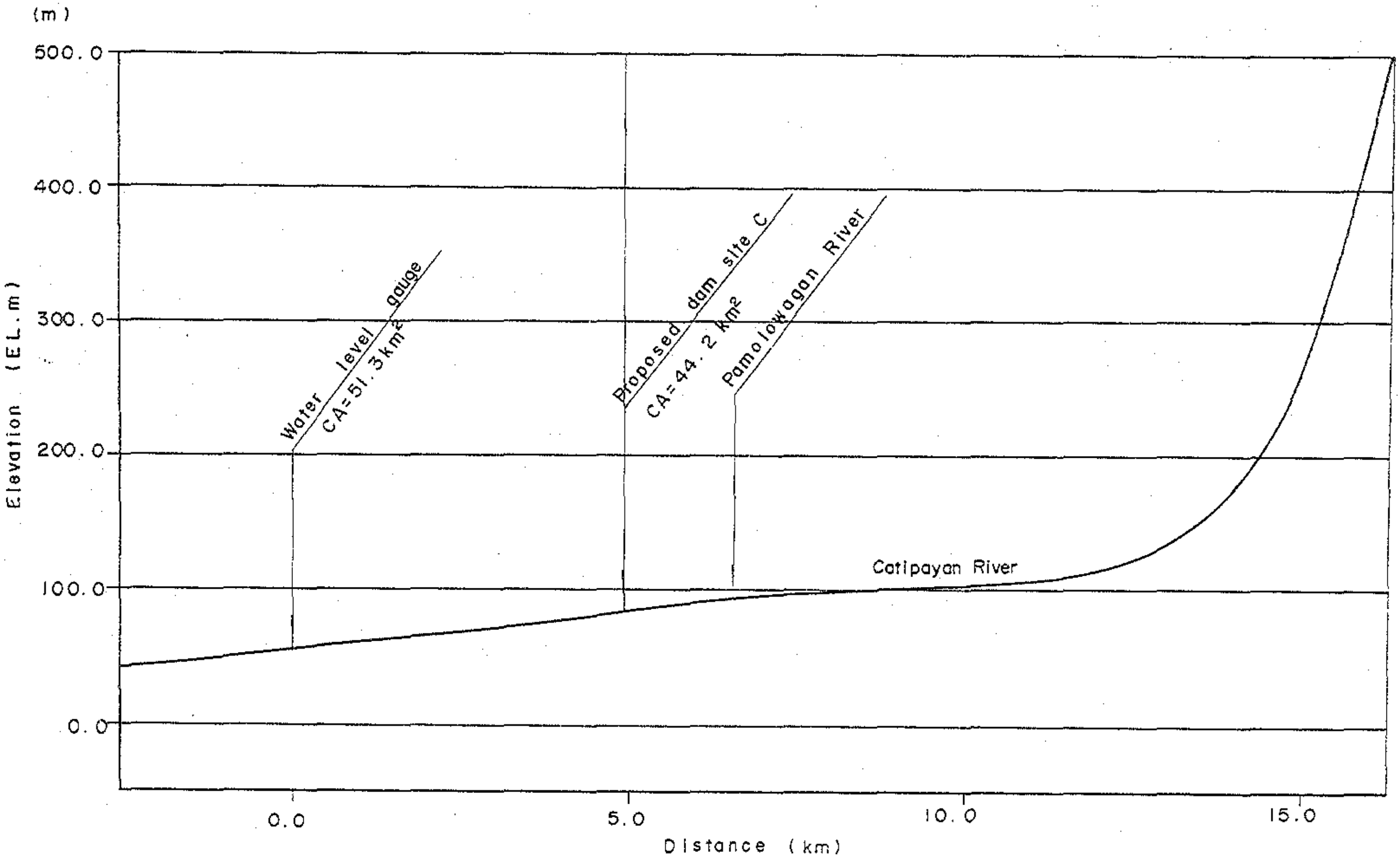
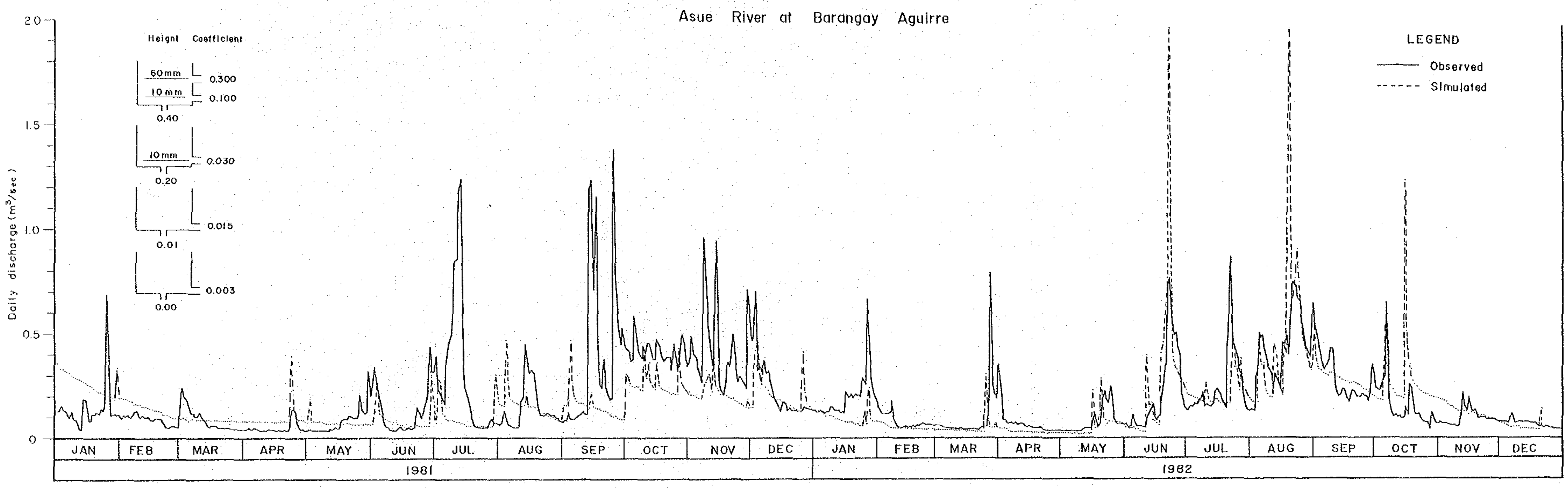


FIG. II -14

COMPARATIVE PLOT OF OBSERVED AND SIMULATED DAILY DISCHARGE



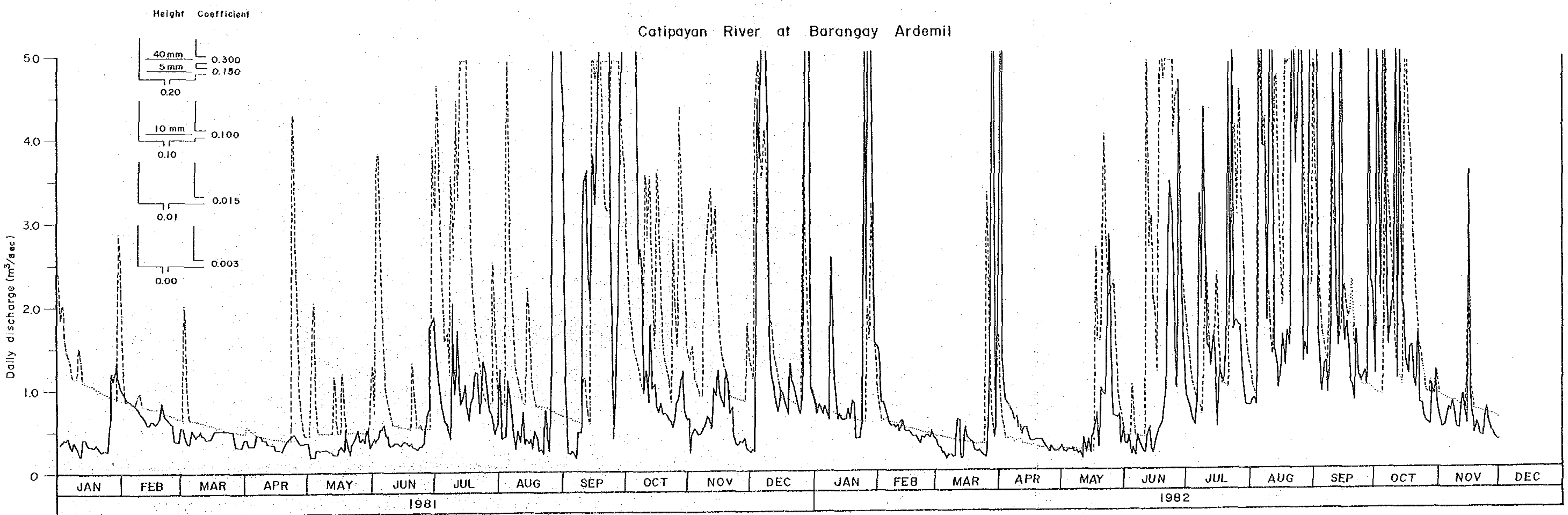


FIG. II - 15

ASUE AND SERRUCO RIVERS MONTHLY DISCHARGE CORRELATION

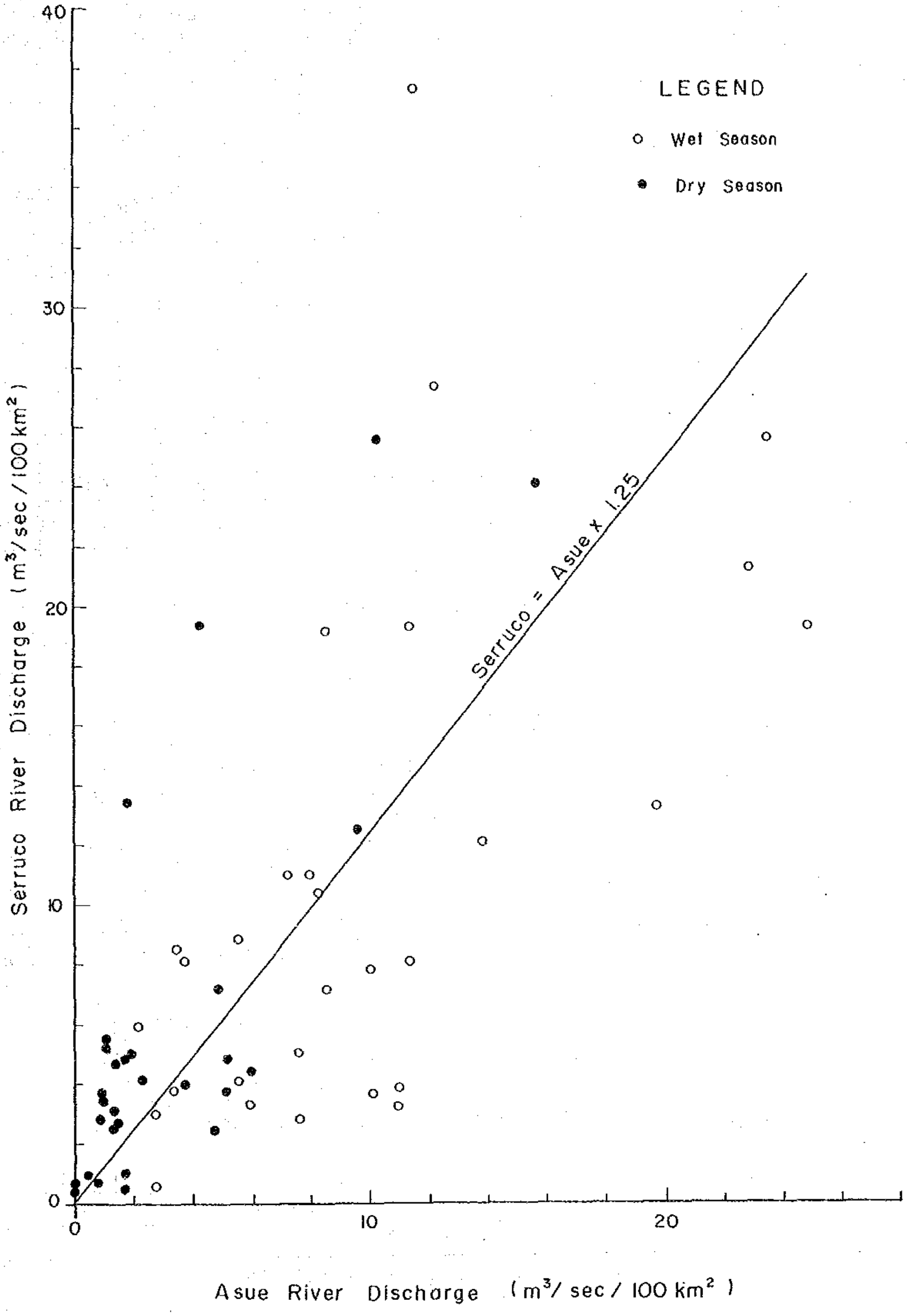


FIG. II - 16

WATER SURFACE PROFILE SURVEY RESULTS

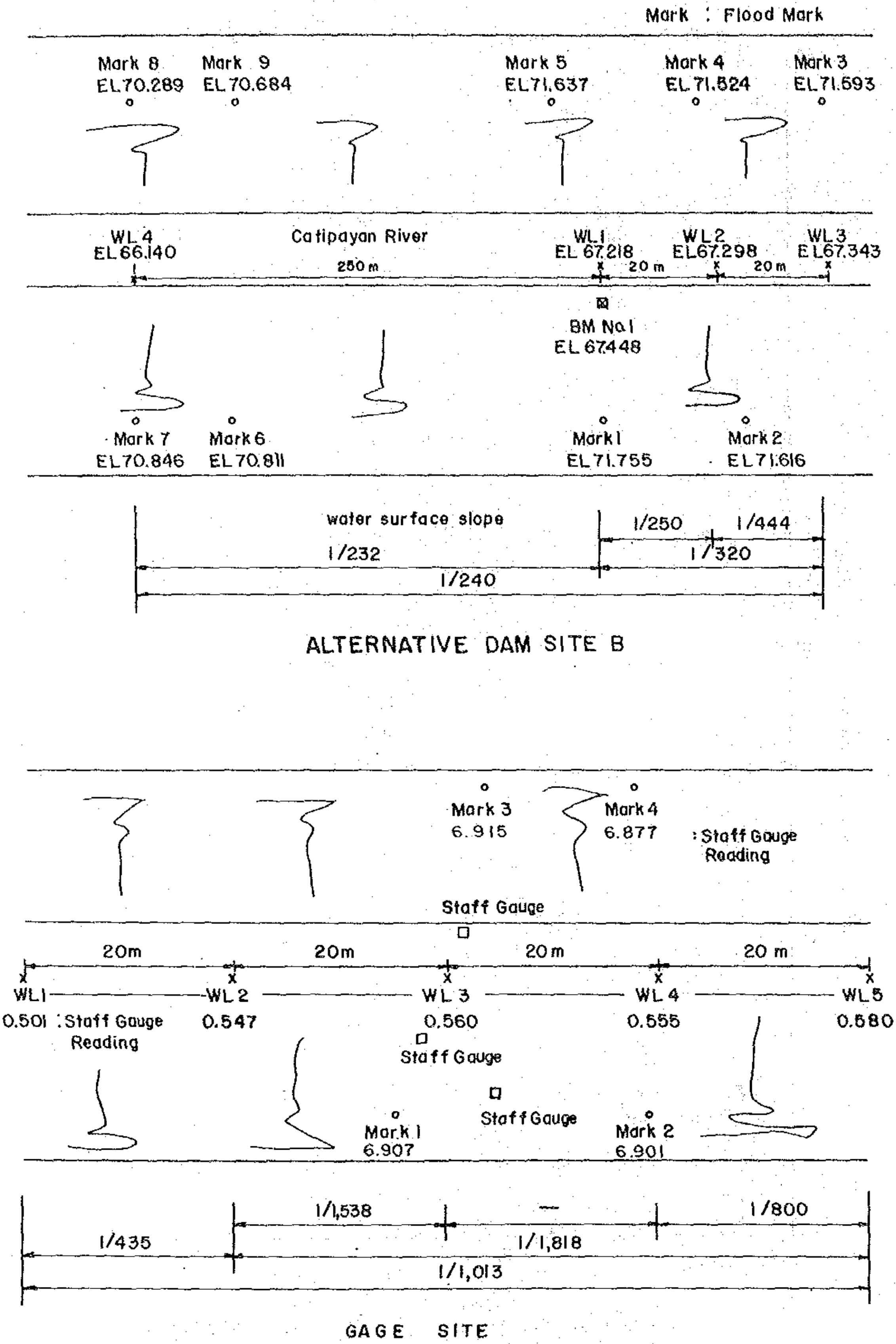
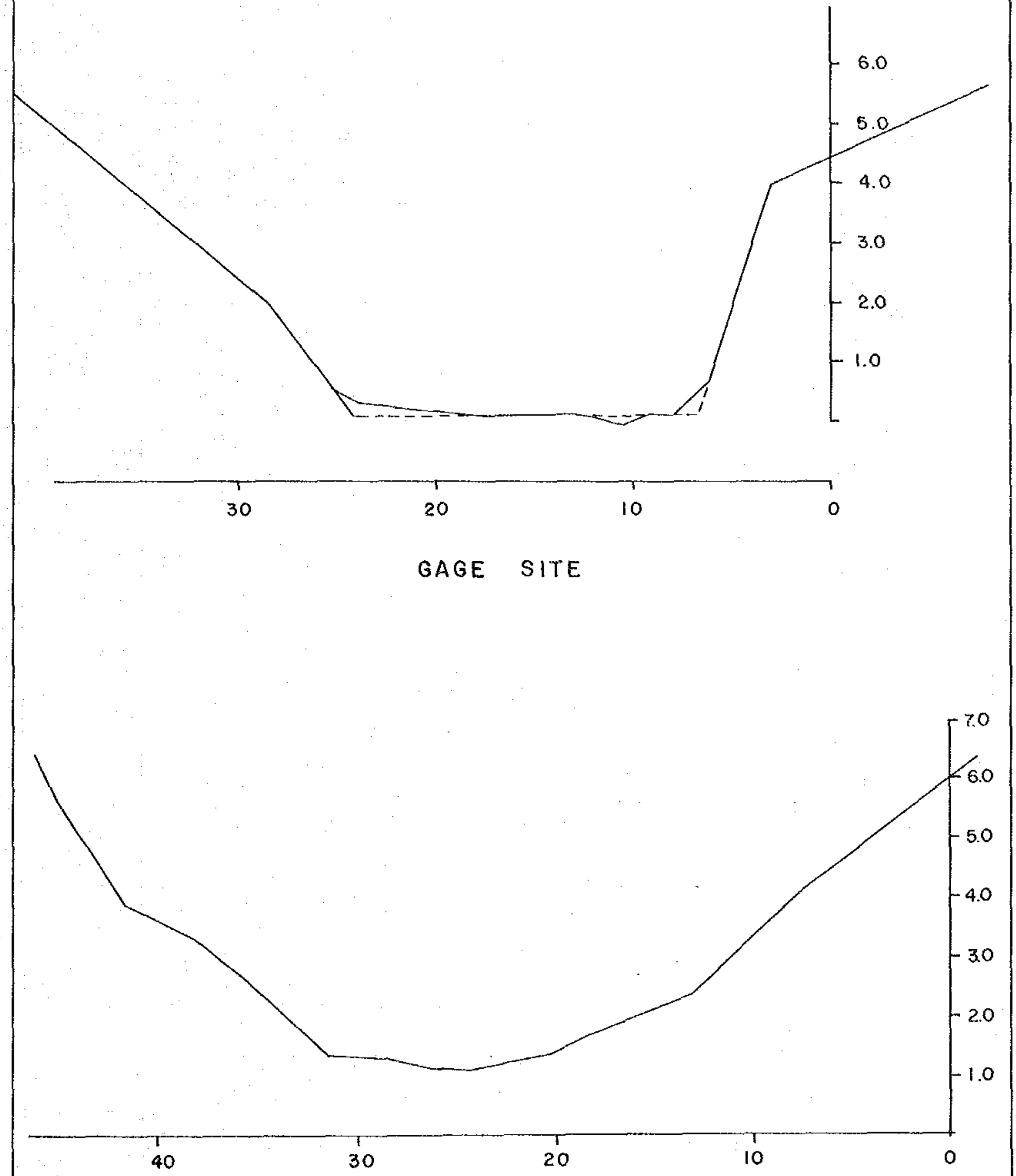


FIG. II-17

CATIPAYAN RIVER CROSS SECTION

SCALE V : 1/100
H : 1/400



ALTERNATIVE DAM SITE B

FIG. II-18

COMPARATIVE PLOT OF OBSERVED AND SIMULATED FLOOD HYDROGRAPH

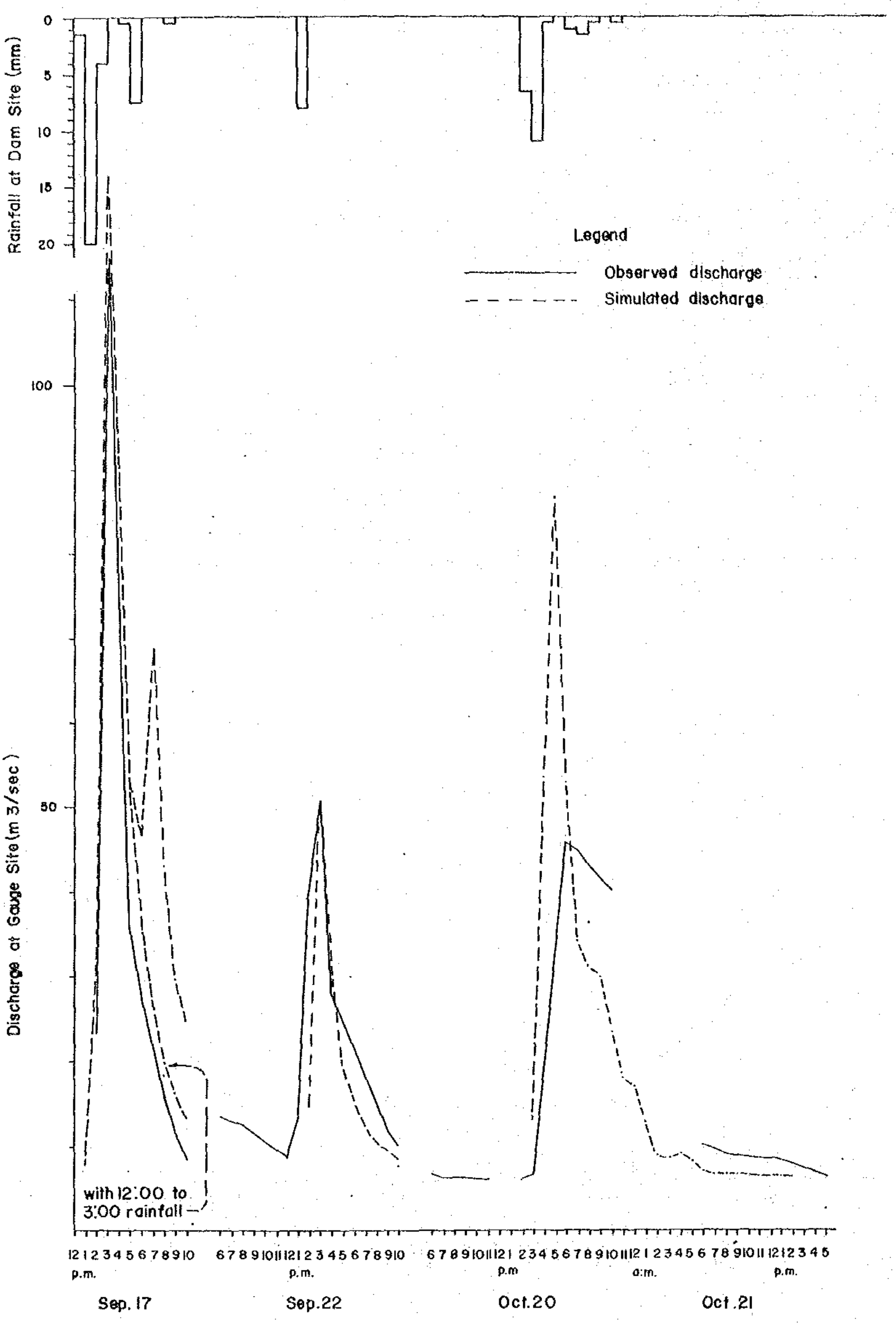
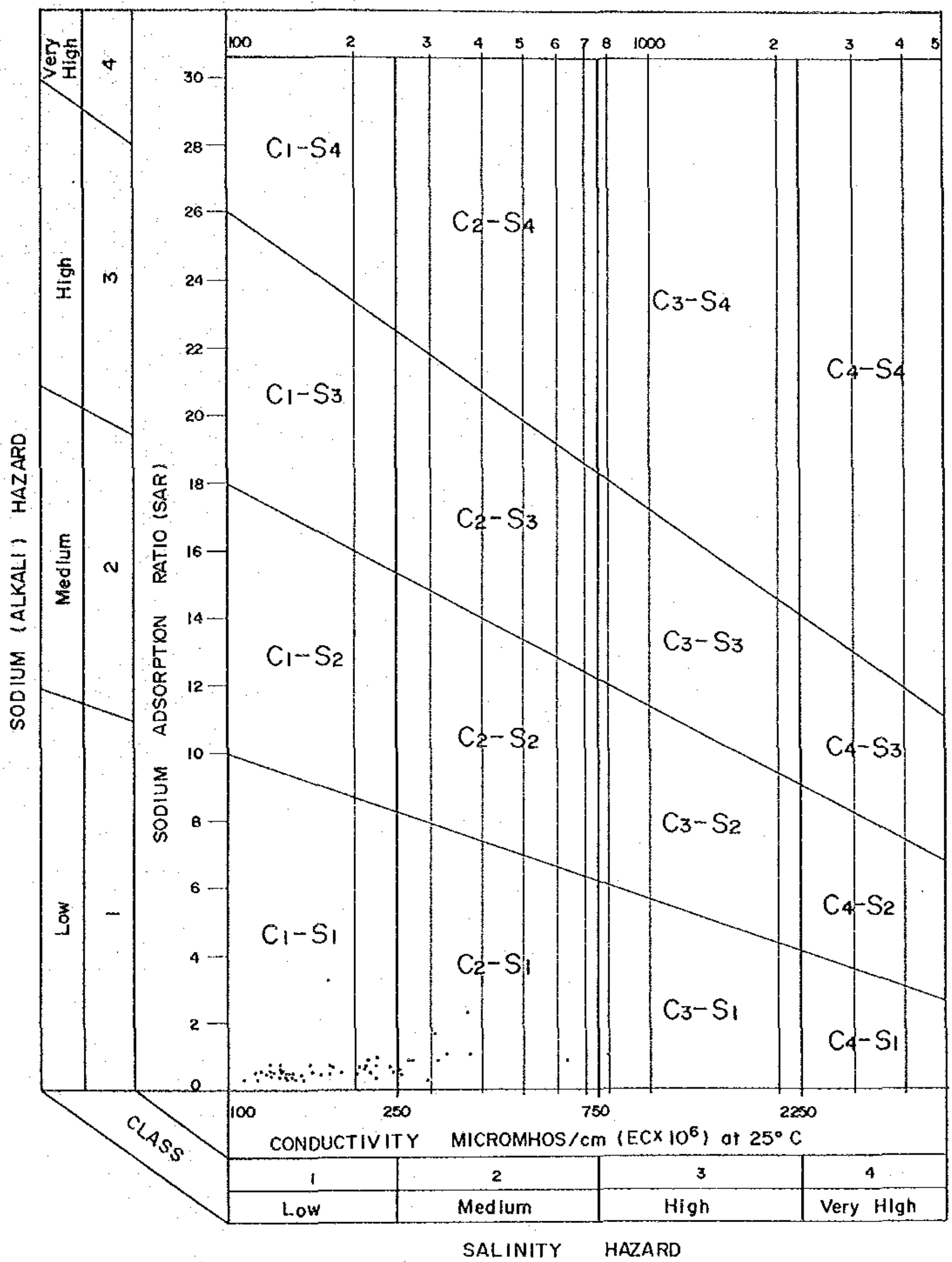


FIG. II-19

DIAGRAM FOR CLASSIFICATION OF IRRIGATION WATER



APPENDIX III

GEOLOGY AND EMBANKMENT MATERIALS

APPENDIX III

GEOLOGY AND EMBANKMENT MATERIALS

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APPENDIX III

GEOLOGY AND EMBANKMENT MATERIALS

1. TOPOGRAPHY AND GENERAL GEOLOGY

1.1 Topography

The Project area is slightly long and slender-shaped and is about 20km in length, trending to the north-south and about 10km in width trending to the east-west. The town of Sara is located in the center of the study area in Iloilo Province. The area is also divided into two different basins. The first is the Asue River basin in the southern area where the irrigation service area is located; the second is the Catipayan River basin in the northern area where there is a proposed dam site.

In the Asue River basin, the alluvial plain, which is surrounded to the north, east and west by hills and mountains, tends to Ajuy Bay located on the southern edge of the Project area. The Asue River which is the main river in the basin springs from the northern hills, flows southward where it is joined by tributaries east of the alluvial plain and finally flows into Ajuy Bay. Other rivers which have their source in the western mountains at levels of 100 - 200m are from north to south, the Alobayog, Serruco, Pasaka and Gubaton rivers. Two of the former join the Asue River slightly south of the center of the alluvial plain.

The Alobayog and the Serruco rivers flow into the Asue River in the downstream portion, while the Pasaka and Gubaton rivers directly flow into Ajuy Bay. The Tabagay River whose basin is located in the northeast portion of the Project area flows northeast of the Project's irrigation area to Bagacay Bay. The irrigation area under the Project is composed of an alluvial plain extending along the Asue River basin and high land surrounding the same.

The Catipayan River basin is mainly composed of gentle mountains, though narrow flat lands are spread over some areas along the river. The Catipayan River originates in the Agusbey mountains (peak elevation: 834m), and flows westward through the mountain area which is located in the northern end of the Project area. The river, after passing the Project's study area, flows 10km before reaching the Maayon River which flows 20km to the confluence of the Panay River.

The proposed dam site is situated 8km north-northwest of Sara Town in the mountain area. The site is a gentle mountainous area with a slope of 20°-45°, maximum elevation difference of 80-100m and a river width of about 20m. The proposed trans-diversion canal route passes along the mountain slope beside the Catipayan River, skirting the mountains, foothills and narrow flat land before reaching the Asue River basin.

In the Project area, alluvial plain is used for paddy while corn is grown in the hills. Mountains are mainly used for rice fields except for a small area of corn fields.

1.2 General Geology

The geology of northeastern Panay is composed of 2 kinds of bedrock and alluvial sediments. A stratigraphical table is presented as TABLE III-1.

One type of bedrock consists of volcanic sediments such as andesitic to basaltic pyroclastic rocks and volcanic flows which are named the Sibara Formation, and are presumably Createceous to Tertiary in age. The Sibara Formation is basically composed of pyroclastic rocks and consists of latilli tuff, tuff, agglomerate and lava flow. It is massive, gray to dark green and its source is volcanic sediments with inconsistent thickness. Moreover, as the environment of sedimentation was different, the same is poorly graded. It was transformed by gravity and intrusions of Sara Diorite before becoming consolidated, resulting in disturbance of the sedimental structure.

The other type of bedrock consists of diorite known as Sara Diorite which is probably Tertiary (Paleocene) in age and intrudes into the Sibara Formation. The area covers about 600km^2 in the north-northeast area and is milkish gray to reddish gray. It mainly consists of quartz, hornblend and pyroxene, has fine to medium granular texture, and is assumed to have been formed during the Paleocene Period on the basis of measurements of the geological age by the K-Ar methods. The mass distributed around the Project area is intensively weathered as deep as the bedrock.

Alluvial sediments lie thinly on the bedrock and consist of loose sand and gravel interbedded with silt and clay. In the Asue River basin, alluvial sediments extend in the central plain area, diorite in the northern to western mountainous areas and pyroclastic rocks in the eastern mountainous areas. In the Catipayan River basin, pyroclastic rocks are extensively distributed around the proposed dam site and reservoir areas. However, diorite is narrowly distributed in the southern part of the basin and in the northwestern ridge of the Catipayan area as a small intrusive mass from the Asue River basin. Alluvial sediments are scattered along the narrow flood plain in the Catipayan River and relatively broad flood plains in the Asue River basin as shown in FIG. III-1.

2. GEOLOGICAL INVESTIGATIONS

2.1 Existing Survey

NIA has planned and executed geological investigations since March, 1983 in the proposed dam site located in the upper reaches of the Catipayan River, and the proposed trans-diversion tunnel, which is about 3.5km south of the proposed dam site. The contents of geological investigations and drilling and water pressure tests, are outlined below while the quantities of the same are shown in TABLE III-2.

2.2 First Survey

The Team undertook the above mentioned geological investigations in cooperation with NIA counterparts, and carried out the First Survey including First Stage Field Work from June to August and First Stage Home Office Work from August to October, 1984.

Contents of geological investigations which were carried out for the period of the First Survey consist of drilling, seismic exploration and soil-rock tests, details of which are shown in TABLE III-3.

2.3 Secondary Survey

After the First Survey, the Team continued geological investigation, carrying out the Secondary Survey including Second Stage Field Work from October to December, 1984, and Second Stage Home Office Work from December, 1984 to March, 1985.

The contents of geological investigations which were undertaken for the Secondary Survey include the remaining items from the First Survey and supplementary works such as drilling and water pressure tests at proposed dam site C. Details are shown in TABLE III-4.

The geological investigations mentioned above are classified as shown in the table with regards to the site. The locations of the same are shown in FIG. III-3 and III-4.

<table>
<tr><th>Site</th><th>Investigation</th><th>Drilling</th><th>Permea-bility Test</th><th>Seismic Explo-ration</th><th>Soil Test</th><th>Rock Test</th></tr>
<tr><td rowspan="2">Dam</td><td>Alternative Dam Site B</td><td>12 holes
540.20(m)</td><td>131 nos.</td><td>3 lines
1155(m)</td><td>-</td><td>-</td></tr>
<tr><td>Proposed Dam Site C</td><td>1 hole
20(m)</td><td>5 nos.</td><td>1 line
550(m)</td><td>-</td><td>-</td></tr>
<tr><td>Borrow</td><td>Impervious Material</td><td rowspan="2">3 holes
160.92(m)</td><td>-</td><td rowspan="2">4 lines
1980(m)</td><td>38 nos.
(13 pits)</td><td>-</td></tr>
<tr><td>Quarry</td><td>Semi-Pervious & Pervious Material</td><td>-</td><td>-</td><td>10 nos.
(3 holes)</td></tr>
<tr><td>Tunnel</td><td>Trans-diversion Tunnel</td><td>3 holes
151.14(m)</td><td>-</td><td>1 line
880(m)</td><td>-</td><td>-</td></tr>
</table>

3. RESULTS OF GEOLOGICAL INVESTIGATION

3.1 Drilling

Drilling was conducted according to the core method at all dam sites, proposed embankment material sites and tunnel sites. The results are shown in FIG. III-5 to III-7 (Bore Hole Log). In each bore hole log, the grade of bedrock is described by the observation of drilling cores such as rock type, state of weathering, hardness, state of fractures and rate of recovery.

Bedrock confirmed by drilling were all andestic to basaltic pyroclastics belonging to the Sibara Formation. The depth of the highly weathered portion of bedrock, which is soil-like in appearance is relatively shallow with a depth of about 2m at the bottom of gullies, and about 10m on the mountain ridge and plateau area.

Results of investigations were arranged according to geological cross sections accompanied by the results of the other investigation, and used to evaluate the potential of bedrock as a foundation for the dam and tunnel construction. Results were also used to estimate the volume of embankment material.

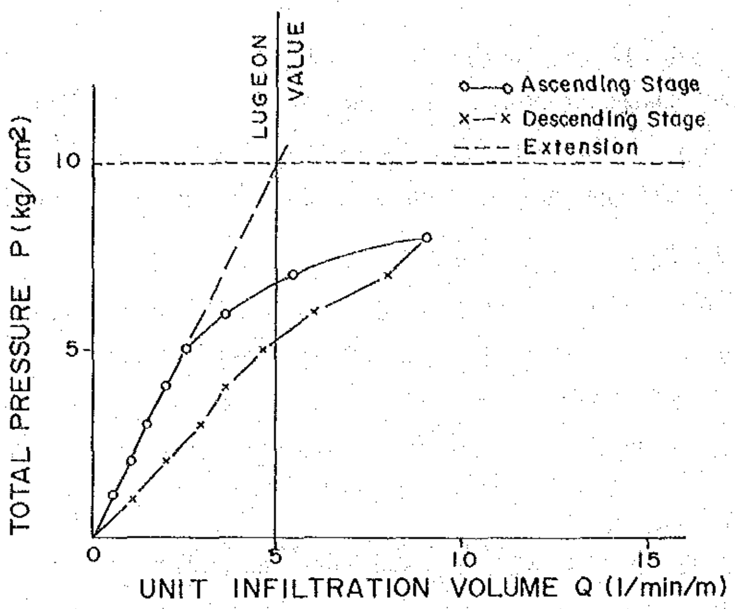
The standard to classify the grade of bedrock is shown in TABLE III-5. In general, bedrock of higher grade than C_L-C_M class are adaptable as a foundation for rock fill type dams, while a wide distribution of rocks graded higher than C_M class bedrock is preferable for tunnel construction.

3.2 Permeability Test

Water pressure tests were carried out in drill holes at dam sites. The interval of each test was 3.05m, and the results of each test are shown in TABLE III-6 by lugeon value.

Lugeon values obtained for each test were small. This indicates that minimal foundation treatment is required and in general bedrock is considered adequate for dam foundation. Lugeon values of more than 5 were obtained at the riverbed of site B, DDH-1,2 at depths from 30m to 37m indicating that deep foundation treatment is necessary. However, the lugeon values in this portion were still less than 50, corresponding to slightly fractured zone rather than fault shear zone.

Lugeon values are given on the following page, with 1Lu being equal to 1.0 x $10^{-5}m^3/sec$ in permeability coefficient and the lugeon value for a unit length of test was determined as in the following figure. In general, 3-5Lu is acceptable as a foundation for a rock fill type dam.



$$Lu = \frac{10 \cdot Q}{P \cdot L}$$

where,

- Lu: Lugeon value
- Q : Infiltration volume (l/min)
- P : Pressure (kg/cm²)
- L : Permeation interval (m)

3.3 Seismic Exploration

Seismic exploration was conducted at the dam site, proposed borrow/quarry sites for embankment material and the tunnel site. Measurements were carried out by NIA experts.

On the basis of recorded data, a 1/500 scale velocity layer cross sectional diagram was prepared. Velocity layers were broadly divided into the 4 strata shown in the table below.

VELOCITY STRATUM OF THE PROJECT AREA

Velocity Stratum	Velocity (km/s)	Rock characteristics
1st Stratum	0.4 - 0.6 (0.3)	Topsoil, talus, weathered rock soil
2nd Stratum	0.9 - 1.5 (0.8)	Heavily weathered rock (including portions of talus)
3rd Stratum	2.0 - 2.6	Moderately weathered rock
4th Stratum	4.0 - 5.3 (3.8)	Slightly weathered rock to fresh rock
Low Zone	Velocity unknown (3.2)	Shear zone, fractured zone, deep strata weathered zone

Through comparison of velocity layer classification for seismic waves and drilling results, the geological characteristics of each layer were estimated. The first velocity stratum (0.4-0.6km/s) consists of cover material including topsoil, talus, weathered rock soil, etc. The second velocity stratum (0.9-1.5km/s) is mainly composed of heavily weathered rock in the form of loose earth and sand, including a portion of unconsolidated sedimentary deposits. On the basis of core examination, this heavily weathered portion of bedrock is determined as D_L-C_L class.

The third velocity stratum (2.0-2.6km/s) is composed of moderate to mildly weathered bedrock. Although sections composed of rock fragments and blocks exhibit hardness, cracking is pronounced throughout the stratum along which weathering has progressed. This stratum is determined as C_L-C_M classes including some other classes.

The forth velocity stratum (4.0-5.3km/s) constitutes the foundation velocity stratum for the site area and is composed of slightly weathered to fresh bedrock. This stratum is determined as more than C_H class. Within the forth velocity stratum, low velocity zones are present wherein velocity values are relatively less than those of adjacent areas. The velocity of such zones was observed at 3.2km/s. Although the precise nature of the relationship and continuity with surrounding formations remains unclear, these low velocity zones may be the result of such factors as fault cracked zones, deep strata weathering and deterioration from folding.

3.4 Soil Test

Soil tests were conducted for the samples which were taken from test pits excavated for 2-3m at proposed sites for impervious materials in the vicinity of dam sites. Soil profiles are shown in FIG. III-9. As shown in TABLE III-7 typical samples were classified into SC-CH. Natural water content (Wn) of the same ranged from 16-35%, dry density (rd) from 1.5-1.7t/m^3 and permeability coefficient (K) from 1x10^{-6}-10^{-8}cm/sec. Although there is a high content of fines, the soil test values indicate the same is suitable for impervious material.

3.5 Rock Test

Drill cores which were classified into D-C_H class sampled from DDH-R1, R2, R3 quarry sites were used for rock test specimens. The results of rock tests are shown in TABLE III-8.

Judging from the typical physical values of each type, rocks of more than C_M class are adequate rock materials in terms of gravity and chemical stability.

Rock Classification	Specific Gravity (Apparent)	Water Content (%)	Soundness Test (%)
D-C_L	2.72	3.5	57
C_L	2.73	2.2	56
C_M	2.77-2.81	0.2-0.3	2-3
C_M-C_H	2.75-2.94	0.5-2.0	6-29
C_M	2.77-2.87	0.2-0.5	3-7

For some C_M-C_H class and C_H class rocks, a high value was obtained for soundness tests. This is due to use of rock specimens extracted by hammer. When samples used in soundness tests are obtained by normal blasting excavation techniques, the value is usually 2-3% of those for the C_M class shown in the table.

4. GEOLOGY AT THE DAM AND RESERVOIR SITES

4.1 Dam Site

4.1.1 General

Alternative dam site B and proposed dam site C which is about 2.5km upstream from site B are situated in the upper reaches of the Catipayan River. Although the bedrocks of these dam sites are andestic to basaltic pyroclastic rocks and are composed of several rock types, these volcanic rocks should be considered as one mass in regard to bedrock for the construction of a dam.

Outcrops of fresh bedrock can be seen along the riverbed of the Catipayan River and its tributaries. Bedrocks observed are classified petrographically into several rocks including latilli tuff, fine tuff, agglomerate, tuff breccia, andesite and fine to coarse grained basalt. The structure of these rocks appears to approximate a bed strike to the northeast with a dip to the northwest. However, the continuity of each layer is not traceable as the thickness of each rock type varies from a few centimeters to several meters. This is due to sedimentation which occurred when the meta-volcanic rock mass was formed as described in section 1.2. The intensity of weathering and the state of fracturing, which are important considerations in dam construction, do not seem to have arisen from changes in the rock type of each layer.

Accordingly, volcanic rocks containing many rock layers should be considered as one mass in regards to bedrock for the construction of a dam.

4.1.2 Alternative Dam Site B

At alternative dam site B, elevation of the riverbed is approximately 68m while the width is about 40m. Inclination of slope at both sides is about 20°; however, a flat portion runs along the left side at elevation 70m and 125m.

The depth of bedrock excavation and curtain grouting is shown in FIG. III-10. The excavation line determined that C_L-C_M class rock with more than 2km/s in seismic velocity is adequate for the foundation of a fill type dam. The average depth of excavation would be approximately 8m, while the maximum depth of excavation would be 20m on the left bank due to thick alluvial deposits. The bottom curtain grouting line has been determined at a lugeon value of more than 5 observed by water pressure test and in consideration of the highest possible water level of the reservoir. As a result of the above the maximum depth of grouting is estimated at about 30m from the excavation line at the riverbed while deep grouting is not required at this site.

Although several faults were recognized by examination of drilling cores, the fault cracking zone is impermeable as the width of the cracking zone is narrow and filled by calcite veins.

4.1.3 Proposed Dam Site C

(1) Dam

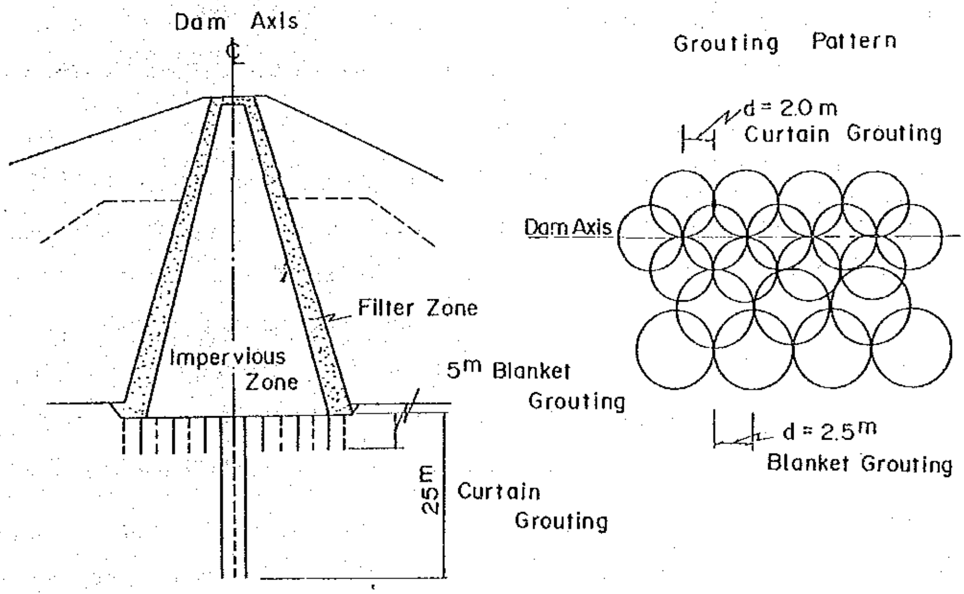
At proposed dam site C, elevation of the riverbed is approximately 85m, while the width is about 20m. However, the slope of both sides is gently inclined ranging from 25° to 30° which is steeper than that of B site. The slope of the left side is moderately inclined ranging about 15° from the hill side at approximate elevation of 140m to the ridge of the hill. The depth of excavation and curtain grouting around the dam axis is shown in FIG. III-11.

Excavation was estimated by correlation of drilling data and the results of seismic exploration. The average depth of excavation is approximately 8m. Deep excavation as required on the left bank of site B is not required at this site. The depth of curtain grouting was estimated by lugeon value, in consideration of the highest possible water level of the reservoir and also correlation of seismic velocity layer cross sectional diagram. The maximum depth of curtain grouting is only about 25m.

On the basis of water pressure tests at dam site B, required volume for grouting is presumed as presented on the following page. Supposing that the interval of the grouting hole is 2.5m zigzag for curtain grouting and 2.0m zigzag for blanket grouting, required quantity of cement is estimated at approximately 700t as shown in the table.

Grouting	Interval of Grouting Hole	Average Length	Number of Grouting Holes	Lugeon Value of Improvement	1/ Total Quantity of Cement
Curtain Grouting	2.0m Zigzag	15m	270 Holes (90 x 3)	$\overline{\quad}$ 10Lu (15Lu → 5Lu)	243.0t
Blanket Grouting	2.5m Zigzag	5m	1008 Hoels (72 x 14)	$\overline{\quad}$ 15Lu (20Lu → 5Lu)	453.6t

1/ 60 kg/m of cement is considered necessary to improve 10Lu.



(2) By-pass Tunnel

Outcrops of C_M class rock are observed along creeks at an inlet portion of the proposed by-pass tunnel site; hence the inlet presents no geological problems for planning. At an outlet of the tunnel, D-C_L class rock is found along the vicinity's creek indicating that a relatively long open cut will be required for the same portion. C_M-C_H class rock is distributed at the tunnel portion

Since ground water is abundant in both the inlet and outlet portions, care should be taken to eliminate water which wells up during construction (FIG. III-12).

(3) Spillway

$D-C_L$ class rock outcrops are observed along the mountain slope around the proposed service spillway crest portion, while the proposed stilling basin site is composed of C_L class rock. Since slightly weathered C_L class rock is enough for spillway bedrock, excavation depth will not be so deep (FIG. III-13).

4.2 Reservoir Site

The basin is slightly long, extending about 10km with a north-south trend and a width of about 4km with an east-west trend. The area ranges from the south facing mountain slopes (EL = 700-800m) of Mount Agudo and Mount Alpasco in the north to the southern foot of the same (EL = 200m).

The area of the basin is about $44.2km^2$ with a dam reservoir submerged area of about $2.10km^2$ for proposed dam site C (FIG III-14). When the watershed area is divided into $4km^2$ blocks, the highest and lowest elevation in each block is as shown in TABLE III-9. According to the same, the average elevation is about 500m in the north and about 150m in the south, indicating that the area is moderately inclined to the south. The height of undulation is from 300 to 600m in the north and from 100m to 200m in the south. The south area is topographically flat.

Bedrocks distributed in the area are composed of volcanic rocks corresponding to the Sibara Formation as at the dam site and diorite. While volcanic rocks are predominately distributed in 80% of the area, diorite is restricted to the south ridge of the area, distributed at elevations of 200-300m.

Outcrops of these bedrocks revealed significant differences in weathering condition. Highly weathered volcanic rocks to gravel/sand conditions contain appropriate clayey materials, and seem to be limited to a depth of 5 to 10m on the mountain ridges. On the other hand, weathered to gravel/sand diorite contains less clayey material, and is generally weathered more deeply, especially on mountain ridges to a depth of 20m or more.

As shown in FIG. III-15, several aerial photos revealed northeast and southwest trends. As these trends are not associated with large landslides or slope collapse, and do not appear to be caused by large fault shearing zones, the same should not present any significant hindrance.

As vegetation cover in the reservoir area is obviously very poor, and traces of small landslides and collapses in the surface area were observed at steeply sloped sections on the hillside and around mountain ridges in the reservoir area, implementation of sodding or other measures should be considered after reservoir construction to prevent sedimentation.

5. EMBANKMENT MATERIALS

5.1 Quarry/Borrow Area

If the dam at site C is assumed to be a rock fill type, the following kind and amount of embankment material are necessary.

Impervious (core material)	137,200m^3
Semi-pervious (filter)	40,000m^3
Pervious (transition, rock, riprap)	619,000m^3
Total	796,200m^3

As described in the next section, volcanic rocks distributed around the dam site are adequate for embankment material; however, the amount of riverbed gravels in the dam site vicinity is insufficient and materials should be collected from the same site. The overburden and totally weathered portion of the bedrock (D-C_L class) would be used for core material, the totally to moderately weathered portion (D-C_M class) for filter material, moderately weathered to fresh portion (better than C_L class) for transition and rock material and the fresh portion (better than C_M class) for riprap material. In addition, it may be necessary to crush fresh portions of the bedrock for concrete aggregate.

Quarry 4 is recommended as the most suitable site for excavation, with a large area for construction and a short transportation distance.

Excavation should be coordinated with embankment planning, and intransit settling should be minimized. FIG. III-16 is an example of excavation planning. The volume of each material is estimated as below and total volume is about 2 million m^3 correlated with the 800,000m^3 required for embankment.

Estimated Volume of Embankment Materials at Quarry 4		Velocity Stratum
Overburden, D-C_L class	950,000m^3 (Core, Filter)	1st, 2nd
C_L-C_M class	746,000m^3 (Filter, Transition)	3rd
Better than C_M class	31,900m^3 (Rock, Riprap)	4th
Total	2,015,000m^3	

5.2 Material Characteristics

The design value of each material is determined by the results of soil/rock tests and according to the values of existing dams. The physical value of compacted materials, such as density and mechanical properties varies according to quality and gradation of the material, and the compaction method. It is thus possible to determine the physical value of embankment material if selection and mixing of the material is made before compaction. Design values of the materials are estimated as shown in TABLE III-10, on the basis of the results of laboratory tests. For reference, TABLE III-11 presents general characteristics and adoptability of soils for dam embankment.

5.2.1 Impervious Materials

Soil tests are based on extraction at test pits from candidate embankment material sites. The results are shown in TABLE III-7. As a result of gradation tests, details of which are shown in FIG. III-17, the majority of data is inconsistent with the USBR Standard guideline. The specimen seems to have been greatly compressed as it contains less than 10% gravel. The depth of excavation is shallow (about 4m), while test specimens mainly consist of fine material. The material might be adequate for core material, classified as SC or GC, since it will be mixed with coarser material and in actuality deeper excavation will be necessary (see

TABLE III-5). In this case, a gradation curve for the same might be represented by the under ridge of the gradation curve shown in FIG. III-17.

1) Specific gravity (Gs)

The Gs value is estimated at 2.61 based on the average of test data.

2) Water content (W%)

As optimum water content (W opt) is considered to be about 20%, W% is determined to be 24% in order to obtain a 95% wet side dry density from maximum density.

3) Wet density (γt)

As the dry density of the 95% wet side (γd 95 wet) is about 1.60t/m^2, γt is estimated at 1.98t/m^3 from the formula

$$\gamma t = \gamma d \left(1 + \frac{W}{100}\right).$$

4) Shearing Strength (C t/m^2, $\emptyset^o$)

The angle of internal friction ($\emptyset^o$) is estimated at 32^o and cohesion (C t/m^2) is disregarded in consideration of gradation, dry density and void ratio, etc.

5) Permeability Co-efficient (Kcm/s)

Although K (1×10^{-6} - 10^{-8} cm/sec) was observed in the tests, the K value could be decreased to 1×10^{-5}cm/sec by mixing sand and gravel.

5.2.2 Semi-Pervious - Pervious Material

As a rule, coarse materials used for semi-pervious - pervious materials must be massive and both mechanically and chemically stable. Furthermore, the same must have appropriate shearing strength and drainage ability. Shearing strength and drainage ability can be broadly determined on the basis of gradation and degree of compaction of the material.

It is prescribed in the USBR Standard that the coefficient of permiability required to satisfy the function for filter material should be from 1.0×10^{-5}cm/s to 1.0×10^{-3}cm/s, and filter material is also provided by the formula as given below in regard to correlation with the gradation of material.

$$\frac{\text{Diameter of a particle of 15\% passing for filter material}}{\text{Diameter of a particle of 15\% passing for core material}} \quad \text{greater than 5}$$

$$\frac{\text{Diameter of a particle of 15\% passing for filter material}}{\text{Diameter of a particle of 85\% passing for core material}} \quad \text{less than 5}$$

If the gradation of core material is assumed to be represented by the under ridge of the gradation curve shown in FIG. III-18, the diameter of a particle of 15% passing should be 0.05mm and the diameter of a particle of 85% passing should be 2.0mm. Therefore the diameter of a particle of 15% passing for filter material should be greater than 0.25mm and less than 10mm.

Furthermore, shearing strength correlated with the gradation of coarse material is proposed by adaptable values as tabulated below with regards to relative density. Approximately 70% of relative density should also be available for coarse material by mechanical compaction of embankment material on the basis of actual results of dam construction.

Diameter and Gradation	Relative Density		
	more than 70% dense	less than 50-70% moderate	50% loose
Equally mixed with fine to coarse sand	34-38°	32-36°	28-30°
Well graded coarse sand to poor graded sand, sand & gravel	37-38°	32-34°	28-30°
Mixed with well graded sand to sand & gravel	40-45°	36-41°	33-36°

$$D\gamma = \frac{\max(\gamma - \gamma\min)}{\gamma(\gamma\max - \gamma\min)} \times 100$$

γ: natural density (t/m^3)

γ max: maximum density (t/m^3)

γ min: minimum density (t/m^3)

Rock materials at the site obviously satisfy the above basic standards and characteristics for embankment material. Accordingly the design values shown above should be used where coarse material falls within the gradations shown. If the material is not included within these gradations, the gradation should be adjusted. On the basis of examination of drilling core, rock classification for embankment material as described in section 5.2.2 is the most suitable classification for each dam zone and adjustment of gradation may be unnecessary.

The design values shown in TABLE III-10 were determined on the basis of the considerations mentioned above and by reference to test values and actual construction results as shown in FIG. III-19 to III-22.

6. SITE GEOLOGY AT MAJOR IRRIGATION FACILITIES

Major irrigation facilities from the dam site to the end of the canal are the trans-diversion canal from the dam site to the trans-diversion tunnel, the trans-diversion tunnel and the proposed diversion dams at 3 sites in the Asue River basin.

6.1 Trans-Diversion Tunnel and Canal

(1) Trans-Diversion Tunnel

The length of the trans-diversion tunnel is approximately 500m and the elevation of the formation line is approximately 80m. The object of excavation is the volcanic rocks which are similar to the rocks at the dam sites as shown in FIG. III-23. The depth of overburden and highly weathered portion of bedrock at both the inlet and outlet sites is about 10m.

While the slope near the inlet is about 25^{o}, the outlet is about 10^{o} and the shallow portion of covered rock (approximately 10m) extends toward the mountain side for about 80m, which is a disadvantage in construction. Moreover, as ground water was observed at a shallow depth of 6m from the surface at both sites, extraction of seepage should be considered for construction and the scale of supports should be determined. It appears that the less weathered portion of bedrock, better than C_M class, is distributed in the tunnel section. It might be possible to use smaller supports for tunnel excavation, but seepage at the same should also be considered.

(2) Trans-Diversion Canal

The trans-diversion canal will run westward through the hilly areas along the Catipayan River for about half of its total length and then change direction to the south towards the flat land to about 2km downstream from alternative dam site B. The canal will then pass through the foot of the mountains and the alluvial plain until it reaches the inlet of the proposed trans-diversion tunnel.

While the construction of a canal along the Catipayan River may require large scale excavation on the steep hill sides, the overburden and highly weathered portion of the volcanic rocks should be excavated in consideration of slope stability. The southern portion of the canal from the Catipayan River presents no difficulty for construction as the geology of the area consists of alluvial sediments, overburden and highly weathered diorite with a gentle slope. It is therefore estimated that minimal cutting and banking works will be required.

6.2 Diversion Dams

Diversion dams are planned at Asue, Bakabak and Gubaton in the Asue River basin as shown in FIG. III-24. In the Asue River basin, alluvial sediments composed of unconsolidated sand, clay and gravel are distributed on the plain, while bedrocks composed of diorite and volcanic rocks are distributed in the mountain slope and isolated hills as described in the section on general geology.

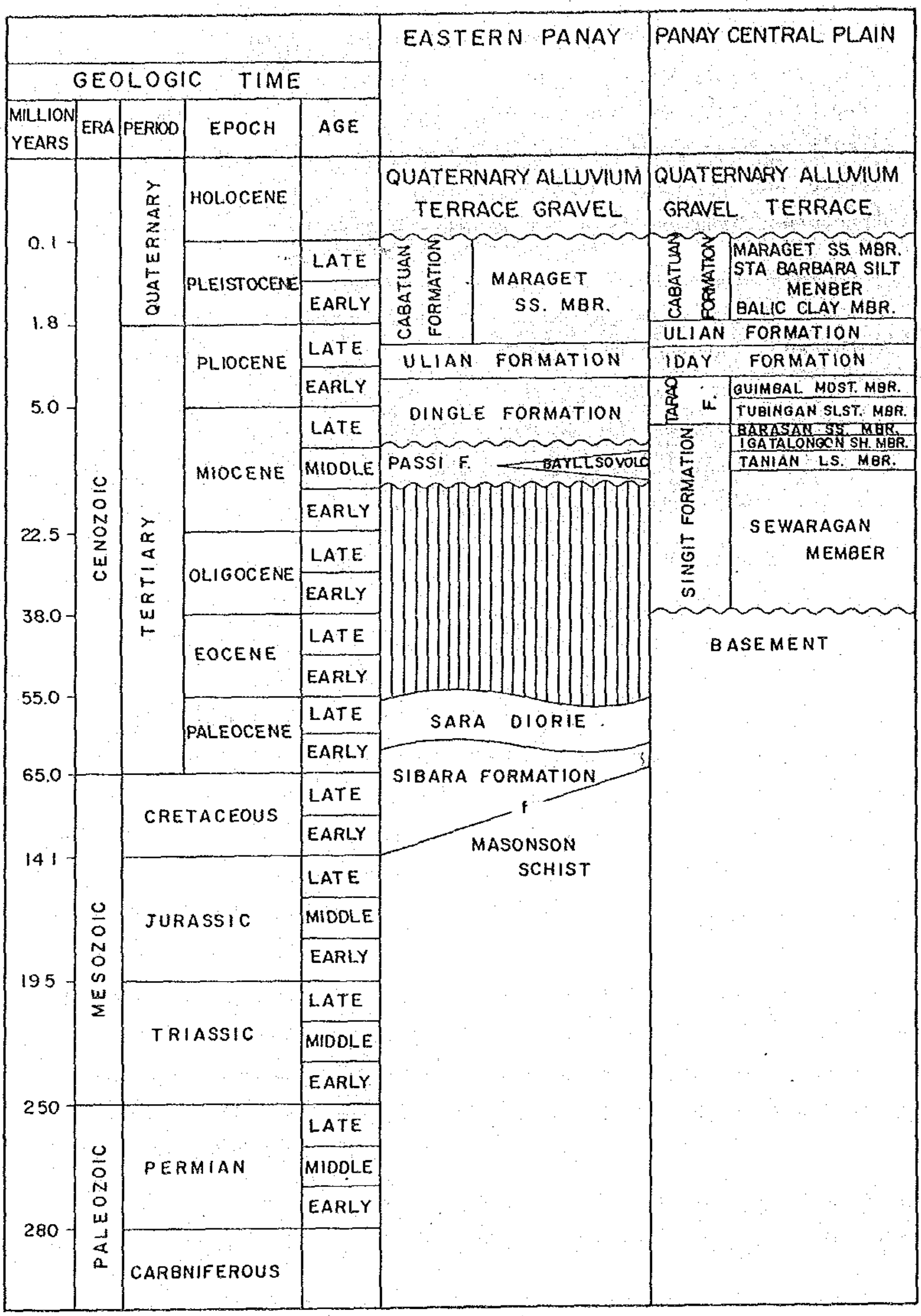
Bedrock is broadly divided into two areas by a geological border which runs north-south passing about 2km east of Sara Town. The area west of the border is predominantly composed of diorite, while the eastern area is composed of pyroclastic rocks which correspond to the rocks found at the proposed Catipayan dam site.

Outcrops of these bedrocks in mountain slopes and isolated hills revealed a significant difference in weathering conditions. As described in section 4.2, diorite is generally deeply weathered especially on mountain ridges where the rocks are highly weathered to a depth of 20m or more.

Weathered diorite contains less clayey material. On the other hand, the highly weathered portion of pyroclastic rock is limited only to a depth of 5 to 10m, and the weathered portion contains appropriate clayey materials. Accordingly, as a foundation for lighter structures both diorite and pyroclast have sufficient strength. In the case of heavy structures, however, pyroclastic rock is advantageous.

Diorite outcrops were observed in the riverbeds and vicinity of the proposed diversion dam sites in Asue and Gubaton, and the same are totally weathered. Outcrops of bedrock were not clearly observed in the vicinity of the proposed diversion dam site at Bakabak. The depth of alluvial sediments is assumed to be shallow at the diversion dam site according to the existing isolated hill on the right side, which is composed of volcanic rocks totally covered by overburden.

STARTIGRAPHICAL TABLE



EXISTING SURVEYS

1) Drilling

Location	Bore Hole No.	Site	Ground Elevation (m)	Drill-ing Length (m)	Permeability Test (nos.)	Note
Alterna-tive Dam Site B	DDH-1	dam axis	83.10	50.00	11	Left bank
	-2	- do -	72.45	60.00	17	riverbed
	-3	- do -	89.61	48.89	15	right bank
	-4	downstream	86.56	60.00	-	- do -
	-5	- do -	70.02	50.18	15	riverbed
	-6	upstream	73.21	60.00	17	- do -
	-7	dam axis	124.04	30.00	6	left bank
	-8	- do -	114.60	30.54	8	right bank
	-9	downstream	70.28	60.00	18	riverbed
	-10	- do -	108.56	30.00	7	left bank
	-11	upstream	84.50	30.21	8	- do -
	-12	- do -	97.62	30.38	9	right bank
Total	12 Holes			540.20 (m)	131 nos.	
Trans Diversion Tunnel	DDH-T1	inlet	116	40.00	-	foot of mt.
	-T2	center	164	90.27	-	saddle of mt.
	-T3	outlet	96	20.87	-	foot of mt.
Total	3 Holes			151.14 (m)		

2) Test Pit and Soil Tests

Location	Pit No.	Excavated Depth (m)	Number of Soil Tests				
			Specific Gravity	Grain Size Analysis	Natural Moisture Content	Atter-berg limit	Compac-tion Test
Borrow-1	TP-1	4.0	5	5	5	5	1
-	-2	1.8	-	-	-	-	-
Borrow-1	-3	3.5	4	4	4	4	1
Borrow-2	-4	4.0	5	5	5	5	1
-	-5	-	-	-	-	-	-
Borrow-2	-6	3.0	4	4	4	4	1
- do -	-7	2.0	3	3	3	3	1
- do -	-8	4.0	5	5	5	5	1
- do -	-9	4.0	5	5	5	5	1
- do -	-10	3.9	5	5	5	5	1
Borrow-1	-11	4.0	-	-	-	-	-
Total	11	34.2m	36 nos.	36 nos.	36 nos.	36 nos.	8 nos.

3) Microscopic Analysis

Location	Hole No.	Number of Specimens
Alternative	DDH - 3	2
Dam Site B	DDH - 6	5
	Total	7

FIRST SURVEY

1) Drilling

Location	Bore Hole No.	Site	Ground Elevation (m)	Drilling Length (m)	Remarks
Quarry Site	DDH-R1	Quarry 1	150	60.12	All core drilling
	" -R2	" 2	140.01	50.00	- do -
	-R3	" 3	125.90	50.80	- do -
Total	3			160.92 (m)	

2) Seismic Exploration

Location	Site	Line No.	Length (m)	Remarks
Alternative Dam Site B	downstream	B - 1	385	
	dam axis	B - 2	440	
	upstream	B - 3	330	
Proposed Dam Site C	dam axis	C - 1	550	Interval of detector is 5m each
Quarry Site	quarry - 1	Q - 1	440	
	quarry - 2	Q - 2	550	
	quarry - 3	Q - 3	495	
	quarry - 4	Q - 4	440	
Tunnel Site	inlet to outlet	T - 1	770	
Total		9 Lines	4,400m	

3) Test Pit and Soil Tests

Location	Pit No.	Excavated Depth (m)	Number of Soil Tests						
			S.G	G.S.A	N.M.C	A.L	C.T	P.T	P.N.T
Quarry 2	TP - 12	3.0	1	1	1	1	1	1	1
Dam Site B	TP - 13	3.0	1	1	1	1	1	1	1

S.G: Specific Gravity
G.S.A: Grain Size Analysis
N.M.C: Natural Moisture Content
A.L: Atterberg Limit
C.T: Compaction Test
P.T: Permeability Test
P.N.T: Penetration Test

4) Rock Test

Location	Hole No.	Specific Gravity	Water Absorption	Soundness Test
Quarry 1	DDH - R1	3	3	3
" 2	- R2	3	3	3
" 3	- R3	4	4	4
Total		10 nos.	10 nos.	10 nos.

SECONDARY SURVEY

(Drilling)

Location	Bore Hole No.	Site	Ground Elevation (m)	Drilling Length (m)	Permeability Test (Nos.)	Note
Proposed Dam Site C	DDH - C1	dam axis	315	20.0	5	left bank
Total	1 hole			20.0 (m)	5 nos.	

CLASSIFICATION OF ROCK QUALITY IN DAM FOUNDATIONS

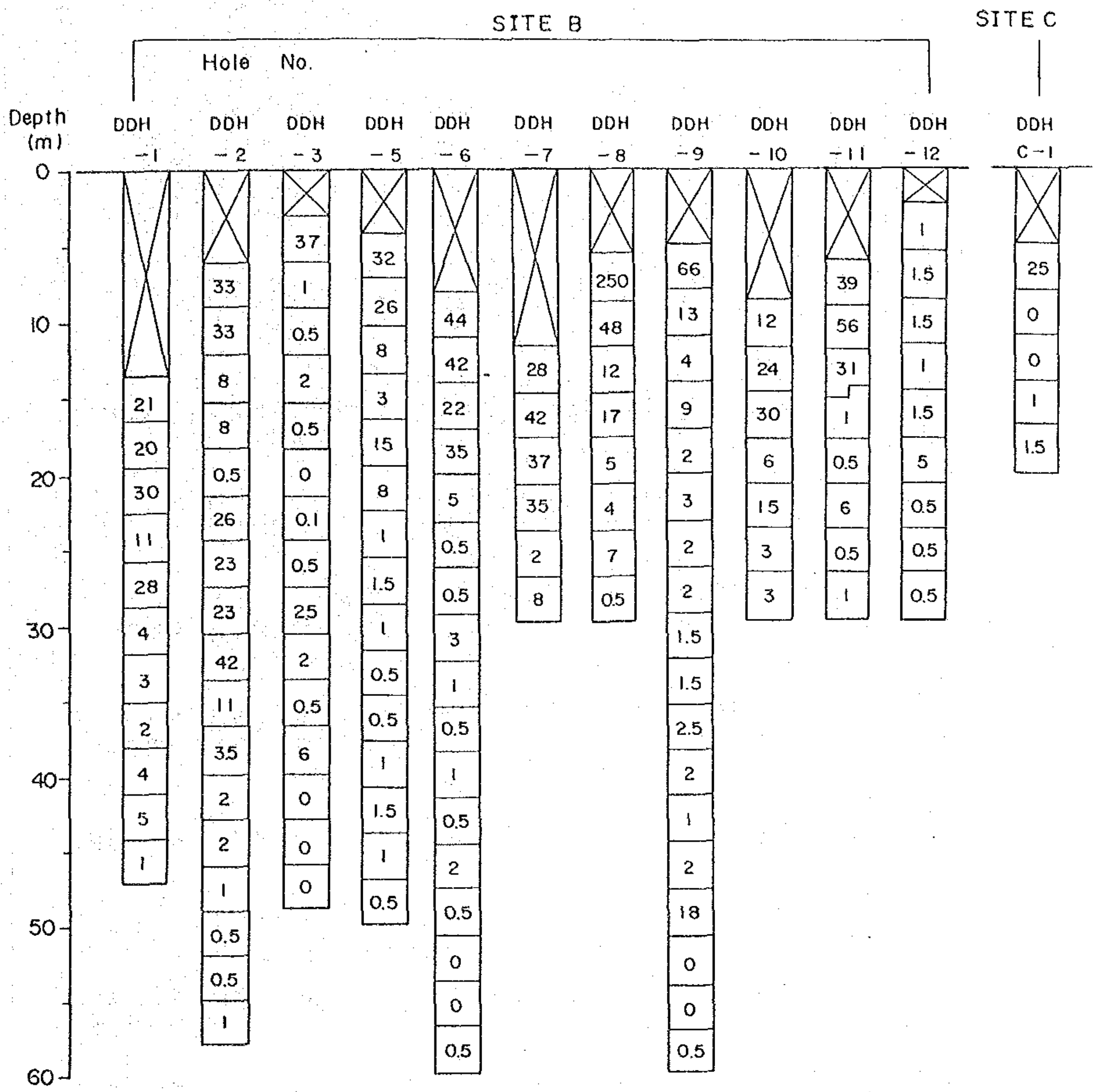
Classification		Characteristics
W-1 1/ H-1 J-1	A	Rock-forming minerals2/ are fresh and not weathered or altered. Joints and cracks are very closely adhered with no weathering along their planes. A clear sound is emitted when hammered.
W-1, 2 H-1 J-1	B	Rock-forming minerals are weathered slightly or partially altered, the rock being hard. Joints and cracks are closely adhered. A clear sound is emitted when hammered.
W-1, 2 H-1 J-2	C_H	Rock-forming minerals are weathered but the rock is fairly hard. The bond between rock blocks is slightly reduced and each block is apt to be exfoliated along joints and cracks by strong hammering. Joints and cracks sometimes contain clay and other material which may be colored by limonite. A slightly dull sound is emitted when hammered.
W-3 H-2, 3 J-2, 3, (4)	C_M	Rock-forming minerals are weathered and the rock is slightly soft. Exfoliation of the rock occurs along joints and cracks by normal hammering. Joints and cracks sometimes contain clay and other material. A somewhat dull sound is emitted when hammered.
W-3, 4 H-3, 4 J-4, 5	C_L	Rock-forming minerals are weathered and the rock is soft. Exfoliation of the rock occurs along joints and cracks by light hammering. Joints and cracks contain clay. A dull sound is emitted when hammered.
W-5 H-4, 5 J-5	D	Rock-forming minerals are weathered, and rock is very soft. There is virtually no bond between rock blocks, and collapse occurs at the slightest hammering. Joints and cracks contain clay. A very dull sound is emitted when hammered.

Note: 1/ Refer to the following table

2/ Except quartz

WEATHERING		HARDNESS		JOINTING	
W-1	SOUND	H-1	VERY HARD (METALLIC SOUND HARDLY BROKEN BY HAMMER)	J-1	< Joint/m -Slightly Jointed
W-2	SLIGHTLY WEATHERED (VISIBLE OXIDATION AT JOINT)	H-2	HARD (DEATH SOUND EASILY BROKEN BY HAMMER)	J-2	1-5 Joints/m -Jointed
W-3	MODERATELY WEATHERED (MATRIX SLIGHTLY WEATHERED)	H-3	MODERATELY HARD (EDGES HARDLY HARDLY BROKEN BY HAMMER)	J-3	5-10 Joints/m -Very Jointed
W-4	INTENSELY WEATHERED (MATRIX DEEPLY WEATHERED)	H-4	SLIGHTLY HARD (HARDLY SQUEEZED BY FINGERS)	J-4	11-20 Joints/m -Intensely Jointed
W-5	TOTALLY WEATHERED (ONLY TRACES OF THE ORIGINAL STRUCTURE)	H-5	SOFT (EASILY BROKEN BY FINGERS)	J-5	>20 Joints/m -Ground

SUMMARY OF LUGEON VALUES



$$Lu = \frac{10 \cdot Q}{P \cdot L}$$

Lu : Lugeon value
Q : Unit Infiltration Volume (l/min)
P : Pressure (kg/cm^2)
L : Tested Length (m)

SUMMARY OF SOIL TESTS

Area	Sample Identification	Gradation Analysis Clay Silt %	Sand %	Gravel %	Classification Symbol Minus #4	Atterberg Liquid Limit %	Limit Minus #40 Plastic Limit %	Specific Gravity of Soil	Natural Moisture of Soil	Compaction Test Opt Moist. Content %	Compaction Test Max. Dry Dens. tf/m3	Coefficient of Permeability (k) cm/s	Note
	TP-1	68.51	31.49	0.00	OH	54.0	21.19	2.56	37.41	30.7	1.382		
	1A	77.91	22.09	0.00	MH	54.7	20.33	2.55	27.46				
	1B	89.07	10.93	0.00	OH	63.3	26.43	2.52	41.34				
	1C	76.27	23.79	0.00	OH	53.3	22.52	2.54	42.83				
	1D	69.79	30.21	0.00	ML	42.7	15.68	2.57	34.26				
BORROW	TP-3	37.06	54.63	8.31	SC	31.90	11.50	2.57	19.28	17.6	1.722		
-1	3A	34.93	61.88	3.19	SC	31.95	11.77	2.58	17.82				
	3B	30.00	68.04	1.96	SC	30.90	9.12	2.58	19.15				
	3C	42.44	55.20	2.36	SC	33.80	14.32	2.56	24.70				
	TP-12		54.36	0.33	SC	38.40	14.45	2.78	28.92	21.4	1.662	$1.7x10^{-6}$-	penetration
	TP-4	69.27	29.95	3.78	C_H	53.10	29.95	2.56	36.66	32.0	1.366	$7.1x10^{-8}$	resistance
	4A	52.97	42.74	4.29	C_H	58.30	30.22	2.57	22.09				$78.73kg/cm^2$
	4B	68.70	31.30	0.00	C_H	59.95	32.79	2.55	36.61				
	4C	53.20	43.28	3.52	C_H	67.00	35.97	2.57	46.45				
	4D	79.47	20.53	0.00	MH	57.20	25.88	2.54	46.81				
	TP-6	43.67	43.55	12.78	SC	45.80	20.85	2.64	24.44	24.25	1.565		
	6A	66.45	31.79	1.76	C_H	58.50	26.70	2.62	32.56				
	6B	54.03	37.22	8.75	C_L	48.05	24.57	2.63	34.32				
	6C	36.44	61.03	2.53	SC	42.10	20.26	2.65	24.68				
	TP-7	66.46	21.39	12.12	C_L	43.00	21.02	2.58		23.6	1.531		
	7A	67.96	24.51	7.53	C_L	38.75	17.78	2.58					
	7B	64.48	27.61	7.91	C_L	36.75	17.56	2.60					
BORROW	TP-8	46.77	47.47	6.36	SC	33.70	14.89	2.56	20.99	24.6	1.535		
-2	8A	47.27	28.28	4.45	SC	37.40	16.48	2.56	18.15				
	8B	52.75	43.05	4.24	C_L	38.50	14.93	2.54	16.72				
	8C	51.17	47.58	1.25	C_L	38.30	14.88	2.55	25.89				
	8D	47.44	45.37	7.19	C_L	36.9	13.55	2.54	24.66				
	TP-9	78.98	24.86	1.16	C_L	45.9	22.2	2.59	36.12	28.6	1.453		
	9A	45.91	50.90	3.19	SC	52.75	26.10	2.61	25.35				
	9B	82.12	16.48	1.40	C_H	72.05	41.35	2.58	40.83				
	9C	86.67	13.23	0.0	C_H	54.35	28.76	2.57	47.18				
	9D	76.14	23.84	0.0	C_L	42.3	19.9	2.59	44.64				
	TP-10	55.73	43.36	0.91	C_L	42.4	20.88	2.51	30.68				
	10A	76.09	23.21	1.0	OH	55.0	25.3	2.48	30.06				
	10B	72.16	27.23	0.61	C_L	49.8	24.38	2.49	30.89				
	10C	56.65	42.34	1.01	C_L	38.8	17.23	2.51	27.84				
	10D	35.08	58.52	6.40	SC	33.4	12.73	2.53	24.07				
SITE-B	TP-13	48.59	42.83	8.53	SC	38.80	18.23	2.75	28.32	19.50	1.716	$4.5-7.8x10^{-8}$	penetration resistance $84.30kg/cm^2$

TABLE III-8

SUMMARY OF ROCK TESTS

Bore Hole No.	DDH - R1			DDH - R2			DDH - R3			
Sample Number	No.1	No.2	No.3	No.1	No.2	No.3	No.1	No.2	No.3	No.4
Sample Depth m	15.2 - 16.3	19.6 - 20.4	46.9 - 48.2	9.1 - 9.8	17.0 - 18.5	39.5 - 40.3	11.3 - 19.6	23.1 - 26.7	35.0 - 38.0	40.0 - 42.8
Rock Type	Agglomerate	"	"	"	"	"	Lapilli tulf	"	Agglomerate	"
Rock Classification	C_M	C_M	C_H	$C_M - C_H$	C_H	$C_M - C_H$	$D - C_L$	C_L	$C_M - C_H$	$C_M - C_H$
Specific Gravity										
Bulk (Dry)	2.726	2.791	2.756	2.822	2.785	2.879	2.405	2.460	2.570	2.701
Bulk (SSD)	2.471	2.798	2.761	2.846	2.814	2.901	2.520	2.557	2.636	2.734
Apparent	2.768	2.812	2.770	2.892	2.868	2.944	2.719	2.725	2.752	2.793
Coefficient of Absorption %	0.553	0.271	0.505	2.420	1.044	0.716	4.803	3.964	2.569	1.213
Density										
Dry g/cm3	2.717	2.750	2.722	2.753	2.784	2.804	2.364	2.514	2.590	2.758
Wet g/cm3	2.725	2.754	2.727	2.773	2.797	2.823	2.446	2.570	2.641	2.781
Effective Void Ratio	0.01508	0.00753	0.00490	0.02445	0.02905	0.02189	0.11380	0.09653	0.06612	0.03272
Porosity %	1.517	0.747	0.577	2.417	2.894	2.208	11.548	9.725	6.577	3.294
Water Content %	0.28	0.15	0.19	0.74	0.46	0.66	3.48	2.24	1.97	0.85
Degree of Saturation %	97.952	100	96.476	98.614	97.554	97.027	88.474	90.523	93.778	96.201
Soundness Test % Loss After 5 Test Cycles	3.42	1.98	2.93	6.022	6.973	12.626	57.175	55.940	29.143	8.988

UNDULATION IN CATIPAYAN RIVER BASIN

Unit: m

Block No. of the Basin	Highest Elevation in the Block	Lowest Elevation in the Block	Undulation	Average Elevation
1	790	190	600	490
2	720	185	535	452.5
3	305	178	127	241.5
4	442	162	280	302
5	385	98	287	241.5
6	385	110	275	247.5
7	303	95	208	199
8	280	95	185	187.5
9	331	157	174	244
10	260	85	175	172.5
11	245	94	151	169.5
12	254	170	84	212
13	432	220	112	326
14	340	168	172	254
15	240	98	142	169
16	222	130	92	176
	Total		3,599	4,084.5
	Average		224.9	255.3

PHYSICAL VALUES OF EMBANKMENT MATERIAL

Material	Geology	Specific Gravity	Water Content (%)	Void Ratio (t/m^3)	Wet Density (t/m^3)	Dry Density (t/m^3)	Saturated Density (t/m^3)	Cohesion (t/m^3)	Angle of Internal Friction(o)	Coefficient of Permeability (m/sec)
Core	Overburden and D - C_L Class Bedrock	2.61	24.0	0.63	1.98	1.60	1.99	-	320	1×10^{-5}
Filter	D - C_M Class Bedrock	2.61	26.0	0.37	1.95	1.90	2.67	-	370	1×10^{-3}
Transistor	Better than C_L Class Bedrock	2.61	26.0	0.37	1.95	1.90	2.67	-	390	$1 \times 10^{-1}-10^{-3}$
Rock	"	2.65	2.0	0.39	1.94	1.90	2.19	-	420	1×10^{-1}

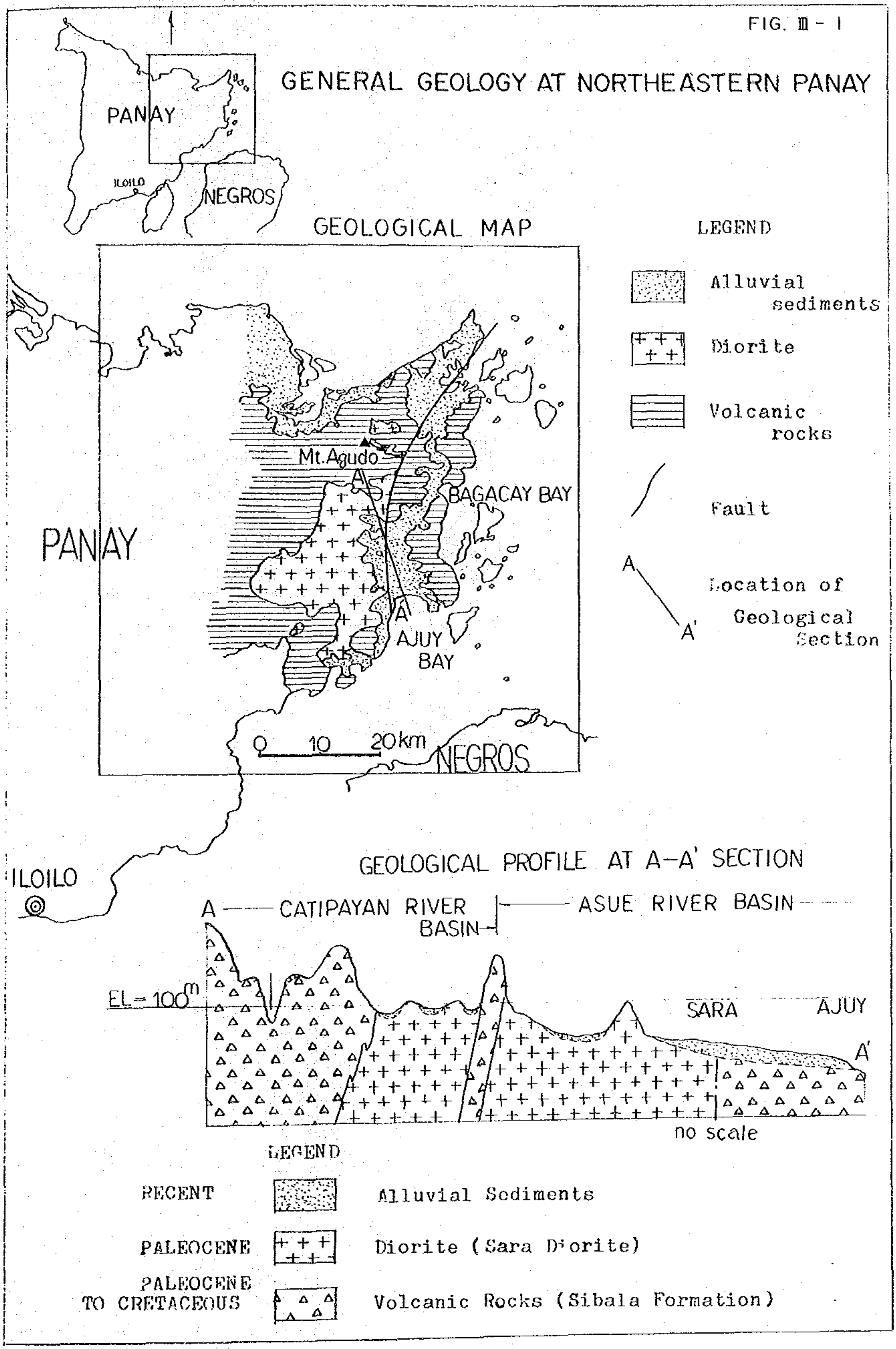
CHARACTERISTICS AND ADAPTABILITY OF SOILS

Soil Classification Group	Characteristics				Adoptability [2]		
	Permeability after Compaction	Shearing [1] Strength	Compress- [1] ability	Workability for Embankment	Earthfill Dam	Impervious Zone	Pervious Zone
GW pervious	excellent	almost none	excellent	-	-	1	
GP very pervious		good	almost none	good	-	-	2
GM semi-pervious to impervious		good	almost none	good	2	4	-
GC impervious	good to adoptable	very small	good	1	1	-	
SW pervious	excellent	almost none	excellent	-	-	3 [3]	
SP pervious	good	very small	adoptable	-	-	4 [3]	
SM semi-pervious to impervious		good	small	adoptable	4	5	-
SC impervious	good to adoptable	small	good	3	2	-	
ML semi-pervious		adoptable	medium	adoptable	6	6	-
CL impervious	adoptable	medium	good to	5	3	-	
OL semi-pervious to impervious		not adoptable	medium	adoptable	8	8	-
MH semi-pervious to impervious	adoptable	adoptable to not	large	not adoptable	9	9	-
CL impervious	not adoptable	large	not adoptable	7	7	-	
OH impervious	not adoptable	large	not adoptable	10	10	-	
PT -	-	-	-	-	-	-	

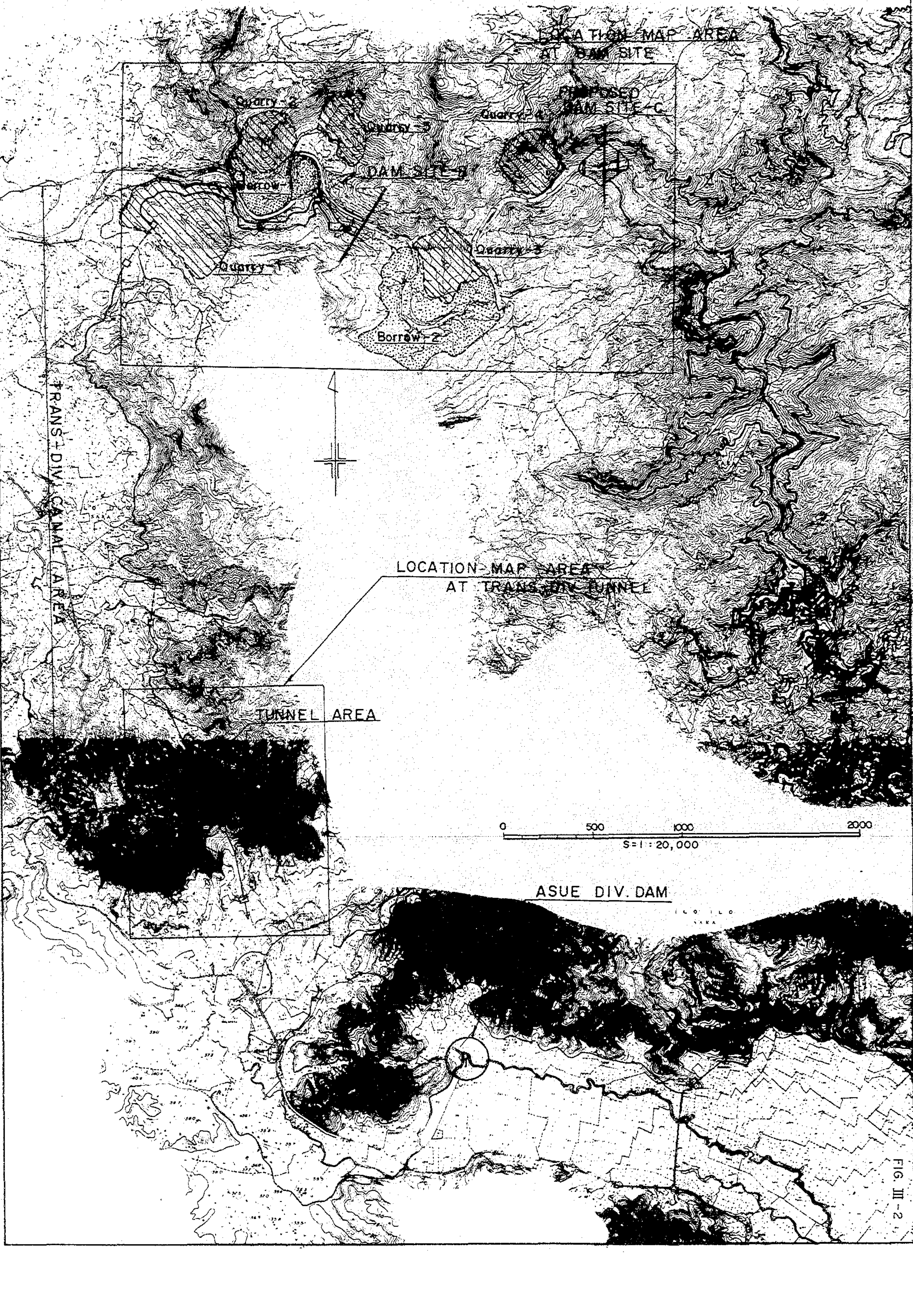
1/ after compaction and saturated condition
2/ with much sand and gravels
3/ adoptability is highest with "1" and lower with large numbers

FIG. III - 1

GENERAL GEOLOGY AT NORTHEASTERN PANAY



LOCATION MAP OF THE STUDY AREA AT CATIPAYAN RIVER BASIN



GEOLOGICAL MAP AT DAMSITE