Fig. B-19 shows the plots of daily sediment discharge versus daily flow rate. The regression analysis is used to develop a relationship between the flow and the sediment discharge, however, several measurement points are excluded from the regression analysis because they appear to be obvious errors.

The equations for sediment discharge rating curve at Kubang Baros and Serut gauging stations are as follows:

$Qs = 0.32 \times Q^{1.28}$ at Kubang Baros (Cidanau)

and $Qs = 2.09 \times Q^{1.72}$ at Serut (Cibanten)

where Qs : sediment discharge (mg/l)

Q : daily mean river discharge (m^3/s)

6.3 Annual Sediment Transport

The estimation of annual sediment discharge rates are calculated by analyzing the daily discharge data at Kubang Baros and Serut gauging stations.

The amount of sediment deposited in the reservoir may depend on its trap efficiency, however, for the study at this stage it is assumed that all of the sediment will deposit in the reservoirs.

In this study, the sediment-river discharge relation are made on suspended load, whereas the bed load is assumed to be about 25% of suspended load[1)], therefore the total sediment is calculated at 125% of suspended load.

The calculation results of annual suspended load at Kubang Baros (Cidanau) and Serut(Cibanten) are listed Table B-17.

6.4 Reservoir Sedimentation

As mentioned above, the suspended loads at Kubang Baros (Cidanau) and Serut (Cibanten) are estimated at 82,871 m^3/year and 55,065 m^3/year respectively, therefore the total annual sediment discharge including bed load are estimated at 91,158 m^3/year and 62,572 m^3/year respectively.

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1) K. Linsley & B. Franzini: Water-Resources Engineering

The catchment areas at Kubang Baros and Serut are 199.50 km^2 and 73.15 km^2 respectively, therefore the specific sediment discharges are estimated at 500 m^3/year/km^2 in the Cidanau river and 900 m^3/year/km^2 in the Cibanten river.

The reservoir sediment discharge at proposed damsites are calculated and listed in Table B-18.

TABLES

Table B-1 Existing Condition of Daily Rainfall Data

	Station No.	Station Name	Annual mean Rainfall (mm)	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	installed year
PMG	3B	CINANGKA	2143					o	o	o	o	o	o	o	o	o	o	o		o					
	4	PADARINCANG	3325			o	o		o		o	o	o	o	o		o	o		o					1972
	5	MENES	4088			o	o	o	o	o	o	o	o	o	o					o					
	6	LABUHAN	3164				o	o	o	o	o	o	o	o	o	o				o					
	7	PAGELARAN	2862		o	o	o							o	o	o	o	o		o					
	7A	PASIRWARINGIN	3645		o		o		o	o	o			o	o		o								
	9	BOJONGDATAR	3438		o	o	o	o	o	o	o	o	o	o	o		o					o			1951
	14	CILEGON	1756										o	o	o	o	o	o							
	18	CIOMAS	2682				o			o	o	o		o	o			o	o	o					1927
	19	PABUARAN	1947				o				o		o					o	o	o	o	o			1973
	21	MANOALANGI	4510	o				o	o	o	o	o			o										
	22	CIMANUK	2823			o			o		o	o			o										
	23	SERANG	1666				o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o			1946
	24	BAROS	2047	o	o	o	o		o	o	o	o	o	o	o	o	o	o	o	o					1927
	24A	NYAPOH	2023			o	o					o	o	o	o										1957
	24B	PETIR	2024					o	o	o	o	o	o	o	o	o		o		o					1974
	32C	RAGASILU	1832		o	o	o						o	o	o										1952
	37B	CIKADU	2930		o	o	o	o	o	o	o														1951
P3SA		KEPUH	2001										o	o	o	o	o	o	o	o	o	o	o	o	1978
		SERUT	1817																o	o		o	o		1979
		PADARINCANG	2354										o	o	o	o	o	o	o	o	o	o	o	o	1978
		CIKADU											o	o	o	o	o	o	o	o	o	o	o	o	1978

Table B-2 (1)   Annual Rainfall

YEAR	NO.3B	NO. 4	NO. 5	NO. 6	NO. 7	NO.7A	NO. 9	NO.14	NO.18	NO.19
1970										
1971					2126	2895	3481			
1972		2408	3583		1847		3087			
1973		3838	4703	4188	3190	4690	3919		3099	
1974	2553		4945	3928			4171			2433
1975	2404	2556	5039	3404		4948	4362			
1976	1430		3462	2167		3602	2636		2207	
1977	1244	1946	3001	2486		3154	2758		3174	2114
1978	1871	3716	4296	3441			3349		2777	
1979	1910	2906	3579	2791			2772	1723		
1980	2234	4673	4152	3237	3315	4724	3563	2275	3245	1870
1981	2253	4065	4605	3250	4093	3643	4240	1953	3012	
1982	1645			2119	2088			1284		
1983	2417	3903			2102	1572	2959	1584		
1984	2961	3113			3149			1714	2294	1679
1985									1922	1595
1986	2797	3454	3607	3793	3844				2408	2550
1987										1649
1988							3398			1685

Table B-2 (2) Annual Rainfall

YEAR	NO.21	NO.22	NO.23	NO.24	NO.24A	NO.24B	NO.32C	NO.37B	PAD.	KEPUH	SERUT
1970	4078			2079							
1971				1838			1418	2217			
1972		1889		1476	1408		1252	2957			
1973				2895	1532		1677	3599			
1974	5170		2179			1896		3084			
1975	4359	4259	1276	2248		1841		3328			
1976	3474		1461	2211		2092		3219			
1977	5470	1965	1524	1896		1940		2105			
1978	3752	2837	1592	2150	2133	2317					
1979			1653	1896	2055	2021	1662		2578	2269	
1980			1975	2173	2511	1361	2168		3155	2308	
1981	5269	3167	1992	2204	2496	2118	2814		2895	2315	
1982			1242	1450		1684			2186	1419	
1983			1524	1941					3814	2260	
1984			1691	2286		2098			2973	2052	
1985			1439	1623					2207	1679	1754
1986			2067	1813		3119			2211	2204	2740
1987			1484						2055	1640	
1988			1898						1746	1771	1197
1989									1403	2217	1578
1990									1068	2150	

Table B-3 Correlation Factor of Annual Rainfall

	SERUT	PAD.	KEPUH	NO.37B	NO.32C	NO.24B	NO.24A	NO.24	NO.23	NO.22	NO.21	NO.19	NO.18	NO.14	NO.9	NO.7A	NO.7	NO.6	NO.5	NO.4
NO.3B	0.890	0.908	0.839	0.689	0.846	0.897	0.851	0.861	0.901	0.960	0.941	0.906	0.896	0.851	0.957	0.972	0.924	0.970	0.974	0.959
NO.4	0.873	0.960	0.914	0.784	0.915	0.936	0.942	0.938	0.945	0.966	0.936	0.947	0.935	0.886	0.970	0.954	0.935	0.952	0.956	
NO.5	0.839	0.937	0.863	0.753	0.822	0.900	0.881	0.881	0.872	0.963	0.917	0.924	0.883	0.796	0.966	0.982	0.955	0.964		
NO.6	0.799	0.893	0.804	0.672	0.833	0.859	0.854	0.851	0.888	0.936	0.972	0.893	0.861	0.821	0.944	0.966	0.918			
NO.7	0.832	0.926	0.871	0.750	0.875	0.941	0.903	0.919	0.883	0.977	0.875	0.894	0.856	0.837	0.975	0.977				
NO.7A	0.855	0.929	0.855	0.703	0.853	0.916	0.874	0.893	0.897	0.973	0.915	0.913	0.873	0.840	0.972					
NO.9	0.901	0.947	0.912	0.814	0.911	0.962	0.933	0.950	0.935	0.995	0.938	0.936	0.917	0.896						
NO.14	0.930	0.792	0.909	0.739	0.976	0.920	0.900	0.910	0.974	0.881	0.840	0.886	0.927							
NO.18	0.903	0.851	0.952	0.864	0.944	0.954	0.946	0.938	0.976	0.896	0.848	0.966								
NO.19	0.864	0.910	0.946	0.850	0.915	0.933	0.950	0.935	0.943	0.910	0.868									
NO.21	0.809	0.883	0.784	0.703	0.836	0.851	0.843	0.852	0.887	0.925										
NO.22	0.902	0.949	0.897	0.788	0.892	0.953	0.916	0.943	0.917											
NO.23	0.913	0.857	0.935	0.804	0.976	0.959	0.941	0.947												
NO.24	0.870	0.909	0.956	0.903	0.938	0.969	0.974													
NO.24A	0.835	0.891	0.973	0.891	0.956	0.945														
NO.24B	0.900	0.895	0.934	0.865	0.947															
NO.32C	0.879	0.826	0.937	0.790																
NO.37B	0.735	0.778	0.883																	
KEPUH	0.901	0.873																		
PAD.	0.829																			
SERUT																				

*PAD. PADARINCANG

Table B-4 Existing Condition of Daily Waterlevel Data

Kubang Baros (Cidanau)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1980	o	o	x	o	x	x	o	x	o	x		o
1981	o	x	o	x	x	o	o	o	o	o	o	o
1982	x	o	o	o	o	o	o	o	o	o	o	o
1983	o	o	x	o	o	x	x	x	x	x	o	o
1984	x	x	o	x	o	o	o	o	o	o	x	x
1985	o	o	o	o	o	o	o	o	o	o	o	o
1986	x	x	o	o	o	o	o	o	o	o	o	o
1987	o	o	o	o	o	o	o	o	o	o	o	o
1988	o	o	o	o	o	o	o	o	o	o	o	o
1989	o	o	x			o	o	o	o	o	o	o
1990	o	o	o	o			x	o	o			o

Serut (Cibanten)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1977						x	o	o	x	x	x	x
1978	o	o	o	o	o	o	o	x	x	x	x	x
1979		x	x	x	o	o	o			x	o	o
1980	x	o	o	o	o	o	o	o	o	o	o	o
1981	o	o	o	o	o	o	o	o	o	o	o	o
1982	o	o	o	o	o	o	o		x	o	o	x
1983	o	o	o	o	o	o	x	x	x	x	x	o
1984	x	o	o	o	o	o	o	o	o	o	o	o
1985	o	o	o	x	o	o	o	o	o	o	x	x
1986	o	o	o	o	o	o	x	o	o	o	o	o
1987	o	o	o	o	o	x	o	o	o	o	o	o
1988	x	o	x		o	o		x	o	o	o	o
1989	o	o	x	o	o	x	x	o	o	o	x	o
1990	o	o	o	o	o	o	x	x	o	x	x	x

o : Available data

x : Not available data

Table B-5 (1) Water-level and Discharge Observation Data at Kubang Baros (Cidanau)

YEAR	DATE		WATERLEVEL (m)	DISCHARGE (m3/s)
1979	22	September	-	1.36
	22	October	0.10	2.36
	22	November	0.50	9.93
	28	December	0.38	6.32
1980	28	August	0.19	3.34
	22	September	0.36	5.94
	17	October	0.59	13.96
	28	November	0.76	16.37
	19	December	0.39	8.34
1981	27	March	0.70	15.27
	8	May	0.62	14.33
	13	June	0.30	5.12
	10	September	0.65	13.41
	20	October	0.31	4.89
1983	26	August	0.09	1.79
	29	September	0.11	1.92
1984	9	January	0.85	18.71
	5	April	0.46	8.94
	5	April	0.45	7.83
	30	May	0.42	7.89
	27	July	0.33	6.23
	29	September	0.32	6.08
	25	October	0.29	5.46
	22	November	0.37	6.71
	22	November	0.37	7.16
	28	December	1.25	39.34
1985	25	February	0.63	11.98
	25	February	0.62	11.06
	19	March	0.43	7.79
	19	March	0.44	7.78
	13	May	0.42	7.42
	13	May	0.42	7.86
	17	July	0.38	7.04
	13	August	0.32	6.01
	13	August	0.32	5.59
	10	September	0.30	5.21
	9	October	0.38	6.45
	5	November	0.38	7.02

Table B-5 (2) Water-level and Discharge Observation Data at Kubang Baros (Cidanau)

YEAR	DATE		WATERLEVEL (m)	DISCHARGE (m3/s)
1986	12	February	0.50	9.15
	30	April	0.50	8.75
	30	April	0.50	8.57
	6	August	0.42	7.35
	6	August	0.42	7.48
	3	September	0.40	6.32
	3	September	0.40	6.65
	2	October	0.32	6.90
1987	9	January	1.25	38.60
	11	February	0.36	5.50
	5	April	0.57	12.09
	11	June	0.40	7.90
	10	August	0.12	1.99
	6	October	0.06	too small
	14	December	0.37	7.21
1988	15	July	0.12	1.95
	19	August	0.18	2.87
	13	September	0.20	3.58
	11	December	0.75	17.00
1989	14	July	0.95	14.76
	9	August	0.15	3.87
	8	September	0.15	2.90
	19	October	0.20	3.45
	24	December	0.25	1.18
1990	8	July	0.38	6.71
	10	August	0.42	7.77
	14	September	0.55	11.44
	16	October	0.60	12.27
	15	December	0.74	17.18
1991	12	February	1.15	31.13
	14	〃	1.20	35.88
	19	〃	1.52	57.94
	21	〃	1.40	50.00
	25	〃	1.05	26.95
	27	〃	0.86	24.19

Table B-6 (1) Water-level and Discharge Observation Data at Serut (Cibanten)

YEAR	DATE		WATERLEVEL (m)	DISCHARGE (m3/s)
1978	23	October	0.48	2.19
	30	October	0.35	1.27
	24	November	0.26	0.81
	31	December	-	3.01
1979	19	January	-	10.42
	17	February	0.48	4.13
	28	March	0.41	1.62
	25	April	0.50	2.86
	26	May	0.30	1.10
	23	June	0.27	0.70
	25	July	o.26	0.60
	15	August	0.41	0.62
	24	September	0.23	0.35
	22	October	0.22	0.50
	22	Nopember	0.35	0.97
	28	December	0.40	1.77
1980	26	January	0.51	2.80
	28	August	0.21	0.44
	22	September	0.30	0.76
	17	October	0.32	0.79
	28	November	0.35	1.09
	19	December	0.38	1.44
1981	16	January	0.56	3.11
	29	March	0.40	1.65
	8	May	0.32	0.24
	13	June	0.37	1.26
	10	September	0.41	1.61
	28	October	0.34	1.02
	19	November	0.52	3.02
1983	26	August	0.12	0.29
	29	September	0.14	0.33
1984	5	April	0.39	1.61
	4	May	0.64	5.38
	30	May	0.36	1.58
	23	June	0.37	1.51
	27	July	0.35	1.36
	29	September	0.55	1.81
	25	October	0.31	1.22
	25	October	0.33	1.31
	22	November	0.26	0.84
	22	November	0.25	0.79
	28	December	0.96	12.03

Table B-6 (2) Water-level and Discharge Observation Data at Serut (Cibanten)

YEAR	DATE		WATERLEVEL (m)	DISCHARGE (m3/s)
1985	9	January	0.45	1.08
	9	January	0.45	1.05
	25	February	0.29	0.96
	19	March	0.40	1.52
	19	March	0.41	1.62
	13	May	0.53	2.88
	13	May	0.39	1.37
	17	June	0.45	1.01
	13	August	0.24	0.79
	13	August	0.24	0.72
	10	October	0.30	0.81
	10	October	0.30	0.78
	5	November	0.33	1.22
	6	December	0.30	0.98
	6	December	0.30	0.92
1986	12	February	0.22	0.33
	16	March	0.28	0.96
	30	April	0.50	1.26
	30	April	0.50	1.21
	6	August	0.42	1.89
	6	August	0.42	1.83
	3	September	0.34	1.36
	3	September	0.34	1.39
	4	November	0.30	1.36
	5	December	0.28	1.12
1987	9	January	0.38	1.44
	11	February	0.35	1.35
	15	April	0.30	0.82
	11	June	0.36	0.21
	10	August	-	small
	6	October	-	small
	18	December	0.26	0.61
1988	8	January	0.34	1.39
	12	June	0.30	0.78
	15	July	0.24	0.70
	18	August	0.29	0.82
	12	September	0.29	0.72
	13	October	0.40	1.38
	17	November	0.37	1.29
	10	December	0.41	1.92

Table B-6 (3) Water-level and Discharge Observation Data at Serut (Cibanten)

YEAR	DATE		WATERLEVEL (m)	DISCHARGE (m3/s)
1989	13	July	0.26	0.64
	8	August	0.35	0.85
	14	September	0.20	0.46
	19	October	0.16	0.43
	24	December	0.20	0.46
1990	10	June	0.38	1.28
	8	July	0.25	0.58
	10	August	0.55	2.19
	14	September	0.47	0.75
	16	October	0.41	1.24
	16	November	0.65	2.68
	15	December	0.42	0.68
1991	9	February	0.70	9.71
	13	〃	0.86	14.18
	18	〃	1.20	27.12
	20	〃	0.65	6.78
	26	〃	0.53	6.19
	27	〃	0.46	4.74

Table B-7 (1) Summary of Flow Discharge at Kubang Baros

(unit;m^3/s)

Year	Max	1」 95day	2」 185day	3」 275day	4」 355day	Min	Mean
1980	177.49	17.67	8.66	4.93	1.05	0.26	18.84
1981	190.04	26.03	14.28	6.81	1.93	0.52	24.44
1982	89.00	9.64	4.54	2.25	0.78	0.39	10.07
1983	131.93	13.70	7.03	3.08	0.65	0.52	12.01
1984	80.90	15.17	9.14	5.13	3.08	1.19	13.09
1985	95.06	12.00	7.94	4.93	2.57	1.05	10.46
1986	101.37	17.67	8.18	5.13	2.09	1.48	13.57
1987	82.03	14.58	6.16	2.25	1.05	1.05	10.34
1988	63.18	17.67	9.39	3.08	1.78	1.48	13.00
1989	141.07	8.42	7.03	3.08	1.48	1.05	10.88
1990	49.01	8.18	2.91	1.93	1.63	1.63	6.94
Total	1201.08	160.73	85.26	42.60	18.09	10.62	143.63
Average	109.19	14.61	7.75	3.87	1.64	0.97	13.06
Max	190.04	26.03	14.28	6.81	3.08	1.63	24.44
Min	49.01	8.18	2.91	1.93	0.65	0.26	6.94

Notes ;

1」 means flow guaranteed over 95-day period with in 365days

2」 means flow guaranteed over 185-day period with in 365days

3」 means flow guaranteed over 275-day period with in 365days

4」 means flow guaranteed over 355-day period with in 365days

Table B-7 (2) Summary of Flow Discharge at Serut

Year	Max	95day	185day	275day	355day	Min	Mean
1980	16.01	2.20	1.06	0.66	0.44	0.06	1.89
1981	41.73	3.77	1.97	1.21	0.66	0.61	3.42
1982	27.10	2.72	1.21	0.54	0.24	0.12	2.30
1983	48.99	2.27	0.86	0.24	0.02	0.01	2.50
1984	30.46	4.11	1.86	1.13	0.66	0.39	3.79
1985	14.28	1.56	0.80	0.61	0.47	0.42	1.40
1986	19.76	2.33	1.29	0.70	0.49	0.29	2.10
1987	12.97	1.46	0.71	0.44	0.43	0.43	1.32
1988	26.00	0.83	0.59	0.46	0.42	0.38	1.18
1989	12.69	0.84	0.53	0.42	0.12	0.09	1.04
1990	15.69	1.63	0.92	0.65	0.45	0.43	1.44
Total	265.68	23.72	11.80	7.06	4.40	3.23	22.38
Average	24.15	2.16	1.07	0.64	0.40	0.29	2.03
Max	48.99	4.11	1.97	1.21	0.66	0.61	3.79
Min	12.69	0.83	0.53	0.24	0.02	0.01	1.04

Table B-8 Enlarge Ratio for Each Calculating Point

Situation	Applied station	Ratio
Cibanten Dam	Serut	1.0
Cidanau Downstream Dam	Kubang Baros	$\frac{208.25km^2}{199.50km^2} = 1.043$
Krakatau Steel Intake	Kubang Baros	$\frac{214.95km^2}{199.50km^2} = 1.007$
Beroeng Intake	Serut	$\frac{2,250mm}{2,000mm} \times \frac{12.10km^2}{73.15km^2} = 0.186$
Anyer Intake	Serut	$\frac{2,500mm}{2,000mm} \times \frac{17.50km^2}{73.15km^2} = 0.299$
Krenceng	Serut	$\frac{2,250mm}{2,000mm} \times \frac{13.30km^2}{73.15km^2} = 0.204$

where : 3,000mm : Annual mean rainfall at Kubang Baros

2,500mm : 〃 at Anyer

2,250mm : 〃 at Krenceng

2,000mm : 〃 at Serut

Annual mean rainfall are derived from Annual Isohyoto Map.

Table B-9 (1)　　Discharge Data of the 5-days Period at Kubang Baros

1980　5-DAYS PERIOD DISCHARGE(M3/S) QT= 18.89

	1	2	3	4	5	6	7	8	9	10	11	12
1	8.37	7.08	9.74	4.79	1.76	8.25	3.51	4.71	5.68	1.84	20.19	59.98
2	8.56	10.88	7.38	3.80	.39	9.44	6.05	9.63	58.08	1.36	23.76	68.15
3	8.71	10.77	30.12	13.97	1.89	4.05	6.04	14.70	61.72	5.46	28.82	70.42
4	8.42	10.88	20.56	10.40	4.10	6.81	10.20	27.59	26.61	13.18	33.29	90.73
5	8.37	10.93	4.91	7.03	11.51	8.11	5.67	11.37	5.32	14.76	39.33	163.47
6	6.37	13.60	3.11	4.28	8.94	5.10	4.91	3.80	3.51	17.68	46.04	84.65

1981　5-DAYS PERIOD DISCHARGE(M3/S) QT= 24.44

	1	2	3	4	5	6	7	8	9	10	11	12
1	133.45	39.60	26.28	26.71	13.82	6.05	9.25	17.26	4.68	89.87	9.91	27.46
2	155.56	46.22	3.76	26.43	9.50	7.93	2.73	6.64	14.01	30.77	8.67	24.97
3	61.80	30.32	4.86	25.04	6.35	10.95	5.98	4.76	15.22	10.64	52.17	18.53
4	65.16	22.71	7.90	21.79	9.35	20.42	11.94	3.39	3.53	7.58	146.59	7.39
5	29.89	4.02	5.02	18.67	6.95	9.27	15.80	8.09	2.44	3.94	55.71	12.44
6	30.65	39.95	21.11	16.73	1.97	9.08	20.47	9.55	21.16	19.48	20.08	67.70

1982　5-DAYS PERIOD DISCHARGE(M3/S) QT= 10.07

	1	2	3	4	5	6	7	8	9	10	11	12
1	45.92	5.96	19.62	22.41	11.68	5.22	3.02	3.60	1.81	2.71	1.05	2.92
2	25.03	2.44	68.17	22.85	7.69	8.15	2.74	2.74	1.23	1.20	11.47	.91
3	9.39	3.71	27.14	15.51	7.22	5.49	2.67	1.75	1.14	.78	3.69	4.78
4	38.97	3.37	36.47	37.14	4.16	5.46	3.84	1.49	.97	2.06	1.67	5.99
5	34.02	7.16	52.72	11.64	3.66	4.06	4.74	1.22	2.06	2.01	5.69	6.29
6	6.56	10.14	14.56	15.99	4.14	2.78	8.55	.96	2.30	1.13	5.46	15.36

1983　5-DAYS PERIOD DISCHARGE(M3/S) QT= 12.01

	1	2	3	4	5	6	7	8	9	10	11	12
1	14.55	16.97	11.63	10.60	4.44	8.65	17.10	3.07	1.06	.81	15.21	41.57
2	15.00	20.20	5.84	9.38	4.36	7.37	10.58	1.46	1.63	.62	12.26	22.10
3	13.26	5.57	4.98	8.17	13.11	5.78	5.45	2.58	1.82	.70	15.82	9.40
4	23.74	6.06	4.27	9.72	6.61	8.42	7.21	3.19	1.51	.79	83.88	9.51
5	43.06	6.70	4.24	8.23	8.66	10.42	5.28	8.45	1.51	5.39	101.38	8.02
6	24.45	8.91	6.32	10.14	5.57	11.05	6.03	1.89	1.16	11.73	46.98	12.63

1984　5-DAYS PERIOD DISCHARGE(M3/S) QT= 13.13

	1	2	3	4	5	6	7	8	9	10	11	12
1	12.19	15.97	12.62	25.53	12.57	13.39	4.92	5.37	3.58	22.34	3.46	42.91
2	2.96	26.90	22.95	6.14	22.95	7.46	10.52	4.14	10.73	9.47	5.93	41.27
3	13.41	12.11	27.83	8.23	33.57	6.73	7.07	3.18	13.45	4.35	10.47	17.05
4	14.92	8.92	23.09	7.23	12.46	5.61	4.62	3.25	10.83	5.14	10.61	15.06
5	15.16	6.16	41.02	9.41	8.52	6.70	5.94	3.01	9.41	4.97	7.66	7.15
6	17.62	16.20	47.29	13.94	22.62	2.99	6.69	3.89	7.47	6.06	8.07	31.05

1985　5-DAYS PERIOD DISCHARGE(M3/S) QT= 10.46

	1	2	3	4	5	6	7	8	9	10	11	12
1	20.38	11.09	12.14	3.94	14.06	4.85	4.41	11.53	2.54	3.75	8.78	31.30
2	18.01	10.99	39.14	5.09	10.94	4.42	4.47	11.20	2.58	5.72	8.33	26.51
3	34.76	13.55	30.47	9.81	8.66	5.35	4.94	6.81	9.47	12.09	9.26	8.98
4	11.89	7.02	10.31	20.24	7.26	6.60	5.28	5.83	7.30	15.53	6.44	4.09
5	8.09	12.20	6.43	14.83	7.78	6.81	12.80	4.43	5.13	20.24	7.98	3.79
6	12.50	13.14	4.74	16.34	6.25	6.23	14.10	3.26	4.78	9.69	14.14	3.94

Table B-9 (2) Discharge Data of the 5-days Period at Kubang Baros

1986 5-DAYS PERIOD DISCHARGE(M3/S) QT= 13.57

	1	2	3	4	5	6	7	8	9	10	11	12
1	14.02	26.41	11.10	22.69	11.78	5.49	2.61	5.63	1.75	7.31	19.71	11.08
2	45.10	17.15	9.32	22.30	9.09	5.13	2.96	6.74	2.87	4.89	30.55	4.33
3	47.60	22.67	7.49	17.62	9.10	4.70	4.32	7.97	5.54	8.18	49.61	13.21
4	24.31	19.35	6.34	16.69	8.72	4.80	2.98	5.25	6.17	8.91	21.40	20.66
5	50.03	15.99	27.13	10.27	5.54	5.51	2.31	2.68	6.33	5.64	8.77	11.10
6	47.38	12.75	49.90	8.05	4.90	3.40	4.58	2.14	8.62	14.76	11.36	6.79

1987 5-DAYS PERIOD DISCHARGE(M3/S) QT= 10.34

	1	2	3	4	5	6	7	8	9	10	11	12
1	10.68	16.55	33.76	10.81	20.93	6.41	5.01	2.71	1.13	1.08	1.43	1.81
2	40.96	26.15	33.71	14.01	16.13	6.51	3.83	1.99	1.05	1.05	2.47	3.10
3	56.84	23.63	18.14	15.00	18.44	7.08	3.08	2.19	1.05	2.61	5.37	6.79
4	31.74	18.90	7.88	14.52	15.62	7.04	2.28	1.69	1.05	2.00	4.93	8.46
5	19.52	39.90	9.72	6.41	8.12	6.41	2.38	1.42	1.05	2.35	3.05	12.25
6	19.08	41.13	10.07	10.41	7.42	5.66	2.94	1.19	1.05	1.44	1.86	6.80

1988 5-DAYS PERIOD DISCHARGE(M3/S) QT= 13.04

	1	2	3	4	5	6	7	8	9	10	11	12
1	3.10	35.54	14.14	44.38	16.70	6.71	4.32	2.22	1.87	3.08	7.72	31.19
2	1.66	44.60	23.15	21.81	18.52	12.28	2.95	4.07	2.46	2.48	9.66	20.27
3	1.82	31.76	14.15	15.69	14.48	13.47	1.96	3.23	3.22	2.42	12.73	28.98
4	4.52	46.53	13.56	15.58	19.86	11.73	2.31	2.98	2.84	4.32	11.70	54.48
5	6.98	23.47	15.50	18.05	16.65	9.60	1.99	3.18	2.78	4.87	17.05	26.57
6	14.84	7.30	20.87	13.11	7.97	6.73	2.06	2.07	2.68	4.62	28.85	13.27

1989 5-DAYS PERIOD DISCHARGE(M3/S) QT= 10.88

	1	2	3	4	5	6	7	8	9	10	11	12
1	9.61	9.13	53.33	7.26	7.26	7.08	2.94	2.48	3.61	2.94	3.60	4.90
2	7.37	34.08	36.83	7.26	7.26	8.62	5.83	1.66	2.22	2.48	3.09	6.04
3	6.05	22.36	20.26	7.26	7.26	8.63	9.76	2.10	4.03	2.03	4.78	8.77
4	7.91	69.43	17.41	7.26	7.26	5.89	11.44	1.34	5.06	1.75	4.50	9.84
5	8.38	128.61	10.02	7.26	7.26	3.48	8.09	1.51	3.29	1.87	4.97	9.19
6	6.83	76.75	7.00	7.26	7.26	3.01	4.12	2.28	1.79	4.35	3.76	9.31

1990 5-DAYS PERIOD DISCHARGE(M3/S) QT= 6.94

	1	2	3	4	5	6	7	8	9	10	11	12
1	8.76	42.49	1.69	2.61	2.19	1.93	1.93	2.61	1.84	4.50	7.21	9.74
2	8.76	26.95	2.12	2.31	1.99	1.93	2.25	2.71	1.66	4.89	7.66	9.44
3	15.94	20.93	2.44	3.05	1.93	1.93	1.87	2.64	1.63	5.29	8.13	9.44
4	25.64	11.08	3.50	3.82	1.93	1.93	1.93	2.31	1.63	5.78	8.71	10.16
5	42.00	2.71	4.20	3.11	1.93	1.93	2.15	1.99	3.49	6.16	9.19	10.31
6	44.43	1.98	3.82	2.61	1.93	1.93	2.04	1.93	4.24	6.66	9.69	8.95

Table B-10 (1) Discharge Data of the 5-days Period at Serut

1980 5-Days Period Discharge(m^3/s)

	1	2	3	4	5	6	7	8	9	10	11	12
1	1.32	2.12	1.68	0.68	1.24	1.25	0.46	1.34	2.59	1.24	2.02	0.52
2	2.24	5.43	2.60	0.74	1.07	0.63	0.44	2.11	2.23	1.39	1.14	0.75
3	3.31	5.56	1.75	3.21	1.23	0.85	0.49	3.21	3.62	1.39	1.43	0.58
4	3.29	8.80	1.84	1.11	1.19	0.53	0.59	4.26	1.25	0.93	3.55	1.99
5	3.25	5.23	0.78	1.93	0.82	0.66	0.53	0.58	0.89	1.35	0.85	6.00
6	3.71	2.63	1.05	1.21	0.57	0.58	0.59	0.47	1.60	1.08	0.71	6.02

1981 5-Days Period Discharge(m^3/s)

	1	2	3	4	5	6	7	8	9	10	11	12
1	19.37	4.51	7.43	1.56	2.40	0.73	0.68	1.87	2.07	3.75	1.56	3.48
2	13.32	3.94	3.75	1.81	1.84	0.65	0.65	1.96	1.93	3.78	3.11	2.23
3	8.08	5.83	5.76	1.09	2.34	1.39	2.40	1.20	5.33	2.88	4.72	1.89
4	4.70	5.80	3.63	1.53	3.26	2.28	3.62	1.64	1.29	1.20	11.13	1.89
5	3.34	5.25	1.89	1.55	1.20	1.00	4.02	1.65	1.15	1.39	1.93	3.81
6	4.65	14.08	2.91	1.19	0.94	1.33	6.33	1.10	1.76	2.07	5.24	7.28

1982 5-Days Period Discharge(m^3/s)

	1	2	3	4	5	6	7	8	9	10	11	12
1	4.39	5.40	3.30	3.11	2.71	2.78	0.91	1.22	0.52	0.71	0.45	0.48
2	10.11	2.53	4.20	2.57	2.40	2.08	0.74	0.92	0.54	0.50	0.72	0.44
3	15.90	3.28	6.87	2.42	1.85	1.51	0.74	0.43	0.48	0.48	0.69	0.48
4	10.23	2.51	6.67	3.90	1.29	1.28	1.88	0.32	0.49	1.12	0.67	0.50
5	7.28	2.01	4.98	2.57	1.27	0.84	1.94	0.25	0.45	0.55	0.66	0.52
6	5.20	2.43	3.94	3.72	1.56	1.27	1.90	0.19	0.59	0.47	0.65	1.18

1983 5-Days Period Discharge(m^3/s)

	1	2	3	4	5	6	7	8	9	10	11	12
1	2.11	2.45	4.90	2.10	2.83	1.67	1.74	0.24	0.05	0.03	0.46	4.18
2	1.21	2.48	2.19	3.34	5.21	10.97	0.25	0.18	0.10	0.02	0.89	4.05
3	0.89	0.63	1.76	0.69	3.22	4.10	0.21	0.15	0.11	0.02	0.09	1.32
4	1.35	1.54	0.72	1.53	3.16	2.43	0.55	0.15	0.13	0.03	5.28	0.90
5	3.66	0.94	0.78	6.69	2.00	1.38	0.51	0.30	0.09	0.43	15.51	0.65
6	0.55	5.00	2.93	5.08	2.58	3.01	0.60	0.11	0.06	0.44	44.25	0.71

1984 5-Days Period Discharge(m^3/s)

	1	2	3	4	5	6	7	8	9	10	11	12
1	1.39	5.17	4.24	2.01	5.68	2.26	2.73	0.99	1.28	5.39	1.66	1.18
2	2.65	3.84	11.43	2.72	4.79	1.88	1.90	0.78	4.39	1.50	0.93	0.97
3	0.95	4.49	16.00	1.83	2.53	2.42	1.01	1.74	4.56	2.54	0.95	1.65
4	1.48	9.00	10.44	2.74	1.72	2.34	0.95	1.07	3.08	2.04	2.12	1.33
5	10.14	8.16	20.10	2.07	2.69	1.58	1.85	0.95	2.07	2.44	1.62	1.12
6	15.91	6.50	19.07	5.17	2.09	1.13	1.65	1.78	4.75	1.27	0.88	3.65

Table B-10 (2) Discharge Data of the 5-days Period at Serut

1985 5-Days Period Discharge(m^3/s)

	1	2	3	4	5	6	7	8	9	10	11	12
1	1.27	1.11	1.93	1.21	1.19	0.69	0.79	2.83	0.46	1.30	0.93	3.40
2	4.61	0.97	4.30	1.70	0.87	0.93	1.57	1.06	0.95	1.19	1.68	1.38
3	1.30	0.84	1.64	2.79	0.99	0.60	1.91	0.70	0.63	0.81	0.67	0.56
4	0.99	0.56	1.70	6.49	0.67	0.63	1.94	0.70	0.54	3.83	0.48	0.86
5	1.37	2.06	0.90	1.99	0.59	2.39	3.02	0.56	0.49	0.78	0.69	1.36
6	2.20	0.54	1.40	2.06	0.88	0.63	1.01	0.62	1.08	0.74	1.15	1.06

1986 5-Days Period Discharge(m^3/s)

	1	2	3	4	5	6	7	8	9	10	11	12
1	0.87	3.81	2.96	3.34	1.15	0.69	1.08	0.53	0.70	2.02	1.17	0.67
2	9.49	3.11	1.81	2.38	1.75	1.21	1.02	0.60	1.61	1.44	2.25	0.52
3	3.32	5.44	2.67	3.14	1.90	2.48	3.43	1.74	1.56	0.78	1.89	2.51
4	4.85	1.91	2.13	1.88	0.93	1.03	1.67	0.76	0.81	0.71	2.79	3.20
5	13.57	2.57	1.98	1.47	1.22	0.60	0.93	0.53	0.60	0.50	1.18	0.71
6	8.59	2.83	1.43	2.37	0.97	0.66	1.34	0.76	0.68	2.86	2.11	1.07

1987 5-Days Period Discharge(m^3/s)

	1	2	3	4	5	6	7	8	9	10	11	12
1	1.81	1.55	2.85	1.40	2.23	0.96	0.69	0.49	0.45	0.43	0.50	0.48
2	6.93	4.25	1.61	1.13	2.97	1.13	0.56	0.43	0.43	0.43	1.18	0.54
3	5.54	1.71	1.23	1.18	2.12	1.51	0.47	0.43	0.45	0.43	0.62	0.77
4	1.98	2.26	1.06	1.11	1.68	0.89	0.47	0.43	0.55	0.43	0.44	3.20
5	2.58	1.47	1.44	1.02	0.84	0.89	0.51	0.43	0.44	0.43	0.43	0.70
6	2.77	8.69	1.52	3.52	0.84	0.75	0.48	0.43	0.43	0.43	0.45	0.43

1988 5-Days Period Discharge(m^3/s)

	1	2	3	4	5	6	7	8	9	10	11	12
1	0.43	14.28	0.93	1.82	0.62	0.89	0.93	0.54	0.46	0.43	3.14	0.57
2	0.82	9.88	0.80	1.10	0.52	0.57	0.63	0.58	0.43	0.43	1.01	0.59
3	0.83	1.80	0.73	0.81	0.65	0.54	0.39	0.67	0.43	2.48	0.77	4.28
4	1.31	0.86	0.72	0.80	0.77	0.45	0.49	0.59	0.42	1.57	0.53	1.01
5	0.91	0.80	0.92	0.95	0.64	0.43	0.40	0.55	0.42	0.74	0.58	0.44
6	3.78	0.77	0.85	0.68	0.51	0.42	0.42	0.48	0.43	1.75	0.52	0.44

1989 5-Days Period Discharge(m^3/s)

	1	2	3	4	5	6	7	8	9	10	11	12
1	0.46	2.45	3.91	0.41	0.23	0.21	0.62	0.70	0.59	0.42	0.42	0.44
2	0.49	2.45	3.36	0.51	0.18	0.78	0.65	0.90	0.78	0.42	0.42	0.85
3	0.62	1.03	2.51	0.47	0.12	1.04	0.69	0.68	0.57	0.42	0.43	5.55
4	0.70	3.03	1.15	0.18	0.14	0.87	0.66	0.70	0.44	0.42	0.49	1.85
5	1.33	8.54	0.41	0.16	0.20	0.89	0.58	0.62	0.43	0.44	0.43	0.82
6	0.77	7.27	0.48	0.12	0.20	0.87	0.74	1.40	0.45	0.43	0.45	2.29

Table B-10 (3)   Discharge Data of the 5-days Period at Serut

1990 5-Days Period Discharge(m^3/s)

	1	2	3	4	5	6	7	8	9	10	11	12
1	1.26	3.45	4.49	1.10	1.34	1.43	0.93	0.94	0.69	0.58	0.48	1.68
2	2.30	2.03	4.83	3.83	1.68	0.78	1.11	1.16	0.81	0.59	0.48	1.16
3	1.59	1.28	1.59	2.26	3.04	0.73	0.87	0.80	0.52	0.51	0.47	0.90
4	1.07	1.53	3.41	3.33	1.34	0.94	0.93	0.70	0.44	0.53	0.47	0.76
5	1.95	0.73	2.35	2.25	0.85	0.84	1.16	1.20	0.47	0.65	0.46	1.52
6	4.29	1.87	2.26	1.21	3.23	1.10	0.98	0.93	0.54	0.50	0.46	1.84

Table B-11 Peak Flow by Unit Hydrograph

River Point	L(km)	H(km)	Tc(hr)	D	Tp	Tr	A(km2)	qp(m^3/s)
Cidanau Kubang Baros	22.5	615	2.8	0.5	2.0	3.5	199.50	2015
Down Stream Dam Site	26.5	680	2.9	0.5	2.0	3.5	208.25	2105
Cibanten Serut	11.0	625	1.2	0.2	0.8	1.4	73.15	1850
Cidanau 1」	5.5	75	0.2	0.1	0.2	0.3	15.45	1717
Cidanau 2」	28.0	690	2.9	0.5	2.0	3.5	214.95	2171
Krenceng Dam	12.0	175	0.4	0.1	0.3	0.5	13.30	924

Notes ;

1」 due to remaining basin area between Kubang Baros and Krakatau intake (15.45km^2)

2」 due to whole basin area at krakatau intake (214.95km^2)

Tp=0.6*Tc+D/2

Tr=1.67*Tp

qp=(CA*10^6*2)/((Tp+Tr)*3600)

Table B-12 Annual Maximum Daily Rainfall

YEAR	SERANG		PABUARAN		KEPUR		PADARINCANG	
	DATE	RAINFALL	DATE	RAINFALL	DATE	RAINFALL	DATE	RAINFALL
1946	30 Jan	88.8						
1947	18 Aug	85.2						
1948	23 Mar	80.3						
1949	8 Jun	52.9						
1950	50 Apr	62						
1951	29 Sep	51						
1952	14 Mar	69						
1953	7 Jan	99						
1954	14 Dec	93						
1955	14 Nov	75						
1956	30 Jan	115						
1957	20 Feb	77						
1958	8 Dec	141						
1959	13 Mar	92						
1960	3 Jan	109						
1961	14 May	122						
1962	28 Oct	76						
1963	23 Jan	107						
1964	31 Mar	80						
1965								
1966								
1967	11 Feb	86						
1968	16 Oct	78						
1969								
1970								
1971								
1972	19 Jan	80						
1973	8 Feb	113						
1974	7 Dec	107						
1975	28 Dec	114						
1976	19 Nov	65						
1977	11 Feb	60	11 Feb	90				
1978	23 Jun	66	27 Apr	120			29 Jun	124
1979	10 Jan	80	24 Feb	48	3 Mar	132	12 Mar	90
1980	21 Feb	68	5 Mar	70	12 Jan	103	11 Jan	139
1981	15 Aug	70	1 Jan	79	24 Sep	80	15 Nov	96
1982	30 May	70	11 Jan	58	9 Jan	126	5 Jan	87
1983	22 Jan	83	27 Mar	56	30 Jun	99	12 Mar	170
1984	1 Oct	97	19 Jun	78	18 Jun	96	4 Dec	150
1985	9 Jan	70	19 Jul	54	7 Jan	73	22 Jan	75
1986	10 Feb	65	25 Sep	80	7 Apr	74	3 Oct	74
1987	11 May	93	29 Nov	91	8 Jan	43	7 Apr	75
1988	9 Feb	59	12 Nov	73	17 Jan	44	12 Nov	73
1989			22 May	70	6 Aug	110	26 May	56
1990					12 Jan	119	3 Jan	53

Table B-13 Probable Rainfall by Hazen Plot

unit (mm/day)

Probability	Point		Krenceng
	Kepuh	Padarincang	=Padarincang× 0.8
1/25	145	180	144
1/50	165	210	168
1/100	175	230	184
1/200	185	250	200

Table B-14 Probable Peak Flood Discharge at Alternative Dam Sites

unit : m^3/s

Station	Probability			
	1/25	1/50	1/100	1/200
Kubang Baros	1446	1781	1996	2202
Downstream Dam Site	1510	1860	2085	2300
	1558	1919	2151	2373
Cidanau Intake Site with out Kubang Barats	326	386	426	466
Serut	815	965	1034	1105
Krenceng	129	154	172	188

Table B-15 (1) Flood Hydrograph at Kubang Baros

(w=1/25)

CIDANAU TIME	199.50MK2 RAIN	RAIN= 180.00 RAIN(EF)	Q
.50	1.96	.00	.00
1.00	3.92	.00	.00
1.50	4.31	.00	.00
2.00	4.70	.00	.00
2.50	5.87	.00	.00
3.00	7.05	.00	.00
3.50	23.10	19.10	.00
4.00	39.15	35.15	96.21
4.50	24.66	20.66	369.49
5.00	10.18	6.18	746.86
5.50	8.22	4.22	1155.36
6.00	6.26	2.26	1433.89
6.50	5.09	1.09	1445.47
7.00	3.92	.00	1298.90
7.50	3.52	.00	1103.78
8.00	3.13	.00	875.55
8.50	.00	.00	629.11
9.00	.00	.00	373.74
9.50	.00	.00	173.37
10.00	.00	.00	74.24
10.50	.00	.00	34.63
11.00	.00	.00	12.80
11.50	.00	.00	3.14
12.00	.00	.00	.00
12.50	.00	.00	.00
13.00	.00	.00	.00
13.50	.00	.00	.00
14.00	.00	.00	.00

(w=1/100)

CIDANAU TIME	199.50MK2 RAIN	RAIN= 230.00 RAIN(EF)	Q
.50	2.50	.00	.00
1.00	5.00	.00	.00
1.50	5.50	.00	.00
2.00	6.00	.00	.00
2.50	7.50	.00	.00
3.00	9.00	5.00	.00
3.50	29.51	25.51	25.21
4.00	50.03	46.03	178.95
4.50	31.52	27.52	564.54
5.00	13.01	9.01	1088.74
5.50	10.51	6.51	1618.69
6.00	8.00	4.00	1979.35
6.50	6.50	2.50	1995.71
7.00	5.00	1.00	1806.89
7.50	4.50	.50	1552.21
8.00	4.00	.00	1248.96
8.50	.00	.00	913.63
9.00	.00	.00	572.54
9.50	.00	.00	296.97
10.00	.00	.00	149.99
10.50	.00	.00	82.25
11.00	.00	.00	40.44
11.50	.00	.00	17.35
12.00	.00	.00	5.80
12.50	.00	.00	1.46
13.00	.00	.00	.01
13.50	.00	.00	.00
14.00	.00	.00	.00

(w=1/200)

CIDANAU TIME	199.50MK2 RAIN	RAIN= 250.00 RAIN(EF)	Q
.50	2.72	.00	.00
1.00	5.44	.00	.00
1.50	5.98	.00	.00
2.00	6.52	.00	.00
2.50	8.16	.00	.00
3.00	9.79	5.79	.00
3.50	32.08	28.08	29.15
4.00	54.38	50.38	199.77
4.50	34.26	30.26	624.15
5.00	14.14	10.14	1200.94
5.50	11.42	7.42	1782.97
6.00	8.70	4.70	2180.00
6.50	7.07	3.07	2201.79
7.00	5.44	1.44	1999.55
7.50	4.89	.89	1724.73
8.00	4.35	.35	1396.11
8.50	.00	.00	1031.63
9.00	.00	.00	659.12
9.50	.00	.00	356.08
10.00	.00	.00	191.07
10.50	.00	.00	110.43
11.00	.00	.00	58.97
11.50	.00	.00	28.88
12.00	.00	.00	12.32
12.50	.00	.00	4.59
13.00	.00	.00	1.01
13.50	.00	.00	.00
14.00	.00	.00	.00

Table B-15 (2) Flood Hydrograph at Dam Site

(w=1/25)

CIDANAU TIME	208.25MK2 RAIN	RAIN= 180.00 RAIN(EF)	Q
.50	1.96	.00	.00
1.00	3.92	.00	.00
1.50	4.31	.00	.00
2.00	4.70	.00	.00
2.50	5.87	.00	.00
3.00	7.05	.00	.00
3.50	23.10	19.10	.00
4.00	39.15	35.15	100.51
4.50	24.66	20.66	385.99
5.00	10.18	6.18	780.22
5.50	8.22	4.22	1206.96
6.00	6.26	2.26	1497.93
6.50	5.09	1.09	1510.03
7.00	3.92	.00	1356.91
7.50	3.52	.00	1153.08
8.00	3.13	.00	914.66
8.50	.00	.00	657.21
9.00	.00	.00	390.43
9.50	.00	.00	181.11
10.00	.00	.00	77.55
10.50	.00	.00	36.18
11.00	.00	.00	13.37
11.50	.00	.00	3.28
12.00	.00	.00	.00
12.50	.00	.00	.00
13.00	.00	.00	.00
13.50	.00	.00	.00
14.00	.00	.00	.00

(w=1/100)

CIDANAU TIME	208.25MK2 RAIN	RAIN= 230.00 RAIN(EF)	Q
.50	2.50	.00	.00
1.00	5.00	.00	.00
1.50	5.50	.00	.00
2.00	6.00	.00	.00
2.50	7.50	.00	.00
3.00	9.00	5.00	.00
3.50	29.51	25.51	26.34
4.00	50.03	46.03	186.94
4.50	31.52	27.52	589.76
5.00	13.01	9.01	1137.37
5.50	10.51	6.51	1690.99
6.00	8.00	4.00	2067.76
6.50	6.50	2.50	2084.85
7.00	5.00	1.00	1887.59
7.50	4.50	.50	1621.54
8.00	4.00	.00	1304.74
8.50	.00	.00	954.44
9.00	.00	.00	598.11
9.50	.00	.00	310.23
10.00	.00	.00	156.69
10.50	.00	.00	85.93
11.00	.00	.00	42.24
11.50	.00	.00	18.13
12.00	.00	.00	6.06
12.50	.00	.00	1.52
13.00	.00	.00	.01
13.50	.00	.00	.00
14.00	.00	.00	.00

(w=1/200)

CIDANAU TIME	208.25MK2 RAIN	RAIN= 250.00 RAIN(EF)	Q
.50	2.72	.00	.00
1.00	5.44	.00	.00
1.50	5.98	.00	.00
2.00	6.52	.00	.00
2.50	8.16	.00	.00
3.00	9.79	5.79	.00
3.50	32.08	28.08	30.46
4.00	54.38	50.38	208.69
4.50	34.26	30.26	652.02
5.00	14.14	10.14	1254.58
5.50	11.42	7.42	1862.61
6.00	8.70	4.70	2277.37
6.50	7.07	3.07	2300.13
7.00	5.44	1.44	2088.86
7.50	4.89	.89	1801.76
8.00	4.35	.35	1458.47
8.50	.00	.00	1077.71
9.00	.00	.00	688.56
9.50	.00	.00	371.99
10.00	.00	.00	199.60
10.50	.00	.00	115.36
11.00	.00	.00	61.61
11.50	.00	.00	30.17
12.00	.00	.00	12.87
12.50	.00	.00	4.80
13.00	.00	.00	1.05
13.50	.00	.00	.00
14.00	.00	.00	.00

Table B-15 (3) Flood Hydrograph at Cidanau Intake Site

(w=1/25)

CIDANAU TIME	214.95MK2 RAIN	RAIN= 180.00 RAIN(EF)	Q
.50	1.96	.00	.00
1.00	3.92	.00	.00
1.50	4.31	.00	.00
2.00	4.70	.00	.00
2.50	5.87	.00	.00
3.00	7.05	.00	.00
3.50	23.10	19.10	.00
4.00	39.15	35.15	103.66
4.50	24.66	20.66	398.09
5.00	10.18	6.18	804.68
5.50	8.22	4.22	1244.81
6.00	6.26	2.26	1544.90
6.50	5.09	1.09	1557.38
7.00	3.92	.00	1399.46
7.50	3.52	.00	1189.23
8.00	3.13	.00	943.34
8.50	.00	.00	677.81
9.00	.00	.00	402.68
9.50	.00	.00	186.79
10.00	.00	.00	79.99
10.50	.00	.00	37.31
11.00	.00	.00	13.79
11.50	.00	.00	3.38
12.00	.00	.00	.00
12.50	.00	.00	.00
13.00	.00	.00	.00
13.50	.00	.00	.00
14.00	.00	.00	.00

(w=1/100)

CIDANAU TIME	214.95MK2 RAIN	RAIN= 230.00 RAIN(EF)	Q
.50	2.50	.00	.00
1.00	5.00	.00	.00
1.50	5.50	.00	.00
2.00	6.00	.00	.00
2.50	7.50	.00	.00
3.00	9.00	5.00	.00
3.50	29.51	25.51	27.16
4.00	50.03	46.03	192.81
4.50	31.52	27.52	608.25
5.00	13.01	9.01	1173.03
5.50	10.51	6.51	1744.00
6.00	8.00	4.00	2132.59
6.50	6.50	2.50	2150.22
7.00	5.00	1.00	1946.78
7.50	4.50	.50	1672.38
8.00	4.00	.00	1345.65
8.50	.00	.00	984.37
9.00	.00	.00	616.86
9.50	.00	.00	319.96
10.00	.00	.00	161.60
10.50	.00	.00	88.62
11.00	.00	.00	43.57
11.50	.00	.00	18.70
12.00	.00	.00	6.25
12.50	.00	.00	1.57
13.00	.00	.00	.01
13.50	.00	.00	.00
14.00	.00	.00	.00

(w=1/200)

CIDANAU TIME	214.95MK2 RAIN	RAIN= 250.00 RAIN(EF)	Q
.50	2.72	.00	.00
1.00	5.44	.00	.00
1.50	5.98	.00	.00
2.00	6.52	.00	.00
2.50	8.16	.00	.00
3.00	9.79	5.79	.00
3.50	32.08	28.08	31.41
4.00	54.38	50.38	215.23
4.50	34.26	30.26	672.47
5.00	14.14	10.14	1293.92
5.50	11.42	7.42	1921.01
6.00	8.70	4.70	2348.77
6.50	7.07	3.07	2372.25
7.00	5.44	1.44	2154.36
7.50	4.89	.89	1858.26
8.00	4.35	.35	1504.20
8.50	.00	.00	1111.50
9.00	.00	.00	710.15
9.50	.00	.00	383.65
10.00	.00	.00	205.86
10.50	.00	.00	118.98
11.00	.00	.00	63.54
11.50	.00	.00	31.12
12.00	.00	.00	13.27
12.50	.00	.00	4.95
13.00	.00	.00	1.09
13.50	.00	.00	.00
14.00	.00	.00	.00

Table B-15 (4) Flood Hydrograph at Cidanau Intake Site due to Remaining Basin Area between Kubang Baros and Krakatau Intake

(w=1/25)

CIDANAU/CILEGON 15.45MK2 RAIN= 180.00

TIME	RAIN	RAIN(EF)	Q
.10	.09	.00	.00
.20	.18	.00	.00
.30	.27	.00	.00
.40	.36	.00	.00
.50	.45	.00	.00
.60	.53	.00	.00
.70	.62	.00	.00
.80	.71	.00	.00
.90	.80	.00	.00
1.00	.89	.00	.00
1.10	.91	.00	.00
1.20	.93	.00	.00
1.30	.94	.00	.00
1.40	.96	.00	.00
1.50	.98	.00	.00
1.60	1.00	.00	.00
1.70	1.02	.00	.00
1.80	1.03	.00	.00
1.90	1.05	.00	.00
2.00	1.07	.00	.00
2.10	1.12	.00	.00
2.20	1.18	.00	.00
2.30	1.23	.00	.00
2.40	1.28	.00	.00
2.50	1.34	.00	.00
2.60	1.39	.00	.00
2.70	1.44	.00	.00
2.80	1.50	.00	.00
2.90	1.55	.75	.00
3.00	1.60	.80	6.44
3.10	2.33	1.53	19.78
3.20	3.07	2.27	35.61
3.30	3.80	3.00	59.29
3.40	4.53	3.73	86.81
3.50	5.26	4.46	118.18
3.60	5.99	5.19	149.54
3.70	6.72	5.92	180.90
3.80	7.45	6.65	212.26
3.90	8.18	7.38	243.62
4.00	8.91	8.11	274.99
4.10	8.25	7.45	306.35
4.20	7.59	6.79	325.78
4.30	6.93	6.13	321.34
4.40	6.27	5.47	300.91
4.50	5.61	4.81	272.61
4.60	4.95	4.15	244.31
4.70	4.29	3.49	216.01
4.80	3.64	2.84	187.71
4.90	2.98	2.18	159.40
5.00	2.32	1.52	131.10
5.10	2.23	1.43	102.80
5.20	2.14	1.34	79.39
5.30	2.05	1.25	65.78
5.40	1.96	1.16	58.72
5.50	1.87	1.07	54.90
5.60	1.78	.98	51.07
5.70	1.69	.89	47.25
5.80	1.60	.80	43.42
5.90	1.51	.71	39.60
6.00	1.43	.63	35.77
6.10	1.37	.57	31.95
6.20	1.32	.52	28.43
6.30	1.27	.47	25.52
6.40	1.21	.41	23.03
6.50	1.16	.36	20.73
6.60	1.10	.30	18.44
6.70	1.05	.25	16.14
6.80	1.00	.20	13.85
6.90	.94	.14	11.55
7.00	.89	.09	9.26
7.10	.87	.07	6.96
7.20	.86	.06	4.97
7.30	.84	.04	3.60
7.40	.82	.02	2.63
7.50	.80	.00	1.87
7.60	.78	.00	1.10
7.70	.77	.00	.47
7.80	.75	.00	.13
7.90	.73	.00	.01
8.00	.71	.00	.00
8.10	.00	.00	.00
8.20	.00	.00	.00
8.30	.00	.00	.00
8.40	.00	.00	.00
8.50	.00	.00	.00
8.60	.00	.00	.00
8.70	.00	.00	.00
8.80	.00	.00	.00
8.90	.00	.00	.00
9.00	.00	.00	.00
9.10	.00	.00	.00
9.20	.00	.00	.00

(w=1/100)

CIDANAU/CILEGON 15.45MK2 RAIN= 230.00

TIME	RAIN	RAIN(EF)	Q
.10	.11	.00	.00
.20	.23	.00	.00
.30	.34	.00	.00
.40	.46	.00	.00
.50	.57	.00	.00
.60	.68	.00	.00
.70	.80	.00	.00
.80	.91	.00	.00
.90	1.02	.00	.00
1.00	1.14	.00	.00
1.10	1.16	.00	.00
1.20	1.18	.00	.00
1.30	1.21	.00	.00
1.40	1.23	.00	.00
1.50	1.25	.00	.00
1.60	1.28	.00	.00
1.70	1.30	.00	.00
1.80	1.32	.00	.00
1.90	1.34	.00	.00
2.00	1.37	.00	.00
2.10	1.43	.00	.00
2.20	1.50	.00	.00
2.30	1.57	.00	.00
2.40	1.64	.00	.00
2.50	1.71	.91	.00
2.60	1.78	.98	7.79
2.70	1.84	1.04	23.97
2.80	1.91	1.11	36.17
2.90	1.98	1.18	43.86
3.00	2.05	1.25	46.79
3.10	2.98	2.18	49.72
3.20	3.92	3.12	60.08
3.30	4.85	4.05	85.30
3.40	5.78	4.98	120.47
3.50	6.72	5.92	160.54
3.60	7.65	6.85	200.62
3.70	8.58	7.78	240.69
3.80	9.52	8.72	280.76
3.90	10.45	9.65	320.84
4.00	11.39	10.59	360.91
4.10	10.54	9.74	400.98
4.20	9.70	8.90	425.81
4.30	8.86	8.06	420.14
4.40	8.02	7.22	394.04
4.50	7.17	6.37	357.88
4.60	6.33	5.53	321.71
4.70	5.49	4.69	285.55
4.80	4.65	3.85	249.38
4.90	3.80	3.00	213.22
5.00	2.96	2.16	177.06
5.10	2.85	2.05	140.89
5.20	2.73	1.93	110.98
5.30	2.62	1.82	93.59
5.40	2.50	1.70	84.57
5.50	2.39	1.59	79.68
5.60	2.28	1.48	74.80
5.70	2.16	1.36	69.91
5.80	2.05	1.25	65.02
5.90	1.94	1.14	60.14
6.00	1.82	1.02	55.25
6.10	1.75	.95	50.36
6.20	1.68	.88	45.87
6.30	1.62	.82	42.15
6.40	1.55	.75	38.96
6.50	1.48	.68	36.03
6.60	1.41	.61	33.10
6.70	1.34	.54	30.16
6.80	1.28	.48	27.23
6.90	1.21	.41	24.30
7.00	1.14	.34	21.37
7.10	1.12	.32	18.44
7.20	1.09	.29	15.89
7.30	1.07	.27	14.14
7.40	1.05	.25	12.90
7.50	1.02	.22	11.92
7.60	1.00	.20	10.95
7.70	.98	.18	9.97
7.80	.96	.16	8.99
7.90	.93	.13	8.01
8.00	.91	.11	7.04
8.10	.00	.00	6.06
8.20	.00	.00	4.32
8.30	.00	.00	2.03
8.40	.00	.00	.63
8.50	.00	.00	.00
8.60	.00	.00	.00
8.70	.00	.00	.00
8.80	.00	.00	.00
8.90	.00	.00	.00
9.00	.00	.00	.00
9.10	.00	.00	.00
9.20	.00	.00	.00

(w=1/200)

CIDANAU/CILEGON 15.45MK2 RAIN= 250.00

TIME	RAIN	RAIN(EF)	Q
.10	.12	.00	.00
.20	.25	.00	.00
.30	.37	.00	.00
.40	.50	.00	.00
.50	.62	.00	.00
.60	.74	.00	.00
.70	.87	.00	.00
.80	.99	.00	.00
.90	1.11	.00	.00
1.00	1.24	.00	.00
1.10	1.26	.00	.00
1.20	1.29	.00	.00
1.30	1.31	.00	.00
1.40	1.34	.00	.00
1.50	1.36	.00	.00
1.60	1.39	.00	.00
1.70	1.41	.00	.00
1.80	1.44	.00	.00
1.90	1.46	.00	.00
2.00	1.49	.00	.00
2.10	1.56	.00	.00
2.20	1.63	.00	.00
2.30	1.71	.00	.00
2.40	1.78	.98	.00
2.50	1.86	1.06	8.43
2.60	1.93	1.13	25.93
2.70	2.00	1.20	39.14
2.80	2.08	1.28	47.47
2.90	2.15	1.35	50.66
3.00	2.23	1.43	53.84
3.10	3.24	2.44	57.03
3.20	4.26	3.46	68.29
3.30	5.27	4.47	95.70
3.40	6.29	5.49	133.93
3.50	7.30	6.50	177.49
3.60	8.32	7.52	221.05
3.70	9.33	8.53	264.60
3.80	10.35	9.55	308.16
3.90	11.36	10.56	351.72
4.00	12.38	11.57	395.28
4.10	11.46	10.66	438.84
4.20	10.54	9.74	465.82
4.30	9.63	8.83	459.66
4.40	8.71	7.91	431.29
4.50	7.80	7.00	391.98
4.60	6.88	6.08	352.67
4.70	5.96	5.16	313.36
4.80	5.05	4.25	274.06
4.90	4.13	3.33	234.75
5.00	3.22	2.42	195.44
5.10	3.09	2.29	156.13
5.20	2.97	2.17	123.62
5.30	2.85	2.05	104.71
5.40	2.72	1.92	94.91
5.50	2.60	1.80	89.60
5.60	2.47	1.67	84.29
5.70	2.35	1.55	78.97
5.80	2.23	1.43	73.66
5.90	2.10	1.30	68.35
6.00	1.98	1.18	63.04
6.10	1.91	1.11	57.73
6.20	1.83	1.03	52.84
6.30	1.76	.96	48.80
6.40	1.68	.88	45.34
6.50	1.61	.81	42.15
6.60	1.53	.73	38.96
6.70	1.46	.66	35.77
6.80	1.39	.59	32.59
6.90	1.31	.51	29.40
7.00	1.24	.44	26.21
7.10	1.21	.41	23.03
7.20	1.19	.39	20.26
7.30	1.16	.36	18.35
7.40	1.14	.34	17.01
7.50	1.11	.31	15.95
7.60	1.09	.29	14.88
7.70	1.06	.26	13.82
7.80	1.04	.24	12.76
7.90	1.01	.21	11.70
8.00	.99	.19	10.63
8.10	.00	.00	9.57
8.20	.00	.00	7.09
8.30	.00	.00	3.40
8.40	.00	.00	1.08
8.50	.00	.00	.00
8.60	.00	.00	.00
8.70	.00	.00	.00
8.80	.00	.00	.00
8.90	.00	.00	.00
9.00	.00	.00	.00
9.10	.00	.00	.00
9.20	.00	.00	.00

Table B-15 (5) Flood Hydrograph at Serut (Cibanten River)

(W=1/25)

SERUT TIME	73.15MK2 RAIN	RAIN= 145.00 RAIN(EF)	Q
.20	.27	.00	.00
.40	.55	.00	.00
.60	.82	.00	.00
.80	1.09	.00	.00
1.00	1.36	.00	.00
1.20	1.42	.00	.00
1.40	1.47	.00	.00
1.60	1.53	.00	.00
1.80	1.58	.00	.00
2.00	1.64	.00	.00
2.20	1.80	.00	.00
2.40	1.96	.00	.00
2.60	2.13	.00	.00
2.80	2.29	.00	.00
3.00	2.45	.00	.00
3.20	4.69	.44	.00
3.40	6.92	5.32	2.04
3.60	9.16	7.56	28.71
3.80	11.39	9.79	90.34
4.00	13.63	12.03	197.27
4.20	11.61	10.01	356.63
4.40	9.60	8.00	523.58
4.60	7.58	5.98	672.56
4.80	5.56	3.96	777.98
5.00	3.54	1.94	814.35
5.20	3.27	1.67	786.95
5.40	3.00	1.40	709.19
5.60	2.73	1.13	595.64
5.80	2.45	.85	472.55
6.00	2.18	.58	359.24
6.20	2.02	.42	262.33
6.40	1.85	.25	188.98
6.60	1.69	.09	135.06
6.80	1.53	.00	96.50
7.00	1.36	.00	69.53
7.20	1.31	.00	50.00
7.40	1.25	.00	33.77
7.60	1.20	.00	21.29
7.80	1.14	.00	12.51
8.00	1.09	.00	6.71
8.20	.00	.00	3.16
8.40	.00	.00	1.15
8.60	.00	.00	.24
8.80	.00	.00	.00
9.00	.00	.00	.00
9.20	.00	.00	.00
9.40	.00	.00	.00
9.60	.00	.00	.00
9.80	.00	.00	.00
10.00	.00	.00	.00
10.20	.00	.00	.00
10.40	.00	.00	.00

(W=1/100)

SERUT TIME	73.15MK2 RAIN	RAIN= 175.00 RAIN(EF)	Q
.20	.33	.00	.00
.40	.66	.00	.00
.60	.99	.00	.00
.80	1.32	.00	.00
1.00	1.65	.00	.00
1.20	1.71	.00	.00
1.40	1.78	.00	.00
1.60	1.84	.00	.00
1.80	1.91	.00	.00
2.00	1.97	.00	.00
2.20	2.17	.00	.00
2.40	2.37	.00	.00
2.60	2.57	.00	.00
2.80	2.76	.00	.00
3.00	2.96	.38	.00
3.20	5.66	4.06	1.75
3.40	8.36	6.76	22.27
3.60	11.05	9.45	74.04
3.80	13.75	12.15	169.53
4.00	16.45	14.85	318.49
4.20	14.02	12.42	506.61
4.40	11.58	9.98	703.03
4.60	9.15	7.55	876.88
4.80	6.71	5.11	997.35
5.00	4.28	2.68	1033.54
5.20	3.95	2.35	991.90
5.40	3.62	2.02	889.60
5.60	3.29	1.69	752.56
5.80	2.96	1.36	604.00
6.00	2.63	1.03	467.24
6.20	2.43	.83	350.29
6.40	2.24	.64	261.76
6.60	2.04	.44	196.69
6.80	1.84	.24	150.15
7.00	1.65	.05	117.19
7.20	1.58	.00	91.89
7.40	1.51	.00	69.03
7.60	1.45	.00	49.18
7.80	1.38	.00	32.90
8.00	1.32	.00	20.76
8.20	.00	.00	12.22
8.40	.00	.00	6.41
8.60	.00	.00	2.80
8.80	.00	.00	.88
9.00	.00	.00	.12
9.20	.00	.00	.00
9.40	.00	.00	.00
9.60	.00	.00	.00
9.80	.00	.00	.00
10.00	.00	.00	.00
10.20	.00	.00	.00
10.40	.00	.00	.00

(W=1/200)

SERUT TIME	73.15MK2 RAIN	RAIN= 185.00 RAIN(EF)	Q
.20	.35	.00	.00
.40	.70	.00	.00
.60	1.04	.00	.00
.80	1.39	.00	.00
1.00	1.74	.00	.00
1.20	1.81	.00	.00
1.40	1.88	.00	.00
1.60	1.95	.00	.00
1.80	2.02	.00	.00
2.00	2.09	.00	.00
2.20	2.30	.00	.00
2.40	2.50	.00	.00
2.60	2.71	.00	.00
2.80	2.92	.00	.00
3.00	3.13	1.53	.00
3.20	5.98	4.38	7.08
3.40	8.83	7.23	34.42
3.60	11.69	10.09	95.22
3.80	14.54	12.94	202.67
4.00	17.39	15.79	358.84
4.20	14.82	13.22	556.17
4.40	12.24	10.64	762.03
4.60	9.67	8.07	943.81
4.80	7.10	5.50	1068.90
5.00	4.52	2.92	1104.65
5.20	4.17	2.57	1057.88
5.40	3.83	2.23	949.73
5.60	3.48	1.88	804.86
5.80	3.13	1.53	647.82
6.00	2.78	1.18	503.25
6.20	2.57	.97	379.61
6.40	2.37	.77	286.02
6.60	2.16	.56	217.23
6.80	1.95	.35	168.03
7.00	1.74	.14	133.19
7.20	1.67	.07	106.44
7.40	1.60	.00	82.17
7.60	1.53	.00	60.66
7.80	1.46	.00	42.51
8.00	1.39	.00	28.31
8.20	.00	.00	17.65
8.40	.00	.00	10.11
8.60	.00	.00	5.15
8.80	.00	.00	2.21
9.00	.00	.00	.74
9.20	.00	.00	.18
9.40	.00	.00	.00
9.60	.00	.00	.00
9.80	.00	.00	.00
10.00	.00	.00	.00
10.20	.00	.00	.00
10.40	.00	.00	.00

Table B-15 (6) Flood Hydrograph at Krenceng Reservoir

(w=1/25)

CIDANAU/CILEGON	13.30MK2		RAIN= 120.00
TIME	RAIN	RAIN(EF)	Q
.10	.06	.00	.00
.20	.12	.00	.00
.30	.18	.00	.00
.40	.24	.00	.00
.50	.30	.00	.00
.60	.36	.00	.00
.70	.42	.00	.00
.80	.48	.00	.00
.90	.53	.00	.00
1.00	.59	.00	.00
1.10	.61	.00	.00
1.20	.62	.00	.00
1.30	.63	.00	.00
1.40	.64	.00	.00
1.50	.65	.00	.00
1.60	.67	.00	.00
1.70	.68	.00	.00
1.80	.69	.00	.00
1.90	.70	.00	.00
2.00	.71	.00	.00
2.10	.75	.00	.00
2.20	.78	.00	.00
2.30	.82	.00	.00
2.40	.86	.00	.00
2.50	.89	.00	.00
2.60	.93	.00	.00
2.70	.96	.00	.00
2.80	1.00	.00	.00
2.90	1.03	.00	.00
3.00	1.07	.00	.00
3.10	1.56	.00	.00
3.20	2.04	.00	.00
3.30	2.53	.00	.00
3.40	3.02	2.22	.00
3.50	3.50	2.70	6.76
3.60	3.99	3.19	21.98
3.70	4.48	3.68	28.52
3.80	4.97	4.17	49.87
3.90	5.45	4.65	70.71
4.00	5.94	5.14	90.16
4.10	5.50	4.70	107.31
4.20	5.06	4.26	118.44
4.30	4.62	3.82	123.83
4.40	4.18	3.38	128.36
4.50	3.74	2.94	126.04
4.60	3.30	2.50	118.59
4.70	2.86	2.06	107.71
4.80	2.42	1.62	95.12
4.90	1.98	1.18	82.53
5.00	1.54	.74	69.94
5.10	1.48	.68	57.35
5.20	1.43	.63	45.92
5.30	1.37	.57	36.84
5.40	1.31	.51	28.11
5.50	1.25	.45	22.20
5.60	1.19	.39	18.39
5.70	1.13	.33	15.98
5.80	1.07	.27	14.28
5.90	1.01	.21	12.58
6.00	.95	.15	10.88
6.10	.91	.11	9.18
6.20	.88	.08	7.55
6.30	.84	.04	6.07
6.40	.81	.01	4.61
6.50	.77	.00	3.32
6.60	.74	.00	2.25
6.70	.70	.00	1.47
6.80	.67	.00	.80
6.90	.63	.00	.35
7.00	.59	.00	.11
7.10	.58	.00	.01
7.20	.57	.00	.00
7.30	.56	.00	.00
7.40	.55	.00	.00
7.50	.53	.00	.00
7.60	.52	.00	.00
7.70	.51	.00	.00
7.80	.50	.00	.00
7.90	.49	.00	.00
8.00	.48	.00	.00
8.10	.00	.00	.00
8.20	.00	.00	.00
8.30	.00	.00	.00
8.40	.00	.00	.00
8.50	.00	.00	.00
8.60	.00	.00	.00
8.70	.00	.00	.00
8.80	.00	.00	.00
8.90	.00	.00	.00
9.00	.00	.00	.00
9.10	.00	.00	.00
9.20	.00	.00	.00

(w=1/100)

CIDANAU/CILEGON	13.30MK2		RAIN= 154.00
TIME	RAIN	RAIN(EF)	Q
.10	.08	.00	.00
.20	.15	.00	.00
.30	.23	.00	.00
.40	.30	.00	.00
.50	.38	.00	.00
.60	.46	.00	.00
.70	.53	.00	.00
.80	.61	.00	.00
.90	.69	.00	.00
1.00	.76	.00	.00
1.10	.78	.00	.00
1.20	.79	.00	.00
1.30	.81	.00	.00
1.40	.82	.00	.00
1.50	.84	.00	.00
1.60	.85	.00	.00
1.70	.87	.00	.00
1.80	.88	.00	.00
1.90	.90	.00	.00
2.00	.91	.00	.00
2.10	.96	.00	.00
2.20	1.01	.00	.00
2.30	1.05	.00	.00
2.40	1.10	.00	.00
2.50	1.14	.00	.00
2.60	1.19	.00	.00
2.70	1.23	.00	.00
2.80	1.28	.00	.00
2.90	1.33	.00	.00
3.00	1.37	.00	.00
3.10	2.00	.51	.00
3.20	2.62	1.82	1.57
3.30	3.25	2.45	8.74
3.40	3.87	3.07	19.22
3.50	4.50	3.70	30.01
3.60	5.12	4.32	48.88
3.70	5.75	4.95	69.01
3.80	6.37	5.57	89.23
3.90	7.00	6.20	108.40
4.00	7.62	6.82	126.30
4.10	7.06	6.26	144.21
4.20	6.49	5.69	158.49
4.30	5.93	5.13	165.40
4.40	5.37	4.57	171.22
4.50	4.80	4.00	168.25
4.60	4.24	3.44	158.68
4.70	3.67	2.87	144.72
4.80	3.11	2.31	128.56
4.90	2.55	1.75	112.41
5.00	1.98	1.18	96.25
5.10	1.91	1.11	80.09
5.20	1.83	1.03	65.42
5.30	1.75	.95	53.77
5.40	1.68	.88	42.57
5.50	1.60	.80	34.98
5.60	1.52	.72	30.09
5.70	1.45	.65	27.00
5.80	1.37	.57	24.82
5.90	1.30	.50	22.64
6.00	1.22	.42	20.45
6.10	1.17	.37	18.27
6.20	1.13	.33	16.18
6.30	1.08	.28	14.28
6.40	1.04	.24	12.40
6.50	.99	.19	10.75
6.60	.95	.15	9.28
6.70	.90	.10	7.91
6.80	.85	.05	6.60
6.90	.81	.01	5.29
7.00	.76	.00	3.98
7.10	.75	.00	2.78
7.20	.73	.00	1.85
7.30	.72	.00	.99
7.40	.70	.00	.43
7.50	.69	.00	.13
7.60	.67	.00	.01
7.70	.66	.00	.00
7.80	.64	.00	.00
7.90	.63	.00	.00
8.00	.61	.00	.00
8.10	.00	.00	.00
8.20	.00	.00	.00
8.30	.00	.00	.00
8.40	.00	.00	.00
8.50	.00	.00	.00
8.60	.00	.00	.00
8.70	.00	.00	.00
8.80	.00	.00	.00
8.90	.00	.00	.00
9.00	.00	.00	.00
9.10	.00	.00	.00
9.20	.00	.00	.00

(w=1/200)

CIDANAU/CILEGON	13.30MK2		RAIN= 167.00
TIME	RAIN	RAIN(EF)	Q
.10	.08	.00	.00
.20	.17	.00	.00
.30	.25	.00	.00
.40	.33	.00	.00
.50	.41	.00	.00
.60	.50	.00	.00
.70	.58	.00	.00
.80	.66	.00	.00
.90	.74	.00	.00
1.00	.83	.00	.00
1.10	.84	.00	.00
1.20	.86	.00	.00
1.30	.88	.00	.00
1.40	.89	.00	.00
1.50	.91	.00	.00
1.60	.93	.00	.00
1.70	.94	.00	.00
1.80	.96	.00	.00
1.90	.98	.00	.00
2.00	.99	.00	.00
2.10	1.04	.00	.00
2.20	1.09	.00	.00
2.30	1.14	.00	.00
2.40	1.19	.00	.00
2.50	1.24	.00	.00
2.60	1.29	.00	.00
2.70	1.34	.00	.00
2.80	1.39	.00	.00
2.90	1.44	.00	.00
3.00	1.49	.57	.00
3.10	2.17	1.37	1.74
3.20	2.84	2.04	7.69
3.30	3.52	2.72	15.21
3.40	4.20	3.40	26.43
3.50	4.88	4.08	42.36
3.60	5.56	4.76	60.78
3.70	6.23	5.43	80.43
3.80	6.91	6.11	100.07
3.90	7.59	6.79	119.48
4.00	8.27	7.47	138.90
4.10	7.65	6.85	158.31
4.20	7.04	6.24	173.80
4.30	6.43	5.63	181.30
4.40	5.82	5.02	187.61
4.50	5.21	4.41	184.39
4.60	4.60	3.80	174.01
4.70	3.98	3.18	158.87
4.80	3.37	2.57	141.35
4.90	2.76	1.96	123.83
5.00	2.15	1.35	106.31
5.10	2.07	1.27	88.78
5.20	1.98	1.18	72.88
5.30	1.90	1.10	60.24
5.40	1.82	1.02	48.10
5.50	1.74	.94	39.86
5.60	1.65	.85	34.56
5.70	1.57	.77	31.22
5.80	1.49	.69	28.85
5.90	1.41	.61	26.48
6.00	1.32	.52	24.11
6.10	1.27	.47	21.75
6.20	1.22	.42	19.48
6.30	1.17	.37	17.42
6.40	1.12	.32	15.38
6.50	1.07	.27	13.60
6.60	1.03	.23	11.99
6.70	.98	.18	10.51
6.80	.93	.13	9.09
6.90	.88	.08	7.67
7.00	.83	.03	6.25
7.10	.81	.01	4.83
7.20	.79	.00	3.51
7.30	.78	.00	2.41
7.40	.76	.00	1.42
7.50	.74	.00	.74
7.60	.73	.00	.30
7.70	.71	.00	.09
7.80	.69	.00	.02
7.90	.68	.00	.00
8.00	.66	.00	.00
8.10	.00	.00	.00
8.20	.00	.00	.00
8.30	.00	.00	.00
8.40	.00	.00	.00
8.50	.00	.00	.00
8.60	.00	.00	.00
8.70	.00	.00	.00
8.80	.00	.00	.00
8.90	.00	.00	.00
9.00	.00	.00	.00
9.10	.00	.00	.00
9.20	.00	.00	.00

Table B-16 Results of Sediment Sampling (Suspended Load)

Serut (Cibanten)

Date	Sediment (mg/ ℓ)	Discharge (m^3/s)
13/2/'91	401.81	14.2
18/2/'91	433.98	27.1
20/2/'91	48.93	6.8
26/2/'91	34.69	6.2
27/2/'91	34.78	4.7

Kubang Baros (Cidanau)

Date	Sediment (mg/ ℓ)	Discharge (m^3/s)	* Remark
12/2/'91	34.60	31.1	29.10
14/2/'91	151.04	35.9	33.20
19/2/'91	28.59	57.9	22.18
21/2/'91	44.31	50.0	16.98
25/2/'91	17.23	27.0	25.71
27/2/'91	87.85	24.2	19.04

* Sediment at Proposed downstream Dam Site

Table B-17 Annual Suspended Sediment Discharge

unit:103m^3

Year	Kubang Baros	Serut
1980	157.070	13.814
81	240.287	91.968
82	28.421	39.898
83	57.300	278.106
84	51.501	118.343
85	14.397	5.413
86	39.792	20.970
87	28.460	6.238
88	202.325	20.274
89	75.003	5.453
90	7.025	5.237
Average	82.871	55.065

calculated conditions $\lambda = 0.4$

$\sigma = 2.4$

Table B-18 Reservoir Sedimentation

River	Reservoir Point	Catchment Area (km^2)	Trap Efficiency	Specific Sediment (m^3/year/km^2)	Period year	Sediment Volume (m^3)
Cibanten	Serut	73.15	1.0	900	100	6,600,000
Cidanau	Downstream site	208.25	0.2	500	100	2,800,000
Anyer	Krenceng	13.3	1.0	900	100	1,200,000

FIGURES

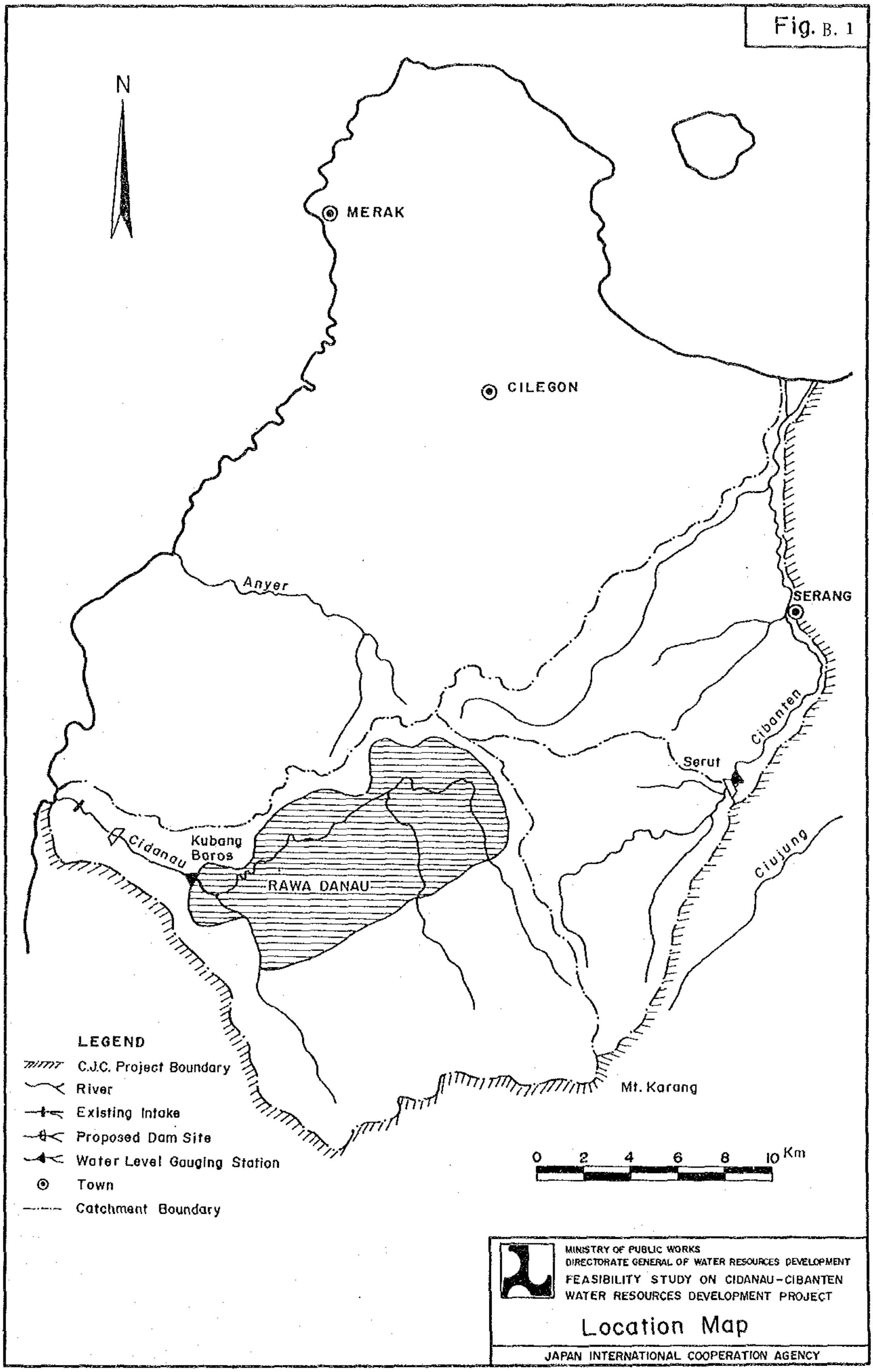

Fig. B. 1
N
MERAK
CILEGON
Anyer
SERANG
Cibanten
Serut
Cidanau
Kubang
Baros
RAWA DANAU
Ciujung
Mt. Karang
LEGEND
C.J.C. Project Boundary
River
Existing Intake
Proposed Dam Site
Water Level Gauging Station
Town
Catchment Boundary
0 2 4 6 8 10 Km
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FEASIBILITY STUDY ON CIDANAU-CIBANTEN
WATER RESOURCES DEVELOPMENT PROJECT
Location Map
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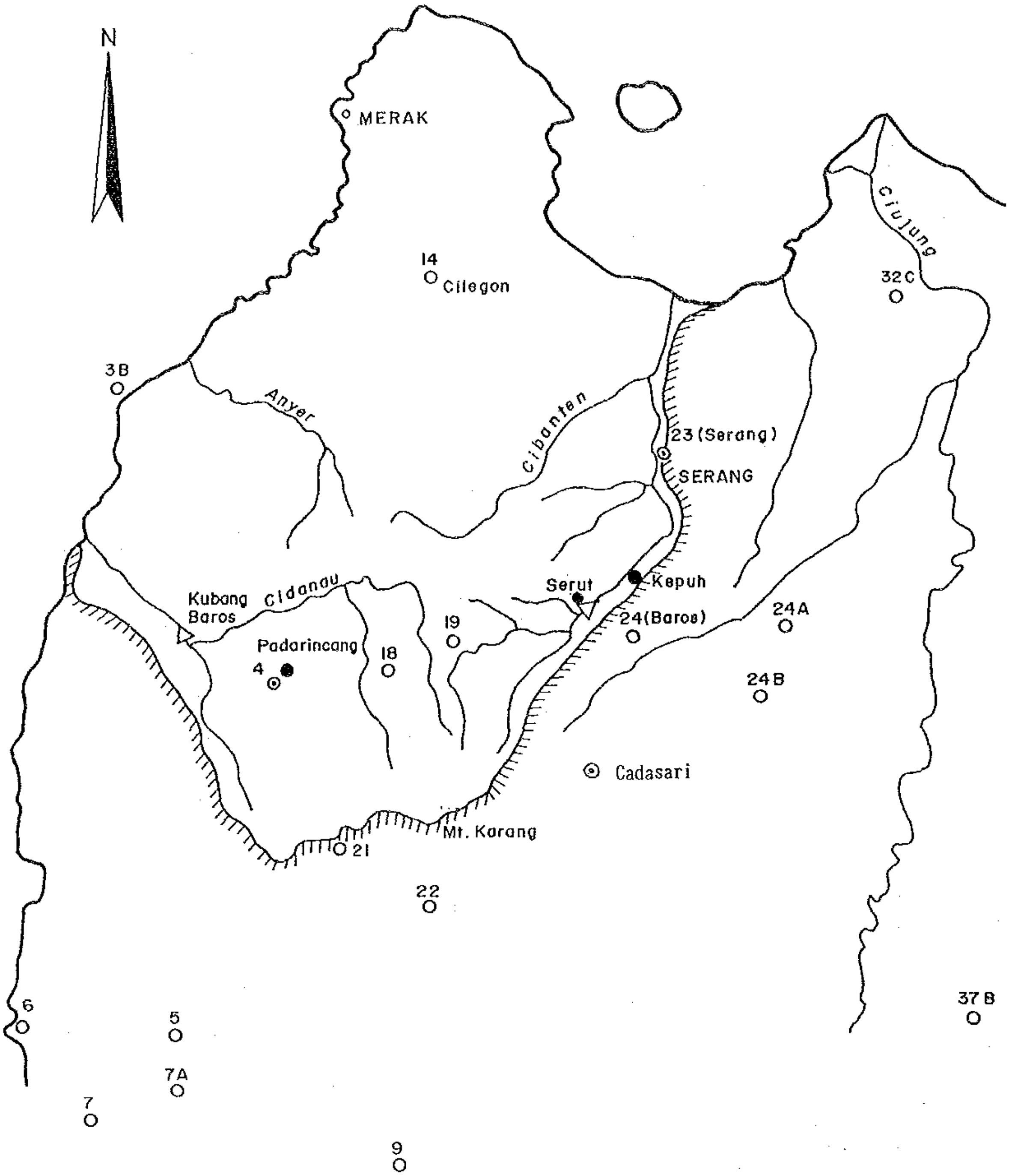
Fig. B.2



LEGEND

● : Rain gauge (P3SA)
○ : Rain gauge (PGM)
▽ : Water level gauging station
⊙ : Meteorological Observation station

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Location of Meteorological and Hydrological Station

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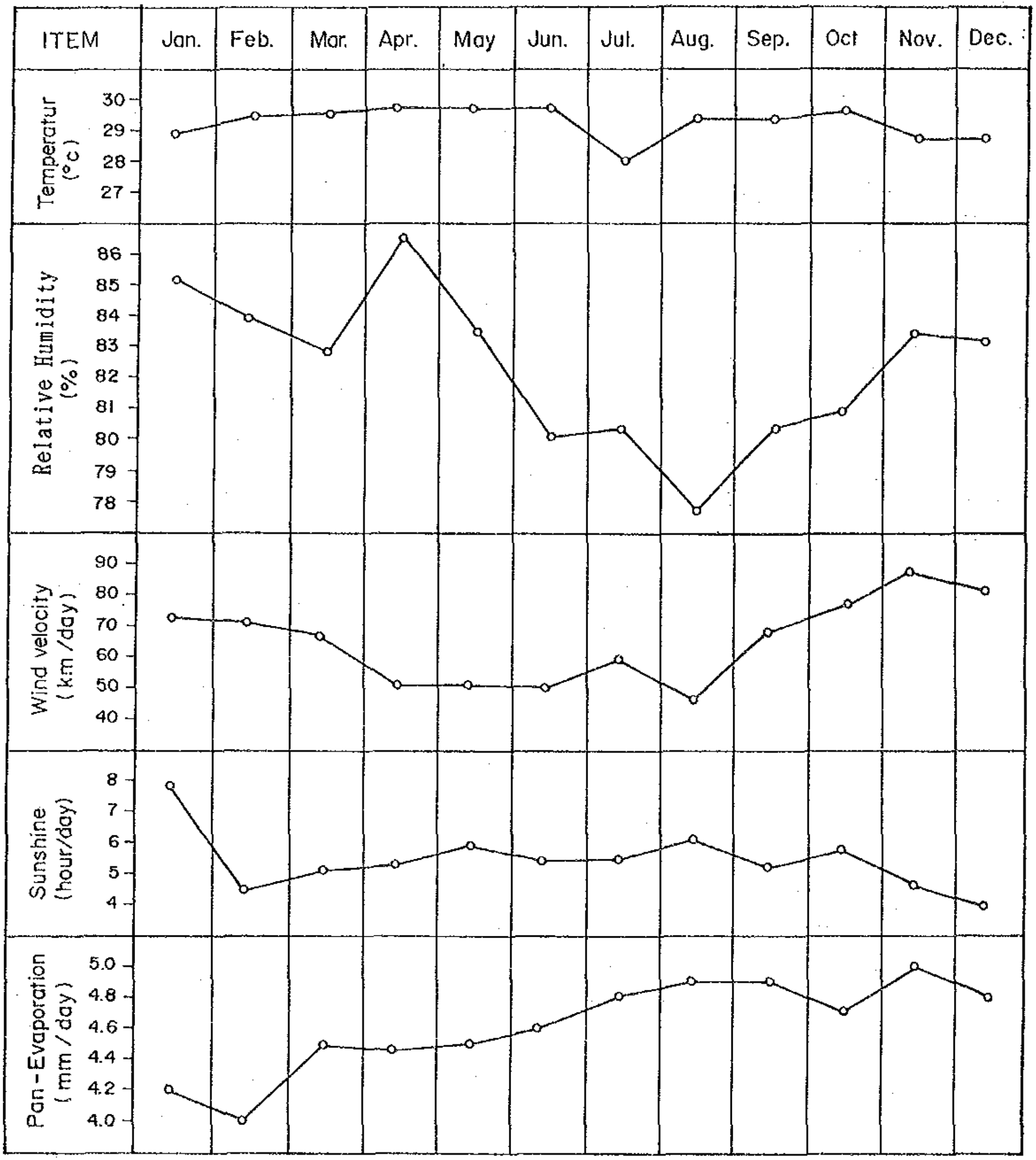
Fig. B.3



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Meteorological Feauture in Serang

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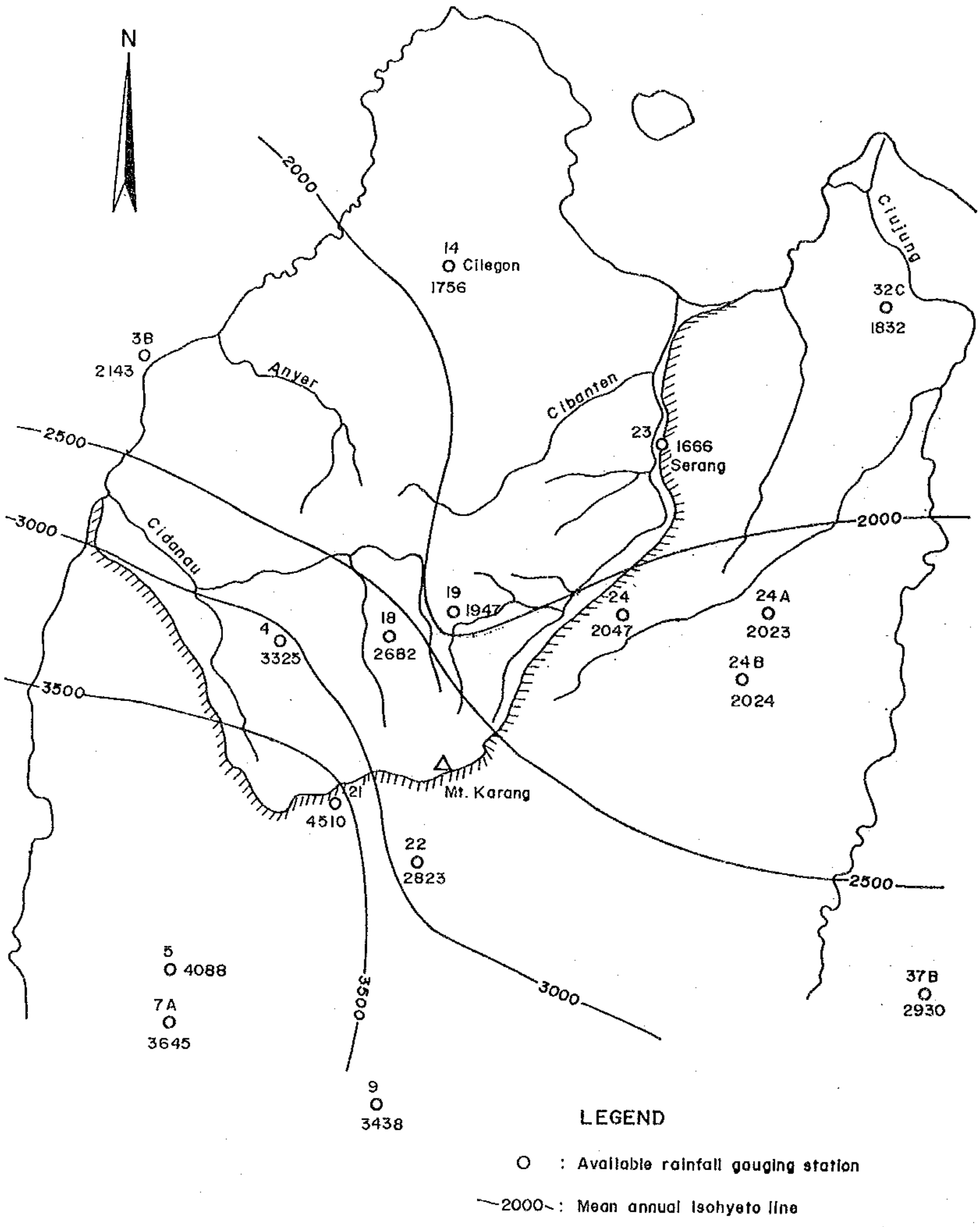
Fig. B.4



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Annual Isohyetal Map

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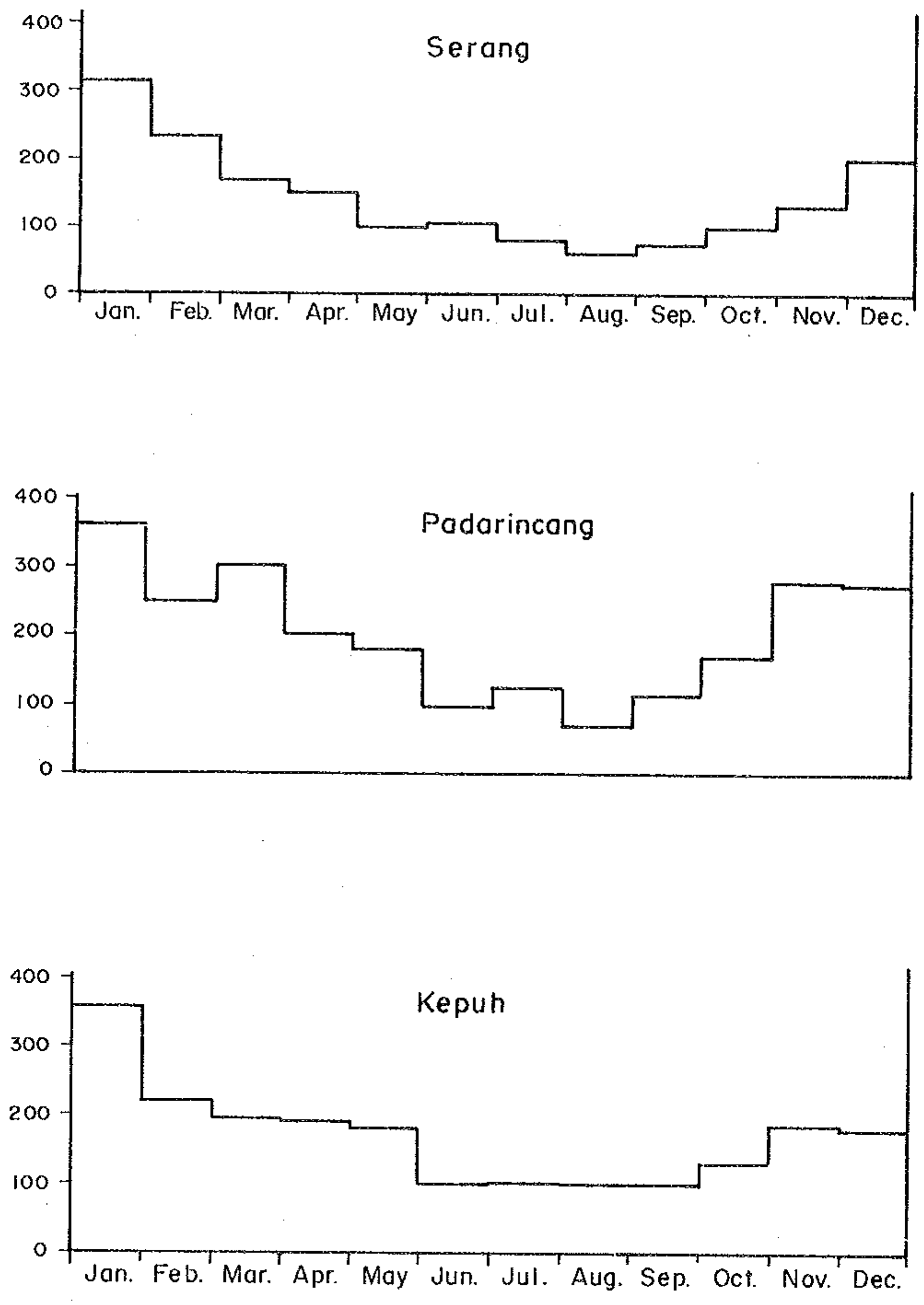
Fig. B. 5



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Monthly Pattern of Rainfall

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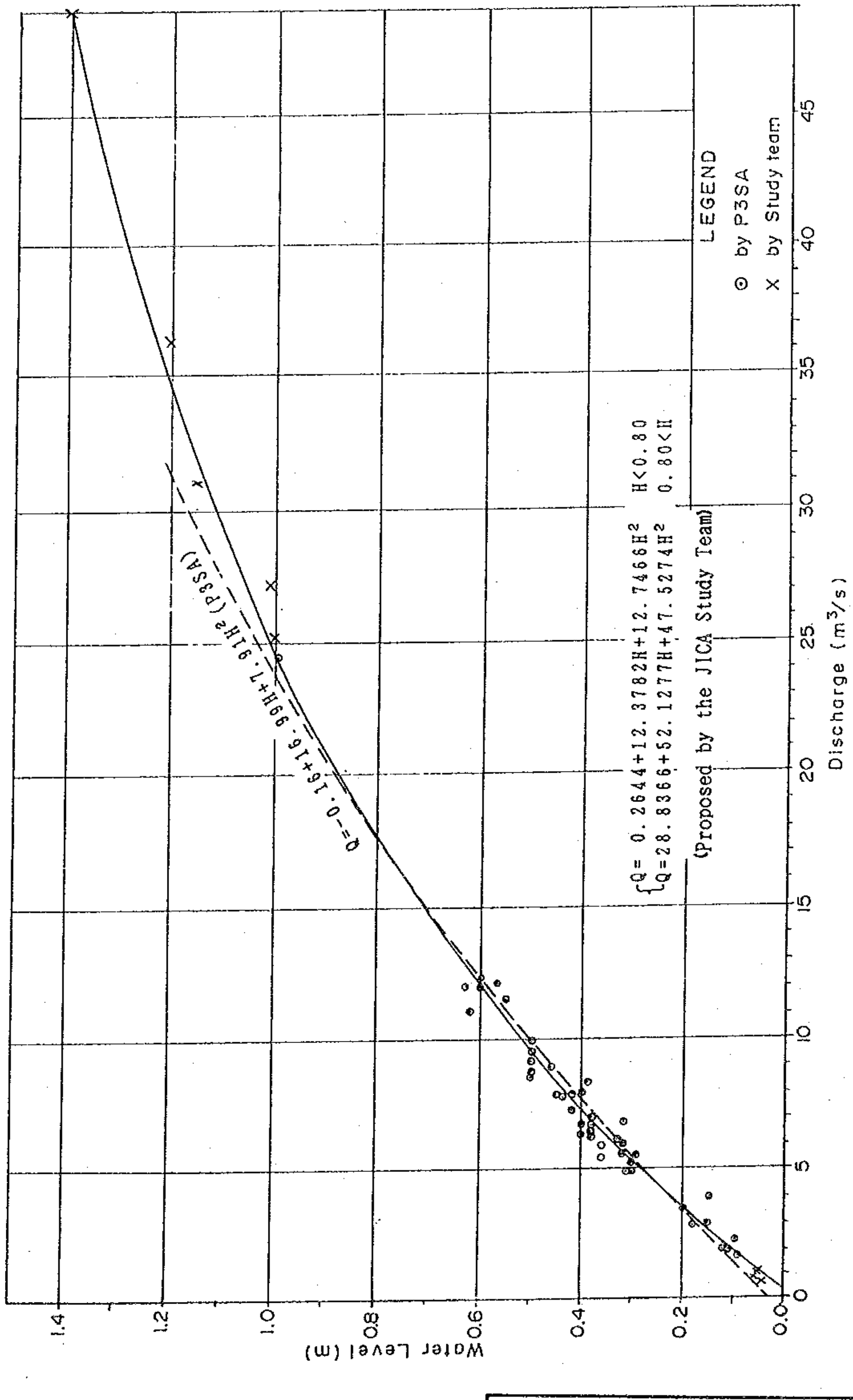
Fig. B.6



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Revised Rating Discharge Curve at Kubang Baros (Cidanau)

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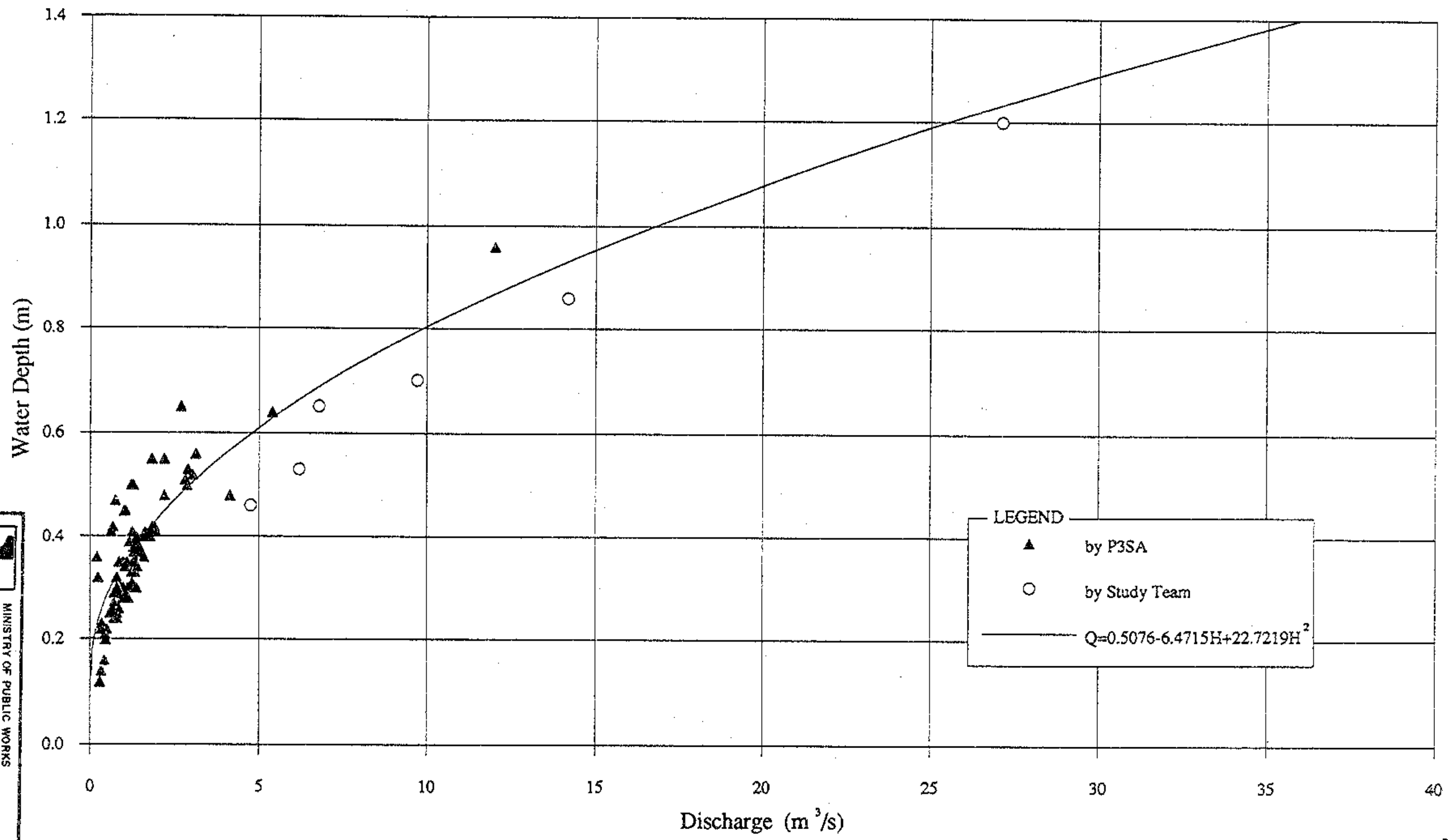
Fig. B-7



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WATER RESOURCES DEVELOPMENT PROJECT

Revised Rating Discharge Curve at Serut

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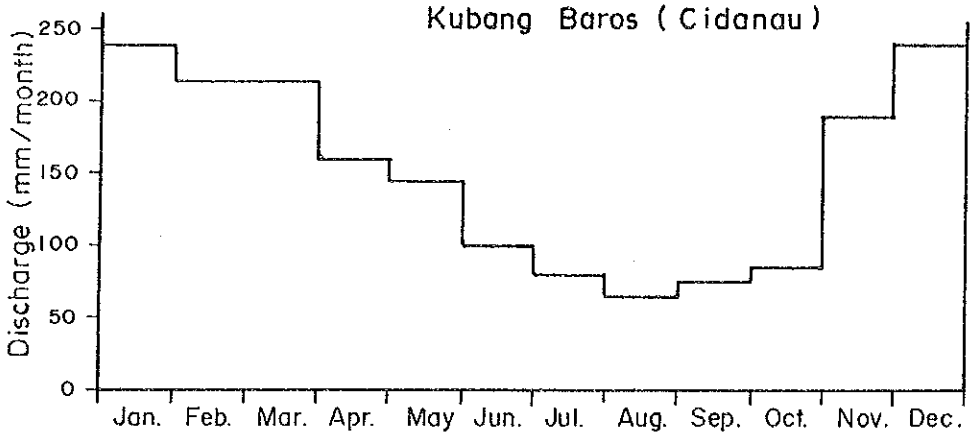
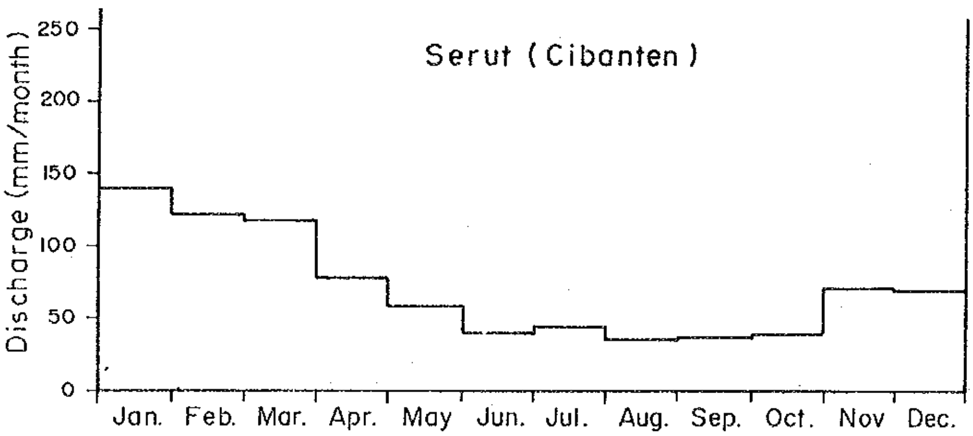
Fig. B. 8





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Monthly Mean Discharge

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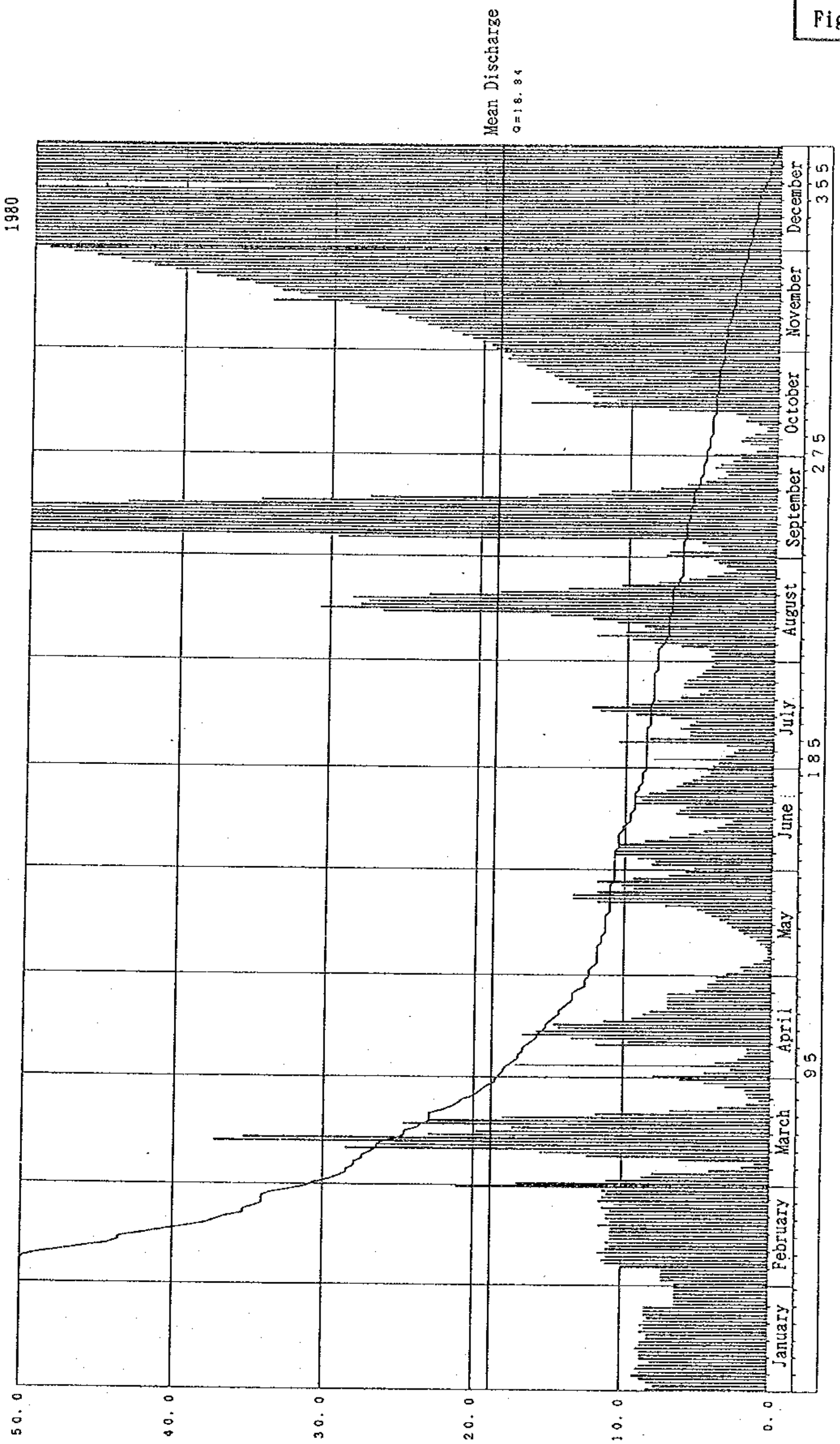
Fig.B. 9(1)



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Flow Duration Curve
at Kubang Baros

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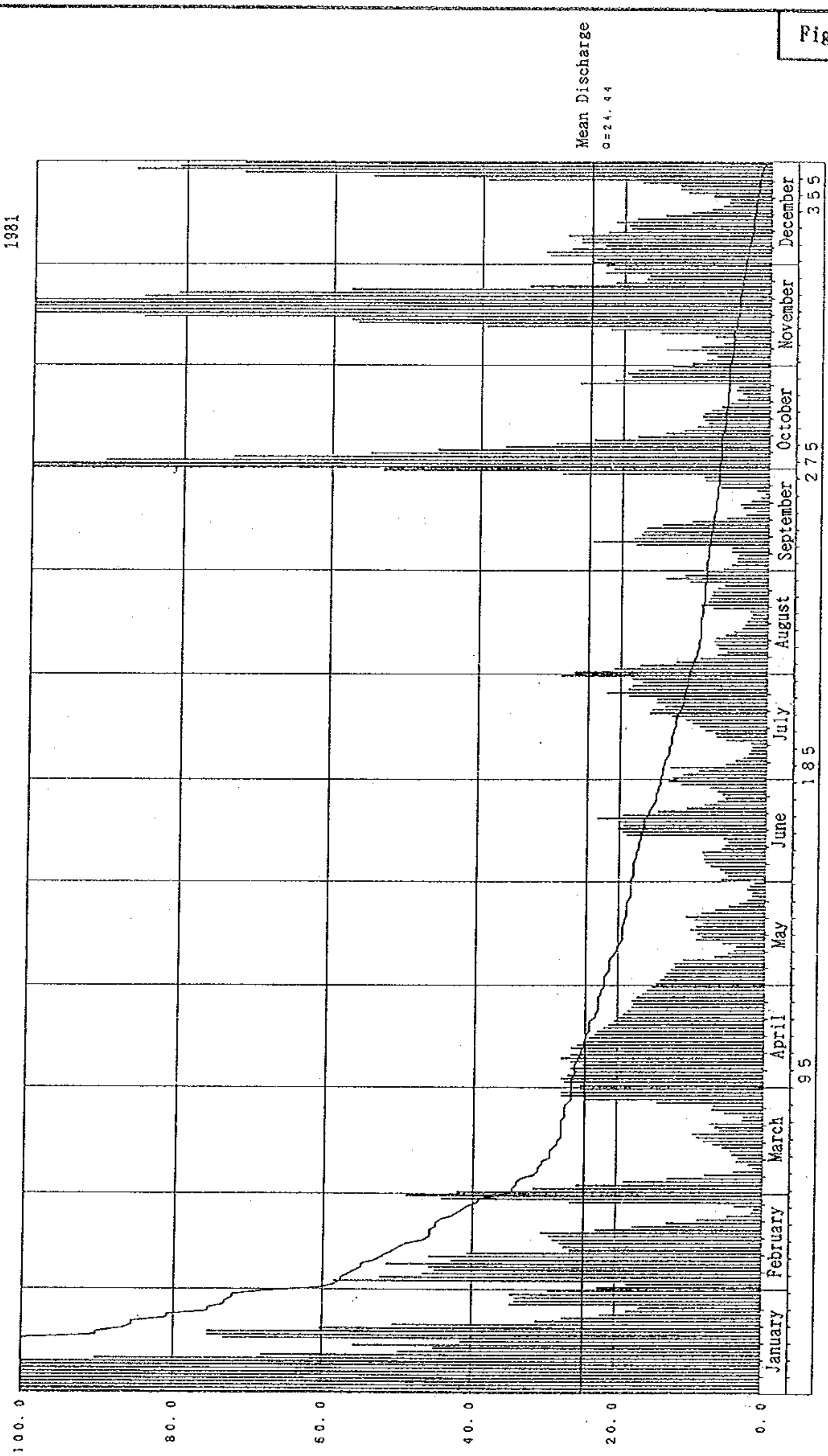
Fig. B. 9(2)



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Flow Duration Curve
at Kubang Baros

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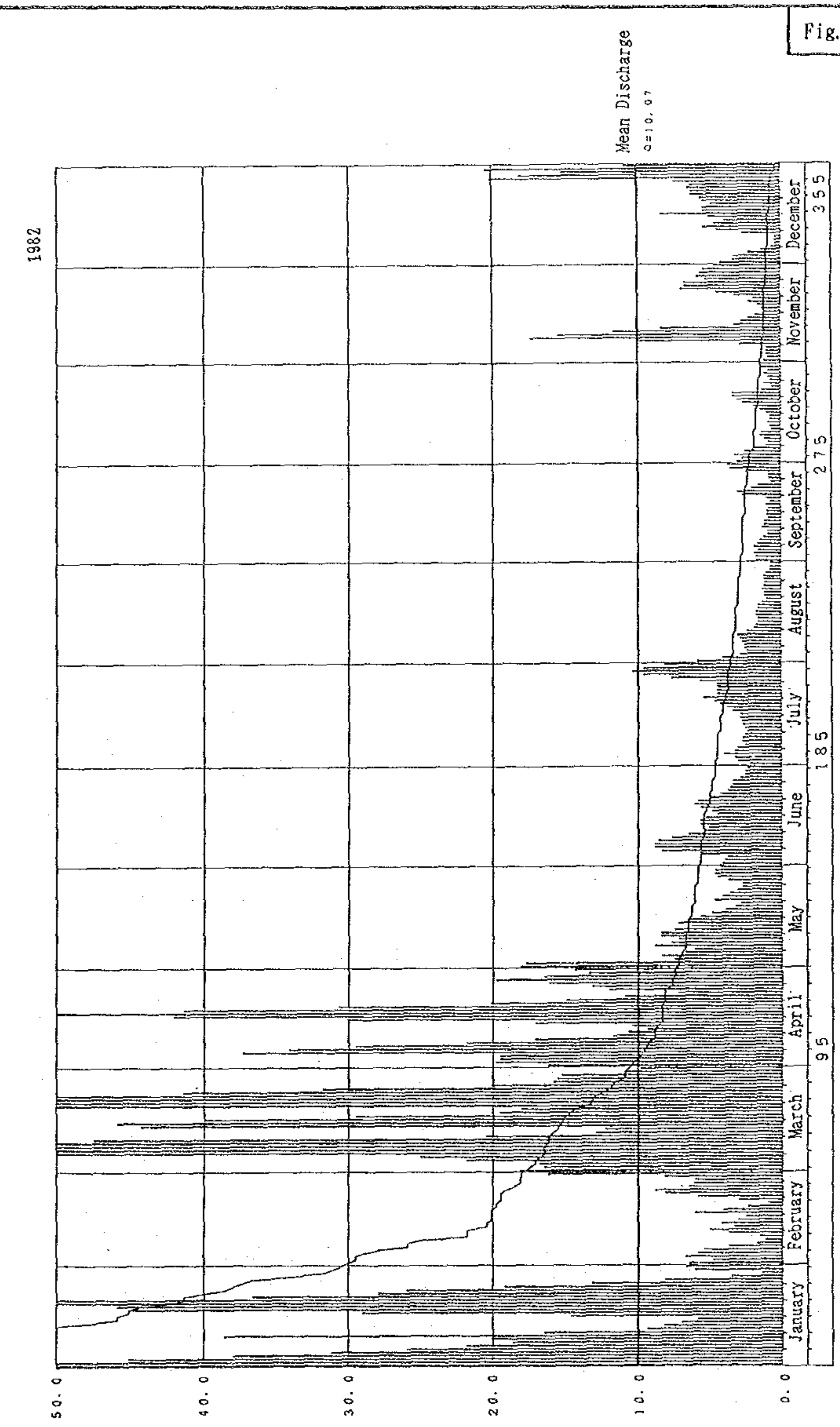
Fig. B. 9(3)



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Flow Duration Curve at Kubang Baros

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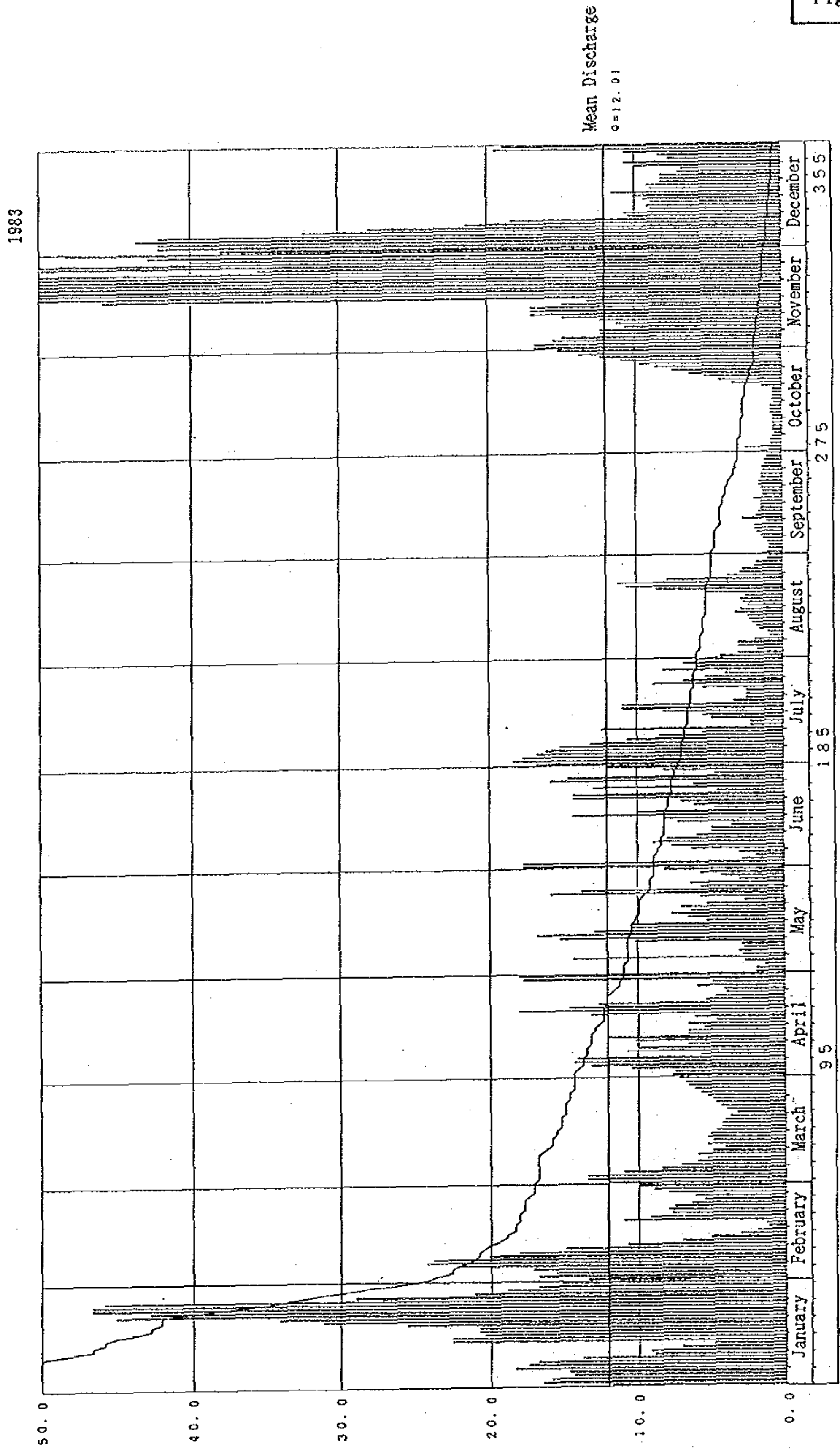
Fig. B. 9(4)



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at Kubang Baros

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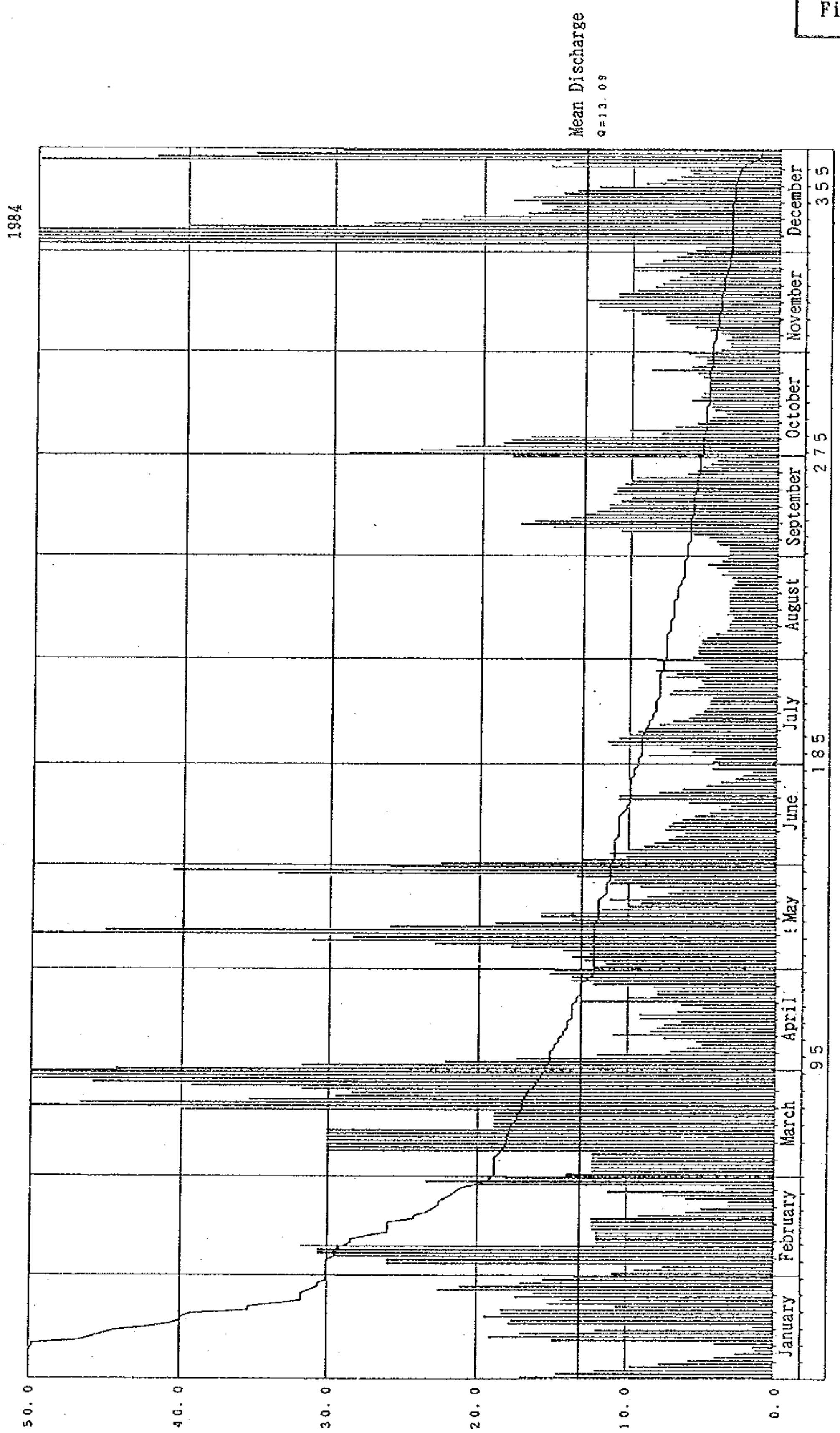
Fig. B. 9(5)



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Flow Duration Curve at Kubang Baros

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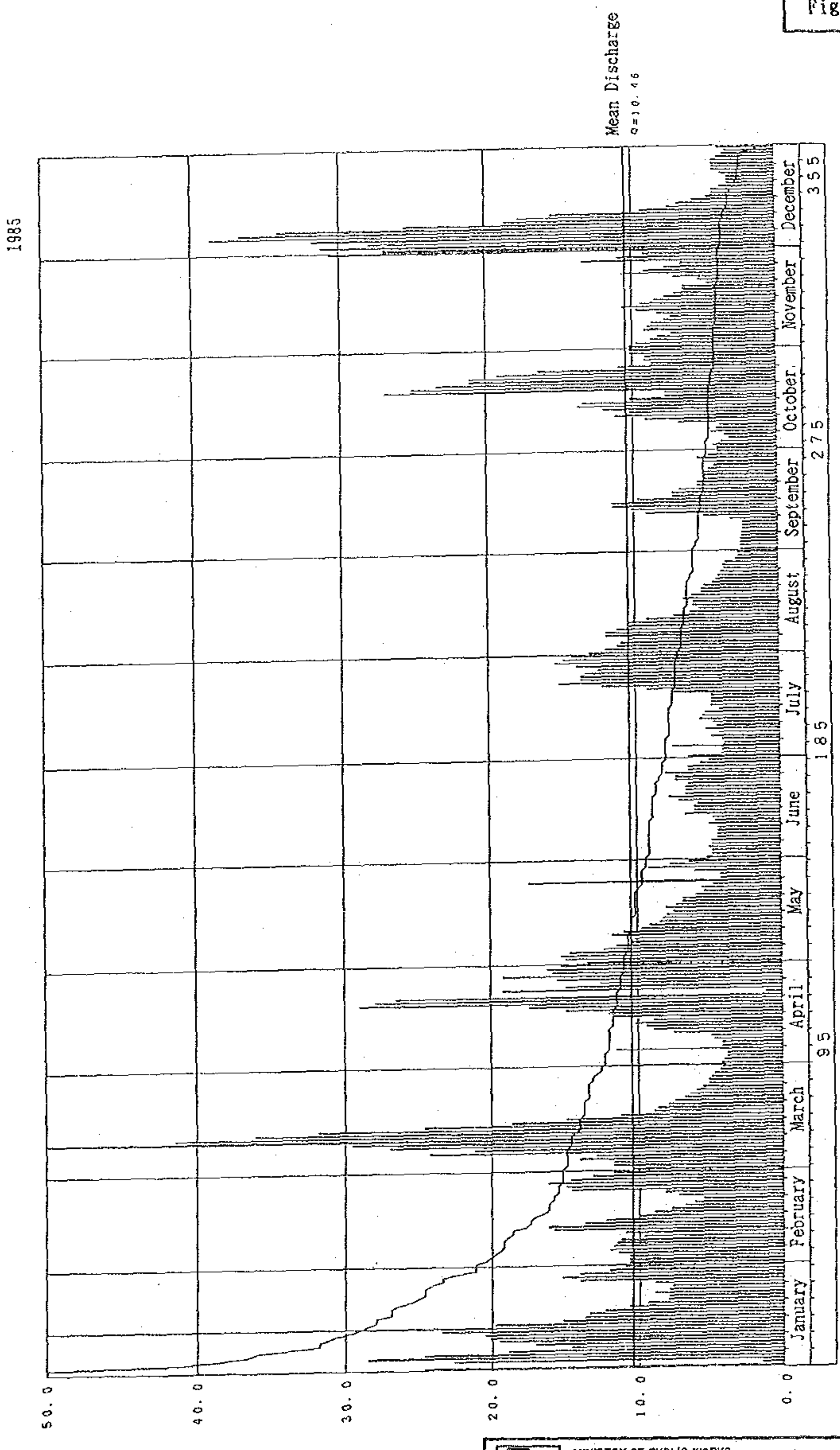
Fig.B.9(6)



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at Kubang Baros

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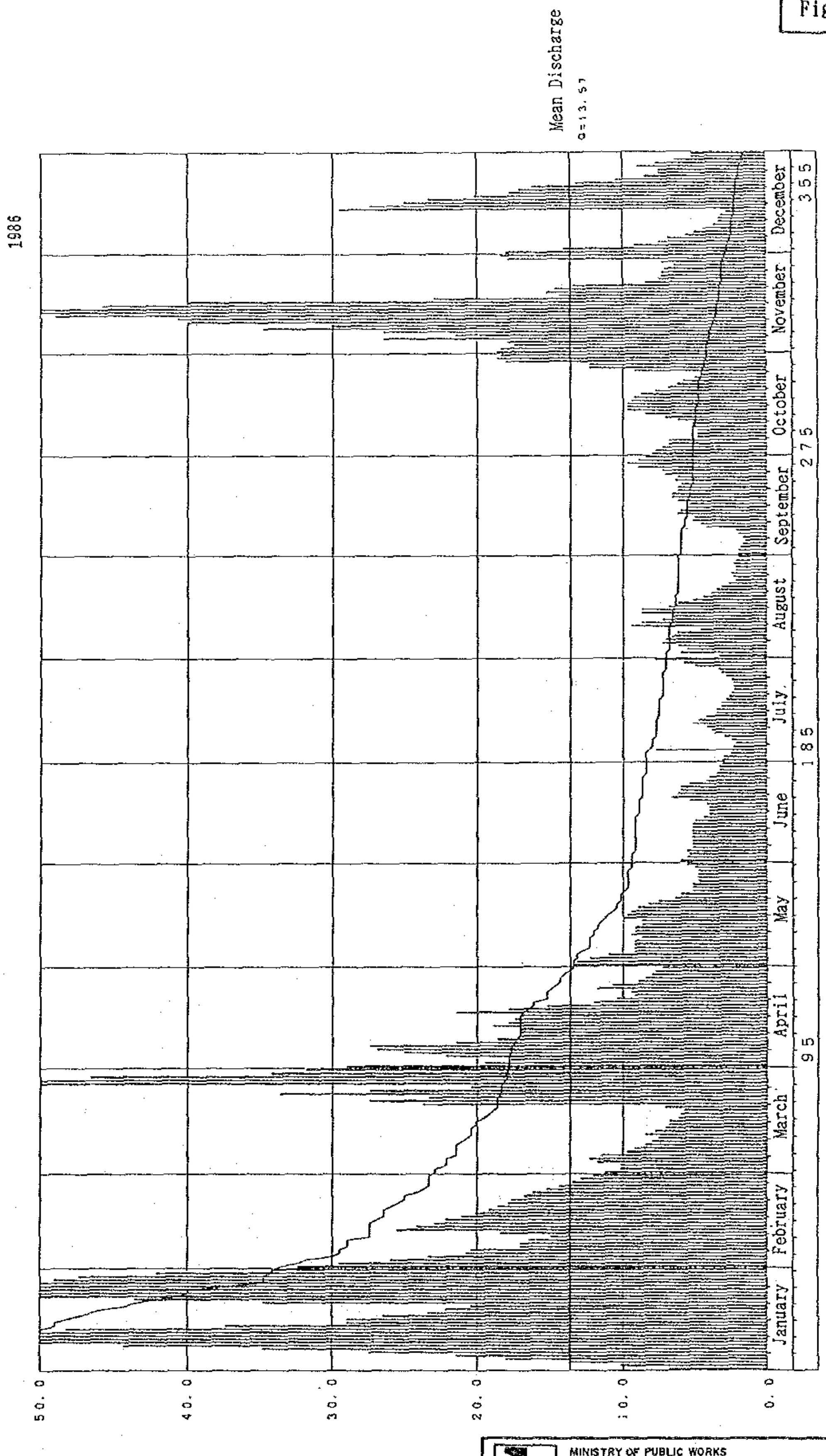
Fig.B.9(7)



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Flow Duration Curve
at Kubang Baros

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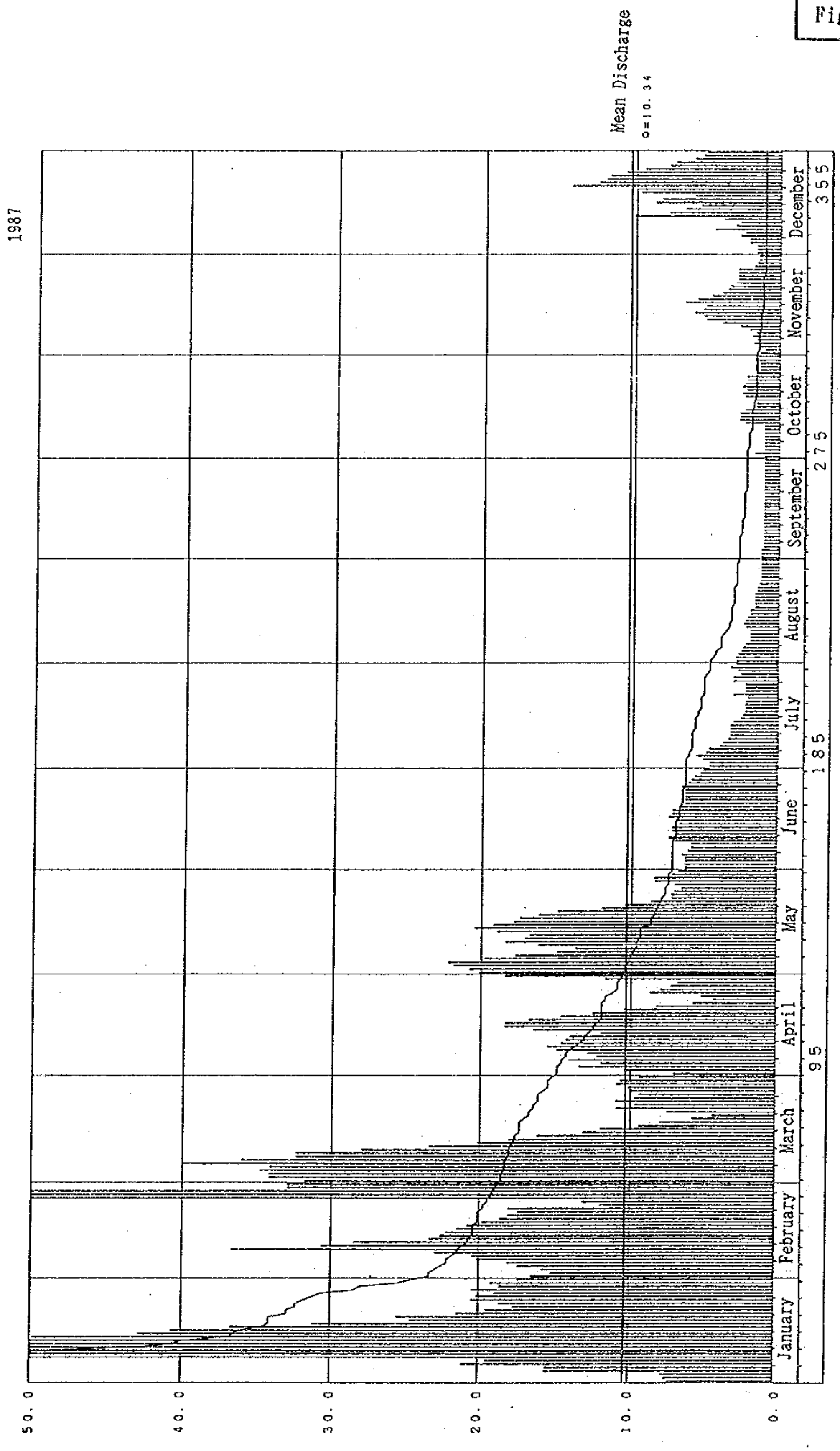
Fig. B. 9(8)



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Flow Duration Curve at Kubang Baros

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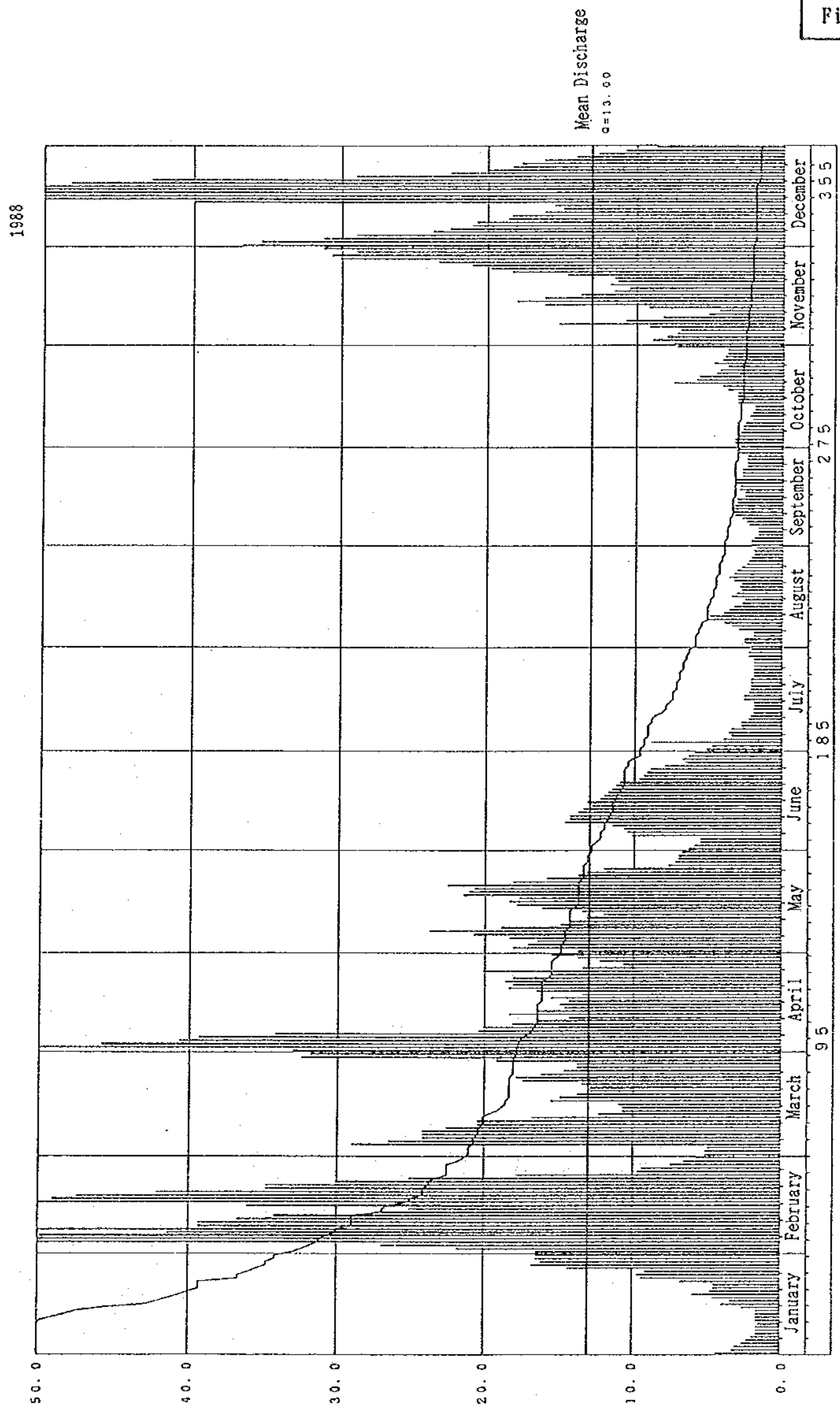
Fig.B.9(9)



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Flow Duration Curve
at Kubang Baros

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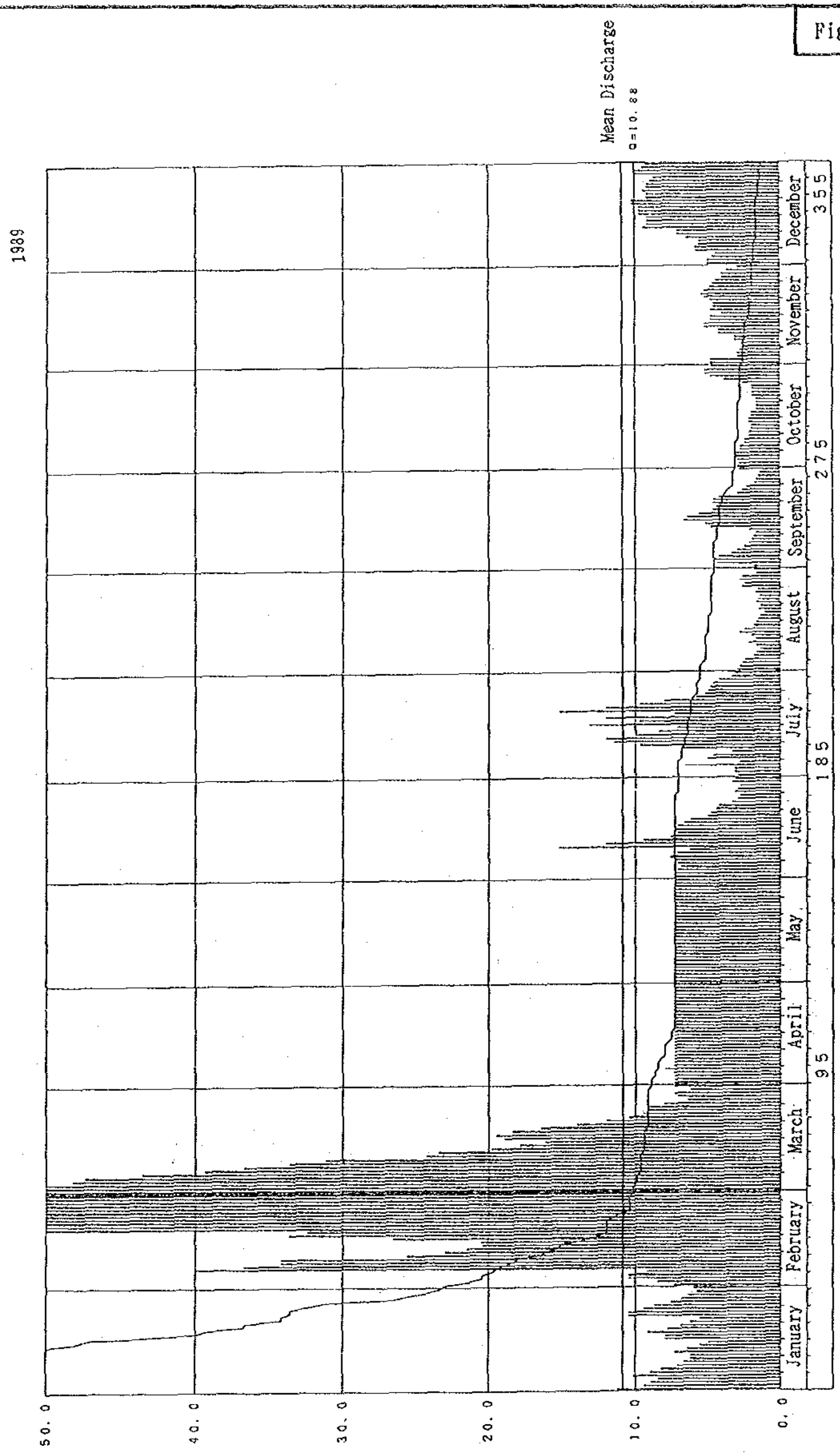
Fig.B.9(10)



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Flow Duration Curve at Kubang Baros

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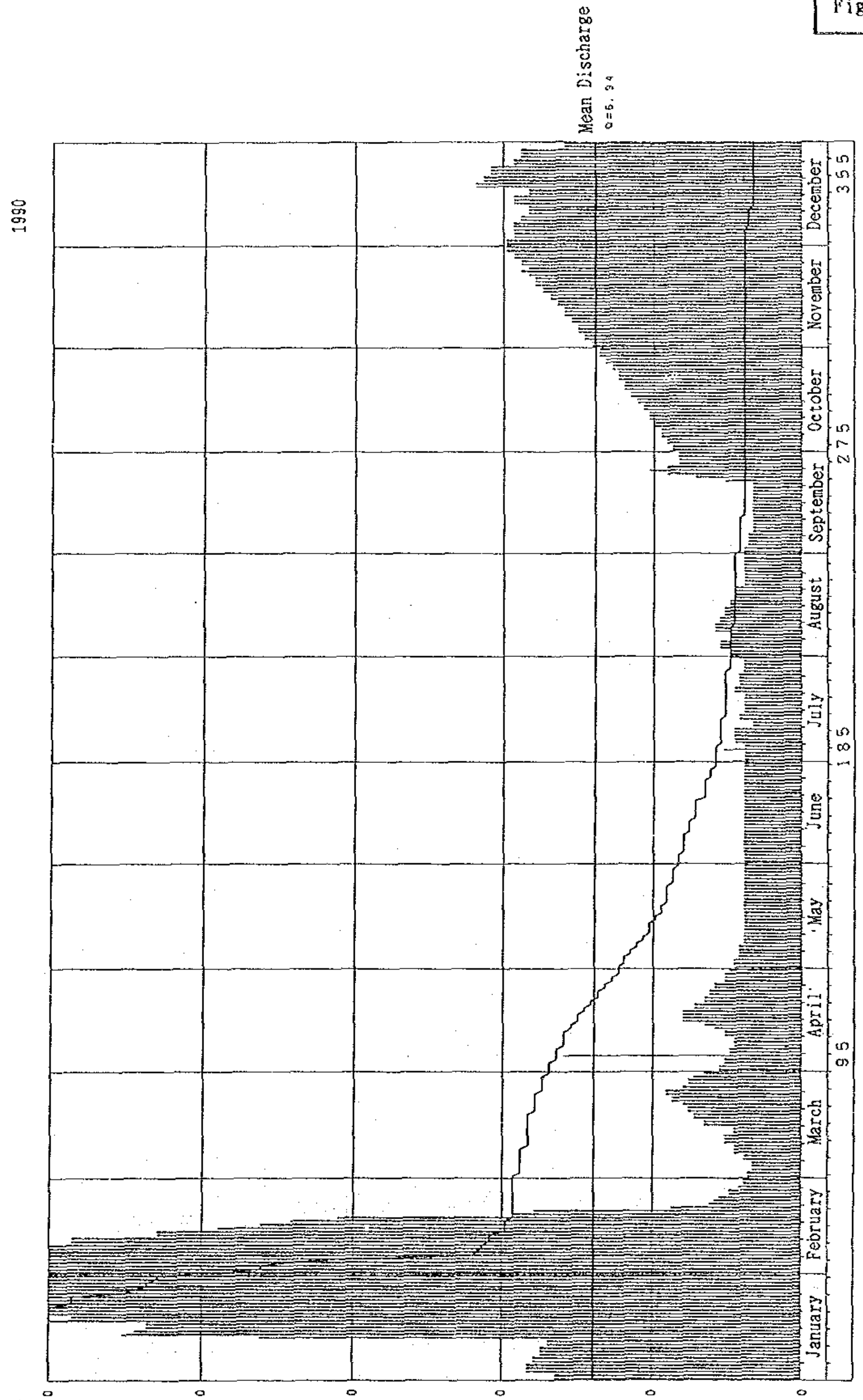
Fig.B.9(11)



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Flow Duration Curve at Kubang Baros

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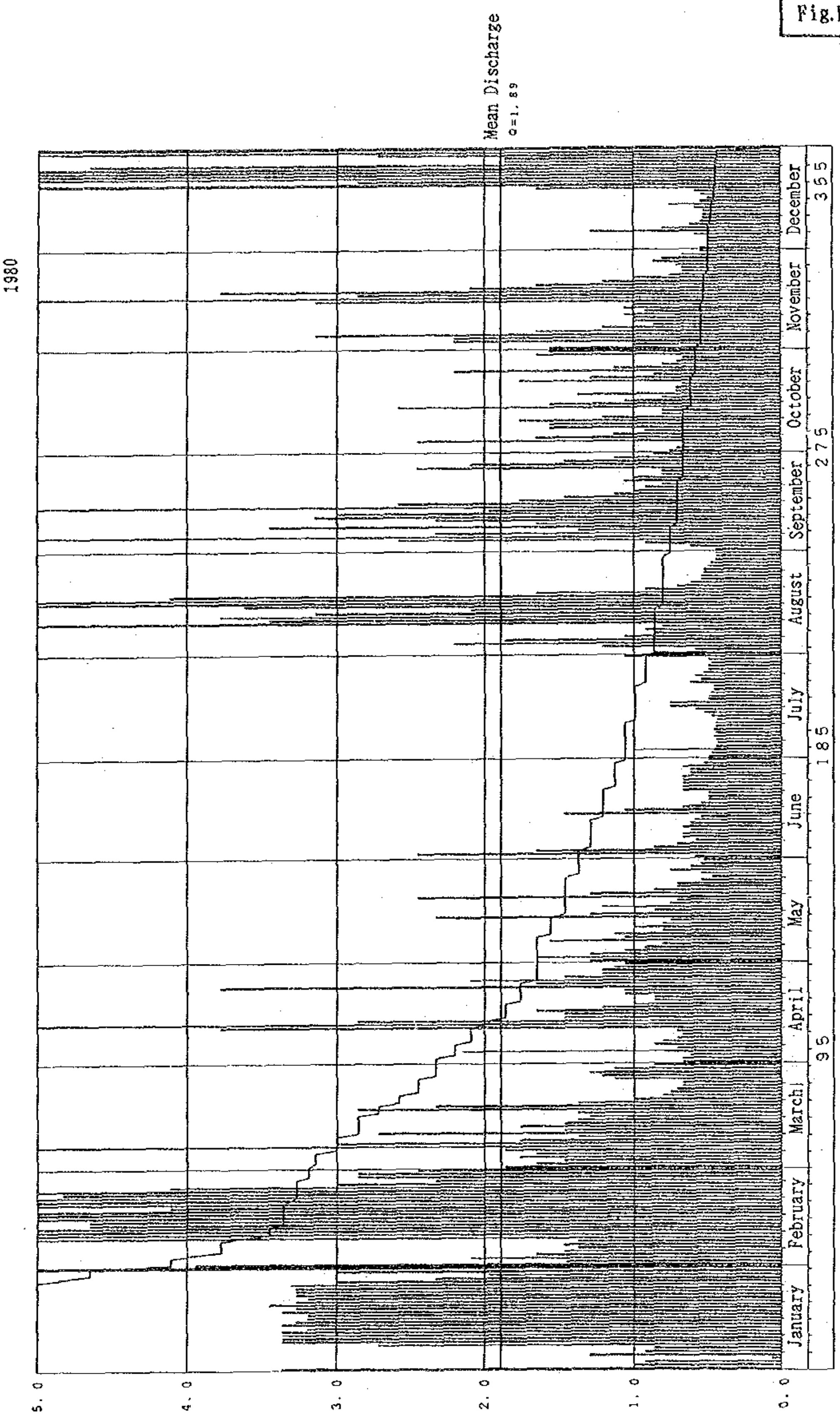
Fig.B.10(1)



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Flow Duration Curve at Serut

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Fig. B. 10(2)

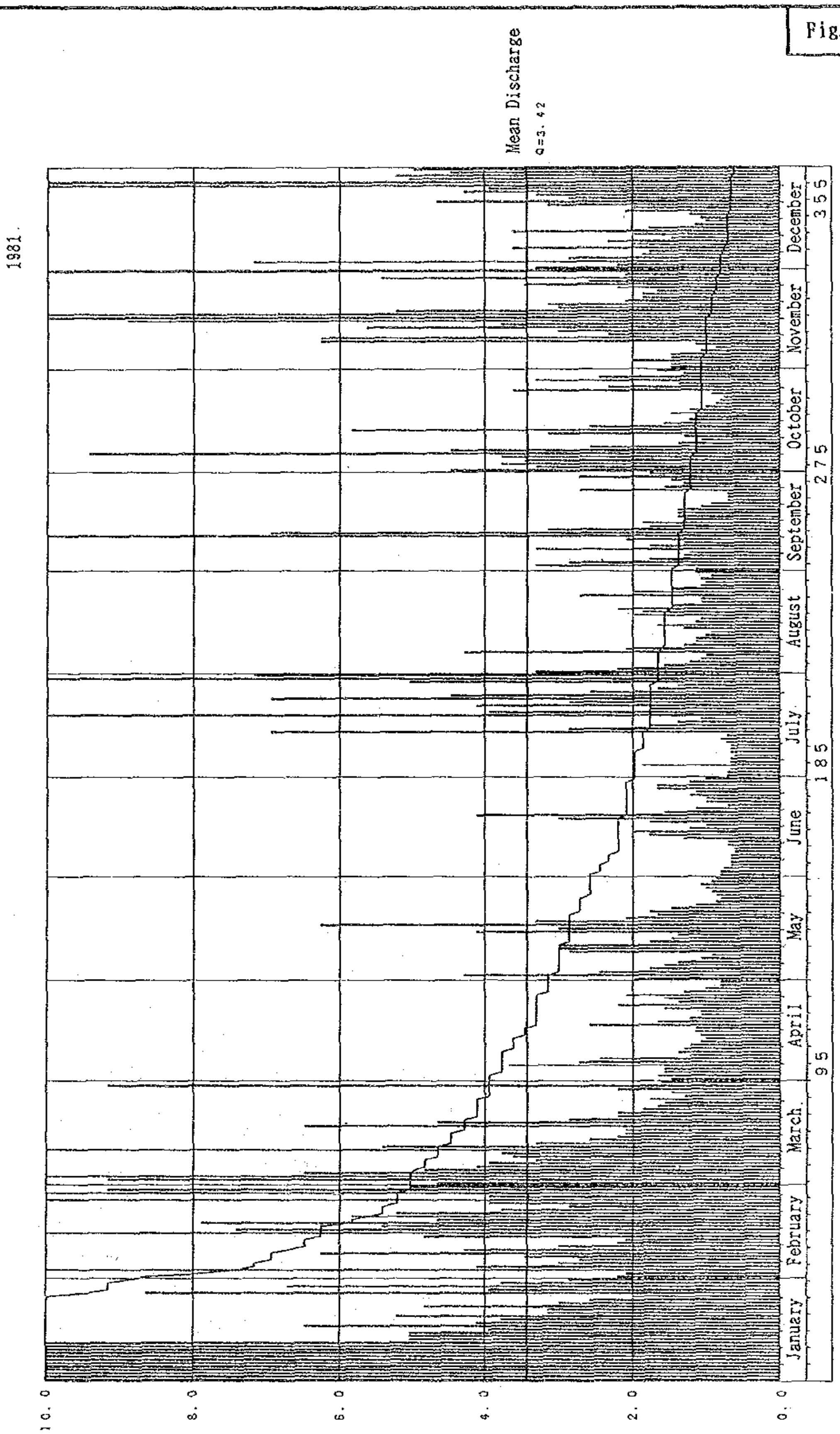

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Fig.B.10(3)

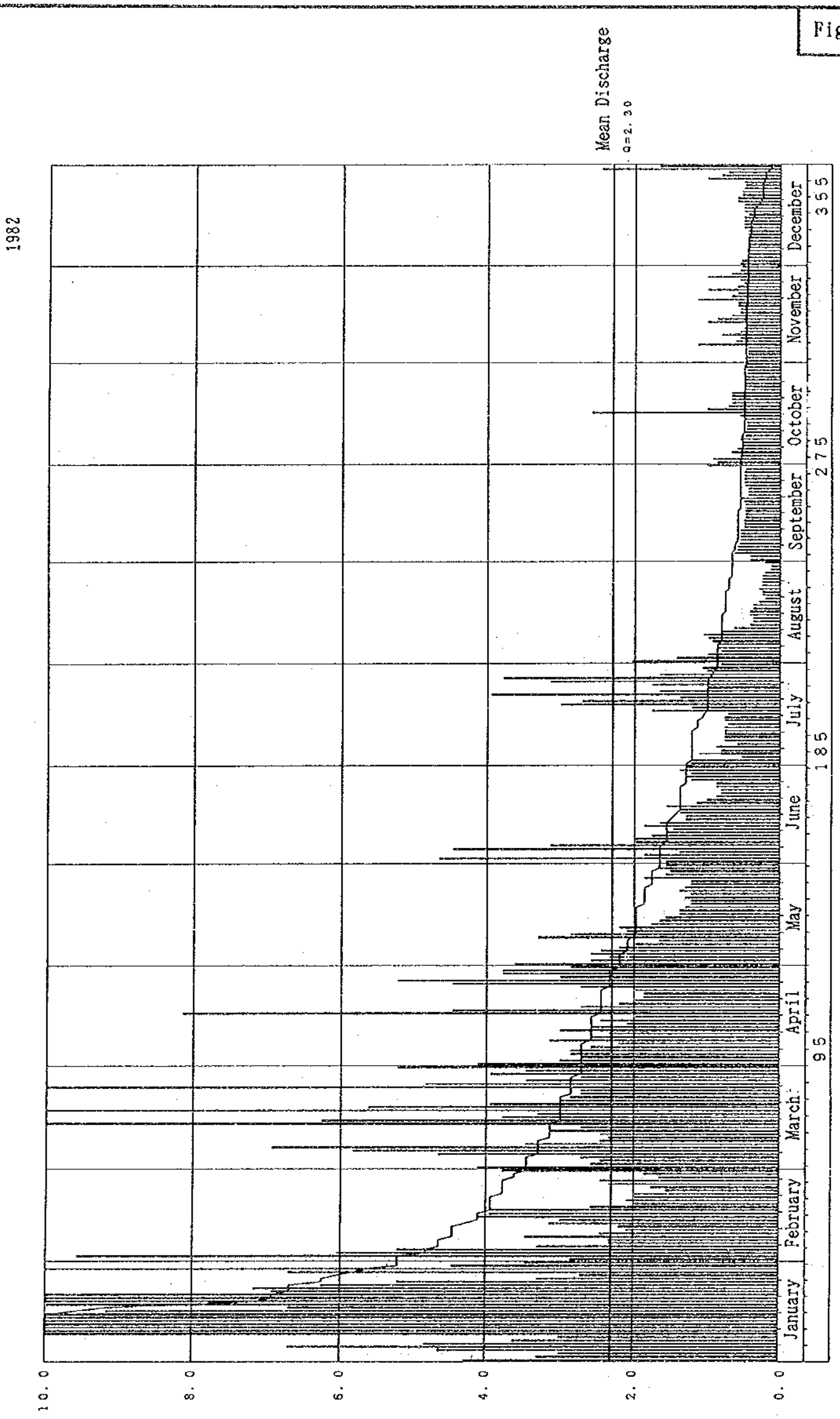

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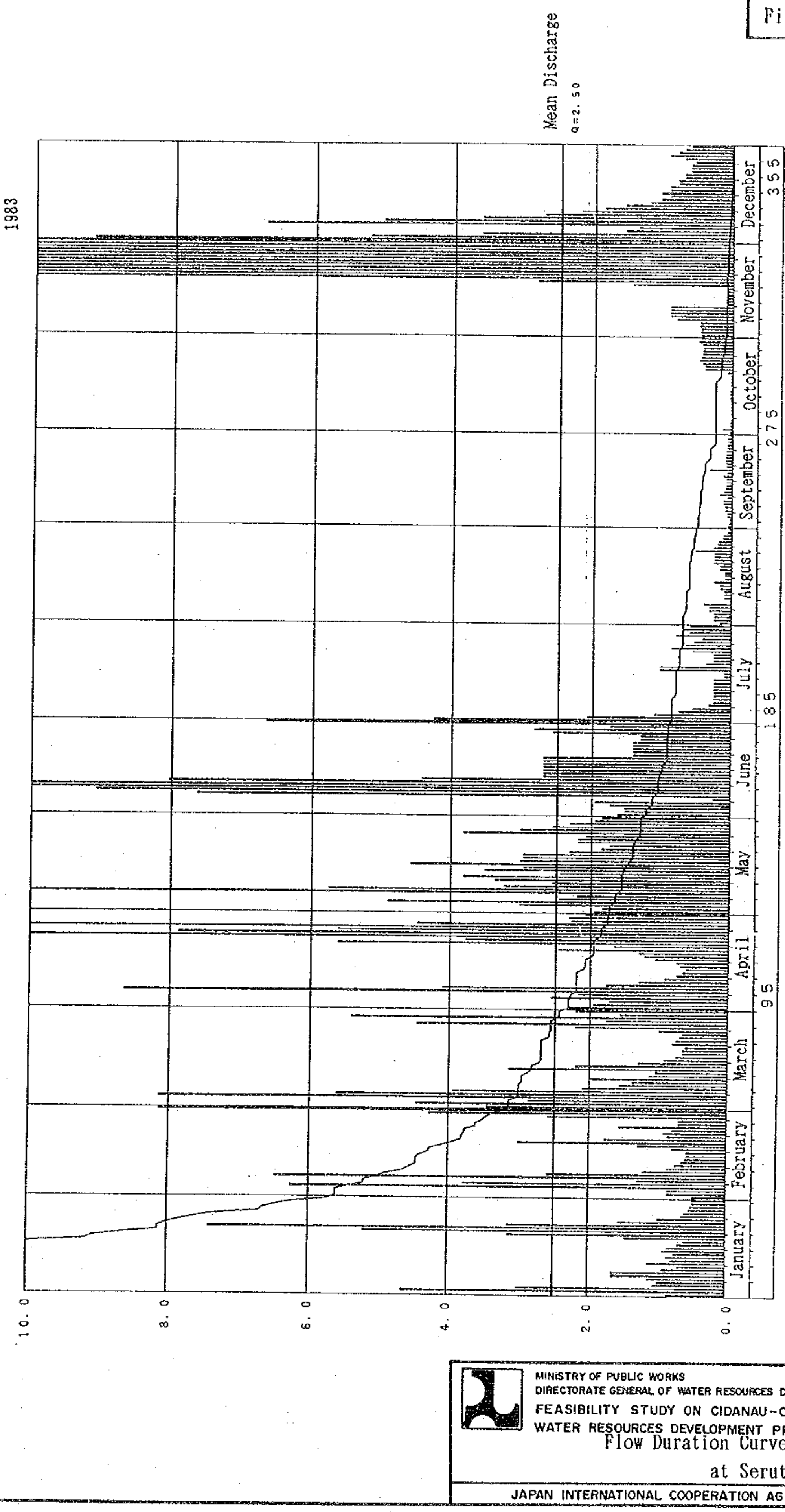
Fig.B.10(4)



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Flow Duration Curve
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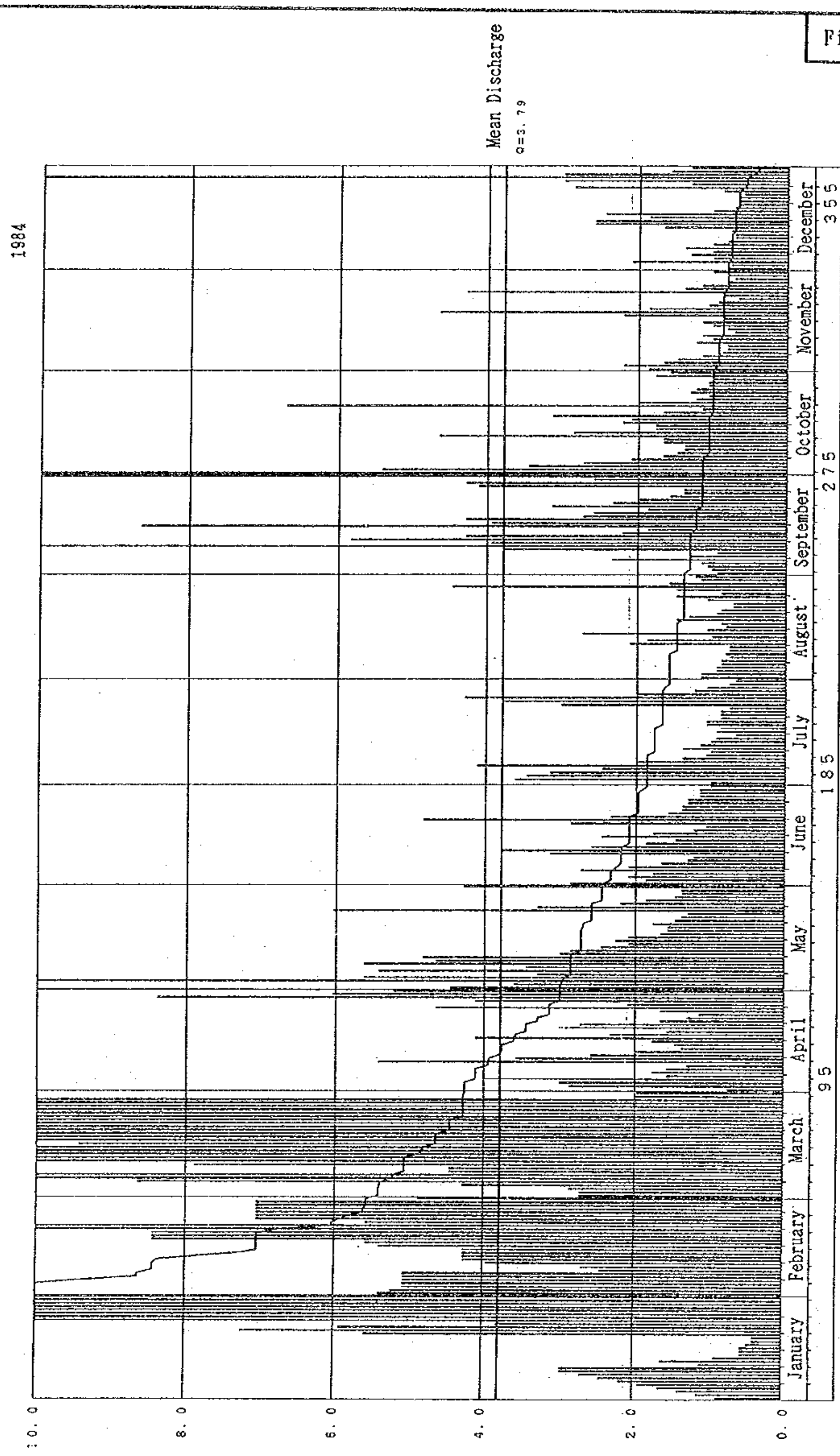
Fig.B.10(5)



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Flow Duration Curve
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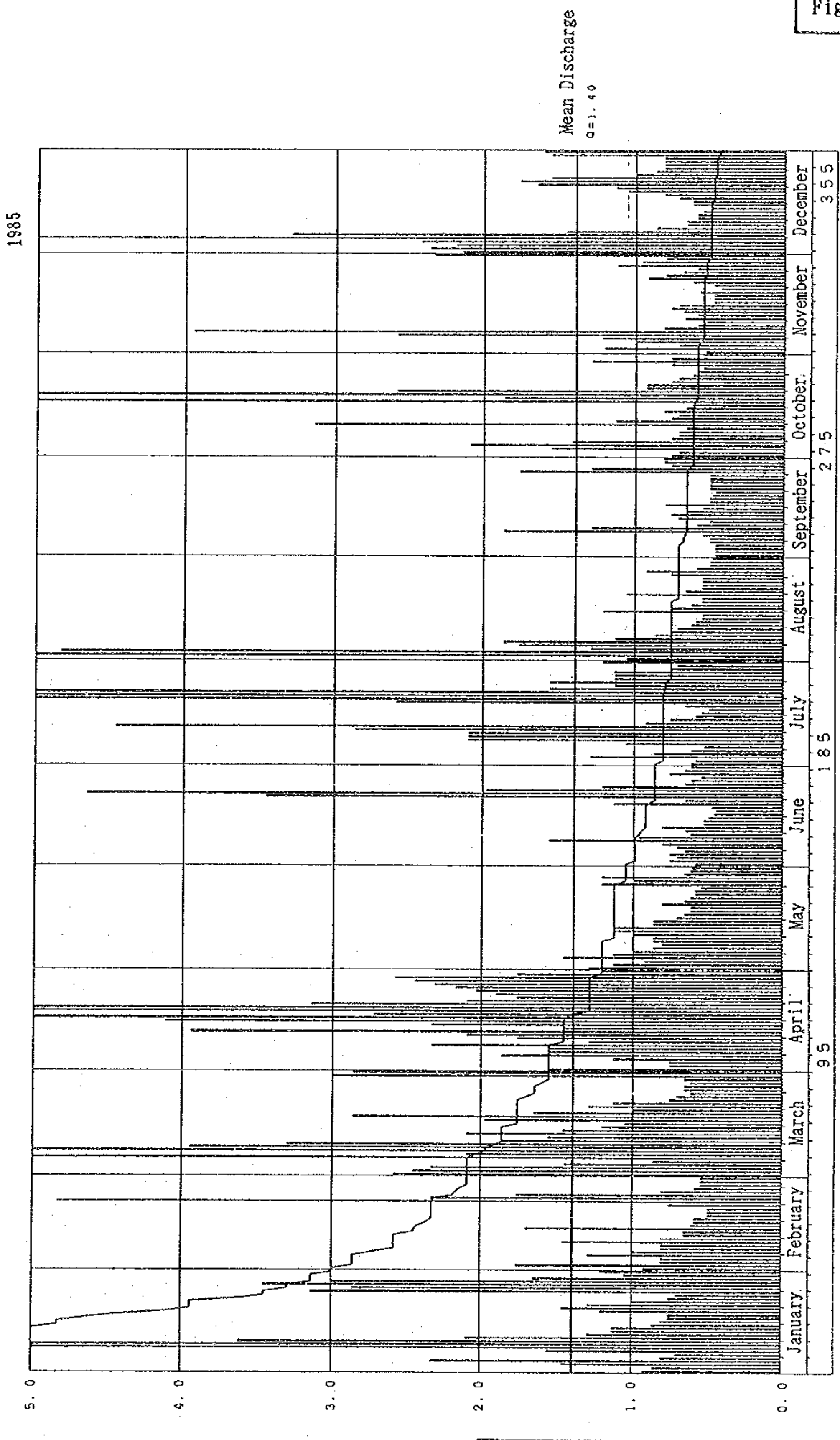
Fig.B.10(6)



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WATER RESOURCES DEVELOPMENT PROJECT

Flow Duration Curve

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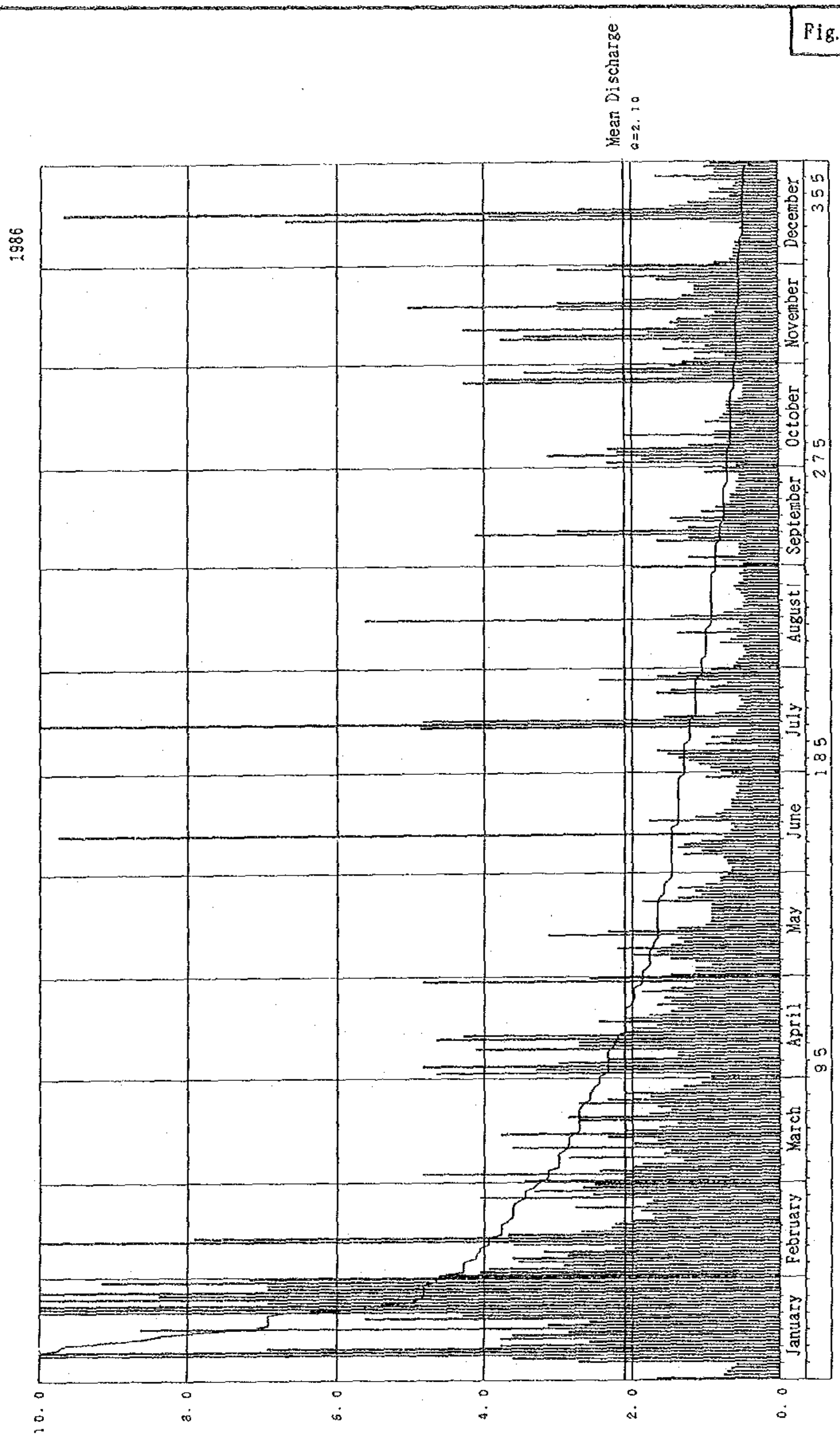
Fig.B.10(7)



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Flow Duration Curve
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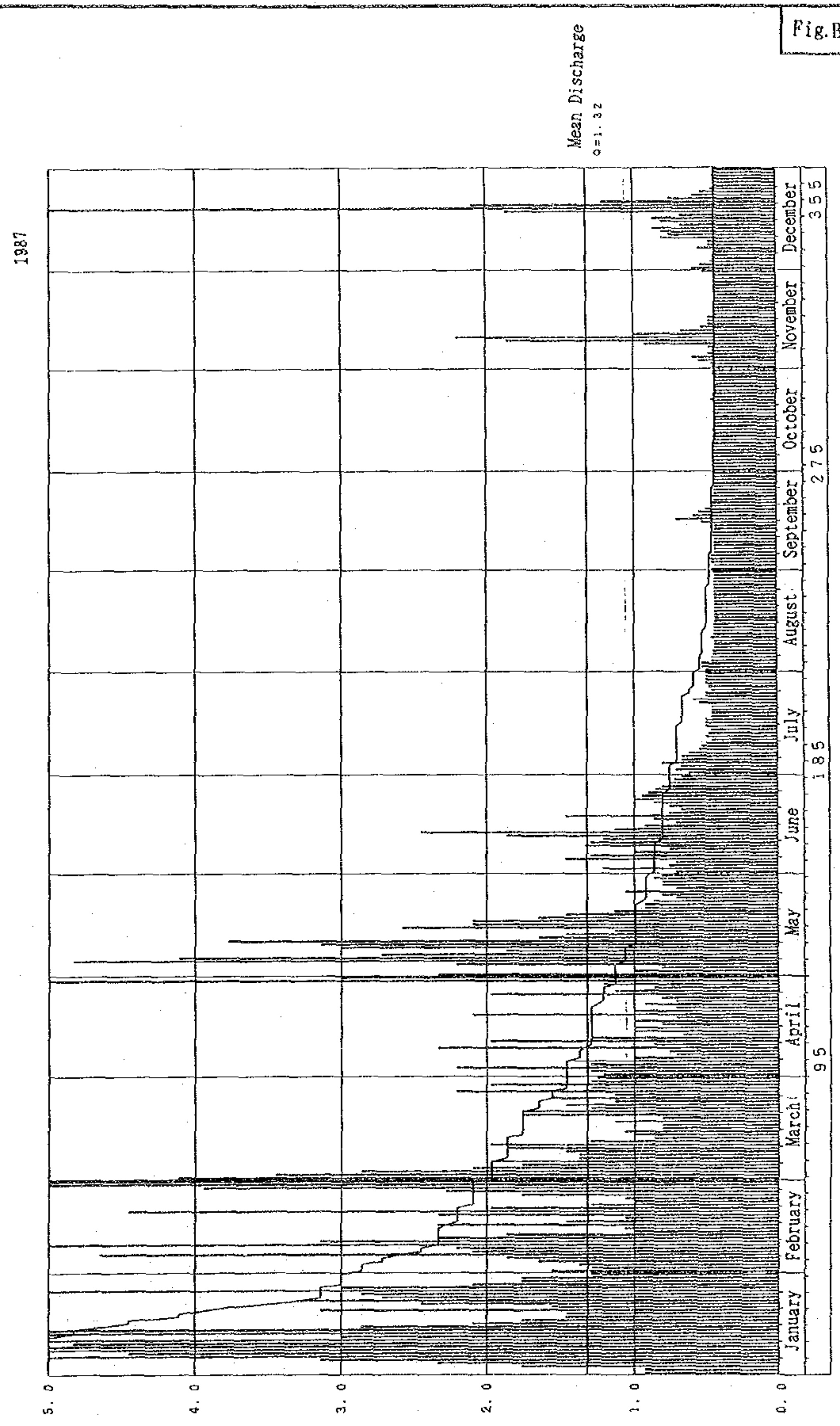
Fig.B.10(8)



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Flow Duration Curve at Serut

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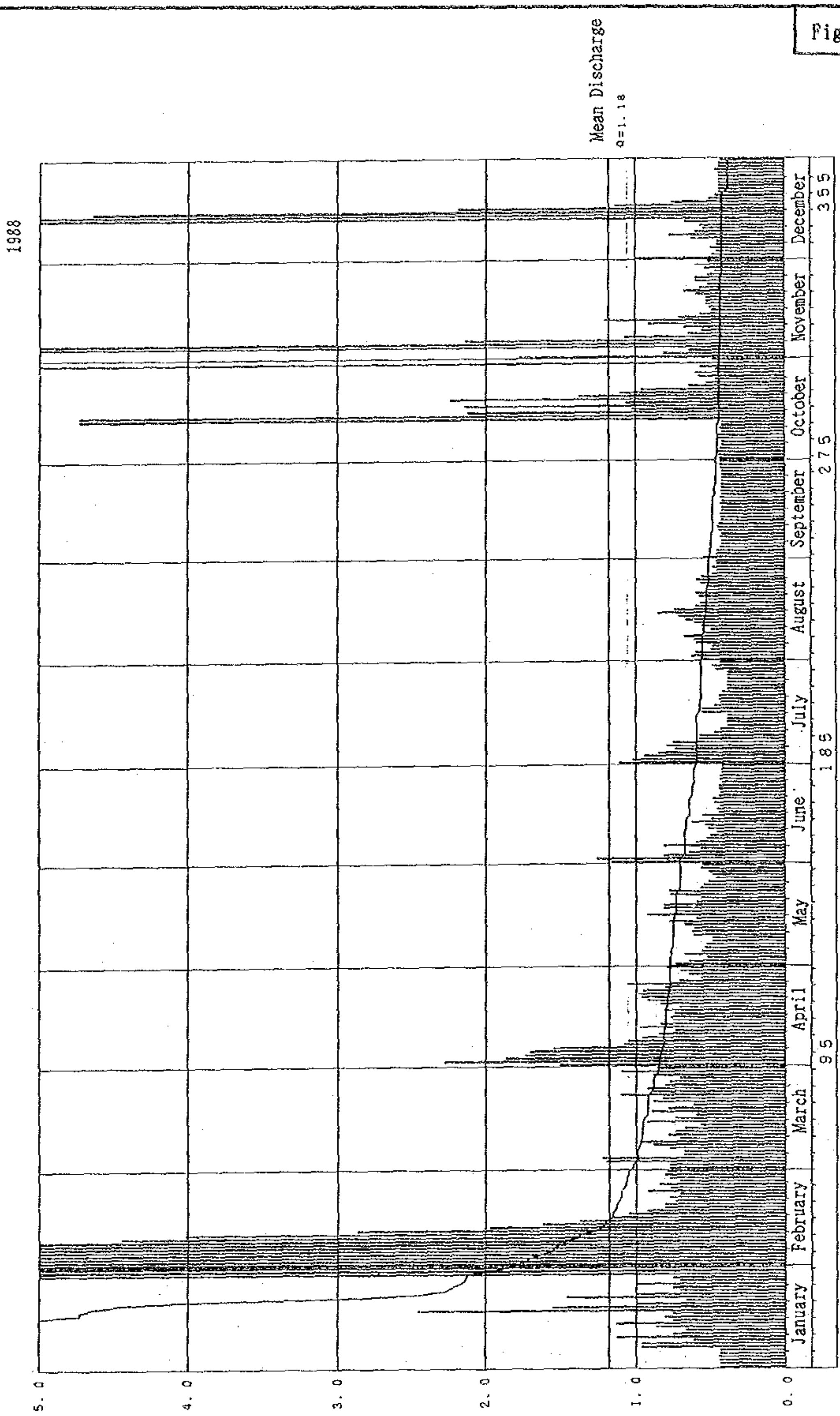
Fig.B.10(9)



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FEASIBILITY STUDY ON CIDANAU-CIBANTEN
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Flow Duration Curve
at Serut

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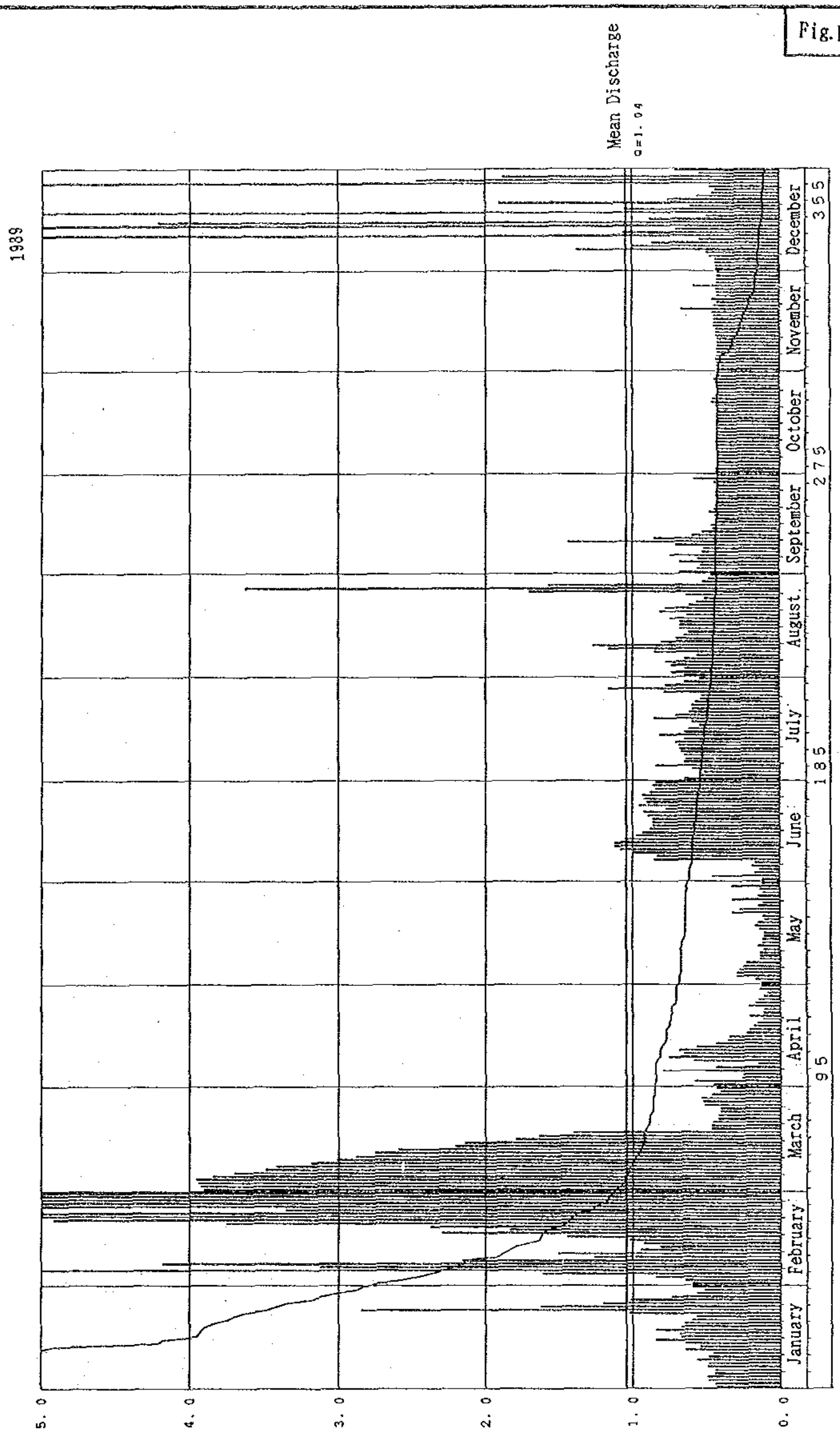
Fig.B.10(10)



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Flow Duration Curve
at Serut

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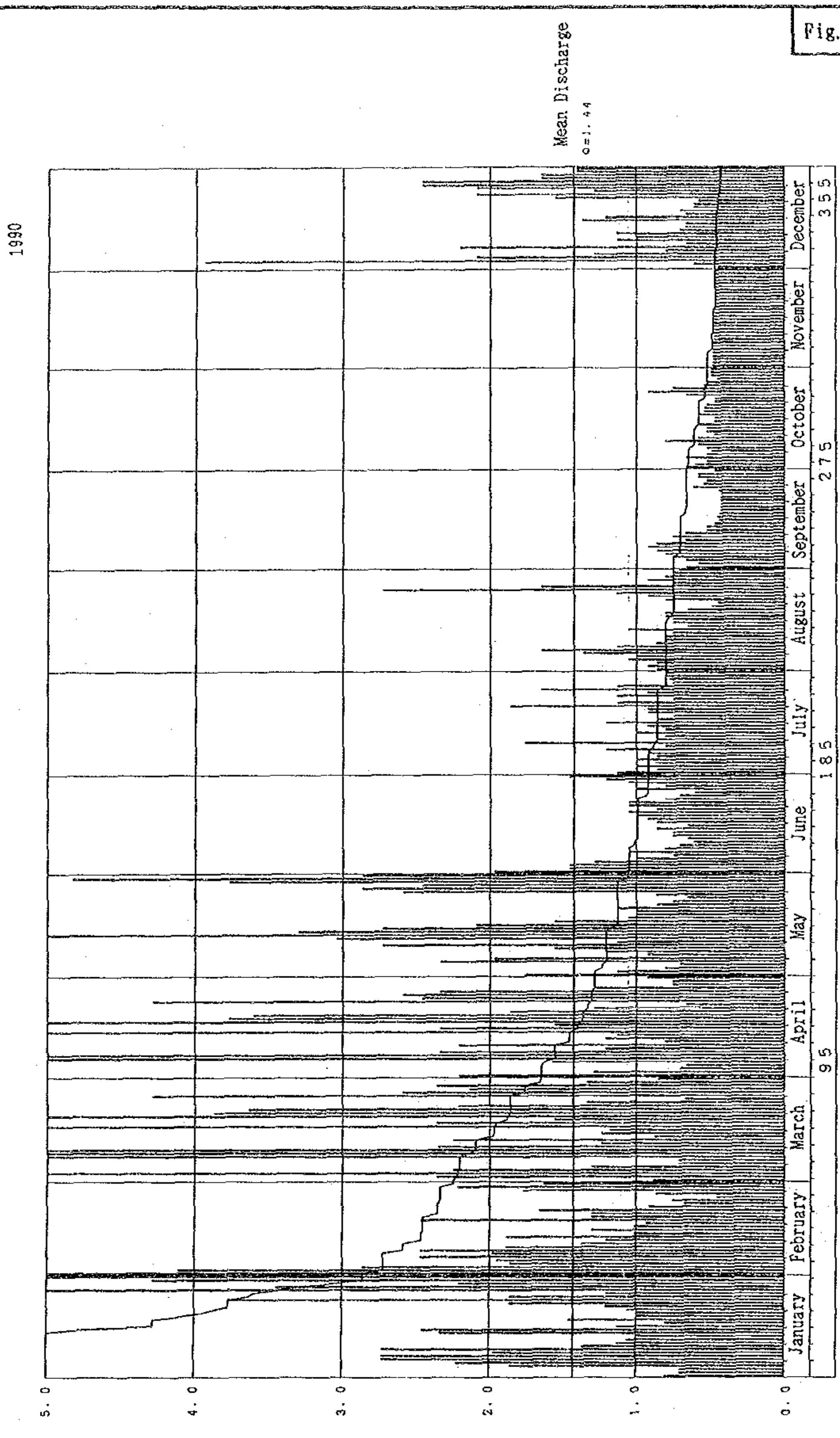
Fig.B.10(11)



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FEASIBILITY STUDY ON CIDANAU-CIBANTEN WATER RESOURCES DEVELOPMENT PROJECT

Flow Duration Curve
at Serut

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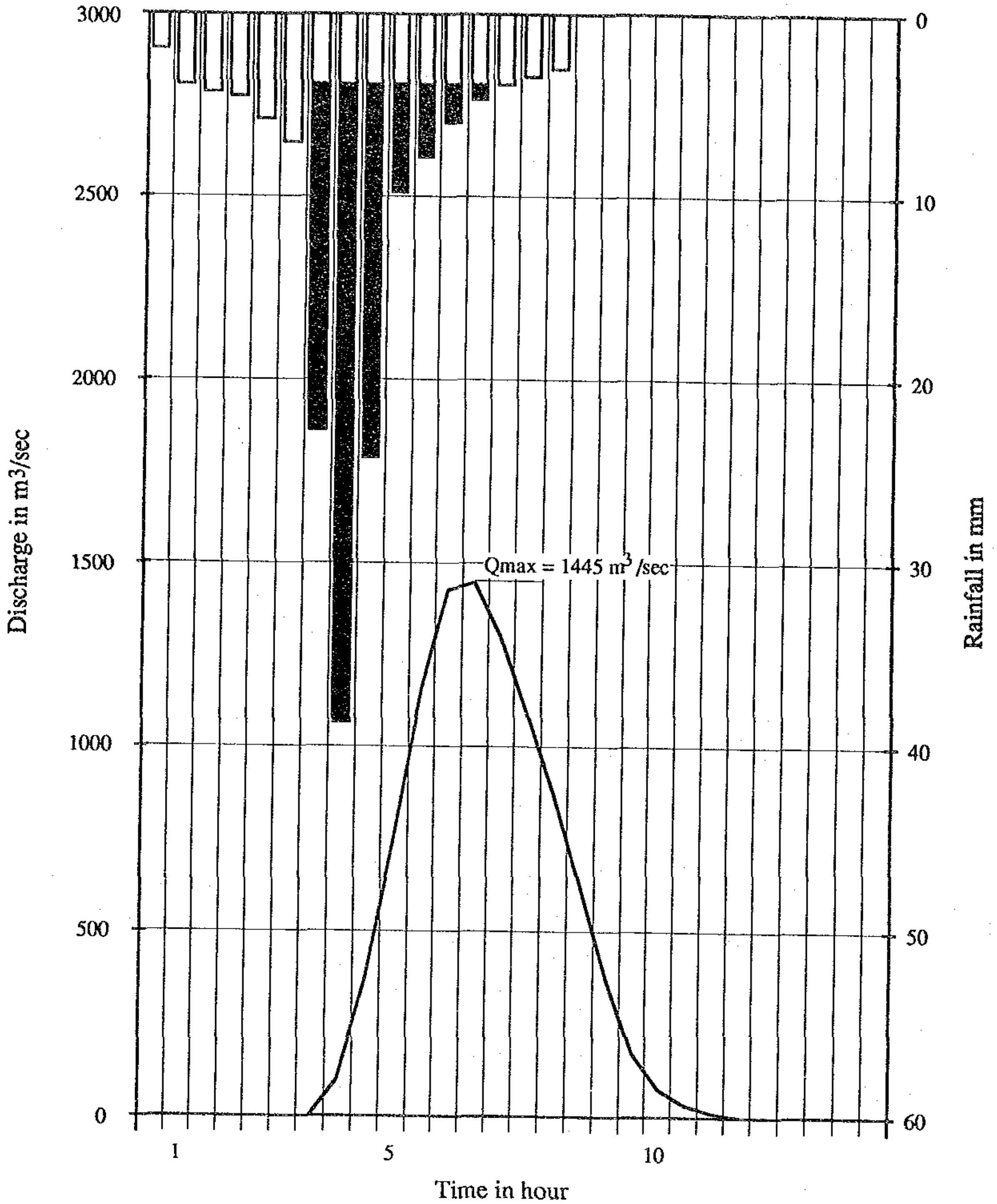

Inflow Hydrograph for 25-year Probable Flood at Kubang Baros

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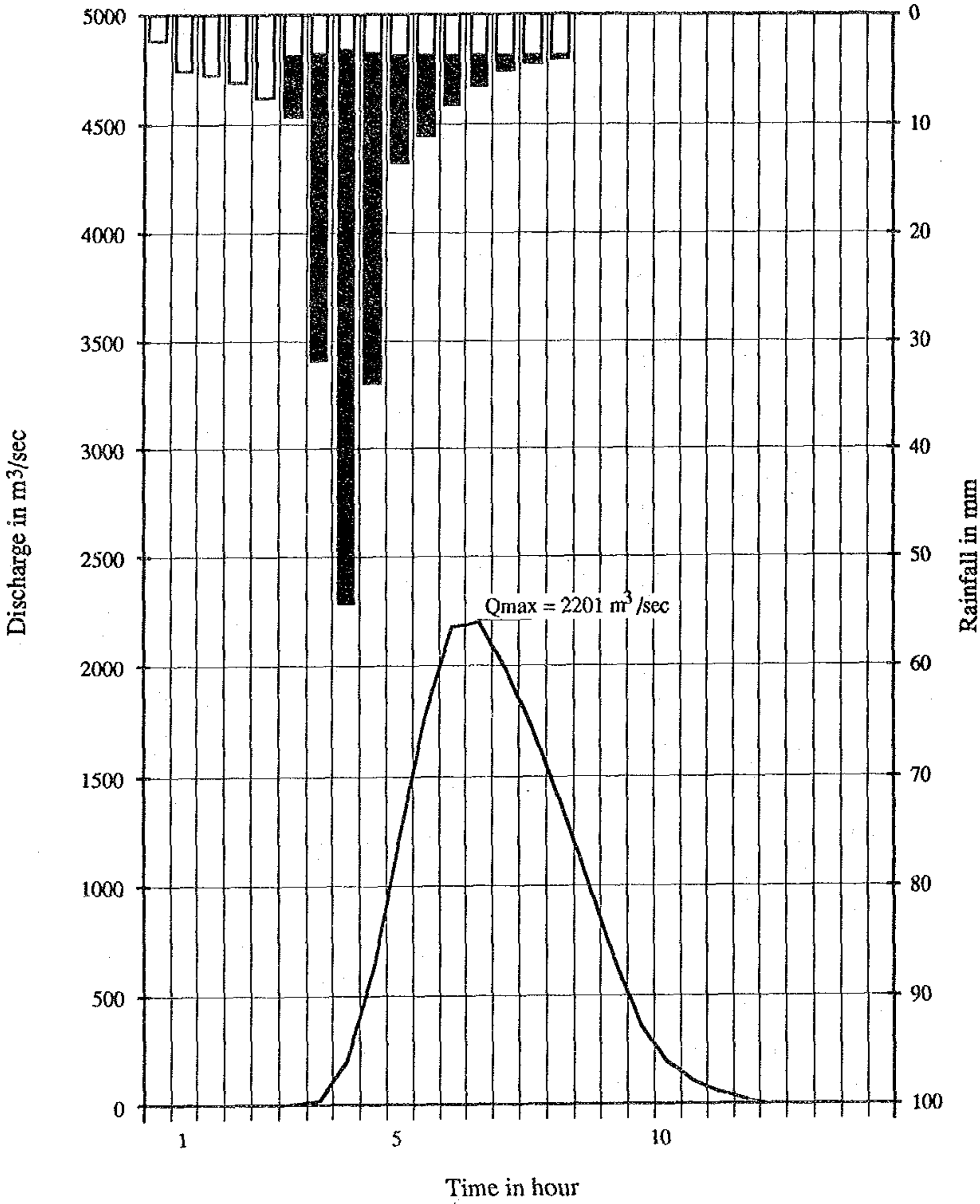
Fig. B-12



Inflow Hydrograph for 200-year Probable Flood at kubang Baros

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WATER RESOURCES DEVELOPMENT PROJECT

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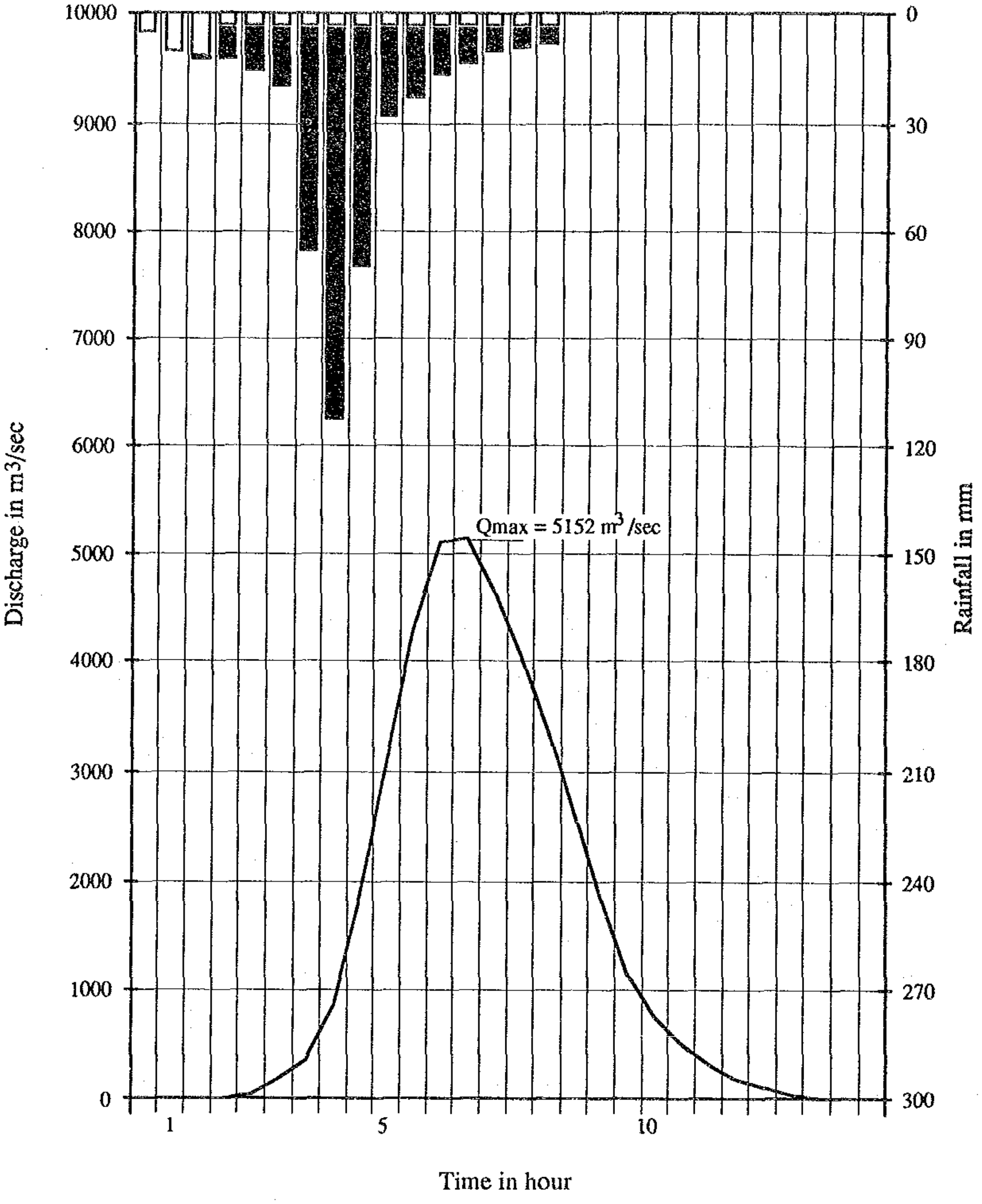
Fig. B-13



Inflow Hydrograph for PMF at Kubang Baros

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FEASIBILITY STUDY ON CIDANAU-CIBANTEN WATER RESOURCES DEVELOPMENT PROJECT

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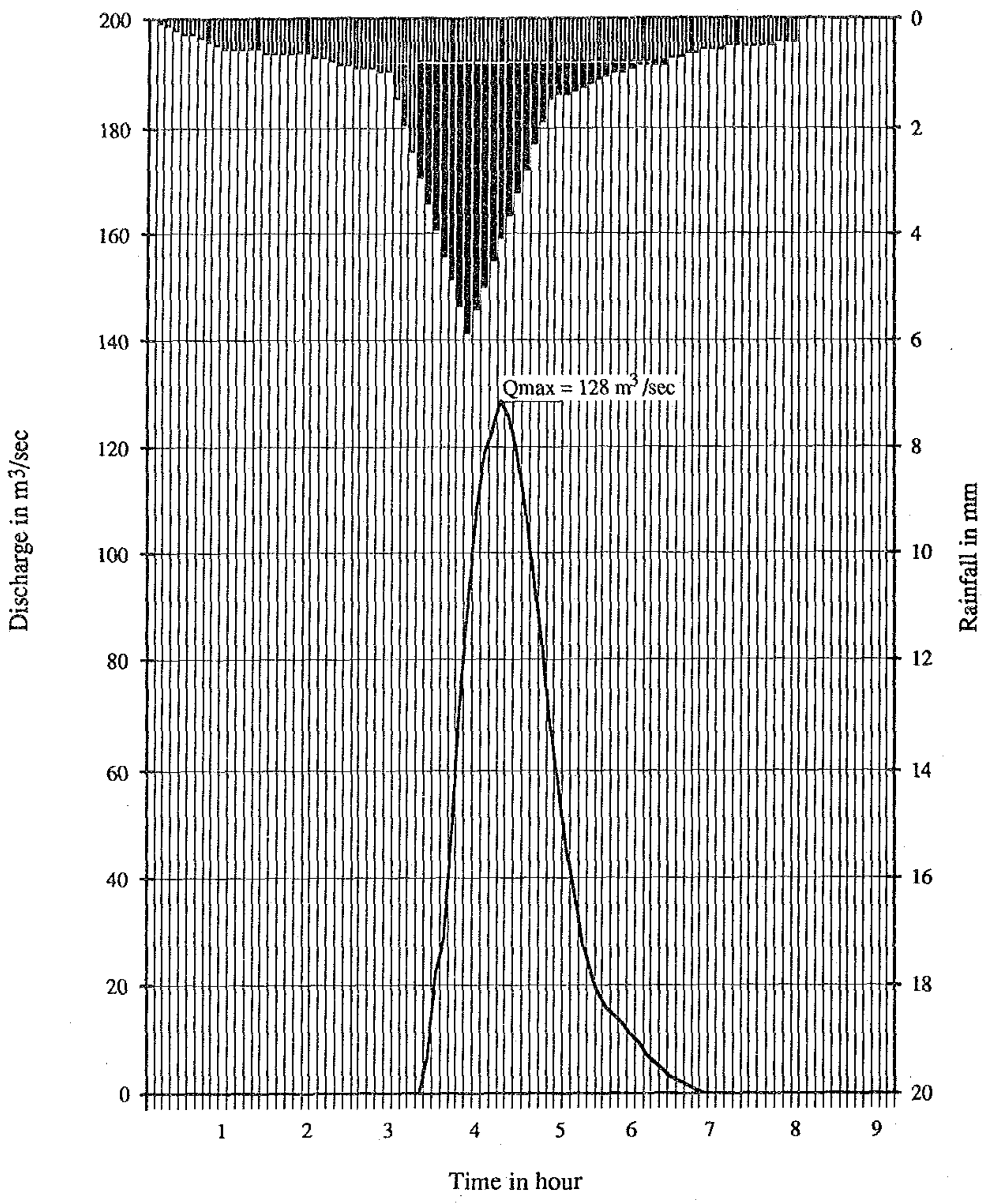

Inflow Hydrograph for 25-year Probable Flood at Heightening of Krenceng Dam

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FEASIBILITY STUDY ON CIDANAU-CIBANTEN
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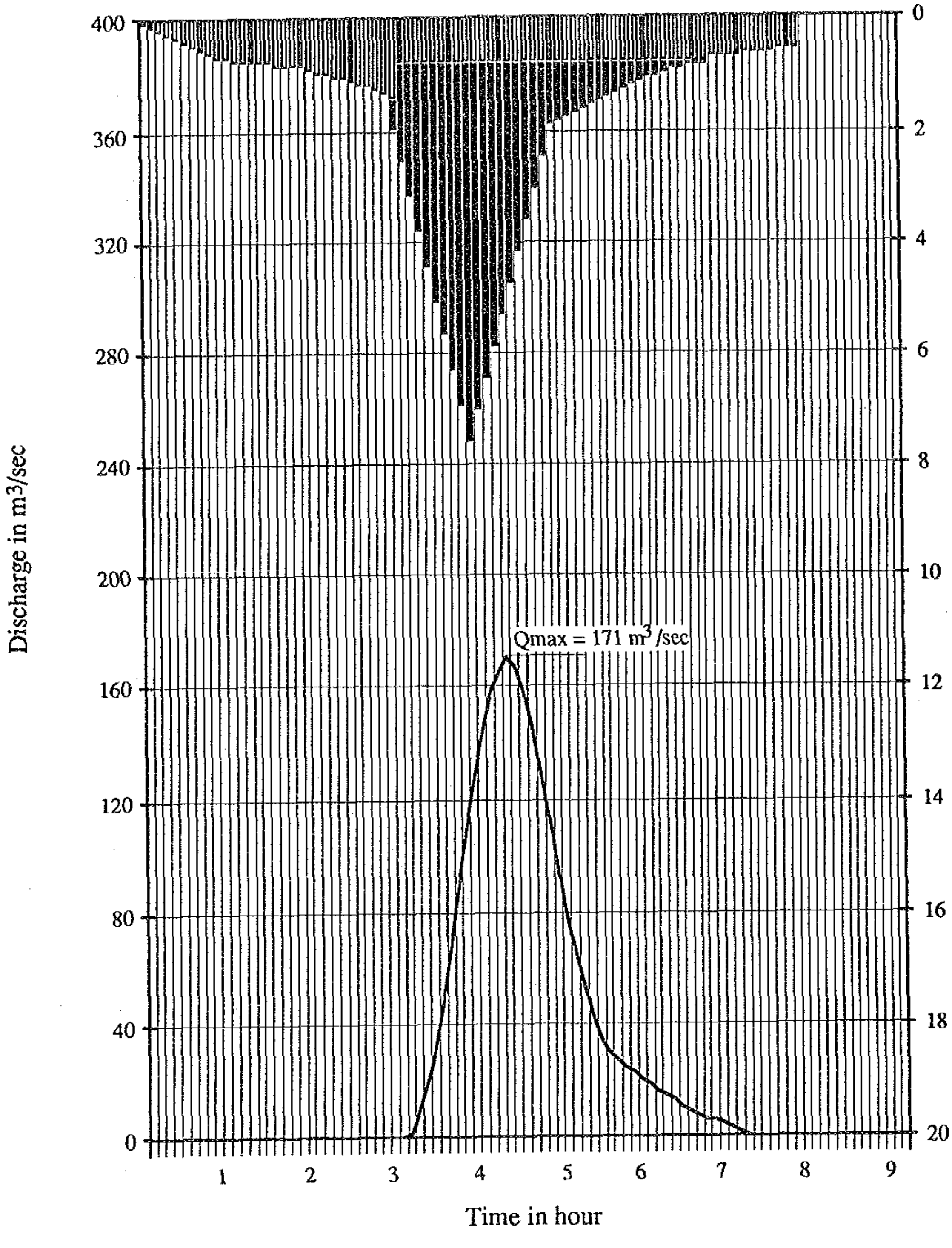
Fig. B-15



Inflow Hydrograph for 100-year Probable Flood at Heightening of Krenceng Dam

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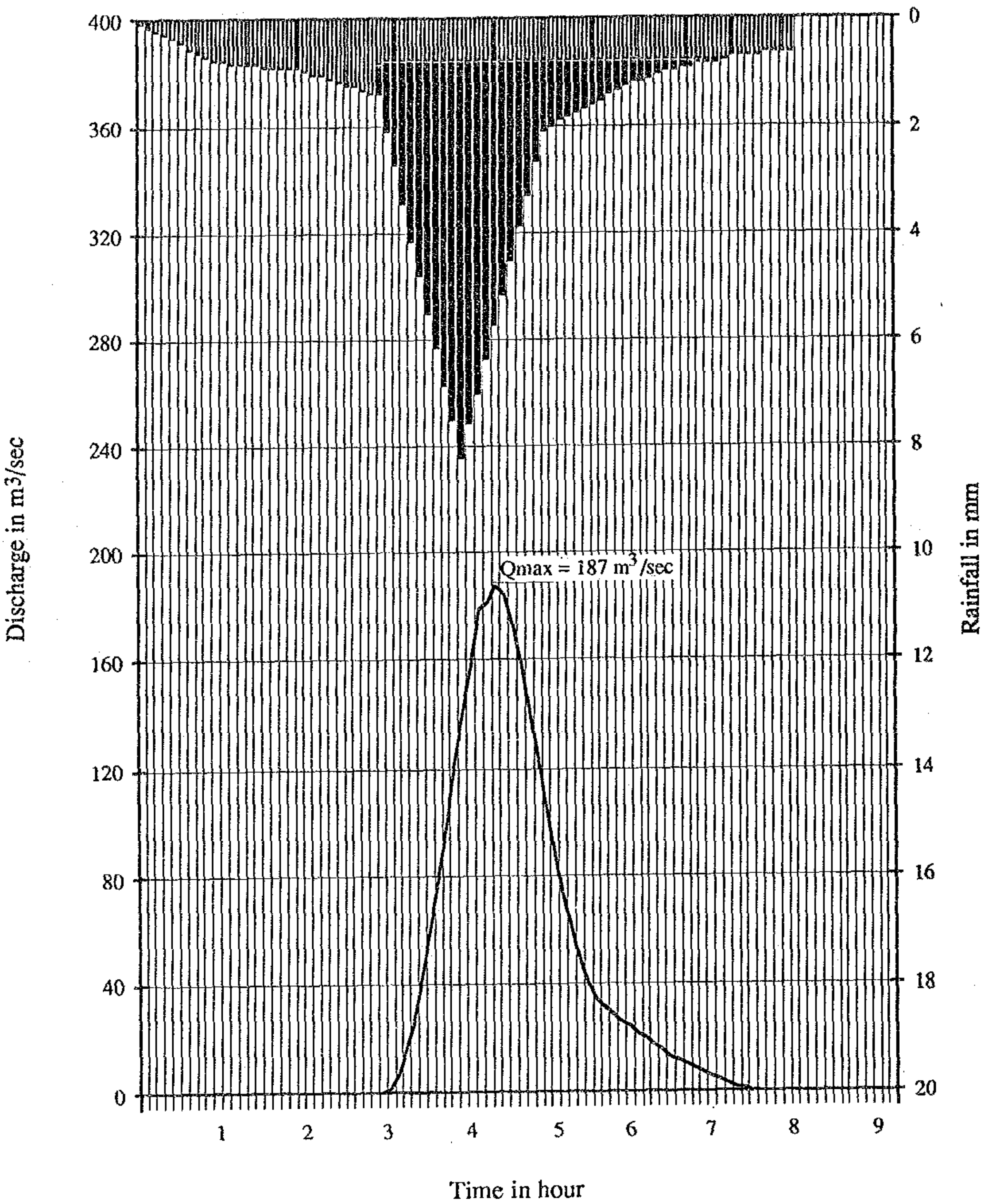
Fig. B-16



Inflow Hydrograph for 200-year Probable Flood at Heightening of Krenceng Dam

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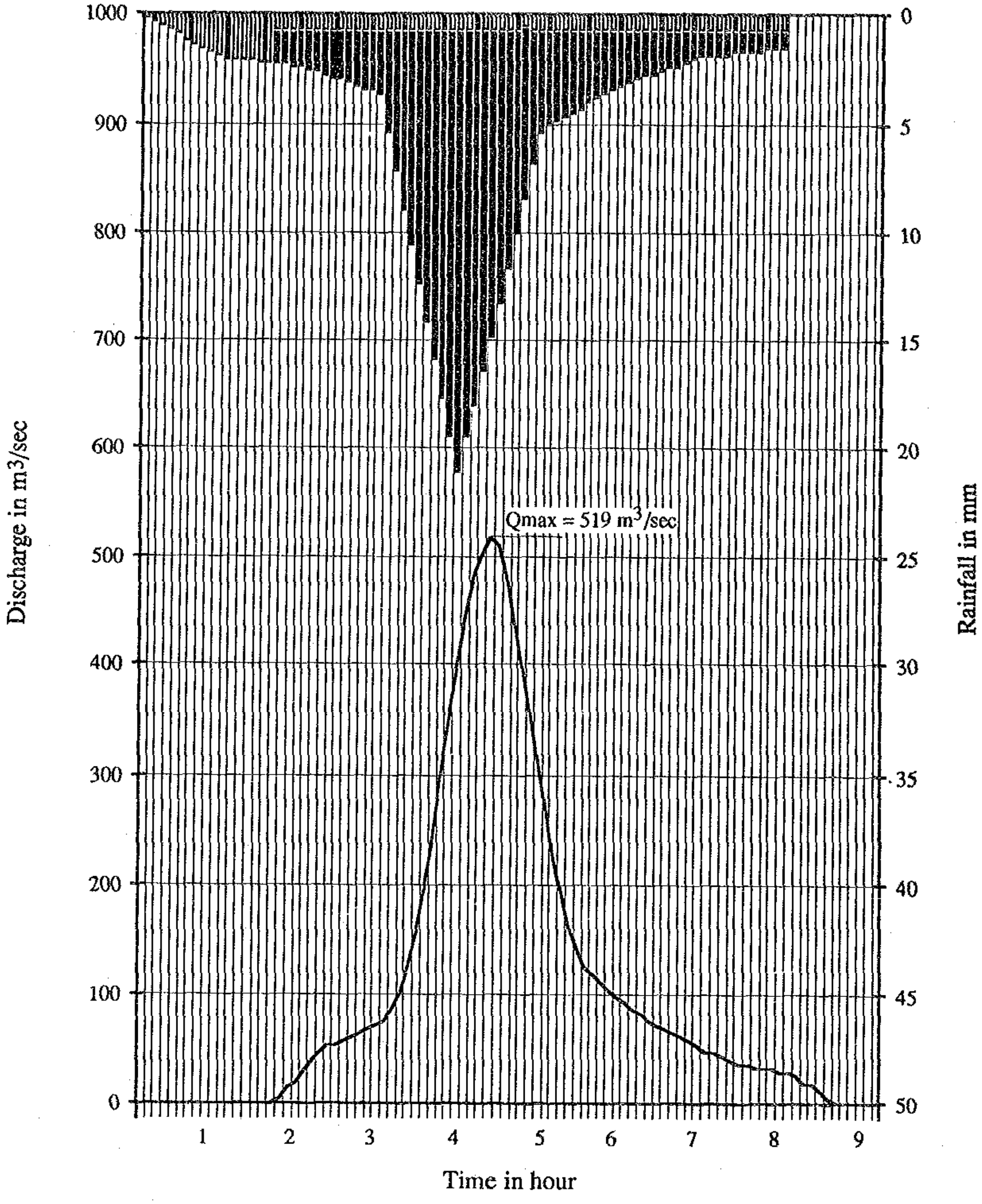
Fig. B-17



Inflow Hydrograph for PMF at Heightening of Krenceng Dam

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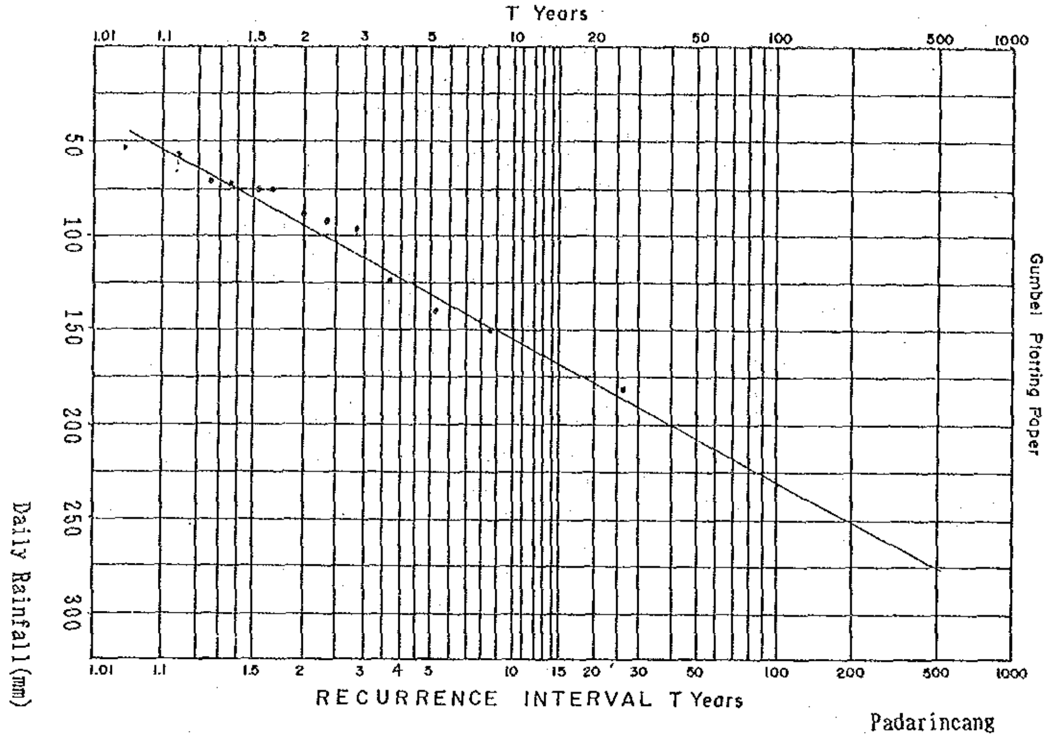
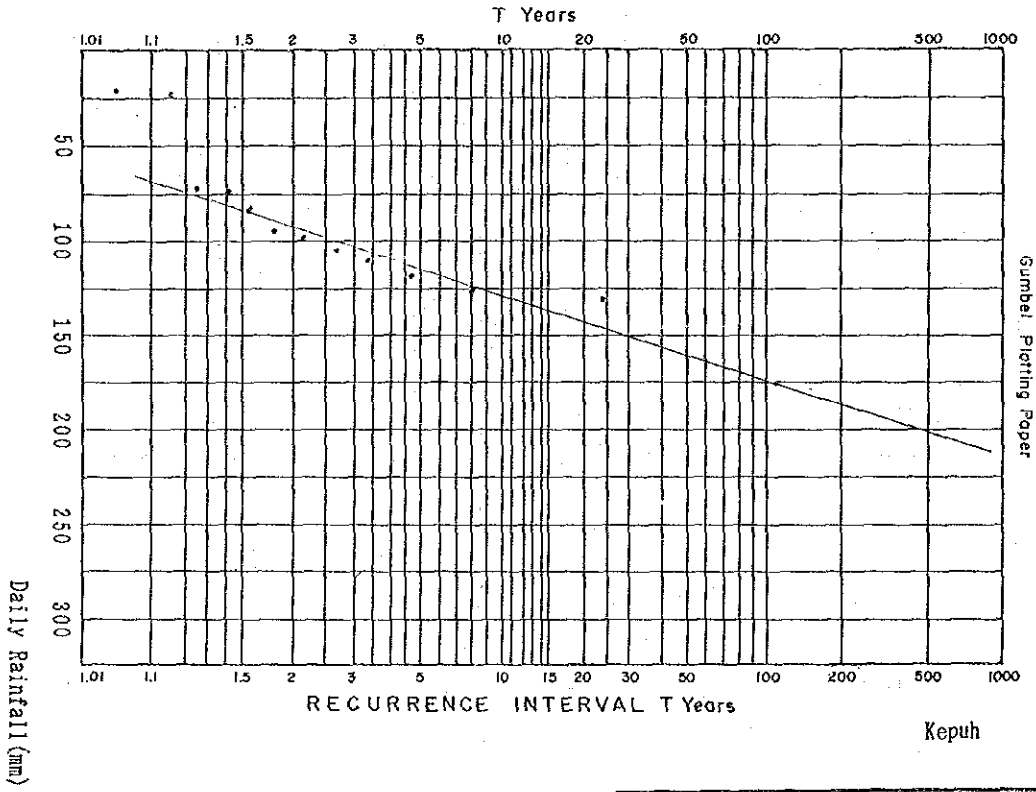
Fig. B-18



Padarincang



Kepuh

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Probable Daily Rainfall

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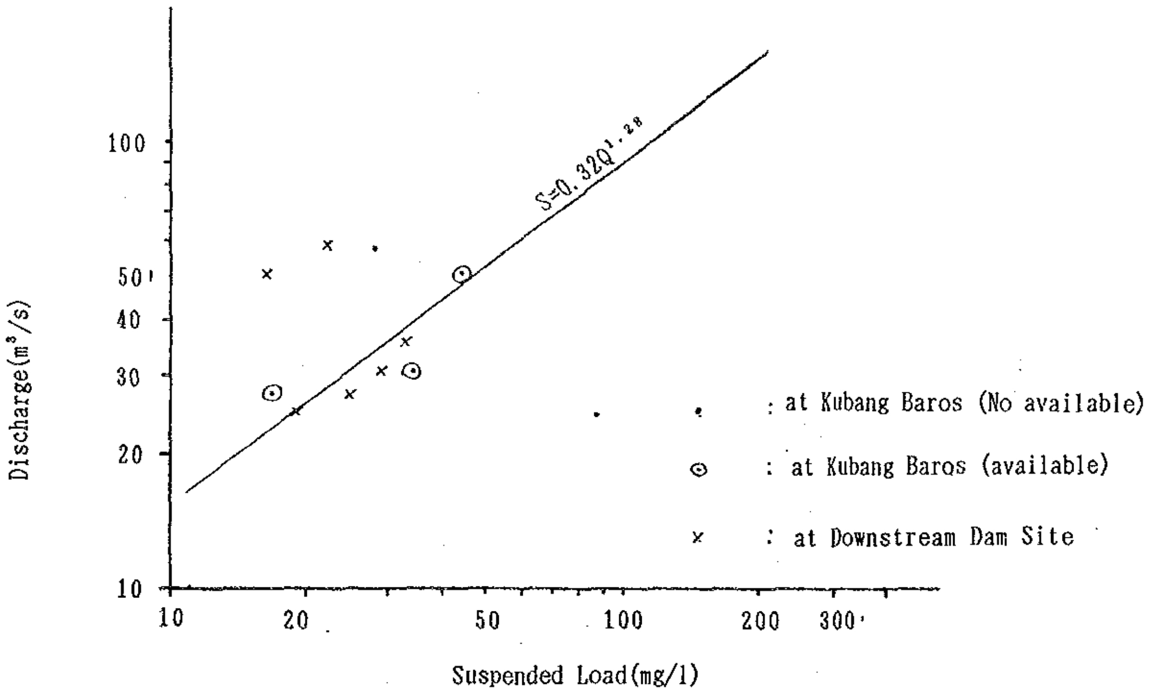
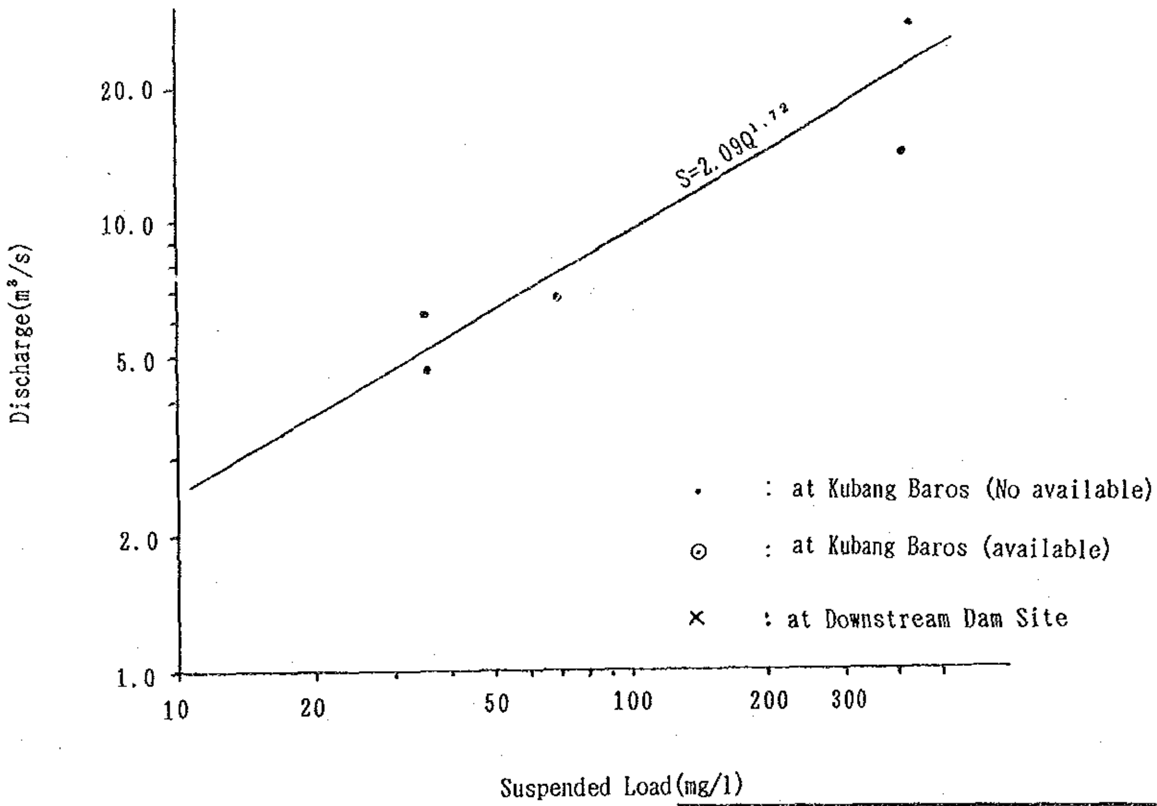
Fig. B-19

at Kubang Baros (Cidanau)



at Serut(Cibanten)



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FEASIBILITY STUDY ON CIDANAU-CIBANTEN WATER RESOURCES DEVELOPMENT PROJECT

Relation of Suspended Load and Discharge

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APPENDIX - C
GEOLOGICAL INVESTIGATION

APPENDIX - C
GEOLOGICAL INVESTIGATION

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1. General

The purpose of the survey is to understand engineering geology and stratigraphy of the study area. The field work was carried out during the middle of December 1990 to the middle of March 1991, the beginning of August and end of August 1991 and the middle of December 1991 to the middle of January 1992.

The geological data and information collected for the study consist of comprehensive engineering study reports, photographs of drilling core samples, drilling logs, drilling core samples, records of seismic survey, records of permeability test, and drawings.

The drilling work was carried out by the local contractors in cooperation with JICA Team's expert. The drilling work consists of core drilling, standard penetration test and field permeability test. Seismic exploration was also performed to grasp the main features of the proposed dam site and the quarry site.

2. Regional Geology

2.1 Topography

The project area is located in the North Banten Region,which is about 100 km from West Jakarta. The area is topographically classified into four (4) physiographic features.

1) Alluvial Plain

The flat areas lies at an elevation of zero to 15 m above mean sea level. The land use is availed for rice fields, settlement and mix plantation.

2) Undulating Hills

The area have a level of gentle undulating relief with slope of 5 to 15% and lies at an elevation of 25 to 150 m above mean sea level. The land on the lower hills was developed for rice paddy fields while the rest on the middle and the high terraces consists of mix upland farming.

3) Caldera Basin

At the middlestream of the Cidanau river lies the basin, at an elevation of about 100 m above sea level, and a wide swamp called Rawa Danau is located in it.

4) High Mountainous Area

Comparatively steep mountains of dissect volcanoes such as Mt. Karang, Mt. Aseupan, Mt. Gede, etc., are surrounding Rawa Danau. They rise at an elevation of about 740 to 1780 m above sea level.

The Cidanau river, having a catchment of 246 km^2, lies in the southern part of the project area. This river originates from Mt. Karang with 1,778 m in elevation and pours into the Sunda Strait after running westward through the Rawa Danau. The Cibanten river also rises from the northern slope of Mt.Karang, and pours into the Banten Bay.

The Rawa Danau, locating in the caldera basin, is a natural preservation area. The Danau Reserve issue of nature preservation, covering 3,791 ha, was established in 1921, mainly because botanically unique fresh-water swamp vegetation contains several Jawa species which can be found only in this area.

2.2 Regional Geology

Physiography of study area is laid on Western Bogor Anticlinorium Zone with undulating hill morphology, of the elevation range 20 - 110 m (Bemmelen, 1943).
Based on the geological map of Anyer Quadragle mapped by S. Santoso in 1987, the study area is underlain by strata as follows:

- Swamp deposits consists of gravel, clay, sand and mud, distributed at Rawa Danau area.

- Colluvial deposits, consists of debris, tallus, detritus and rock waste, derived from volcanic rocks.

- Old volcanic rocks of Danau, consist of jointed andesite or basaltic lava flow, volcanic breccia and tuff.

- Upper Banten Tuff, distributed at the site area, is classified into 2 parts, such as upper part which consists of lithc tuff, pumiceous tuff and sandy tuff, and, lower part which consist of intercalation of crystalline tuff, pumiceous lapilli tuff, glassy tuff and red clayey tuff.

- Lower Banten Tuff, consists of tuff breccia, agglomerate, pumice tuff, lapilli tuff and sandy tuff.

3. Geology of the Alternative Sites

Various alternative schemes have been examined in the study area, through the previous studies and the study of phase I in this feasibility study.

Out of these identified alternatives, six (6) schemes were finally selected as the conceivable alternatives for comparative study. Those are;

(i) Cibanten Damsite
(ii) Upstream Cidanau Intake Weir Site
(iii) Middlestream Cidanau Damsite
(iv) Downstream Cidanau Damsite
(v) Cidanau Gated Weir Site
(vi) Heightening of Krenceng Dam

The locations of above six (6) alternative sites are shown in Fig. C-1. Among these alternative sites, Krenceng Dam is situated in gentle flat planes. The other sites are in the gorge along the Cidanau River and the Cibanten River.

3.1 Geological Investigation on Alternative Schemes

Geological investigations consisting of the core drilling with field tests such as standard penetration tests (SPT) and permeability tests (Lugeon test or open-end test by constant head method), seismic exploration and laboratory tests on core samples were carried out for the comparative study an the alternative sites.

(1) Core drilling

In the drilled boreholes permeability tests, Lugeon test in hard consolidated rocks and open-end tests in soft unconsolidated formation have been conducted. In soft material zones SPT has been made for sounding density of the materials. The location of core drilling sites are shown in Fig. C-2 to C-7.

The number and length of core drillings carried out in the alternative schemes are as follows:

Boreholes for the Alternative Schemes

Site	Borehole No.	Drilled depth (m)
Cibanten Damsite	CB-1	43.0
	CB-2	50.0
	CB-3	43.0
Cibanten Quarry Site	QB-1	30.0
	QB-2	30.0
Cidanau Intake Weir	CD-1	14.0
Middlestream Cidanau Damsite	CD-2	45.0
Downstream Cidanau Damsite	CD-3	40.0
	CD-4	30.0
Cidanau Gated Weir Site	CD-5	20.0
	CD-6	20.0
	CD-7	20.0
Heightening Krenceng Dam	KR-1	15.0
	KR-2	15.0
	KR-3	15.0
Total	15 holes	430.0

(2) Seismic exploration

To clarify more detailed geological conditions and to interpret the geological data more accurately, seismic exploration was executed with use of explosives such as dynamites and detonators at the proposed Cibanten damsite and the quarry site.

a) Location and length of seismic exploration

Location of seismic exploration is shown in Fig. C-38 (1) and (2), and the summary of seismic exploration line is as follows;

Length of Seismic Exploration Line

Site	Line No.	Length (m)	Remarks
Cibanten Damsite	Line A	500	Along dam axis
	Line B	300	Along the river
Cibanten Quarry	Line C	200	On the slope of proposed quarry site
Total	3 Lines	1000	

b) Applied method

The seismic exploration by refraction method has been applied for this investigation. The exploration was performed by using explosives (dynamite and electric instantaneous detonators).

The interval of each geophones is 5 m for detecting elastic p-waves. The interval of blasting points is 50 m in a general standard. Analysis of seismic exploration results for producing velocity profiles is made by so called ABC method and path calculation. Subsurface velocity profiles of each seismic line are obtained by adapting these analysis.

3.2 Investigation Result

3.2.1 Core Drilling and Field Tests

Fig. C-16 to Fig. C-30 present the drill logs obtained through the boring investigation with the core recovery, permeability and rock quality designation. The details of permeability test result are indicated in DATA BOOK. The geological profile at each damsite obtained through the geological investigations as mentioned is seen in Fig. C-8 to C-14 (1).

3.2.2 Seismic Exploration

The seismic analysis has been completed and distribution of P-wave velosity is summarized as follows for the project area (See Figs. C-38 (1) to C-40).

Geological Conditions of the Seismic Velocity Layers

Layers	Velocity (km/sec)	Geological conditions
1	0.2 - 0.4	Top soil. Unsaturated and unconsolidated alluvial deposit along the river course.
2	0.5 - 0.7	Residual soil derived from heavily or completely weathered basement rock.
3	0.9 - 1.3	Highly weathered rock (deteriorated or decomposed along crack surfaces distributing frequently). Unsaturated.
4	1.1 - 1.8	Moderately weathering basement rock (slightly deteriorating along crack surfaces developed occasionally). Mostly saturated condition.
5	1.9 - 3.6	Slightly weathering or fresh basement rock.

Relationship between seismic velocity and geological conditions

Layer (velocity) (km/sec)	Thickness (m)	Core recovery (%)	RQD (%)	Permeability coefficient (m/sec)	Geology
1 (0.2-0.4)	1 - 3	80 - 100	---	k = 1x10-3 - 1x10-4	Top soil, River deposits
2 (0.5)	1 - 7	90 - 100	---	k = 1x10-3	Residual soil.
3 (0.9-1.3)	2 - 12	60 -100	0	k = 1x10-3	Heavily weathered lapilli tuff/sandy tuff
4 (1.4)	2 (river bed) -20 (bank top)	100	40-90	7 - 12.5	Moderately weathered lapilli tuff
5 (2.0-2.4) (3.1-3.6)	---	100	80-100	4 - 6	Fresh and massive lapilli tuff

As shown in above data and profiles of Line A and B, the interpreted results of the seismic exploration reveal the following conclusion:

Geotechnical considerations of the layers 1 and 2

A dam in this site shall be planned by rock fill type or earth fill type from the viewpoints of dam scale and availability of materials in the site, and economy.

The layer 1 (0.2 - 0.4 km/sec) and layer 2 (0.5 km/sec) consist of top soil, alluvial deposits in CB-2 and residual soil respectively. The drilled cores in the layers 1 and 2 show tuffaceous sandy clay (unconsolidated strata having N-value less than 50 in CB-1 develops up to the depth of 4 m, and so on). The drilled results of the hole CB-2 and CB-3, spots of which are located at river side of the right bank and middle portion of the right bank, show that such unconsolidated soil is rather thinly developing.

However, the interpreted results of seismic line A indicate the layer 1 and layer 2 are rather thickly distributed at the upper portions of the both banks. The maximum thickness may be 6 m.

Geotechnical considerations of the layer 3

The layer 3 has a seismic velocity of 0.9 to 1.3 km/sec. The thickness is 1 to 2 m at the river bed and 12 m at the top of the both banks.

This velocity value suggests the layer might be unsaturated condition and lies above groundwater table, and extended lapilli tuff deteriorating mainly along crack surface.

The drilled cores of CB-1 and CB-3 in the layer also show heavily or highly weathering, loosened or brittle lapilli tuff (CL in Rock classification), which was not applicable for water pressure test in some tested section due to its fragility. Therefore, the treatment method for the layer shall be carefully examined in future stage.

In the case of core zone excavation for rock fill or earth fill dam, some sections in some sections in the layer may be necessary to remove in some extent to rest on stable(undeteriorated) portion.

3.3 Site Geology

3.3.1 Cibanten Damsite

The gentle undulating hilly area around the Cibanten damsite and its reservoir is composed of massive, welded pumice tuff. At the surface, pumice tuff has been altered by superficial weathering to the depth of 5 to 10 m. Surface soil and deposits on the hill slope are thin. Riverbed deposits composed of sand and boulders overlie the valley bottom.

The proposed quarry site of rock material and concrete aggregate for Cibanten Dam is located on the southern slope of a mountain ridge, which is about 5 km north of the damsite. The ridge is composed of the old volcanic rocks such as slightly altered andesite lavas with intercalated layers of andesitic pyroclastic rocks.

3.3.2 Middlestream Cidanau Damsite

In addition to the existing drilling cores, one (1) borehole was drilled at the top of the left bank. According to the observation of these drilling cores. Both dam abutments are comparatively steep, and composed of unconsolidated pumice tuff, which is intercalated with welded layer of 10 to 20 m in thickness. The bottom of the valley is also composed of weakly welded pumice tuff, which is underlain by alternating beds of mudstone, tuffaceous sandstone and pyroclastic rock. At the top of the hill, the residual soil derived from pumice tuff lies to the depth of 5 to 10 m.

3.3.3 Downstream Cidanau Damsite

Downstream Cidanau damsite is composed of welded pumice tuff of about 40 m in thickness, which is underlain by alternating beds of mudstone, tuff breccia, lapilli tuff, etc.. Colluvial deposits and alluvial deposits are thin in general. At the surface, lateritic residual soil of about 5 m in thickness overlies the unconsolidated pumice tuff.

3.3.4 Cidanau Gated Weir Site

The proposed weir site is located at 200 m upstream of the existing intake weir. Gently undulating hills around the weir site is composed of weakly to moderately welded pumice tuff. At the central part of the valley bottom. riverbed is deeply eroded to the depth of 10 m, and filled with loose sand and silt.

3.3.5 Krenceng Damsite

The foundation rock of existing Krenceng Dam is composed of weakly welded pumice tuff, which is underlain by moderately welded layer. Colluvial deposits are very thin. while alluvial deposits of several meters in thickness, which are composed of silt and secondary deposits of tuff fill the river bed.

3.4 Geology in Selected Dam and Weir Sites

3.4.1 General

Heightening Krenceng Dam and Cidanau Gated Weir were selected as the most optimum scheme for the Cidanau-Cibanten Water Resources Development Project through the comparative study on the conceivable alternative schemes. Following the above selection, more detailed geological investigations (phase II) were carried out on the selected scheme for formulating the project and examining the project feasibility.

The geological investigation were composed mainly of the core drilling with field tests in boreholes. The core drilling for 140 m with field tests were additionally carried out at the existing Krenceng Dam. The additional drilling executed for the Krenceng Dam are summarized as follows:

Site	No. of hole	Depth (m)
Krenceng	KR-4	20
Dam	KR-5	10
	KR-6	30
	KR-7	20
	KR-8	20
Diversion	Dt-1	20
Tunnel	Dt-2	20
Total	6 holes	140

Core drillings at the Krenceng Dam consist of four boreholes, for 100 m in the Phase-II. In the Phase-I three boreholes were drilled for 45 m. These boreholes are for confirming the foundation condition such as consolidation of rocks, weathering on rocks, permeability of rocks, groundwater tables in boreholes and so on.

Core drillings at the diversion tunnel site from Beroeng River to Krenceng River, confirm the condition of foundation rocks, development of weathering, thickness of talus deposits. The drill logs and the geological profiles are shown in Figs. C-31 to C-37 and Figs. C-14 (2) and C-15.

3.4.2 Foundation Rocks of Krenceng Dam

1) Rocks Underlying Krenceng Damsite and Reservoir Area

Unconsolidated pumice tuff occupy the most part of the dam foundation, which are underlain by tightly welded pumice tuff layer of about 20 m in thickness. In the reservoir area almost the same types of pumice tuff as the damsite crop out along the Krenceng river. Weathering on the rocks distributed at the Krenceng damsite and the reservoir area is developed in the surface zone of the undulating hill.

The borrow area for the soil material is proposed at the low ridge which is located between main stream and a tributary of the Krenceng river, at about 1 km south from the damsite. The elevation of the ridge is ranging from 35 m to 45 m.

2) Mechanical Strength of Foundation Rock

Unconsolidated pumice tuff occupies most parts of the surface of the dam foundation. Comparatively hard layer of welded pumice tuff is underlying under the elevation of about 5 m from the mean sea level.

In this stage, mechanical tests on the foundation rocks are not conducted except unconfined compression test with bulk density test on recovered core samples of welded pumice tuff from boreholes, KR-6, KR-4 and Dt-2. The test results are summarized as follows:

Sample No.	Borehole No.	Depth (m)	Bulk density (g/cm^3)	Compressive strength (kg/cm^2)
1	KR-6	17.50-17.80	1.903	65.43
2	KR-4	19.25-19.65	1.794	49.24
3	Dt-2	19.15-19.40	1.925	55.92

The smallest uniaxial compressive strength (qu) of about 50 kg/cm^3 was obtained for the sample of welded pumice tuff. The results of triaxial compression test in UU condition for unconsolidated pumice tuff show that values of internal friction angle (ø) range from 33.5° to 34.5°. Assuming that ø=35° and qu=50 kg/cm^2, the shearing stress of about 13 kg/cm^2 can be determined graphically using Mohr's circle .

The smallest bulk density of 1.8 was obtained for the samples of which compressive strength was smallest.

The strength of the unconsolidated pumice tuff was measured only by standard penetration test (SPT). N-value range from 20 to 50, and any close relation between N-value and their depth. The internal friction angle (ø) of about 34° for unconsolidated pumice tuff can be calculated from the N-value of about 30. On the other hand, shearing stress for this layer has not been measured, and the value should be determined with careful consideration.

3) Permeability of foundation rocks

At Krenceng Dam,Lugeon test was conducted in the drilled boreholes for welded pumice tuff by single packer method at 5 m interval in a general rule. The obtained Lugeon values range from Lu=0.1 to Lu=4.3, generally falling into Lu=0.2 to Lu=1.2, which are equivalent to the lower range of $K=1x10^{-5}$ cm/sec..

The Lugeon value of higher than Lu=5 were measured for tightly welded pumice tuff, at the other alternative sites. Judging from the the recovered cores, these high permeability is caused by joints and cracks. In the boreholes at the top of the steep slope of the hill, permeability coefficients of about $K=1x10^{-5}$ were obtained by open-end method for unconsolidated pumice tuff.

4. Seismicity

4.1 General

The location of the Study Area is placed in the northwest corner of the Java island. It is bordered by the Banten Sea in the north,by the Sunda Strait in the northwest, by the watershed of the Cibanten river in the east, and by the watershed of the Cidanau in the south.

To evaluate the seismic design coefficient for the dam and other structures, the seismic analysis is made based on the available earthquake record of the area within about 500 km of distance from the Project site.

4.2 Collected Data for Seismicity Analysis

1) Project site

The Project site is situated at the following location which corresponds to that of existing Krenceng dam near Cilegon.

Latitude	6 00 S
Longitude	106 00 E

2) Earthquake data

Taking into effectivity induced by earthquake to the Project,the collected data of earthquakes covers an area falling as below.

Latitude	1 00 S	to	11 00 S
Longitude	101 00 E	to	111 00 E

Seismic records for this range were collected from ISC (International Seismological Centre, England).

Source	Observation Period	Nos. of Record	Remarks
ISC	1913 to 1989	161	Magnitude > 4

4.3 Seismicity Analysis

4.3.1 Seismicity Intensity by Kawazumi's Method

In order to estimate impact induced by each earthquake to the Project site,seismic intensity at the site was computed for the ISC data on the basis of the following Kawazumi's formula.

$$Ij = Mk - 0.00183\,(d-100) - 4.605\,\log(d/100) \qquad d < 100\text{ km} \qquad (1)$$

$$Ij = Mk + 4.605\,\log(Do/D) + 2\,K\,(D-Do)\,\log(e) \qquad d \geq 100\text{ km} \qquad (2)$$

$$Mk = 2\,(M - 4.85) \qquad (3)$$

where,
- M : Magnitude in Richter Scale
- Mk : Magnitude in Kawazumi's formula, that is, JMA Intensity at the distance of 100 km from the epicenter
- Ij : Intensity in JMA (Japan Meteorological Agency) Scale
- d : Distance from the epicenter to the site (km)
- D : Distance from the focus to the site (km)
- Do : Distance from the focus to the point of 100 km from the epicenter (km)
- k : Damping rate of S-wave (= 0.0192/km)
- e : Base of natural logarithm

The expected acceleration is given by the following formula:

$$a = 0.45 \times 10^{Ij/2} \qquad Ij < 5.5 \qquad (4)$$

$$= 20 \times 10^{Ij/5} \qquad 5.5 < Ij < 7.0 \qquad (5)$$

where, a : Acceleration (cm/sec^2)

Ij : Intensity in JMA

Probable ground acceleration was revealed to be 70 to 80 gals as summarized in Table C-1 (1) to C-1 (3) at the Site.

4.3.2 Frequency Analysis

To compute the probable intensity for the 100 years return period, the recurrence analysis is made as below.

In plotting position analysis,the recurrence interval "Tr" is computed by the following equation:

$$Tr = P / m \qquad (6)$$

where, P : the observatory period

m : the serial number of an earthquake in observatory period

All records of the data were arranged in decreasing order of intensity Ij. The corresponding peak ground acceleration "a", and recurrence interval "Tr" were computed according to the equations (4) and (6) respectively. Using the same data as the frequency analysis, the relation between the peak ground acceleration "a" and the recurrence interval "Tr" is obtained follows:

$$\log(a) = -0.21235 + 1.13017 \log(Tr) \qquad (7)$$

The results for recurrence analysis are presented in Table C-2 (1) to C-2 (4) and plotted in Fig. C-42. The peak ground acceleration reaches 112 gal (0.11 G) for 100 years recurrence interval.

4.3.3 Design Criteria in Indonesia

The design seismic coefficient is obtained by the formula shown below and with a map of Indonesia earthquake zoning.