TABLE EP-2(1) EXISTING TRANSMISSION LINES

No.	Section			Circuit No.	Route Length (km)	Conductors
	(I) 150 kV Transmission Line					
1.	Waru	-	Bangil	1	31.547	ACSR 330
2.	Waru	-	Kebonagung	1	89.495	ACSR 330
3.	Bangil	-	Sutami	1	82.947	ACSR 330
4.	Kebonagung	-	Sutami	1	27.950	ACSR 330
5.	Waru	-	Perak	1	17.800	ACSR 330
6.	Waru	-	Gresik	2	24.950	ACSR 330
7.	Gresik	-	Segoromadu	2	3.900	ACSR 344.1
8.	Segoromadu	-	Lamongan	2	28.200	ACSR 240
9.	Lamongan	-	Batat	2	31.000	ACSR 240
10.	Babat	-	Bojonegoro	2	35.300	ACSR 240
11.	Waru	-	Mojokerto	1	35.700	ACSR 330
12.	Mojokerto	-	Kediri	1	69.100	ACSR 330
13.	Kediri	-	Manisrejo	1	71.000	ACSR 330
14.	Probolinggo	-	Jember	1	92.850	ACSR 330
15.	Jember	-	Banyuwangi	1	82.400	ACSR 330
16.	Waru	-	Tandes	1	13.800	ACSR 330
17.	Tandes	-	Perak	1	4.000	ACSR 330 + of Cab 200x2
18.	Manisrejo	-	Palur (Jateng)	2	78.674	ACSR 330
19.	Sukolilo	-	Waru	1	11.05	ACSR 330
20.	Lumajang	-	Incoming	2	7.3	ACSR 330
21.	Segoromadu	-	Petrokimia	2	2.1	ACSR 330
	Sub-Total (I)				841.063	(1,052.487 km-cct)

TABLE EP-2(2)

No.	Section			Circuit No.	Route Length (km)	Conductors
	(II) 70 kV Transmission Line					
1.	Waru	-	Bangil	2	31.850	CU 50
2.	Waru	-	Sukolilo	2	11.0	CU 50
3.	Sukolilo	-	Ngagel	2	4.5	CU 50
4.	Ngagel	-	Ujung	2	13.297	CU 50
5.	Ujung	-	Perak	2	2.89	ACSR 300 MCM
6.	Perak	-	Krembangan	2	2.456	CVT 100
7.	Krembangan	-	Swahan	2	5.5	ACSR 300 MCM
8.	Sawahan	-	Mojokerto	2	37.1	ACSR (3/0)
9.	Sawahan	-	Waru	2	10.6	CU 50
10.	Sawahan	-	Tandes	2	3.5	ACSR 300 MCM
11.	Tandes	-	Segoromadu	2	10.5	ACSR 300 MCM
12.	Segoromadu	-	Semen Gresik	2	2.1	ACSR 300 MCM
13.	Segoromadu	-	Barat	2	1.0	ACSR (3/0)
14.	Segoromadu	-	Petrokimia	2	8.4	ACSR 300 MCM
15.	Bangil	-	Pandaan	2	9.7	ACSR 300 MCM
16.	Bangil	-	Probolinggo	2	52.704	ACSR 300 MCM
17.	Bangil	-	Buduran	1	14.831	CU 50
18.	Bangil	-	Blimbing	2	43.5	ACSR (3/0)
19.	Blimbing	-	Mendalan	2	39.331	ACSR (3/0)
20.	Blimbing	-	Polehan	2	12.159	CU 50
21.	Polehan	-	Kebonagung	2	13.0	ACSR 300 MCM
22.	Kebonagung	-	Turen	1	21.126	CU 50
23.	Mendalan	-	Mojokerto	2	49.8	ACSR (3/0)
24.	Mojokerto	-	Kertosono	1	45.4	ACSR 300 MCM
25.	Manisrejo	-	Dolopo	1	14.0	ACSR 300 MCM
26.	Dolopo	-	Ponorogo	1	15.5	ACSR 300 MCM
27.	Manisrejo	-	Ponorogo	1	29.5	ACSR 300 MCM
28.	Ponorogo	-	Pacitan	2	62.2	ACSR 300 MCM
29.	Ponorogo	-	Trenggalek	2	38.8	ACSR 300 MCM
30.	Trenggalek	-	Tulungagung	2	33.0	ACSR 300 MCM
31.	Kertosono	-	Manisrejo	1	1.6	ACSR 300 MCM
32.	Tulungagung	-	Blitar	2	28.0	ACSR 300 MCM
33.	Blitar	-	Wlingi	2	12.0	ACSR 300 MCM
34.	Kertosono	-	Ploso	2	25.0	ACSR 300 MCM
35.	Sengguruh	-	Karangkates	1	12.772	ACSR (3/0)
36.	Tulungagung	-	Kediri	2	29.2	ACSR 300 MCM
37.	Madium	-	Maospati	2	10.25	ACSR 300 MCM
	Sub-Total (II)				758.066 (1,361.403 km-cct)	

TABLE EP-2(3)

No.	Section			Curcuit No.	Route Length (km)	Conductors
	(III) 30 kV Sub-transmission Line					
1.	Probolinggo	-	Leces	2	9.831	CU 35
2.	Probolinggo	-	Winongan	2	38.164	CU 35
3.	Leces	-	Lumajang	1	33.253	ACSR (1/0)
4.	Mendalan	-	Jombang	1	39.9392	CU 25
5.	Mendalan	-	Kediri	2	33.809	ACSR (1/0)
6.	Kediri	-	Tulungagung	2	27.791	CU 35
7.	Tulungagung	-	Blitar	2	28.781	ACSR (1/0)
8.	Tulungagung	-	Trenggalek	2	32.684	ACSR (1/0)
	Sub-Total (III)				243.705 (414.765 km-cct)	
	(IV) 25 kV Sub-transmission Line					
1.	Giringan	-	Golang	2	2.682	CU 35
2.	Golang	-	Mranggen	2	6.014	CU 35
3.	Dungus	-	Dolopo	2	11.2	CU 50
4.	Dolopo	-	Ponorogo	1	16.162	ACSR (1/0)
5.	Dolopo	-	Ngebel	1	10.75	ACSR (3/0)
6.	Golang	-	Madiun	2	8.4	ACSR (1/0)
7.	Madiun	-	Mranggen	1	11.175	CU 25
	Sub-Total (IV)				66.383 (94.679 km-cct)	
	TOTAL (I + II + III + IV)				1,909.217 (2,923.334 km-cct)	

Note: /1 - Figures in parentheses show the line length of the line (Circuit No. x Route Length).

(Source: Ref. EP-01 - 07 & 08)

TABLE EP-3(1) EXISTING SUBSTATION TRANSFORMERS IN EAST JAVA SYSTEM

(As of 1983/84)

	Name	Voltage Ratio (KV)	Capacity (No.) x (MVA)	Total Capacity (MVA)
1.	Sawahan	70/20/6	2 x 10	46
		70/20	1 x 20	
		70/6	1 x 6	
2.	Tandes	150/20	1 x 30	30
3.	Segoromadu (Gresik)	150/70	1 x 50	
		70/20	1 x 20	70
4.	Krembangan (Perak)	70/20	2 x 20	40
5.	Ujung	70/20/6	1 x 20	32
		70/6	2 x 6	
6.	Lamongan	150/20	1 x 20	20
7.	Babat	150/20	1 x 20	20
8.	Bojonegoro	150/20	1 x 20	20
9.	Driyorejo	70/20	1 x 20	20
10.	Waru	150/70	3 x 39	
		150/70	2 x 50	317
		150/20	1 x 30	
		70/20	2 x 20	
		70/20	1 x 30	
11.	Sukolilo	150/20	1 x 30	
		70/20	1 x 10	90
		70/20	1 x 20	
		70/20	1 x 30	
12.	Buduran (Sidoarjo)	70/20	1 x 20	20
13.	Ngagel	70/6	2 x 3	22
		70/20/6	1 x 16	

TABLE EP-3(2)

(As of 1983/84)

	Name	Voltage Ratio (KV)	Capacity (No.) x (MVA)	Total Capacity (MVA)
14.	Bangil	150/70	2 x 35	80
		70/20/6	1 x 10	
15.	Pandaan	70/20	1 x 20	20
16.	Probolinggo	150/70	1 x 35	
		70/30	1 x 6	61
		70/30/6	1 x 10	
		70/20	1 x 10	
17.	Porong	70/6	1 x 1	5
			1 x 4	
18.	Sukorejo	70/6	1 x 1.5	11.5
		70/20	1 x 10	
19.	Plered	70/20	1 x 20	28
		70/6	1 x 6	
		30/6	2 x 1	
20.	Gondan Wetan	70/20	1 x 6	6
21.	Winongan	30/20/6	1 x 6	6
22.	Jember	150/70/20	1 x 20	20
23.	Banyuwangi	150/70/20	1 x 20	20
24.	Lumajang	30/6	1 x 3	3
25.	Klakah	30/6	1 x 0.2	0.2
26.	Leces	30/6	2 x 3	6
27.	Blimbing	70/6	1 x 3	
		70/6	1 x 10	33
		70/20	1 x 20	
28.	Kebonagung (Malang Selatan)	150/70	1 x 35	45
		70/20	1 x 10	
29.	Polehan	70/6	2 x 6	32
		70/20	1 x 20	
30.	Turen	70/6	1 x 3.3	13.3
		70/20	1 x 10	
31.	Lawang	70/6	1 x 4	24
		70/20	1 x 20	

TABLE EP-3(3)

(As of 1983/84)

	Name	Voltage Ratio (KV)	Capacity (No.) x (MVA)	Total Capacity (MVA)
32.	Sengkaling	70/6	1 x 4	10
		70/20	1 x 6	
33.	Sengguruh	70/6	1 x 3	3
34.	Karangkates	70/6	1 x 5	5
35.	Kediri	150/70	1 x 35	52
		70/20	1 x 10	
		30/6	2 x 3.5	
36.	Pranggang	30/6	2 x 1	2
37.	Tulungagung	70/30/20	1 x 10	23
		70/30	1 x 10	
		30/6	1 x 3	
38.	Blitar	30/6	1 x 1	1
39.	Blitar Baru	70/20	1 x 6	6
40.	Trenggalek	30/6	1 x 1	1
41.	Mojokerto	150/70	1 x 35	51
		70/20/6	1 x 16	
42.	Kertosono	70/20	1 x 10	10
43	Jombang	30/6	1 x 1	3
		30/6	1 x 2	
44.	Ploso	70/20	1 x 6	6
45.	Madium	25/6	1 x 1.5	
		25/6	1 x 2	9.5
		25/20/6	1 x 6	
46.	Manisrejo (New Madiun)	150/70	1 x 35	55
		70/25/20	1 x 10	
		70/20	1 x 10	
47.	Ponorogo	70/25/20	1 x 10	13
		25/20/6	1 x 3	
48.	Dolopo	70/25/20	1 x 10	10.8
		25/6	1 x 0.8	
49.	Caruban	70/6	1 x 6	6
50.	Mranggen	25/20	1 x 9	11
		25/6	1 x 2	

TABLE EP-3(4)

(As of 1983/84)

	Name	Voltage Ratio (KV)	Capacity (No.) x (MVA)	Total Capacity (MVA)
51.	Pacitan	70/30/6	1 x 3	3
52.	Perak Tie Tr.	150/70	1 x 35	35
53.	Barata	70/20	2 x 10	20
54.	Petrokimia	70/20	1 x 20	50
		150/20	1 x 30	50
55.	Semen Gresik	70/20	2 x 20	64
		70/20	1 x 24	
56.	Ispat Indo	70/11	2 x 20	40
57.	Gudang Garam	70/20	2 x 10	20
58.	Mojowarno	30/6	1 x 0.63	0.63
59.	Ngoro	30/6	1 x 0.63	0.63
60.	Kandangan	30/6	1 x 63	0.73
		30/0.2	1 x 0.1	
61.	Kasembon	30/6	1 x 0.125	0.125
62.	Brenggolo	30/6	1 x 0.125	0.125
63.	Ngadiluwih	30/6	1 x 0.2	0.2
64.	Keras	30/6	1 x 0.2	0.2
65.	Kunir	30/6	1 x 0.63	0.63
66.	Srengat	30/6	2 x 0.2	0.4
67.	K.D. Lurah	30/0.38	1 x 0.1	0.1
68.	Durenan	30/6	1 x 0.63	0.63
69.	Malasan	30/6	1 x 0.2	0.2
70.	Katrengan	25/0.22	1 x 0.025	0.025
71.	Dungus	25/0.22	1 x 0.1	0.1
72.	Ngetal	30/6	1 x 0.2	0.2
73.	Jenangan	25/6	1 x 0.2	0.2
74.	Tongas	30/6	1 x 0.2	0.2
	TOTAL			1,676.625

(Source: Ref. EP-07 & EP-08)

TABLE EP-3(5) ON-GOING SUBSTATION EQUIPMENT IN EAST JAVA

PELITA III

(As of 1983/84)

No.	Name of Substations	Voltage Ratio (kV)	Capacity (No. x MVA)	Total Capacity (MVA)
1.	Maospati	70/20	1 x 6	6
2.	Leces	150/20	1 x 20	20
3.	Lumajang	150/20	1 x 20	20
4.	Pacitan	70/20	3 x 3	9
5.	Krembangan	70/20	1 x 10	10
6.	Probolinggo (Unit S/S)	70/20	1 x 10	10
7.	Tandes	150/20	1 x 20	20
8.	Waru	150/20	1 x 60	60
9.	Sukolilo	150/20	1 x 60	60
	TOTAL			215

(Source: PLN PIRING Jatim)

TABLE EP-4

GENERATED AND SOLD ENERGY IN EAST JAVA

	1974/75	75/76	76/77	77/78	78/79	79/80	80/81	81/82	82/83
PRODUCTION (GWh)									
Hydro	433	514	477	451	631	683	616	833	631
Steam oil	141	129	192	267	310	512	785	987	1,524
Diesel	37	40	48	57	55	67	80	83	44
Steam coal	-	-	-	-	-	-	-	-	-
Gas turbine	-	-	-	-	-	-	-	-	-
Geo-thermal	-	-	-	-	-	-	-	-	-
Total	611	683	717	775	996	1,262	1,481	1,903	2,199
Increase (%)	-	11.8	5.0	8.1	28.5	26.7	17.4	28.15	15.6
LOSSES (GWh)									
Station use	15	13	16	19	26	58	70	70	90
T/C loss	29	33	42	46	37	58	71	137	140
Distribution loss	107	109	123	152	199	186	269	246	292
Total	151	155	181	217	262	302	410	453	522
% W.R.T. Production	24.8	22.7	25.2	28.0	26.3	24.0	27.7	23.8	23.7
SALES (GWh)									
Residental	204	224	241	266	319	393	459	553	641
Commercial	60	78	78	82	94	108	192	211	232
Industry	172	200	190	197	301	372	459	655	863
Public	24	27	28	35	39	46	51	56	62
Total	460	529	537	580	753	919	1,161	1,475	1,798
Increase (%)	-	15.0	1.6	8.0	29.8	22.0	26.4	27.0	21.8
MVA CONNECTED									
Residental	67	75	83	100	128	167	208	252	301
Commercial	40	42	45	51	57	65	120	130	149
Industry	104	113	119	143	192	247	231	304	357
Public	8	9	10	17	14	15	21	24	27
Total	219	239	257	311	391	494	580	710	834
Increase (%)	-	9.0	7.6	21.1	25.6	26.3	17.4	22.5	17.5
NO. OF CONSUMERS (1,000)									
Residental	210	220	231	255	301	367	445	519	617
Commercial	16	17	19	21	23	27	30	33	35
Industry	2	2	2	2	2	2	2	2	3
Public	2	2	2	3	3	4	5	6	7
Total	230	241	254	281	329	400	482	560	662
Increase (%)	-	4.9	5.4	10.4	17.3	21.5	20.7	17.0	18.4

(Source: REf. EP-04)

TABLE EP-5

WAITING BIG CUSTOMERS IN EAST JAVA

(As of 1982/83)

	Name of Customers	Required Capacity & Voltage	Year to be connected	Status
1.	PT. Petrokimia Gresik	1) 8.13 MVA/20 kV 2) 9.38 MVA/20 kV	Aug. 1983 Jun. 1985	Data on electric requirement is not yet officially fixed.
2.	PT. Pabrik Kertas Leces	1) 6.0 MVA/6 kV 2) 6.0 MVA/6 kV	1983 1985	Waiting more detail information
3.	PT. Surabaya Agung Industri Pulp dan Kertas	1) 10.0 MVA/70 kV 2) 8.0 MVA/70 kV	1983 1985	Waiting more detail information
4.	PT. Gudang Garam (Cigarette)	1) 12.0 MVA/70 kV 2) 12.0 MVA/70 kV	1982 1983	Contract was signed on Oct. 1981
5.	PT. Pakerin (Paper)	1) 2.0 MVA/20 kV 2) 3.0 MVA/20 kV 3) 5.0 MVA/20 kV	1982/83 1983/84 1984/85	Negotiation will be done by PLN Wilayah XII
6.	PT. Ciwi Kimia (Paper)	1) 24.0 MVA/70 kV	Oct. 1983	Existing contract: 5.54 MVA/ 20 kV
		2) 12.0 MVA/70 kv	1985/86	Draft contract for addition is under processing.
7.	Perum Kertas Banyuwangi (Paper)	7.5 MVA	1982	Contract will be made by PLN Wilayah XII
8.	PT. Semen Madura	62.5 MVA/50 kV	Jun. 1985	Connection schedule will be changed from June. 1985 to Oct. 1985.
9.	PT. Semen Madura (Packing plant)	6.25 MVA/20 kV	Jun. 1985	Contract was signed on May 26, 1982.
	TOTAL	21.5 MVA in 1982/83 62.13 MVA in 1983/84 5.0 MVA in 1984/85 104.13 MVA in 1985 193.76 MVA		

(Source: Ref. EP-02)

TABLE EP-6 BASIC POWER TARIFF IN INDONESIA

	Tariff Level	Power Limit	Load Charge in Rp./kVA 1/ 1983	2/ 1984	Consumption Charge in Rp./kWh 1983	1984
S_1	Small consumer	200 VA	3/	-	-	-
S_2	Social bodies	250 A - 200 kVA	1,600	2,100	35	43.50
R_1	Simple household	250 VA - 500 kVA	1,600	2,100	56	70.50
R_2	Small household	501 VA - 2,200 VA	1,600	2,100	67	84.50
R_3	Medium household	2,201 VA - 6,600 VA	2,800	3,680	97	126.50
R_4	Big household	6,601 VA	2,800	3,680	117.5	158
U_1	Small commerce	250 VA - 2,200 VA	2,800	3,680	99.5	134
U_2	Medium commerce	2,201 VA - 200 kVA	2,800	3,680	108.5	150
U_3	Big commerce	201 kVA up	1,750	2,300	4/ WBP = 111 LWBP = 70	158 99
U_4	Temporary connection	-	-	-	221	307
I_1	Industry (low voltage)	3.8 kVA - 99 kVA	1,750	2,300	WBP = 81.5 LWBP = 50	106 66
I_2	Industry (low voltage)	100 kVA - 200 kVA	1,750	2,300	WBP = 77 LWBP = 48	100 62.50
I_3	Industry (medium voltage)	201 kVA up	1,600	2,100	WBP = 68.5 LWBP = 43	96.50 60.50
I_4	Industry (high voltage)	5,000 kVA up	1,500	1,970	WBP = 58 LWBP = 37	81.50 52
G_1	Office (low voltage)	250 VA - 200 kVA	2,800	3,680	71	96
G_2	Office (medium voltage)	201 kVA up	1,500	1,970	WBP = 72 LWBP = 47	99 65
J	Street lights	-	-	-	56.5	76.50

1/ Source: PLN Surat Keputusan Direksi No.003/DIE/83 of Jan. 11, 1983

2/ Source: PLN Surat Keputusan Direksi No.030/DIR/84 of March 1st, 1984

3/

Tariff Level	Power Limit	Monthly Fee (Rp.) 1/ 1983	2/ 1984
S_1	60 VA	1,240	1,550
	75 VA	1,555	1,940
	100 VA	2,010	2,510
	125 VA	2,560	3,200
	150 VA	3,015	3,765
	175 VA	3,480	4,350
	200 VA	4,020	5,025

4/ WBP = Peak load hour (18:00 - 22:00 local time)
LBWP = Off-peak load hour (22:00 - 18:00 local time)

TABLE EP-7(1) PLANNING OF SUBSTATION EQUIPMENT IN EAST JAVA SYSTEM

PELITA IV

(1984/85 - 1988/89)

No.	Name of Substation	Voltage Ratio (kV)	Capacity (No. x MVA)	Total Capacity (MVA)
	(I) Committed			
1.	Kenjeran	150/20	1 x 50	50
2.	Rungkut	150/20	1 x 50	50
3.	Krembangan	70/20	1 x 30	30
4.	Sidoarjo	70/20	1 x 20	20
5.	Tandes	150/70 150/20	2 x 50 1 x 50	150
6.	Krian	150/20	2 x 20	40
7.	Gilitimur	150/20	1 x 10	10
8.	Tanjungan	150/20	1 x 2	2
9.	Situbondo	150/20	1 x 15	15
10.	Bondowoso	150/20	1 x 15	15
11.	Nganjuk	70/20	1 x 10	10
12.	Kediri	150/20	1 x 30	30
13.	Sengkaling	70/20	1 x 20	20
14.	Kebonagung	150/20	1 x 30	30
15.	Porong	70/20	1 x 20	20
16.	Darmogrand	150/20	1 x 50	50
17.	Ngagel	150/20	1 x 20	20
18.	Simpang	150/20	1 x 50	50
19.	Polehan	70/20	1 x 10	10
20.	Kebonagung	150/70	1 x 35	35
21.	Segoromadu	150/70 150/70	2 x 50 1 x 30	130
22.	Rungkut	150/20	1 x 50	50
23.	Babatan	150/20	1 x 50	50
24.	Tuban	150/20	1 x 20	20
25.	Ngawi	150/20	1 x 10	10

TABLE EP-7(2)

No.	Name of Substation	Voltage Ratio (kV)	Capacity (No. x MVA)	Total Capacity (MVA)
26.	Bangkalan	150/20	1 x 10	10
27.	Sampang	150/20	1 x 10	10
28.	Pamekasan	150/20	1 x 10	10
29.	Sumenep	150/20	1 x 10	10
30.	Kertosono	70/20	1 x 10	10
31.	New Madium (Manisrejo)	150/20	1 x 20	20
32.	Mobile trafo	150/20	1 x 30	30
33.	Kraksaan	150/20	1 x 20	20
	Sub-Total (I)			1,037
	(II) Proposed			
1.	Kepanjen	70/20	1 x 10	10
2.	Besuki	150/20	1 x 20	20
3.	Surabaya 12A	150/20	1 x 50	50
4.	Jombang	70/20	1 x 10	10
5.	Trenggalek	70/20	1 x 10	10
6.	Mojokerto	150/70	1 x 50	50
7.	Probolinggo	150/20	1 x 20	20
8.	Kediri	150/20	1 x 50	50
9.	Kraksaan	150/20	1 x 20	20
10.	Segoromadu	(150/70 150/20	2 x 50 1 x 30)	130
	Sub-Total (II)			370
	TOTAL			1,407

(Source: PLN PIRING Jatim)

TABLE EP-8(1) PLANNING OF TRANSMISSION LINES IN EAST JAVA SYSTEM

PELITA IV

(1984/85 - 1988/89)

No.	Section	Circuit No.	Route Length (km)
	(I) 150 kV Transmission Lines		
1.	Sukolilo - Kenjeran	1	6
2.	Sukolilo - Waru	+1	11.05
3.	Gresik - Krian	2	12
4.	Krian Branch	4	0.9
5.	Waru - Mojokerto	+1	35.6
6.	Bangil - Probolinggo	2	27.5
7.	Krian - Babatan	2	4.5
8.	Gilitimur - Bangkalan	1	15.6
9.	Bangkalan - Sampang	1	57
10.	Sampang - Pamekasan	1	25.3
11.	Pamekasan - Sumenep	1	50
12.	Probolinggo - Kraksaan	2	15
13.	Kraksaan - Paiton	2	15
14.	Sukolilo - Kenjeran	+1	6
15.	Ngawi incoming	2	5
16.	Babat - Tuban	1	40
17.	Gresik - Tajungan	2	2.5
18.	Tajungan - Gilitimur	2	1.85
19.	Gilitimur - Labang	2	3
20.	Labang - Sekarbungu	2	1.9
21.	Kebonagung incoming	2	1.5
22.	Kebonagung - Sengkaling	2	7.5
23.	Jember - Bondowoso	1	42
24.	Bondowoso - Situbondo	1	36
25.	Leces - Jember	+1	84.2
26.	Jember - Banyuwangi	+1	82

TABLE EP-8(2)

No.	Section	Circuit No.	Route Length (km)
27.	Mojokerto - Kediri	+1	69
28.	Kediri - Manisrejo (Madiun)	+1	71
29.	Bangil incoming	1	1
30.	Lumajang Branch	1	7.5
31.	Darmo Grand Branch	2	2.5
32.	Sukolilo - Ngagel	2	2.25
	(under ground)	2	2.25
33.	Ngagel - Simpang	2	2.75
	(under ground)		
	Sub-Total (I)		744.9
			(853.350 km-cct)
	(II) 70 kV Transmission Lines		
1.	Sukolilo - Waru	2	11.05
2.	Sukolilo - Ngagel	2	0.5
3.	Sidoarjo incoming	+2	1.0
4.	Kebonagung - Sengguruh	1	21
5.	Nganjuk incoming	2	1.7
6.	Sengkaling Branch	2	1
7.	Porong incoming	+1	1
8.	Sawahan - Mojokerto	2	18.5
	Sub-Total (II)		55.75
			(89.5 km-cct)
	TOTAL		800.65
			(942.85 km-cct)

Note: The symbol "+" means additional circuit stringing on the existing towers.

(Source: PLN PIRING Jatim)

ANNEX MP

DAM DEVELOPMENT STUDY

ANNEX MP

The Supporting Report of Dam Development Study (ANNEX MP) comprises of 14 series. The contents of ANNEX MP are compiled in the form of Note-MP. In ANNEX MP, a series of Note-MP is taken up as an independent chapter. Therefore, Tables and Figures are attached to each related Note-MP. The title of each Note-MP forming ANNEX MP is shown as follows:

NOTE MP-1

RESERVOIR LIFE

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURES

NOTE MP - 1 RESERVOIR LIFE

1. Karangkates and Lahor reservoirs

(1) Reservoir Sediment Survey

The original storage capacities of these two reservoirs were estimated during the design stage as shown on Fig. 1 and 2.

Intensive reservoir sediment survey was commenced in the Karangkates reservoir in 1977 and in the Lahor reservoir in 1984, and has been continued. Results of these survey in the Karangkates reservoir are as follows;

Survey Year	Estimated Period	Annual Deposit x 10^3 m^3	Annual Yield Rate mm/year	Estimate by
1980	1977- 80	1,600	0.87	NK
1982	1977- 82	2,045	1.11	HRS
1983	1981- 83	1,426	0.77	BRBDEO

The survey result of the Lahor reservoir is not yer processed by BRBDEO.

(2) Check on new topographic maps

Aerophoto shooting was made over the Karangkates reservoir in 1982 when the reservoir water level was lowered below EL. 260.0 m.
In 1983, topographic maps of 1 to 2,500 scale with the contour interval of 2.5 m were prepared. From these maps, the storage capacity above EL. 260.0 m is checked by plainmetering.

Below EL. 260.0 m, the following methods are adopted.

(a) Plotting the location of beacons for sediment survey on the 1 to 5,000 scale maps reduced from 1 to 2,500 scale maps.

(b) Putting the elevations obtained by 1982 sediment survey along the cross section line.

(c) Drawing up the contour lines referring to the topography above EL. 260.0 m.

(d) Measuring the area and calculation of storage capacity.

Results of the above works are as shown in Table 1 together with the original storage capacity. From this table, it is known that the gross storage below EL. 272.5 m has changed from 343 x 10^6 m^3 in 1972 to 314.8 x 10^6 m^3 in 1982. Difference is 28.2 x 10^6 m^3. In terms of the effective storage, the change is from 253.0 x 10^6 m^3 to 234 x 10^6 m^3.

If difference of 28.2 x 10^6 m^3 is assumed to be caused all by the reservoir sediment, the sediment inflow from the catchment area of 2,050 km^2 in this period is calculated at 28.2 x 10^6 m^3 per annum or 1.38 mm per annum.

Taking into account the density of the available cross section lines in large reservoir area and the unavoidable errors in drawing up the contour lines based on the sounding data, the obtained sediment yield rate of 1.38 mm per annum is considered to indicate only a rough figure of reservoir sediment in this period.

Aerophoto shooting and mapping when the water level is lowered near to the low water level is considered the most reliable method to estimate the storage capacity more accurately.

(3) Reservoir sediment based on sediment discharge measurement records

Other method to estimated the reservoir sedimentation is estimation from the water discharge and sediment rating curve, which is developed from the sediment discharge measurement records.

In the catchment area of the Karangkates reservoir, sediment measurement has been carried out at Blobo on the Brantas river, Sumberejo on the Lesti river and Metro on the Metro river. From the measurement records, the sediment rating curves are developed as shown on Fig. 3, 4 and 5 and can be expressed by the following formula;

Blobo	$Qs = 1.2 \times Q^{2.1}$
Sumberejo	$Qs = 1.2 \times Q^{2.4}$
Metro	$Qs = 4.0 \times Q^{2.0}$

Where; Qs ; sediment load in ton per day

Q ; water discharge in m^3/sec

Data on bed load are very scare in and around the study area. In this study the bed load amount is assumed to be 10% of the total sediment amount referring the emperical values in the Brantas river basin.

Using the above formula and the discharge for the Brantas river, Lesti river and Metro river sub-basins estimated from the estimated discharge at the Karangkates damsite as mentioned later, the annual sediment production in the catchment area at the damsite is estimated at 3,235 x 10^3 ton/year consisting of;

Brantas river sub-basin	1,140 x 10^3 ton/year
Lesti river sub-basin	1,892 x 10^3 ton/year
Metro river sub-basin	203 x 10^3 ton/year

Assuming the unit weight of sediment as 1.4 ton/m^3, the annual sediment production in volume is estimated at 2.3 x 106 m^3. Then, the sediment yield rate is 1.1 mm per annum.

If the trap efficiency of the Karangkates reservoir is 90%, the sediment yield rate in terms of the deposited amount in the reservoir is 1 mm per annum. This figure well coincides with the figures obtained by the reservoir sediment survey.

To this end, as for the sediment in the Karangkates reservoir, 1 mm per annum over the catchment area of 2,050 km^2 is taken and used further study.

Since data on the reservoir sediment in the Lahor reservoir is yet to be made available, the same figure as 1 mm per annum is applied to the Lahor reservoir.

(4) Sediment distribution in reservoir

The storage capacity is affected not only by the amount of the reservoir sediment but also the distribution pattern of the sediment in the reservoir.

Sediment distribution study is made by the modified empirical area reduction method, in which the reservoir is classified according to reservoir water depth and storage capacity.
Based on the original relationships between water depth and capacity as shown in Table 2., the Karangkates and Lahor reservoirs are classified in US - Type I and US - Type II, respectively.

The storage capacity resulted from the sediment distribution study is as shown in Table 3. and Fig. 6 for the Karangkates reservoir and Table 4 for the Lahor reservoir.

Results are summaried as shown below;

	Effective Stor.ge Capacity (MCM)		
	K.Kates	Lalor	Total
Original	253.0	29.4	282.4
1982	232.5	28.6	261.1
2000	195.6	27.6	223.2
After 50 years	150.5	25.4	175.9

The obtained storage capacity curves are used for further study.

2. Selorejo Reservoir

(1) Reservoir sediment survey

The sediment survey in the Selorejo reservoir was commenced in 1977, and has been continued since 1982. For the period from 1977 to 1982, the reservoir sedimentation volume was estimated as follows;

	Catchment area (sq.km)	Annual sediment volume (MCM)	Sediment yield rate (mm)
Konto river arm	185	0.175	0.95
Kwayangan river	53	0.057	1.08
Konto river, total	238	0.232	0.98

Judging from the above figures, the reservoir sediment in the Selorejo reservoir can be said to be 1 mm per annum from its catchment area.

(2) Storage capacity

The original storage capacity curve of the Selorejo reservoir is as shown on Fig. 7. According to the water depth and storage capacity relations shown in Table 5, the Selorejo reservoir is classified into US - Type II reservoir. Taking the annual sediment volume of 238,000 m^3, the present and future storage capacity is estimated by the empirical area reduction method.

Results are as shown below

	Effective storage capacity (MCM)	
	HWL EL. 620 m Dec. - Apr. (Flood season)	HWL EL. 622 m May - Nov.
Original	46.5	54.6
1982	44.9	52.9
2000	42.4	49.5
After 50 years	39.4	46.5

The above figures are used for the reservoir study.

3. Wlingi Reservoir

The Wlingi dam is located 22 km downstream of the Karangkates dam and has a catchment area of 2,890 km^2. Of this catchment area, 2,050 km^2 is controlled by the Karangkates dam, and 160 km^2 by the Lahor dam. Then, the remaining sub-basin is 680 km^2.

The effective capacity of 5.2 x 10^6 m^3 is for daily regulation of flow for peak power generation. The dead storage capacity of 14.8 x 10^6 m^3 is provided for the inflow of sediment mainly from the mountain-side of Mt. Kelud in the right side of the reservoir.

Among the tributaries, Putih river and Ganggang river flow into the reservoir in the location close to the dam embankment at an acute angle to the dam axis.

During design and construction, it was considered that if a sediment banks were formed in high and flat shape between the mouths of two tributaries and the dam embankment, there would be possibilities of direct attack of floods from two tributaries against the dam embankment.

Condition of the sediment development in the reservoir is checked based on the sounding survey data in 1982. Cross sections near the dam, No. 140, 138, and 136, are as shown on Fig. 8. Judging from these cross sections, it can be said that the sediment development near the dam embankment is little, and there would be few possibilities of direct attack of floods against the dam embankment, for the time being.
If the sediment from the Putih river and Ganggang river form a high deposit between the river mouth and the dam in future and the dam em embankment becomes dangerous against the direct attack of floods, it will be neccessary to divert floods from the Putih river and Ganggang river to the downstream of the Wlingi dam through a diversion channel.

Table 1 COMPARISON OF RESERVOIR AREA AND STORAGE OF KARANGKATES DAM

Elevation (EL.m)	Original (1972) Area ($\times 10^6 m^2$)	Original (1972) Storage ($\times 10^6 m^3$)	Survey (1982) Area ($\times 10^6 m^2$)	Survey (1982) Storage ($\times 10^6 m^3$)
186.0	0.00	0.00		
190.0	0.07	0.01		
195.0	0.08	0.26		
200.0	0.10	1.00		
205.0	0.25	2.38		
210.0	0.50	4.51	0.0	0.0
215.0	0.70	7.88	0.37	0.92
220.0	1.10	12.00	0.93	4.18
225.0	1.70	18.00	1.52	10.32
230.0	2.30	28.00	2.23	19.70
235.0	3.25	42.00	3.09	32.99
240.0	4.40	60.00	4.15	51.09
245.0	5.50	85.00	5.28	74.66
246.0	6.10	90.00	- -	80.34
250.0	6.70	114.00	6.10	103.09
255.0	7.80	150.00	7.10	136.08
260.0	9.40	197.00	8.26	174.47
262.5	10.20	220.00	9.41	196.55
265.0	11.40	245.00	10.60	221.56
267.5	12.50	274.00	11.71	249.04
270.0	13.70	305.00	13.01	280.34
272.5	15.00	343.00	14.56	314.81
275.0	16.5	385.0	16.19	353.26
277.5	19.0	425.0	17.19	395.97
280.0	21.0	480.0	20.03	443.47

Note: (1) Original area and storage data (1972) is estimated based on Fig. MP-1.1.

(2) Area above EL. 260m (Survey in 1982) are estimated based on aerophoto shooting map.

Area under EL. 260m (Survey in 1982) are estimated based on cross section survey data.

Table 2 **RELATIONSHIP BETWEEN RESERVOIR STORAGE (C) AND RESERVOIR WATER DEPTH (h) (KARANGKATES AND LAHOR DAM)**

(Karangkates Dam)				(Lahor Dam)			
Elevation (El. m)	Storage ($\times 10^6 m^3$)	h (%)	C (%)	Elevation (El. m)	Storage ($\times 10^6 m^3$)	h (%)	C (%)
186.0	0.0	0.0	0.0	220.0	0.0	0.0	0.0
205.0	1.0	20.0	0.3	225.0	0.2	9.5	0.5
210.0	2.0	28.0	1.0	230.0	0.5	19.0	1.4
215.0	4.0	34.0	1.2	235.0	1.0	28.6	2.8
220.0	12.0	39.0	3.5	240.0	1.9	38.1	5.3
225.0	18.0	45.0	5.2	245.0	3.2	47.6	8.9
230.0	28.0	51.0	8.2	250.0	5.0	57.1	13.9
235.0	42.0	57.0	12.2	253.0	6.7	62.9	18.6
240.0	60.0	62.0	17.5	255.0	8.0	66.7	22.2
245.0	85.0	68.0	24.8	257.5	10.0	71.4	27.7
250.0	114.0	74.0	33.2	260.0	12.6	76.2	34.9
255.0	150.0	80.0	43.7	262.5	16.0	81.0	44.3
260.0	197.0	86.0	57.4	265.0	20.2	85.7	56.0
265.0	245.0	91.0	71.4	267.5	24.6	90.5	68.1
270.0	305.0	97.0	88.3	270.0	30.1	95.2	83.1
272.5	343.0	100.0	100.0	272.7	36.1	100.0	100.0

Table 3 ESTIMATED RESERVOIR STORAGE OF KARANGKATES DAM

(Unit : x 10^6 m^3)

Elevation (El. m)	Original Storage (1972)	Estimated Storage After 10 years (1982) US-TYPE I	US-TYPE II	US-TYPE III	US-TYPE IV	JP-TYPE II	JP-TYPE III	After 50 years US-TYPE I
186.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
190.0	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
195.0	0.26	0.21	0.00	0.00	0.00	0.09	0.12	0.01
200.0	1.00	0.82	0.00	0.00	0.00	0.48	0.58	0.24
205.0	2.38	1.94	0.29	0.00	0.00	1.32	1.50	0.53
210.0	4.51	3.66	1.19	0.00	0.00	2.73	2.99	0.95
215.0	7.88	6.45	3.23	0.92	0.40	5.21	5.54	1.88
220.0	12.00	10.80	6.94	3.58	2.82	9.26	9.67	3.75
225.0	18.00	17.19	11.43	8.60	7.91	13.97	15.87	6.99
230.0	28.00	26.12	21.42	16.59	16.10	24.14	24.65	12.07
235.0	42.00	38.69	33.86	28.73	28.50	36.61	37.14	20.10
240.0	60.00	56.06	51.29	46.19	46.19	53.97	54.49	32.23
245.0	85.00	78.72	74.24	69.49	69.64	76.72	77.22	49.00
246.0	90.00	83.95	79.55	74.90	75.08	81.98	82.47	52.98
250.0	114.00	107.20	103.22	99.11	99.34	105.40	105.86	71.02
255.0	150.00	141.92	138.65	135.40	135.62	140.43	140.81	98.85
260.0	197.00	183.32	180.93	178.69	178.85	182.23	182.51	133.13
265.0	245.00	232.88	231.50	230.30	230.37	232.25	232.42	175.69
270.0	305.00	292.20	291.81	291.51	291.52	292.03	292.08	228.82
272.5	343.00	322.50	322.50	322.50	322.50	322.50	322.50	256.90

Note (1) US ; United States

(2) JP ; Japan

(3) Estimated Storage is given by applying Modified Empirical Area - Reduction Method

(4) Original Storage (1972) is based on Fig.

(5) Sediment deposit after 50 years is estimated considering effect of Sengguruh dam (under construction) and the annual sediment deposit rate is estimated to be 0.84 mm per annum.

TABLE 4 ESTIMATED RESERVOIR STORAGE OF LAHOR DAM

(Unit : x 10^6 m^3)

Elevation (El.m)	Original Storage (1977)	Estimated Storage After 5 years (1982) US - TYPE II
220.00	0.0	0.00
225.00	0.2	0.08
230.00	0.5	0.32
235.00	1.0	0.77
240.00	1.9	1.52
245.00	3.2	2.68
250.00	5.0	4.58
253.00	6.7	6.28
255.00	8.0	7.69
257.50	10.0	10.08
260.00	12.6	12.47
262.50	16.0	16.01
265.00	20.2	19.54
267.50	24.6	24.47
270.00	30.0	29.39
272.50	36.1	35.3

NOTE: (1) US ; United States

(2) Estimated storage is given by applying Modified Empirical Area - Reduction Method

Table 5 RELATIONSHIP BETWEEN RESERVOIR STORAGE (C) AND RESERVOIR WATER DEPTH (h) (SELOREJO DAM)

Elevation (El.m)	Storage (x 10^6 m^3)	h (%)	C (%)
597.0	0	0	0
580.0	0.055	2.3	0.1
585.0	0.530	14.0	0.9
590.0	2.015	25.6	3.2
595.0	5.000	37.2	8.0
600.0	9.815	48.8	15.8
605.0	16.855	60.5	27.1
610.0	26.490	72.1	42.5
615.0	38.760	83.7	62.2
620.0	54.220	95.3	87.0
622.0	62.300	100.0	100.0

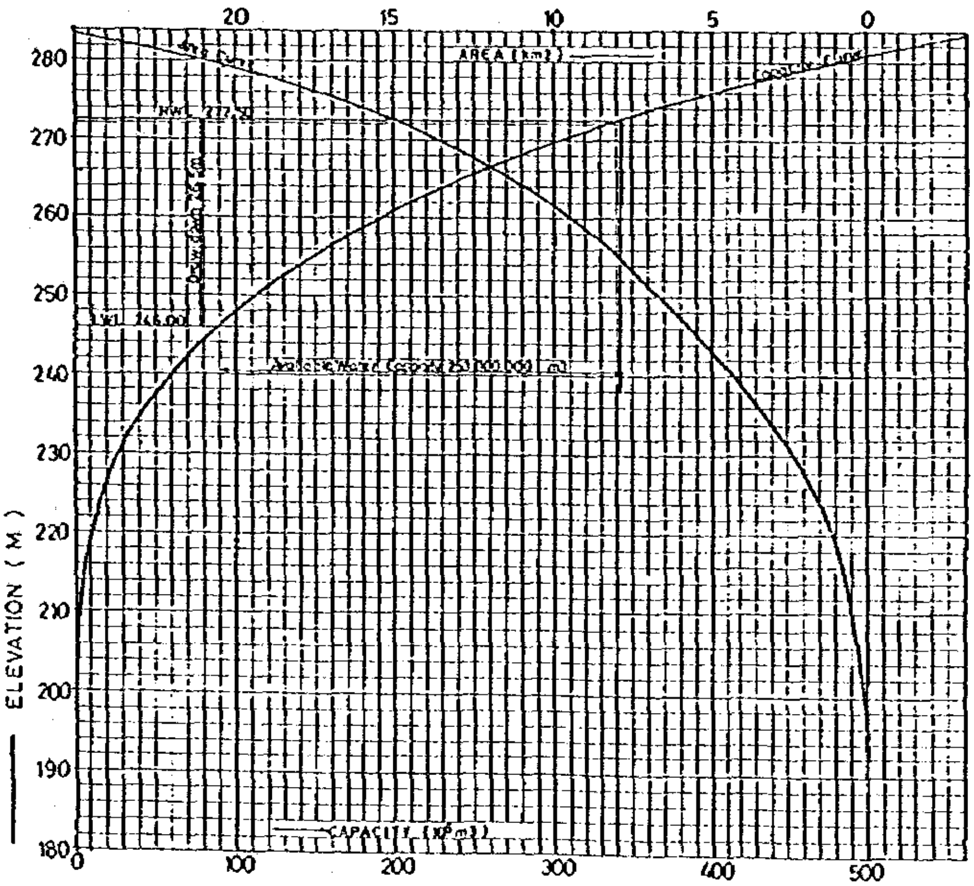


Fig. 1 RESERVOIR AREA AND STORAGE CURVE OF KARANGKATES DAM (original; 1972)

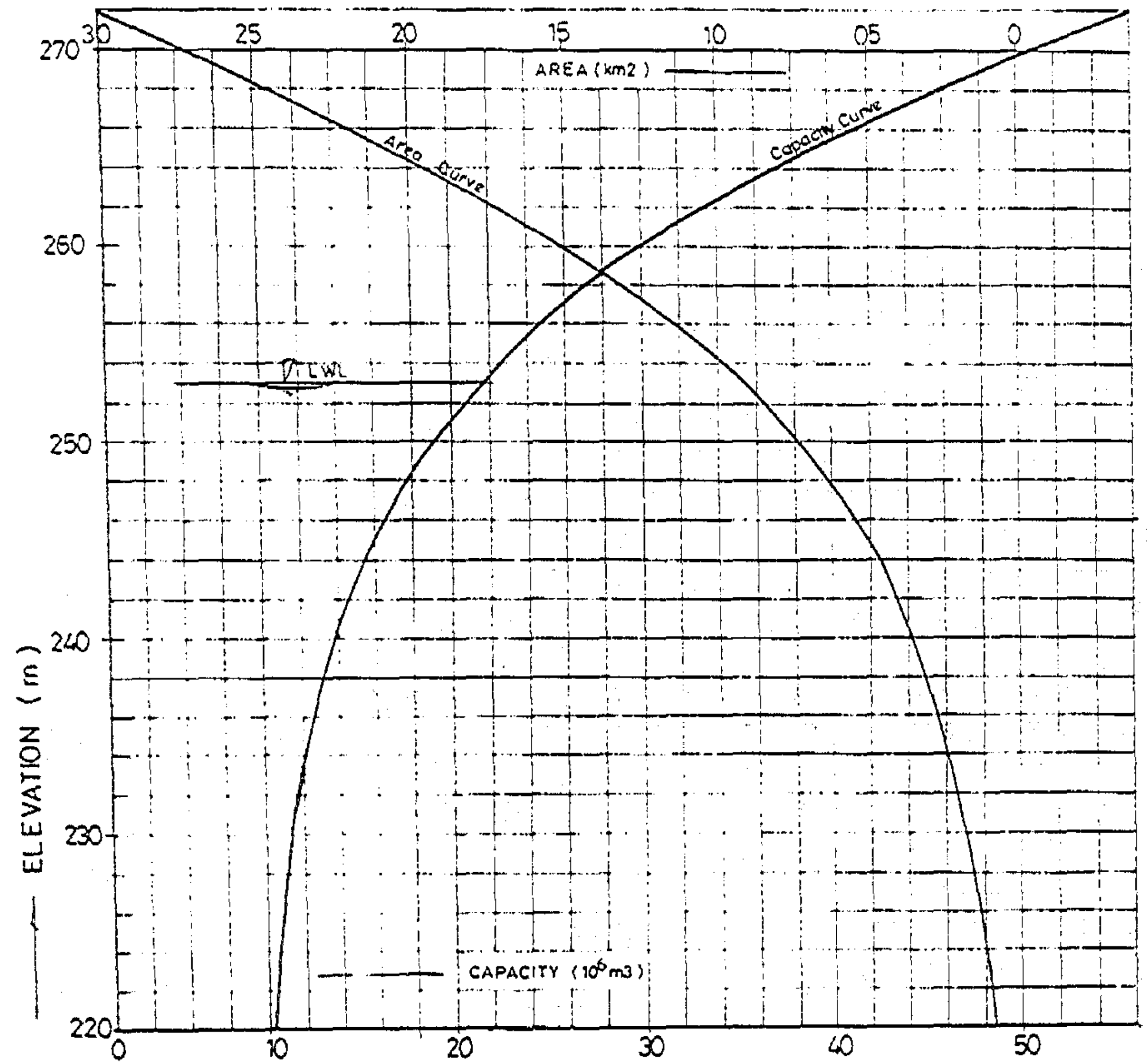


Fig. 2 RESERVOIR AREA AND STORAGE CURVE OF LAHOR DAM (ORIGINAL -1977)

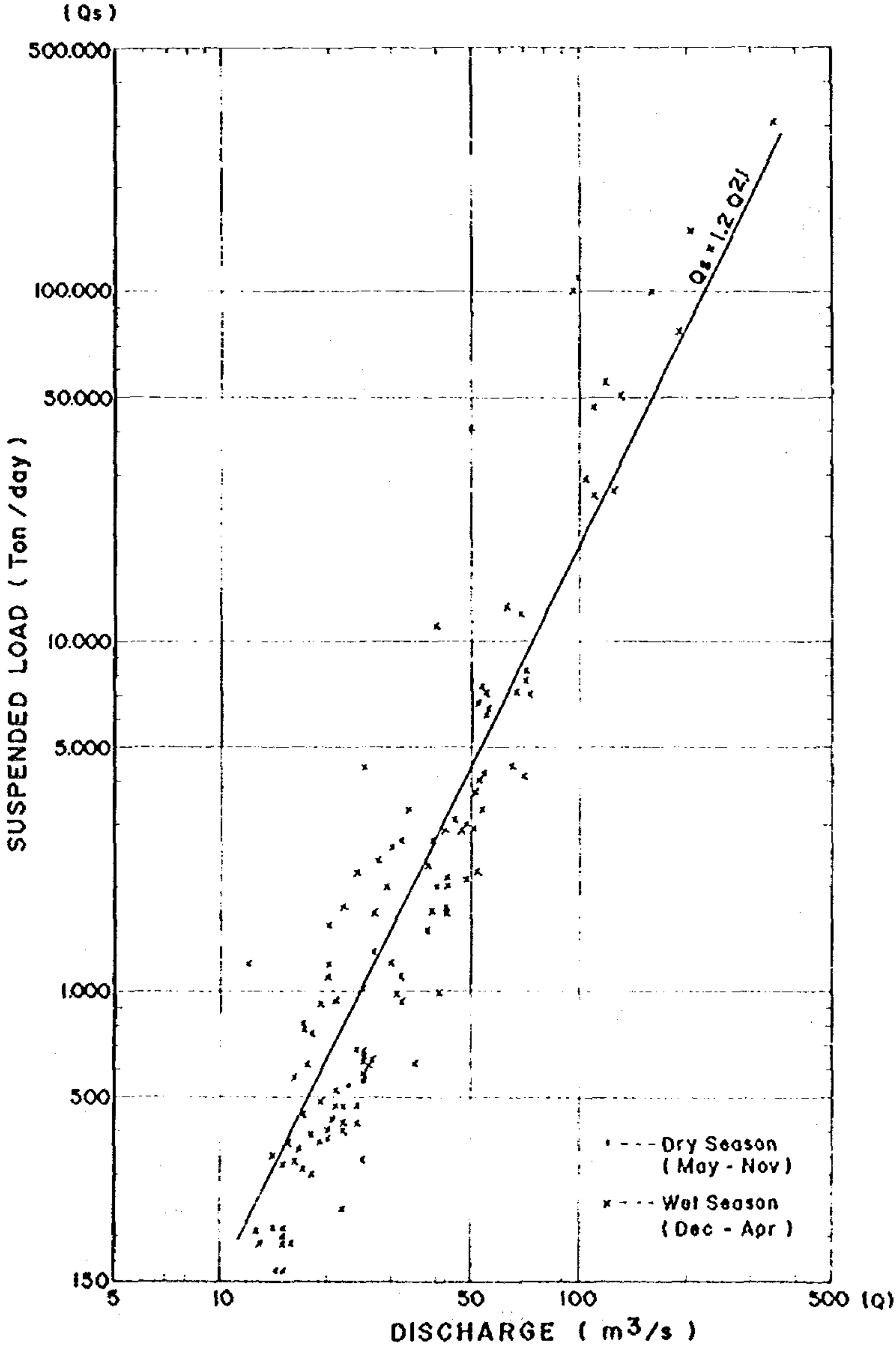


Fig. 3 SEDIMENT RATING CURVE AT BLOBO

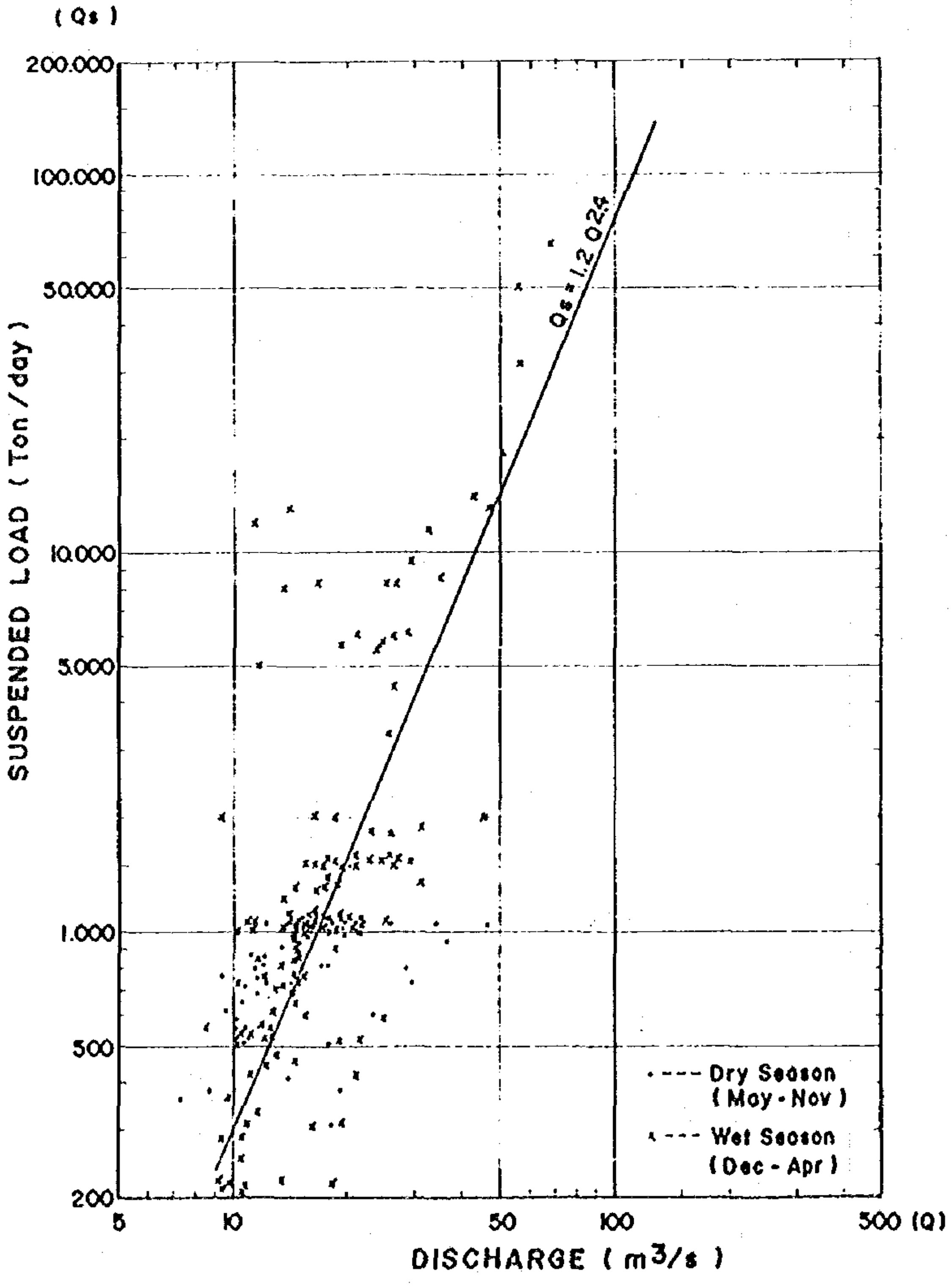


Fig. 4 SEDIMENT RATING CURVE AT SUMBEREJO

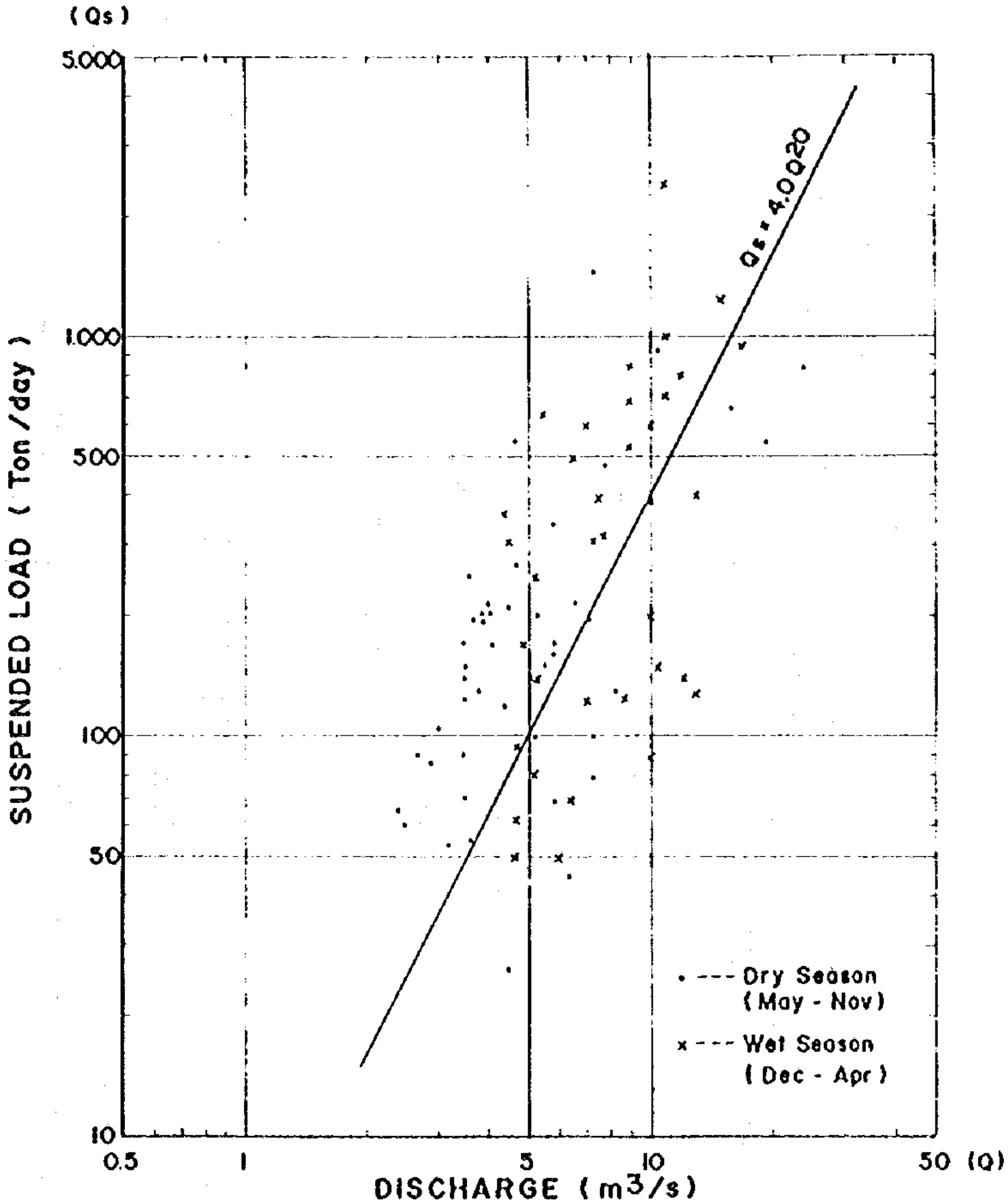


Fig. 5 SEDIMENT RATING CURVE AT METRO

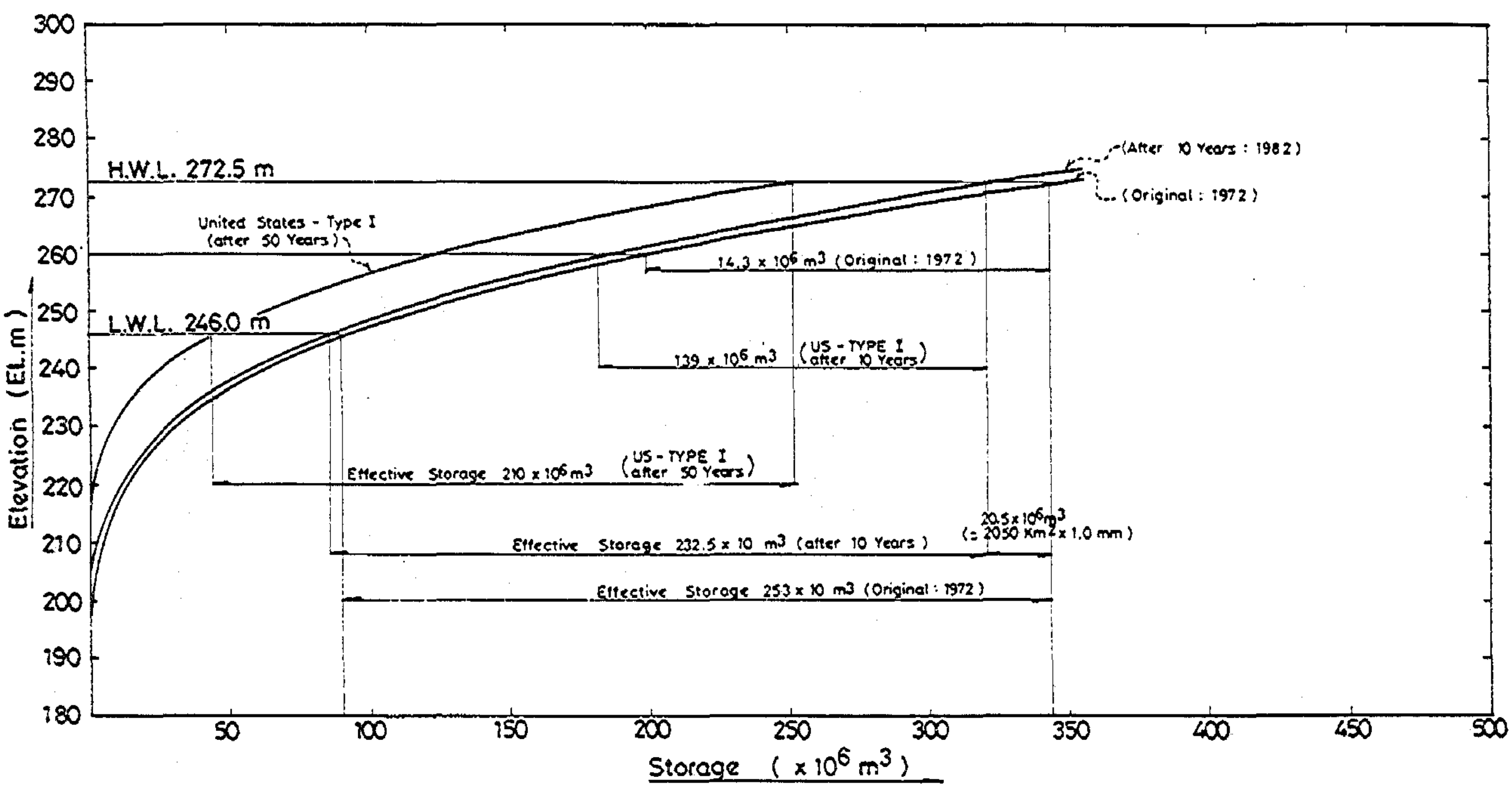
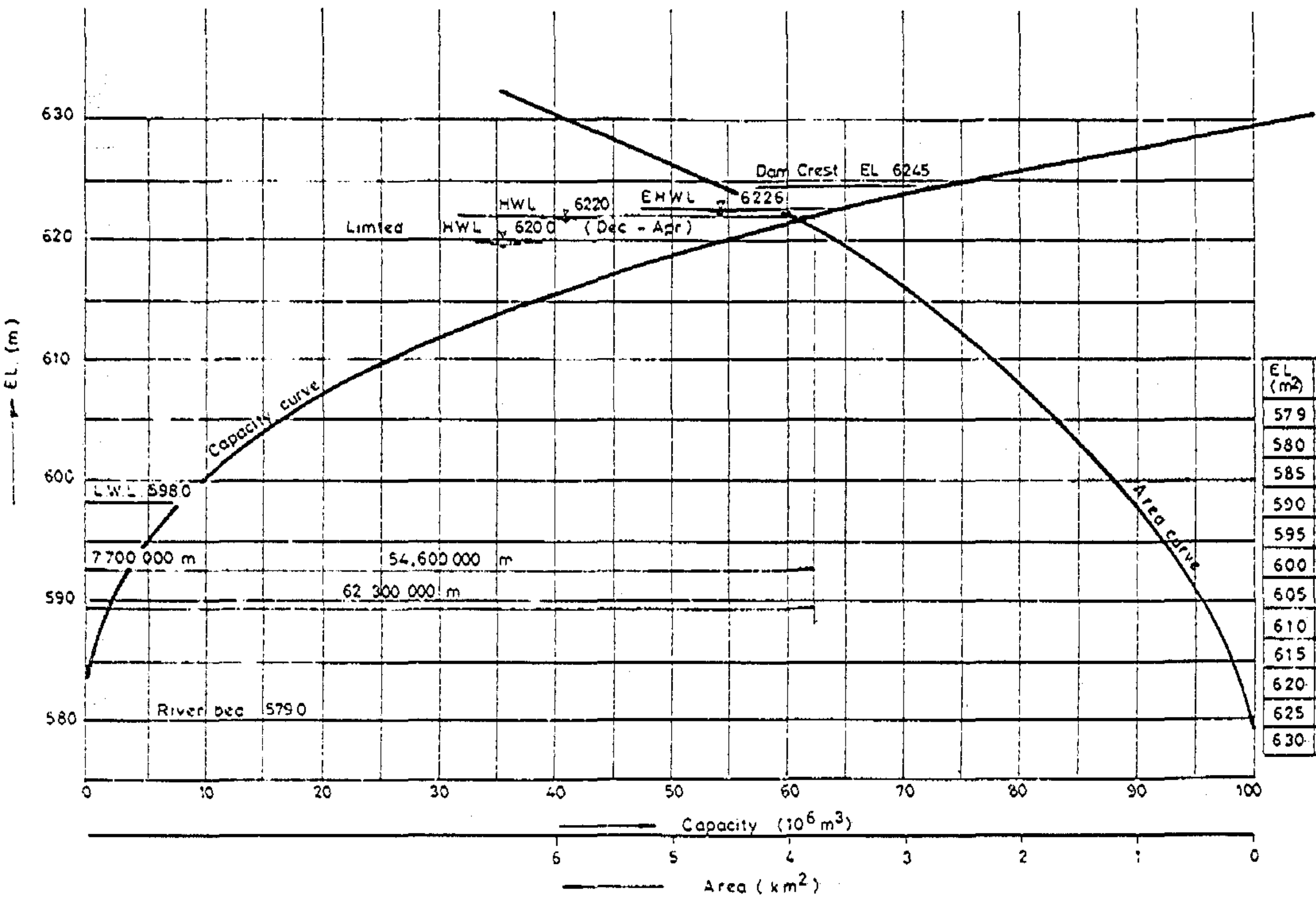


Fig. 6 ESTIMATED RESERVOIR STORAGE OF KARANGKATES DAM



EL (m)	Area (km²)	Capacity (10⁶ m³)
579	0	0
580	0.022	0.055
585	0.167	0.530
590	0.427	2.015
595	0.767	5.000
600	1.159	9.815
605	1.658	16.855
610	2.196	26.490
615	2.712	38.760
620	3.471	54.220
625	4.632	74.476
630	5.835	100.645

Fig. 7 RESERVOIR AREA AND STORAGE CURVE OF SELOREJO DAM

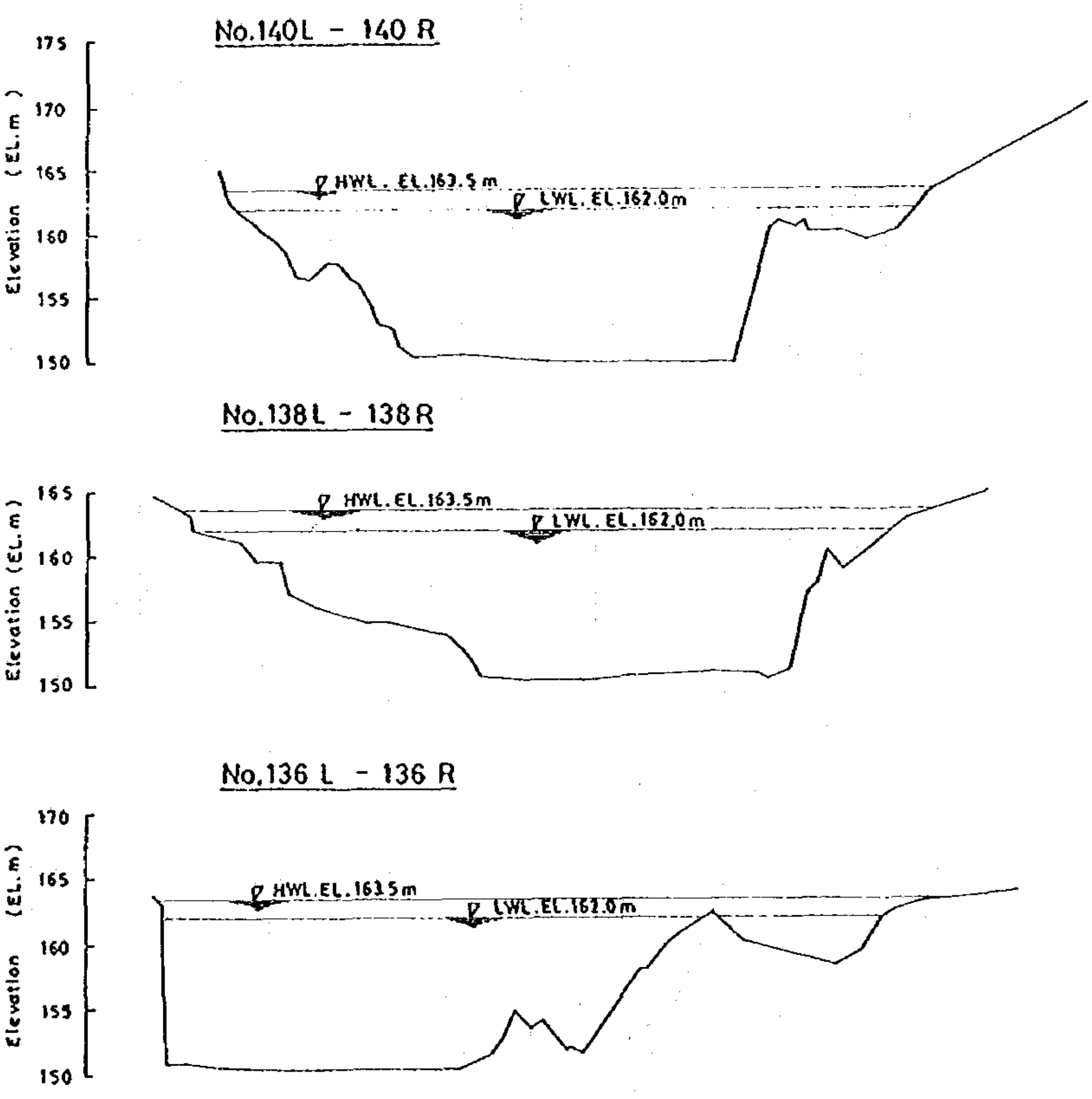


Fig. 8 CROSS SECTION OF WLINGI RESERVOIR

NOTE MP-2

OPERATION OF KARANGKATES-LAHOR RESERVOIR

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Note MP - 2 Operation of Karangkates-Lahor Reservoir

1. Present operation rule and operation performance

At the completion of the Karangkates dam, an operation rule was worked out with an emphasis on the irrigation water supply. The rule was made based on the mass curve method. This operation rule, however, was complicated and difficult to operate the reservoir. There was a request of making an operation rule simple and easy to implement.

In 1978, when the Lahor dam was completed, the operation rule was revised putting an emphasis on simplication of operation rule and maximization of power out put. This revision was made based on the inflow data in the period from 1972 to 1975. As the results of case studies on different water level settings (high water level, low water level and timing to reach the certain water level), the following rule curve was recomemended as the optimum one fom the viewpoint of power generation ;

RESERVOIR WATER LEVEL (EL. m)

	First 10-day	Middle 10-day	Last 10-day
Jan.	261.85	262.85	263.90
Feb.	265.00	266.10	166.90
Mar.	268.05	269.15	270.30
Apr.	270.80	271.30	271.80
May	271.86	271.93	272.00
June	272.00	272.00	272.00
July	271.65	271.30	270.90
Aug.	270.05	269.15	268.10
Sep.	266.90	265.65	264.30
Oct.	263.30	262.30	261.10
Nov.	260.75	260.40	260.00
Dec.	260.25	260.50	260.80

Since 1978, no study on operation rule has been made so far. Therefore, the above rule curve is still effective.

Actual operation of Karangkates - Lahor reservoir is made in the following manner;

(a) At the beginning of the dry season, BRBDEO prepares a schedule of water release from the reservoir according to the present rule curve

(b) The schedule is submitted to the Coordination Committee organized among BRBDEO, PLN, Irrigation Services, PDAM, Surabaya, and other water users, and the schedule is authorized by the Committee.

(c) If there is no deficit in the water supply for the irrigation, the water release is made according to the schedule.

(d) If water deficit occursin the Irrigation water supply, the Irrigation Services request BRBDEO to release more water than scheduled.

(e) BRBDEO examines the request, and operates the reservoir to the extent as possible, acording to the request.

The actual operation performance records are as shown in Fig. 1. In the water rich years like 1981 and 1983, the reservoir water level was lowered up to the elevation of 260 m or so as indicated by the rule curve. But in the drought years like 1980 and 1982, the reservoir water level was lowered to the level near El. 250 m according to the request. According to BRBDEO, in December, 1982, to lower the water level down to L.W.L of El. 246 m was planned. Fortunately, the rainfall started in the middle of December, and the reservoir water level recovered as shown on Fig. 1. From these facts, it can be said that the Karangkates - Lahor reservoir has been operated not only based on the rule curve but also according to water requirement in the middle and lower reaches.

2. Runoff Sedimentation

For examination of the reservoir operation, long-term and reliable discharge data are needed. Especially, data on the drought years are important, since the reservoir operation will become critical in such years.

At Karangkates and Selorejo damsites, discharge measurement records are available since early 1950s. However, they contain gaps and doubtful values. Therefore, it become necessary to generate more reliable and continuous discharge data by other means.

Since rainfall observation is rather simple and rainfall records can be cross-checked among the records obtained at stations nearby, a method to estimate discharge from the rainfall is selected for obtaining reliable and continuous discharge data. For obtaining the relationships between rainfall and runoff, the Tank Model method is used.

Monthly rainfall amount in the Karangkates basin are estimated as shown in Table 1 and Fig. 2.

The evapotranspiration is estimated by the modified Pennman method from the meteorological data.

For calibration of the coefficients of the Tank Model, reliable discharge data are needed. Both Karangkates and Selorejo damsites, outflow through turbines and valves, overflow from spillway and reservoir water level have been recorded on the hourly basis since the commencement of operation. Using these data and the storage capacity curves estimated in the previous section, inflow into the reservoirs are estimated by the following formula;

Qinflow = (Change in storage) / 86,400 + Qoutflow

The estimated inflow into the Karangkates - Lahor reservoir and the Selorejo reservoir is presented on the monthly mean basin in Table 2 and 3, respectively.

Using the trial and error method, the best sets of the tank coefficients are sought for. Finally, the sets of the tank coefficients shown in Table 4 and 5 are found to be capable of covering the rainfall into the runoff with the acceptable accuracy as shown on Fig. 3 and 4.

Using these coefficients, and inputting the rainfall in the period from 1951 to 1983, the daily runoff at damsite for 33 years has been generated. Results are presented in Table 6 for the Karngkates - Lahor site and Table 7 for the Selorejo site.

3. Limitation of Reservoirs

From the generated daily runoff, the mass curves are prepared as shown on Fig. 5 and 6. Using the effective storage fully, the possible constant outflow from the reservoir is obtained as shown in Table 5 and 6. From these Tables, the probable possible constant outflow in the dry season is estimated as follows;

Probability	Constant outflow in dry season	
	K.Kates-Lahor	Selorejo
Once in 2 years	51.36 m^3/sec	10.13 m^3/sec
in 5 years	41.98	8.95
in 10 years	38.24	8.39
in 15 years	35.74	8.23
minimum in 33 years	34.78	7.95

Since the storage capacities of the Karangkates - Lahor and Selorejo reservoirs are already fixed, it is impossible to take water more than the above in the dry season with corresponding recurrence period. Only remaining measure is change of the pattern of outflow from the reservoirs according to the pattern of the water demands within the total amount of possible outflow.

4. Conditions for reservoir operation consideration

The 1978 rule curve for the Karangkates - Lahor reservoir aimed maximization of the energy production in the hydropower plan. Since large scale thermal plants are scheduled to enter into the system in the coming decades, requirement of the energy from the Karangkates power station will decrease. But the value of the installed capacity using the characteristics of the hydropower will increase according to the lowering the load factor in the system.

According to the water balance study, water deficit is foreseenable in the near future and onward. Water has no alternative, but the electric power has alternative sources of supply.

In this context, study on the reservoir operation for the Karangkates - Lahor reservoir is oriented to water supply.

It is desirable to use the storage capacity fully every year as far as water demands exist. However, since the onset of the rainy season is irregular and amount of inflow at the beginning of the rainy season is unknown in advance, it is very risky to empty completely the reservoir at the fixed time of the year. Foe example, if the reservoir is emptied at the end of November, and the onset of the rainy season delays upto the end of December, the reservoir can not cope with the water requirement in December. Since the Karangkates - Lahor reservoir is only one reservoir which can contribute to the emergency case of late onset of rainfall, it will be necessary to keep the minimum reserve in the reservoir. Such minimum requirement is examined as follows;

(a) The ten-day mean inflow with the recurrence period of once in 5 years in December is calculated by the Gumbel's method as follows;

Dec. 1st ten-day	33.61 m^3/sec
Dec. 2nd ten-day	42.42 m^3/sec
Dec. 3rd ten-day	57.51 m^3/sec

(b) As for the water demand in the lower reaches, the following figures in December, 1982 are taken.

Period	Irrigation	Domestic	Industry	City Water	Total
Dec. 1st	25.71	3.52 m^3/s	2.64 m^3/s	15.00 m^3/s	46.37 m^3/S
Dec. 2nd	29.71	3.52	2.64	15.00	50.87
Dec. 3rd	45.26	3.52	2.64	15.00	66.42

(c) Therefore, the deficit and the amount to be supplemented from the reservoir are;

Period	Deficit	Amount to be supplemented
Dec. 1st	12.76 m^3/s	11.02×10^6 m^3
Dec. 2nd	8.45	7.30
Dec. 3rd	8.91	8.47
Total		26.79×10^6 m^3

(d) If the reservoir reserves the amount of 26.79×10^6 m³ over the low water level of EL. 246.0 m, the operational low water level becomes EL. 250.50 m according to the storage capacity curve.

(e) By reserving the above amount, the reservoir can cope with the once in five years drought in December.

5. Forecast of dry season inflow into Karangkates - Lahor reservoir

Except years when rainfall occurs in the dry season, the dry season inflow into the reservoir is governed mainly by the rainfall amount during the previous rainy season. The relationships between the amount of rainfall in the previous rainy season and the dry season runoff are checked using the runoff data in the years when the dry season rainfall was little. Results are as shown on Fig. 7. The relationships are further examined by regression anlysis between the monthly rainfall and monthly mean runoff. Results are as shown in Table 8. By collecting rainfall records in the catchment area of the Karangkates - Lahor reservoir by the beginning of the dry season, the nearly minimum inflow into the reservoir can be forecasted by the formula shown in the table. Then, all the parties concerning to use of water in Brantas river can know the available amount of water including the stored water in the reservoirs in the dry season. This will be beneficial to the water users in planning the water use schedule in the dry season.

The above forecasting method is rather simplified. Since the Tank Model is already developed for the Karangkates - Lahor basin, the following forecasting method is recommendable;

- Prepare two programs, one is for forecasting the dry season runoff , and the other is for tracing the runoff.

- By inputting the rainfall data in the rainy season, and assuming the dry season rainfall is nil, run the first program for forecasting the dry season runoff.

- For the second program, rainfall data will be inputted from time to time for calculation of the water depths in the tanks.

- The above method will depend on the capacity of rainfall data collection. It is considered possible to collect in ten-day interval through the present communication system, and estimation in this interval will be still viable.

6. Reservoir operation rule

Before entering the reservoir operation study, the following conditions are confirmed again;

- The reservoir operation rule will be made with a priority on water supply to the downstream area.

- The hydropower will be guaranteed water necessary to make peak power production for 5 hours a day at the head given by the reservoir water level at that time, unless the reservoir water level is lowered below EL. 246 m. The required amount of water at each reservoir water level is as shown in Table 9 and on Fig. 8.

- The reservoir will release water consisting of the inflow and the storage between EL. 272.5 m anf El. 250.5 m during the dry season from June to December, keeping an emergency reserve of 26.8 x 10^6 m' between El. 250.5 m and El. 246 m, under the drought hydrological condition with the reccurence period of once in five years.

Taking the above conditions as given, the remaining works of the reservoir operation study are as follows;

- To determine a pattern of water release during the dry season

- To determine an operation pattern in the reservoir filling stage

(1) Water release pattern in the dry season with 50% or less dependability

Although there are fluctuation in the irrigation water requirement, the water demand is in almost same level throughout the dry seasons. However, the flow in the river decreases according to the progress of the dry season. Therefore, it is considered that if the release from the reservoir can be increased according to the decrease of the river flow, it will be beneficial to the water users. This pattern will also be beneficial to the hydropower, as decrease of the power head by water release will be compensated by the increase in the amount of released water. In this context, release pattern with 'HQ constant method' is introduced. This method means that the release 'Q' multiplied by head 'H' at that time will have to have certain value through out the dry season. HQ value changes according to inflow into the reservoir or setting of the operational low water level. Several trials are made as shown in Table 10 to 13. Finally, the water level setting as shown in Table 14. and Fig. 9 is found to reach the water level of EL. 250.5 m at the end of November and to be recommendable.

(2) Reservoir filling

The amount to be used for the reservoir filling is calculated as the balance between the expectable inflow with the recurrence period of once in five years and the power discharge, required for the 5 hour peak power generation at the head given by the reservoir water level at that time. Table 15 shows the results of this calculation.

Table 1 MONTHLY BASIN RAINFALL IN THE KARANGKATES BASIN

(Unit: mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1951	329.9	315.3	134.9	59.8	64.6	137.8	24.5	63.4	25.1	15.9	77.8	413.5	1,622.5
1952	311.1	384.3	368.6	72.8	86.5	20.9	3.2	18.8	92.5	152.3	450.0	387.4	2,348.4
1953	253.7	214.0	294.5	252.9	239.5	7.6	58.3	5.6	2.2	11.2	134.3	323.1	1,796.9
1954	392.3	292.8	270.8	306.5	216.6	133.7	48.5	91.9	47.6	150.2	450.2	427.7	2,828.8
1955	274.6	289.6	241.9	196.4	134.5	141.7	340.7	71.8	63.9	158.5	380.6	254.6	2,548.5
1956	324.4	227.0	137.2	89.5	81.0	123.6	125.9	112.2	27.0	114.3	198.0	329.6	1,889.7
1957	301.0	298.7	468.3	117.8	71.2	3.0	247.1	24.7	3.1	19.1	101.7	299.7	1,955.4
1958	237.8	289.8	325.0	262.2	128.6	94.6	106.0	47.6	20.4	65.4	134.3	493.1	2,204.8
1959	295.4	288.6	329.8	117.7	203.7	76.3	16.1	1.0	20.8	47.6	180.2	502.7	2,079.9
1960	272.5	281.6	328.6	210.6	196.2	73.3	22.6	5.2	5.1	56.1	215.6	218.8	1,830.1
1961	362.0	237.6	171.6	160.2	73.9	3.1	6.4	0.0	4.5	13.2	131.1	303.7	1,467.3
1962	488.9	275.6	291.5	275.5	63.6	36.4	22.7	37.8	1.0	108.1	228.6	503.2	2,332.9
1963	338.9	333.0	354.3	110.7	11.3	7.8	0.0	0.0	3.4	8.7	33.1	290.4	1,491.6
1964	172.4	165.1	320.7	154.3	105.9	85.6	4.7	11.7	32.6	403.7	195.5	238.8	1,891.0
1965	279.2	270.4	199.2	147.7	53.9	1.1	6.6	0.0	1.7	4.4	119.0	331.1	1,414.3
1966	343.7	354.1	326.8	190.2	68.6	41.9	0.9	4.7	3.3	100.6	196.4	249.7	1,880.9
1967	407.3	267.7	164.3	181.4	22.1	0.0	0.0	0.0	1.0	39.4	123.8	387.2	1,594.2
1968	275.7	223.2	359.4	196.0	272.4	235.8	201.1	43.0	19.6	95.0	244.5	357.3	2,523.9
1969	366.1	275.9	499.3	157.8	60.0	34.7	4.0	0.0	7.3	51.9	122.7	299.9	1,879.6
1970	337.7	261.6	282.8	213.8	147.4	56.7	36.9	0.0	34.8	70.3	245.0	275.6	1,962.6
1971	378.6	222.1	316.4	66.1	180.1	77.1	4.1	4.1	12.6	156.9	234.1	363.7	2,015.9
1972	316.0	163.8	287.0	71.8	104.9	0.0	0.0	0.0	0.0	0.0	94.9	223.0	1,261.4
1973	324.4	249.3	296.7	291.5	371.3	78.1	53.2	18.2	145.4	105.2	208.2	241.7	2,383.2
1974	169.8	285.8	159.5	158.4	148.7	36.0	25.0	61.3	79.3	224.6	231.2	209.6	1,789.2
1975	330.1	305.3	345.8	291.2	152.2	13.2	18.5	18.5	189.8	344.7	405.9	322.4	2,737.6
1976	237.5	220.1	272.1	75.0	24.6	1.8	6.8	0.0	4.5	95.0	294.5	145.5	1,377.4
1977	274.9	272.4	338.7	157.8	54.2	47.3	0.0	0.0	2.3	4.0	96.2	380.4	1,628.2
1978	349.4	240.0	304.9	172.1	262.7	220.5	133.5	40.9	71.7	144.8	263.1	318.4	2,522.0
1979	388.7	242.5	274.7	202.4	243.3	112.7	2.0	3.0	9.1	55.0	155.0	284.9	1,973.3
1980	252.5	188.9	156.6	216.2	36.3	0.7	8.9	10.6	7.8	77.3	284.3	377.8	1,617.9
1981	332.2	237.7	188.7	163.6	182.9	93.1	143.6	22.9	102.0	131.0	365.1	304.2	2,267.0
1982	277.2	304.2	224.1	199.9	1.8	2.3	0.4	1.0	0.0	2.2	52.2	360.6	1,426.0
1983	422.4	359.3	252.3	257.4	260.4	30.4	4.1	0.7	7.8	151.4	267.9	303.9	2,318.0
Mean	315.7	267.8	281.4	175.7	131.1	61.5	50.8	21.8	31.8	96.3	209.5	324.9	1,966.7

Table 2 ESTIMATED MONTHLY INFLOW TO THE KARANGKATES RESERVOIR (INCLUDING INFLOW TO THE LAHOR RESERVOIR)

(Unit : mm)

	1978	1979	1980	1981	1982	1983	Mean
Jan.	98	155	100	115	138	113	119.8
Feb.	76	133	83	81	127	112	102.0
Mar.	110	132	84	83	129	107	107.5
Apr.	77	121	84	74	103	109	95.5
May	102	151	59	82	58	145	99.5
June	138	112	40	67	47	78	80.3
July	113	63	36	103	44	55	69.0
Aug.	69	51	35	50	40	42	47.8
Sep.	66	42	27	49	30	33	41.2
Oct.	68	39	33	56	26	65	47.8
Nov.	91	55	67	95	26	87	70.2
Dec.	118	94	101	135	78	95	103.5
Total	1,127	1,150	755	990	847	1,041	985

Note: (1) The values above are estimated by reservoir water level and outflow data.

(2) C.A. = 2,210 km^2 (K. Kates 2,050 km^2, Lahor 160 km^2).

Table 3 MONTHLY INFLOW TO THE SELOREJO RESERVOIR

(Unit : mm)

	1978	1979	1980	1981	1982	1983	Mean
Jan.	166	165	124	284	271	118	188.0
Feb.	152	123	136	219	264	120	169.0
Mar.	144	145	121	156	229	133	154.7
Apr.	113	139	122	138	189	129	138.3
May	126	142	92	137	117	128	123.7
Jun.	129	102	67	109	95	83	97.5
Jul.	108	88	63	103	89	76	87.8
Aug.	79	78	57	78	85	69	74.3
Sep.	81	69	55	96	72	61	72.3
Oct.	79	69	63	106	70	79	77.7
Nov.	78	65	80	122	69	92	84.3
Dec.	116	75	110	166	92	93	108.7
Total	1,372	1,261	1,089	1,713	1,641	1,181	1,376.2

Note: (1) The values above are estimated by reservoir water level and outflow data.

(2) C.A. = 236 km^2

Table 4 TANK MODEL COEFFICIENT OF KARANGKATES BASIN

(1) Top tank

	Height (mm)	Coefficient
Hole 3	45	0.30
Hole 2	15	0.20
Hole 1	0	0.15
Bottom	-	0.45

Maximum depth = 70 mm

(2) Lower tank

Tank No.	Height (mm)	Coefficient	Bottom Coefficient
No. 2	0	0.05	0.03
No. 3	0	0.015	0.015
No. 4	0	0.004	0.000

(3) River channel tanks

	Height (mm)	Coefficient
Hole 2	2	0.15
Hole 1	0	0.15

(4) Initial Depth (mm)

Tank No.	Zone 1	2	3	4
No. 1				
Free of water Depth	30	30	40	40
Moisture Depth	50	50	100	200
No. 2	50	100	150	200
No. 3	50	100	150	200
No. 4	50	100	500	1500

(5) Depth in river channel = 10 mm

(6) Evaporation coefficient = 0.65

Table 5 TANK MODEL COEFFICIENT OF SELOREJO BASIN

(1) Top tank

	Height (mm)	Coefficient
Hole 3	40	0.20
Hole 2	20	0.10
Hole 1	0	0.04
Bottom	-	0.40

Maximum depth = 70 mm

(2) Lower tank

Tank No.	Height (mm)	Coefficient	Bottom Coefficient
No. 2	0	0.050	0.050
No. 3	0	0.025	0.025
No. 4	0	0.010	0.000

(3) River channel tanks

	Height (mm)	Coefficient
Hole 2	2	0.15
Hole 1	0	0.15

(4) Initial Depth (mm)

Tank No.	Zone 1	2	3	4
No.1				
Free of water Depth	30	30	40	40
Moisture Depth	50	50	100	200
No.2	50	100	150	200
No.3	50	100	150	200
No.4	50	100	500	2000

(5) Depth in river channel = 10 mm

(6) Evaporation coefficient = 0.65

Table 6 MONTHLY RUNOFF AT KARANGKATES DAMSITE

Year	Annual Rainfall (mm)	Runoff (mm) Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Runoff Coeffi-cient
1951	1,663	104	119	90	54	43	42	34	29	23	22	19	88	667	0.40
1952	2,348	99	103	156	109	62	44	33	27	24	26	124	134	971	0.41
1953	1,797	124	107	112	122	143	81	60	43	34	31	30	67	955	0.53
1954	2,829	114	122	133	147	128	97	72	58	45	44	131	194	1,285	0.45
1955	2,549	147	150	137	112	97	84	130	104	70	67	146	126	1,368	0.54
1956	1,890	151	124	114	79	65	68	68	65	52	47	55	137	1,025	0.54
1957	1,955	106	132	220	133	91	61	96	69	47	41	37	84	1,119	0.57
1958	2,205	78	115	138	135	102	69	82	52	39	35	35	128	1,007	0.46
1959	2,080	146	121	146	112	99	81	57	43	35	33	38	150	1,060	0.51
1960	1,886	123	112	144	137	117	76	65	45	36	34	41	69	997	0.53
1961	1,467	124	110	89	78	66	42	34	28	25	23	21	52	693	0.47
1962	2,333	164	115	132	115	95	52	38	30	25	24	62	163	1,015	0.44
1963	1,492	125	137	157	108	72	46	37	31	27	26	22	59	849	0.57
1964	1,891	51	41	92	73	51	49	30	21	17	95	85	58	663	0.35
1965	1,414	89	96	98	86	51	34	27	22	19	18	16	61	617	0.44
1966	1,881	93	121	133	112	75	45	32	25	20	20	24	67	768	0.41
1967	1,594	137	98	85	87	53	32	25	21	18	17	15	72	662	0.42
1968	2,524	94	75	106	112	113	103	110	67	41	35	45	111	1,011	0.40
1969	1,880	136	132	210	155	95	72	50	42	35	34	32	78	1,072	0.57
1970	1,963	102	106	118	109	96	68	48	38	31	30	46	75	867	0.44
1971	2,016	128	104	122	96	78	64	47	35	29	34	66	106	909	0.45
1972	1,261	127	88	108	73	68	42	33	28	25	23	20	32	667	0.53
1973	2,388	70	70	106	120	147	97	65	42	37	36	41	73	904	0.38
1974	1,789	69	83	94	84	76	47	37	31	28	43	67	73	731	0.41
1975	2,738	109	124	143	139	120	76	52	42	56	94	147	162	1,266	0.45
1976	1,377	135	106	142	95	65	48	42	38	34	33	61	56	856	0.62
1977	1,628	87	91	121	111	71	46	37	30	26	24	22	73	739	0.45
1978	2,522	115 (98)	89 (76)	118 (110)	89 (77)	122 (102)	102 (138)	100 (113)	56 (69)	39 (66)	42 (68)	63 (91)	111 (118)	1,044 (1,127)	0.41 (0.45)
1979	1,973	142 (155)	119 (133)	122 (132)	118 (121)	128 (151)	103 (112)	68 (63)	50 (51)	40 (42)	37 (39)	37 (55)	76 (94)	1,040 (1,150)	0.53 (0.58)
1980	1,618	93 (100)	80 (83)	74 (84)	82 (84)	68 (59)	43 (40)	35 (36)	30 (35)	26 (27)	25 (33)	49 (67)	113 (101)	717 (755)	0.44 (0.47)
1981	2,265	135 (115)	101 (81)	93 (83)	77 (74)	92 (82)	63 (67)	71 (103)	48 (50)	34 (49)	45 (56)	70 (95)	138 (135)	966 (990)	0.43 (0.44)
1982	1,424	130 (138)	129 (127)	129 (124)	97 (103)	74 (58)	47 (47)	39 (44)	33 (40)	29 (30)	28 (26)	25 (26)	52 (78)	811 (847)	0.57 (0.59)
1983	2,328	144 (113)	131 (112)	129 (107)	107 (109)	119 (145)	89 (78)	55 (55)	39 (42)	31 (33)	30 (65)	60 (87)	87 (95)	1,023 (1,041)	0.44 (0.45)
Mean	1,969	114.9	107.6	107.6	104.9	89.1	64	54.8	41.3	33.2	36.2	53.1	94.7	920	0.47
Mean (1978 -1983)	2,202	127 (120)	108 (102)	111 (108)	95 (96)	101 (100)	75 (80)	61 (69)	43 (48)	33 (41)	35 (48)	51 (70)	96 (104)	934 (985)	0.46 (0.49)

Note: (1) Runoff is estimated by tank model.
(2) The values parenthesized are estimated by reservoir water level and outflow data.

Table 7 MONTHLY RUN-OFF AT SELOREJO DAMSITE

Year	Annual Rainfall (mm)	Runoff (mm) Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Runoff Coeffi-cient
1950	2,568	83	238	265	119	83	76	71	55	47	55	134	149	1,374	0.54
1951	1,750	131	163	161	112	90	78	79	63	59	54	45	86	1,123	0.64
1952	2,309	152	184	193	131	101	78	67	61	54	50	95	113	1,279	0.55
1953	1,829	103	128	123	126	149	91	77	63	55	49	50	106	1,121	0.61
1954	2,823	175	163	154	149	127	101	88	85	72	71	130	179	1,494	0.53
1955	3,040	207	186	205	420	170	146	154	130	105	108	160	155	2,146	0.71
1956	2,418	178	208	200	149	140	158	116	100	83	99	100	153	1,685	0.70
1957	2,321	131	173	276	166	146	108	125	97	78	70	69	152	1,591	0.69
1958	2,289	119	119	160	141	120	94	112	80	64	62	67	131	1,269	0.55
1959	2,422	241	172	174	142	132	108	95	79	67	64	71	201	1,546	0.64
1960	2,645	170	285	210	210	200	138	124	103	87	83	104	122	1,835	0.69
1961	2,095	287	167	167	144	133	99	85	73	64	58	66	102	1,443	0.69
1962	3,263	271	324	210	247	178	134	117	106	87	86	131	176	2,067	0.63
1963	2,075	327	235	235	168	134	108	97	86	73	76	60	76	1,675	0.81
1964	2,463	79	90	146	129	117	111	81	67	64	137	109	103	1,232	0.50
1965	1,705	185	144	191	151	116	92	80	70	60	53	45	74	1,262	0.74
1966	2,283	96	143	186	128	109	82	69	59	50	55	75	119	1,172	0.51
1967	2,182	203	194	175	144	118	90	79	70	60	53	55	127	1,367	0.63
1968	2,887	148	160	178	168	154	133	144	117	94	90	116	167	1,672	0.58
1969	1,609	162	168	172	142	113	93	80	70	60	58	58	71	1,246	0.77
1970	2,383	104	151	183	126	110	92	75	63	56	56	100	112	1,229	0.52
1971	3,039	184	247	208	178	164	144	117	100	90	101	126	229	1,887	0.62
1972	1,707	196	148	235	158	151	110	95	83	70	64	57	76	1,442	0.84
1973	2,636	97	109	155	126	142	111	87	74	75	83	97	143	1,300	0.49
1974	2,920	298	219	228	227	165	127	114	108	108	123	120	137	1,975	0.68
1975	2,850	168	173	207	207	171	129	111	102	111	128	172	176	1,855	0.65
1976	2,410	250	197	612	172	146	114	104	92	77	84	90	82	2,019	0.84
1977	1,827	144	159	273	136	115	92	75	65	55	49	40	53	1,258	0.69
1978	2,180	148	137	142	100	108	107	91	72	59	54	51	65	1,132	0.52
		(166)	(152)	(144)	(113)	(126)	(129)	(108)	(79)	(81)	(79)	(78)	(116)	(1,372)	(0.63)
1979	1,816	113	103	113	94	120	86	68	55	46	42	44	72	954	0.53
		(165)	(123)	(145)	(139)	(142)	(102)	(88)	(78)	(69)	(69)	(65)	(75)	(1,261)	(0.69)
1980	2,168	122	127	140	124	103	76	65	56	48	48	51	129	1,096	0.51
		(124)	(136)	(121)	(122)	(92)	(67)	(63)	(51)	(55)	(63)	(80)	(110)	(1,089)	(0.50)
1981	2,878	255	174	172	139	154	121	113	93	90	95	125	166	1,699	0.59
		(284)	(219)	(156)	(138)	(137)	(109)	(103)	(78)	(96)	(106)	(122)	(166)	(1,713)	(0.60)
1982	1,941	244	248	229	169	134	107	96	85	72	63	55	100	1,602	0.83
		(271)	(264)	(229)	(189)	(117)	(95)	(89)	(85)	(72)	(70)	(69)	(92)	(1,641)	(0.85)
1983	2,389	185	128	143	158	167	102	83	69	59	63	94	110	1,361	0.57
		(118)	(120)	(133)	(129)	(128)	(83)	(76)	(69)	(61)	(79)	(93)	(93)	(1,181)	(0.49)
Mean	2,356	175.2	175.4	200.6	158.8	134.7	106.9	95.1	80.9	70.6	73.1	87.3	123.9	1,483	0.63
(Mean 1978 -1983)	2,229	177.8	152.8	156.5	130.7	131.0	99.8	86.0	71.7	62.3	60.8	71.0	107.0	1,307.3	0.59
		(188.0)	(169.0)	(154.7)	(138.3)	(123.7)	(97.5)	(87.8)	(74.3)	(72.3)	(77.7)	(84.3)	(108.7)	(1,376.2)	(0.62)

Note: (1) Runoff is estimated by tank model.
(2) The values parenthesized are estimated by reservoir water level and outflow data.

Table 8 EQUATION OF INFLOW FORECASTING

	Jun.	Jul.	Aug.	Sept.	Oct.
A_0	-11.0899638	-15.5299962	-2.87097038	-0.61494647	3.07925388
A_1	0.0149239665	0.0525167239	0.0384507892	0.042389943	0.0313118965
A_2	0.0297891733	0.0101756963	0.0107804442	0.005352747	0.0105785789
A_3	0.0083712475	0.0242773289	0.169692058	0.020534444	0.01038751
A_4	-0.0541001518	0.0124031042	-0.020504488	-0.014334763	-0.0272584739
A_5	0.0987755701	0.0498220939	0.0459776609	0.034219894	0.0369615015
A_6	0.169481819	0.0461714545	0.0428709541	0.010738026	0.031367007
A_7	0.0506207894	0.0559367462	0.0027992661	-0.004698774	-0.022273360
RR	0.973412	0.963390	0.931206	0.883487	0.879276

$$Q_i = A_0 + A_1 \times R_{11} + A_2 \times R_{12} + A_3 \times R_1 + A_4 \times R_2 + A \times R_3$$

$$+ A_6 \times R_4 + A_7 \times R_5$$

where,

Q_i	:	Monthly runoff (mm)
$A_0 \ldots\ldots A_7$	:	constant
R_{11}	:	monthly runoff in November
R_{12}	:	monthly runoff in December
R_1	:	monthly runoff in January
R_2	:	monthly runoff in February
R_3	:	monthly runoff in March
R_4	:	monthly runoff in April
R_5	:	monthly runoff in May
RR	:	Correlation coefficient

Table 9 WATER REQUIREMENT FOR PEAK POWER OUTPUT (5 hrs)

(Karangkates Dam)

Water Level (EL.m)	(24 hrs.)	(5 hrs)	Peak Output (kW)
HWL 272.5	27.7	133.0	105.0
271.0	28.1	134.9	105.0
270.0	28.5	136.8	105.0
269.0	28.9	138.7	105.0
268.0	29.4	141.1	105.0
267.0	29.8	140.6	105.0
266.0	30.3	145.4	105.0
265.0	30.9	148.3	105.0
264.0	31.5	151.2	105.0
263.0	32.1	154.1	104.8
262.0	31.9	153.1	102.7
261.0	31.6	151.7	100.5
260.0	31.3	150.2	98.2
259.0	31.1	149.3	96.2
258.0	30.8	147.8	94.2
257.0	30.5	146.4	92.2
256.0	30.3	145.4	90.2
255.0	30.0	144.0	88.3
254.0	29.7	142.6	86.2
253.0	29.5	141.6	83.9
252.0	29.2	140.2	81.9
251.0	29.0	139.2	79.7
250.0	28.7	137.8	77.7
249.0	28.4	136.3	75.5
248.0	28.2	135.4	73.5
247.0	27.9	133.9	71.4
LWL. 246.0	27.6	133.0	69.4

Table 10 RESERVOIR OPERATON RESULTS (1966 Year, T ≒ 1/5)

Case		Item	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Annual
Case. 1		Monthly Mean Possible Outflow (m^3/s)	39.14	35.17	35.99	37.41	39.63	43.50	30.34	49.14	87.98	70.23	74.57	44.14	-
		Water Level at the End of Month (EL.m)	272.40	270.94	268.09	264.03	258.09	250.50	258.90	272.50	272.50	272.50	272.50	272.49	-
		Storage at the End of Month ($x10^6m^3$)	352.64	329.58	288.23	236.45	174.80	116.10	182.36	354.23	354.23	354.23	354.23	354.08	-
	(5 hrs)	Monthly Mean Output (MW)	105.0	105.0	105.0	105.0	100.8	85.6	90.7	104.2	105.0	105.0	105.0	105.0	-
	(5 hrs)	Monthly Energy (MWH)	15,750	16,275	16,275	15,750	15,621	12,837	14,065	16,149	14,700	16,275	15,750	16,275	185,722
	(Off-peak)	Monthly Mean Output (MW)	17.7	17.7	17.6	17.0	16.0	14.4	0	22.9	58.7	40.5	44.6	19.4	-
	(Off-peak)	Monthly Energy (MWH)	5,847	3,833	3,837	3,479	3,844	5,687	0	11,515	31,220	23,825	25,416	8,919	127,425
	(Total)	Monthly Mean Operation Hour (Hrs.)	11.0	7.0	7.0	6.8	7.8	13.3	0	7.4	19.0	19.0	19.0	14.4	-
	(Total)	Monthly Mean Energy (MWH)	21,597	20,108	20,112	19,229	19,466	18,525	14,065	27,665	45,920	40,100	41,166	25,194	313,147
Case. 2		Monthly Mean Possible Outflow (m^3/s)	38.53	33.20	33.83	34.94	36.58	39.13	31.40	62.28	87.98	70.23	74.57	44.08	-
		Water Level at the End of Month (EL.m)	272.46	271.35	268.96	265.56	260.85	255.69	262.36	272.50	272.50	272.50	272.50	272.50	-
		Storage at the End of Month ($x10^6m^3$)	353.72	335.94	300.38	255.01	201.51	154.06	217.56	354.23	354.23	354.23	354.23	354.23	-
	(5 hrs)	Monthly Mean Output (MW)	105.0	105.0	105.0	105.0	103.9	93.7	99.1	105.0	105.0	105.0	105.0	105.0	-
	(5 hrs)	Monthly Energy (MWH)	15,750	16,275	16,275	15,750	16,112	14,059	15,353	16,268	14,700	16,275	15,750	16,275	188,842
	(Off-peak)	Monthly Mean Output (MW)	17.7	17.7	17.7	17.2	16.4	15.3	0	34.9	58.7	40.5	44.6	19.4	-
	(Off-peak)	Monthly Energy (MWH)	5,634	2,838	2,846	2,605	2,481	3,682	0	19,119	31,220	23,825	25,416	8,889	128,555
	(Total)	Monthly Mean Operation Hour (Hrs)	10.6	5.2	5.2	5.1	4.9	8.1	0	12.1	19.0	19.0	19.0	14.4	-
	(Total)	Monthly Mean Energy (MWH)	21,384	19,113	19,121	18,355	18,593	17,741	15,353	35,387	45,920	40,100	41,166	25,164	317,397
Case. 3		Monthly Mean Possible Outflow (m^3/s)	38.53	30.91	31.35	32.17	33.33	34.96	31.33	77.02	87.98	70.23	74.57	44.08	-
		Water Level at the End of Month (EL.m)	272.50	271.77	269.88	267.15	263.53	260.11	265.78	272.50	272.50	272.50	272.50	272.50	-
		Storage at the End of Month ($x10^6m^3$)	354.23	342.57	313.64	275.46	230.69	194.05	257.73	354.23	354.23	354.23	354.23	354.23	-
	(5 hrs)	Monthly Mean Output (MW)	105.0	105.0	105.0	105.0	105.0	101.2	104.2	105.0	105.0	105.0	105.0	105.0	-
	(5 hrs)	Monthly Energy (MWH)	15,750	16,275	16,275	15,750	16,275	15,176	16,157	16,275	14,700	16,275	15,750	16,275	190,933
	(Off-peak)	Monthly Mean Output (MW)	17.7	17.7	17.7	17.4	16.8	16.0	0	47.7	58.7	40.5	44.6	19.4	-
	(Off-peak)	Monthly Energy (MWH)	5,535	1,672	1,676	1,550	1,323	1,532	0	27,799	31,220	23,825	25,416	8,889	130,437
	(Total)	Monthly Mean Operation Hour (Hrs.)	10.4	3.1	3.1	3.0	2.5	3.2	0	15.4	19.0	19.0	19.0	14.4	-
	(Total)	Monthly Mean Energy (MWH)	21,285	17,947	17,951	17,300	17,598	16,708	16,157	44,074	45,920	40,100	41,166	25,164	321,370

Note: Case.1 ... Q·h = 3,170 Q; Possible outflow (m^3/s)
Case.2 ... Q·h = 3,000 h; Effective head (m)
Case.3 ... Q·h = 2,800

Table 11 RESERVOIR OPERATION RESULTS (1972 Year, T ≑ 1/10)

Case	Mode	Item	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Annual
Case. 1		Monthly Mean Possible Outflow (m^3/s)	37.41	36.26	37.09	38.37	40.36	43.94	28.58	29.65	31.52	54.15	100.16	118.84	-
		Water Level at the End of Month (EL.m)	272.19	270.67	268.08	264.58	259.22	250.50	249.57	259.23	266.32	272.50	272.50	272.50	-
		Storage at the End of Month ($x10^6m^3$)	349.33	325.60	288.08	242.95	185.34	116.10	110.26	185.45	264.58	354.23	354.23	354.23	-
	(5 hrs.)	Monthly Mean Output (MW)	105.0	105.0	105.0	105.0	102.2	88.4	76.3	85.3	102.2	105.0	105.0	105.0	-
		Monthly Energy (MWH)	15,750	16,275	16,275	15,750	15,841	13,255	11,822	13,215	14,308	16,275	15,750	16,275	180,791
	(Off-peak)	Monthly Mean Output (MW)	17.7	17.7	17.6	17.0	16.2	14.7	0	0	0	27.1	71.5	90.4	-
		Monthly Energy (MWH)	4,955	4,367	4,367	4,020	4,208	5,846	0	0	0	14,752	40,771	53,242	136,528
	(Total)	Monthly Mean Operation Hour (Hrs.)	9.3	8.0	8.0	7.9	8.4	13.4	0	0	0	8.3	19.0	19.0	-
		Monthly Mean Energy (MWH)	20,705	20,642	20,642	19,770	20,049	19,101	11,822	13,215	14,308	31,027	56,521	69,517	317,319
Case. 2		Monthly Mean Possible Outflow (m^3/s)	36.03	33.20	33.73	34.55	35.77	37.68	30.58	31.20	30.32	73.77	100.16	118.84	-
		Water Level at the End of Month (EL.m)	272.41	271.44	269.55	267.01	263.32	258.14	256.88	263.91	270.11	272.50	272.50	272.50	-
		Storage at the End of Month ($x10^6m^3$)	352.90	337.37	308.85	273.61	228.27	175.24	164.05	235.09	317.12	354.23	354.23	354.23	-
	(5 hrs.)	Monthly Mean Output (MW)	105.0	105.0	105.0	105.0	105.0	100.1	92.3	97.8	105.0	105.0	105.0	105.0	-
		Monthly Energy (MWH)	15,750	16,275	16,275	15,750	16,275	15,011	14,312	15,162	14,700	16,275	15,750	16,275	187,810
	(Off-peak)	Monthly Mean Output (MW)	17.7	17.7	17.7	17.4	16.8	15.9	0	0	0	48.5	71.5	90.4	-
		Monthly Energy (MWH)	4,262	2,838	2,851	2,688	2,497	2,822	0	0	0	26,202	40,771	53,242	138,174
	(Total)	Monthly Mean Operation Hour (Hrs.)	8.0	5.2	5.2	5.2	4.8	5.9	0	0	0	14.7	19.0	19.0	-
		Monthly Mean Energy (MWH)	20,012	19,113	19,126	18,438	18,772	17,834	14,312	15,162	14,700	42,477	56,521	69,517	325,984
Case. 3		Monthly Mean Possible Outflow (m^3/s)	35.54	30.90	31.24	31.81	32.65	33.88	31.63	31.45	30.00	87.48	100.16	118.84	-
		Water Level at the End of Month (EL.m)	272.49	271.91	270.50	268.57	265.79	262.10	260.77	266.82	272.47	272.50	272.50	272.50	-
		Storage of the End of Month ($x10^6m^3$)	354.18	344.81	322.95	294.82	257.86	214.68	200.68	271.05	353.87	354.23	354.23	354.23	-
	(5 hrs.)	Monthly Mean Output (MW)	105.0	105.0	105.0	105.0	105.0	104.7	100.6	103.1	105.0	105.0	105.0	105.0	-
		Monthly Energy (MWH)	15,750	16,275	16,275	15,750	16,275	15,708	15,599	15,981	14,700	16,275	15,750	16,275	190,613
	(Off-peak)	Monthly Mean Output (MW)	17.7	17.7	17.7	17.6	17.2	16.5	0	0	6.3	57.5	71.5	90.4	-
		Monthly Energy (MWH)	4,012	1,672	1,676	1,601	1,497	1,186	0	0	547	33,974	40,771	53,242	140,178
	(Total)	Monthly Mean Operation Hour (Hrs.)	7.6	3.1	3.1	3.0	2.8	2.4	0	0	1.1	19.0	19.0	19.0	-
		Monthly Mean Energy (MWH)	19,762	17,947	17,951	17,351	17,772	16,834	15,599	15,981	15,247	50,249	56,521	69,517	330,791

Note: Case. 1 ... Q·h = 3,260
Case. 2 ... Q·h = 3,000
Case. 3 ... Q·g = 2,800

Q; Possible outflow (m^3/s)
h; Effective head (m)

Table 12 RESERVOIR OPERATION RESULTS (1976 Year, T ≒ 1/2)

Case	Period	Item	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Annual
Case. 1		Monthly Mean Possible Outflow (m^3/s)	46.17	46.89	48.30	50.53	54.44	60.50	29.66	31.11	48.54	99.68	94.92	58.98	-
Case. 1		Water Level at the End of Month (EL.m)	271.68	269.59	266.30	261.58	253.52	250.50	256.40	266.72	272.50	272.50	272.50	272.50	-
Case. 1		Storage at the End of Month ($x10^6m^3$)	341.21	309.47	264.38	209.13	137.10	116.10	159.94	269.79	354.23	354.23	354.23	354.23	-
Case. 1	(5 hrs.)	Monthly Mean Output (MW)	105.0	105.0	105.0	104.5	94.0	77.3	85.3	99.1	105.0	105.0	105.0	105.0	-
Case. 1	(5 hrs.)	Monthly Energy (MWH)	15,750	16,275	16,275	15,680	14,564	11,601	13,220	15,360	14,700	16,275	15,750	16,275	181,725
Case. 1	(Off-peak)	Monthly Mean Output (MW)	17.7	17.7	17.3	16.6	19.0	23.4	0	0	19.4	70.6	65.8	29.3	-
Case. 1	(Off-peak)	Monthly Energy (MWH)	9,380	9,812	9,758	9,163	11,174	13,335	0	0	10,117	41,573	37,496	17,233	169,042
Case. 1	(Total)	Monthly Mean Operation Hour (Hrs.)	17.7	17.9	18.2	18.4	19.0	19.0	0	0	11.8	19.0	19.0	19.0	-
Case. 1	(Total)	Monthly Mean Energy (MWH)	25,130	26,087	26,033	24,843	25,739	24,936	13,220	15,360	24,817	57,848	53,246	33,508	350,767
Case. 2		Monthly Mean Possible Outflow (m^3/s)	44.16	44.62	45.69	47.33	49.99	53.10	31.35	31.72	69.85	99.68	94.92	58.98	-
Case. 2		Water Level at the End of Month (EL.m)	272.01	270.36	267.69	263.97	258.18	257.96	261.95	270.39	272.50	272.50	272.50	272.50	-
Case. 2		Storage at the End of Month ($x10^6m^3$)	346.43	320.78	282.71	235.73	175.62	173.61	213.12	321.35	354.23	354.23	354.23	354.23	-
Case. 2	(5 hrs.)	Monthly Mean Output (MW)	105.0	105.0	105.0	105.0	100.8	91.0	98.5	104.8	105.0	105.0	105.0	105.0	-
Case. 2	(5 hrs.)	Monthly Energy (MWH)	15,750	16,275	16,275	15,750	15,631	13,655	15,268	16,237	14,700	16,275	15,750	16,275	187,841
Case. 2	(Off-peak)	Monthly Mean Output (MW)	17.7	17.7	17.5	16.9	16.1	17.7	0	1.1	41.2	70.6	65.8	29.3	-
Case. 2	(Off-peak)	Monthly Energy (MWH)	8,379	8,716	8,755	8,228	8,787	10,104	0	568	21,473	41,573	37,496	17,233	171,313
Case. 2	(Total)	Monthly Mean Operation Hour (Hrs.)	15.8	15.9	16.1	16.2	17.6	19.0	0	1.0	18.1	19.0	19.0	19.0	-
Case. 2	(Total)	Monthly Mean Energy (MWH)	24,129	24,991	25,030	23,978	24,418	23,760	15,268	16,805	36,173	57,848	53,246	33,508	359,154
Case. 3		Monthly Mean Possible Outflow (m^3/s)	42.47	42.17	42.93	44.10	45.89	47.56	31.32	38.90	83.44	99.68	94.92	58.98	-
Case. 3		Water Level at the End of Month (EL.m)	272.28	271.07	269.01	266.15	261.97	263.09	266.37	272.50	272.50	272.50	272.50	272.50	-
Case. 3		Storage at the End of Month ($x10^6m^3$)	350.81	331.73	301.04	262.44	213.31	225.66	265.24	354.23	354.23	354.23	354.23	354.23	-
Case. 3	(5 hrs.)	Monthly Mean Output (MW)	105.0	105.0	105.0	105.0	104.7	100.9	105.0	105.0	105.0	105.0	105.0	105.0	-
Case. 3	(5 hrs.)	Monthly Energy (MWH)	15,750	16,275	16,275	15,750	16,229	15,132	16,275	16,275	14,700	16,275	15,750	16,275	190,961
Case. 3	(Off-peak)	Monthly Mean Output (MW)	17.7	17.7	17.6	17.2	16.6	16.0	0	10.0	54.2	70.6	65.8	29.3	-
Case. 3	(Off-peak)	Monthly Energy (MWH)	7,533	7,513	7,589	7,229	7,194	7,346	0	5,324	28,838	41,573	37,496	17,233	174,870
Case. 3	(Total)	Monthly Mean Operation Hour (Hrs.)	14.2	13.7	13.9	14.0	14.0	15.3	0	6.4	19.0	19.0	19.0	19.0	-
Case. 3	(Total)	Monthly Mean Energy (MWH)	23,283	23,788	23,864	22,939	23,424	22,479	16,275	21,599	43,538	57,848	53,246	33,508	365,831

Note: Case. 1 ... Q·h = 4,180 Q; Possible outflow (m^3/s)
Case. 2 ... Q·h = 4,000 h; Effective head (m)
Case. 3 ... Q·h = 3,800

Table 13 RESERVOIR OPERATION RESULTS (1982 Year, T ≑ 1/4)

Case	Period	Item	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Annual
Case. 1		Monthly Mean Possible Outflow (m^3/s)	41.44	40.31	41.18	42.57	44.77	49.80	28.88	44.35	115.70	106.25	88.90	96.17	-
		Water Level at the End of Month (EL.m)	272.28	270.89	268.36	264.89	259.52	250.50	255.66	272.50	272.50	272.50	272.50	272.50	-
		Storage at the End of Month ($x10^6m^3$)	350.75	328.92	291.97	246.72	188.23	116.10	153.78	354.23	354.23	354.23	354.23	354.23	-
	(5 hrs)	Month Mean Output (MWH)	105.0	105.0	105.0	105.0	102.6	88.8	78.9	103.2	105.0	105.0	105.0	105.0	-
		Monthly Energy (MWH)	15,750	16,275	16,275	15,750	15,910	13,320	12,236	16,003	14,700	16,275	15,750	16,275	184,519
	(Off-peak)	Monthly Mean Output (MW)	17.7	17.7	17.6	17.1	16.2	15.2	0	15.2	86.8	77.4	59.8	67.9	-
		Monthly Energy (MWH)	7,012	6,524	6,571	6,169	6,363	7,952	0	8,449	46,203	45,608	34,106	40,008	214,966
	(Total)	Monthly Mean Operation Hour (Hrs.)	13.2	11.9	12.0	12.1	12.7	17.4	0	5.8	19.0	19.0	19.0	19.0	-
		Monthly Mean Energy (MWH)	22,762	22,799	22,846	21,919	22,273	21,273	12,236	24,452	60,903	61,883	49,856	56,283	399,485
Case. 2		Monthly Mean Possible Outflow (m^3/s)	49.36	37.60	38.18	39.14	40.57	42.88	30.65	61.55	115.70	106.25	88.90	96.17	-
		Water Level at the End of Month (EL.m)	272.45	271.54	269.63	267.02	263.16	257.52	260.94	272.50	272.50	272.50	272.50	272.50	-
		Storage at the End of Month ($x10^6m^3$)	353.54	338.99	310.07	273.74	226.48	169.65	202.64	354.23	354.23	354.23	354.23	354.23	-
	(5 hrs)	Monthly Mean Output (MW)	105.0	105.0	105.0	105.0	105.0	99.4	93.0	104.8	105.0	105.0	105.0	105.0	-
		Monthly Energy (MWH)	15,750	16,275	16,275	15,750	16,275	14,904	14,414	16,240	14,700	16,275	15,750	16 [illegible]	188,883
	(Off-peak)	Monthly Mean Output (MW)	17.7	17.7	17.7	15.6	16.8	15.9	0	33.2	86.8	77.4	59.8	67.9	-
		Monthly Energy (MWH)	6,469	5,164	5,212	4,983	4,871	5,217	0	18,910	46,203	45,608	34,106	40,008	216,753
	(Total)	Monthly Mean Operation Hour (Hrs.)	12.2	9.4	9.5	9.6	9.4	11.0	0	9.2	19.0	19.0	19.0	19.0	-
		Monthly Mean Energy (MWH)	22,219	21,439	21,497	20,733	21,146	20,122	14,414	35,151	60,903	61,883	49,856	56,283	405,636
Case. 3		Monthly Mean Possible Outflow (m^3/s)	40.10	35.30	35.68	36.35	37.34	38.85	31.67	75.05	115.70	106.25	88.90	96.17	-
		Water Level at the End of Month (EL.m)	272.50	271.97	270.54	268.54	265.63	261.61	264.31	272.50	272.50	272.50	272.50	272.50	-
		Storage at the End of Month ($x10^6m^3$)	354.23	345.82	323.61	294.49	255.89	209.51	239.77	354.23	354.23	354.23	354.23	354.23	-
	(5 hrs.)	Monthly Mean Output (MW)	105.0	105.0	105.0	105.0	105.0	104.5	101.2	105.0	105.0	105.0	105.0	105.0	-
		Monthly Energy (MWH)	15,750	16,275	16,275	15,750	16,275	15,670	15,693	16,275	14,700	16,275	15,750	16,275	190,963
	(Off-peak)	Monthly Mean Output (MW)	17.7	17.7	17.7	17.6	17.1	16.5	0	47.8	86.8	77.4	59.8	67.9	-
		Monthly Energy (MWH)	6,334	3,994	4,022	3,891	3,871	3,506	0	27,109	46,203	45,608	34,106	40,008	218,652
	(Total)	Monthly Mean Operation Hour (Hrs.)	11.9	7.3	7.3	7.4	7.3	7.1	0	12.2	19.0	19.0	19.0	19.0	-
		Monthly Mean Energy (MWH)	22,084	20,269	20,297	19,641	20,146	19,176	15,693	43,384	60,903	61,883	49,856	56,283	409,615

Note: Case. 1 ... Q·h = 3,630
Case. 2 ... Q·h = 3,400
Case. 3 ... Q·h = 3,200

Q: Possible outflow (m^3/s)
h: Effective head (m)

Table 14 SCHEDULED WATER LEVEL AND POSSIBLE OUTFLOW

Month	First 10-day Water Level (EL. m)	First 10-day Possible Outflow (m^3/s) T=1/5	Second 10-day Water Level (EL. m)	Second 10-day Possible Outflow (m^3/s) T=1/5	Last 10-day Water Level (EL. m)	Last 10-day Possible Outflow (m^3/s) T=1/5
June	272.5	42.20	272.50	38.37	272.40	34.91
July	272.08	35.00	271.61	35.14	270.94	35.35
Augt.	270.17	35.64	269.26	35.97	268.09	36.36
Sept.	266.88	36.87	265.54	37.41	264.03	38.03
Oct.	262.39	38.74	260.53	39.55	258.09	40.54
Nov.	255.43	41.93	252.51	43.54	250.50	45.39
Dec.	251.02	28.80	252.34	29.20	256.02	29.70
Jan.	259.77	30.70	262.99	31.60	266.73	40.39
Feb.	269.78	36.29	270.60		271.20	
Mar.	271.60		271.90		272.10	
Apr.	272.30		272.40		272.50	
May	272.50		272.50		272.50	

Note : Each water level shows the water level at the end of each period.

Table 15 AMOUNT FOR RESERVOIR FILLING

		Expectable Inflow (m^3/s)	to be required for Peak Power (5 hrs)	Amount for Reservoir Filling ($\times 10^6\ m^3$)	Water Level (EL. m)
Dec.	1ST	33.6	28.8	4.16	251.02
	2ND	42.4	29.2	11.42	252.34
	3RD	57.5	29.7	26.43	256.02
Jan.	1ST	64.0	30.7	28.77	259.77
	2ND	68.0	31.6	31.44	262.99
	3RD	73.5	31.0	40.39	266.73
Feb.	1ST	71.2	29.2	36.29	269.78
	2ND	76.0	28.5	-	270.00
	3RD	80.6	-	-	-
Mar.	1ST	75.8	-	-	-
	2ND	81.4	-	-	-
	3RD	71.1	-	-	-

Note: Expectable inflow is estimated by Gumbel's method.

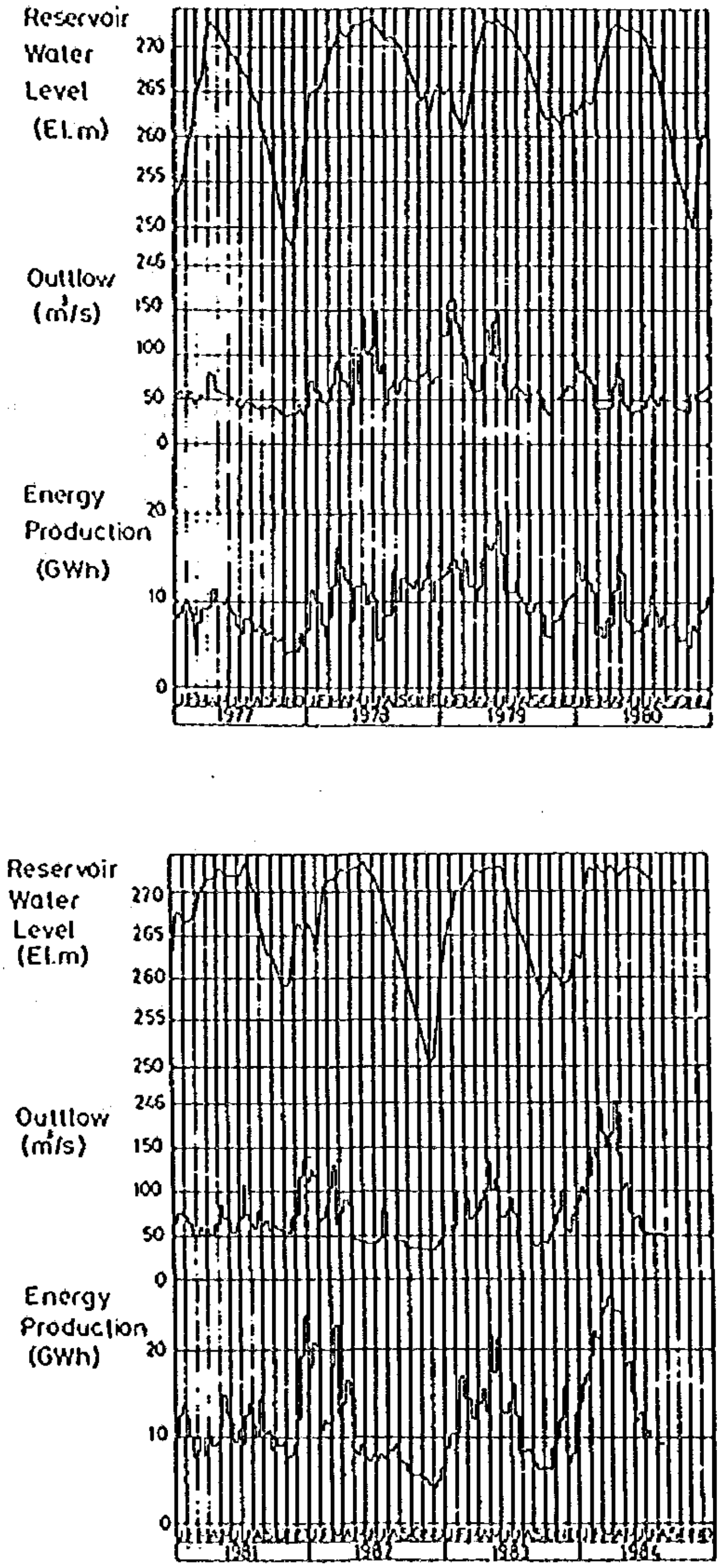


Fig. 1 OPERATION RECORD OF KARANG KATES RESERVOIR

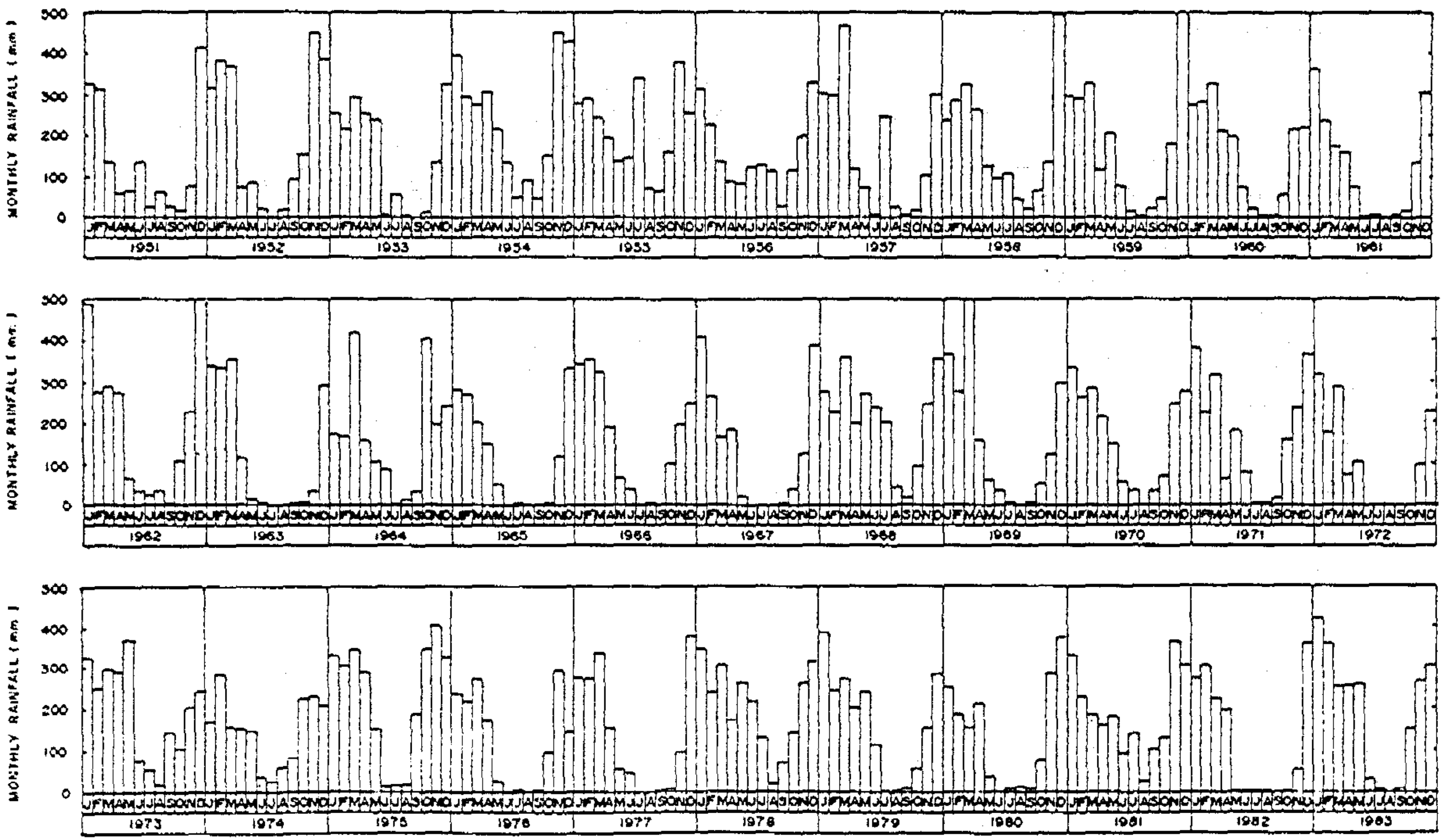
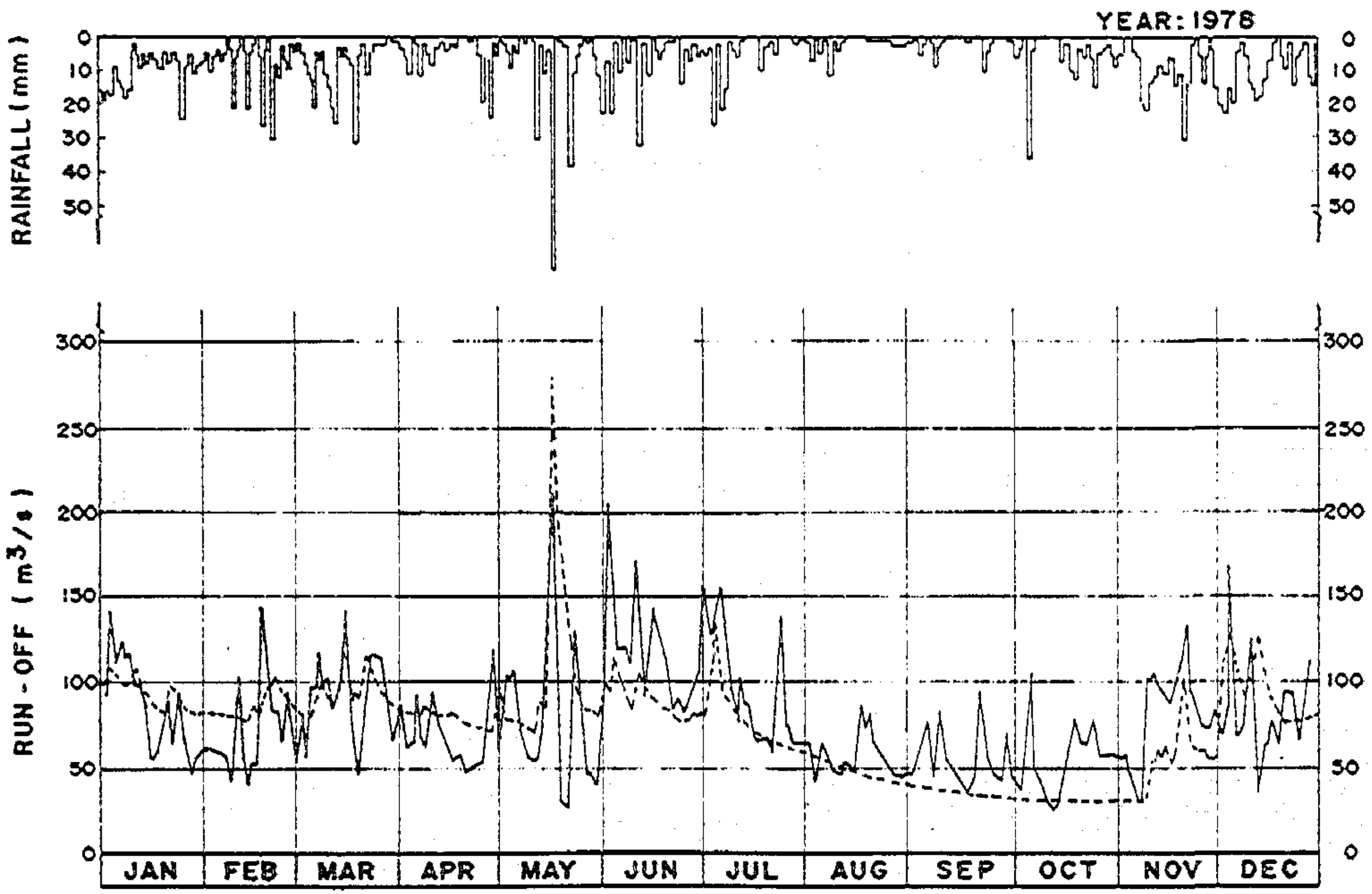
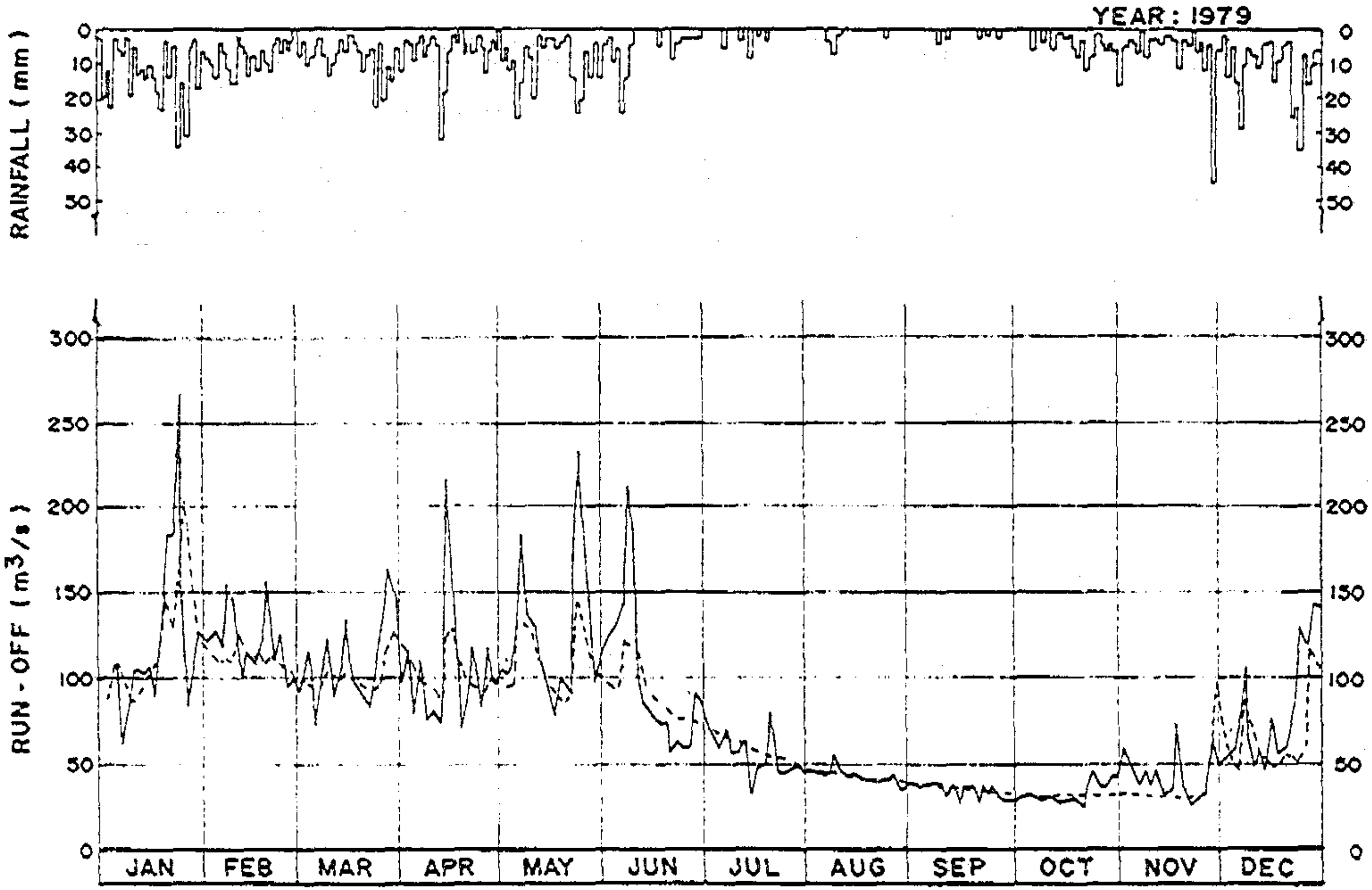


Fig. 2 MONTHLY RAINFALL IN THE KARANGKATES BASIN



Note : —— ; Run - off estimated by using reservoir water level and outflow
--- ; Run - off estimated by applying Tank Model Method
C.A = 2.210 Km^2 (Including 160 Km^2 of Lahor basin)

Fig. 3(1) SIMULATED RUN - OFF AT KARANGKATES DAMSITE

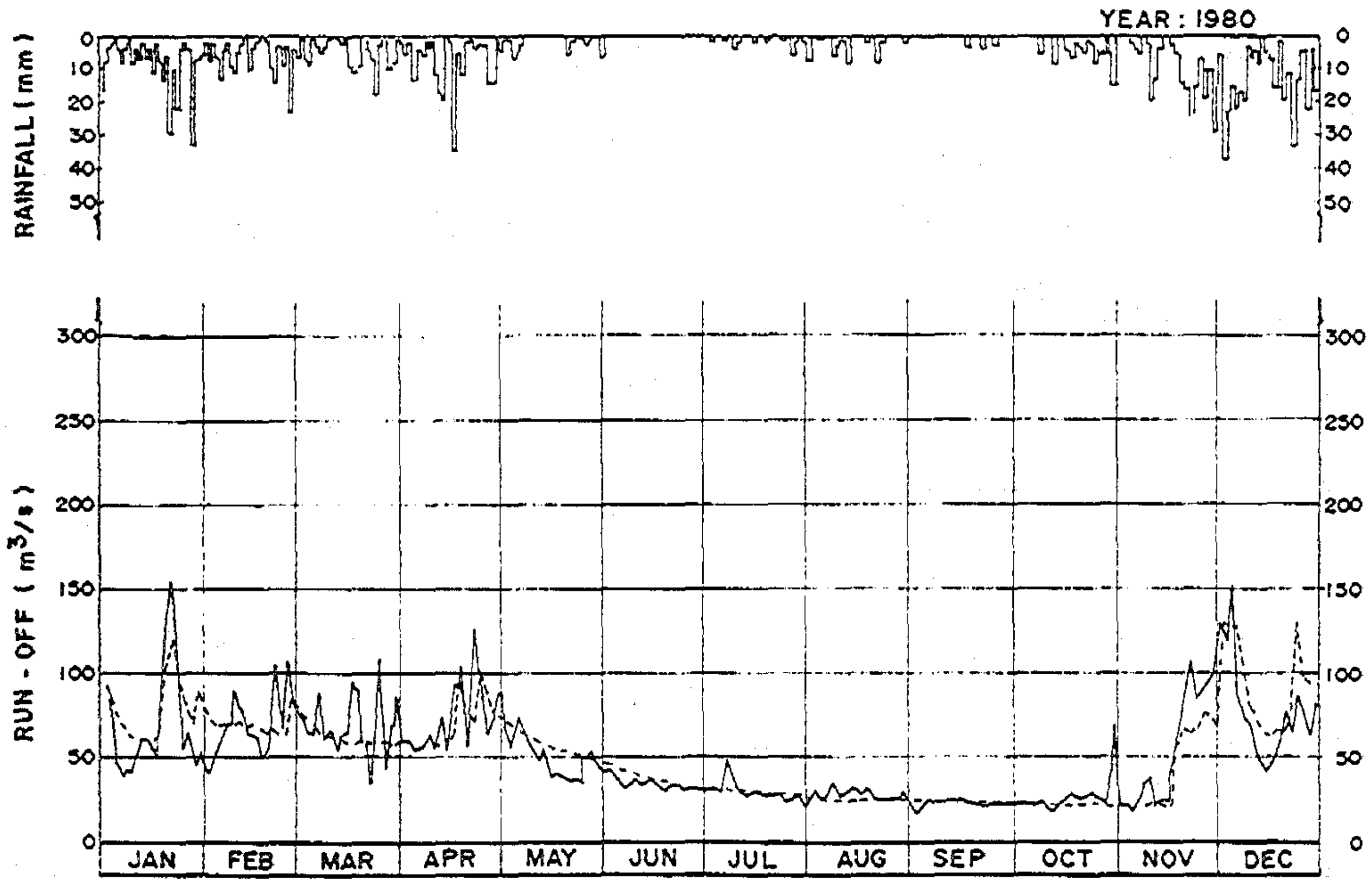


Note : —— ; Run - off estimated by using reservoir water level and outfow

--- ; Run - off estimated by applying Tank Model Method

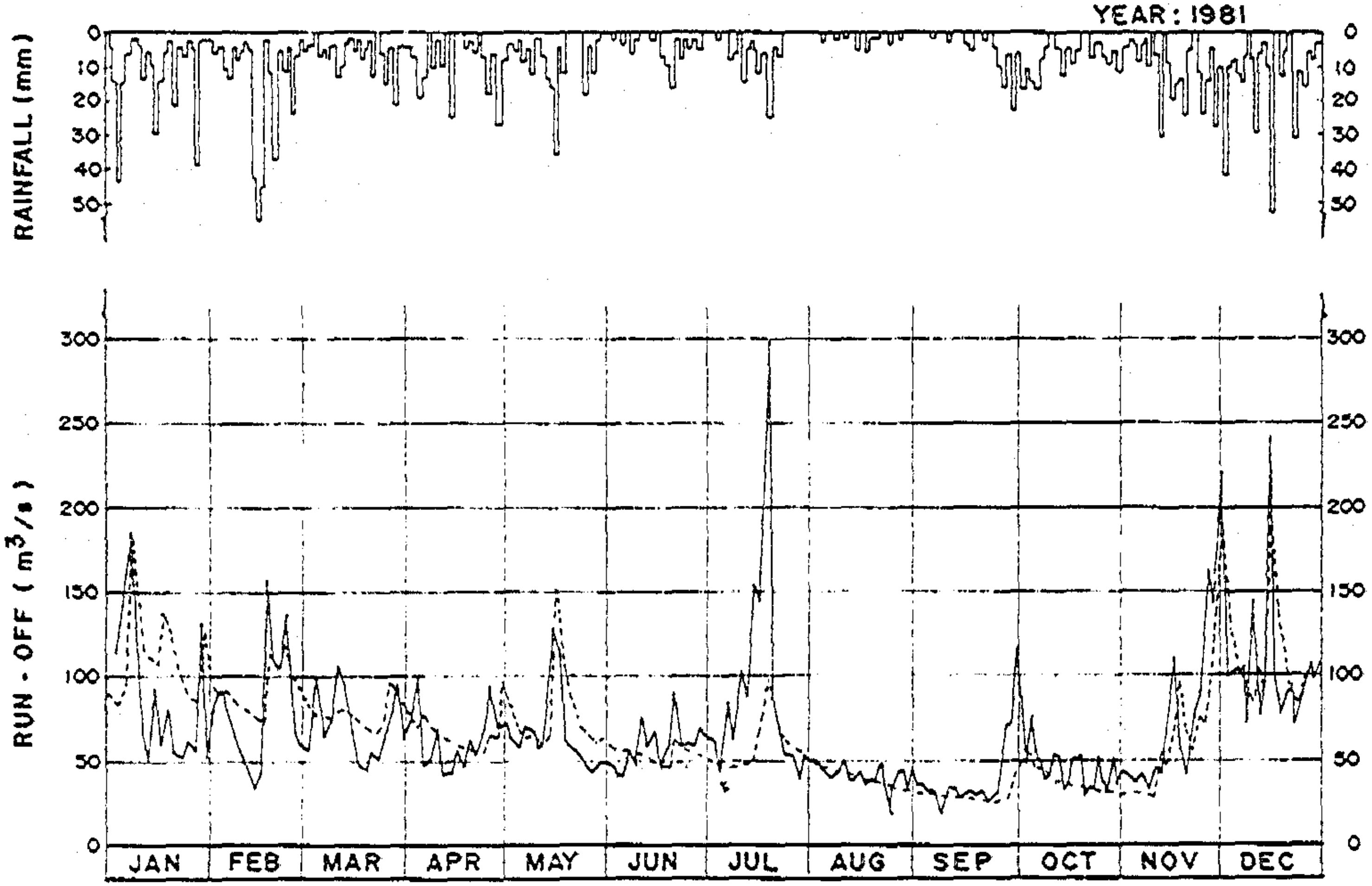
C.A = 2.210 Km^2 (Including 160 Km^2 of Lahor basin)

Fig. 3(2) SIMULATED RUN - OFF AT KARANGKATES DAMSITE



Note : —— ; Run - off estimated by using reservoir water level and outflow
--- ; Run - off estimated by applying Tank Model Method
C.A = 2.210 Km^2 (Including 160 Km^2 of Lahor basin)

Fig.- 3(3) SIMULATED RUN - OFF AT KARANGKATES DAMSITE

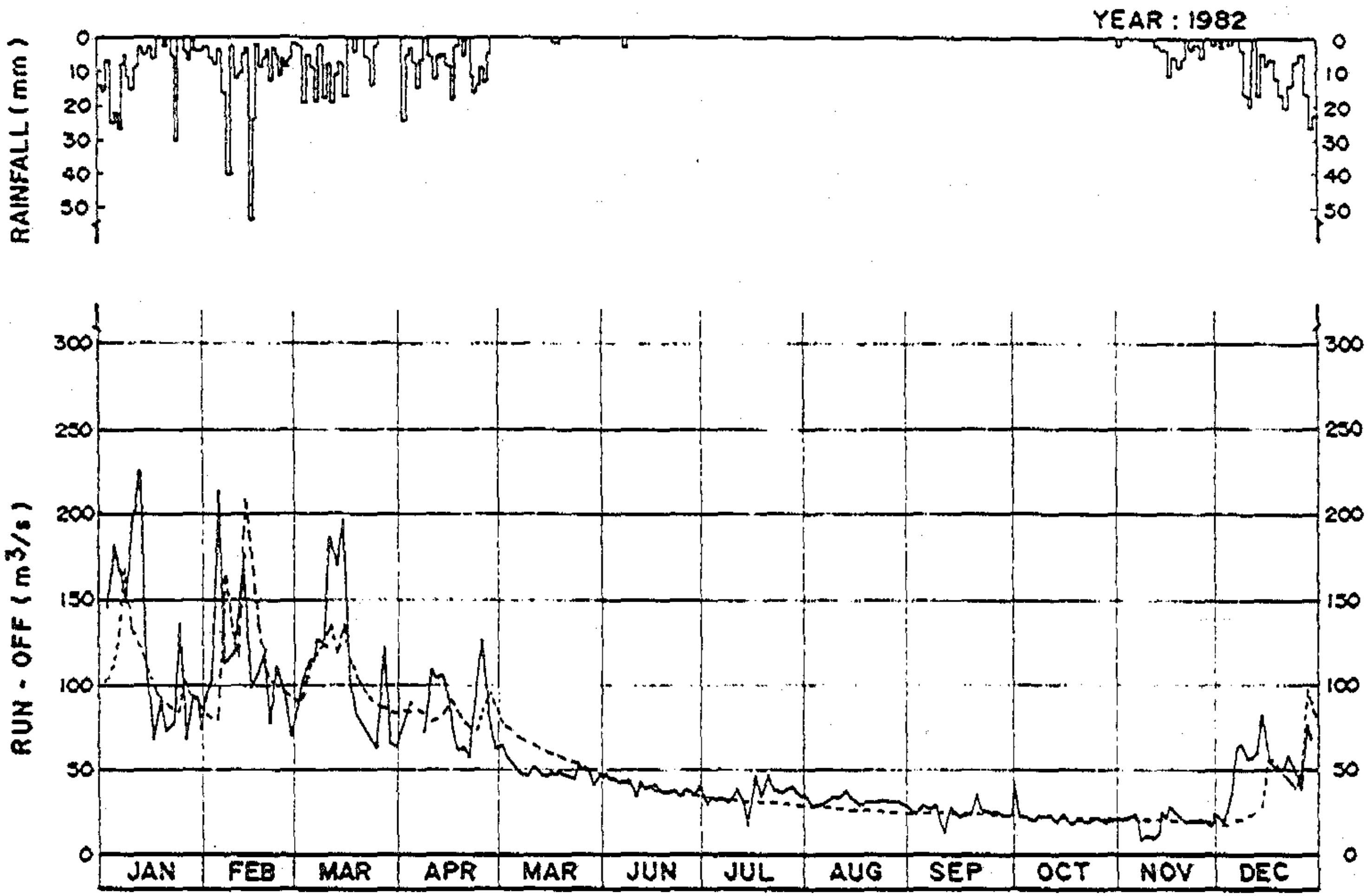


Note : —— ; Run - off estimated by using reservoir water level and outfow

--- ; Run - off estimated by applying Tank Model Method

C.A = 2.210 Km^2 (Including 160 Km^2 of Lahor basin)

Fig. 3(4) SIMULATED RUN - OFF AT KARANGKATES DAMSITE

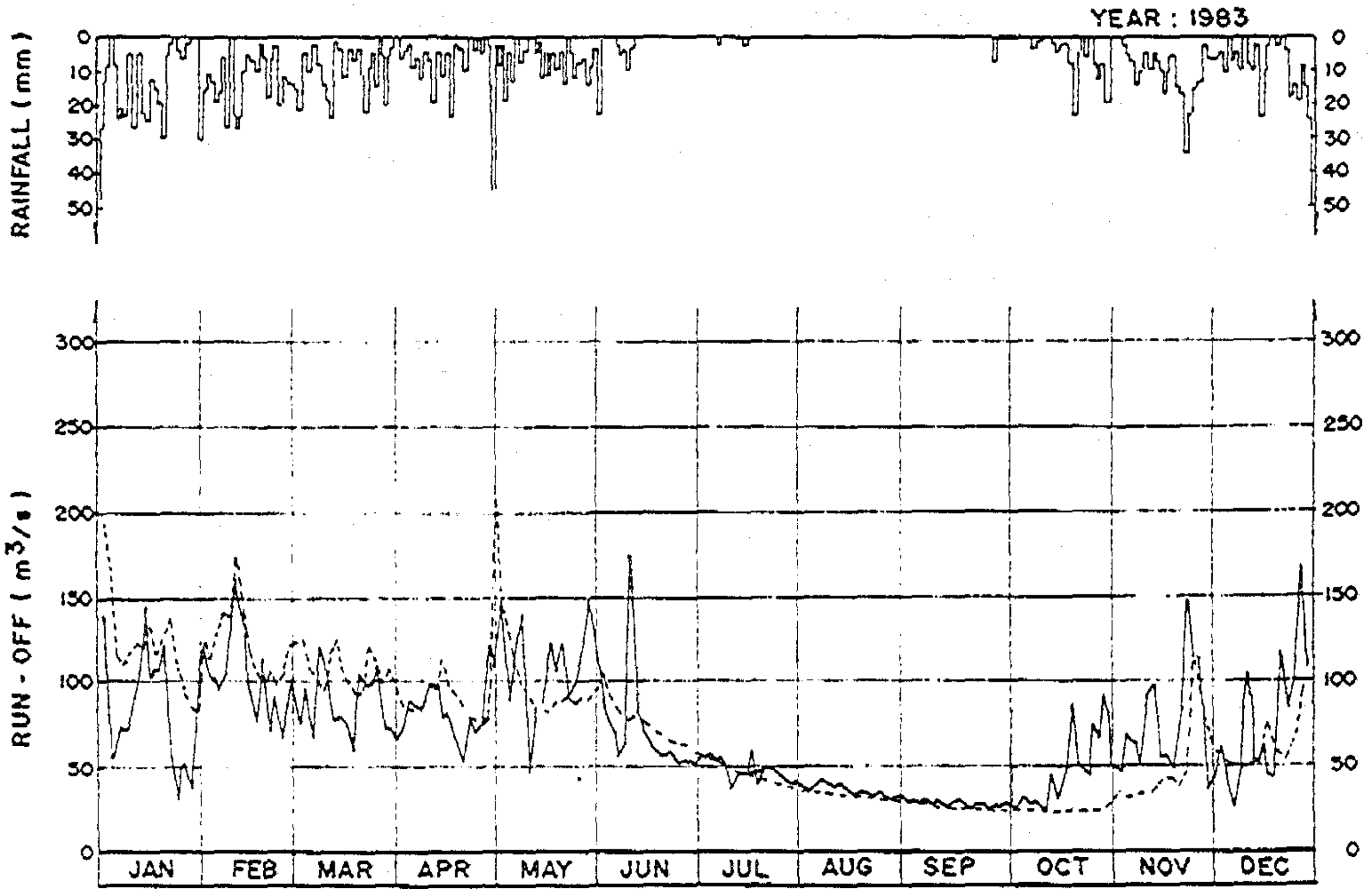


Note : —— ; Run - off estimated by using reservoir water level and outfow

--- ; Run - off estimated by applying Tank Model Method

C.A = 2.210 Km^2 (Including 160 Km^2 of Lahor basin)

Fig. 3(5) SIMULATED RUN - OFF AT KARANGKATES DAMSITE



Note : —— ; Run - off estimated by using reservoir water level and outflow

--- ; Run - off estimated by applying Tank Model Method

C.A = 2.210 Km^2 (Including 160 Km^2 of Lahor basin)

Fig. 3(6) SIMULATED RUN - OFF AT KARANGKATES DAMSITE

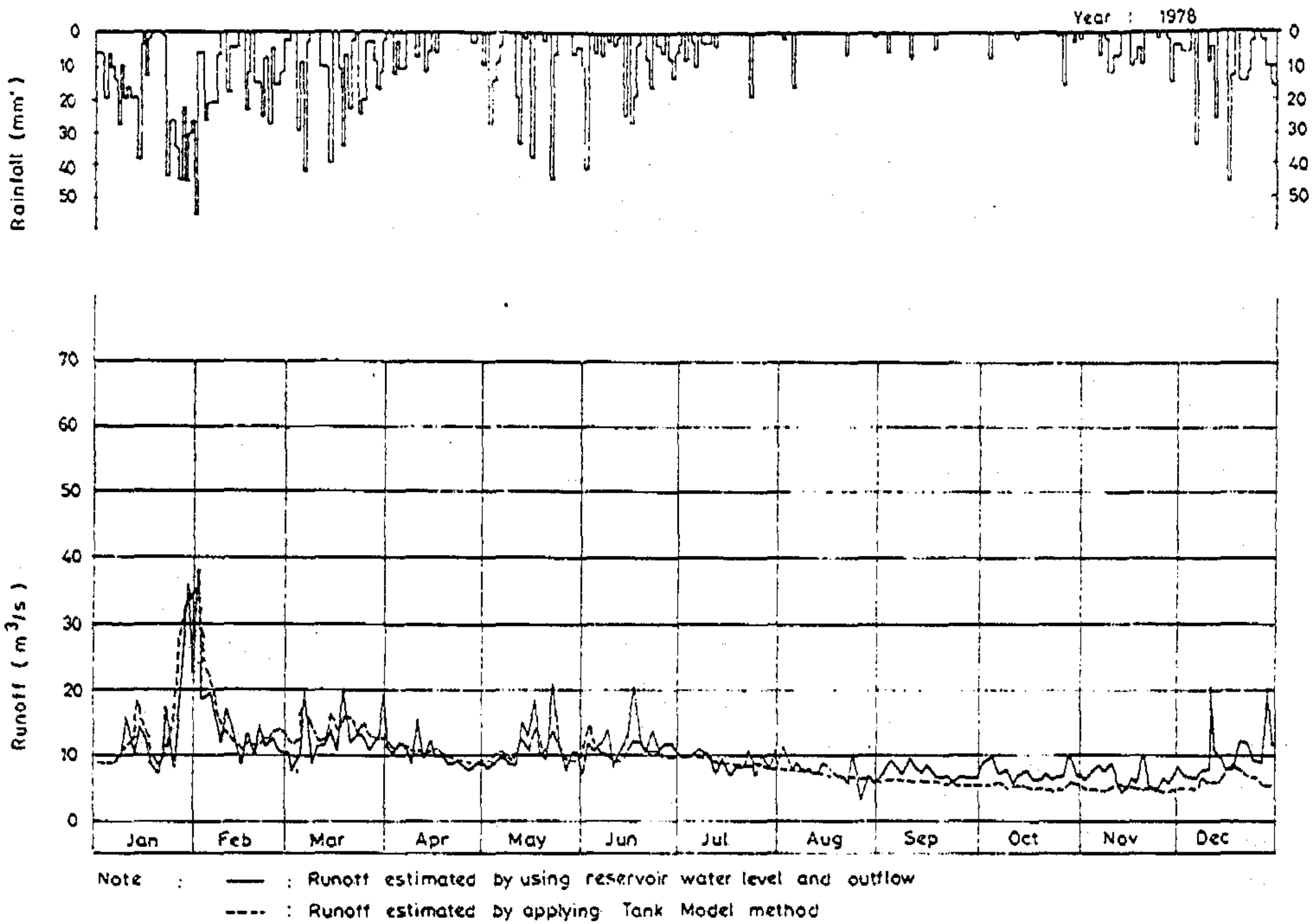


Fig. -4(1) SIMULATED RUNOFF AT SELOREJO DAMSITE

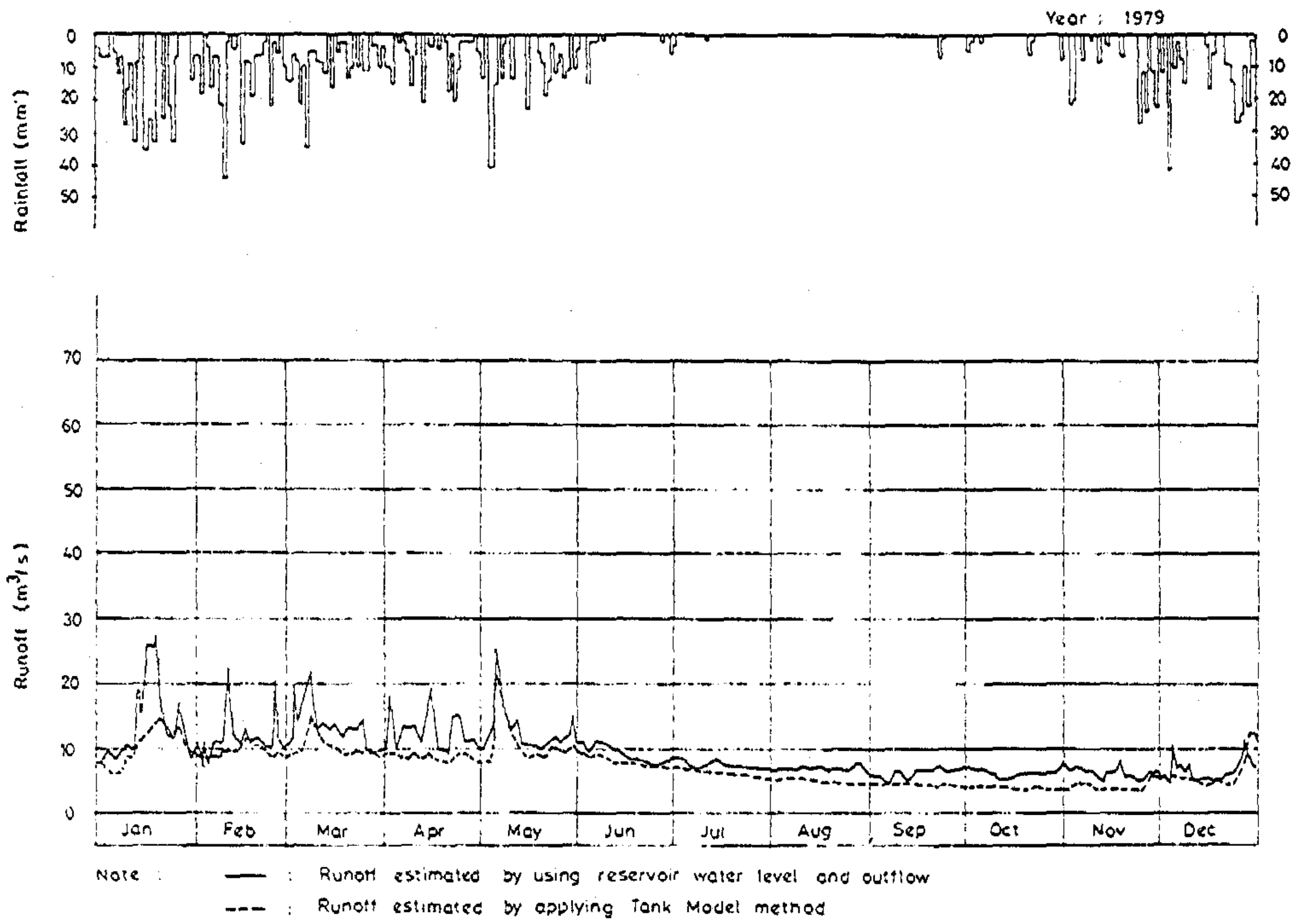
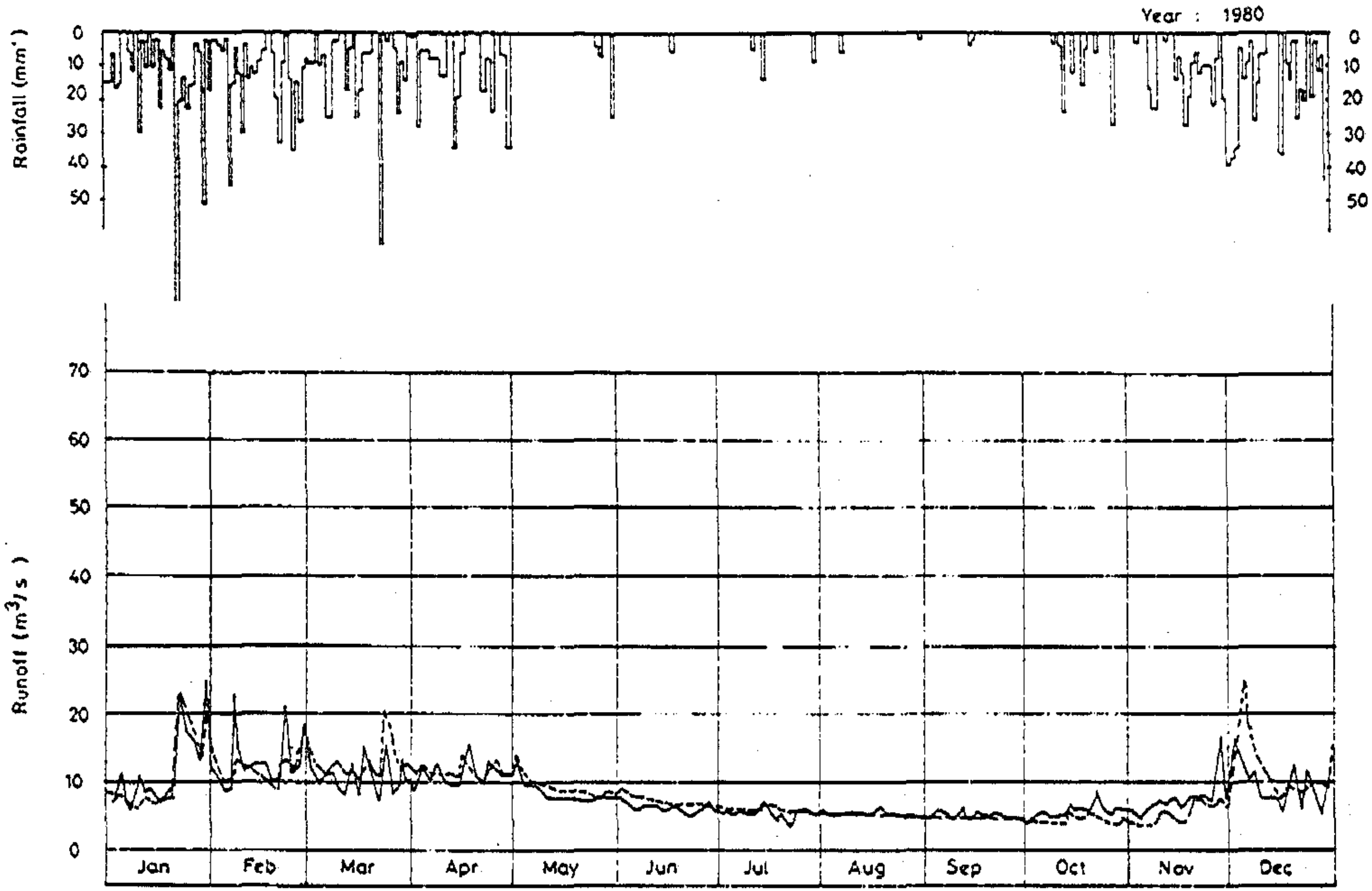


Fig. 4(2) SIMULATED RUNOFF AT SELOREJO DAMSITE



Note : —— : Runoff estimated by using reservoir water level and outflow
---- : Runoff estimated by applying Tank Model method

Fig. 4(3) SIMULATED RUNOFF AT SELOREJO DAMSITE

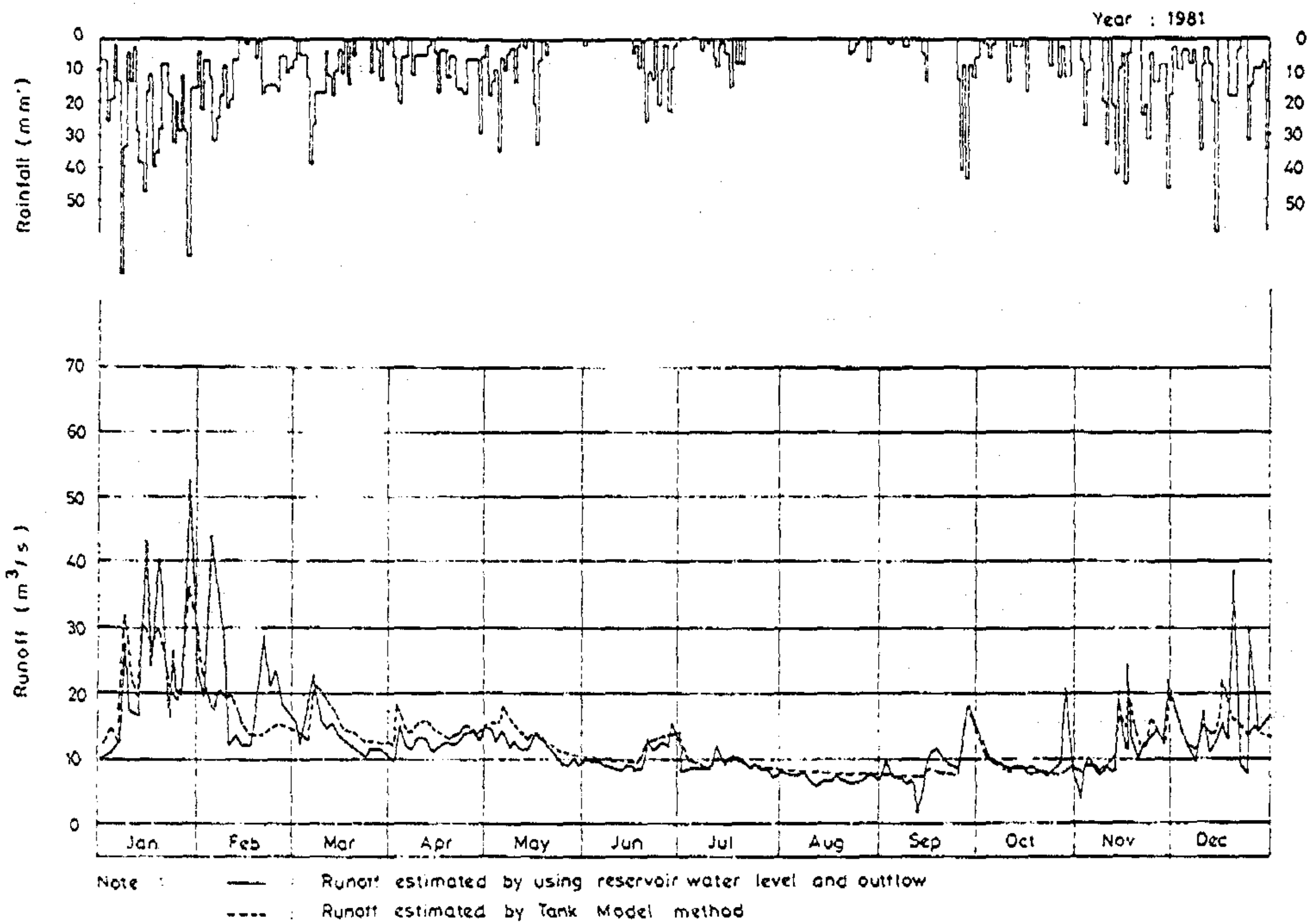


Fig. 4(4) SIMULATED RUNOFF AT SELOREJO DAMSITE

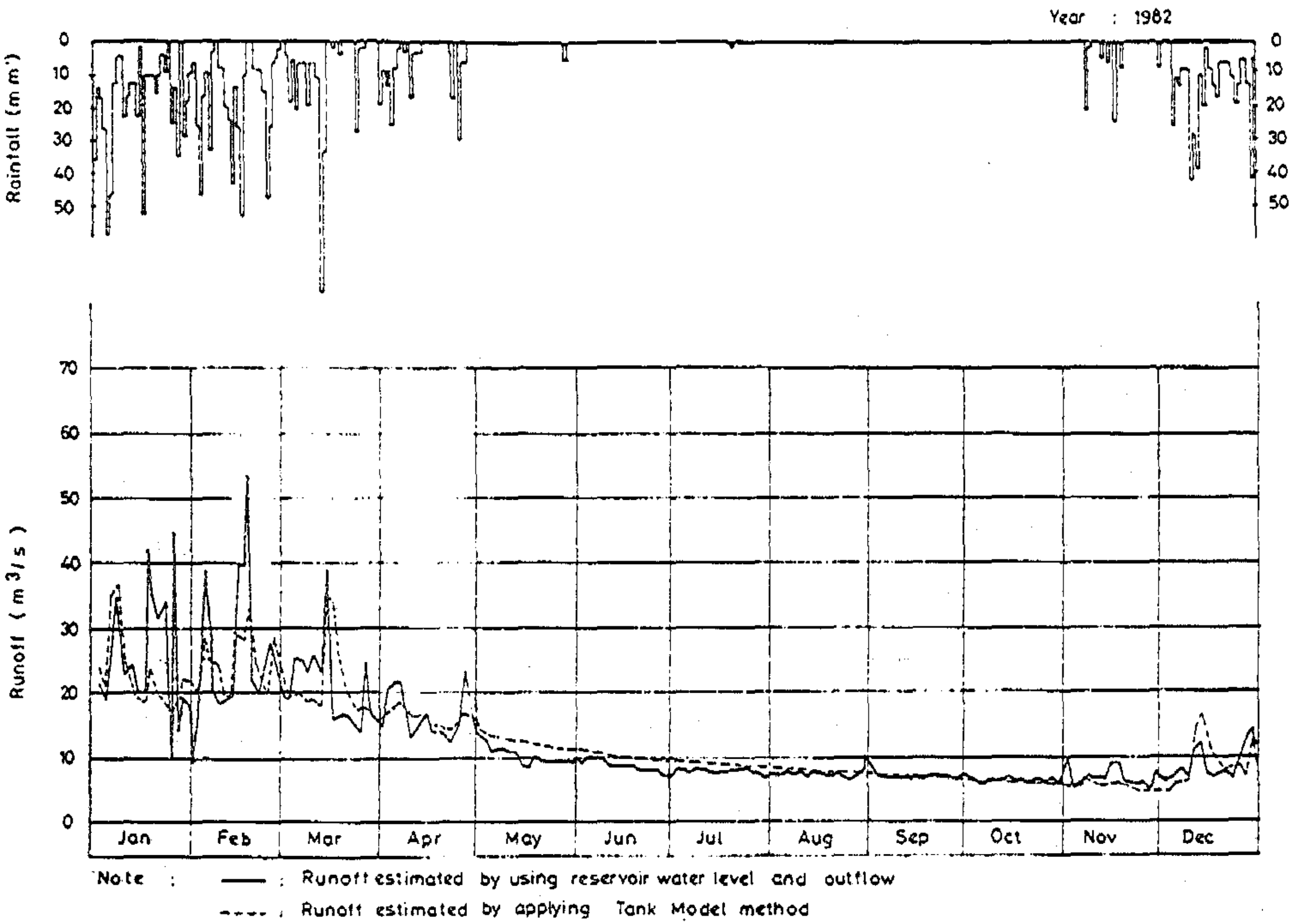
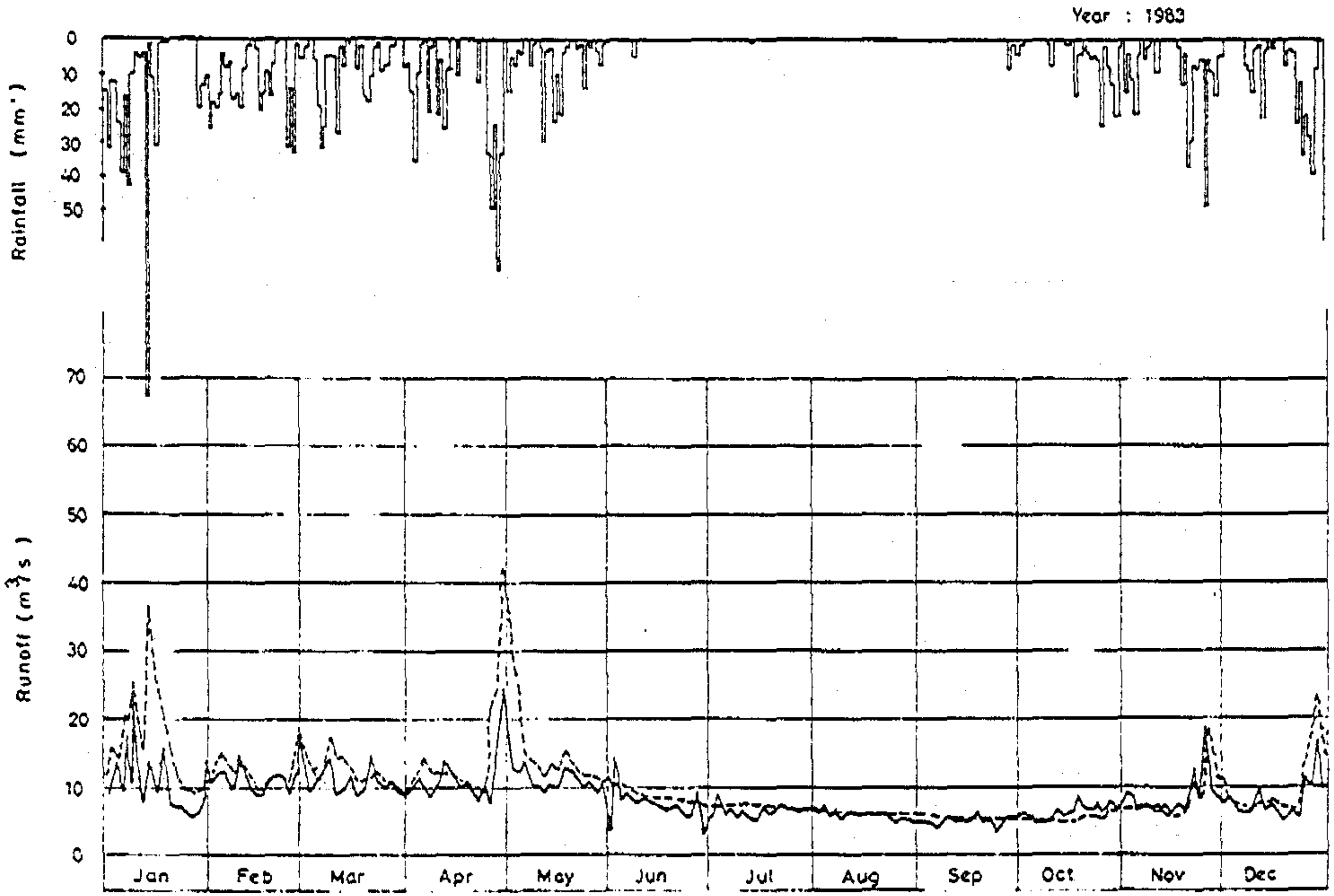
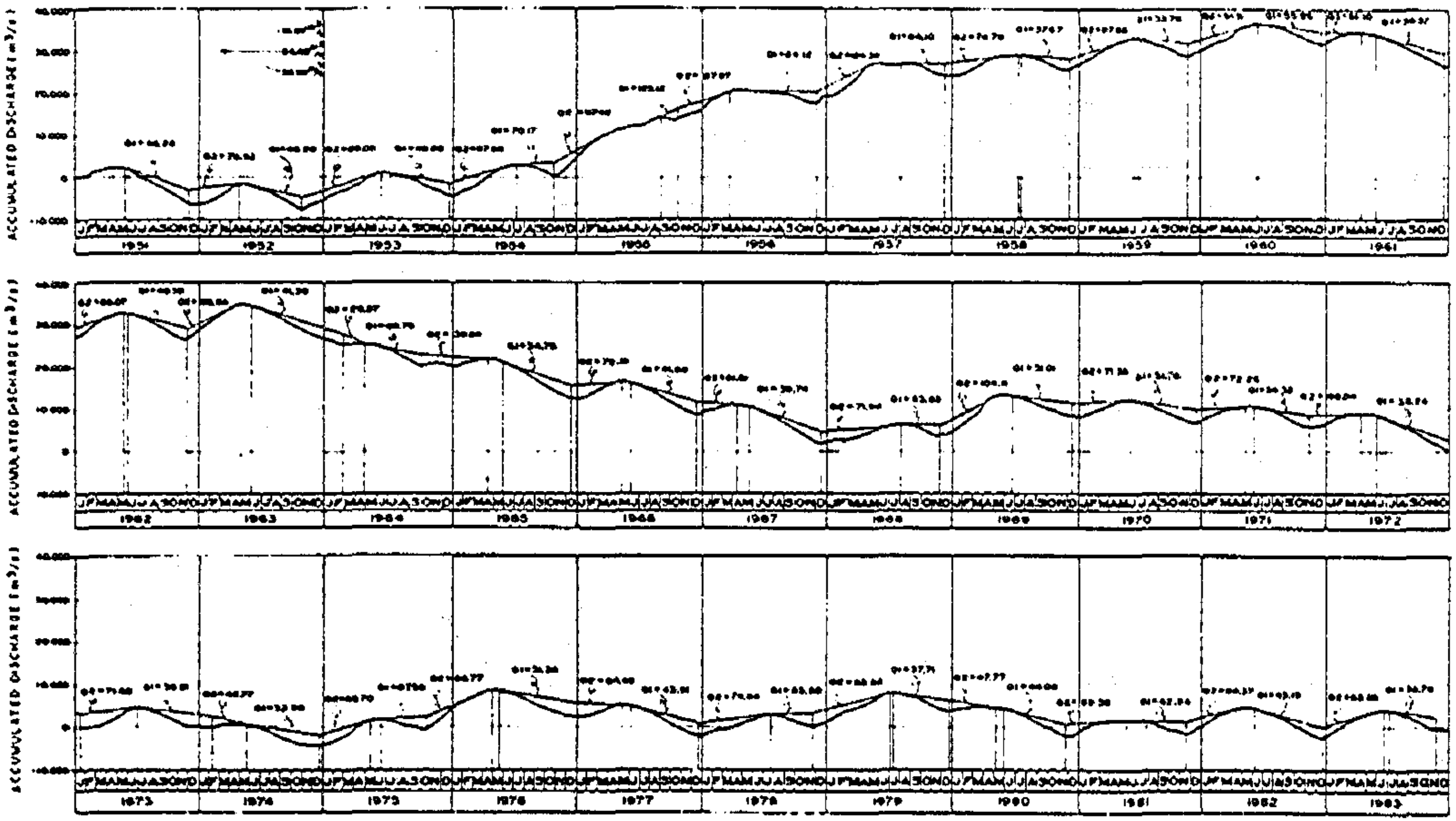


Fig. 4(5) SIMULATED RUNOFF AT SELOREJO DAMSITE



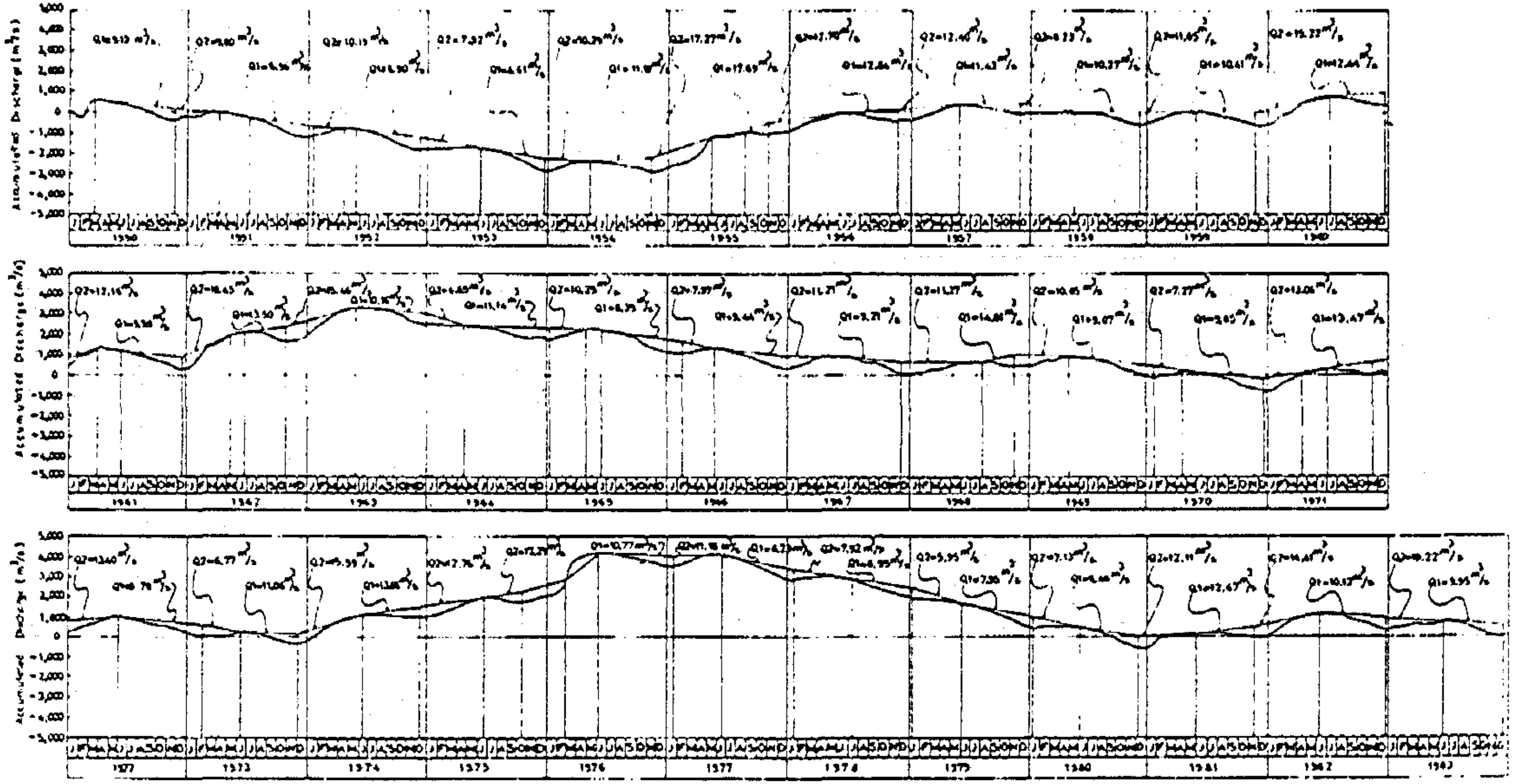
Note : —— : Runoff estimated by using reservoir water level and outflow
--- : Runoff estimated by applying Tank Model method

Fig. 4(6) SIMULLATED RUNOFF AT SELOREJO DAMSITE



Note :
(1) Discharge is estimated by applying Tank Model Method
(2) Catchment area is 2,210 Km^2 (including 160 Km^2 of Lahor area)
(3) Q1 means possible outflow from Karangkates reservoir during releasing
(4) Q2 means possible outflow from Karangkates reservoir during filling

Fig. 5 —MASS CURVE AT KARANGKATES DAMSITE.



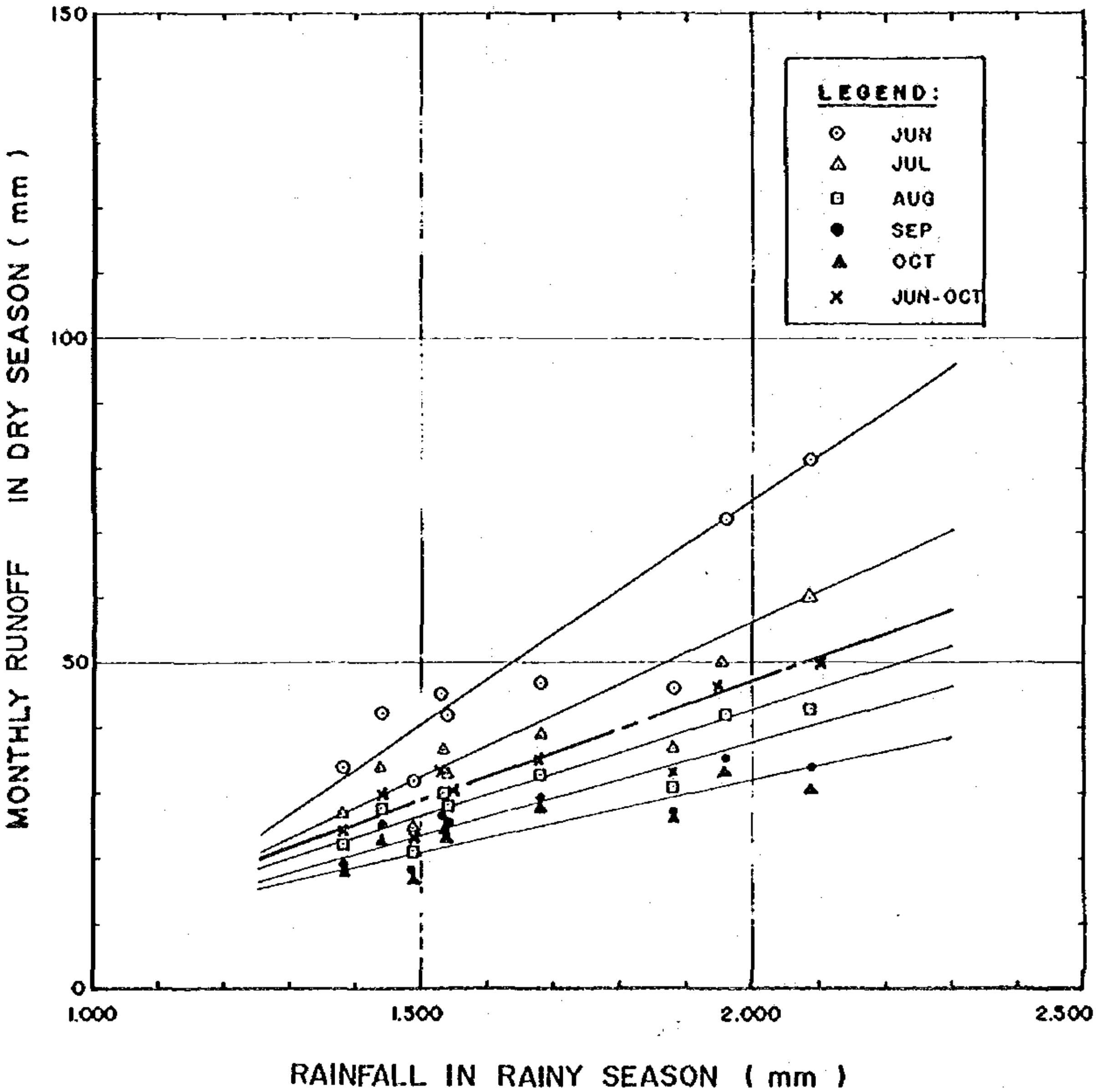
NOTE. (1) Discharge is estimated by applying Tank Model Method

(2) Catchment area is 236 km^2

(3) Q1 means possible outflow from Selorejo reservoir during releasing

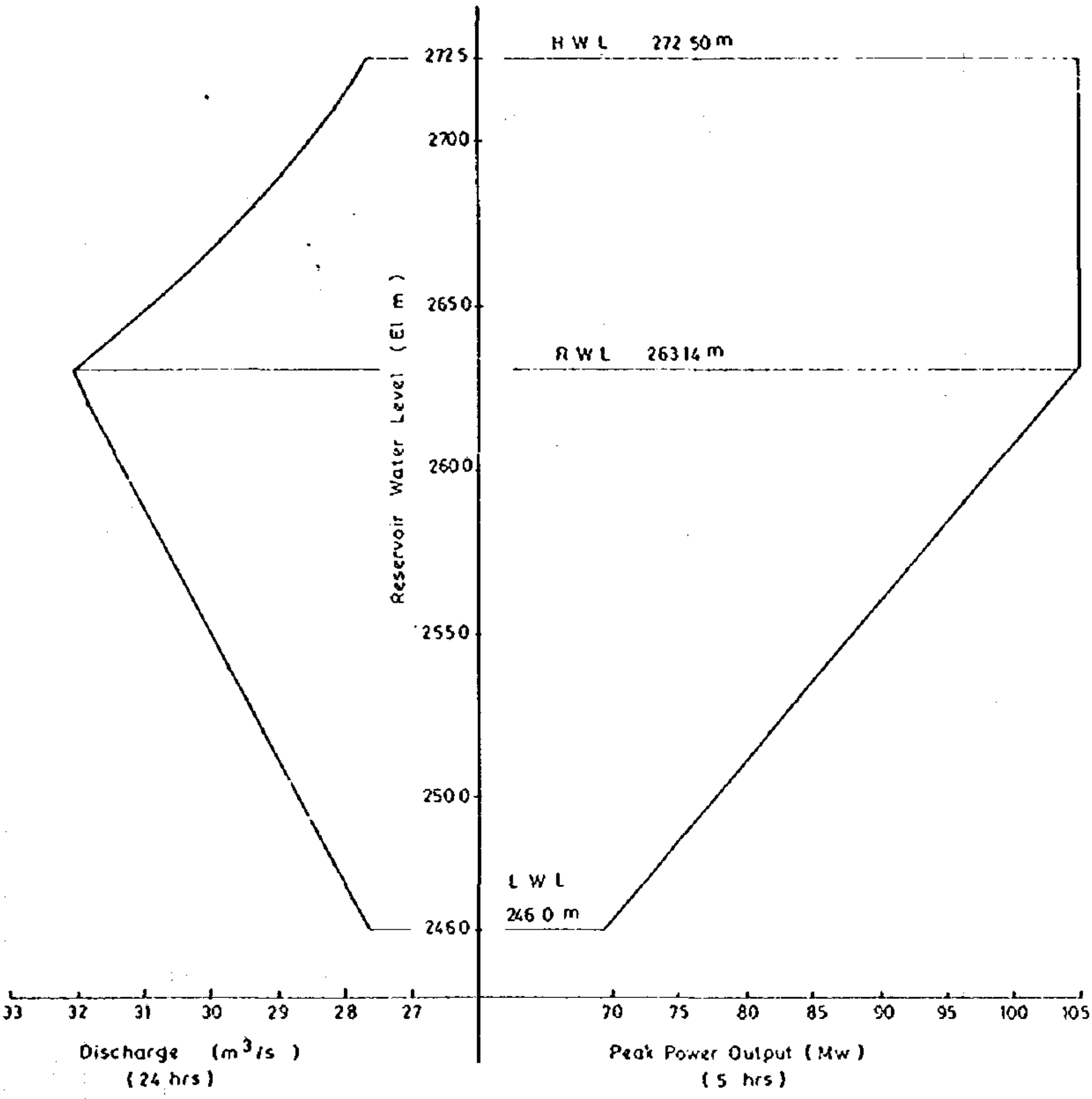
(4) Q2 means possible outflow from Selorejo reservoir during filling

Fig. 6 MASS CURVE AT SELOREJO DAMSITE



Note : RAINY Season ; from November to next May.

Fig. 7 RELATIONSHIP BETWEEN MONTHLY RUNOFF AND RAINFALL IN RAINY SEASON (KARANGKATES BASIN)



Conditions : No off - peak power generation is taken into account

Fig. 8 WATER REQUIREMENT FOR PEAK POWER OUTPUT (KARANGKATES DAM)

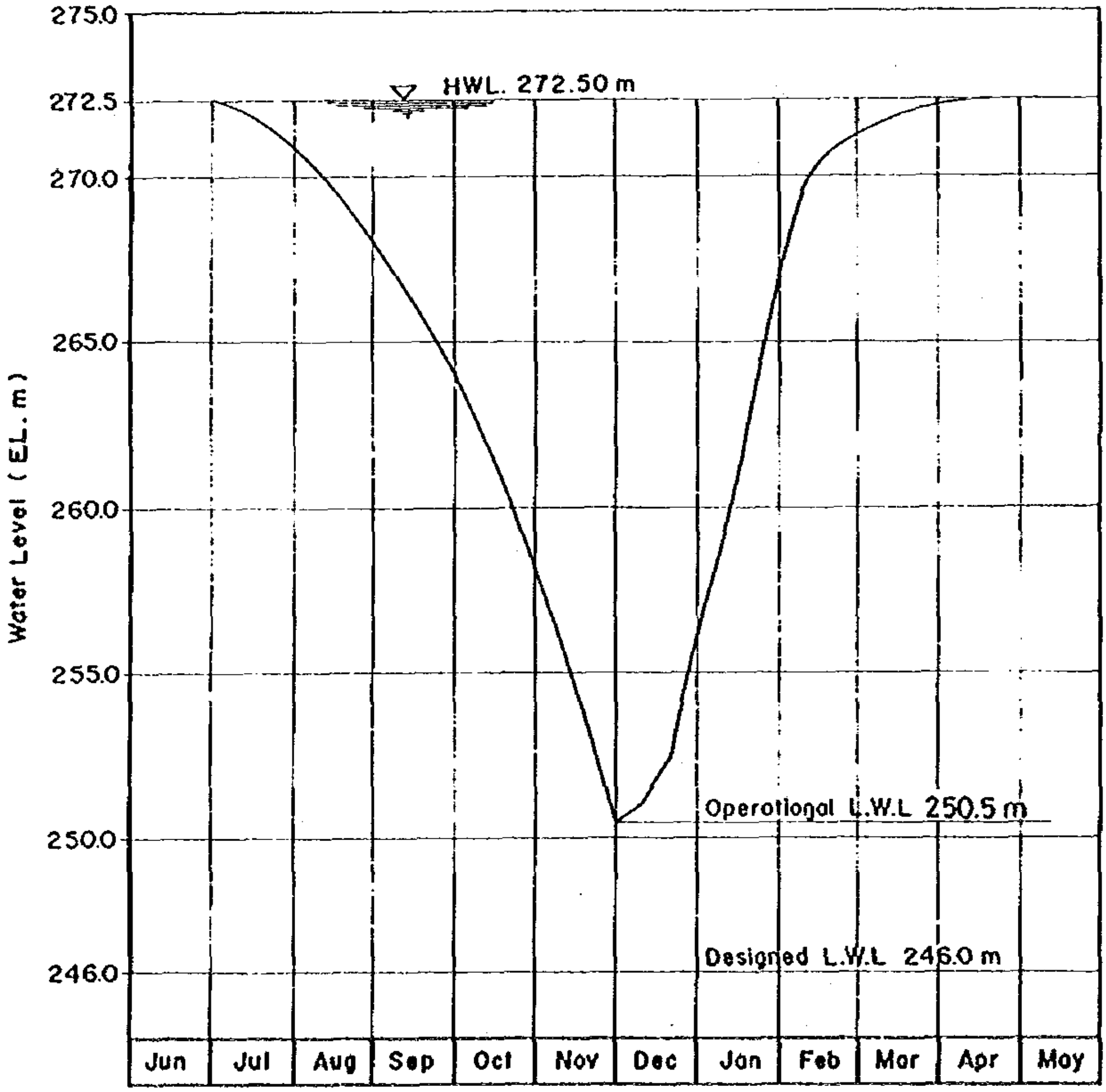


Fig. 9 SCHEDULED WATER LEVEL.

NOTE MP-3

SPILLWAY CAPACITY

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Note MP-3 Spillway Capacity

The spillways of the existing dams were designed according to the old design standards and available hydrological data during the design stage of each dams. At present, hydrological data for more than 10 years are additionally available, and the design standards of spillway have been changed to the more severe ones. The spillway capacities adequate at the time of the design seem to be insufficient against floods estimated including newly available hydrological data.

In this context, review of the spillway capacities is made.

1. Design flood

For checking the capacities of existing dams, the following probable floods are taken into account;

200 year probable flood times 1.2
10,000 year probable flood for extra-ordinary condition

Procedures to estimate the above probable floods are as follows;

- Daily areal rainfall is calculated for the catchment area upstream of each dam
- Annual maximum three-day continuous rainfall is sampled
- Probable three-day rainfalls are calculated by the the Gumbel's method
- Rainfall pattern applicable for each catchment area is selected for the rainfall records which caused big floods
- Maximization of the selected rainfall pattern up to the rainfall amount of the estimated probable three-day rainfall is made
- The probable three-day rainfall with hourly distribution over three days is put into the storage function model whose constants are examined and determined in the Hydrological Study.

The probable three-day rainfalls are estimated as shown in Table 1. The design storm and areal weights of rainfall gauging stations in and around each basin under study are as shown in Table 2 to 5. The basin and channel constants of the Storage function are determined in the Hydrological Study, as shown in Table 6 and 7 referred to Fig.1.

2. Required freeboard

As for the freeboard to be required for each dam, the Japanese standard shown in Table 8 is applied. The standard requires estimation of wave height and water height due to earthquake. Wave height is calculated based on the Sverdrup - Munk - Bretschmeider and Saville method as shown in Fig. 2. Water height due to earthquake is calculated by the Sato's equation. Results are shown in Table 9.

Applying the Japanese standard, the freeboard of each dam is determined as follows ;

Karangkates dam	3.0 m
Lahor dam	1.9 m
Selorejo dam	1.7 m
Wlingi dam	2.5 m

The present setting of the designed high water level and the crest elevation satisfies the above requirement.

In case of the extra-ordinary condition like 10,000 years probable flood, the heighest flood water level is set lower than or equal to the level 1 m below the top of the impervious zone of dam. In case of gated spillway, an allowance of 0.5 m for gates is added to the above.

3. Karangkates Dam

The spillway and the water level setting of the Karangkates dam are as follows;

Gated weir	length;	10 m
	elevation ;	EL. 267.00 m
Non-gated weir	length ;	50 m
	elevation ;	EL. 272.5 m
Top elevation of core	EL 278.5 m	
Flood water level	EL. 275.5 m (design)	
	EL. 277.5 m (in case of abnormal flood)	

For the above conditions, the estimated probable floods are put in with retarding effect in the reservoir.

Results are as follows ;

Probable flood	Allowable water level	Highest water level	Peak	
			Inflow	Outflow
		EL. m	m^3/sec	
200 year x 1.2	275.50	267.17	3,939	1,046
10,000 year	277,00	278.42	6,241	1,764

According to the newly estimated probable floods, it can be said that the spillway capacity of the Karangkates dam may be insufficient shown on Fig. 3. Careful study on necessary countermeasures is recommended.

4. Lahor Dam

The spillway and the water level setting of the Lahor dam are as follows;

Non-gated weir	length ;	35 m
	elevation ;	EL. 272.6 m
Top elevation of core	EL. 277.5 m	
Flood water level	EL. 274.5 m	

For the above conditions, the estimated probable floods are put in. Results are follows ;

Probable flood	Allowable water level	Highest water level	Peak	
			Inflow	Outflow
		EL. m	m^3/sec	
200 year x 1.2	275.60	275.18	645	295
10,000 year	276.50	277.58	2,776	816

According to the newly estimated probable floods, it can be said that the spillway capacity of the Lahor dam may be insufficient as shown on Fig. 4. Careful study on necessary countermeasure is recommended.

5. Selorejo Dam

The spillway and the water level setting of the Selorejo dam are as follows ;

Gated weir	length	;	10 m x 3 nos
	elevation	;	EL.620 m during flood season
			EL. 622 m during non-flood season
Top elevation of core	EL. 624.5 m		
Flood water level	EL. 622.6 m		

For the above conditions, the estimated probable floods are put in. Results are as follows ;

Probable flood	Allowable water level	Highest water level	Peak	
			Inflow	Outflow
		EL. m	m^3/sec	
200 year x 1.2	622.60	622.78	818	280
10,000 year	623.50	625.74	2,009	779

According to the newly estimated probable floods, it can be said that the spillway capacity of the Selorejo dam is insufficient as shown on Fig. 5. Careful study on necessary countermeasures is recommended.

6. Wlingi Dam

The spillway and the water level setting of the Wlingi dam are as follows ;

Gated weir	length	; 10.6 m x 4 nos
	elevation	; 153.5 m
Top elevation of core	EL. 166.5 m	
Flood water level	EL. 164.5 m	

For the above conditions, the estimated probable floods are put into the reservoir. Results are as follows ;

Probable flood	Allowable water level	Highest water level EL.m	Peak Inflow	Peak Outflow
			m^3/sec	
200 years x 1.2	164.50	163.70	2.927	2,900
10,000 year	165.00	166.10	4,596	3,983

Table 1 PROBABLE 3-DAY RAINFALL

(Unit: mm)

Return Period	K.Kates	Lahor	Wlingi	Selorejo
2	83	124	82	118
5	108	165	107	148
10	125	191	124	169
20	141	217	141	188
50	162	250	162	213
100	178	274	178	232
200	194	298	194	250
500	215	331	215	275
1,000	230	356	230	294
10,000	282	437	283	356

Table 2 DESIGN STORM AND AREAL WEIGHT OF KARANGKATES BASIN

(Unit: mm)

	Jan. 1981 Storm		
	6	7	8
7	0.0	0.0	0.4
8	0.0	2.3	0.1
9	0.1	0.5	0.1
10	0.1	0.6	0.1
11	0.0	2.4	0.2
12	0.0	2.9	0.0
13	0.2	3.1	0.0
14	0.0	4.9	0.0
15	0.1	3.7	0.0
16	0.6	4.0	0.0
17	0.8	3.8	0.0
18	2.8	0.5	0.0
19	4.0	1.0	0.1
20	2.6	0.2	0.0
21	17.8	0.1	0.0
22	14.0	0.0	0.0
23	6.6	0.0	1.2
24	3.3	0.5	0.3
1	1.6	0.0	0.2
2	0.5	0.0	0.2
3	0.9	1.4	0.0
4	0.2	0.5	0.0
5	0.2	0.7	0.0
6	0.2	0.8	0.0
Total	57.6	34.7	3.7

R_{3day} = 96.0 mm

Basin No.	Station name	Areal weight
1	Batu	0.108
2	Singosari	0.092
3	Kayutangan	0.097
4	Wagir	0.035
5	Jabung	0.065
6	Tumpang	0.042
7	Poncokusumo	0.121
8	Tangkil	0.064
9	Dampit	0.121
10	Gondanglegi	0.118
12	Kesamben	0.004
13	Birowo	0.017
44	Pujon	0.025
Total	Total	1.000

Table 3 DESIGN STORM AND AREAL WEIGHT OF LAHOR BASIN

(Unit: mm)

	Mar. 1984 Storm		
	2	3	4
7	0.0	0.0	0.0
8	0.0	0.0	0.0
9	0.0	0.0	0.0
10	0.0	0.0	0.0
11	0.0	0.0	0.0
12	0.0	11.7	2.0
13	0.0	2.3	2.0
14	6.0	5.0	1.0
15	11.0	2.0	0.0
16	4.0	1.0	0.0
17	7.0	6.0	1.0
18	0.0	1.0	1.0
19	0.0	1.0	1.0
20	7.0	14.0	0.0
21	0.0	5.0	0.0
22	0.0	2.0	0.0
23	0.0	1.0	0.0
24	0.0	2.0	0.0
1	0.0	0.0	0.0
2	0.0	1.0	0.0
3	0.0	1.0	0.0
4	0.0	1.0	0.0
5	0.0	0.0	0.0
6	0.0	0.0	0.0
Total	35.0	38.0	7.0

R_{3day} = 80.0 mm

Basin No.	Station name	Areal weight
1	Batu	0.008
4	Wagir	0.155
11	Kepanjen	0.507
12	Kesamben	0.060
14	Doko	0.246
15	Semen	0.016
44	Pujon	0.008
	Total	1.000

Table 4 DESIGN STORM AND AREAL WEIGHT OF SELOREJO BASIN

(Unit: mm)

	Mar. 1984 Storm		
	2	3	4
7	0.0	0.0	0.1
8	0.0	0.0	0.0
9	0.0	0.0	0.0
10	0.0	0.0	0.0
11	0.0	0.0	0.0
12	0.0	0.0	0.0
13	0.0	0.0	4.0
14	0.0	0.0	3.0
15	0.0	0.0	4.0
16	0.0	0.0	12.0
17	0.0	0.0	2.0
18	0.0	0.0	11.0
19	13.0	8.0	1.0
20	1.0	8.0	0.0
21	0.0	7.0	0.0
22	1.0	0.0	1.0
23	0.0	1.0	0.0
24	0.0	1.0	0.0
1	0.0	0.0	0.0
2	0.0	0.0	0.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0
5	0.0	0.0	0.0
6	0.0	0.0	0.0
Total	15.0	24.0	38.0

R_{3day} = 77.0 mm

Basin No.	Station name	Areal weight
43	Sekar	0.422
44	Pujon	0.578

Table 5 DESIGN STORM AND AREAL WEIGHT OF WLINGI BASIN

(Unit: mm)

	Mar. 1984 Storm		
	2	3	4
7	0.0	0.0	0.0
8	0.0	0.0	0.0
9	0.0	0.0	0.0
10	0.00	0.0	0.0
11	0.0	0.0	1.0
12	0.0	0.0	1.0
13	0.0	0.0	2.0
14	2.0	1.0	1.0
15	5.0	1.0	0.0
16	13.0	1.0	1.0
17	8.0	3.0	0.0
18	3.0	2.0	1.0
19	1.0	3.0	0.0
20	3.0	5.0	0.0
21	0.0	2.0	0.0
22	0.0	1.0	0.0
23	0.0	1.0	0.0
24	0.0	1.0	0.0
1	0.0	0.0	0.0
2	0.0	0.0	0.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0
5	1.0	0.0	1.0
6	0.0	0.0	0.0
Total	43.0	24.0	9.0

R_{3day} = 76.0 mm

Basin No.	Station name	Areal weight
1	Batu	0.077
2	Singosari	0.065
3	Kayutangan	0.025
4	Wagir	0.057
5	Jabung	0.046
6	Tumpang	0.030
7	Poncokusumo	0.086
8	Tangkil	0.046
9	Dampit	0.086
10	Gondanglegi	0.084
11	Kepanjen	0.111
12	Kesamben	0.036
13	Birowo	0.058
14	Doko	0.058
15	Semen	0.047
16	Wlingi	0.041
17	Lodoyo	0.012
18	Garum	0.003
19	Badak	0.002
43	Sekar	0.012
44	Pujon	0.018
	Total	1.000

Table 6 BASIN CONSTANTS FOR STORAGE FUNCTION METHOD

No. of Sub-basin	Catchment Area (km^2)	River Length (km)	Gradient	K	P	T_l	f_1	Rsa
1	760.0	14.0	1/25	28.2		0.1		
2	156.5	11.9	1/35	39.0		0.0		
3	24.5	7.5	1/55	38.8		0.0		
4	381.0	27.5	1/30	47.1		0.7		
5	271.0	20.0	1/60	55.2		0.4		
6	236.0	31.5	1/20	42/6		0.9		
7	221.0	7.5	1/20	27.4	1/3	0.0	0.5	100
8	157.5	17.5	1/64	54.0		0.3		
9	212.5	15.0	1/20	33.6		0.2		
10	245.4	25.0	1/30	47.0		0.6		
11	116.4	12.5	1/40	39.8		0.0		
12	83.8	8.8	1/55	40.8		0.0		
13	24.4	5.0	1/45	31.7		0.0		
27	236.0	12.5	1/20	28.9		0.0		

Table 7 CHANNEL CONSTANTS FOR STORAGE FUNCTION METHOD

No. of Channel	River Length (km)	Gradient	K	P	T_l	f	Remarks
1	6.0	1/100	4.7	0.61	0.0	1.0	

Table -8 STANDARD FOR FREEBOARD

Dam Type	Concrete Gravity	Rockfill	
	-	Hd $>$ 2.5m	Hd $\leqq$ 2.5m
Gated Weir	Hf+hw+he+0.5 (if (hw+he) $<$ 1.5 $\rightarrow$ Hf + 2)	Hf+hw+he+1.5 (if (hw+he) $<$ 1.5 $\rightarrow$ Hf + 3)	Hf+hw+he+1.5 (if (hw+he) $<$ 1.5 $\rightarrow$ Hf + 3)
	Hs+hw+ $\frac{he}{2}$ + 0.5 (if (hw + $\frac{he}{2}$) $<$ 1.5 $\rightarrow$ Hs + 2)	Hs+hw + $\frac{he}{2}$ + 1.5 (if (hw+ $\frac{he}{2}$) $<$ 1.5 $\rightarrow$ Hs + 3)	Hs+hw+ $\frac{he}{2}$ + 1.5 (if(hw + $\frac{he}{2}$) $<$ 1.5 $\rightarrow$ Hs + 3)
	Hh + hw + 0.5 (if hw $<$ 0.5 $\rightarrow$ Hh + 1)	Hh + hw + 1.5 (if hw $<$ 0.5 — Hh + 2)	Hh + hw + 1.5 (if hw $<$ 0.5 $\rightarrow$ Hh + 2)
Non-gated Weir	Hf + hw + he (if (hw+he) $<$ 2 $\rightarrow$ Hf + 2)	Hf + hw + he + 1 (if (hw+he) $<$ 2 — Hf + 3)	Hf + hw + he + 1 (if (hw + he) $<$ 1 $\rightarrow$ Hf + 2)
	Hs+hw + $\frac{he}{2}$ (if (hw+ $\frac{he}{2}$) $<$ 2 $\rightarrow$ Hs + 2)	Hs+hw+ $\frac{he}{2}$ + 1 (if (hw + $\frac{he}{2}$) $<$ 2 $\rightarrow$ Hs + 3)	Hs+hw + $\frac{he}{2}$ + 1 (if (hw + $\frac{he}{2}$) $<$ 1 $\rightarrow$ Hs + 2)
	Hh + hw (if hw $<$ 1 $\rightarrow$ Hh + 1)	Hh + hw + 1 (if hw $<$ 1 $\rightarrow$ Hh + 2)	Hh + hw + 1 (if hw $<$ 1 $\rightarrow$ Hh + 2)

Note:
- Hf ; high water level
- Hs ; surcharge water level
- Hh ; designed flood water level
- hw ; wave height
- he ; water height due to earthquake
- hd ; design flood outflow depth

Table 9 WAVE HEIGHT AND WATER HEIGHT DUE TO EARTHQUAKE

(1) hw ; Wave Height

Dam	Type	Distance between Damsite and the end of Reservoir (km)	Slope of Surface (upstream)	hw (m)
Karangkates	rock	11	1 : 2.2	1.5
Lahor	rock	6	1 : 2.2	0.9
Wlingi	rock	4	1 : 3.0	0.7
Selorejo	earth	4	1 : 3.0	0.7

(2) he : Water Height due to earthquake

Dam	H.W.L. (EL.m)	Riverbed (EL.m)	Ho=HWL-Riverbed (m)	he (m)
Karangkates	272.5	186	86.5	0.56
Lahor	272.7	206	66.7	0.49
Wlingi	163.5	139	24.5	0.30
Selorejo	620.0	579	41.0	0.38

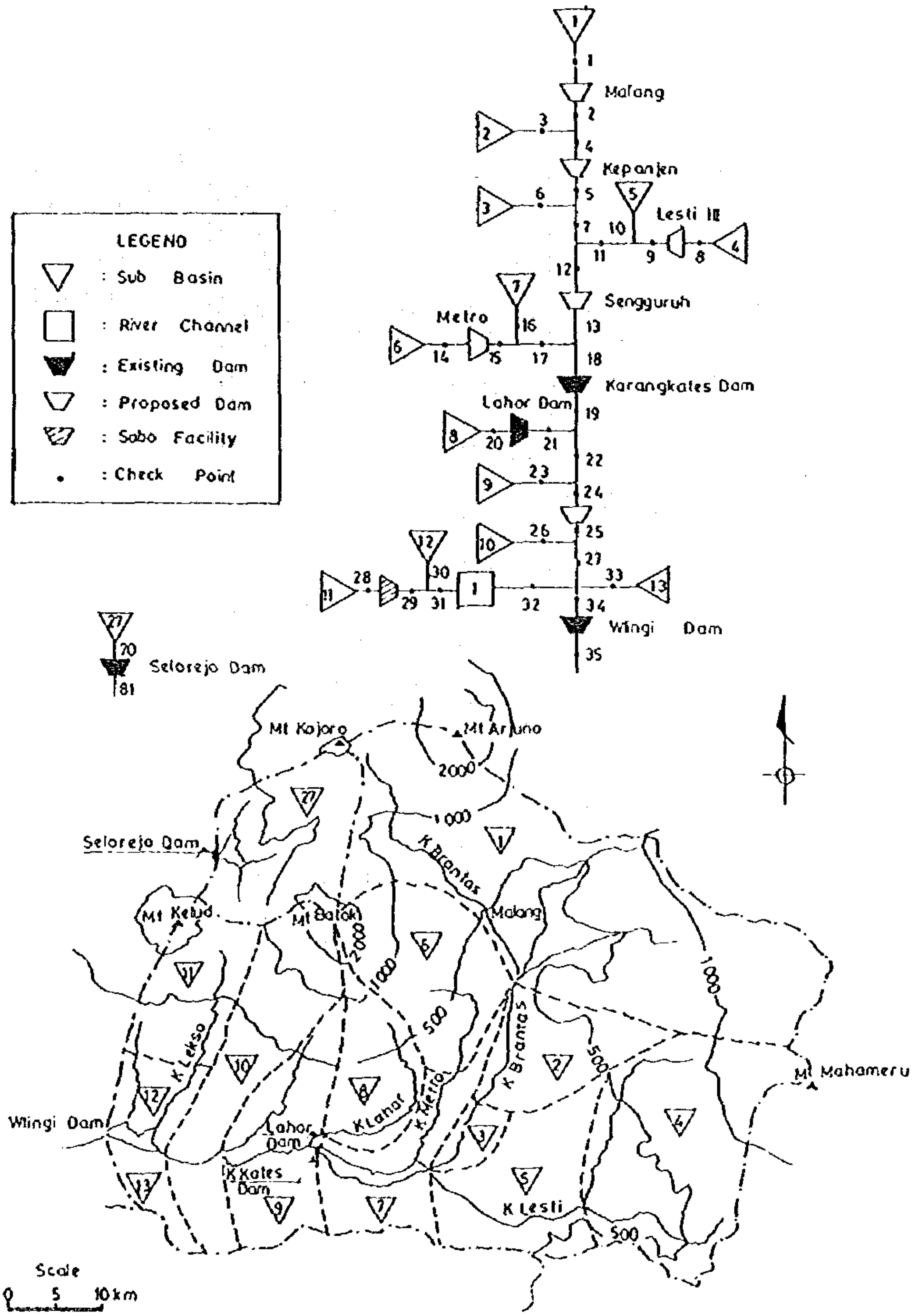
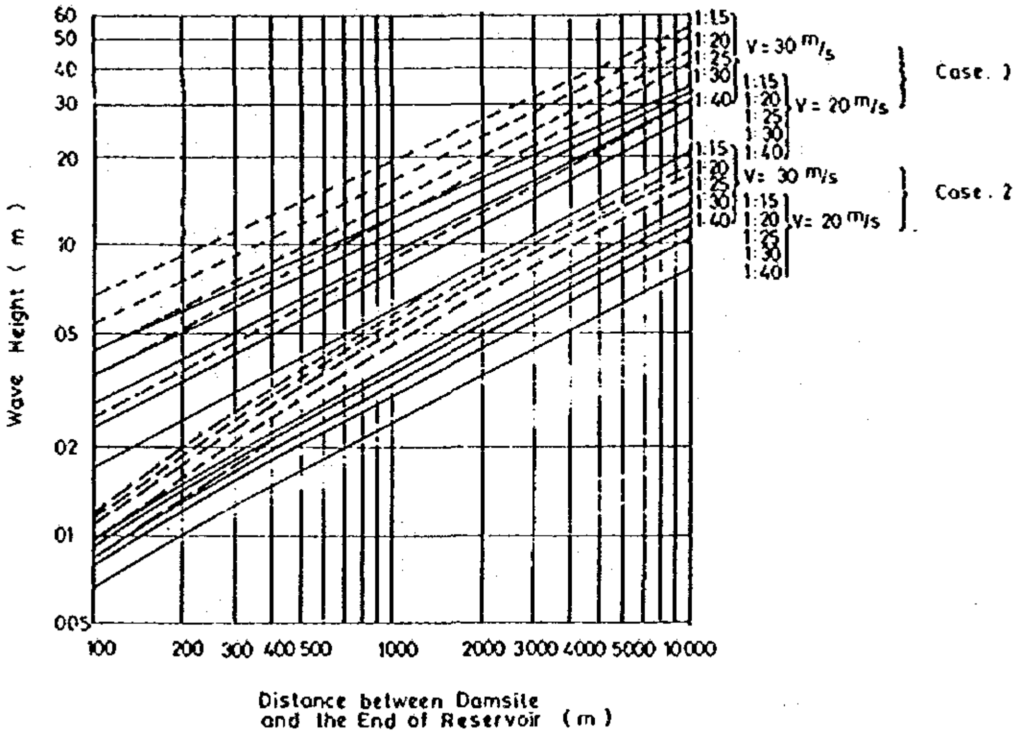


Fig. 1 FLOOD RUNOFF MODEL



Note :

Case 1	;	Smoose surface
Case 2	;	Rough surface
V	;	Maximum Wind Velocity (m /s)
———	;	In case of V = 20 m/s
- - - - -	;	In case of V = 30 m/s

Fig. 2 WAVE HEIGHT BY APPLYING SMB METHOD AND SAVILLE METHOD

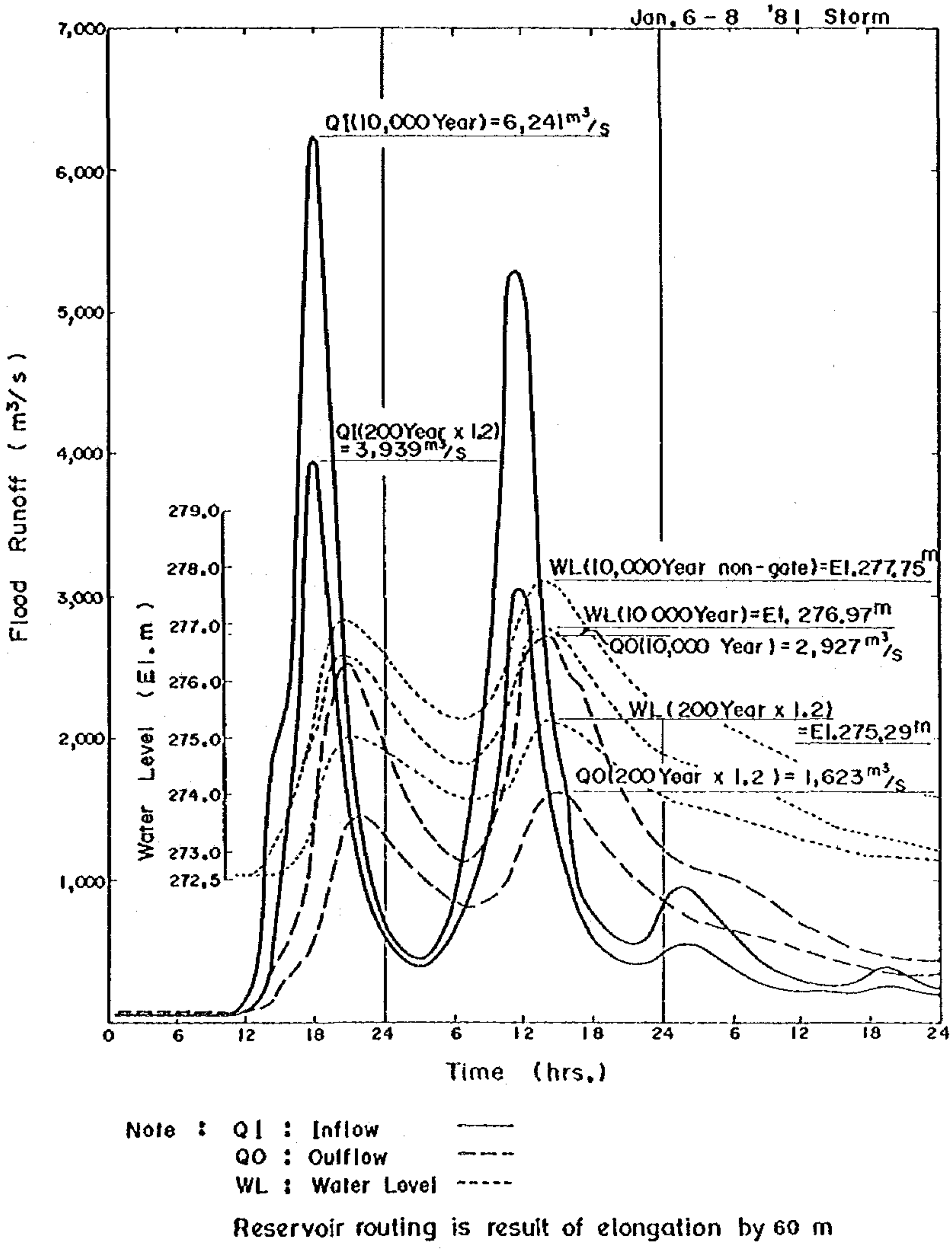
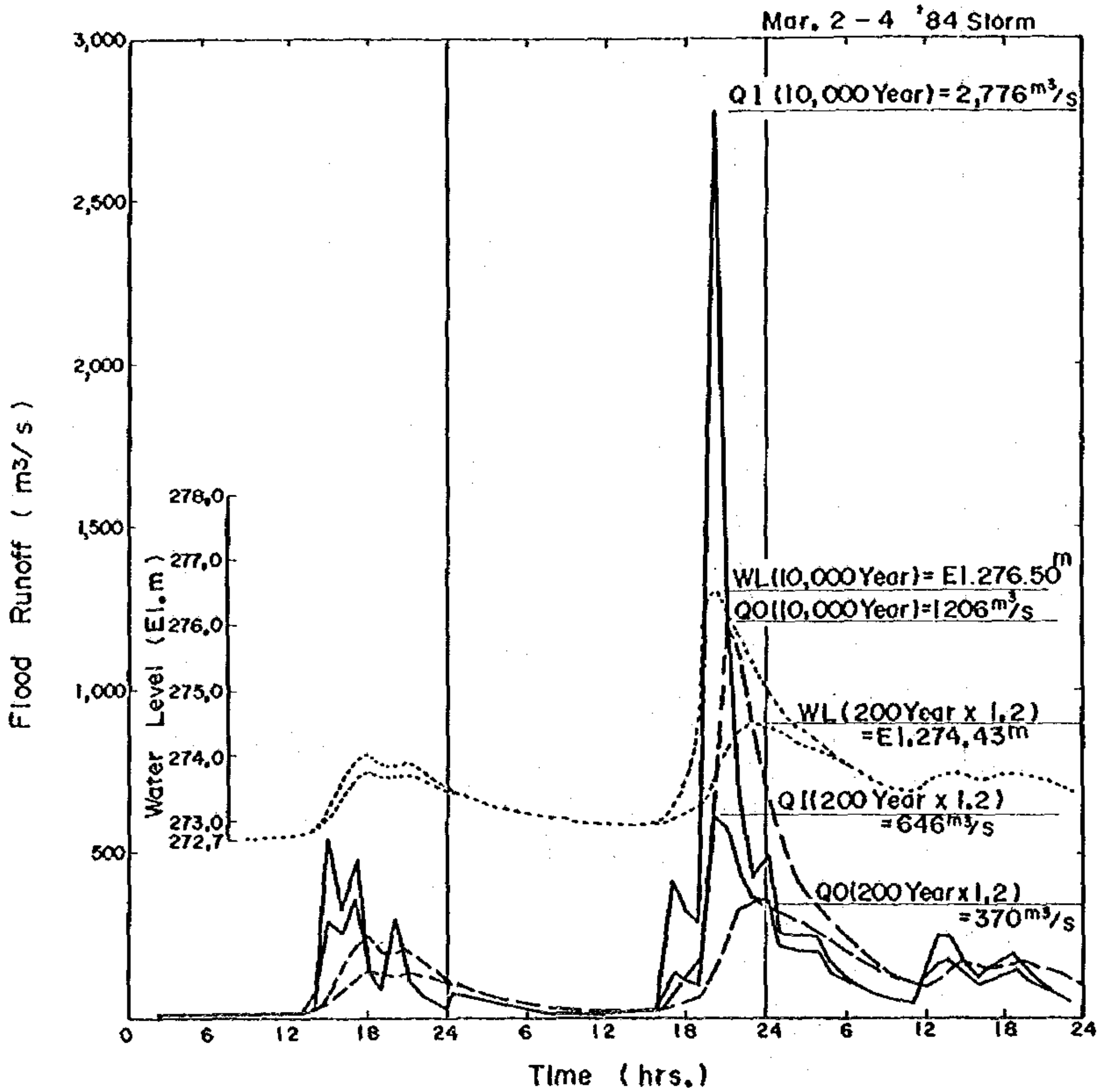


Fig. 3 FLOOD RUNOFF AT KARANGKATES DAMSITE



Note : QI : Inflow ———

QO : Outflow – – –

WL : Water Level ······

Reservoir routing is result of elongation by 40 m

Fig. 4 FLOOD RUNOFF AT LAHOR DAMSITE

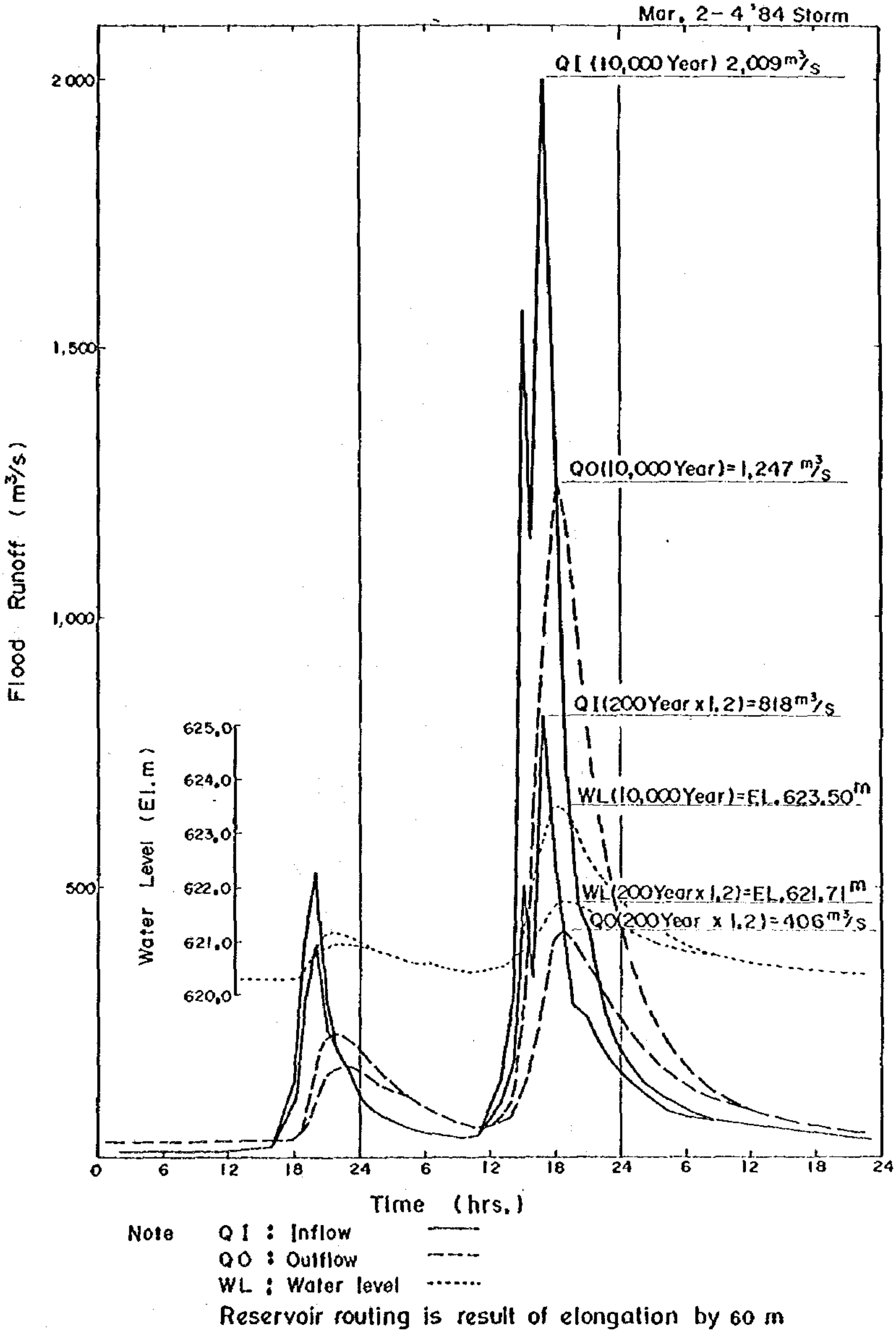
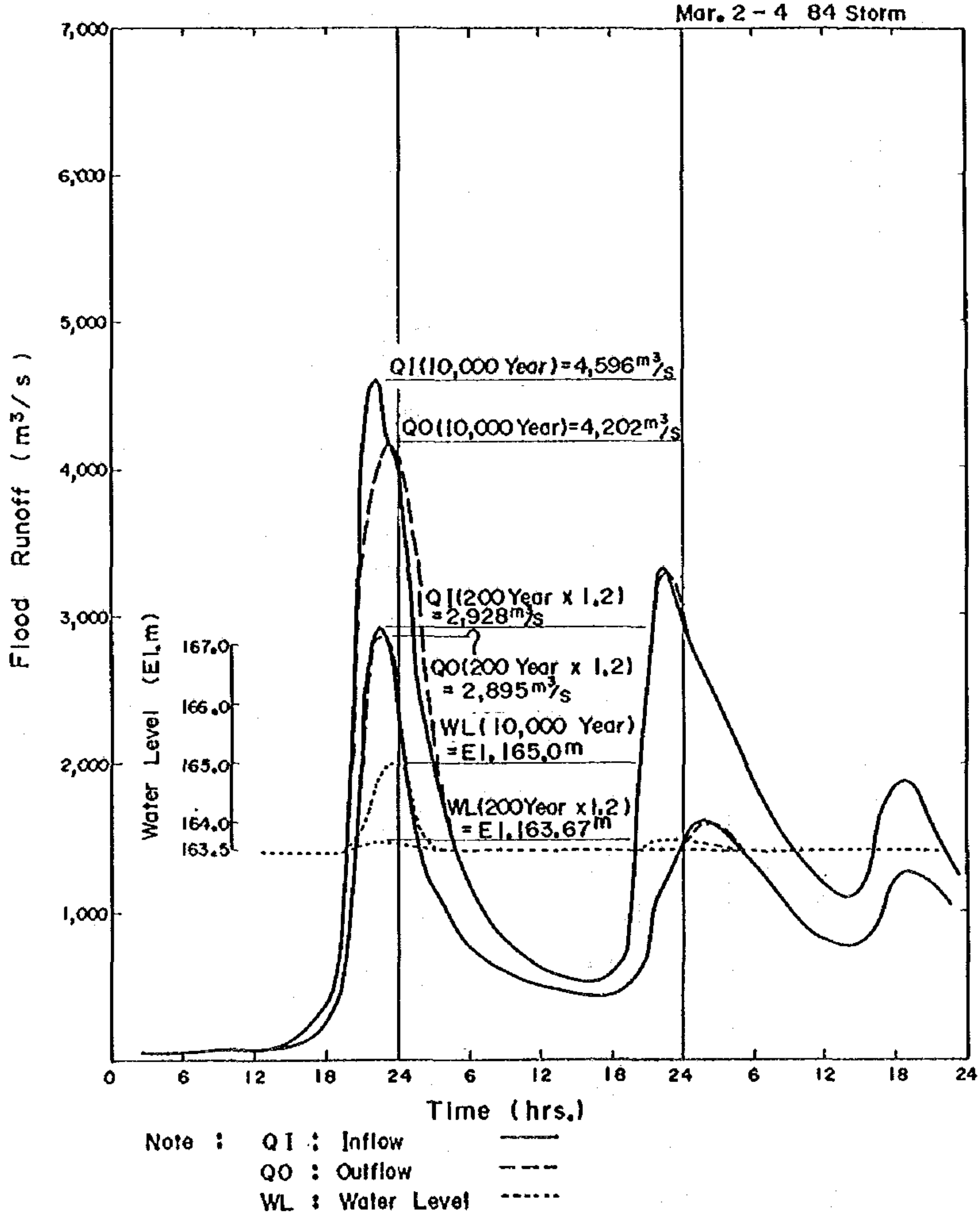


Fig. 5 FLOOD RUNOFF AT SELOREJO DAMSITE



Reservoir routing is result of elongation by 30 m

Fig.-6 FLOOD RUNOFF AT WLINGI DAMSITE

NOTE MP-4

GETENG I SCHEME

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

NOTE MP-4 GENTENG I SCHEME

1. Objectives of Scheme

This scheme is envisaged as a storage reservoir with hydropower plant. The reservoir can store sediment which will flow into the downstream reservoir.

2. Natural Conditions

Location and Topography

The site is selected on Genteng river, a tributary of Lesti river, 2 km south-east from Dampit. The catchment area at the proposed damsite is 98.7 km^2. Topographically, it is possible to divert water in Juwok and Gangsil river in the north and in Manjung river in the east through connection tunnels to the Genteng I reservoir. If all are diverted, the catchment area can be increased to 160.5 km^2.

The damsite is in the narrow gorge between Mt. Nawang of 496 m high in the right bank and a mountain of 463 m high. In the right and left sides of the damsite, there are lower parts which need saddle dams.

Hydrology

Lowflow is calculated from that at the Lesti III damsite by multiplying the area ratio. Mean monthly runoff from the catchment area of 160 km^2 is estimated as follows;

Unit : m^3/s

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
14.6	17.7	15.9	15.2	11.6	8.4	6.5	5.2	4.5	4.6	6.2	10.4

Ten-day mean runoff is as shown in Table 1.

Probable floods are estimated by the Nakayasu's Unit Hydrograph method. Results are as follows.

Probability	Probable Flood Peak Discharge
Once in 25 years	916 m^3/s
100	1226
200	1380
1,000	1735
10,000	2240

Geology

At the proposed damsite, test boring was carried out by BRBDEO.

The base rock at the damsite is the volcanic breccia with intersecting sand stone, volcanic sand and massive andesite layers. The abutment are covered by the weathered breccia consisting of clay and andesite gravel, which has to be removed. The thickness of the weathered breccia is less than 10 m. The volcanic sand layer beneath the right abutment has unknown degree of consolidation. Detailed investigation by large bore hole is needed.

The permeability of the bed rock is in an order of 1×10^{-4} - 5×10^{-5} cm/sec.

3. Possible Development

The catchment area receives large rainfall due to its high elevation and the runoff from it is large. Since this site locates the upstream end of the Brantas basin, the regulation effect of discharge will be extended to the reservoirs in the downstream.

In this context, development of the topographically maximum is intended, although it is necessary to provide three saddle dams.

4. Development Scale

The high water level of the reservoir is set at El. 436 m, taking it into account that the height of the saddle dams be as low as 10 m or so. The low water level is set at EL. 408.5 m, taking into consideration of the probable large inflow of sediment from the mountain side of Mt. Semeru. Then, effective storage capacity is 70×10^6 m^3, as shown in the stage. Storage capacity curve on Fig. 1.

By the above setting, the hydropower potential at the assumed rated head is estimated as shown in Table 2

5. Preliminary Layout

Preliminary layout is drawn based on 1 to 2,500 scale map as shown on Fig. 2 to 5. The rockfill type dam of 82 m high is planned. The diversion system consisting of two tunnel of 7.5 m in diameter is arranged in the left side. The spillway is arranged in the depression in the left side.

The powerhouse with installed capacity of 18,000 kW is planned at the end of diversion tunnels.

Principal features are as follows;

PRINCIPAL FAETURES OF GENTENG I SCHEME

Location		2 km south-east from Dampit
River basin		Lesti river
Stream		Genteng river
Hydrology		
Catchment area	own	98.7 km^2
	by 3 transbasin	160.5 km^2
Average runoff		10.1 m^3/s
10,000 year probable flood		2,240 m^3/sec.
Reservoir		
High water level		EL. 436.0 m
Low water level		EL. 408.5 m
Gross storage capacity		86,000,000 m^3
Effective storage capacity		70,000,000 m^3
Reservoir surface area at HWL		4.1 km^2
Transbasin Scheme		
K. Juwok - K. Gangsil		7.0 km^2
Catchment area		7.0 km^2
Tunnel length		1.0 km
K. Gangsil - K. Genteng		
Catchment area		20 km^2
Tunnel length		0.75 km
K. Manjung		
Catchment area		35 km^2
Tunnel length		2.0 km
D a m		
Type		Center core Rockfill Dam
Crest elevation		EL. 441.0 m
Crest length		460 m
Height above river bed		78 m
Dam height		82 m
Upstream slope		1 : 2.6
Downstream slope		1 : 2.0
Embankment volume		3,000,000 m^3
Spillway		
Type		Center flow type
Crest elevation		EL. 436.0 m
Crest width		130 m
Chuteway		375 m
Plunge pool		100 m
Diversion Tunnel		
Type		Circuler section x 2 nos
Design discharge		916 m^3/sec.
Diameter		7.5 m
Length		700 m / 1 nos

Intake	
Dimension	5 m x 8 m
Sill elevation	EL. 400 m
Intake tunnel	
Type	Circular section
Diameter	4.4 m
Length	70 m
Penstock	
Type	conduit
Diameter	2.1 m - 3.1 m
Length	250 m
Powerhouse	
Type	Open air type
Building dimension	17 m x 25 m x 13 m
Power and Energy	
Average firm discharge	10.7 m^3/s
Max. plant discharge	38 $m^3/sec.$
Head gross	72 m
rated	63 m
Installed capacity	18,600 kW
Dependable capacity	18,600 kW
Annual energy	54.9 Gwh

6. Cost Estimation

The construction is estimated at Rp. 91,102 million. Breakdown is as shown in Table 3

7. Anticipated Benefit

The anticipated benefits from the scheme are as follows:

Positive Benefit

Water supply

70×10^6 m^3 x Rp. 100 = Rp. 7,000 x 10^6/year

Power Benefit

Capacity Benefit

18.600 kW x Rp. 58.2 x 10^3 kW = Rp. 1,082.5 x 10^6/year

Energy Benefit

x 10^6 kWh x Rp. 121/kWh = Rp. 6,640 x 10^6/year

Sediment Control

16×10^6 m^3 x Rp. 100 / 50 years = Rp.32 x 10^6/year

Negative Benefit

Since paddy field area is small in the reservoir area, the land value is cost as Rp. 0.5 x 10^6/ha. Then, negative benefit is 410 ha x Rp. o.5 x 10^6/ha = Rp. 205 /ha

Net Benefit

The net benefit is estimated Rp. 14,549 x 10^6 / year.

Table 1(1)

****
* ESTIMAED RUNOFF *
****

GENTENG I

Month		1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Jan.	1st	2.58	14.61	21.73	6.57	17.57	22.23	11.51	9.87	18.41	18.04
	2nd	3.30	15.22	20.15	8.37	16.59	21.79	11.86	8.50	19.02	19.56
	3rd	6.12	15.26	17.69	10.11	13.82	20.00	13.43	8.39	15.87	18.20
Feb.	1st	10.23	18.57	18.84	12.51	15.77	21.05	17.34	9.59	16.93	19.02
	2nd	15.07	22.35	17.05	12.29	14.85	19.87	17.17	9.16	17.39	18.18
	3rd	23.81	27.24	19.23	14.87	17.11	20.97	23.49	11.99	20.28	19.42
Mar.	1st	19.18	25.22	13.71	10.99	11.65	17.76	19.10	12.53	16.37	17.61
	2nd	17.71	26.01	13.45	11.18	11.77	15.59	20.52	14.15	17.68	15.68
	3rd	13.91	23.12	11.74	11.78	12.14	11.70	20.02	13.58	16.82	14.51
Apr.	1st	12.28	23.12	11.09	20.01	14.83	10.69	21.27	14.64	16.99	17.59
	2nd	9.66	20.02	10.08	23.18	15.27	9.05	18.90	13.72	14.87	16.71
	3rd	7.64	16.17	11.97	26.01	14.51	7.83	15.67	12.02	13.26	15.34
May	1st	6.03	12.81	15.21	26.74	13.47	6.77	12.82	11.89	11.46	15.07
	2nd	5.95	10.14	17.03	26.17	12.35	6.12	10.53	12.15	9.53	14.67
	3rd	4.52	7.83	14.43	21.39	9.53	5.36	7.93	9.79	8.01	11.81
June	1st	4.42	7.18	13.28	20.01	8.78	5.51	7.39	9.43	8.71	10.65
	2nd	6.54	5.97	10.70	20.25	8.96	5.17	6.44	7.86	7.48	8.67
	3rd	6.36	5.11	8.61	20.56	9.03	4.91	5.78	8.66	6.48	8.61
July	1st	5.41	4.51	7.11	19.57	11.09	4.74	5.30	9.81	5.87	7.43
	2nd	4.53	4.09	6.04	16.70	12.55	7.37	9.30	8.93	5.23	6.28
	3rd	3.55	3.45	4.81	12.86	15.15	7.16	9.47	6.97	4.35	4.96
Aug.	1st	4.68	3.58	4.76	11.85	16.66	7.28	9.78	7.56	4.47	4.87
	2nd	5.97	3.43	4.39	9.58	14.90	7.35	8.33	6.51	4.24	4.45
	3rd	4.86	3.01	3.75	7.04	13.98	7.08	6.46	5.18	3.70	3.78
Sep.	1st	4.57	3.95	3.94	6.45	13.98	6.98	6.21	5.10	3.95	3.94
	2nd	3.98	6.70	3.80	5.53	11.89	6.21	5.58	4.68	3.86	3.79
	3rd	3.58	7.97	3.70	4.89	9.74	5.65	5.13	4.38	3.79	3.67
Oct.	1st	3.30	9.00	3.62	4.43	7.99	5.25	4.80	5.43	3.73	3.58
	2nd	3.11	8.02	3.56	4.11	8.65	4.98	4.56	5.10	3.68	3.51
	3rd	2.70	7.63	3.20	3.73	10.27	4.34	3.99	4.24	3.31	3.16
Nov.	1st	2.88	10.44	3.48	7.76	14.83	4.66	4.25	4.37	3.61	3.46
	2nd	2.82	12.20	3.44	9.95	17.47	4.69	4.14	4.16	3.57	4.78
	3rd	2.77	12.59	3.41	12.44	18.72	5.83	4.20	4.01	4.07	6.19
Dec.	1st	4.67	11.32	3.38	14.87	19.28	9.19	6.99	8.14	8.11	7.03
	2nd	7.85	16.92	3.63	17.65	18.03	11.84	10.26	12.62	12.66	7.07
	3rd	10.53	18.82	4.93	16.72	17.86	10.79	9.81	14.63	14.27	7.89
Mean	1st	7.14	12.32	9.47	13.59	13.64	9.82	10.54	8.88	9.77	10.25

Table 1(2)

ESTIMATED RUNOFF

GENTENG I

Month		1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Jan.	1st	13.06	9.72	12.54	13.66	10.59	11.39	22.90	16.99	19.08	8.93
	2nd	18.26	12.85	11.39	13.82	11.66	11.96	24.57	17.39	20.07	11.40
	3rd	17.34	13.27	11.46	13.75	10.93	11.56	21.95	14.37	19.93	13.96
Feb.	1st	18.26	16.69	13.98	15.41	14.19	11.61	22.17	14.83	21.46	17.26
	2nd	19.52	17.08	13.75	15.88	15.08	12.19	22.42	14.08	20.00	18.41
	3rd	23.39	19.94	18.36	16.82	19.09	19.11	25.82	15.08	23.32	23.69
Mar.	1st	17.32	18.65	15.87	15.15	14.36	17.58	18.08	14.63	17.07	19.20
	2nd	17.27	18.16	18.45	15.78	13.20	18.88	15.11	15.15	16.61	18.89
	3rd	14.61	18.94	19.03	15.30	10.11	17.77	11.65	14.17	17.81	15.63
Apr.	1st	15.69	24.14	20.97	15.93	9.13	19.24	11.15	18.54	22.28	15.82
	2nd	15.24	23.66	19.00	18.91	9.51	17.69	9.33	19.68	21.69	13.57
	3rd	13.53	24.17	16.15	19.24	8.28	16.36	7.99	19.31	19.07	12.86
May	1st	11.30	21.99	13.19	17.67	6.81	14.07	6.55	19.83	15.69	11.68
	2nd	10.39	18.36	10.54	14.94	5.81	11.45	5.48	21.18	12.51	11.65
	3rd	7.93	13.28	7.63	13.12	4.57	8.29	4.29	17.95	9.66	10.55
June	1st	7.18	11.45	6.80	13.21	4.44	9.07	4.19	17.32	8.80	9.94
	2nd	6.06	9.00	5.68	10.85	4.03	7.63	3.81	16.12	7.29	9.03
	3rd	5.26	7.25	4.89	8.61	3.74	6.26	3.54	15.04	6.17	7.53
July	1st	4.70	6.00	4.33	6.89	3.54	5.28	3.35	13.73	5.38	6.32
	2nd	4.31	5.12	3.94	5.67	3.39	4.59	3.21	15.13	4.83	5.47
	3rd	3.66	4.09	3.33	4.38	2.99	3.74	2.83	12.71	4.04	6.12
Aug.	1st	3.82	4.06	3.46	4.21	3.21	3.77	3.03	11.53	4.17	6.13
	2nd	3.67	3.75	3.32	3.78	3.15	3.52	2.97	9.23	3.97	5.34
	3rd	3.24	3.20	2.92	3.16	2.82	3.04	2.66	6.82	3.48	4.35
Sep.	1st	3.48	3.35	3.13	3.26	3.07	3.21	2.89	6.15	3.73	4.38
	2nd	3.41	3.23	3.07	3.10	3.04	3.12	2.85	5.20	3.66	4.10
	3rd	3.36	3.14	3.02	2.99	3.01	3.05	2.82	4.53	3.60	3.89
Oct.	1st	3.32	3.07	2.98	5.20	2.99	2.99	4.05	5.26	3.55	3.74
	2nd	3.28	3.15	2.94	8.56	2.97	2.96	3.73	4.74	3.52	3.63
	3rd	2.95	3.44	2.65	9.21	2.68	2.66	3.11	3.84	3.18	3.23
Nov.	1st	3.50	6.61	2.88	11.22	2.93	2.89	3.21	5.54	3.87	3.94
	2nd	3.40	7.39	2.86	11.25	2.93	5.27	3.05	5.73	3.74	4.90
	3rd	3.31	7.83	2.83	9.76	2.93	8.54	2.95	7.31	3.63	5.15
Dec.	1st	3.24	11.25	2.80	9.18	4.51	12.23	7.42	9.18	4.25	4.87
	2nd	4.84	13.69	6.78	8.53	7.76	14.04	9.47	13.72	6.61	5.19
	3rd	6.09	12.59	9.37	7.68	8.21	15.34	11.42	16.71	7.79	7.75
Mean	1st	8.86	11.21	8.50	10.72	6.71	9.50	8.77	12.74	10.43	9.40

Table 1(3)

ESTIMAED RUNOFF

BENTENG I

Month		1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Jan.	1st	9.58	15.02	8.19	14.29	9.82	22.65	10.55	13.86	16.26	15.68
	2nd	12.38	17.25	10.47	13.61	12.96	21.83	11.25	14.00	18.28	17.75
	3rd	12.77	15.72	11.54	12.56	14.92	17.91	11.92	11.96	17.39	17.01
Feb.	1st	13.67	17.84	14.82	13.48	19.80	18.17	14.15	12.50	19.24	18.23
	2nd	13.77	18.33	18.10	13.75	21.51	16.52	14.66	11.70	18.39	16.67
	3rd	17.15	19.01	25.79	18.63	26.66	18.31	18.68	13.89	21.25	17.54
Mar.	1st	14.87	16.57	21.72	15.48	21.75	16.68	14.03	11.75	15.29	14.83
	2nd	15.83	17.27	21.25	15.24	22.76	16.37	13.40	12.43	15.33	13.67
	3rd	16.19	15.48	19.27	12.26	22.10	13.98	13.35	12.89	14.83	11.57
Apr.	1st	18.18	14.88	20.68	12.96	23.33	13.86	15.90	14.73	15.61	11.96
	2nd	16.63	12.68	21.61	11.26	22.14	11.52	14.61	13.66	15.22	12.51
	3rd	13.89	11.81	20.61	9.22	21.83	9.48	13.34	12.61	13.85	12.72
May	1st	12.31	11.86	20.05	9.77	19.89	7.84	11.18	11.59	14.44	11.95
	2nd	10.11	10.38	18.20	8.74	17.38	6.62	9.08	11.41	13.08	10.08
	3rd	7.67	7.71	15.19	7.65	12.88	5.24	6.79	10.52	11.30	7.53
June	1st	7.07	6.91	14.52	7.12	11.28	5.16	6.26	11.82	13.20	6.91
	2nd	6.01	5.80	11.73	6.03	9.04	4.73	5.41	13.00	11.78	5.89
	3rd	5.26	5.01	9.51	5.27	7.43	4.42	4.81	12.38	11.31	5.18
July	1st	4.73	4.45	9.13	4.73	6.31	4.20	4.39	13.32	9.58	4.67
	2nd	4.35	4.06	8.78	4.35	5.51	4.04	4.08	11.96	7.86	4.31
	3rd	3.71	3.43	6.63	3.71	4.50	3.57	3.51	9.23	5.98	3.68
Aug.	1st	3.89	3.57	5.99	3.89	4.56	3.84	3.70	8.25	5.67	3.86
	2nd	3.75	3.42	5.06	3.76	4.27	3.76	3.58	6.77	5.04	3.73
	3rd	3.31	3.00	4.01	3.33	3.70	3.37	3.17	5.16	4.17	3.29
Sep.	1st	3.56	3.22	3.95	3.59	3.94	3.66	3.42	4.91	4.28	3.54
	2nd	3.50	3.15	5.21	3.54	8.55	3.62	3.36	4.37	4.05	3.48
	3rd	3.45	3.10	8.45	3.50	10.69	3.58	3.31	4.00	3.89	3.42
Oct.	1st	3.41	3.05	9.39	6.48	11.22	4.35	3.26	3.79	3.78	3.38
	2nd	3.37	3.01	8.57	9.17	10.19	4.37	3.23	3.59	3.69	3.34
	3rd	3.03	2.70	6.77	9.28	13.34	3.72	2.90	3.13	3.30	3.79
Nov.	1st	3.30	2.94	7.70	11.25	16.95	4.16	3.15	4.23	3.58	4.18
	2nd	3.28	2.91	8.16	11.88	17.26	8.71	3.12	6.73	3.54	5.49
	3rd	3.26	2.88	10.64	11.37	18.57	11.11	3.36	9.38	3.50	8.24
Dec.	1st	4.47	2.86	12.89	10.47	21.54	11.45	6.91	13.07	6.40	10.50
	2nd	9.68	4.03	13.61	8.97	22.68	11.15	9.20	14.18	9.12	11.65
	3rd	11.60	4.92	12.06	7.62	20.30	9.87	10.46	13.76	12.73	12.52
Mean	1st	8.41	8.33	12.50	9.11	14.48	9.27	7.98	10.18	10.46	9.02

Table 1(4)

ESTIMAED RUNOFF

GENTENG I

Month		1981	1982	Mean
Jan.	1st	18.17	17.50	14.17
	2nd	20.89	16.75	15.16
	3rd	18.94	13.77	14.49
Feb.	1st	21.02	14.47	16.34
	2nd	21.70	14.87	16.63
	3rd	25.30	17.41	20.08
Mar.	1st	18.66	13.90	16.48
	2nd	16.16	13.06	16.37
	3rd	12.68	10.16	14.97
Apr.	1st	11.47	9.50	16.20
	2nd	9.23	9.14	15.31
	3rd	9.60	8.87	14.22
May	1st	9.37	7.64	13.09
	2nd	14.83	6.47	11.98
	3rd	15.98	5.11	9.73
June	1st	17.49	5.03	9.39
	2nd	15.31	4.60	8.33
	3rd	13.51	4.30	7.52
July	1st	11.25	4.09	6.91
	2nd	15.34	3.93	6.72
	3rd	13.93	3.47	5.81
Aug.	1st	13.60	3.73	5.85
	2nd	11.65	3.67	5.32
	3rd	8.57	3.29	4.46
Sep.	1st	7.64	3.57	4.53
	2nd	6.37	3.53	4.48
	3rd	5.53	3.50	4.44
Oct.	1st	4.89	3.47	4.64
	2nd	4.45	3.43	4.66
	3rd	3.78	3.09	4.44
Nov.	1st	3.93	3.37	5.47
	2nd	5.64	3.34	6.18
	3rd	10.50	3.31	7.01
Dec.	1st	14.21	5.05	8.80
	2nd	16.12	8.11	10.86
	3rd	14.82	11.85	11.61
Mean	1st	12.84	7.50	10.07

Table 2

ENERGY POTENTIAL AT SENTENG-I

UNIT :MWH

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1951	1891	6649	7825	4435	2541	2596	2075	2398	1818	1406	1269	3614	38523
1952	6989	9811	11494	8892	4732	2737	1858	1547	2791	3810	5282	7338	67288
1953	9197	7688	6008	4969	7214	4886	2765	1990	1715	1604	1548	1864	51451
1954	3907	5502	5267	10375	11491	9119	7559	4374	2529	1895	4520	7633	74176
1955	7401	6643	5513	6683	5443	4013	6043	7037	5339	4188	7649	8539	74504
1956	9899	8965	6930	4133	2816	2337	2996	3361	2824	2249	2276	4932	53724
1957	5719	7992	9242	8372	4809	2940	3751	3780	2536	2061	1887	4204	57298
1958	4138	4249	6240	6054	5219	3890	3959	2964	2123	2278	1880	5525	48523
1959	8229	7578	7879	6765	4468	3399	2381	1916	1739	1656	1686	5467	53169
1960	8639	8198	7384	7443	6407	4187	2873	2020	1709	1584	2163	3415	56027
1961	7556	8470	7596	6666	4580	2773	1954	1657	1536	1476	1530	2215	47994
1962	5572	7455	8643	10791	8240	4153	2341	1698	1457	1499	3273	5816	60943
1963	5478	6360	8284	8414	4816	2604	1789	1498	1382	1324	1284	2981	46220
1964	6388	6961	7161	8108	7053	4898	2605	1719	1401	3582	4832	3922	58635
1965	5138	6678	5799	4036	2645	1830	1532	1418	1367	1335	1317	3193	36296
1966	5407	5860	8397	7990	5193	3442	2096	1594	1406	1330	2503	6469	51694
1967	10737	9782	6897	4268	2511	1730	1450	1338	1283	1679	1380	4416	47478
1968	7525	6369	6802	8626	9109	7269	6423	4237	2381	2132	2785	6189	69852
1969	9157	9013	7987	9452	5821	3337	2197	1794	1647	1584	1685	2913	56592
1970	5350	8190	8289	6334	5238	3973	2777	2437	1654	1637	2097	2786	50967
1971	5398	6171	7273	7302	4626	2749	1973	1691	1575	1516	1475	4034	45789
1972	7431	7988	7627	5903	4606	2656	1841	1542	1419	1353	1308	1844	45525
1973	4703	8029	9621	9431	8240	5361	3778	2318	2640	3809	3975	5962	67868
1974	6254	6317	6628	5013	4037	2761	1973	1696	1593	3877	5172	4171	49498
1975	5876	9391	10318	10090	7712	4160	2514	1934	3475	5410	7913	9978	78778
1976	9628	7672	7261	5226	3032	2145	1824	1695	1628	1921	3595	5016	50647
1977	5234	6560	6314	6574	4157	2471	1848	1614	1512	1451	1443	4140	43325
1978	6149	5294	5751	6147	5183	5577	5312	3103	1991	1622	3049	6355	55540
1979	8047	8251	7037	6699	5990	5441	3601	2293	1832	1664	1592	4426	56876
1980	7818	7599	6181	5576	4553	2695	1953	1680	1565	1632	2685	5386	49328
1981	8980	9440	7312	4543	6271	6943	6284	5199	2929	2023	3009	6992	69930
1982	7406	6487	5718	4124	2958	2088	1774	1652	1589	1544	1502	3927	40774
MEAN	6789	7425	7396	6857	5365	3786	3003	2412	2018	2129	2799	4864	54851

Table 3(1) CONSTRUCTION COST ESTIMATE FOR GENTENG I SCHEME

Item No.	Work	Unit	Quantity	Unit Price (10^3Rp)	Amount (10^6Rp)
1	Civil Works				59,997
1-1	Preparatory Works	LS			4,444
1-2	Diversion Works				
	Excavation (earth)	m^3	56,000	3.5	196
	(rock)	m^3	56,000	7.5	420
	(tunnel)	m^3	82,000	43.4	3,559
	Steel Support	ton	610	653.3	399
	Concrete	m3	28,000	124.4	2,861
	Reinforcement bar	ton	1,000	609.8	610
	Sub-total				8,044
1-3	Dam				
	Excavation (earth)	m^3	186,000	3.5	651
	(rock)	m^3	80,000	7.5	600
	Embankment (core)	m^3	494,000	5.5	2,717
	(filter)	m^3	142,000	4.8	682
	(rock)	m^3	2,484,000	7.8	19,375
	Concrete	m^3	7,000	74.6	662
	Reinforcement bar	ton	210	609.8	128
	Curtain & blanket grout	m	34,000	72	2,448
	Sub-total				27,263
1-4	Spillway				
	Excavation (earth)	m^3	100,000	3.5	350
	(rock)	m^3	200,000	7.5	1,500
	Concrete	m^3	61,500	94.6	5,818
	Reinforcement bar	ton	1,230	609.8	750
	Slope protection	m^2	5,300	279	148
	Sub-total				8,566
1-5	Waterway				
	Excavation (rock)	m^3	7,000	7.5	53
	(shaft)	m^3	4,100	43.4	178
	Steel support	ton	24	653.3	16
	Concrete	m3	5,400	124.4	672
	Reinforcement bar	ton	110	609.8	67
	Consolidation grout	m	2,800	72	202
	Sub-total				1,187

-- to be continued --

Table 3(2) CONSTRUCTION COST ESTIMATE FOR GENTENG I SCHEME

Item No.	Work	Unit	Quantity	Unit Price (10^3Rp)	Amount (10^6Rp)
1-6	Powerhouse				
	Excavation	m^3	19,500	7.5	146
	Concrete	m^3	5,500	94.6	520
	Reinforcement bar	ton	1,270	609.8	165
	Backfill	m^3	1,500	3.5	5
	Slope protection	m^2	600	27.9	17
	Architectural works	L.S.			623
	Utility works	L.S.			664
	Sub-total				2,141
1-7	Transbasin Scheme				
	Intake weir	L.S.			1,563
	Connection tunnel	L.S.			6,391
	Miscellaneous				398
	Sub-toal				8,352
2.	Metal Works				1,981
2-1	Gates, Stop log	ton	42	5,150	216
2-2	Penstock	ton	547	2,884	1,578
2-3	Hollow Jet Valve	ton	15		188
3.	Generating Equipment including T/L	L.S.			6,908
	Total				68,886
4.	Engineering Service				6,889
5.	Administration				3,444
6.	Base Cost				79,219
7.	Physical Contingency				11,883
	Grand Total				91,102

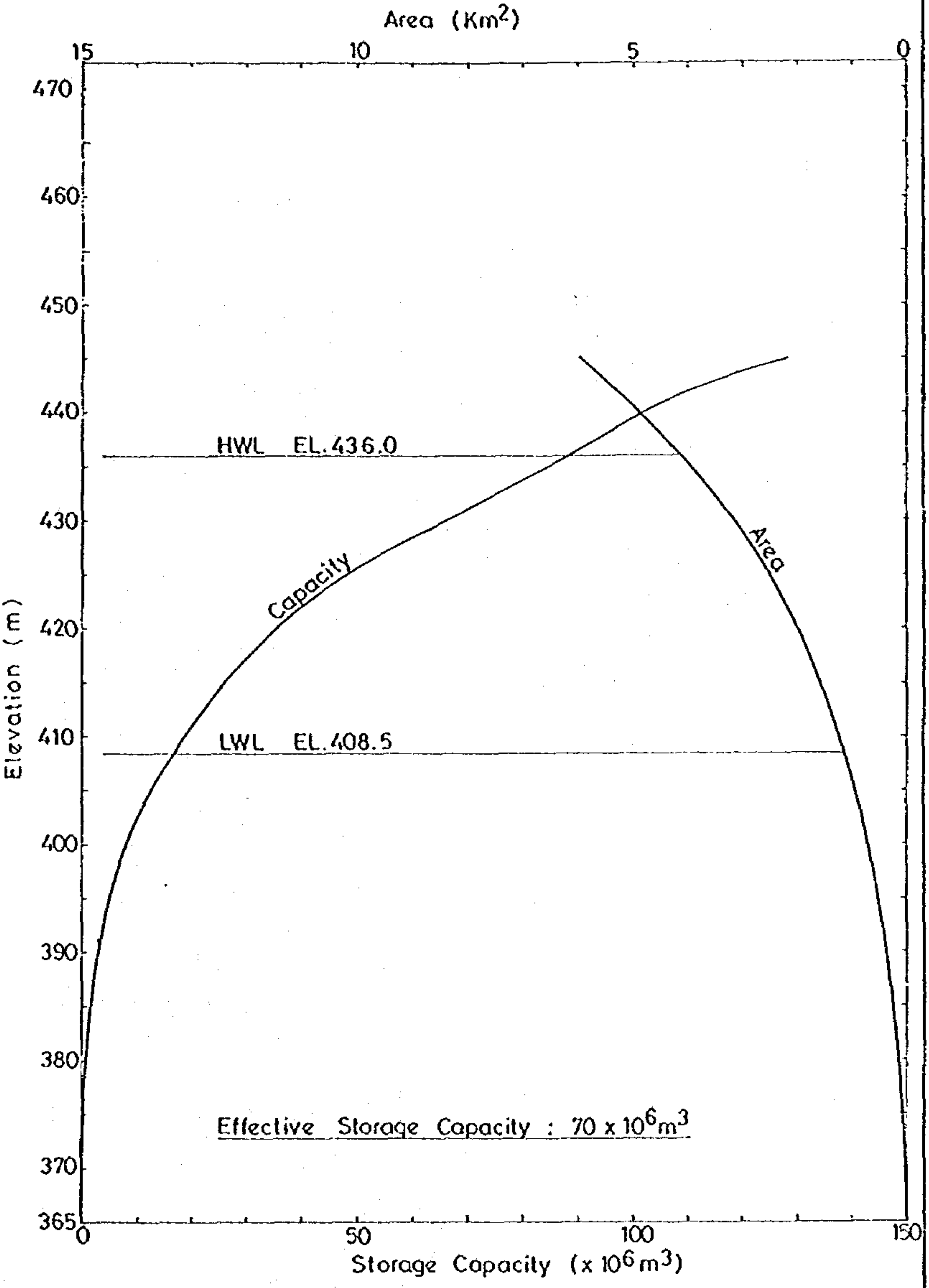


Fig 1 STORAGE CAPACITY OF GENTENG I RESERVOIR

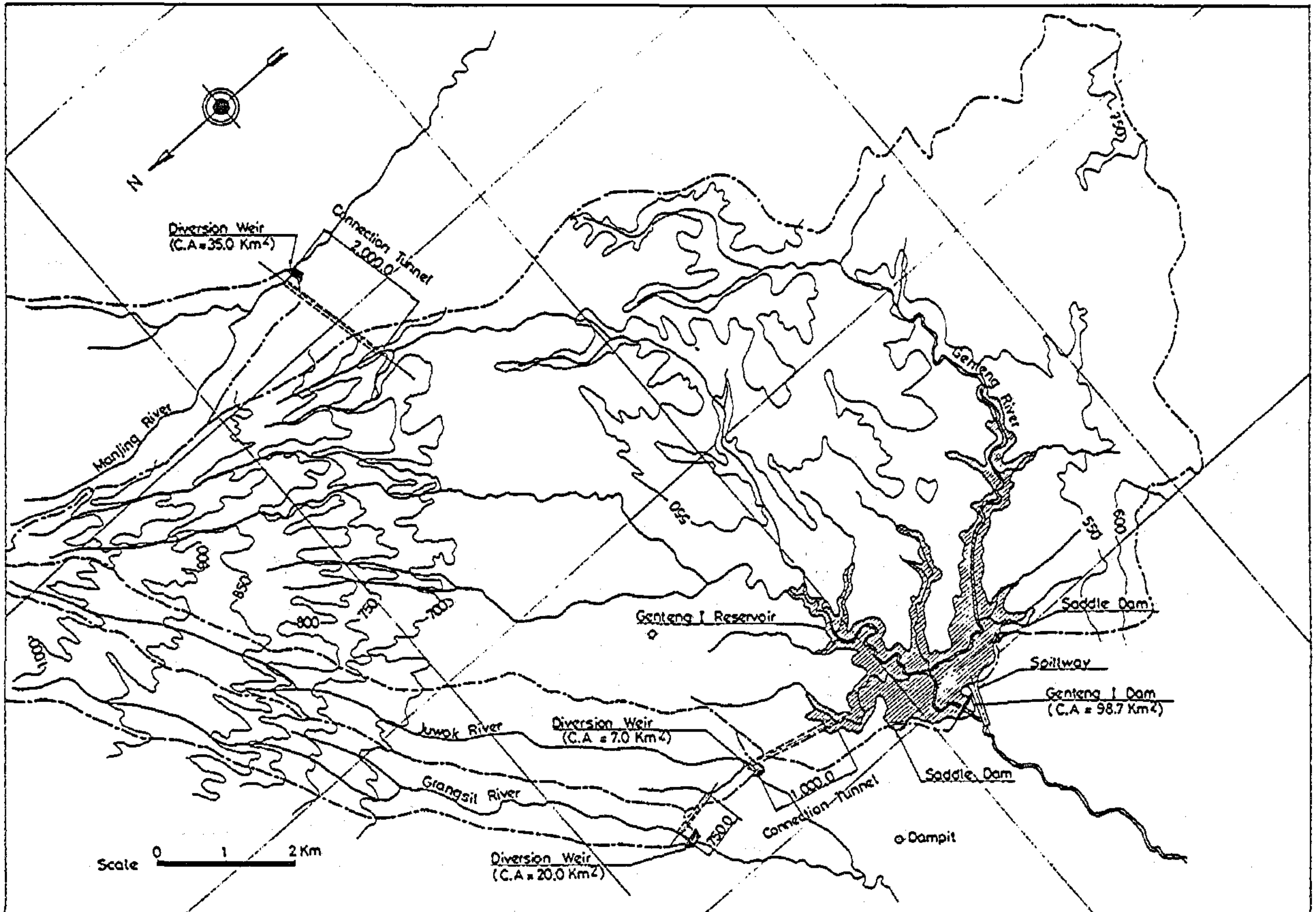
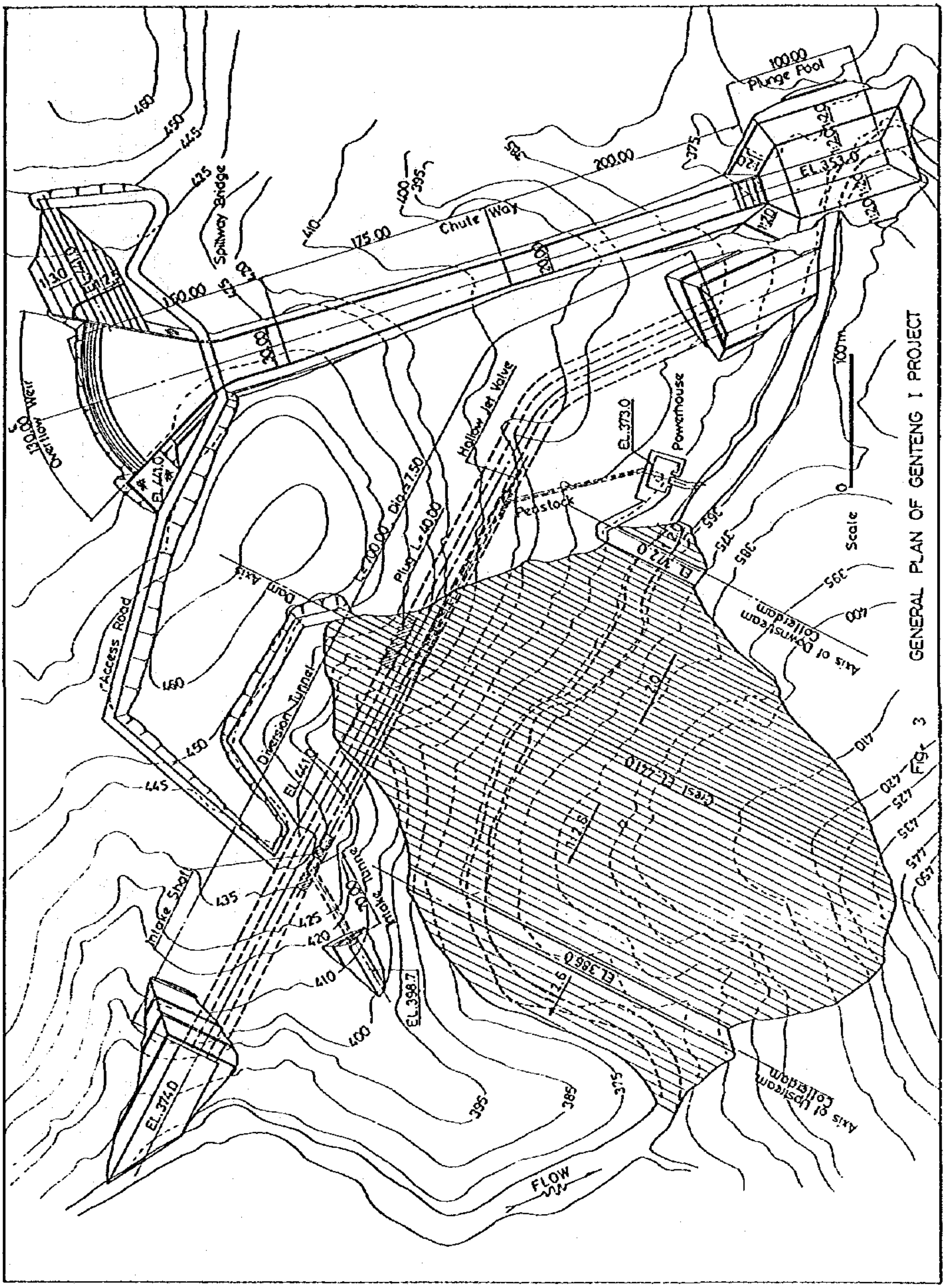


Fig. 2 GENERAL LAYOUT OF GENTENG I PROJECT



GENERAL PLAN OF GENTENG I PROJECT
Fig. 3
Scale
100m
Plunge Pool
Chute Way
Spillway Bridge
Overflow Weir
Hollow Jet Valve
Powerhouse
Penstock
Dam Axis
Access Road
Diversion Tunnel
Intake Shaft
Intake Tunnel
Axis of Downstream Cofferdam
Axis of Upstream Cofferdam
Crest EL.441.0
EL.386.0
EL.374.0
EL.398.7
EL.373.0
EL.353.0
EL.441.0
FLOW

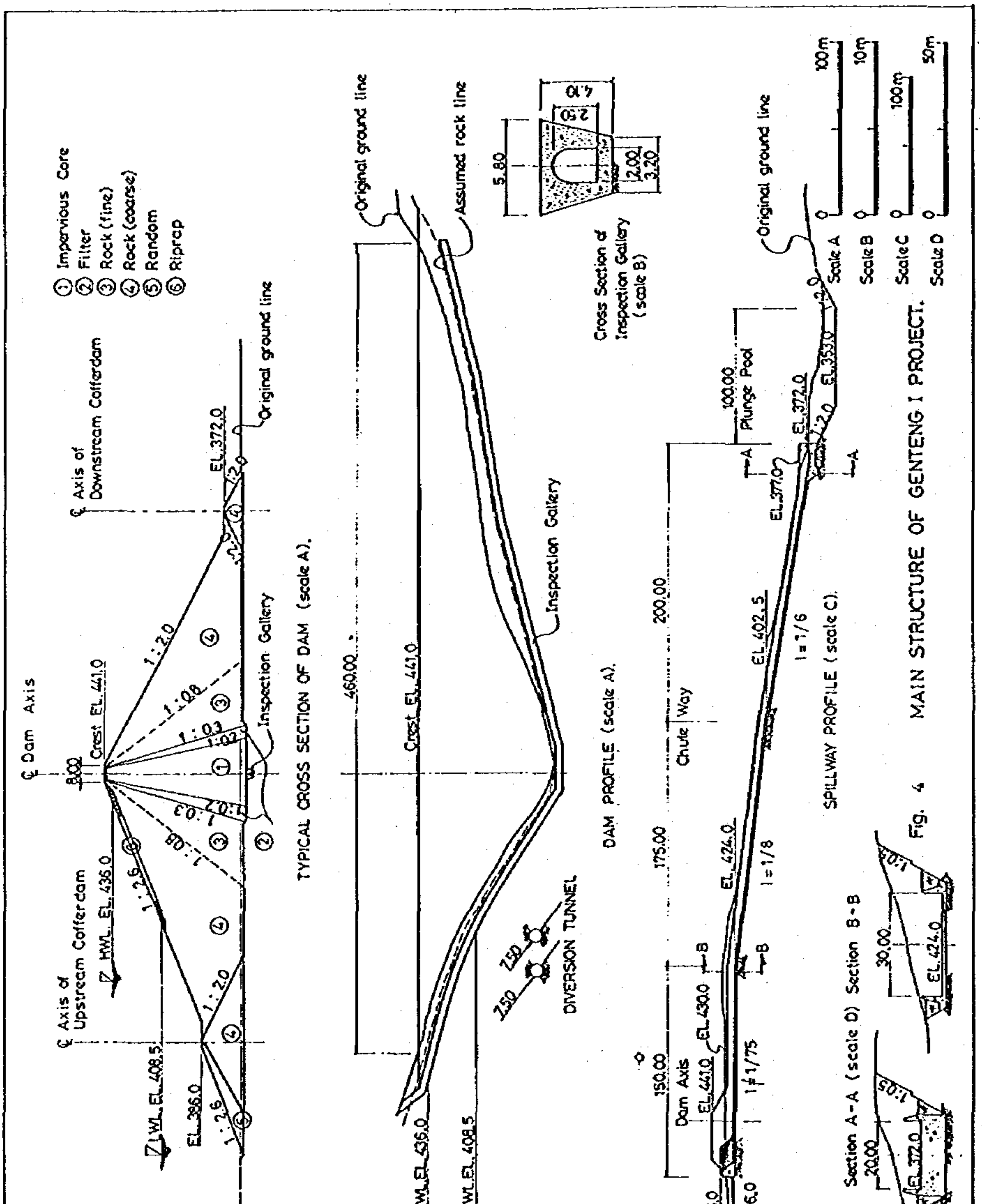
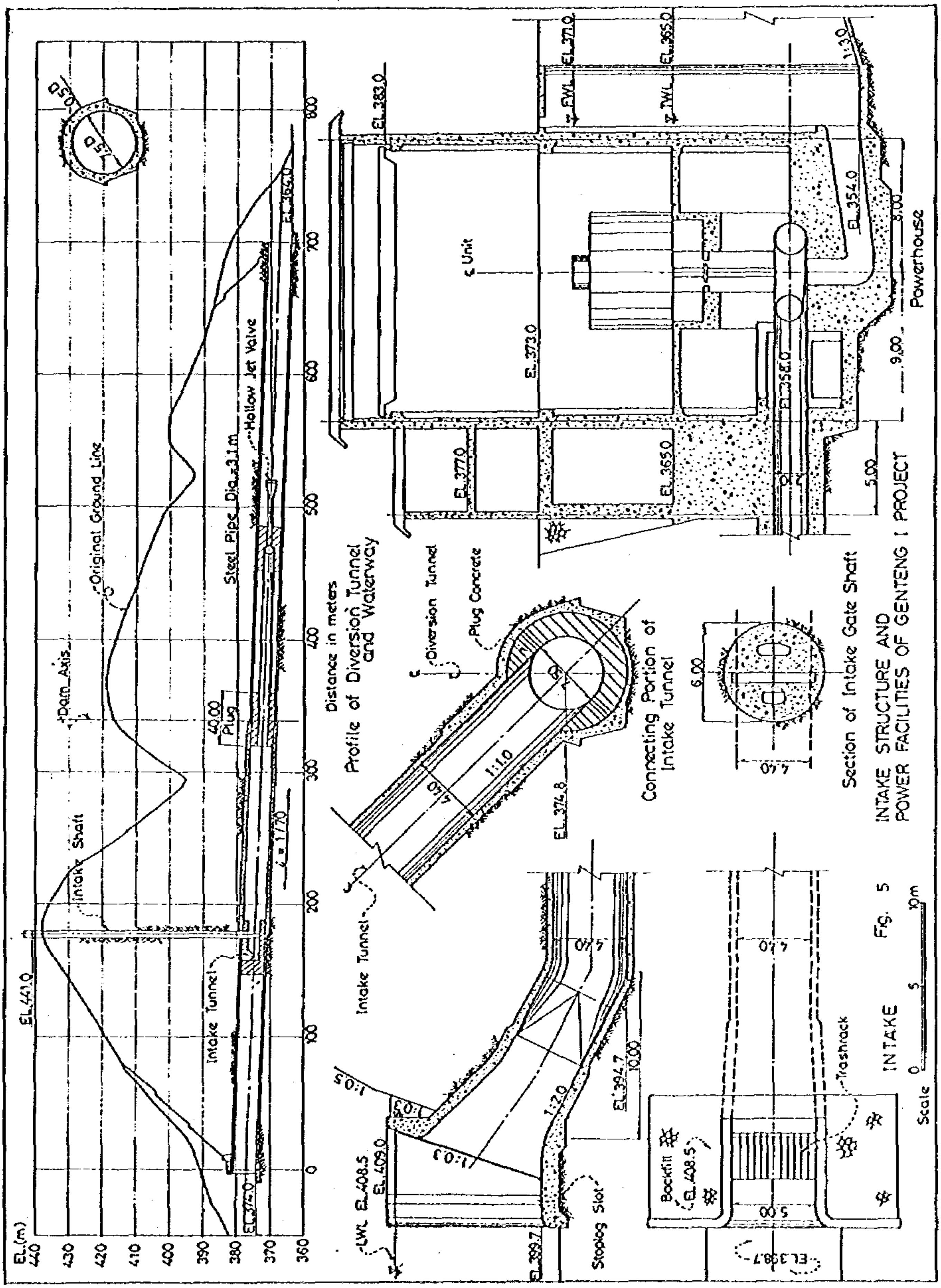


Fig. 4 MAIN STRUCTURE OF GENTENG I PROJECT.


Profile of Diversion Tunnel and Waterway
Distance in meters
EL.(m)
Original Ground Line
Dam Axis
Intake Shaft
Intake Tunnel
EL.441.0
Plug
40.00
Steel Pipe Dia.=3.1 m
Hollow Jet Valve
EL.364.0
EL.374.0
i = 1/70
Connecting Portion of Intake Tunnel
Diversion Tunnel
Plug Concrete
Intake Tunnel
EL.374.8
1:1.0
4.40
Section of Intake Gate Shaft
6.00
Powerhouse
EL.383.0
EL.373.0
EL.377.0
EL.365.0
EL.371.0
EL.354.0
EL.358.0
FWL
TWL
Unit
9.00
5.00
8.00
1:3.0
INTAKE
LWL EL.408.5
EL.409.0
EL.399.7
EL.394.7
Stoplog Slot
Trashrack
Backfill
EL.408.5
5.00
10.00
1:2.0
1:0.3
1:0.5
Scale 0 5 10m
Fig. 5
INTAKE STRUCTURE AND POWER FACILITIES OF GENTENG I PROJECT

NOTE MP-5

KONTO RIVER II SCHEME

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

NOTE MP - 5 KONTO RIVER II SCHEME

1. Objectives of Scheme

The objectives of the scheme are envisaged as follows;

- Water supply
- Hydropower generation
- Flood control
- Sediment control (enlongation of lifetime of the Selorejo reservoir)

2. Natural Conditions

Location and Topography

The site is selected on Konto river, 3 km downstream from Pujon and 10 km upstream from the Selorejo dam. The catchment area at the damsite is 107 km^2. Konto river has formed a deep gorge with the bottom width of about 150 m. The riverbed elevation is around EL. 885 m and the elevation of the shoulder of the abutments is around EL. 1010 m. The width of the valley at the level of the shoulder is around 600 m.

Hydrology

Run-off at the damsite is estimated from the discharge at the Selorejo damsite by multiplying area ratio (107 km^2/236km^2).
The discharge at the Selorejo damsite is that estimated by the tank model method as shown in Table 1. The monthly mean run-off is as follows;

Unit m^3/s

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
7.00	7.76	8.08	6.58	5.41	4.43	3.82	3.24	2.92	2.93	3.61	4.95

The mean run-off is estimated at 5.06 m^3/s. Ten-day run-off is as shown on Table 2. The run-off available from the upstream of Brantas river by a transbasin plan as described later is estimated also by area-ratio as shown in Table 3.

Probable floods are estimated as follows;

Probability	Probable Flood Peak
25 years	405 m^3/s
100	568
200	646
1,000	826
10,000	1,084

Geology

There is no geological data at this moment. Additional boring investigation is proposed.

According to the reconnaissance survey, the andesite and volcanic breccia outcrops are found in the abutment.

3. Possible Development

Storage Development

The Selorejo reservoir has a storage capacity to regulate the run-off throughout the year. However, the capacity is insufficient to carry out an inter-seasonal regulation (shift of water from the rainy season to the dry season).

The topographic condition of the Konto river II damsite allows a storage of about 73 x 10^6 m^3 in gross as shown on Fig. 1. By using this storage capacity together with the Selorejo reservoir, it will become possible to make the inter-seasonal regulation.

Hydropower Potential

Konto river has a steep gradient in the stretches where the dam is located. A gross head of about 350 m is attainable within a distance of about 6.5 km. This hydropower potential is worth for development.

Transbasin from the upstream of Brantas river

Within a distance of about 8 km from the reservoir area,the Brantas river exist.

The catchment area of Brantas river at this point is about 60 km^2. Discharge from this catchment is now used for hydropower generation at Karangkates, Wlingi and Lodoyo. If this discharge is diverted to the Konto river II reservoir, the discharge can be used for power generation at Konto river II, Selorejo Mendalan, and Siman. Difference of the total head is as follows;

K. Brantas		K. Konto	
K. Kates	78 m	K. Konto II	310 m
Wlingi	35 m	Selorejo	37 m
Lodoyo	12 m	Mendalan	148 m
	125 m		599 m

The transbasin scheme is worth for considering.

4. Preliminary Layout

Preliminary layout of the scheme is drawn as shown on Fig. 2. to 6. The dam type is assumed as rock-fill type. The diversion tunnels and spillway are arranged in the right abutment. The headrace tunnel is also arranged in the right side. Principal features of the scheme is as follows;

PRINCIPAL FEATURES OF KONTO II PROJECT

Location	: 3 km downstream from Pujon
	: 10 km upstream from Selorejo Dam
River Basin	: Konto River Basin
Stream	: Konto River
Hydrology	
Catchment area	107 km^2
Average run-off	5.06 ± 2.09
Dependable run-off for power	5 m^3/sec
10,000 year probable flood	1,100 m^3/sec
Reservoir	
High water level	EL. 1000.0 m
Low water level	EL. 944.0 m
Gross storage capacity	73 x 10^6 m^3
Effective storage capacity	63 x 10^6 m^3
Reservoir surface area at HWL	22 km^2
Trans-basin Scheme	
Upstream of K. Brantas - Konto	
Catchment area	61 km^2
Tunnel length	7900 m
Dam	
Type	: Zoned Rockfill type
Crest elevation	: EL. 1004.0 m
Crest length	: 585 m
Height above river bed	: 116 m
Dam height	: 120 m
Upstream slope	: 1 : 2.6
Downstream slope	: 1 : 2.0
Embankment volume	: 9.3 x 10^6 m^3
Spillway	
Type	: Side channel-Flip bucket type
Crest elevation	: EL. 1,000.0 m
Crest width	: 130 m
Chuteway	: 385 m long, 15 m - 10 m wide
Diversion Tunnel	
Type	: Circular Tunnel x 2 lines
Design discharge	: 400 m^3/sec
Diameter	: 4.5 m ø
Length	: 930 m (No.1), 945 m (No.2)
Intake	
Dimension	: 8.0 m high and 5.0 m wide
Sill elevation	: EL. 937.0 m
Headrace tunnel	
Type	: Circular tunnel
Diameter	: 3.5 m ø
Length	: 5,525 m (including intake tunnel of 235 m long)
Surge Tank	
Type	: Port type
Riser shaft	: 8 m in diameter, top elevation of EL. 101.6 m)
Port diameter	: 1.3 m ø
Up-surging water level	: EL. 1,014.3 m
Down-surging water level	: EL. 929.7 m

Penstock

Type	:	Steel conduit
Diameter	:	2.5 m ø
Length	:	1,645 (including penstock tunnel of 550 m long)

Powerhouse

Type	:	Open air type
Building dimension	:	25 m long x 23 m wide x 33 m high

Power and Energy

Average firm discharge	:	5 m^3/sec
Max. plant discharge	:	24 m^3/sec
Head gross	:	350 m
raged (effective)	:	310 m
Installed capacity	:	31 MW x 2 units = 62 MW
Dependable capacity	:	62 MW
Annual energy	:	179.6 Gwh

By the above setting, the hydropower potential at the assumed rated head is estimated as shown in Table 4.

5. Construction Cost

The total construction cost is estimated at Rp. 202,741 million. Breakdown of the estimated cost is as shown in Table 5.

6. Anticipated Benefits

The anticipated benefits of the scheme are as follows;

<u>Water supply benefit</u>

63×10^6 m^3 x Rp. 100 = Rp. 6,300 x 10^6/year

<u>Power Benefit</u>

Capacity Benefit
62,000 kW x Rp. 58.2 x 10^3/kW = Rp.3,608.4 x 10^6/year

Energy Benefit (K. Konto II + Transbasin)
179.614 x 10^3 kWh x Rp. 90 / kWh = Rp. 16,165.3 x 10^6/year
Energy Benefit in the downstream
9.8 x (599 - 125 - 310) x 2.9 x 0.8 x 0.85 x 24 x 365
= 27.764 x 10^3 kWh
27.764 x 10^3 kWh x Rp. / kWh = Rp. 2,498.8 x 10^6/year

<u>Sediment Control Benefit</u>

10 x 106 m^3 x Rp. 100/m^3/50 years = Rp. 20 x 10^6/year

<u>Negative Benefit</u>

In the reservoir area, use of the land as paddy fields is very limited. Therefore the submerged area is valued as other use.

<u>Net Benefit</u>

Rp. 28,482.5 x 10^6/year

Table 1(1)

ESTIMAED RUNOFF

SELOREJO

Month		1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Jan.	1st	7.76	10.49	7.57	9.00	11.62	23.48	16.23	11.60	11.03	26.78
	2nd	7.68	9.33	19.77	9.28	11.10	17.66	13.90	11.39	9.48	24.08
	3rd	6.44	14.60	12.90	9.03	22.85	14.06	16.84	11.54	10.95	13.55
Feb.	1st	5.90	12.96	11.97	15.02	22.13	21.01	16.80	18.75	10.57	12.38
	2nd	7.06	16.73	24.54	12.22	11.71	17.78	22.27	11.92	11.65	20.33
	3rd	65.02	18.54	15.24	9.68	13.27	14.99	19.67	20.66	12.85	17.74
Mar.	1st	51.10	16.57	15.76	9.39	11.83	13.64	19.69	28.28	11.69	14.96
	2nd	10.10	13.87	20.77	11.15	16.00	23.27	18.70	19.25	18.47	16.39
	3rd	10.12	12.24	14.67	11.76	12.89	17.37	14.80	25.41	12.21	14.77
Apr.	1st	13.49	11.38	13.24	12.85	14.62	14.95	13.47	16.55	12.85	14.00
	2nd	10.23	9.85	12.42	10.09	14.16	72.02	13.49	15.04	14.44	11.83
	3rd	8.86	9.40	10.10	11.55	11.92	27.82	13.68	13.62	11.31	12.84
May	1st	7.62	8.59	9.28	17.63	12.02	16.29	11.61	13.42	10.86	11.73
	2nd	7.43	7.87	8.68	12.02	10.48	14.95	11.33	13.57	11.33	11.15
	3rd	6.84	7.39	8.79	9.95	11.10	13.80	13.78	11.71	9.66	12.05
June	1st	5.79	7.13	7.70	8.98	9.68	13.45	19.83	10.52	9.29	10.48
	2nd	6.57	7.15	6.98	8.24	9.39	13.72	11.71	9.78	8.23	9.89
	3rd	8.44	7.06	6.67	7.71	8.46	12.73	11.59	9.16	8.01	9.04
July	1st	7.09	8.04	6.23	7.24	8.58	13.69	10.73	9.25	12.49	9.00
	2nd	6.18	6.64	5.91	6.86	7.63	12.45	10.27	9.73	9.18	8.33
	3rd	5.46	6.37	5.64	6.23	7.02	14.45	9.72	13.73	8.03	7.87
Aug.	1st	5.20	5.83	5.41	5.88	7.12	12.15	9.10	9.29	7.46	7.25
	2nd	5.01	5.71	5.22	5.58	8.70	11.52	8.87	8.55	6.94	6.91
	3rd	4.39	5.26	5.49	5.32	6.82	10.67	8.55	7.94	6.71	6.67
Sep.	1st	4.08	5.05	5.10	5.26	7.21	9.88	7.97	7.48	6.12	6.32
	2nd	4.23	5.64	4.76	4.94	6.65	9.36	7.54	7.14	5.76	6.11
	3rd	4.54	5.34	4.82	4.71	5.90	9.34	7.28	6.70	5.50	5.85
Oct.	1st	4.62	5.49	4.45	4.50	5.80	8.36	7.31	6.59	5.60	5.92
	2nd	5.20	4.62	4.02	4.26	6.11	9.23	11.74	6.17	5.62	6.01
	3rd	4.67	4.18	4.66	4.20	6.83	10.40	7.36	5.87	5.24	5.16
Nov.	1st	8.81	4.14	7.72	4.68	10.72	14.54	9.92	6.12	6.87	5.30
	2nd	6.95	4.09	8.38	4.41	10.59	16.14	8.34	6.17	6.23	5.45
	3rd	20.75	4.17	9.82	4.61	14.15	12.98	9.17	6.67	5.06	8.72
Dec.	1st	11.86	7.98	8.01	4.02	17.66	11.36	17.92	11.34	9.08	16.23
	2nd	14.04	5.79	12.19	6.24	16.90	10.34	12.74	18.97	11.73	19.57
	3rd	13.43	8.79	9.71	17.01	12.98	18.68	10.03	10.15	13.67	17.30
Mean	1st	10.64	8.45	9.57	8.38	11.18	16.08	12.61	11.95	9.51	11.61

Table 1(2)

* ESTIMAED RUNOFF *

SELOREJO

Month		1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Jan.	1st	15.62	28.11	14.62	22.38	7.46	9.82	8.54	14.85	14.81	12.82
	2nd	11.48	24.12	16.98	37.32	6.37	16.20	9.32	14.75	10.62	15.15
	3rd	17.49	23.78	38.57	26.87	7.06	22.27	7.58	23.40	13.63	14.81
Feb.	1st	29.53	16.22	36.00	26.26	8.21	12.95	7.04	18.74	14.21	16.15
	2nd	18.49	16.45	31.10	21.96	8.33	14.12	16.75	13.70	15.46	14.20
	3rd	33.19	16.08	26.69	20.03	9.00	15.34	19.15	25.81	15.62	18.49
Mar.	1st	22.41	17.11	21.22	23.42	13.02	13.08	15.67	18.40	16.79	13.37
	2nd	15.23	13.64	19.21	19.50	14.10	21.48	18.33	13.43	15.90	16.27
	3rd	17.86	13.48	15.50	19.24	11.64	15.99	15.35	14.42	14.43	15.86
Apr.	1st	24.90	12.93	15.30	16.34	13.76	16.27	12.98	14.85	18.56	14.02
	2nd	17.31	13.73	28.11	15.00	11.37	13.30	10.81	12.66	13.63	12.95
	3rd	15.23	12.55	24.09	14.49	9.99	11.71	11.04	11.90	13.60	11.89
May	1st	17.24	13.16	19.46	12.80	10.22	10.83	10.98	11.07	14.35	10.63
	2nd	20.36	11.75	14.54	11.79	11.33	9.87	9.54	10.29	13.37	9.80
	3rd	15.45	10.30	13.27	11.01	9.37	9.85	8.48	9.97	13.04	9.36
June	1st	13.26	9.74	12.49	10.52	12.70	8.85	8.43	8.68	11.87	9.28
	2nd	12.27	8.89	12.75	9.78	9.03	8.51	7.32	8.11	12.85	8.31
	3rd	12.04	8.32	11.39	9.31	8.55	7.79	6.71	7.66	11.71	7.76
July	1st	12.34	7.92	11.05	8.89	7.80	7.38	6.63	7.29	11.93	7.53
	2nd	10.53	7.60	10.30	8.52	7.12	7.07	5.95	6.95	14.09	7.07
	3rd	9.88	7.07	9.51	8.17	6.41	6.74	5.62	6.63	12.15	6.68
Aug.	1st	9.36	6.73	9.39	7.88	5.97	6.45	5.35	6.36	10.85	6.44
	2nd	9.06	6.45	9.92	7.57	5.69	6.22	5.13	6.14	10.09	6.16
	3rd	8.75	6.19	8.64	7.27	5.94	5.96	5.21	5.91	9.98	5.87
Sep.	1st	8.23	5.92	8.18	6.94	5.14	5.69	4.77	5.66	8.85	5.58
	2nd	7.88	5.68	7.94	6.62	6.95	5.44	4.57	5.42	8.68	5.31
	3rd	7.62	5.73	7.70	6.30	5.41	5.17	4.38	5.17	8.16	5.37
Oct.	1st	7.33	5.22	7.25	7.61	10.42	4.90	4.58	4.92	8.31	4.88
	2nd	7.03	5.08	7.15	6.32	16.64	4.83	5.52	4.75	7.68	4.51
	3rd	7.50	4.90	8.28	6.21	9.28	4.36	4.53	4.41	7.74	5.77
Nov.	1st	7.28	5.97	17.12	6.38	10.17	4.11	5.31	4.95	9.05	5.53
	2nd	9.10	6.72	10.07	5.24	10.31	3.85	5.52	5.08	12.51	4.57
	3rd	12.10	5.23	8.52	4.75	9.37	4.36	9.53	4.94	10.15	5.85
Dec.	1st	10.30	6.52	16.28	5.11	9.56	4.46	12.98	8.78	11.78	5.10
	2nd	9.29	7.44	12.70	8.40	8.68	6.51	9.67	10.33	16.15	6.54
	3rd	12.39	12.54	17.33	6.58	9.04	8.43	8.86	14.04	16.59	6.93
Mean	1st	13.76	10.81	15.52	12.58	9.21	9.45	8.84	10.29	12.48	9.37

Table 1(3)

ESTIMAED RUNOFF

SELOREJO

Month		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Jan.	1st	5.84	11.52	17.47	7.55	25.70	11.75	13.56	6.90	6.52	6.84
	2nd	9.36	17.15	19.82	8.86	34.09	17.71	23.06	14.88	9.89	11.87
	3rd	11.99	19.50	14.67	9.25	19.72	15.03	28.73	16.00	21.74	10.97
Feb.	1st	14.50	26.43	14.17	12.16	20.56	16.54	16.98	13.19	17.79	9.53
	2nd	14.53	26.91	13.89	9.47	23.20	17.24	18.83	14.00	9.90	11.17
	3rd	15.32	17.65	13.68	10.34	20.14	16.89	20.04	20.33	12.15	9.12
Mar.	1st	12.75	16.56	20.78	18.03	26.17	16.36	122.22	32.03	12.22	10.89
	2nd	18.30	16.36	19.72	11.13	18.71	17.49	26.57	22.43	12.97	9.88
	3rd	17.11	21.67	21.52	12.03	15.89	20.72	16.76	18.25	12.26	9.11
Apr.	1st	12.60	17.66	14.81	13.25	18.78	22.82	17.15	13.04	10.14	8.73
	2nd	10.95	16.49	14.43	10.69	27.66	16.32	14.80	12.60	9.21	8.38
	3rd	10.97	14.39	13.91	10.54	15.59	17.33	15.02	11.60	7.96	8.51
May	1st	10.09	14.46	15.20	10.94	14.95	15.62	14.08	10.89	8.68	12.94
	2nd	9.85	14.16	13.33	12.36	15.76	15.29	12.89	9.99	10.22	9.36
	3rd	9.22	14.77	11.53	14.14	13.10	14.33	11.67	9.65	9.51	9.41
June	1st	9.22	15.19	10.70	11.54	12.28	12.67	10.97	9.22	10.08	8.83
	2nd	8.53	12.26	9.94	9.54	11.54	11.70	10.34	8.19	9.86	7.58
	3rd	7.47	11.98	9.31	9.27	10.79	10.95	9.77	7.79	9.34	6.97
July	1st	6.93	11.04	8.81	8.27	10.75	10.52	9.84	7.03	8.84	6.59
	2nd	6.76	10.25	8.36	7.74	9.92	9.67	9.01	6.63	7.78	5.92
	3rd	6.26	9.61	7.93	6.94	9.45	9.29	8.55	6.28	7.49	5.46
Aug.	1st	5.80	9.14	7.74	6.50	9.95	9.17	8.71	5.96	7.00	5.12
	2nd	5.58	8.68	7.26	6.59	9.06	9.26	7.94	5.70	6.21	4.82
	3rd	5.28	8.55	6.96	6.37	9.41	8.55	7.69	5.47	5.92	4.55
Sep.	1st	5.06	9.06	6.66	6.06	8.99	8.28	7.30	5.25	5.62	4.33
	2nd	4.94	7.92	6.37	6.51	11.54	12.47	6.98	5.04	5.41	4.16
	3rd	5.36	7.52	6.07	7.91	8.98	9.43	6.66	4.82	4.99	4.14
Oct.	1st	4.56	7.39	5.77	6.53	10.82	10.12	7.43	4.59	4.89	4.00
	2nd	4.66	7.03	5.46	7.80	11.65	9.22	7.98	4.35	4.59	3.62
	3rd	5.49	11.52	5.77	7.69	10.20	14.21	6.85	4.09	4.70	3.57
Nov.	1st	6.27	10.48	4.91	9.34	9.85	17.60	6.65	3.89	4.54	4.31
	2nd	10.35	10.27	4.91	8.38	11.98	13.74	6.44	3.67	4.96	3.46
	3rd	10.68	13.58	5.69	8.67	10.82	15.57	11.41	3.34	4.37	4.13
Dec.	1st	8.85	21.41	7.19	13.64	9.87	19.15	7.62	4.70	4.98	6.44
	2nd	8.85	25.25	6.74	13.45	14.23	14.89	7.26	5.24	6.45	4.50
	3rd	11.67	14.33	6.13	10.85	12.11	12.62	6.76	4.13	5.68	7.82
Mean	1st	9.22	14.13	10.77	9.73	14.84	13.90	15.12	9.48	8.47	7.14

Table 1(4)

*** ESTIMAED RUNOFF ***

SELOREJO

Month		1980	1981	1982	1983	Mean
Jan.	1st	7.15	17.00	25.42	17.16	13.68
	2nd	7.22	25.13	20.95	22.10	15.83
	3rd	17.18	25.04	18.34	10.31	16.67
Feb.	1st	11.73	20.36	22.85	12.96	16.56
	2nd	10.77	15.21	26.43	11.51	16.17
	3rd	13.45	14.79	23.20	13.03	18.45
Mar.	1st	12.39	15.71	18.65	14.22	21.07
	2nd	11.12	17.05	25.61	12.56	16.91
	3rd	13.45	12.97	16.70	11.21	15.28
Apr.	1st	11.09	12.83	16.84	12.52	14.69
	2nd	11.76	12.11	14.74	11.38	15.41
	3rd	11.10	13.07	14.56	19.19	13.27
May	1st	10.68	15.06	12.82	19.42	12.81
	2nd	8.62	13.70	11.74	13.48	11.83
	3rd	8.02	11.97	10.97	11.58	11.03
June	1st	7.81	10.68	10.24	10.21	10.54
	2nd	6.76	10.12	9.68	9.29	9.55
	3rd	6.28	12.32	9.22	8.45	9.12
July	1st	5.86	10.31	8.80	7.77	8.90
	2nd	5.92	10.26	8.44	7.25	8.30
	3rd	5.38	9.45	8.11	6.84	7.96
Aug.	1st	5.24	8.62	7.77	6.43	7.43
	2nd	4.88	8.10	7.49	6.11	7.15
	3rd	4.66	7.97	7.18	5.81	6.82
Sep.	1st	4.52	7.51	6.86	5.57	6.49
	2nd	4.41	7.48	6.54	5.36	6.52
	3rd	4.13	9.56	6.22	5.26	6.24
Oct.	1st	3.90	9.79	5.90	5.13	6.35
	2nd	4.60	7.95	5.56	5.19	6.53
	3rd	4.26	7.55	5.21	6.22	6.44
Nov.	1st	3.89	7.86	5.17	7.21	7.55
	2nd	5.09	13.68	5.40	6.17	7.60
	3rd	6.68	12.63	4.47	12.15	8.68
Dec.	1st	15.65	13.81	5.37	8.03	10.38
	2nd	8.59	16.30	12.71	7.49	11.06
	3rd	10.07	13.93	8.44	13.14	11.24
Mean	1st	8.18	12.72	12.07	10.21	11.13

Table. 2(1)

ESTIMAED RUNOFF

K.KONTO II

Month		1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Jan.	1st	3.53	4.77	3.44	4.09	5.28	10.68	7.38	5.28	5.02	12.19
	2nd	3.49	4.24	8.99	4.22	5.05	8.03	6.32	5.18	4.31	10.96
	3rd	2.93	6.64	5.87	4.10	10.39	6.40	7.66	5.25	4.98	6.16
Feb.	1st	2.68	5.89	5.45	6.83	10.07	9.56	7.64	8.53	4.81	5.63
	2nd	3.21	7.61	11.17	5.56	5.33	8.09	10.13	5.42	5.30	9.25
	3rd	29.59	8.43	6.93	4.40	6.03	6.82	8.95	9.40	5.84	8.07
Mar.	1st	23.25	7.54	7.17	4.27	5.38	6.21	8.96	12.87	5.32	6.80
	2nd	4.59	6.31	9.45	5.07	7.28	10.59	8.51	8.76	8.40	7.46
	3rd	4.60	5.57	6.67	5.35	5.86	7.90	6.73	11.56	5.55	6.72
Apr.	1st	6.13	5.17	6.02	5.84	6.65	6.80	6.13	7.53	5.85	6.37
	2nd	4.65	4.48	5.65	4.59	6.44	32.77	6.14	6.84	6.57	5.38
	3rd	4.03	4.27	4.60	5.25	5.42	12.66	6.22	6.20	5.14	5.84
May	1st	3.46	3.91	4.22	8.02	5.47	7.41	5.28	6.10	4.94	5.34
	2nd	3.38	3.58	3.95	5.47	4.77	6.80	5.15	6.17	5.15	5.07
	3rd	3.11	3.36	4.00	4.53	5.05	6.28	6.27	5.33	4.39	5.48
June	1st	2.63	3.24	3.50	4.08	4.40	6.12	9.02	4.78	4.23	4.77
	2nd	2.99	3.25	3.17	3.75	4.27	6.24	5.33	4.45	3.74	4.50
	3rd	3.84	3.21	3.03	3.50	3.85	5.79	5.27	4.17	3.84	4.11
July	1st	3.22	3.66	2.83	3.29	3.90	6.23	4.88	4.21	5.68	4.09
	2nd	2.81	3.02	2.69	3.12	3.47	5.66	4.67	4.42	4.18	3.79
	3rd	2.48	2.90	2.56	2.83	3.19	6.57	4.42	6.25	3.67	3.58
Aug.	1st	2.37	2.65	2.46	2.67	3.24	5.53	4.14	4.23	3.39	3.30
	2nd	2.28	2.60	2.37	2.54	3.96	5.24	4.03	3.89	3.15	3.14
	3rd	1.99	2.39	2.49	2.42	3.10	4.85	3.89	3.61	3.05	3.03
Sep.	1st	1.85	2.30	2.32	2.39	3.28	4.49	3.62	3.40	2.78	2.87
	2nd	1.92	2.56	2.17	2.25	3.02	4.25	3.43	3.25	2.62	2.78
	3rd	2.06	2.43	2.19	2.14	2.68	4.25	3.31	3.05	2.50	2.66
Oct.	1st	2.10	2.49	2.02	2.05	2.64	4.03	3.32	3.00	2.55	2.69
	2nd	2.36	2.10	1.82	1.94	2.78	4.20	5.34	2.81	2.55	2.73
	3rd	2.12	1.90	2.12	1.91	3.11	4.73	3.35	2.67	2.38	2.34
Nov.	1st	4.01	1.88	3.51	2.13	4.88	6.62	4.51	2.78	3.12	2.41
	2nd	3.16	1.86	3.81	2.00	4.82	7.34	3.79	2.81	2.83	2.48
	3rd	9.44	1.90	4.47	2.10	6.44	5.90	4.17	3.03	2.30	3.97
Dec.	1st	5.40	3.63	3.64	1.83	8.03	5.17	8.15	5.16	4.13	7.38
	2nd	6.39	2.63	5.55	2.84	7.69	4.70	5.80	8.63	5.34	8.91
	3rd	6.11	4.00	4.42	7.74	5.91	8.50	4.56	4.62	6.22	7.87
Mean	1st	4.84	3.84	4.35	3.81	5.09	7.32	5.74	5.43	4.32	5.28

Table 2(2)

ESTIMAED RUNOFF

K.KONTO II

Month		1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Jan.	1st	7.11	12.79	6.65	10.18	3.39	4.47	3.89	6.75	6.74	5.83
	2nd	5.22	10.97	7.73	16.98	2.90	7.37	4.24	6.71	4.83	6.89
	3rd	7.96	10.82	17.55	12.22	3.21	10.13	3.45	10.65	6.20	6.74
Feb.	1st	13.44	7.38	16.38	11.95	3.76	5.89	3.20	8.52	6.46	7.62
	2nd	8.41	7.48	14.15	9.99	3.79	6.43	7.62	6.23	7.03	6.46
	3rd	15.10	7.31	12.14	9.11	4.09	6.98	8.71	11.74	7.11	8.41
Mar.	1st	10.19	7.78	9.65	10.65	5.92	5.95	7.13	8.37	7.64	6.08
	2nd	6.93	6.20	8.74	8.87	6.42	9.77	8.34	6.11	7.23	7.40
	3rd	8.13	6.13	7.05	8.75	5.29	7.27	6.98	6.56	6.57	7.21
Apr.	1st	11.33	5.88	6.96	7.42	6.26	7.40	5.90	6.75	8.44	6.38
	2nd	7.87	6.24	12.79	6.83	5.17	6.05	4.92	5.76	6.20	5.89
	3rd	6.93	5.71	10.96	6.59	4.54	5.33	5.02	5.41	6.19	5.41
May	1st	7.84	5.99	8.85	5.82	4.65	4.93	4.99	5.04	6.53	4.83
	2nd	9.26	5.35	6.62	5.36	5.15	4.49	4.34	4.68	6.08	4.46
	3rd	7.03	4.68	6.04	5.01	4.26	4.48	3.86	4.53	5.93	4.26
June	1st	6.03	4.43	5.68	4.78	5.78	4.02	3.83	3.95	5.40	4.22
	2nd	5.58	4.04	5.80	4.45	4.10	3.87	3.33	3.69	5.84	3.78
	3rd	5.48	3.79	5.18	4.23	3.89	3.54	3.05	3.48	5.33	3.53
July	1st	5.61	3.60	5.03	4.04	3.55	3.35	3.01	3.31	5.43	3.42
	2nd	4.79	3.46	4.68	3.87	3.24	3.22	2.70	3.16	6.41	3.21
	3rd	4.49	3.22	4.33	3.72	2.92	3.06	2.56	3.02	5.52	3.04
Aug.	1st	4.26	3.06	4.27	3.58	2.71	2.93	2.43	2.89	4.94	2.93
	2nd	4.12	2.93	4.51	3.44	2.59	2.83	2.33	2.79	4.59	2.80
	3rd	3.98	2.81	3.93	3.30	2.70	2.71	2.37	2.69	4.54	2.67
Sep.	1st	3.74	2.69	3.72	3.15	2.33	2.59	2.17	2.57	4.03	2.54
	2nd	3.58	2.58	3.61	3.01	3.16	2.47	2.08	2.46	3.95	2.41
	3rd	3.46	2.61	3.50	2.87	2.46	2.35	1.99	2.35	3.71	2.44
Oct.	1st	3.33	2.37	3.30	3.46	4.74	2.23	2.08	2.24	3.78	2.22
	2nd	3.20	2.31	3.25	2.87	7.57	2.20	2.51	2.16	3.49	2.05
	3rd	3.41	2.23	3.77	2.82	4.22	1.98	2.06	2.01	3.52	2.62
Nov.	1st	3.31	2.72	7.79	2.90	4.63	1.87	2.41	2.25	4.11	2.51
	2nd	4.14	3.06	4.58	2.38	4.69	1.75	2.51	2.31	5.69	2.08
	3rd	5.51	2.38	3.88	2.16	4.26	1.98	4.33	2.24	4.62	2.66
Dec.	1st	4.69	2.97	7.40	2.32	4.35	2.03	5.90	3.99	5.36	2.32
	2nd	4.23	3.38	5.78	3.82	3.95	2.96	4.40	4.70	7.35	2.97
	3rd	5.63	5.70	7.88	2.99	4.11	3.83	4.03	6,39	7.55	3.15
Mean	1st	6.26	4.92	7.06	5.72	4.19	4.30	4.02	4.68	5.68	4.26

Table 2(3)

****
* ESTIMAED RUNOFF *
****

K.KONTO II

Month		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Jan.	1st	2.65	5.24	7.95	3.43	11.69	5.34	6.17	3.14	2.96	3.11
	2nd	4.26	7.80	9.02	4.03	15.51	8.06	10.49	6.77	4.50	5.40
	3rd	5.45	8.87	6.67	4.21	8.97	6.84	13.07	7.28	9.89	4.99
Feb.	1st	6.60	12.02	6.45	5.53	9.36	7.52	7.72	6.00	8.09	4.33
	2nd	6.61	12.25	6.32	4.30	10.56	7.84	8.57	6.37	4.50	5.08
	3rd	6.97	8.03	6.22	4.70	9.16	7.68	9.12	9.25	5.53	4.15
Mar.	1st	5.80	7.54	9.45	8.20	11.91	7.44	55.62	14.57	5.56	4.95
	2nd	8.32	7.44	8.97	5.06	8.51	7.96	12.09	10.20	5.90	4.49
	3rd	7.78	9.86	9.79	5.47	7.23	9.43	7.62	8.30	5.58	4.14
Apr.	1st	5.73	8.04	6.73	6.03	8.55	10.38	7.80	5.93	4.61	3.97
	2nd	4.98	7.50	6.56	4.86	12.58	7.42	6.73	5.73	4.19	3.81
	3rd	4.99	6.54	6.33	4.79	7.09	7.89	6.83	5.28	3.62	3.87
May	1st	4.59	6.58	6.92	4.98	6.80	7.10	6.41	4.95	3.95	5.88
	2nd	4.48	6.44	6.06	5.62	7.17	6.95	5.86	4.54	4.65	4.26
	3rd	4.19	6.72	5.25	6.43	5.96	6.52	5.31	4.39	4.33	4.28
June	1st	4.20	6.91	4.87	5.25	5.59	5.76	4.99	4.19	4.58	4.01
	2nd	3.83	5.58	4.52	4.34	5.25	5.32	4.70	3.72	4.48	3.45
	3rd	3.39	5.45	4.23	4.22	4.91	4.98	4.44	3.54	4.25	3.17
July	1st	3.15	5.02	4.01	3.76	4.89	4.79	4.48	3.20	4.02	3.00
	2nd	3.07	4.66	3.80	3.52	4.51	4.40	4.10	3.02	3.54	2.69
	3rd	2.85	4.37	3.61	3.15	4.30	4.22	3.89	2.86	3.41	2.48
Aug.	1st	2.64	4.16	3.52	2.95	4.52	4.17	3.96	2.71	3.18	2.33
	2nd	2.54	3.95	3.30	2.99	4.12	4.21	3.61	2.59	2.82	2.19
	3rd	2.40	3.39	3.16	2.90	4.28	3.89	3.50	2.49	2.69	2.07
Sep.	1st	2.30	4.12	3.03	2.76	4.09	3.77	3.32	2.39	2.56	1.97
	2nd	2.24	3.60	2.90	2.96	5.25	5.67	3.17	2.29	2.46	1.89
	3rd	2.44	3.42	2.76	3.60	4.09	4.29	3.03	2.19	2.27	1.88
Oct.	1st	2.07	3.59	2.62	2.97	4.92	4.60	3.38	2.08	2.22	1.82
	2nd	2.12	3.20	2.48	3.55	5.30	4.19	3.63	1.98	2.09	1.64
	3rd	2.49	5.24	2.62	3.50	4.64	6.46	3.11	1.86	2.14	1.62
Nov.	1st	2.85	4.77	2.23	4.25	4.48	8.01	3.02	1.77	2.06	1.96
	2nd	4.71	4.67	2.23	3.81	5.45	6.25	2.93	1.67	2.26	1.57
	3rd	4.86	6.18	2.59	3.94	4.92	7.08	5.19	1.52	1.99	1.88
Dec.	1st	4.02	9.74	3.27	6.20	4.49	8.71	3.47	2.13	2.26	2.93
	2nd	4.02	11.49	3.07	6.12	6.47	6.77	3.30	2.38	2.93	2.05
	3rd	5.31	6.52	2.79	4.94	5.51	5.74	3.08	1.88	2.58	3.56
Mean	1st	4.19	6.43	4.90	4.43	6.75	6.32	6.88	4.31	3.85	3.25

Table 2(4)

ESTIMATED RUNOFF

K.KONTO II

Month		1980	1981	1982	1983	Mean
Jan.	1st	3.25	7.73	11.57	7.81	6.22
	2nd	3.28	11.43	9.53	10.06	7.20
	3rd	7.82	11.39	8.34	4.69	7.58
Feb.	1st	5.34	9.26	10.40	5.89	7.54
	2nd	4.90	6.92	12.03	5.23	7.36
	3rd	6.12	6.73	10.55	5.93	8.39
Mar.	1st	5.63	7.15	8.49	6.47	9.59
	2nd	5.06	7.76	11.65	5.71	7.69
	3rd	6.12	5.90	7.60	5.10	6.95
Apr.	1st	5.04	5.84	7.66	5.70	6.68
	2nd	5.35	5.51	6.71	5.17	7.01
	3rd	5.05	5.95	6.62	8.73	6.04
May	1st	4.86	6.85	5.83	8.84	5.83
	2nd	3.92	6.23	5.34	6.13	5.38
	3rd	3.65	5.44	4.99	5.27	5.02
June	1st	3.55	4.86	4.66	4.64	4.79
	2nd	3.07	4.60	4.40	4.23	4.34
	3rd	2.86	5.61	4.19	3.84	4.15
July	1st	2.67	4.69	4.00	3.53	4.05
	2nd	2.69	4.67	3.84	3.30	3.78
	3rd	2.44	4.30	3.69	3.11	3.62
Aug.	1st	2.38	3.92	3.54	2.92	3.38
	2nd	2.22	3.68	3.41	2.78	3.25
	3rd	2.12	3.62	3.26	2.64	3.10
Sep.	1st	2.05	3.42	3.12	2.53	2.95
	2nd	2.01	3.40	2.97	2.44	2.97
	3rd	1.88	4.35	2.83	2.39	2.84
Oct.	1st	1.77	4.45	2.68	2.33	2.89
	2nd	2.09	3.61	2.53	2.36	2.97
	3rd	1.93	3.43	2.37	2.83	2.93
Nov.	1st	1.77	3.57	2.35	3.28	3.43
	2nd	2.31	6.22	2.46	2.81	3.45
	3rd	3.04	5.74	2.03	5.53	3.95
Dec.	1st	7.12	6.28	2.44	3.65	4.72
	2nd	3.91	7.42	5.78	3.41	5.03
	3rd	4.58	6.33	3.84	5.98	5.11
Mean	1st	3.72	5.79	5.49	4.65	5.06

Table 3(1)

* ESTIMAED RUNOFF *

TRANS-BASIN TO K.KONTO

Month		1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
Jan.	1st	2.02	2.73	1.97	2.34	3.02	6.12	4.23	3.02	2.87	6.98
	2nd	2.00	2.43	5.15	2.41	2.89	4.60	3.62	2.96	2.47	6.27
	3rd	1.68	3.80	3.36	2.35	5.95	3.86	4.38	3.00	2.85	3.53
Feb.	1st	1.53	3.37	3.12	3.91	5.76	5.47	4.37	4.88	2.75	3.22
	2nd	1.84	4.35	6.39	3.18	3.05	4.63	5.80	3.10	3.03	5.29
	3rd	16.94	4.83	3.97	2.52	3.45	3.90	5.12	5.38	3.34	4.62
Mar.	1st	13.31	4.31	4.10	2.44	3.08	3.55	5.13	7.37	3.04	3.89
	2nd	2.63	3.61	5.41	2.90	4.17	6.06	4.87	5.01	4.81	4.27
	3rd	2.63	3.19	3.82	3.06	3.35	4.52	3.85	6.62	3.18	3.85
Apr.	1st	3.51	2.96	3.45	3.34	3.81	3.89	3.51	4.31	3.35	3.64
	2nd	2.66	2.56	3.23	2.63	3.69	18.76	3.51	3.91	3.76	3.08
	3rd	2.31	2.45	2.63	3.01	3.10	7.25	3.56	3.55	2.94	3.34
May	1st	1.98	2.24	2.41	4.59	3.13	4.24	3.02	3.49	2.83	3.05
	2nd	1.93	2.05	2.26	3.13	2.73	3.89	2.95	3.53	2.95	2.90
	3rd	1.78	1.92	2.29	2.59	2.89	3.59	3.59	3.05	2.51	3.14
June	1st	1.31	1.85	2.00	2.34	2.52	3.50	5.16	2.74	2.42	2.73
	2nd	1.71	1.86	1.82	2.14	2.44	3.57	3.05	2.55	2.14	2.57
	3rd	2.20	1.84	1.74	2.00	2.20	3.31	3.02	2.38	2.08	2.35
July	1st	1.84	2.09	1.62	1.88	2.23	3.56	2.79	2.41	3.25	2.34
	2nd	1.61	1.73	1.54	1.78	1.98	3.24	2.67	2.53	2.39	2.17
	3rd	1.42	1.66	1.47	1.62	1.83	3.76	2.53	3.57	2.10	2.05
Aug.	1st	1.35	1.51	1.41	1.53	1.85	3.16	2.37	2.42	1.94	1.89
	2nd	1.30	1.48	1.36	1.45	2.26	3.00	2.31	2.22	1.60	1.80
	3rd	1.14	1.37	1.43	1.38	1.77	2.78	2.22	2.07	1.75	1.73
Sep.	1st	1.06	1.31	1.33	1.37	1.87	2.57	2.07	1.94	1.59	1.64
	2nd	1.10	1.47	1.24	1.28	1.73	2.43	1.96	1.86	1.50	1.59
	3rd	1.18	1.39	1.25	1.22	1.53	2.43	1.89	1.74	1.43	1.52
Oct.	1st	1.20	1.43	1.16	1.17	1.51	2.30	1.90	1.71	1.46	1.54
	2nd	1.35	1.20	1.04	1.11	1.59	2.40	3.06	1.61	1.46	1.56
	3rd	1.21	1.09	1.21	1.09	1.78	2.71	1.91	1.53	1.36	1.34
Nov.	1st	2.29	1.08	2.01	1.22	2.79	3.79	2.58	1.59	1.79	1.38
	2nd	1.81	1.06	2.18	1.14	2.76	4.20	2.17	1.61	1.62	1.42
	3rd	5.40	1.08	2.56	1.20	3.68	3.38	2.39	1.73	1.32	2.27
Dec.	1st	3.09	2.08	2.08	1.04	4.60	2.96	4.67	2.95	2.36	4.23
	2nd	3.65	1.50	3.17	1.62	4.40	2.69	3.32	4.94	3.05	5.10
	3rd	3.50	2.29	2.53	4.43	3.38	4.87	2.61	2.64	3.56	4.51
Mean	1st	2.77	2.20	2.49	2.18	2.91	4.19	3.28	3.11	2.47	3.02

Table 3(2)

****
* ESTIMAED RUNOFF *
****

TRANS-BASIN TO K.KONTO

Month		1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Jan.	1st	4.07	7.32	3.81	5.83	1.94	2.56	2.22	3.87	3.86	3.34
	2nd	2.99	6.28	4.42	9.72	1.66	4.22	2.43	3.84	2.76	3.94
	3rd	4.56	6.19	10.05	7.00	1.84	5.80	1.97	6.09	3.55	3.86
Feb.	1st	7.69	4.22	7.38	6.84	2.15	3.37	1.83	4.88	3.70	4.36
	2nd	4.81	4.28	8.10	5.72	2.17	3.68	4.36	3.57	4.02	3.70
	3rd	8.64	4.19	6.95	5.22	2.34	3.99	4.99	6.72	4.07	4.82
Mar.	1st	5.84	4.45	5.53	6.10	3.39	3.41	4.08	4.79	4.37	3.48
	2nd	3.97	3.55	5.00	5.08	3.67	5.59	4.77	3.50	4.14	4.24
	3rd	4.65	3.51	4.04	5.01	3.03	4.16	4.00	3.75	3.76	4.13
Apr.	1st	6.48	3.36	3.98	4.25	3.58	4.24	3.38	3.87	4.83	3.65
	2nd	4.51	3.57	7.32	3.91	2.96	3.46	2.81	3.29	3.55	3.37
	3rd	3.96	3.27	6.27	3.77	2.60	3.05	2.87	3.10	3.54	3.09
May	1st	4.49	3.43	5.07	3.33	2.66	2.82	2.86	2.88	3.73	2.77
	2nd	5.30	3.06	3.79	3.07	2.95	2.57	2.48	2.68	3.48	2.55
	3rd	4.02	2.68	3.46	2.86	2.44	2.56	2.21	2.59	3.39	2.43
June	1st	3.45	2.53	3.25	2.74	3.31	2.30	2.19	2.26	3.09	2.41
	2nd	3.19	2.31	3.32	2.54	2.35	2.22	1.90	2.11	3.34	2.16
	3rd	3.13	2.17	2.96	2.42	2.22	2.03	1.75	1.99	3.05	2.02
July	1st	3.21	2.06	2.88	2.31	2.03	1.92	1.72	1.90	3.10	1.96
	2nd	2.74	1.98	2.68	2.22	1.85	1.84	1.55	1.81	3.67	1.84
	3rd	2.57	1.84	2.48	2.13	1.67	1.75	1.46	1.72	3.16	1.74
Aug.	1st	2.44	1.75	2.44	2.05	1.55	1.68	1.39	1.65	2.82	1.67
	2nd	2.36	1.68	2.58	1.97	1.48	1.62	1.35	1.60	2.63	1.60
	3rd	2.28	1.61	2.25	1.89	1.54	1.55	1.36	1.54	2.60	1.53
Sep.	1st	2.14	1.54	2.13	1.80	1.33	1.48	1.24	1.47	2.31	1.45
	2nd	2.05	1.48	2.07	1.72	1.81	1.41	1.19	1.41	2.26	1.38
	3rd	1.98	1.49	2.00	1.64	1.41	1.34	1.14	1.34	2.12	1.40
Oct.	1st	1.91	1.36	1.89	1.98	2.71	1.27	1.19	1.28	2.16	1.27
	2nd	1.83	1.32	1.86	1.64	4.33	1.25	1.44	1.23	2.00	1.17
	3rd	1.95	1.27	2.16	1.61	2.42	1.13	1.18	1.15	2.01	1.50
Nov.	1st	1.89	1.55	4.46	1.66	2.65	1.07	1.38	1.29	2.35	1.44
	2nd	2.37	1.75	2.62	1.36	2.68	1.00	1.44	1.32	3.26	1.19
	3rd	3.15	1.36	2.22	1.23	2.44	1.13	2.48	1.28	2.64	1.52
Dec.	1st	2.68	1.70	4.24	1.33	2.49	1.16	3.38	2.28	3.07	1.33
	2nd	2.42	1.94	3.30	2.18	2.26	1.69	2.52	2.69	4.21	1.70
	3rd	3.22	3.26	4.51	1.71	2.35	2.19	2.31	3.66	4.32	1.80
Mean	1st	3.58	2.81	4.04	3.27	2.40	2.46	2.30	2.68	3.25	2.44

Table 3(3)

*** ESTIMAED RUNOFF ***

TRANS-BASIN TO K.KONTO

Month		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Jan.	1st	1.52	3.00	4.55	1.96	6.69	3.06	3.53	1.80	1.69	1.78
	2nd	2.44	4.47	5.16	2.30	8.68	4.61	6.01	3.87	2.57	3.09
	3rd	3.12	5.08	3.82	2.41	5.13	3.91	7.48	4.16	5.66	2.86
Feb.	1st	3.78	6.88	3.69	3.16	5.35	4.31	4.42	3.43	4.63	2.48
	2nd	3.78	7.01	3.62	2.46	6.04	4.49	4.90	3.64	2.58	2.91
	3rd	3.99	4.60	3.56	2.69	5.24	4.40	5.22	5.30	3.16	2.37
Mar.	1st	3.32	4.31	5.41	4.69	6.82	4.26	31.85	8.34	3.18	2.84
	2nd	4.76	4.26	5.14	2.90	4.87	4.55	6.92	5.84	3.38	2.57
	3rd	4.46	5.64	5.60	3.13	4.14	5.40	4.36	4.75	3.19	2.37
Apr.	1st	3.28	4.60	3.85	3.45	4.89	5.94	4.47	3.39	2.64	2.27
	2nd	2.85	4.29	3.76	2.78	7.20	4.25	3.85	3.28	2.40	2.18
	3rd	2.86	3.75	3.62	2.74	4.06	4.51	3.91	3.02	2.07	2.21
May	1st	2.62	3.76	3.96	2.85	3.87	4.07	3.67	2.83	2.26	3.37
	2nd	2.56	3.69	3.47	3.22	4.10	3.98	3.36	2.60	2.66	2.44
	3rd	2.40	3.85	3.00	3.68	3.41	3.73	3.04	2.51	2.48	2.45
June	1st	2.40	3.96	2.78	3.00	3.20	3.30	2.85	2.40	2.62	2.30
	2nd	2.22	3.19	2.59	2.48	3.00	3.05	2.69	2.13	2.56	1.97
	3rd	1.94	3.12	2.42	2.41	2.81	2.85	2.54	2.03	2.43	1.81
July	1st	1.80	2.87	2.29	2.15	2.80	2.74	2.56	1.83	2.30	1.71
	2nd	1.76	2.67	2.17	2.01	2.58	2.52	2.34	1.72	2.02	1.54
	3rd	1.63	2.50	2.06	1.80	2.46	2.42	2.23	1.63	1.95	1.42
Aug.	1st	1.51	2.38	2.01	1.69	2.59	2.39	2.27	1.55	1.82	1.33
	2nd	1.45	2.26	1.89	1.71	2.36	2.41	2.06	1.48	1.61	1.25
	3rd	1.37	2.23	1.81	1.66	2.45	2.23	2.00	1.42	1.54	1.18
Sep.	1st	1.31	2.36	1.73	1.58	2.34	2.15	1.90	1.37	1.46	1.13
	2nd	1.28	2.06	1.66	1.69	3.00	3.25	1.81	1.31	1.41	1.08
	3rd	1.39	1.96	1.58	2.06	2.34	2.45	1.73	1.25	1.30	1.07
Oct.	1st	1.19	2.05	1.50	1.70	2.82	2.63	1.93	1.19	1.27	1.04
	2nd	1.21	1.83	1.42	2.03	3.03	2.40	2.08	1.13	1.19	0.94
	3rd	1.43	3.00	1.50	2.00	2.66	3.70	1.78	1.06	1.22	0.93
Nov.	1st	1.63	2.73	1.27	2.43	2.56	4.58	1.73	1.01	1.18	1.12
	2nd	2.69	2.67	1.28	2.18	3.12	3.58	1.67	0.95	1.29	0.90
	3rd	2.78	3.53	1.48	2.26	2.82	4.05	2.97	0.87	1.13	1.07
Dec.	1st	2.30	5.58	1.87	3.55	2.57	4.99	1.98	1.22	1.29	1.68
	2nd	2.30	6.58	1.75	3.50	3.70	3.88	1.89	1.36	1.68	1.17
	3rd	3.04	3.73	1.59	2.82	3.15	3.29	1.76	1.07	1.48	2.04
Mean	1st	2.49	3.68	2.80	2.53	3.86	3.62	3.94	2.47	2.20	1.86

Table 3(4)

****
* ESTIMAED RUNOFF *
****

TRANS-BASIN TO K.KONTO

Month		1980	1981	1982	1983	Mean
Jan.	1st	1.86	4.43	6.62	4.47	3.56
	2nd	1.88	6.55	5.46	5.76	4.12
	3rd	4.47	6.52	4.78	2.68	4.34
Feb.	1st	3.05	5.30	5.95	3.37	4.31
	2nd	2.80	3.96	6.88	3.00	4.21
	3rd	3.50	3.85	6.04	3.39	4.80
Mar.	1st	3.22	4.09	4.86	3.70	5.49
	2nd	2.89	4.44	6.67	3.27	4.40
	3rd	3.50	3.38	4.35	2.92	3.98
Apr.	1st	2.89	3.34	4.39	3.26	3.82
	2nd	3.06	3.15	3.84	2.96	4.01
	3rd	2.89	3.40	3.79	5.00	3.46
May	1st	2.78	3.92	3.34	5.06	3.34
	2nd	2.24	3.57	3.06	3.51	3.08
	3rd	2.09	3.11	2.86	3.01	2.87
June	1st	2.03	2.78	2.67	2.66	2.74
	2nd	1.76	2.63	2.52	2.42	2.49
	3rd	1.63	3.21	2.40	2.20	2.37
July	1st	1.52	2.68	2.29	2.02	2.31
	2nd	1.54	2.67	2.20	1.88	2.16
	3rd	1.40	2.46	2.11	1.78	2.07
Aug.	1st	1.36	2.24	2.02	1.67	1.93
	2nd	1.27	2.11	1.95	1.59	1.86
	3rd	1.21	2.07	1.87	1.51	1.77
Sep.	1st	1.17	1.95	1.78	1.45	1.69
	2nd	1.15	1.95	1.70	1.39	1.70
	3rd	1.07	2.49	1.62	1.37	1.62
Oct.	1st	1.01	2.55	1.53	1.33	1.65
	2nd	1.19	2.07	1.45	1.35	1.70
	3rd	1.11	1.96	1.36	1.62	1.67
Nov.	1st	1.01	2.04	1.34	1.87	1.96
	2nd	1.32	3.56	1.40	1.60	1.98
	3rd	1.74	3.29	1.16	3.16	2.26
Dec.	1st	4.08	3.60	1.40	2.09	2.70
	2nd	2.23	4.25	3.31	1.95	2.88
	3rd	2.62	3.63	2.20	3.42	2.93
Mean	1st	2.13	3.31	3.14	2.66	2.90

Table 4(1)

ENERGY POTENTIAL AT K.KONTO II

UNIT :MWH

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1950	6357	18329	20402	9193	6371	5871	5437	4247	3626	4222	10301	11477	105838
1951	10125	12558	12386	8642	6939	6024	6123	4888	4525	4153	3502	6616	86485
1952	11718	14169	14856	10090	7795	6925	5179	4703	4144	3838	7315	8714	98550
1953	7960	9872	9448	9730	11454	7035	5913	4887	4209	3777	3868	8174	86332
1954	13500	12541	11850	11485	9796	7767	6754	6582	5576	5483	10005	13777	115121
1955	15970	14325	15804	32380	13096	11255	11859	9989	8065	8330	12319	11920	165317
1956	13726	16016	15423	11464	10749	12169	8940	7725	6430	7661	7739	11762	129809
1957	10066	13315	21296	12754	11248	8312	9617	7499	6015	5424	5352	11701	122605
1958	9185	9169	12298	10891	9261	7206	8622	6146	4906	4793	5126	10116	97725
1959	18553	13231	13430	10910	10196	8298	7330	6065	5159	4968	5496	15471	119111
1960	13076	21972	16161	16201	15402	10598	9519	7914	6696	6380	8038	9373	141336
1961	22112	12846	12856	11061	10226	7606	6576	5643	4893	4431	5059	7833	111148
1962	20884	24953	16215	19011	13713	10335	8978	8131	6723	6637	10077	13552	159244
1963	25176	18120	18077	12921	10355	8353	7418	6616	5606	5860	4618	5856	129010
1964	6097	6968	11263	9907	8990	8544	6201	5135	4936	10516	8424	7955	94941
1965	14253	11101	14714	11646	8899	7099	6169	5425	4600	4099	3479	5713	97202
1966	7395	11035	14358	9827	8419	6341	5295	4577	3875	4261	5745	9140	90274
1967	15613	14975	13457	11118	9121	6901	6076	5362	4587	4099	4223	9750	105287
1968	11404	12336	13701	12918	11867	10277	11111	9008	7256	6915	8947	13031	128776
1969	12486	12906	13285	10963	8668	7153	6193	5377	4590	4410	4502	5436	96003
1970	8010	11648	14069	9740	8487	7117	5807	4853	4334	4307	7706	8617	94702
1971	14141	19030	16013	13695	12659	11125	8991	7683	6914	7785	9686	17610	145338
1972	15073	11393	18104	12174	11628	8451	7305	6394	5392	4962	4378	5834	111095
1973	7502	8434	11961	9729	10962	8564	6671	5670	5780	6432	7448	11011	100171
1974	22983	16890	17590	17500	12727	9765	8762	8283	8328	9506	9215	10558	152112
1975	12977	13341	15980	15932	13166	9968	8581	7854	8514	9868	13236	13521	142942
1976	19243	15188	47168	13250	11232	8769	7975	7084	5910	6475	6911	6299	155509
1977	11111	12259	21025	10507	8886	7109	5807	4990	4266	3791	3079	4089	96925
1978	11373	10553	10912	7705	8285	8261	7015	5567	4521	4136	3916	4991	87242
1979	8687	7898	8688	7228	9214	6597	5227	4217	3565	3261	3360	5519	73467
1980	9383	9763	10805	9579	7934	5885	4995	4307	3686	3720	4421	9964	84455
1981	19655	13373	13267	10726	11829	9346	8737	7191	6927	7349	9640	12819	130865
1982	18772	19137	17669	13017	10337	8224	7381	6536	5538	4854	4247	7720	123438
1983	14275	9843	11034	12158	12874	7887	6363	5342	4570	4846	7205	8458	104861
MEAN	13495	13514	15458	12238	10376	8242	7322	6232	5431	5635	6723	9540	114213

Table 4(2)

ENERGY POTENTIAL AT K.KONT II+TRANS-BASIN

UNIT :MWH

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL
1950	9997	28824	32086	14457	10020	9234	8550	6679	5703	6640	16200	18049	166444
1951	15923	19749	19478	13592	10913	9474	9629	7688	7116	6531	5508	10404	136009
1952	18428	22283	23363	15868	12259	9475	8145	7396	6518	6935	11504	13704	154983
1953	12518	15525	14859	15302	18014	11063	9299	7685	6619	5940	6083	12855	135768
1954	21230	19723	18636	18062	15405	12214	10622	10351	8770	8623	15734	21666	181043
1955	25116	22528	24854	50921	20595	17700	18650	15709	12684	13100	19373	18745	259982
1956	21587	25187	24256	18029	16904	19137	14059	12149	10112	12048	12171	18497	204141
1957	15831	20940	33491	20058	17689	13072	15124	11794	9460	8530	8417	18403	192812
1958	14445	14419	19340	17428	14565	11332	13560	9666	7716	7538	8062	15909	153686
1959	29177	20808	21120	17157	16034	13050	11528	9538	8113	7813	8644	24331	187318
1960	20564	34554	25415	25479	24222	16668	14970	12447	10531	10033	12641	14740	222269
1961	34774	20203	20219	17395	16083	11961	10342	8875	7695	6968	7956	12318	174794
1962	32843	39242	25500	29945	21566	16253	14119	12787	10573	10438	15848	21313	250431
1963	39592	28496	28428	20320	16285	13136	11713	10404	8817	9216	7263	9210	202885
1964	9589	10959	17712	15581	14138	13437	9752	8076	7763	16538	13248	12510	149307
1965	22415	17458	23140	18315	13995	11164	9701	8532	7235	6447	5471	8984	152863
1966	11630	17355	22580	15454	13240	9973	8328	7198	6093	6702	9035	14374	141968
1967	24554	23550	21162	17484	14344	10852	9556	8433	7214	6447	6641	15334	165578
1968	17935	19401	21547	20316	18663	16163	17473	14166	11411	10875	14070	20493	202517
1969	19636	20296	20892	17241	13632	11249	9739	8456	7219	6983	7080	8549	150977
1970	12597	18318	22126	15318	13347	11193	9133	7632	6817	6773	12120	13552	148930
1971	22238	29928	25182	21538	19909	17496	14139	12083	10874	12243	15232	27694	228563
1972	23704	17917	28472	19145	18288	13291	11488	10056	8480	7803	6886	9176	174712
1973	11797	13263	18811	15300	17240	13468	10491	8918	9091	10116	11714	17317	157531
1974	36144	26562	27662	27522	20015	15357	13779	13026	13097	14950	14492	16604	239216
1975	20408	20981	25130	25055	20706	15675	13495	12352	13389	15519	20816	21263	224795
1976	30262	23886	74178	20838	17664	13790	12541	11141	9294	10184	10869	9906	244558
1977	17473	19280	33065	16524	13974	11181	9132	7848	6709	5963	4842	6432	152427
1978	17897	16596	17161	12117	13029	12992	11033	8755	7110	6505	6159	7849	137199
1979	13662	12421	13663	11367	14491	10375	8221	6633	5606	5128	5284	8680	115537
1980	14764	15354	16992	15065	12478	9256	7856	6773	5797	5851	6952	15671	132816
1981	30910	21032	20864	16869	18603	14698	13741	11309	10894	11557	15161	20159	205802
1982	29522	30096	27787	20472	16256	12934	11607	10279	8709	7633	6680	12141	194123
1983	22449	15480	17352	19120	20247	12404	10007	8401	7188	7621	11331	13301	164907
MEAN	21224	21253	24310	19246	16318	12962	11515	9801	8542	8862	10573	15004	179614

Table 5(1) CONSTRUCTION COST ESTIMATE FOR

K. KONTO II SCHEME

Item No.	Work		Unit	Quantity	Unit Price (10^3 Rp)	Amount (10^6Rp)
1.	Civil Works					114,689
1-1	Preparatory Works		L.S.			8,495
1-2	Access Road (new)		km	4	275,000	1,100
1-3	Relocation Road		km	11	34,000	374
1-4	Diversion Works					
	Excavation	(earth)	m^3	9,200	3.5	32
		(rock)	m^3	9,200	7.5	69
		(tunnel)	m^3	44,900	43.4	1,985
	Steel support		ton	565	653.3	364
	Concrete		m^3	17,720	124.4	2,204
	Reinforcement bar		ton	886	609.8	540
	Consolidation grout		m	4,700	72	338
	Sub-toal					5,538
1-5	Dam					
	Excavation	(earth)	m^3	400,600	3.5	1,402
		(rock)	m^3	267,000	7.5	2,003
	Embankment	(random)	m^3	71,400	3.5	250
		(core)	m^3	986,600	5.5	5,426
		(filter)	m^3	580,500	4.8	2,786
		(rock)	m^3	7,877,200	7.8	61,442
	Curtain & blanket grout		m	38,700	72	2,786
	Sub-total					76,096
1-6	Spillway					
	Excavation	(earth)	m^3	236,000	3.5	826
		(rock)	m^3	235,900	7.5	1,769
	Concrete		m^3	42,350	94.6	4,006
	Reinforcement bar		ton	847	609.8	517
	Backfill		m^3	19,400	3.5	68
	Sub-total					7,186

-- to be continued --

Table 5(2) CONSTRUCTION COST ESTIMATE FOR K. KONTO II SCHEME

Item No.	Work	Unit	Quantity	Unit Price (10^3Rp)	Amount (10^6Rp)
1-7	Waterway				
	Excavation (earth)	m^3	14,500	3.5	51
	(rock)	m^3	33,800	7.5	254
	(tunnel)	m^3	48,300	43.4	2,096
	Steel support	ton	1,400	653.3	915
	Concrete	m^3	45,430	124.4	5,651
	Reinforcement bar	ton	2,200	609.8	1,342
	Consolidation grout	m	32,600	72	2,347
	Sub-total				12,655
1-8	Powerhouse				
	Excavation (earth)	m^3	20,600	3.5	72
	(rock)	m^3	10,300	7.5	77
	Concrete	m^3	8,060	94.6	762
	Reinforcement bar	ton	403	609.8	246
	Backfill	m^3	4,100	3.5	14
	Architectural works	L.S.			1,003
	Utility works	L.S.			1,069
	Sub-total				3,244
1-9	Transbasin Scheme				
	Intake weir	L.S.			521
	Connection tunnel	L.S.			12,623
	Sub-total				13,144
2.	Metal Works				16,039
2-1	Gates, Valve, etc.	ton	68	5,150	350
2-2	Penstock	ton	5,440	2,884	15,689
3.	Generating Equipment including T/L	L.S.			9,430
	Total				153,302
4.	Engineering Service				15,330
5.	Administration				7,665
6.	Base Cost				176,297
7.	Physical Contingency				26,445
	Grand Total				202,741

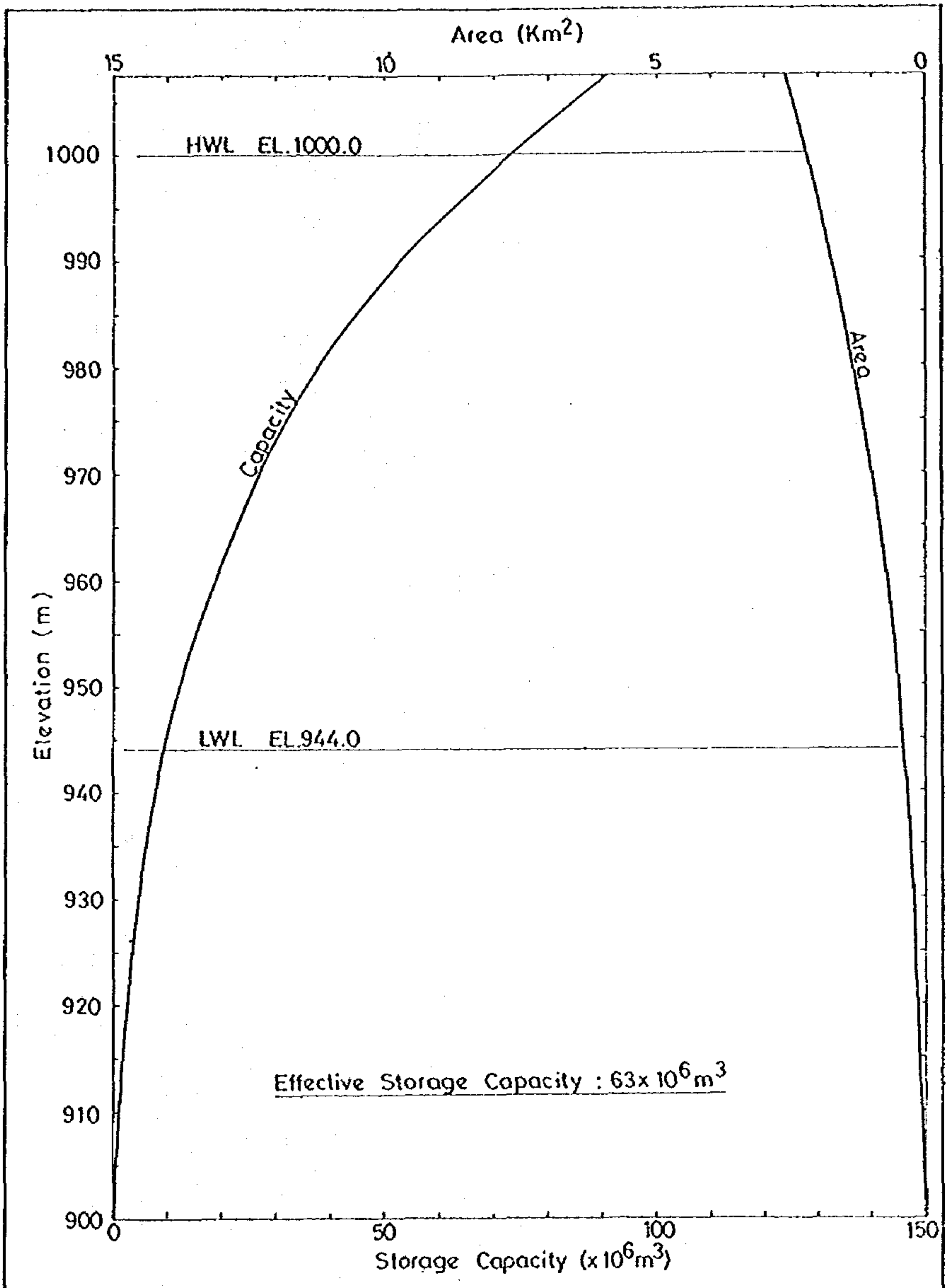


Fig. 1 STORAGE CAPACITY OF KONTO II RESERVOIR

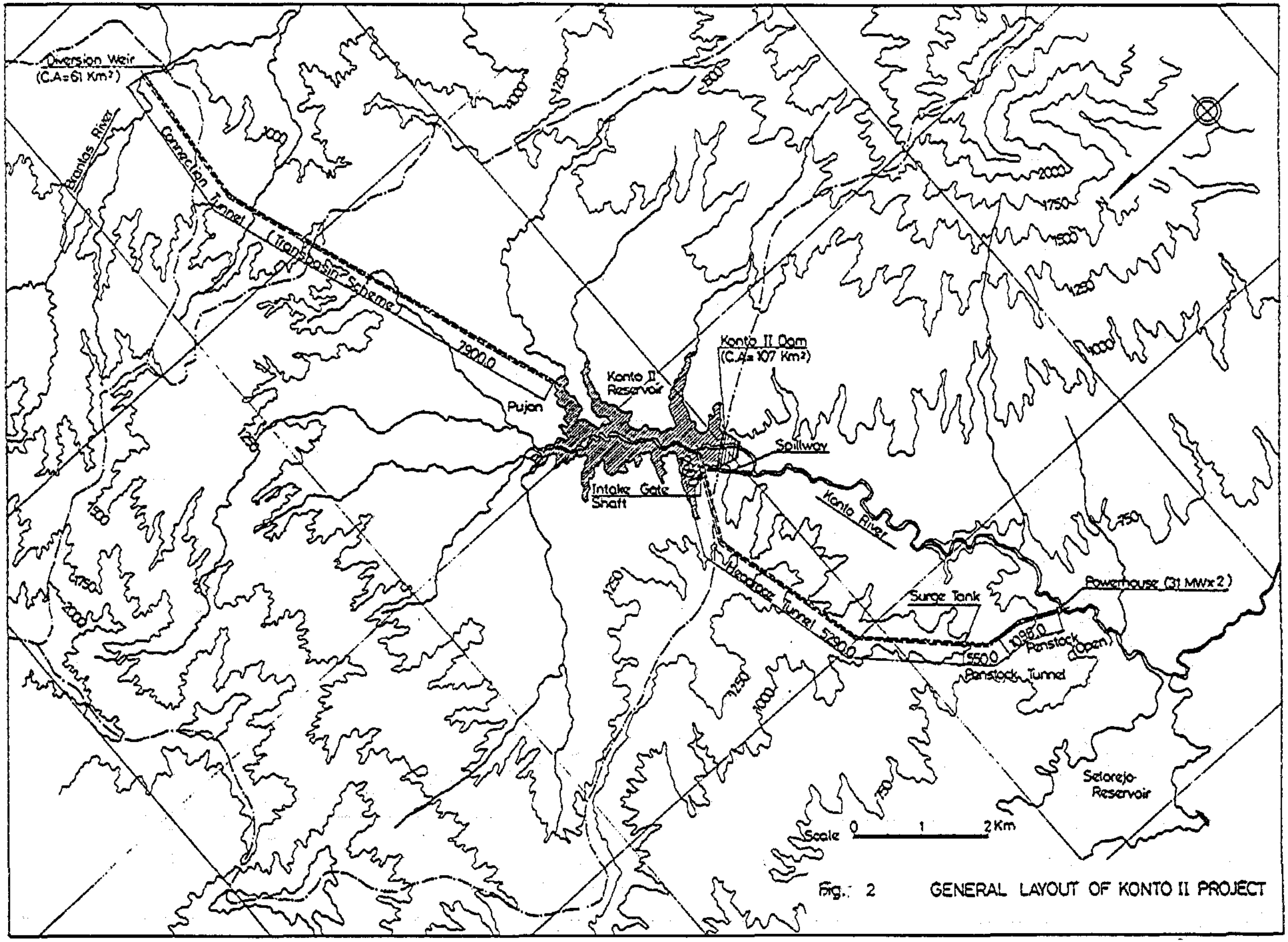


Fig.: 2 GENERAL LAYOUT OF KONTO II PROJECT

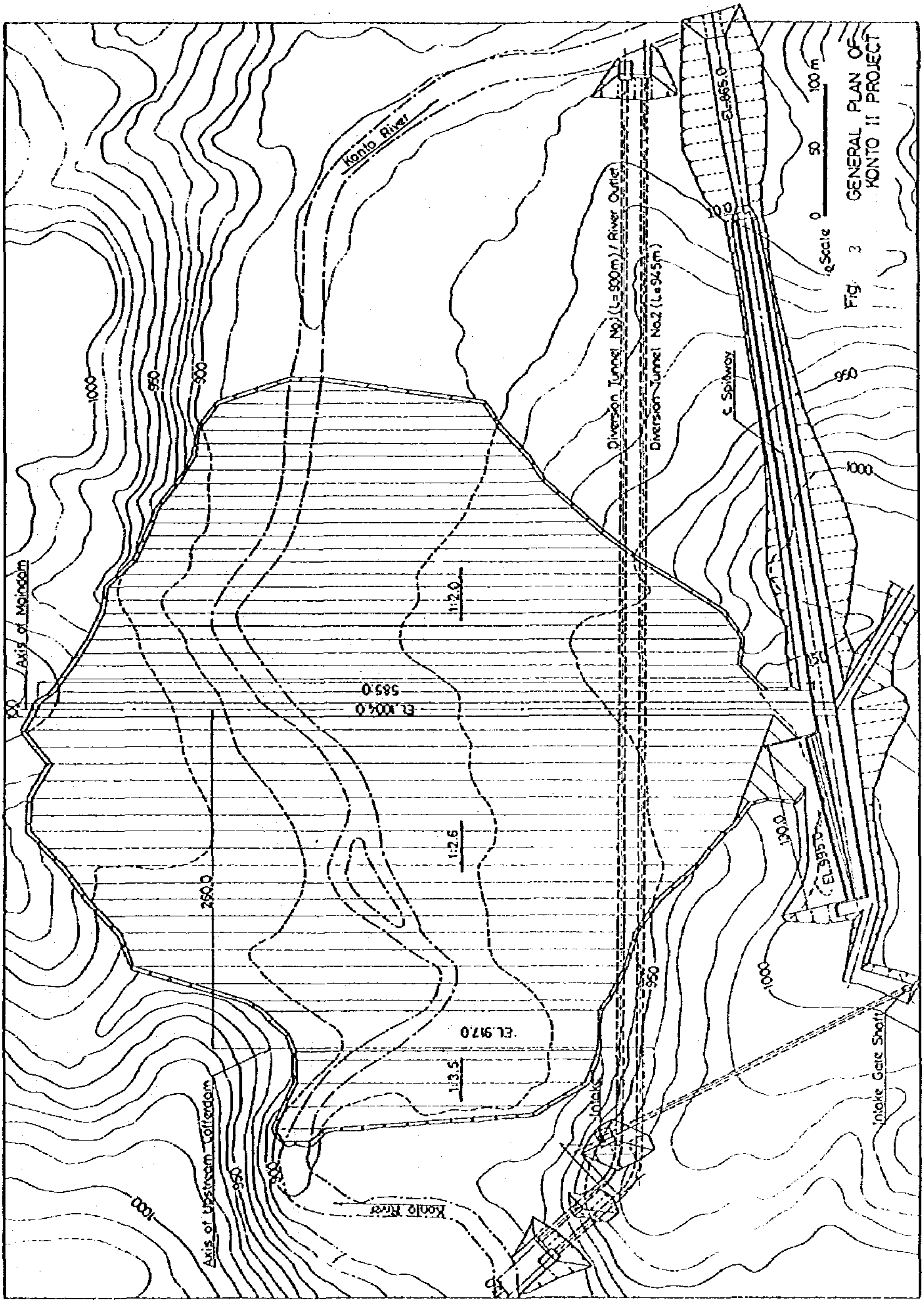


Fig. 3 GENERAL PLAN OF KONTO II PROJECT

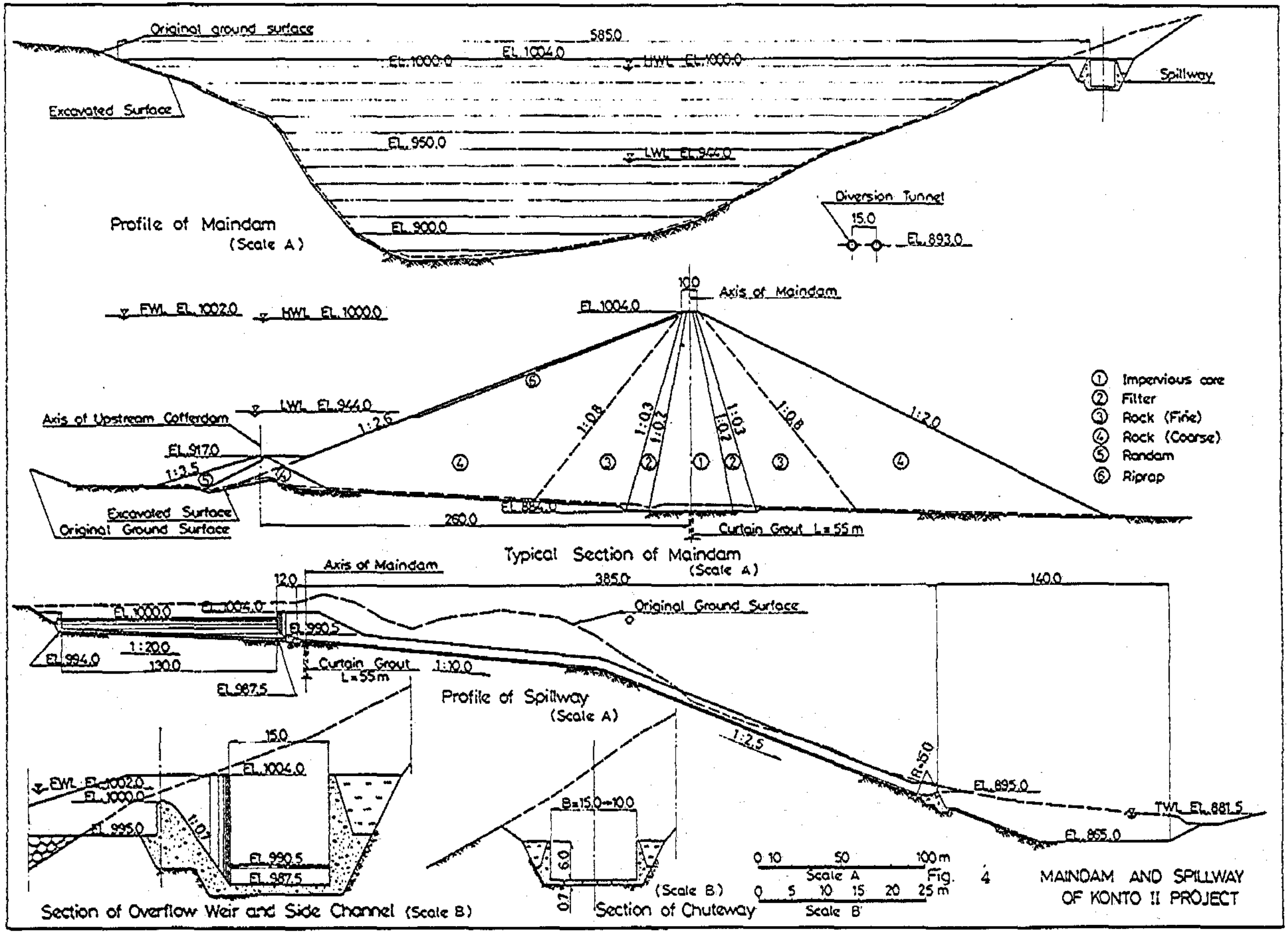
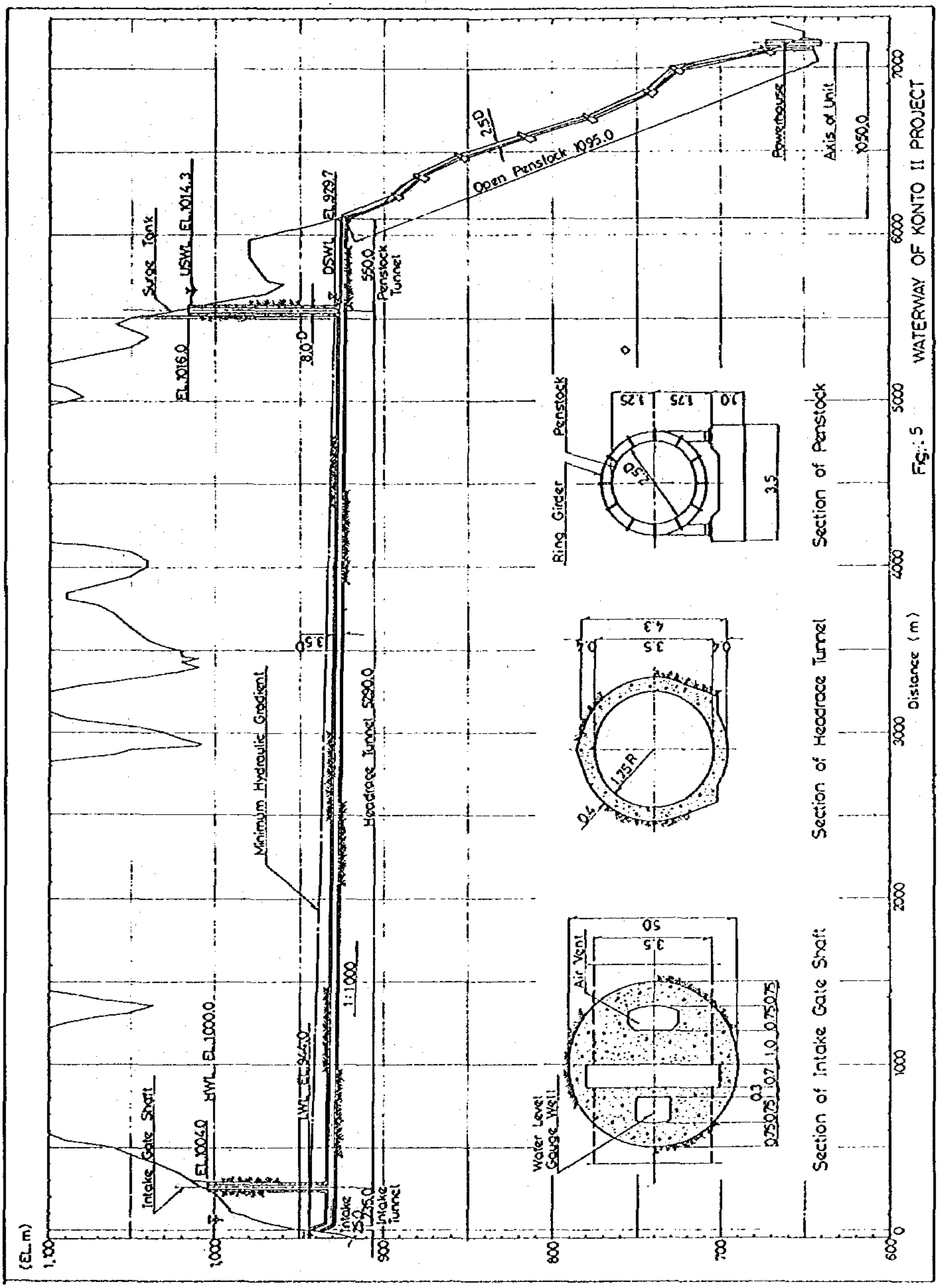


Fig. 4

MAINDAM AND SPILLWAY
OF KONTO II PROJECT



WATERWAY OF KONTO II PROJECT

Fig. 5

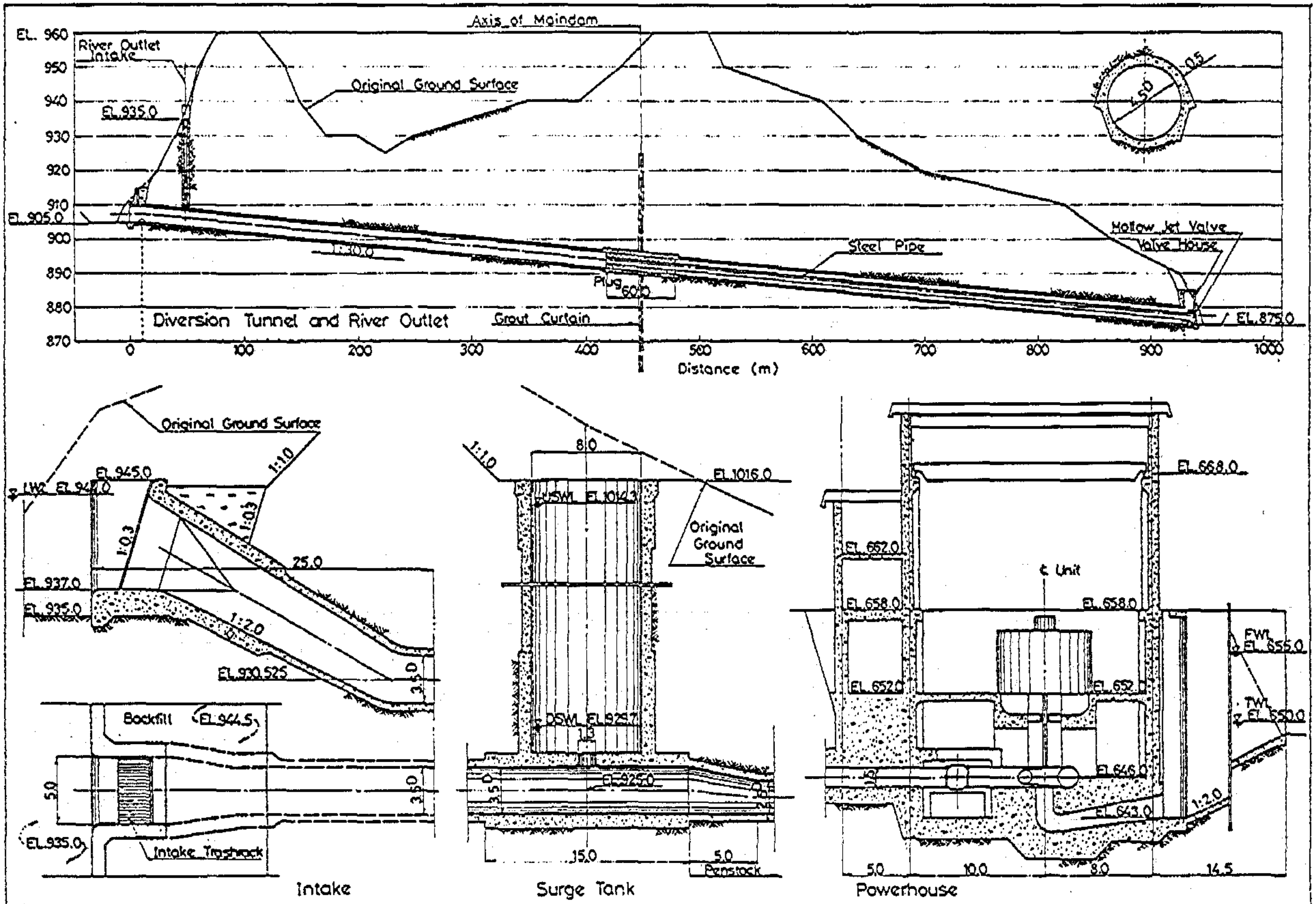


Fig. 6 DIVERSION TUNNEL AND POWER FACILITIES OF KONTO II PROJECT