PREPARATORY SURVEY ON THE

REPUBLIC OF
PHILIPPINES PASIG-POTRERO HYDRO POWER POTENTIAL DEVELOPMENT PROJECT

VOLUME IV

SUPPORTING REPORT

MASTER PLAN STUDY

OCTOBER 1991

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO, JAPAN

FEDERATIVE REPUBLIC OF BRAZIL

THE STUDY ON ITAJAI RIVER BASIN HYDROELECTRIC POWER POTENTIAL INVENTORY PROJECT

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LIST OF VOLUMES

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ABBREVIATIONS

(1) Organizations and Agencies

JICA	:	Japan International Cooperation Agency
ACARESC	:	Associação de Crédito e Assistência Rural de Santa Catarina
CASAN	:	Companhia Catarinense de Águas e Saneamento
CEDEC	:	Coordenação Estadual de Defesa Civil
CELESC	:	Centrais Elétricas de Santa Catarina S.A.
CEPA	:	Instituto de Planejamento e Economia Agrícola de Santa Catarina
CIDASC	:	Companhia Integrada de Desenvolvimento Agrícola de Santa Catarina
DNAEE	:	Departamento Nacional de Águas e Energia Elétrica
DNER	:	Departamento Nacional de Estradas de Rodagem
DER	:	Departamento de Estradas de Rodagem
DNOS	:	Departamento Nacional de Obras de Saneamento
ELETROBRAS	:	Centrais Elétricas Brasileiras S.A.
ELETROSUL	:	Centrais Elétricas do Sul do Brasil S.A.
EMATER	:	Empresa de Assistência Técnica e Extenção Rural
EMBRAPA	:	Empresa Brasileira de Pesquisa Agropecuária
EMPASC	:	Empresa de Pesquisa Agropecuária de Santa Catarina
FATMA	:	Fundação de Amparo à Tecnologia e Meio Ambiente
FGV	:	Fundação Getúlio Vargas
GAPLAN	:	Gabinete de Planejamento e Coordenação Geral
GCPS	:	Grupo Coordenador do Planejamento dos Sistemas Elétricos
IBDF	:	Instituto Brasileiro de Desenvolvimento Florestal
IBGE	:	Instituto Brasileiro de Geografia e Estatística
IBRD	:	International Bank for Reconstruction and Development
ITAG	:	Instituto Técnico de Administração e Gerência
MA	:	Ministério da Agricultura
MDUMA	:	Ministério do Desenvolvimento Urbano e Meio Ambiente
PORTOBRAS	:	Empresa Brasileira de Portos
SAMAE	:	Serviço Autônomo Municipal de Água e Esgoto
SUDEPE	:	Superintendência do Desenvolvimento da Pesca
ITAIPU BINATIONAL	:	Entity for hydropower development of Rio Parana, which was established based on the treaty between Brazil and Paraguay

(2) Abbreviations of Measurement

Length

mm	:	millimeter
cm	:	centimeter
m	:	meter
km	:	kilometer

Area

cm^2	:	square centimeter
m^2	:	square meter
ha	:	hectare
km^2	:	square kilometer

Volume

cm^3	:	cubic centimeter
l	:	liter
m^3	:	cubic meter
MCM	:	million cubic meter

Weight

g	:	gram
kg	:	kilogram
ton	:	metric ton

Electricity

Hz	:	Hertz
kV	:	Kilovolt
MVA	:	Megavolt Ampere
kVA	:	Kilovolt Ampere
MW	:	Megawatt
kW	:	Kilowatt
GWh	:	Gigawatt hour
MWh	:	Megawatt hour
kWh	:	Kilowatt hour
V	:	Volt
W	:	Watt

Time

s or sec	:	second
min	:	minute
h or hr	:	hour
d	:	day
y or yr	:	year

Others

%	:	percent
℃	:	degree centigrade
10^3	:	thousand
10^6	:	million
10^9	:	billion

Derived Measure

m^3/s	:	cubic meter per second

Money

Cr$	:	Cruzeiro
US$	:	US dollar
¥	:	Japanese Yen

(3) **Exchange Rate**

Official rate as of end of June 1990 : US$1 = Cr$61.05 = ¥ 150

(4) **Others**

Socio-economic Technical Terms

GDP	:	Gross Domestic Product
GRDP	:	Gross Regional Domestic Product
GVA	:	Gross Value Added
VA	:	Value Added
PV	:	Production Value

ANNEX I

HYDROLOGICAL SURVEY

ANNEX I. HYDROLOGICAL SURVEY

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1. INTRODUCTION

The hydrological survey aimed to clarify the meteorological and hydrological conditions for the identified hydropower potential sites. To achieve the objectives, the following data collection and analyses for these data were made:

a) Hydrological data collection and compilation of climatic records, rainfall data, water level and discharge data including discharge measurement and hydrograph records, sediment , and results of water quality tests,

b) Establishment of flow discharge duration and storage-draft curves for the identified hydropower potential sites to study the electricpower output of these schemes,

c) Estimation of probable peak flood discharges at the dam sites to design dam facilities and derivation of the flood hydrograph for 1/10000-year probability required for examination of dam safety, and

d) Estimation of annual sediment yield in the Itajai river basin.

2. CLIMATIC AND HYDROLOGICAL DATA

Available data for the hydrological study are shown in Table I.2.1 and the location of the observation stations are given in Fig.I.2.1.

(1) Climate

Climatic observations of a temperature, relative humidity, evaporation, wind velocity and atmospheric pressure have been carried out at 5 observatories in Itajai, Blumenau, Brusque, Indaial, Timbó, and Ituporanga by INMET and EMPASC since 1911 in the Itajai river basin. Of these, the observations at Blumenau and Brusque were stopped at the end of the 1960's.

(2) Rainfall

There are 77 rainfall gauging stations in and around the Itajai river basin at which the daily rainfall amount has been observed at 7 o'clock every morning by DNOS, DNAEE, INMET, CELESC, EMPASC and SOUZA CRUZ. 19 stations are located around the basin and another 58 stations are densely distributed along the Itajai river and its tributaries in the basin. Among the above 77 stations, 6 stations were installed in the 1930's, and 14 stations in the 1940's, and most of others in the 1970's. Since then, the observations at 12 gauging stations have been discontinued.

Hourly rainfall observation was commenced at Indaial city in 1970 and 15 stations are installed in the Itajai river basin at present. 11 stations were constructed after the large flood in July, 1983. Especially, telemetering rainfall and water level gauging stations were constructed by DNAEE at Blumenau, Apiúna, Ibirama, Ituporanga and Taió just after the flood in 1984 and have been operated by CEOPS.

(3) Water level and discharge

Water level observation and discharge measurement were commenced in 1920 and 37 water level gauging stations which are operated by CELESC, DNOS and DNAEE are installed along the Itajai river and its tributaries at present. Water levels at these stations are observed twice a day at seven o'clock in the morning and five o'clock in the evening. Water level observations by an automatic recorder was commenced at Apiúna

on August, 1971. Since then another 6 stations, namely, Rio do Sul Novo, Brusque, Taio, Ituporanga, Ibirama, and Blumenau have been installed and operated.

Discharge measurements are carried out about 10 times a year by current-meter by the above mentioned organizations. Discharge rating curves for converting water levels to discharges are made periodically by using the discharge measurement records.

(4) Sediment

Sediment concentrations of suspended load on the Itajai river and its tributaries have been observed by DNAEE several times a year since 1976 at Rio do Sul, Apiúna, Indaial, Barra do Prata and Brusque. However, in regard of wash and bed loads, no observations have been carried out up to the present.

(5) Water quality tests

Since 1986, DNAEE has conducted water quality tests 2 to 3 times a year at 10 major water level gauging stations along the Itajai river and its tributaries to detect heavy metals and to monitor the water quality of the river water.

3. CLIMATIC AND HYDROLOGICAL CONDITION OF THE ITAJAI RIVER BASIN

3.1 Climate

The mean monthly climatic records at Itajai, Blumenau, Indaial, Ituporanga, Brusque, Timbó are listed in Table I.3.1 and summarized as follows:

The annual mean temperature in the Itajai river basin is 19.7°C at Itajai and 20.1°C at Blumenau in the lower area, and 18.4°C at Ituporanga in the mountainous area. The minimum temperature is 13.2°C at Ituporanga in June and the maximum is 25.5°C at Timbó in January.

The basin mean annual evaporation amount was estimated to be around 800 mm in the Itajai river basin which corresponds to an evaporation rate of 2.2 mm/day. The maximum monthly evaporation amount is 104 mm at Itajai and Timbó which corresponds to an evaporation rate of 3.3 mm/day.

The annual mean relative humidity is 85.7% at Itajai and 77.0% at Indaial which are the maximum and the minimum in the basin. The monthly mean relative humidity from June to August is higher than in other months.

3.2 Rainfall

Fig.I.3.1 shows the isohyetal map of annual mean rainfall in the Itajai river basin established by using the rainfall data for 44 years from 1941 to 1984. The annual rainfall ranges from 1,300 mm to 1,500 mm in the center of the basin and from 1,600 mm to 1,800 mm in the mountainous area of the northern and southern parts of the basin. The basin mean annual rainfall is estimated to be about 1,500 mm to 1,600 mm.

The mean monthly rainfall at several gauging stations in the basin is given in Fig.I.3.2. As shown in the figure, the monthly rainfall amount ranges from 100 mm in March to August to 150 mm in September to February throughout the entire basin. In the figure, the monthly rainfalls in 1983, when the large scale floods frequently occurred in the basin, are also illustrated. In that year, the annual rainfall reached twice of the mean annual rainfall and monthly rainfall in July was over 500 mm.

3.3 Runoff

Monthly discharges at the major water level gauging stations, namely, Ituporanga in the Itajai do Sul river, Taio in the Itajai do Oeste river, Ibirama in the Itajai do Norte river, Timbó in the Benedito river, Brusque in the Itajai Mirim river, Rio do Sul, Apiúna and Indaial in the main stream of Itajai river, are given in Tables I.3.2 to I.3.9. The mean monthly discharges are summarized as follows:

(Unit : m^3/s)

Name of Station	Month												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
Ituporanga	27.2	31.0	24.1	18.3	21.9	24.4	31.8	43.9	42.8	41.2	30.6	26.1	30.3
Taio	35.4	49.6	43.6	23.9	25.9	30.2	30.7	38.7	47.5	52.5	36.7	33.3	37.3
Ibirama	44.1	52.6	48.9	34.6	43.8	52.2	58.7	64.2	70.0	76.2	54.3	52.0	54.3
Timbó	43.1	52.9	47.7	34.2	32.4	31.3	32.0	34.2	38.7	45.4	41.4	38.1	39.2
Brusque	25.2	28.7	25.3	20.5	20.4	20.5	22.8	28.3	28.7	30.1	26.0	24.2	25.1
Rio do Sul	90.9	119	98.7	63.7	74.3	83.7	103	126	141	138	100.9	89.7	103
Apiúna	144	181	159	106	123	144	169	206	222	231	167	150	166
Indaial	200	256	220	153	170	189	211	256	275	296	220	197	220

From the above table, it was defined that the drought season in the Itajai river basin is from March to June, and the wet season from July to February. The average runoff coefficients for annual rainfall based on the above and the preceding isohyetal map of annual rainfall are as follows:

Name of Station	Catchment Area (km^2)	Mean Discharge (m^3/s)	Annual Runoff (mm)	Basin Mean Rainfall (mm)	Runoff Coefficient	Annual Loss (mm)
Ituporanga	1,590	30.3	601	1,590	0.38	989
Taio	1,585	37.3	742	1,560	0.48	818
Ibirama	3,341	54.3	512	1,510	0.34	998
Timbó	1,450	39.2	853	1,620	0.52	767
Brusque	1,220	25.1	649	1,560	0.42	911
Rio do Sul	5,230	103	621	1,530	0.41	909
Apiúna	9,487	166	552	1,510	0.37	958
Indaial	11,491	220	604	1,510	0.40	906

In the above table, the annual losses include the river water consumption as follows:

River Basin	Annual Mean Intake Water (m^3/sec)				Water Volume (mil.m^3)
	Irrigation	Municipal Water	Industrial Water	Total	
Itajai do Sul	0.29	0.08	0.02	0.39	12
Itajai do Oeste	4.05	0.02	0.09	4.16	131
Itajai do Norte	0.17	0.02	0.08	0.27	9
Benedito	2.76	0.03	0.02	2.81	89
Main stream of Itajai (Rio do Sul to Indaial)	1.91	0.02	0.26	2.19	69
Total	9.18	0.17	0.47	9.82	310
Itajai Mirim (upstream of Brusque)	1.55	0.08	0.23	1.86	59

Source : Bacia do Rio Itajai, DNAEE

Water consumption of 310 million m^3 in the upstream river basin, where the identified schemes are located, corresponds to about 2 % of annual rainfall or 4 % of annual runoff at Indaial.

3.4 Flood Flows and Rain Storms

(1) Flood Flows

According to flood records at the main water level gauging stations shown in Table I.3.3, four large scale floods have occurred since construction of Sul and Oeste dams. The recorded flood peak discharge at these stations were as follows:

Name of Station	Flood Peak Discharge (m^3/sec)			
	Dec.1978	Dec.1980	Jul.1983	Aug.1984
Rio do Sul Novo	750	1,290	2,560	2,370
Ibirama	1,010	2,500	2,420	2,130
Timbó	560	690	930	860
Apiúna	2,160	3,090	4,330	4,320
Indaial	2,840	3,700	4,790	5,030
Brusque	600	300	580	990 /1

Remark : /1 : Estimated value in the Itajai River Basin Flood Control Project by JICA

The flood hydrographs at Indaial in 1978,1980, 1983 and 1984 shown in Fig.I.3.3 have a rising phase of 1 to 2 days and a falling phase of 3 to 4 days. The flood in 1983 is characterized by the long duration of the peak flood.

The following table shows the frequency of flood occurrence through a year prepared from the flood records at Indaial:

(Unit : %)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
4	11	4	2	11	7	4	17	11	11	11	7

This shows that there is possibility of flood occurrence in every month of the year though the frequency is comparatively low in January, March, April and July.

(2) Rain Storms

Rain storms which caused the above floods are characterized by regional and hourly rainfall distribution. According to the isohyetal maps of the rain storms for the above mentioned large scale floods as shown in Figs.I.3.4 to I.3.6, heavy rainfall occurs throughout the Itajai river basin and is intensive in the mountainous area of the main tributaries, the Benedito river, the Itajai do Norte river, the Itajai do Oeste river, the Itajai do Sul river and the Itajai Mirim river. In 1984 the rainfall in the Itajai Mirim river basin was around 150 mm a day.

Basin mean 1-day maximum rainfall and mean total rainfall in a rain storm were 110 mm and 124 mm in 1978, 65 mm and 138 mm in 1980, 64 mm and 324 mm in 1983 , and 110 mm and 210 mm in 1984 respectively. Rain storm in 1983 was noteworthy for its great quantity of rainfall (324 mm) as compared to the other storms.

From the hourly rainfall distribution recorded in July 1983 and August 1984 as shown in Figs. I.3.7 and I.3.8, a maximum hourly rainfall of 10 to 25 mm/hour was observed in the basin in 1983 and 1984 and these were not regarded as intensive. The recorded maximum rainfall intensity was 94 mm/hour at Blumenau in March 1965.

3.5 Sediment

A sediment study to establish a wash and suspended loads rating formula was made by using the sediment concentration and flow discharge records up to 1985 at 5 stations on the main stream of the Itajai river and its tributaries by the Itajai River Basin Flood Control Project, and the following formula was derived:

$Qs = 0.096\ Q^{1.759}$

where, Qs : Suspended load (tons / day)

Q : Flow discharge (m^3/sec)

This rating formula was checked by comparing it with the sediment data updated to the end of 1988 as listed in Table I.3.11. The result of the comparison is illustrated in Fig.I.3.9. From the figure, this rating formula is judged to be applicable for estimating the annual sediment yield because of its fit with the actual data.

Based on this formula and the long-term daily mean discharges for 54 years from 1935 to 1988 at Indaial, the annual mean wash and suspended loads were estimated at 879 thousand m^3 tons as shown in Table I.3.12. Assuming the wet density of sediment to be 1.2 tons/m^3, the annual sediment volume was calculated to be about 733 thousand m^3 corresponding to a specific sediment yield of 64 m^3/km^2/year.

Since there are no data on river bed load in the Itajai river, the annual amount of bed load was roughly estimated to be 145 thousand m^3 assuming that 20 % of the wash and suspended loads corresponds to river bed load.

Consequently, the total sediment load at Indaial was estimated as 879 thousand m^3 or 76 m^3/km^2/year.

3.6 Water Quality

The results of chemical analysis made by DNAEE are given in Table I.3.13. Of the test items for water quality, acidity is of importance for estimating the corrosion of such metal structures for hydropower schemes as steel gates in intakes and spillways, penstocks and generation equipment.

According to the above mentioned table, the measured pH value, which is the indicator of acidity, was in the range of 5 to 7.5 in the Itajai river and its tributaries. This range is classified as neutral and it is judged that there will be no adverse effect on corrosion of metal structures.

4. LOW FLOW ANALYSIS

4.1 General Procedure

The identified scheme sites in the inventory study are widely located along the main stream of the Itajai, Trombudo Central (one of the tributaries of the Itajai do Oeste river), Itajai do Norte, Benedito and Itajai Mirim rivers. Since there are no runoff data at the dam sites, it is necessary for low flow analysis to work out the long-term runoff for these schemes based on the data available in the basin. Then, establishment of flow duration curve for run-of-river schemes and storage-draft curves for reservoir schemes based on estimated runoff was also necessary to examine the hydropower potential of each scheme.

To cover these requirements, the following studies were carried out in accordance with work flow diagram as illustrated in Fig.I.4.1:

a) Selection of the key gauge for estimating the flow discharge at the project site,
b) Interpolation of missing daily mean discharge data at the key gauge,
c) Estimation of the daily mean discharge and derivation of monthly mean discharges at the project site based on the hydrological relationship between the key gauge and the project site,
d) Preparation of a flow duration curve based on the estimated daily mean discharges at the project site in the hydrologically critical period, and
e) Estimation of a storage-draft rate curve based on the estimated monthly mean discharges at the project site in the hydrological critical period. In this study, the draft curve is defined as the ratio of firm discharge to mean discharge in the hydrologically critical period.

4.2 Discharge Data at Project Site

4.2.1 Key Gauges

The following gauges were selected as key gauges for the respective identified schemes because these gauges have long term runoff records of more than 40 years and are located near the project site or in the same basin as that for the project sites.

	Name of River	Name of Key Gauge	Available data	Location
a)	Itajai river	Rio do Sul and Rio do Sul Novo	1941 - 1987 (49 years)	Just downstream of confluence of Itajai do Oeste and Itajai do Sul rivers
		Apiúna	1934 - 1987 (54 years)	Downstream of confluence of Itajai do Norte river
		Indaial	1934 - 1988 (54 years)	Downstream of confluence of Benedito river
b)	Itajai do Oeste river	Taio	1934 - 1987 (54 years)	Downstream of Oeste dam
c)	Itajai do Norte river	Ibirama	1934 - 1987 (54 years)	Upstream of confluence of Itajai river
d)	Benedito river	Timbó	1934 - 1987 (54 years)	Confluence of Benedito river and Rio dos Cedros river
e)	Itajai Mirim river	Brusque	1934 - 1988 (55 years)	40 km upstream from confluence of Itajai river

4.2.2 Interpolation of missing daily discharge data

In the runoff data of the above-mentioned seven key gauges, there are several periods in which the data are not available. The runoffs in such period were interpolated by using runoff data at upstream or downstream gauge or the gauge in the neighboring basin, and by multiplying ratio of annual rainfall and catchment area between key gauge and the gauge to runoff data thereof. Water level gauge used for the interpolation and its annual rainfall and catchment area are shown as follows:

	Key Gauge			Gauge used for the interpolation		
	Name of Gauge	Catchment Area(km^2)	Annual Rainfall (mm)	Name of Gauge	Catchment Area (km^2)	Annual Rainfall (mm)
a)	Rio do Sul	5,230	1,530	Apiúna	9,487	1,510
b)	Apiúna	9,487	1,510	Indaial	11,491	1,510
c)	Indaial	11,491	1,510	Apiúna	9,487	1,510
d)	Taio	1,585	1,560	Ituporanga	1,461	1,590
e)	Ibirama	3,341	1,510	Timbó	1,450	1,620
f)	Timbó	1,450	1,620	Benedito Novo	692	1,520
g)	Brusque	1,220	1,560	Ituporanga	1,461	1,590

4.2.3 Estimation of flow discharge at project site

Since there are no discharge data at the project sites, flow discharges at project sites were estimated based on daily mean discharge at the key gauge. In this estimation, the daily mean discharges at the key gauge were converted into those at the project site by using annual rainfall and catchment area of the key gauge and project area as follows:

$$Q_{site} = Q_{key} \cdot (R_{site} / R_{key}) \cdot (A_{site} / A_{key})$$

where;

Q_{site}, R_{site}, A_{site} : daily mean discharge, annual rainfall and catchment area at the project site, respectively.

Q_{key}, R_{key}, A_{key} : daily mean discharge, annual rainfall and catchment area at the key gauge site, respectively.

Annual rainfall and catchment area of the key gauges and project sites are as follows:

Project			Key Gauge		
Name of Scheme	Catchment Area (km^2)	Annual Rainfall (mm)	Name of Gauge	Catchment Area (km^2)	Annual Rainfall (mm)
Itajai river					
1. Salto Pilao (1)	5,597	1,530	Rio do Sul	5,230	1,530
2. Salto Pilao (2)	5,597	1,530	Rio do Sul	5,230	1,530
3. Ibirama	9,041	1,510	Apiúna	9,487	1,510
4. Subida	9,147	1,510	Apiúna	9,487	1,510
5. Ascurra	9,586	1,510	Apiúna	9,487	1,510
6. Indaial	11,493	1,500	Indaial	11,491	1,500
Itajai do Norte river					
7. Dalbergia	3,212	1,520	Ibirama	3,341	1,510
8. Barra da Pratinha	1,405	1,620	Ibirama	3,341	1,510
9. Barra das Pombas	979	1,670	Ibirama	3,341	1,510
Benedito river					
10. Timbó	765	1,510	Timbó	1,450	1,620
11. Benedito Novo	586	1,510	Timbó	1,450	1,620
12. Alto Benedito Novo	473	1,520	Timbó	1,450	1,620
13. Doutor Pedrinho	161	1,550	Timbó	1,450	1,620
Itajai do Oeste river					
14. Trombudo Central (1)	293	1,550	Taio	1,585	1,560
15. Trombudo Central (2)	117	1,550	Taio	1,585	1,560
Itajai Mirim river					
16. Botuvera	625	1,560	Brusque	1,220	1,560

The monthly mean discharge at the project site derived from the estimated daily mean discharge is shown in Tables I.4.1 to I.4.15.

4.3 Flow Duration and Storage - Draft Curves

4.3.1 Flow Duration Curve

Flow duration curve, which is used to determine the development scale of run-of-river type scheme, was established by arranging daily mean discharge in the critical period from April 1949 to November 1956.

Fig.I.4.2 gives the flow duration curves for the schemes and the following table shows several excess percentages:

(Unit : m^3/sec)

Name of Scheme	Max.	Percentage against 365 days						
		10%	25%	50%	75%	97%	100%	Mean
1. Salto Pilao (1)	1,498	204	102	53.1	31.6	11.9	7.3	91.1
2. Salto Pilao (2)	1,498	204	102	53.1	31.6	11.9	7.3	91.1
3. Ibirama	2,411	281	147	76.5	47.2	18.9	11.2	130
4. Subida	2,439	284	149	77.4	47.8	19.0	11.4	132
5. Ascurra	2,556	298	157	81.1	50.0	19.9	11.9	138
6. Indaial	3,760	388	196	109	66.4	28.4	17.0	177
7. Dalbergia	894	82.8	40.7	20.8	11.9	3.9	1.2	38.7
11. Benedito Novo	174	20.6	12.4	7.6	5.1	2.4	1.9	11.3
12. Alto B. Novo	141	16.7	10.1	6.2	4.2	2.0	1.5	9.2

4.3.2 Storage-Draft Curve

Storage-draft curve is needed to determine the relationship between the draft rate and required effective storage volume in reservoir type scheme. The storage-draft curve for each reservoir scheme was established through mass curve analysis using monthly mean discharge for the critical period from April 1949 to November 1956 at the project site. The mass curve analysis was made assuming draft rate from 10 % to 100 % with in intervals of 10 %.

Fig I.4.3 shows the storage-draft curves for reservoir type schemes.

5. FLOOD RUNOFF ANALYSIS

5.1 General Procedures

According to the design criteria of diversion and spillway facilities for run-of-river and reservoir type schemes as described in ANNEX VI, the design scale of the spillway facilities is the 200-year probable flood for a concrete dam and 1.2 times the 200-year probable flood for a fill type dam without allowance for the retardation effects of reservoir and flood control effects of the existing Sul, Oeste and Norte dams assuming a rain storm with a long duration as long as in 1983 would fill the storage volume up to flood water level and that a design flood occurs in the project area at that time. The diversion facility is based on a 2-year probable flood for a concrete dam and a 20-year probable flood for a fill type dam under the same conditions.

As for reservoir schemes having a dam height of about 40 m to 100 m, dam safety is examined by using 10000-year probable flood hydrograph which is the design scale in Brazil (Manual de Inventario Hidreletrico de Bacias Hidrograficas, ELETROBRAS) and is considered to correspond to possible maximum flood in general.

Flood runoff analysis was made to estimate the probable peak flood discharges for several return periods for design of diversion and spillway facilities, and to derive the 10000-year probable flood hydrograph for checking dam safety for reservoir schemes to meet the above-mentioned design criteria.

The key gauge records include not only daily mean discharge over 40 years but also the annual maximum flood discharges.

The probable peak flood discharges were estimated by the following procedures which are illustrated in Fig. I.5.1 and using the recorded annual maximum discharges.

a) Estimation of probable peak flood discharges at key gauge site,
b) Establishment of relationship between catchment area and specific discharges of the estimated probable peak flood, and
c) Estimation of probable peak flood discharge using catchment area of the schemes and the relationship obtained in the above.

10,000-year probable flood hydrograph was derived through simulation study based on rainfall data as shown Fig.I.5.1. In the simulation study, the following analysis were carried out:

a) Estimate of basin mean 10000-year probable rainfall in the project catchment area,
b) Preparation of typical hyetgraph for probable rainfall, and
c) Simulation of 10000-year probable flood hydrograph using the storage function model established in the Itajai River Basin Flood Control Project by JICA, and inputting the hyetgraph of the probable rainfall into the model.

5.2 Probable Peak Flood Discharge based on the Flood Records

5.2.1 Frequency analysis

Frequency analysis was carried out for the annual maximum peak floods in Table I.3.3 by means of Pearson's third type distribution method. The data in the Itajai and the Itajai do Oeste rivers after the year of 1972 and in the Itajai do Sul river after 1975 include the flood retardation effect of the existing flood control dams. Therefore, these are excluded in the said frequency analysis in order to estimate the probable peak flood discharges under the condition without flood control effect. While, the flood control project studied the peak flood discharges and its hydrograph for the floods in 1978, 1980, 1983 and 1984 establishing simulation model. The results for these floods in the study were used for the frequency analysis since these have large magnitude corresponding to 10-year to 50-year probability. The estimated peak flood discharges are as follows:

Name of Station	Peak Flood Discharge (m^3/sec)			
	Dec.1978	Dec.1980	Jul.1983	Aug.1984
Rio do Sul Novo	1,260	1,840	2,640	3,130
Apiúna	2,300	3,480	4,740	4,700
Indaial	2,920	4,230	5,710	5,520
Ituporanga	460	690	1,540	1,420

Fig.I.5.2 shows the frequency curve of the annual maximums and the estimated probable peak flood discharges and their specific discharges are listed in Table I.5.1.

5.2.2 Relationship between specific peak flood discharge and catchment area

In order to estimate the probable peak flood discharge at the project site based on the catchment area at the project site, the relationship between the specific probable flood discharge and the catchment area was examined using the results of the mentioned frequency analysis and the following equation:

$$q = C \cdot A^{(n-1)}$$

where, q : specific peak flood discharge ($m^3/sec/km^2$)

A : catchment area (km^2)

C and n : constant

Constants of C and n were determined from the envelopment curve of each probable flood as shown in Fig.I.5.3. Consequently, n was set at 0.6 and C is as follows:

Return Period (Years)	C
2	6
5	10
10	15
20	18
50	24
100	27
200	32

5.2.3 Probable peak flood discharge at project site

Probable peak flood discharges were estimated based the established formula and catchment area of the project. The result is shown in Table I.5.2 and summarized as follows:

(Unit : m^3/sec)

Name of Scheme	Return Period (Years)		
	2	20	200
1. Salto Pilao (1)	1,300	3,200	5,700
2. Salto Pilao (2)	1,300	3,200	5,700
3. Ibirama	1,700	4,300	7,600
4. Subida	1,700	4,300	7,700
5. Ascurra	1,800	4,500	7,900
6. Indaial	2,000	5,000	8,800
7. Dalbergia	890	2,300	4,100
8. Barra da Pratinha	550	1,400	2,500
9. Barra das Pombas	440	1,200	2,000
10. Timbó	380	1,000	1,800
11. Benedito Novo	330	900	1,500
12. Alto Benedito Novo	290	800	1,300
13. Doutor Pedrinho	150	380	680
14. Trombudo Central (1)	220	550	1,000
15. Trombudo Central (2)	130	320	560
16. Botuvera	340	810	1,600

5.3 Flood Hydrograph Analysis

5.3.1 Simulation model

For the estimate of 10000-year probable flood hydrograph of the project sites, mathematical simulation method based on rainfall data is usually applied. In the Itajai river basin, the flood control project by JICA established the simulation model by means of the storage function developed in Japan. The model was resulted through calibration using rainfall and flood records during the major floods in 1978, 1980, 1983 and 1984 after the construction of Sul and Oeste dams.

The above simulation model mainly consists of:

a) Basin model which converts rainfall into flood discharge from a basin,
b) River channel model which enables to express retardation effect in a river channel and flooding in a inland area, and
c) Model for flood control facilities.

Estimate of 10000-year probable flood hydrograph for reservoir schemes, which are located in the mountainous area, was carried out by the above basin model because the riverbed slope is rather steep in the catchment area of the project and the retardation effect of the river channel is judged to be negligible.

The basin model is expressed by the following equation:

$$S = K \cdot Q^{P}$$

$$dS/dt = (1 / 3.6) \cdot f \cdot r \cdot A - Q$$

Where,

S	:	basin storage (m^3)
Q	:	runoff from basin except base flow (m^3/ sec)
K and P	:	constants
t	:	time (sec)
f	:	runoff coefficient
r	:	basin mean rainfall (mm/hr)
A	:	catchment area (km^2)

Constants of K, P in the equation were estimated by the following formula which are described by average river bed slope in a basin and used for the flood control project:

$$K = 1.3 \cdot 118.84 \cdot i^{0.3}$$

$$P = 0.175 \cdot i^{-0.235}$$

Where, i : average river bed slope

As shown in the above formula, the following inputs are required to work out the probable flood hydrograph:

a) Average riverbed slope of the project river basin to estimate the coefficients K and P,
b) Runoff coefficient during flood,
c) Base flow, and
d) Basin mean probable rainfall by a calculation interval (mm),

Details of the above are described in the following sections.

5.3.2 Inputs to the simulation model

(1) Basin Model

An average riverbed slope of the river basin for each reservoir type scheme was estimated based on the topographic map at a scale of 1:50,000. The coefficients of K and P for each basin are as follows:

No.	Name of Scheme	Average Riverbed Slope	Coefficient K	P
8.	Barra da Pratinha	1/250	29	0.641
9.	Barra das Pombas	1/300	28	0.669
10.	Timbó	1/60	45	0.458
13.	Doutor Pedrinho	1/30	56	0.389
14.	Trombudo Central (1)	1/350	27	0.693
15.	Trombudo Central (2)	1/200	32	0.609
16.	Botuvera	1/145	36	0.564

(2) Runoff coefficient

The runoff coefficients during floods was studied by using rainfall and runoff data during large scale floods in 1978, 1980, 1983 and 1984 in the flood control project. Since there have been no large scale floods corresponding to the preceding floods after the flood in 1984, the results of the study for the flood control project are applied to this study.

Fig.I.5.4 shows the relationship between flood runoff depth and rainfall amount during the preceding four floods. From the figure, a preliminary runoff coefficient was set at 0.5, and the saturated rainfall, which is the turning point from preliminary runoff coefficient, was set at 200 mm.

(3) Base flow

The annual mean discharge was adopted as the base flow at each project site as follows:

No.	Name of Scheme	Base Flow (m^3/s)
8.	Barra da Pratinha	24.5
9.	Barra das Pombas	17.6
10.	Timbó	19.9
13.	Doutor Pedrinho	4.3
14.	Trombudo Central (1)	6.9
15.	Trombudo Central (2)	2.7
16.	Botuvera	12.9

(4) Basin mean probable rainfall

a) Duration of probable rainfall

Fig.I.5.5 shows the relationship between duration and basin mean daily rainfall in 1978 and 1980, and the mathematical average of hourly rainfall in 1983 and 1984. Table I.5.3 shows the basin mean annual maximum rainfall of 4 days / 7 days from 1951 to 1984. These figures and the table indicate that more than 70 % of the rainfall tends to fall within 4 days and this rainfall tends to induce floods. On the basis of these observations, 4 days was adopted as the duration of probable rainfall.

b) Typical hyetograph

To establish the typical hyetograph, the relationship between rainfall intensity and duration was examined by using hourly rainfall data at Saltinho, Rio do Sul, Timbó Grande and Doutor Pedrinho during rain storms in 1983 and 1984 and Blumenau in 1965. Fig.I.5.6 shows the result and related formula enveloping the plotted data, which is made by using a Talbot type formula as follows:

$$I_t = R_{4\text{-day}} \cdot \{ 10.57 / (t^{0.8} + 4.16) \}$$

where, I_t : rainfall intensity (mm/hr)

$R_{4\text{-day}}$: rainfall amount for 4 days

t : time (hour)

Fig.I.5.7 shows the relationship between cumulative rainfall for 4 days at the above-mentioned stations and duration during the floods in 1983 and 1984. This figure indicates that about 60 % to 70 % of the 4-day rainfall intends to fall within 24 to 60 hours from the start of rainfall.

The typical hyetograph was prepared based on the equation given above and the rainfall characteristics shown in Fig.I.5.8.

c) Probable basin mean 4-day rainfall

The river basins of the reservoir schemes are located in mountainous areas, where there are no rainfall gauging stations or the observation period of rainfall data is limited even if there is a station. The basin mean rainfall, therefore, was estimated

from rainfall data at a rain gauge with a long-term observation period and located near the project area.

Rainfall data at a gauge were converted into the basin mean rainfall by using a relationship between basin mean and point rainfalls based on the isohyetal map of the rain storms.

The following rainfall gauges were selected for estimating the probable basin mean rainfall for the reservoir schemes because of their locations and observation periods:

No.	Name of Scheme	Rainfall Gauge	
		Name	Period (year)
8.	Barra da Pratinha	Ibirama	1934 to 1989
9.	Barra das Pombas	-ditto-	-ditto-
10.	Timbó	Timbó	1929 to 1989
13.	Doutor Pedrinho	-ditto-	-ditto-
14.	Trombudo Central (1)	Trombudo Central	1946 to 1988
15.	Trombudo Central (2)	-ditto-	-ditto-
16.	Botuvera	Brusque	1941 to 1989

Based on daily rainfall data at the above stations, the annual maximum 4-day rainfalls were obtained as listed in Table I.5.4. 10000-year probable rainfall was then derived from the annual maximum series and by means of Pearson's third type distribution method as shown in Fig.I.5.9. The result was as follows:

Name of Station	10000-year Probable 4-day Rainfall (mm)
Trombudo Central	710
Ibirama	440
Timbó	420
Brusque	480

Usually, it is said that basin mean rainfall intensity decreases with the spread of the rainy area. The isohyetal maps of rain storms in Figs.I.3.4 to I.3.6 provide evidence of this hydrological common sense. Fig.I.5.10 shows the relationship between basin mean and point rainfalls during the rain storms. Developing the envelopment curve against the plotted data, the relationship between the basin mean rainfall and the point rainfall is expressed by the following equation:

$$P / P_0 = \exp (-1.54 \times 10^{-3} \cdot A^{0.45})$$

where, P : basin mean 4-day rainfall (mm)

P_0 : point 4-day rainfall (mm)

A : area (km2)

From the above, area reduction factors (P/P_0) for the river basin of reservoir schemes were estimated as follows:

No.	Name of Scheme	Catchment Area (km^2)	P/P_0	10000-year Basin Mean Rainfall (mm/4-day)
8.	Barra da Pratinha	1,405	0.96	420
9.	Barra das Pombas	979	0.97	425
10.	Timbó	765	0.97	410
13.	Doutor Pedrinho	161	0.98	410
14.	Trombudo Central (1)	293	0.98	700
15.	Trombudo Central (2)	117	0.99	710
16.	Botuvera	625	0.97	465

The probable basin mean rainfall with a return period of 10000 years were estimated from these area reduction factor and probable point rainfall as shown in the above table.

5.3.3 10000-year probable flood hydrograph

Based on the mentioned inputs and the simulation model, flood hydrograph with recurrence period of 10000 years were worked out as shown in Fig.I.5.11. The flood peak discharge and volume for these hydrographs are as follows:

No.	Name of Scheme	Catchment Area (km^2)	Flood Peak Discharge (m^3/s)	Flood Volume (mil. m^3)
8.	Barra da Pratinha	1,405	6,100	450
9.	Barra das Pombas	979	4,100	318
10.	Timbó	765	3,800	237
13.	Doutor Pedrinho	161	900	50
14.	Trombudo Central (1)	293	2,800	179
15.	Trombudo Central (2)	117	1,400	71
16.	Botuvera	625	3,500	228

TABLES

Table I.2.1 LIST OF DATA COLLECTED (1/3)

	Name of Station	No.	Institute	Type of Data	Period
(A)	Climate				
	1) Itajai	02648024	EMPASC	Daily	1981 to 1987
	2) Itajai	02648024	EMPASC	Monthly	1986 to 1989
	3) Blumenau		INMET	Monthly	1911 to 1969
	4) Brusque		INMET	Monthly	1911 to 1966
	5) Indaial		INMET	Monthly	1971 to 1984
	6) Ituporanga		INMET/ EMPASC	Monthly	1979 to 1989
	7) Timbó		INMET	Monthly	1955 to 1969
(B)	Rainfall				
	1) Ilhota	02648001	DNAEE	Daily	1928 to Jan.1989
	2) Luiz Alves	02648002	DNAEE	Daily	1938 to 1989
	3) Post Estrada Blumenau KM18	02648003	DNOS	Daily	1985 to Jan.1989
	4) Itajai	02648008	DNOS	Daily	1968 to 1989
	5) Itajai	02648024	EMPASC	Daily	1981 to Jan.1989
	6) Warnow	02649001	DNAEE	Daily	1935 to 1989
	7) Pomerode	02649002	DNAEE	Daily	1928 to 1989
	8) Benedito Novo	02649003	DNAEE	Daily	1935 to 1989
	9) Timbo	02649004	DNAEE	Daily	1928 to 1989
	10) Indaial	02649005	DNAEE	Daily	1935 to 1989
	11) Blumenau	02649007	DNAEE	Daily	1945 to 1989
	12) Blumenau	02649007	DNAEE	Hourly	1985 to 1988
	13) Arrozeira	02649008	DNAEE	Daily	1941 to 1989
	14) Garcia	02649009	DNAEE	Daily	1941 to 1989
	15) Itoupava Central	02649010	DNAEE	Daily	1941 to 1989
	16) Doutor Pedrinho	02649017	DNAEE	Daily	1953 to 1989
	17) Usina Salto	02649025	CELESC	Daily	1985 and 1989
	18) Timbo	02649026	CELESC	Daily	1985 and 1989
	19) Indaial	02649027	CELESC	Daily	1985 and 1989
	20) Usina Cedros	02649030	CELESC	Daily	1988 and 1989
	21) Pinhal	02649031	CELESC	Daily	1985 and 1989
	22) Usina Palmeiras	02649032	CELESC	Daily	1985 and 1989
	23) Indaial 83872	02649038	INEMET	Daily	1985
	24) Hering	02649052	-	Daily	1985
	25) Witmarsum	02649053	DNAEE	Daily	1976 to 1989
	26) Moema	02649054	DNAEE	Daily	1976 to 1989
	27) Corredeira	02649055	DNAEE	Daily	1976 to 1989
	28) Itaiopolis	02649056	DNAEE	Daily	1976 to 1989
	29) Barra do Prata	02649058	DNAEE	Daily	1977 to 1989
	30) Barragem Norte	02649061	DNOS	Daily	1976 to 1989
	31) Barra do Avencal	02649065	DNAEE	Daily	1985 to 1989
	32) Salto Canhoinas	02650000	DNAEE	Daily	1951 to 1988
	33) Rio do Campo	02650014	DNAEE	Daily	1976 to 1989
	34) Monte Castelo	02650015	DNAEE	Daily	1976 to 1988
	35) Santa Cecilia	02650016	DNAEE	Daily	1976 to 1988
	36) Picarras	02650019	DNAEE	Daily	1986 to 1989
	37) Iracema	02650022	DNAEE	Daily	1985 to 1989
	38) Nova Cultura	02650023	DNAEE	Daily	1985 to 1989
	39) Brusque	02748000	DNAEE	Daily	1941 to 1989
	40) Major Gercino	02748001	DNAEE	Daily	1945 to 1989
	41) Nova Trento	02748002	DNAEE	Daily	1945 to 1989
	42) Garcia	02748003	DNAEE	Daily	1929 to 1989
	43) Apiuna-Tele.	02749000	DNAEE	Daily	1984 to 1989
	44) Ibirama-Tele.	02749001	DNAEE	Daily	1934 to 1989
	45) Ituporanga-Tele.	02749002	DNAEE	Daily	1984 to 1989
	46) Taio-Tele.	02749003	DNAEE	Daily	1984 to 1989
	47) Jararaca	02749004	DNAEE	Daily	1941 to 1989
	48) Nova Bremen	02749005	DNAEE	Daily	1941 to 1989
	49) Pouso Redondo	02749006	DNAEE	Daily	1941 to 1989
	50) Lomba Alta	02749007	DNAEE	Daily	1941 to 1980
	51) Rio do Sul	02749008	DNAEE	Daily	1941 to 1983
	52) Lages	02749009	DNAEE	Daily	1959 to 1963
	53) Pres. Getulio	02749011	DNAEE	Daily	1941 to 1989
	54) Trombudo Central	02749013	DNAEE	Daily	1945 to 1989

Table I.2.1 LIST OF DATA COLLECTED (2/3)

Name of Station	No.	Institute	Type of Data	Period
55) Barracao	02749014	DNAEE	Daily	1941 to 1976
56) Fazenda boa Esperanca	02749015	DNAEE	Daily	1955 to 1989
57) Neisse Central	02749016	DNAEE	Daily	1956 to 1989
58) Barragem Sul	02749017	DNOS	Daily	1971 to 1989
59) Barragem Oeste	02749018	DNOS	Daily	1966 to 1989
60) Rancho Queimado	02749020	DNAEE	Daily	1976 to 1989
61) Ibirama	02749022	CELESC	Daily	1945 to 1989
62) Pregidente Getulio	02749023	CELESC	Daily	1985 to 1989
63) Rio do Sul	02749024	CELESC	Daily	1946 to 1989
64) Apiuna	02749025	DNAEE	Daily	1951 to 1989
65) *Anitapolis*	02749027	DNAEE	Daily	1950 to 1989
66) Santa Clara	02749032	DNAEE	Daily	1959 to 1989
67) Vidal Ramos	02749033	DNAEE	Daily	1976 to 1989
68) Loberto Leal	02749034	DNAEE	Daily	1976 to 1989
69) Saltinho	02749037	DNAEE	Daily	1976 to 1989
70) Botuvera	02749038	DNAEE	Daily	1985 to 1989
71) Rio do Sul Novo	02749039	DNAEE	Daily	1977 to 1989
72) Agrolandia	02749041	DNAEE	Daily	1983 to 1988
73) Agrolandia	02749042	EMPASC	Daily	1985 and 1989
74) Ituporanga	02749043	EMPASC	Daily	1985 and 1989
75) Lages	02750005	DNAEE	Daily	1985 to 1989
76) Ponte Alta do Sul	02750011	DNAEE	Daily	1985 to 1989
77) Cabeceira Ribeirao *Caetano*	02750021	DNAEE	Daily	1985 to 1989
78) Itajai	02648024	EMPASC	Hourly	1984 to 1989
79) Blumenau	02649007	DNAEE	Hourly	1984 to 1989
80) Doutor Pedrinho	02649017	DNAEE	Hourly	1981 to 1989
81) Indaial	02649038	INMET	Hourly	1970 to 1989
82) Barra do Prata	02649058	DNAEE	Hourly	1984 to 1989
83) Barragem Norte	02649061	DNOS	Hourly	1984 to 1989
84) Rio do Campo	02650014	DNAEE	Hourly	1984 to 1989
85) Apiuna	02749000	DNAEE	Hourly	1984 to 1989
86) Ibirama	02749001	DNAEE	Hourly	1984 to 1989
87) Ituporanga	02749002	DNAEE	Hourly	1984 to 1989
88) Taio	02749003	DNAEE	Hourly	1984 to 1989
89) Barragem Sul	02749017	DNOS	Hourly	1984 to 1989
90) *Saltinho*	02749037	DNAEE	Hourly	1984 to 1989
91) Rio do Sul	02749039	DNAEE	Hourly	1977 to 1989
92) Barragem Oeste	02749018	DNOS	Hourly	1984 to 1989
(C) Water level and discharge records				
Main stream of Itajai river				
1) Rio do Sul	83300002	DNAEE	Daily D/W	1941 to 1980
2) Rio do Sul Novo	83300200	DNAEE	Daily D/W	1977 to 1989
3) Subida	83460000	DNAEE	Daily W	1929 to 1940
4) Apiuna	83500002	DNAEE	Daily D/W	1934 to 1989
5) Warnow	83520000	DNAEE	Daily W	1927 to 1985
6) Indaial	83690000	DNAEE	Daily D/W	1934 to 1989
7) Passo Manso	83700000	DNAEE	Daily W	1931 to 1967
8) *Itoupava Seca*	83780000	DNAEE	Daily D/W	1927 to 1954
9) Blumenau	83800002	DNAEE	Daily W	1939 to 1985
10) Gaspar	83840000	DNAEE	Daily W	1927 to 1966
11) Ilhota	83860000	DNAEE	Daily W	1927 to 1985
Tributary				
Itajai Mirim River				
12) Brusque	83900000	DNAEE	Daily D/W	1934 to 1989
Luis Alves River				
13) Luis Alves	83880000	DNAEE	Daily D/W	1934 to 1989
Testo River				
14) Rio do Testo	83720000	DNAEE	Daily D/W	1934 to 1967
Garcia River				
15) Garcia	83820000	DNAEE	Daily D/W	1934 to 1967
Benedito River				
16) Benedito Novo	83660000	DNAEE	Daily D/W	1934 to 1989
17) Timbó	83680000	DNAEE	Daily D/W	1934 to 1989

Table I.2.1 LIST OF DATA COLLECTED (3/3)

Name of Station	No.	Institute	Type of Data	Period
(C) Water Level and Discharge				
Itajai do Norte River				
18) Barra do Prata	83345000	DNAEE	Daily D/W	1977 to 1984
19) Nova Bremen	83421000	DNAEE	Daily W	1928 to 1967
20) Ibirama	83440000	DNAEE	Daily D/W	1934 to 1989
21) Barragem Norte	83349400	DNOS	Daily W	1977 to 1984
Neisse River				
22) Neisse Central	83480000	DNAEE	Daily D/W	1942 to 1966
Itajai do Oeste River				
23) Taio	83050000	DNAEE	Daily D/W	1934 to 1989
24) Barragem Oeste	83030000	DNOS	Daily W	1971 to 1984
Itajai do Sul River				
25) Barracao	83100000	DNAEE	Daily D/W	1955 to 1975
26) Saltinho	83105000	DNAEE		
27) Jararaca	83120000	DNAEE	Daily D/W	1930 to 1950
28) Barragem Sul	83145000	DNOS	Daily W	1971 to 1984
29) Ituporanga	83250000	DNAEE	Daily D/W	1934 to 1989
30) Rio do Sul	83300000	DNAEE	Daily W	1955 to 1975
Pombas River				
31) Pouso Redondo	83060000	DNAEE	Daily D/W	1934 to 1967
Trombudo Central River				
32) Trombudo Central	83070000	DNAEE	Daily D/W	1942 to 1967
Adaga River				
33) Barracao	83095000	DNAEE	Daily W	1962 to 1967
Kranel River				
35) Presidente Getulio	83401000	DNAEE	Daily W	1929 to 1963
Cedros River				
36) Arrozeira	83675000	DNAEE	Daily D/W	1941 to 1985
Itoupava River				
37) Itoupava	83760000	DNAEE	Daily W	1929 to 1943
Telemetering Stations				
38) Blumenau-Tele.		DNAEE	Hourly D/W	1984 to 1989
39) Apiuna-Tele.		DNAEE	Hourly D/W	1984 to 1989
40) Ibirama-Tele.		DNAEE	Hourly D/W	1984 to 1989
41) Ituporanga-Tele.		DNAEE	Hourly D/W	1984 to 1989
42) Taio-Tele.		DNAEE	Hourly D/W	1984 to 1989
43) Rio do Sul-Tele.		DNAEE	Hourly D/W	1984 to 1989
(D) Sediment				
1) Iadaial		DNAEE	Concentration	1976 to 1988
2) Apiuna		DNAEE	Concentration	1981 to 1988
3) Rio do Sul Novo		DNAEE	Concentration	1979 to 1988
4) Barra do Prata		DNAEE	Concentration	1979 to 1988
5) Brusque		DNAEE	Concentration	1977 to 1988
(E) Result of Water Quality Test				
1) Blumenau		DNAEE		1986 to 1989
2) Indaial		DNAEE		1986 to 1989
3) Gaspar		DNAEE		1986 to 1989
4) Ilhota		DNAEE		1986 to 1989
5) Ituporanga		DNAEE		1986 to 1989
6) Rio do Sul		DNAEE		1986 to 1989
7) Taio		DNAEE		1986 to 1989
8) Ibirama		DNAEE		1986 to 1989
9) Timbo		DNAEE		1986 to 1989
10) Brusque		DNAEE		1987 to 1989

Table I.3.1 CLIMATIC FEATURES IN THE ITAJAI RIVER BASIN

(1) Temperature

Unit : °C

Name of Station	Month												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
Itajai	24.5	24.5	23.3	21.2	18.2	15.5	15.5	15.0	16.4	17.5	19.3	21.6	19.4
Blumenau	24.5	24.4	23.2	21.0	18.1	16.3	15.5	16.4	17.9	19.6	21.5	23.4	20.2
Indaial	24.5	24.7	23.8	21.0	18.9	15.6	15.8	16.9	17.9	20.1	21.8	23.8	20.4
Ituporanga	22.9	23.4	21.9	18.8	17.0	13.8	13.2	14.6	15.2	17.7	20.2	21.8	18.4
Brusque	24.4	24.1	23.2	20.5	17.8	15.7	15.1	16.0	17.6	19.3	21.2	23.0	19.8
Timbó	25.5	24.4	23.3	20.9	17.5	15.7	15.5	16.6	18.1	20.4	21.9	23.2	20.3

(2) Evaporation

Unit : mm

Name of Station	Month												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Itajai	104	82	79	58	60	61	53	41	68	77	82	94	859
Blumenau	59	50	54	43	38	31	34	38	39	47	53	61	547
Indaial	97	75	71	67	63	50	57	59	61	79	89	94	862
Ituporanga	69	65	75	51	41	39	47	56	59	78	103	90	773
Brusque	75	58	63	65	41	34	38	40	37	50	62	68	631
Timbó	104	86	76	64	59	44	50	58	57	77	90	97	862

(3) Relative Humidity

Unit : %

Name of Station	Month												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
Itajai	83.2	85.6	85.0	87.3	87.8	88.1	89.4	87.9	84.8	82.5	82.8	83.7	85.7
Blumenau	82.1	83.7	84.3	85.1	85.8	87.2	86.2	85.2	85.2	83.5	81.2	81.0	84.2
Indaial	73.7	77.7	76.7	77.7	77.4	79.5	80.2	77.6	77.8	76.7	75.1	73.9	77.0
Ituporanga	84.6	84.1	82.5	87.1	88.3	88.3	84.7	82.5	82.1	77.5	74.4	76.4	82.7
Brusque	83.1	84.3	84.8	86.1	86.5	87.4	87.2	86.5	86.9	85.7	83.9	82.8	85.4
Timbó	79.4	81.4	83.4	84.3	85.1	86.6	86.9	84.9	85.3	82.8	80.1	80.2	83.4

Table I.3.2 MONTHLY MEAN DISCHARGE AT TAIO

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	61.3	106.0	42.1	57.8	29.7	10.7	13.2	22.7	21.6	43.8	12.8	23.3	37.1
1935	12.0	8.0	28.2	4.8	2.5	11.7	14.5	31.5	67.8	140.0	16.5	21.7	29.9
1936	54.8	14.8	8.8	6.6	12.5	62.9	22.5	90.1	77.0	57.4	22.9	22.1	37.7
1937	14.1	17.1	52.9	50.4	13.6	9.4	6.1	21.6	14.9	63.8	51.1	33.3	29.0
1938	55.1	55.8	17.8	32.9	42.3	69.7	45.9	16.6	10.4	11.1	8.4	13.1	31.6
1939	25.4	41.7	59.2	26.5	23.3	48.9	22.9	8.0	52.1	28.4	95.7	73.1	42.1
1940	54.0	29.1	42.4	16.7	16.1	9.1	16.2	54.2	15.1	35.8	20.3	26.2	27.9
1941	37.0	73.9	76.5	15.9	21.3	34.3	12.9	53.4	24.9	35.4	38.5	23.2	37.3
1942	10.0	46.8	42.7	40.0	30.9	27.4	21.1	30.5	28.0	19.1	7.6	9.8	26.2
1943	14.1	22.6	6.5	5.5	22.6	86.6	45.3	85.6	44.4	32.6	30.0	12.7	34.0
1944	43.6	14.1	63.8	13.1	6.1	6.9	6.2	7.1	8.7	8.7	20.7	7.0	17.2
1945	3.8	26.4	11.6	5.3	3.4	4.3	9.2	5.6	18.3	30.8	6.7	8.6	11.2
1946	30.0	89.6	78.8	21.4	15.6	44.7	54.2	29.5	15.2	39.7	19.6	31.0	39.1
1947	24.6	69.1	32.3	9.4	8.8	20.0	19.2	39.5	88.7	75.2	32.0	26.4	37.1
1948	26.0	51.3	40.3	30.7	75.3	16.1	22.8	68.2	12.4	16.0	19.4	6.4	32.1
1949	11.5	5.0	12.1	26.3	7.5	32.2	8.1	22.0	31.4	21.3	8.8	8.2	16.2
1950	43.4	40.4	44.4	8.0	11.9	12.9	7.7	30.4	21.2	72.4	13.6	18.0	27.0
1951	58.2	107.0	45.2	11.6	6.1	6.4	11.9	3.6	5.3	84.2	34.1	18.7	32.7
1952	20.8	12.4	5.3	6.1	4.7	20.5	21.4	4.9	55.5	77.0	51.2	14.4	24.5
1953	29.2	56.7	18.3	7.1	7.9	4.7	5.3	7.8	18.6	56.8	72.2	30.9	26.3
1954	22.9	20.2	42.2	37.6	61.8	56.6	68.2	17.6	80.0	114.0	13.1	6.1	45.0
1955	6.6	26.5	28.1	24.6	46.4	45.9	76.4	32.0	48.4	13.3	15.7	31.1	32.9
1956	62.5	41.8	22.1	37.8	43.6	17.3	16.4	29.9	68.9	42.0	22.0	15.2	35.0
1957	19.4	15.3	39.3	36.0	27.2	24.1	85.5	151.0	149.0	50.3	23.1	13.7	52.8
1958	13.9	45.7	99.7	14.3	11.1	28.1	16.9	42.4	72.1	53.8	32.6	44.1	39.6
1959	22.5	47.9	19.7	22.0	17.0	11.4	7.6	17.7	50.7	18.5	7.3	8.4	20.9
1960	10.1	31.9	26.9	26.8	16.7	10.6	5.9	44.6	25.3	80.0	85.2	44.2	34.0
1961	35.2	56.7	63.1	31.7	13.7	22.3	20.9	7.2	137.0	120.0	87.8	51.2	53.9
1962	26.9	34.7	49.9	12.8	29.1	11.6	17.8	13.4	53.1	46.6	29.9	14.5	28.4
1963	73.3	133.0	128.0	22.7	7.1	5.8	6.5	7.9	47.2	120.0	101.0	36.7	57.4
1964	12.4	30.0	19.4	27.4	30.3	12.4	16.6	27.7	32.6	23.0	9.9	13.3	21.2
1965	9.2	5.9	21.2	15.9	48.2	18.9	37.4	46.5	53.8	41.3	41.4	78.1	34.8
1966	62.6	183.0	55.1	31.8	18.2	40.1	21.0	19.5	71.4	67.3	36.5	49.6	54.7
1967	34.6	120.0	52.4	20.5	12.7	24.0	18.7	21.7	69.1	38.5	48.4	42.0	41.9
1968	12.4	5.8	12.9	10.0	4.1	5.4	8.8	3.9	24.3	22.4	33.3	27.0	14.2
1969	42.2	108.0	47.7	83.9	17.6	58.7	35.2	15.4	17.3	14.5	24.9	10.1	39.6
1970	19.5	22.2	26.5	19.5	19.4	49.3	36.5	20.5	30.5	29.1	11.8	48.5	27.8
1971	101.0	80.1	83.5	64.9	52.1	71.7	43.9	22.6	27.2	26.3	6.8	4.9	48.8
1972	17.5	94.6	47.3	30.8	7.3	30.7	20.4	84.4	106.0	68.8	47.4	30.7	48.8
1973	43.2	46.2	30.5	23.3	37.7	44.4	55.6	103.0	96.0	32.3	25.5	18.3	46.3
1974	52.3	63.8	73.1	18.4	8.7	18.7	31.7	13.1	43.2	18.5	10.5	9.0	30.1
1975	32.3	23.2	70.0	16.2	24.5	29.5	13.8	45.0	133.0	113.0	32.9	112.0	53.8
1976	63.7	30.7	57.5	16.4	49.7	76.5	23.7	56.8	42.5	34.7	29.0	86.7	47.3
1977	110.0	57.2	59.8	37.6	12.9	9.6	10.9	74.8	26.6	119.0	50.0	25.0	49.5
1978	24.2	16.8	37.0	7.8	4.9	6.3	20.4	15.0	41.2	26.7	27.6	39.0	22.2
1979	14.6	10.4	25.0	19.4	81.2	22.8	22.1	24.2	33.1	132.0	61.4	54.1	41.7
1980	34.9	20.1	93.2	17.1	19.9	20.2	60.0	95.6	79.8	50.0	36.8	120.0	54.0
1981	63.7	50.5	16.9	15.9	10.5	10.2	13.6	12.7	29.3	25.8	26.5	44.2	26.7
1982	18.2	97.5	59.3	27.1	22.6	43.5	57.6	39.9	23.1	69.9	152.0	60.8	56.0
1983	90.1	97.5	87.4	41.9	126.0	113.0	(302.0)	122.0	77.1	50.9	47.0	64.0	101.6
1984	34.8	24.6	52.2	39.7	49.4	68.6	35.8	156.0	43.8	55.1	78.7	37.9	56.4
1985	21.2	85.4	33.7	48.4	21.1	7.8	11.9	7.6	14.1	15.3	39.2	5.7	26.0
1986	7.2	36.9	27.0	19.9	12.8	12.9	9.8	19.7	42.6	47.4	64.3	107.0	34.0
1987	92.2	84.6	17.8	11.1	72.3	41.9	26.8	30.5	19.3	95.9	18.1	9.0	43.3
Mean	35.4	49.6	43.6	23.9	25.9	30.2	30.7	38.7	47.5	52.5	36.7	33.3	37.3

Remarks:
Values in parentheses show monthly mean discharges interporated by using daily data at Ituporanga.

Table I.3.3 MONTHLY MEAN DISCHARGE AT ITUPORANGA

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	-	-	-	-	-	-	-	-	13.8	14.3	10.6	9.7	-
1935	14.1	7.6	12.4	8.3	5.5	13.4	13.8	34.7	40.4	71.8	26.0	19.4	22.3
1936	27.5	12.7	8.7	7.3	9.4	49.7	26.6	87.7	55.8	50.8	18.6	12.0	30.6
1937	10.3	17.8	15.5	24.4	11.9	10.0	9.1	28.5	17.2	45.4	19.0	13.7	18.6
1938	30.9	40.8	18.1	14.7	16.2	34.0	27.3	18.0	12.9	13.0	13.0	9.5	20.7
1939	12.2	21.2	28.7	13.4	25.0	30.0	18.4	10.2	24.3	16.3	100.0	49.1	29.1
1940	47.7	43.9	13.8	14.7	18.7	10.1	17.9	61.6	21.0	34.4	22.3	41.3	29.0
1941	14.2	10.5	8.0	6.7	19.3	19.4	8.2	19.0	17.7	12.9	24.6	14.1	14.6
1942	10.8	20.7	15.2	15.1	17.2	15.4	15.6	12.8	13.6	13.4	7.4	7.2	13.7
1943	4.1	4.8	4.2	3.1	10.7	26.7	29.9	79.6	39.7	22.7	12.8	8.8	20.6
1944	24.2	10.7	20.5	6.4	4.1	8.0	7.0	5.7	7.7	9.1	11.5	3.4	9.8
1945	3.1	14.2	7.4	8.6	3.8	8.5	10.7	6.7	15.6	11.1	4.9	12.0	8.9
1946	25.2	42.5	21.8	10.0	20.0	46.3	59.5	36.1	18.9	29.2	11.4	12.5	27.8
1947	11.2	28.1	22.1	6.0	7.1	12.8	18.4	23.2	65.5	53.6	30.6	25.1	25.3
1948	20.0	34.7	38.3	29.8	71.8	15.6	46.1	138.0	16.6	17.2	16.2	5.8	37.5
1949	14.3	5.8	12.8	21.6	11.7	24.3	13.2	26.7	29.4	17.9	7.5	10.3	16.3
1950	20.4	14.7	32.1	9.5	12.4	9.1	10.1	36.1	19.0	56.9	12.2	22.1	21.2
1951	33.9	46.6	31.9	11.5	7.1	7.0	10.1	3.4	2.6	30.5	18.2	13.0	18.0
1952	31.1	13.4	7.2	5.6	6.4	17.6	30.6	10.7	30.3	48.6	35.3	17.4	21.2
1953	17.7	21.3	15.3	6.8	4.9	4.9	10.0	5.5	22.3	38.4	34.6	21.3	16.9
1954	26.1	31.6	33.5	18.7	63.7	49.4	86.0	23.0	89.9	145.0	19.0	15.1	50.1
1955	14.2	16.3	13.3	27.9	38.4	26.1	91.2	32.6	41.3	19.1	15.6	18.9	29.6
1956	56.1	55.2	15.3	37.8	39.1	19.8	18.4	34.4	84.1	46.8	16.1	17.4	36.7
1957	23.6	35.5	14.4	20.6	25.0	18.1	66.5	215.0	131.0	62.5	32.0	16.8	55.1
1958	14.6	11.1	28.5	14.4	13.8	34.2	13.2	32.1	68.6	63.7	67.1	35.2	33.0
1959	24.2	26.0	14.4	41.0	24.2	13.6	9.6	23.0	53.8	24.0	10.2	17.1	23.4
1960	11.5	26.8	29.0	20.3	8.0	9.6	7.7	61.5	40.6	30.9	35.7	21.8	25.3
1961	16.9	37.8	51.6	27.0	17.2	15.3	21.8	9.2	101.0	121.0	124.0	65.6	50.7
1962	(25.3)	19.2	20.8	16.1	36.2	22.2	22.8	14.7	78.2	24.1	35.9	17.0	27.7
1963	57.1	100.0	65.5	23.5	10.3	6.9	8.0	16.5	88.8	99.3	70.5	33.1	48.3
1964	10.7	20.8	10.4	27.5	29.0	18.0	11.8	13.7	40.3	54.6	16.5	12.2	22.1
1965	(8.7)	(5.6)	(19.9)	(14.9)	27.4	13.7	31.7	(43.7)	72.4	29.8	21.6	43.2	27.7
1966	55.8	133.0	55.0	27.9	22.6	42.9	25.8	24.0	81.2	48.6	24.8	37.1	48.2
1967	39.2	46.5	34.5	19.5	14.0	21.4	22.9	23.6	72.2	40.6	27.8	28.5	32.6
1968	11.1	8.8	7.3	5.5	2.7	7.2	13.9	3.6	20.5	18.7	28.9	37.9	13.8
1969	68.8	50.2	39.9	89.9	13.1	38.3	32.1	21.5	20.1	15.4	50.2	16.9	38.0
1970	29.6	24.0	28.6	13.4	26.1	34.7	53.6	46.7	40.4	28.7	13.6	21.0	30.0
1971	40.9	38.5	94.0	51.2	47.6	55.7	62.5	30.8	38.2	30.6	10.8	5.6	42.2
1972	12.3	61.6	16.0	10.9	5.7	24.9	34.2	100.0	76.2	45.4	31.9	41.8	38.4
1973	34.9	29.9	14.0	15.8	37.7	52.2	52.7	89.7	63.4	17.4	17.3	23.5	37.4
1974	35.5	24.5	40.8	10.8	6.4	15.7	16.8	12.3	33.4	13.6	28.5	11.2	20.8
1975	12.2	13.2	18.2	8.5	10.0	14.6	11.4	36.1	86.3	65.5	24.0	75.2	31.3
1976	55.6	16.0	32.9	11.8	41.0	46.3	31.9	86.1	31.8	23.5	22.7	63.9	38.6
1977	64.5	103.0	22.7	22.9	10.0	7.9	12.0	88.8	31.2	66.7	75.7	23.5	44.1
1978	23.8	27.7	23.9	6.8	5.5	6.5	12.8	8.7	30.7	15.0	22.0	36.3	18.3
1979	16.0	11.7	8.5	11.3	23.6	15.4	14.8	24.5	19.7	128.0	48.6	34.2	29.7
1980	31.1	16.8	41.2	15.5	17.2	12.6	40.3	116.0	81.6	43.0	31.0	100.0	45.5
1981	63.5	29.6	12.8	10.0	8.2	8.9	16.0	11.0	18.7	26.1	15.6	16.1	19.7
1982	8.6	34.1	15.7	7.8	7.3	23.5	26.3	23.2	12.5	49.1	96.5	37.8	28.5
1983	42.2	42.4	54.2	42.4	101.0	121.0	284.0	157.0	64.7	29.7	31.2	67.1	86.4
1984	33.4	19.3	17.3	20.4	24.4	68.2	82.4	193.0	57.7	45.4	36.9	28.7	52.3
1985	15.1	37.8	24.2	25.8	13.3	10.6	25.6	9.8	16.4	19.2	24.5	6.6	19.1
1986	10.7	22.9	7.4	10.4	13.1	16.0	9.9	10.6	17.0	42.2	72.4	35.5	22.3
1987	77.0	54.8	15.9	20.9	96.9	37.4	30.7	48.5	23.8	84.5	16.6	21.0	44.0
Mean	27.2	31.0	24.1	18.3	21.9	24.4	31.8	43.9	42.8	41.2	30.6	26.1	30.3

Remarks:
Values in parentheses show monthly mean discharges interporated by using daily data at Taio.

Table I.3.4 MONTHLY MEAN DISCHARGE AT RIO DO SUL

(Unit : cu.m/s)

Year	Month												Mean
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1941	81.8	137.2	(92.7)	(37.9)	(65.9)	(98.4)	(42.2)	(132.8)	(75.9)	(87.4)	(124.6)	(72.8)	87.5
1942	36.9	124.7	82.5	88.9	70.3	70.4	61.9	68.4	65.9	54.8	25.4	32.9	65.3
1943	29.1	50.2	21.8	17.1	53.8	182.8	110.1	260.6	135.2	85.6	63.5	36.0	87.2
1944	106.5	39.9	98.4	30.3	17.7	21.7	21.3	19.3	25.0	26.2	47.8	15.5	39.1
1945	9.5	59.3	27.7	23.8	13.2	18.9	29.2	20.9	54.5	62.4	23.0	28.2	30.9
1946	80.8	213.7	159.2	56.8	57.5	133.0	179.5	106.5	65.9	100.9	50.4	59.4	105.3
1947	57.1	129.1	77.3	25.3	30.9	51.1	59.9	94.4	231.9	207.7	92.1	79.4	94.7
1948	64.9	121.7	111.7	92.2	225.4	55.5	111.7	274.8	54.7	52.5	64.6	22.2	104.3
1949	33.3	16.7	35.0	65.4	29.0	86.3	33.6	81.8	97.5	60.0	27.0	25.4	49.3
1950	92.0	77.5	106.0	32.1	41.9	33.6	30.2	101.4	70.5	189.7	41.4	58.8	72.9
1951	110.8	226.7	135.7	39.3	20.8	18.9	35.2	14.6	14.2	174.3	84.5	47.1	76.8
1952	67.3	46.5	21.5	18.9	15.7	54.5	90.3	31.8	141.3	190.3	141.6	50.7	72.5
1953	70.0	108.1	53.2	26.1	22.1	18.0	22.8	23.1	70.8	130.8	171.0	68.9	65.4
1954	68.4	65.8	109.6	71.7	170.5	156.1	232.7	65.5	234.7	350.6	61.5	31.8	134.9
1955	29.1	49.9	61.5	67.1	116.9	102.5	244.1	106.5	132.1	49.0	44.9	71.1	89.6
1956	156.2	144.9	52.8	103.2	123.6	55.0	49.6	87.3	213.1	128.7	61.4	52.3	102.3
1957	55.2	62.3	69.6	74.0	68.1	53.2	211.8	506.2	427.8	180.9	83.8	45.4	153.2
1958	40.5	68.5	193.4	49.6	30.7	93.2	47.7	113.0	206.7	156.4	137.2	117.8	104.6
1959	59.0	101.3	47.7	80.3	71.6	38.1	26.5	54.7	166.8	55.9	24.6	32.9	63.3
1960	29.2	74.9	75.1	61.6	29.3	25.2	(17.4)	150.6	93.4	130.7	158.1	82.3	77.3
1961	66.8	118.0	152.6	73.6	40.2	44.9	51.9	20.4	331.6	323.4	319.5	161.1	142.0
1962	67.8	66.8	83.3	36.4	87.6	52.6	75.0	39.9	150.8	102.6	78.1	53.2	74.5
1963	165.8	(228.6)	(211.4)	(78.2)	37.8	22.3	24.8	(28.7)	(114.8)	(270.7)	(197.5)	(105.7)	123.9
1964	35.6	57.1	37.6	(52.9)	(76.7)	(41.7)	(47.2)	(70.1)	(104.3)	(84.0)	(41.4)	(37.5)	57.2
1965	(31.1)	(21.6)	(47.4)	(45.4)	(130.5)	(48.4)	(118.0)	152.2	201.7	106.4	87.7	162.2	96.1
1966	161.3	507.1	179.6	90.8	63.4	128.8	69.4	68.7	199.9	151.5	89.8	132.0	153.5
1967	93.7	195.5	123.8	55.5	40.9	78.0	62.6	67.6	215.1	130.7	111.8	108.3	107.0
1968	35.1	23.3	24.3	19.8	10.8	17.0	24.7	11.0	61.6	56.4	91.7	74.2	37.5
1969	157.7	224.4	128.8	229.6	49.5	137.7	117.9	58.1	65.9	50.4	88.5	37.0	112.1
1970	77.3	68.1	69.7	42.8	52.2	145.7	125.3	93.4	109.2	96.4	37.2	107.1	85.4
1971	246.1	148.7	236.1	211.3	182.4	232.4	180.6	84.6	102.0	94.9	29.2	20.6	147.4
1972	49.0	230.3	96.5	76.2	28.7	100.0	91.4	317.3	288.5	184.6	121.0	114.5	141.5
1973	119.2	129.0	67.0	57.4	114.8	173.9	191.0	325.3	285.9	97.6	71.3	56.1	140.7
1974	126.5	137.8	153.4	41.6	28.5	49.6	80.0	38.2	115.9	54.8	64.2	26.8	76.4
1975	62.5	47.9	127.7	40.2	48.1	69.2	35.9	141.5	368.9	311.3	90.4	307.5	137.6
1976	176.4	65.9	143.5	45.8	128.3	191.1	82.9	234.1	121.6	92.0	65.2	244.5	132.6
1977	281.4	254.5	124.8	87.3	45.4	29.1	36.3	254.6	89.6	284.0	203.3	77.7	147.3
1978	67.6	55.2	82.2	24.0	16.2	24.3	53.3	34.8	115.0	46.4	90.3	121.5	60.9
1979	49.7	29.2	38.4	45.3	133.1	61.7	56.8	60.2	72.4	355.5	168.3	124.3	99.6
1980	101.4	51.3	176.7	58.6	63.2	55.1	166.9	323.6	255.9	151.4	126.1	332.9	155.3
1981	174.9	110.2	45.9	40.2	31.3	29.7	43.4	33.7	68.3	68.7	60.3	97.3	67.0
1982	43.2	187.8	98.6	53.8	40.8	88.4	123.4	98.4	57.6	166.9	354.4	139.7	121.1
1983	190.5	184.8	265.0	132.1	339.0	337.5	(970.0)	354.3	216.5	134.9	122.0	181.7	285.7
1984	110.4	73.2	106.8	85.1	110.3	205.6	174.3	504.0	159.1	177.9	176.1	100.4	165.3
1985	58.1	223.0	93.9	111.0	58.5	33.4	58.9	27.9	48.1	55.0	90.2	15.8	72.8
1986	22.2	83.4	49.5	41.9	30.7	47.7	28.2	40.8	70.0	125.6	194.0	196.8	77.6
1987	233.0	194.7	57.1	55.8	233.8	126.8	112.8	138.6	83.6	257.7	67.3	47.9	134.1
Mean	91.1	119.9	99.0	63.7	74.4	83.8	103.4	126.3	141.5	138.4	101.4	89.7	102.7

Remarks:

(1) Monthly mean discharges at Rio do Sul are derived from the data at Rio do Sul (1941 to 1979) and Rio do Sul Novo (1980 to 1987).

(2) Values in parentheses show monthly mean discharges interporated by using daily data at Apiuna.

Table I.3.5 MONTHLY MEAN DISCHARGE AT IBIRAMA

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1935	16.3	15.0	31.9	9.3	4.8	12.6	12.5	45.7	133.8	257.5	31.2	28.3	49.9
1936	102.0	21.5	13.8	10.6	18.0	73.3	25.3	161.3	117.0	63.5	33.6	22.4	55.2
1937	23.9	21.0	45.5	52.3	21.9	18.9	11.5	35.9	18.2	92.2	84.9	21.2	37.3
1938	73.0	80.5	27.2	65.8	90.8	133.2	88.4	29.8	24.1	23.7	15.0	13.9	55.5
1939	17.2	20.6	41.3	28.3	44.1	49.0	28.8	11.6	48.4	34.4	162.0	138.1	52.0
1940	43.3	23.7	16.5	26.5	17.7	11.5	18.2	55.1	17.1	27.8	13.0	22.1	24.4
1941	39.8	37.0	35.3	16.0	30.0	52.0	18.6	68.1	34.8	58.4	69.3	40.9	41.7
1942	21.9	113.1	54.4	58.1	43.6	67.5	46.3	46.3	34.3	27.6	18.4	19.9	46.0
1943	18.9	18.2	10.4	6.8	13.6	65.3	56.7	134.9	61.2	33.7	22.6	17.2	38.3
1944	39.4	17.4	30.7	11.0	6.6	6.5	5.9	9.7	13.3	10.2	28.4	11.9	15.9
1945	4.5	35.0	15.0	7.8	5.9	7.2	28.0	7.8	13.6	20.9	7.9	8.6	13.5
1946	30.6	151.1	110.8	45.3	22.8	99.8	100.8	57.9	33.5	64.2	27.0	48.9	66.1
1947	26.6	57.6	28.6	12.2	16.4	31.7	31.8	52.9	149.9	104.5	45.7	41.3	49.9
1948	53.9	69.5	68.1	67.7	120.4	36.5	42.9	126.2	32.4	27.0	39.0	11.8	58.0
1949	14.7	7.2	19.0	60.4	18.5	51.0	14.5	31.6	34.6	17.1	13.2	10.2	24.3
1950	53.1	45.2	72.2	20.5	19.5	18.0	14.0	25.5	23.4	104.0	19.9	27.7	36.9
1951	37.3	97.8	68.2	19.2	11.8	10.8	15.3	6.6	6.9	107.8	41.2	20.2	36.9
1952	11.8	11.5	6.4	3.4	2.5	23.2	16.0	6.9	68.3	99.8	57.6	24.2	27.6
1953	43.3	43.8	25.2	14.4	16.4	13.2	11.6	11.9	32.5	99.1	85.8	23.5	35.1
1954	35.9	40.7	85.5	22.7	123.6	70.9	100.5	30.8	56.9	145.0	27.0	15.2	62.9
1955	8.4	15.0	19.9	25.6	79.7	77.9	131.3	51.8	82.2	19.6	14.4	28.9	46.2
1956	50.8	35.8	20.3	34.5	82.4	27.7	27.5	45.1	90.0	40.1	20.0	9.8	40.3
1957	15.7	28.6	39.0	30.9	26.3	53.3	162.6	275.5	248.0	68.8	46.6	24.2	85.0
1958	19.5	47.3	135.9	31.8	20.1	79.2	26.3	56.5	91.9	58.8	37.1	81.3	57.1
1959	38.4	39.8	15.1	27.2	39.7	16.1	11.7	45.9	103.7	28.8	16.0	12.6	32.9
1960	14.5	31.1	22.3	18.9	16.9	19.8	8.2	94.9	33.2	87.1	112.2	35.9	41.3
1961	25.3	39.8	73.3	27.2	19.0	35.7	23.6	11.2	194.1	164.2	140.9	72.8	68.9
1962	23.0	26.6	55.8	16.6	19.1	15.3	19.1	10.9	83.4	63.9	45.0	13.8	32.7
1963	53.0	68.5	75.6	35.9	10.2	6.3	7.4	8.7	48.8	128.7	112.1	79.6	52.9
1964	17.3	40.6	27.7	28.2	56.1	26.2	33.0	59.9	84.0	(78.4)	(53.5)	(55.3)	46.7
1965	21.7	18.5	35.1	30.8	147.9	45.8	120.2	129.3	81.3	111.4	67.9	187.0	83.1
1966	83.8	246.9	70.6	37.5	31.3	103.9	52.6	36.2	92.4	119.7	75.5	62.8	84.4
1967	45.8	129.0	84.8	36.1	17.3	39.2	35.1	22.7	93.8	45.5	66.9	89.6	58.8
1968	27.3	16.7	20.1	23.9	8.3	7.8	11.9	7.8	22.9	23.7	27.3	27.2	18.7
1969	57.4	57.3	44.7	120.1	41.0	106.9	70.3	39.8	44.9	39.8	36.7	21.6	56.7
1970	33.1	24.1	24.3	18.8	31.1	92.5	78.6	35.5	49.0	57.7	19.6	57.4	43.5
1971	170.0	86.8	80.5	93.2	91.1	125.2	86.2	33.5	29.3	57.7	18.4	16.9	74.1
1972	20.7	84.4	56.7	43.5	15.7	45.1	46.2	182.1	144.3	122.2	45.3	47.1	71.1
1973	50.1	45.1	23.3	31.7	55.8	122.6	84.1	179.6	140.2	75.6	41.9	43.1	74.4
1974	96.8	84.4	102.4	36.1	20.3	36.8	90.7	29.2	79.8	25.2	22.6	11.8	53.0
1975	26.9	21.3	38.0	19.6	26.3	32.4	25.6	82.0	115.4	154.2	61.5	144.5	62.3
1976	72.5	33.5	63.9	37.2	80.0	142.0	57.1	116.0	80.9	54.1	64.2	81.5	73.6
1977	105.5	36.2	62.0	65.2	20.1	14.5	21.9	60.7	32.6	152.7	79.6	40.2	57.6
1978	24.0	21.7	61.2	12.4	9.8	14.5	41.2	35.8	69.0	41.2	43.7	80.4	37.9
1979	26.4	17.1	15.4	27.5	150.9	40.6	49.7	39.3	75.7	225.8	127.7	112.0	75.7
1980	70.4	46.5	98.7	39.4	35.3	36.3	144.0	144.0	142.5	83.2	75.7	229.8	95.5
1981	97.7	77.0	34.7	25.4	20.7	17.9	24.3	21.2	31.3	40.2	48.9	91.1	44.2
1982	34.4	84.0	58.6	33.6	29.5	77.1	96.7	71.6	44.1	101.3	222.1	115.3	80.7
1983	103.0	116.7	162.6	65.5	221.8	200.5	652.4	154.2	130.4	87.6	50.0	85.8	169.2
1984	38.8	34.4	59.7	41.8	51.4	105.4	79.2	258.6	81.7	76.6	97.2	40.3	80.4
1985	27.8	75.1	38.8	82.3	31.1	18.1	29.6	13.0	27.7	17.8	30.2	8.8	33.4
1986	14.2	32.3	37.8	49.3	18.8	21.1	14.3	23.9	39.5	59.1	80.2	151.1	45.1
1987	115.1	97.7	29.5	26.8	147.0	109.7	59.1	70.8	46.9	107.0	34.7	28.6	72.7
Mean	44.1	52.6	48.9	34.6	43.8	52.2	58.7	64.2	70.0	76.2	54.3	52.0	54.3

Remarks:
Values in parentheses show monthly mean discharges interporated by using daily data at Timbó.

Table I.3.6 MONTHLY MEAN DISCHARGE AT APIUNA

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	163.3	399.4	143.2	226.7	94.4	53.3	72.1	92.9	87.9	154.2	62.5	78.8	135.7
1935	55.5	38.6	87.1	30.5	19.1	43.2	50.1	138.3	310.1	603.2	105.8	94.2	131.3
1936	224.1	66.4	41.8	35.3	49.5	237.0	105.7	473.0	342.6	255.8	96.0	73.1	166.7
1937	64.4	75.5	142.0	166.2	67.7	43.7	33.1	112.8	64.7	258.4	179.4	74.7	106.9
1938	157.7	223.6	89.4	135.1	186.1	273.7	204.3	79.2	57.6	56.0	53.2	46.2	130.2
1939	74.7	91.8	164.3	87.4	115.2	147.4	105.9	40.7	159.0	110.3	440.4	327.3	155.4
1940	219.7	140.4	98.9	84.5	81.2	42.7	84.2	244.3	78.2	125.3	64.6	99.1	113.6
1941	140.5	185.8	165.8	67.8	118.0	176.0	75.6	237.5	135.7	156.4	222.9	130.2	151.0
1942	70.8	270.3	149.1	162.8	134.7	152.1	122.4	126.8	108.1	93.1	46.6	61.0	124.8
1943	50.4	81.9	39.7	26.4	68.8	258.9	173.6	447.4	211.9	134.1	95.4	61.8	137.5
1944	150.7	68.0	136.0	48.8	26.7	30.0	29.2	29.4	47.2	40.1	78.7	31.9	59.7
1945	16.3	124.6	49.1	35.1	20.2	25.4	61.1	30.5	70.0	85.0	30.9	37.7	48.8
1946	114.0	369.6	283.8	114.3	88.6	241.6	300.5	178.8	108.0	169.9	82.2	111.0	180.2
1947	89.2	193.6	120.5	42.3	50.3	83.8	95.1	157.8	393.0	333.6	150.2	139.2	154.1
1948	132.7	200.5	205.4	172.4	388.7	101.1	164.5	437.5	96.0	88.1	117.3	38.2	178.5
1949	52.4	26.7	63.2	134.3	52.1	144.8	52.9	122.9	139.9	82.4	45.5	42.2	79.9
1950	151.5	132.9	198.8	59.0	65.4	56.7	46.8	138.0	102.8	313.9	71.9	91.3	119.1
1951	166.8	333.6	214.1	68.7	37.3	34.2	54.4	24.7	25.7	307.2	140.8	85.7	124.4
1952	90.5	70.3	36.7	27.1	21.1	80.8	110.4	42.8	218.2	297.8	205.8	80.8	106.9
1953	132.5	156.2	88.1	45.1	40.2	36.4	39.2	40.6	110.9	239.0	282.1	115.0	110.4
1954	117.6	123.9	209.4	105.4	308.3	247.2	352.3	109.2	297.2	572.1	97.9	58.3	216.6
1955	50.1	73.6	86.3	103.5	216.9	189.6	395.4	175.5	238.7	83.6	72.3	120.1	150.5
1956	(204.9)	192.2	83.4	146.1	219.9	95.2	91.0	147.2	342.9	188.7	96.3	76.5	157.0
1957	95.3	99.5	120.5	118.6	115.7	120.3	408.6	884.8	740.4	274.4	154.6	84.3	268.1
1958	74.1	130.0	373.1	100.3	64.0	186.4	86.4	186.4	316.5	238.8	197.1	212.9	180.5
1959	116.7	151.8	75.3	122.9	120.3	66.8	50.2	108.6	294.9	101.1	50.7	49.9	109.1
1960	49.4	129.9	116.2	93.0	54.6	52.6	31.2	265.8	144.4	229.8	281.6	130.9	131.6
1961	103.6	166.4	245.1	110.7	67.0	90.3	80.9	37.8	570.7	520.1	557.3	258.2	234.0
1962	105.3	106.4	156.0	61.4	111.6	79.0	113.7	63.0	246.9	190.6	135.9	71.7	120.1
1963	219.7	408.9	378.3	125.1	51.0	33.5	40.2	51.2	205.3	484.4	353.4	189.0	211.7
1964	70.4	115.7	77.0	94.6	137.2	74.7	84.4	125.5	186.6	150.3	74.0	67.1	104.8
1965	55.7	38.6	84.8	81.2	233.4	86.6	211.2	290.4	298.2	231.5	199.9	372.8	182.0
1966	268.4	841.2	298.5	149.8	110.3	258.9	143.2	113.3	342.2	278.6	184.3	228.4	268.1
1967	164.7	344.1	251.6	102.3	66.0	120.4	106.0	102.5	314.9	184.2	184.3	221.2	180.2
1968	68.0	47.3	54.3	45.1	26.2	28.9	44.0	23.4	103.7	87.8	127.4	104.8	63.4
1969	228.0	313.3	182.3	378.8	94.0	302.7	205.2	104.3	112.0	93.0	129.5	69.1	184.4
1970	130.6	99.3	108.3	75.1	85.7	260.3	222.8	143.4	179.6	160.0	58.7	173.2	141.4
1971	436.2	264.6	342.8	313.9	294.9	383.1	294.7	134.1	151.3	165.4	54.3	41.4	239.7
1972	78.5	345.1	167.3	126.4	42.9	146.9	152.0	448.0	455.2	333.6	190.7	192.4	223.3
1973	185.4	188.7	109.7	95.0	178.7	299.1	289.4	553.6	442.1	183.3	129.6	110.2	230.4
1974	240.0	224.6	275.4	88.8	50.2	92.3	179.0	75.9	214.3	87.2	92.6	42.8	138.6
1975	94.5	74.1	170.9	67.1	76.2	105.1	76.1	230.3	497.2	498.8	177.7	461.7	210.8
1976	267.5	112.6	205.9	90.2	222.3	342.0	151.4	349.2	198.9	148.8	139.9	329.4	213.2
1977	393.0	294.1	198.5	178.1	68.3	49.5	68.8	349.5	136.9	483.1	285.8	134.9	220.0
1978	109.7	95.1	144.9	41.9	30.9	40.9	96.7	79.5	189.3	115.0	139.0	213.5	108.0
1979	82.9	49.2	55.9	80.0	317.8	103.3	110.3	110.1	161.5	596.2	304.4	260.0	186.0
1980	175.8	97.9	288.8	108.2	100.3	93.8	334.9	504.1	414.3	246.5	214.7	577.1	263.0
1981	279.8	194.8	80.8	66.7	53.7	46.9	68.2	56.2	101.4	114.0	116.9	194.7	114.5
1982	78.3	274.5	154.0	87.5	70.4	178.5	250.1	171.3	101.9	291.8	598.0	264.0	210.0
1983	306.7	323.6	451.7	203.9	599.7	561.4	1,763.2	626.1	391.7	233.9	186.8	298.0	495.6
1984	158.0	118.3	169.7	130.8	160.7	327.2	260.1	851.9	246.4	265.6	276.3	141.7	258.9
1985	87.6	301.7	141.5	201.4	94.7	52.1	90.8	41.9	79.4	81.2	122.7	25.5	110.0
1986	35.9	119.8	90.2	90.3	49.1	74.1	46.0	67.6	118.0	190.4	278.8	346.6	125.6
1987	352.3	296.3	90.9	83.8	375.9	237.7	172.4	208.7	129.2	373.0	100.6	73.6	207.9
Mean	144.1	181.3	158.7	105.9	122.6	144.1	169.4	205.5	221.6	230.7	167.4	149.7	166.2

Remarks:
Values in parentheses show monthly mean discharges interpolated by using daily data at Indaial.

Table I.3.7 MONTHLY MEAN DISCHARGE AT TIMBO

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	-	-	-	-	-	-	-	-	-	-	13.8	22.6	-
1935	17.5	19.6	28.3	14.7	8.4	12.5	10.8	21.9	58.2	103.9	24.1	26.6	28.9
1936	93.3	21.0	19.7	15.7	17.3	36.8	13.2	77.5	67.4	40.9	26.6	21.4	37.6
1937	26.9	51.7	64.0	79.3	51.5	23.1	14.9	26.5	18.4	61.6	50.6	21.0	40.8
1938	77.0	49.4	34.8	48.2	47.7	57.0	42.4	21.6	21.1	22.9	17.6	25.3	38.8
1939	25.5	20.6	48.8	32.2	30.1	21.2	12.9	9.8	52.8	31.9	121.0	76.1	40.2
1940	58.4	31.3	26.7	32.4	18.6	11.5	12.7	32.7	11.5	32.3	20.3	27.6	26.3
1941	25.0	41.2	25.3	16.7	27.6	28.5	13.6	18.4	16.5	21.9	38.3	39.4	26.0
1942	19.2	115.1	43.2	46.0	35.1	42.6	30.8	27.8	24.5	20.1	27.3	35.3	38.9
1943	23.6	25.3	17.6	12.9	20.3	55.3	38.6	68.9	40.2	44.8	26.5	18.7	32.7
1944	40.2	36.5	54.0	23.7	12.8	10.8	8.7	20.1	15.2	12.0	48.7	26.5	25.8
1945	18.4	67.7	29.5	26.4	13.3	12.6	31.1	11.8	30.2	55.3	21.5	31.2	29.1
1946	69.5	157.6	100.0	43.0	23.4	49.9	41.3	36.4	19.9	36.3	17.6	27.5	51.9
1947	46.4	97.4	52.9	22.3	31.4	30.1	36.6	45.1	83.0	103.5	59.1	66.0	56.2
1948	83.4	112.5	71.0	45.4	76.2	25.1	27.9	59.9	24.7	22.2	26.0	11.5	48.8
1949	22.0	11.3	32.9	49.1	17.0	35.6	15.7	24.2	31.1	23.1	22.3	25.1	25.8
1950	46.2	37.5	74.1	30.3	27.2	26.3	14.3	12.7	16.8	44.1	14.8	26.1	30.9
1951	38.2	79.8	42.8	18.5	11.6	9.6	13.5	6.5	9.1	55.3	30.0	25.1	28.3
1952	23.7	20.2	19.6	11.2	7.2	23.5	14.4	8.3	28.5	40.5	44.5	23.7	22.1
1953	39.2	36.9	28.4	17.0	18.1	11.8	11.0	9.3	16.6	62.3	64.2	34.6	29.1
1954	28.9	45.0	57.5	67.3	81.3	40.1	40.4	19.3	31.7	86.0	18.8	12.7	44.1
1955	15.8	17.1	26.2	25.4	59.6	38.0	60.2	23.8	46.7	16.4	17.6	21.3	30.7
1956	44.8	36.1	25.5	34.9	51.6	26.3	24.4	23.7	34.0	37.6	18.6	14.1	31.0
1957	27.7	30.7	33.6	32.4	53.8	37.8	98.9	114.8	118.8	43.1	43.7	43.9	56.6
1958	31.7	88.1	117.5	42.2	28.4	49.3	20.0	23.8	47.6	33.2	41.3	45.7	47.4
1959	67.3	49.6	28.1	35.5	24.5	15.7	13.8	18.9	48.5	26.6	14.1	15.0	29.8
1960	34.3	56.1	52.4	29.5	21.2	16.7	12.8	53.2	26.4	32.5	86.1	37.5	38.2
1961	32.6	76.7	66.3	23.9	25.3	24.3	17.6	12.1	73.5	60.1	106.1	35.7	46.2
1962	23.6	28.7	36.4	17.5	18.8	13.7	16.0	11.5	32.4	29.2	23.6	21.5	22.7
1963	45.9	77.1	72.8	27.2	14.6	11.4	12.7	9.0	38.3	62.8	62.0	50.9	40.4
1964	17.8	25.7	24.7	24.0	32.6	24.1	23.4	28.9	43.5	34.3	23.4	24.1	27.2
1965	52.9	27.4	19.5	32.5	90.5	31.6	49.9	57.8	42.7	49.0	54.4	73.0	48.4
1966	75.2	81.1	37.0	69.5	26.8	35.2	29.3	18.5	49.1	47.1	57.1	28.6	46.2
1967	53.5	117.2	75.1	(20.4)	(12.2)	22.9	(30.9)	(17.9)	33.5	26.2	44.6	67.5	43.5
1968	(29.9)	(19.8)	(17.2)	(18.9)	(7.6)	(8.8)	(5.8)	(5.1)	(27.3)	(39.3)	(20.5)	(15.5)	18.0
1969	(33.1)	(51.8)	(40.0)	(85.6)	(31.6)	(96.3)	(49.8)	(26.7)	(23.9)	(26.8)	(64.5)	(20.6)	45.9
1970	(32.7)	(39.6)	(38.1)	(29.0)	(19.2)	(40.8)	(54.7)	(27.2)	(26.9)	(34.0)	(23.5)	(61.1)	35.6
1971	104.6	54.7	88.9	45.6	44.2	56.0	39.6	25.1	34.7	59.4	18.8	13.3	48.7
1972	18.0	47.0	41.8	33.8	15.6	25.5	25.2	81.8	55.1	65.7	(50.6)	(71.4)	44.3
1973	74.1	73.5	32.2	39.7	36.2	59.5	48.1	100.6	83.8	60.9	41.0	36.0	57.1
1974	71.3	57.0	163.3	44.9	26.7	23.5	43.9	25.4	35.9	19.2	15.8	13.6	45.0
1975	28.5	21.6	34.3	24.4	21.7	23.2	21.2	44.2	65.5	88.5	72.6	111.2	46.4
1976	56.2	47.1	77.7	32.8	54.8	67.5	38.8	49.6	37.6	32.5	32.2	36.4	46.9
1977	54.6	49.2	61.5	52.7	25.9	18.0	15.1	27.0	19.1	91.5	56.1	36.5	42.3
1978	32.8	40.0	57.4	16.7	11.6	12.6	16.1	19.4	34.9	24.7	26.7	45.8	28.2
1979	17.6	14.5	18.2	24.0	65.5	23.2	24.9	18.6	28.4	78.8	(66.8)	(49.6)	35.8
1980	43.7	53.1	55.5	29.9	20.4	17.9	53.9	55.8	56.0	52.3	54.6	104.6	49.8
1981	77.6	68.8	41.7	30.0	21.3	14.9	19.9	13.1	14.5	42.0	43.3	58.7	37.2
1982	28.7	67.7	50.6	33.9	32.7	41.9	43.4	32.4	23.0	50.6	87.0	52.8	45.4
1983	72.5	77.1	87.7	46.3	116.1	91.9	240.3	86.9	81.2	61.2	43.8	81.2	90.5
1984	42.2	35.4	48.7	41.1	40.4	45.9	39.7	138.8	51.7	46.1	70.5	31.1	52.6
1985	21.9	45.5	33.0	60.6	24.5	17.9	16.2	11.4	23.7	22.6	37.3	14.3	27.4
1986	22.0	41.6	21.1	25.8	14.7	13.4	14.2	17.7	38.4	45.3	34.6	63.5	29.4
1987	77.5	109.6	32.6	28.1	52.2	49.8	29.5	32.3	38.1	47.1	23.5	23.1	45.3
Mean	43.1	52.9	47.7	34.2	32.4	31.3	32.0	34.2	38.7	45.4	41.4	38.1	39.2

Remarks:
Values in parentheses show monthly mean discharges interporated by using daily data at Benedito Novo.

Table I.3.8 MONTHLY MEAN DISCHARGE AT INDAIAL

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	-	-	102.2	323.1	108.7	66.8	91.8	112.8	120.8	213.1	77.8	102.4	-
1935	75.5	59.4	120.8	45.4	27.8	56.5	64.5	176.4	395.8	780.3	137.5	127.2	172.3
1936	357.7	89.4	65.5	51.8	72.5	286.8	130.5	577.9	446.9	333.3	125.3	98.5	219.7
1937	101.1	129.8	223.8	251.7	120.3	68.2	50.2	156.7	84.1	354.7	241.3	97.1	156.6
1938	252.4	321.1	130.0	204.1	235.3	386.3	274.2	101.6	80.0	81.1	75.5	71.7	184.4
1939	106.7	122.7	236.1	122.2	152.4	190.9	137.0	52.4	244.4	162.0	614.9	452.0	216.2
1940	310.8	194.1	138.6	136.0	111.5	57.9	110.1	320.2	102.4	172.8	96.3	145.7	158.0
1941	174.2	249.0	204.7	85.9	163.0	231.7	95.8	271.7	157.2	192.1	274.1	175.8	189.6
1942	96.9	413.1	204.6	227.3	170.4	211.7	160.0	161.9	135.6	118.3	74.5	101.4	173.0
1943	81.9	114.9	56.7	40.8	91.1	357.4	221.6	551.1	277.8	187.5	127.4	83.7	182.7
1944	209.5	111.6	207.0	73.7	39.8	41.8	38.6	52.2	65.1	53.2	139.6	57.7	90.8
1945	34.2	212.8	85.4	64.5	33.8	39.7	99.8	43.4	104.6	151.7	53.9	73.7	83.1
1946	199.2	583.5	427.4	171.2	116.5	314.2	372.4	234.5	138.4	221.4	113.4	147.7	253.3
1947	150.5	319.2	194.7	68.2	88.1	120.1	137.3	219.6	492.1	486.1	226.3	212.6	226.2
1948	227.9	349.2	305.6	229.2	464.4	134.7	208.2	571.0	127.7	118.1	143.6	52.5	244.3
1949	85.1	40.0	105.2	192.6	73.8	195.3	72.5	154.5	180.0	108.9	71.9	69.6	112.5
1950	221.4	187.2	309.7	94.5	98.9	89.4	63.7	160.4	128.4	405.2	87.5	120.8	163.9
1951	217.0	448.2	279.2	88.2	50.3	45.7	74.2	32.3	37.1	392.1	173.1	111.4	162.4
1952	124.2	93.8	59.7	40.5	31.7	114.1	130.3	50.2	264.9	357.8	264.9	107.3	136.6
1953	173.8	207.2	121.5	63.9	61.2	50.4	52.8	51.0	133.0	315.0	426.3	151.6	150.6
1954	153.2	170.2	300.9	188.0	398.5	307.1	418.1	132.3	343.6	789.5	122.9	77.6	283.5
1955	68.9	100.6	117.1	130.7	298.7	238.8	481.3	204.9	294.5	102.0	91.5	144.6	189.5
1956	247.8	250.5	115.8	189.2	298.2	129.3	118.5	173.9	401.3	235.6	117.7	94.1	197.7
1957	131.1	145.2	159.8	166.3	186.5	173.7	553.3	1,244.5	940.5	339.5	204.7	139.3	365.4
1958	115.8	238.8	520.7	158.7	105.1	246.2	111.0	215.7	389.0	283.5	253.5	295.8	244.5
1959	201.6	234.4	113.1	177.5	155.0	89.4	70.0	134.5	377.3	135.4	74.6	72.9	153.0
1960	87.2	221.5	194.7	136.0	87.4	75.6	50.0	346.7	182.2	290.1	409.9	177.2	188.2
1961	145.7	272.3	326.3	143.2	101.5	130.7	102.8	56.1	668.3	626.8	694.5	326.9	299.6
1962	143.7	146.9	203.9	81.5	136.2	93.5	134.2	76.7	288.2	233.6	163.8	96.7	149.9
1963	278.2	513.7	479.8	157.2	65.7	48.0	52.6	61.4	255.7	589.2	439.6	247.4	265.7
1964	89.9	144.0	104.2	126.1	176.5	105.8	114.1	161.4	248.1	226.5	117.5	(81.3)	141.3
1965	(67.4)	69.6	115.3	128.4	367.0	122.5	308.9	372.3	(361.1)	(280.4)	(242.0)	(451.4)	240.5
1966	(325.0)	1,046.5	384.0	238.2	151.7	343.9	191.2	142.9	(414.4)	(337.5)	(223.1)	(276.6)	339.6
1967	228.3	478.0	358.2	148.3	93.1	189.0	158.9	154.4	391.0	250.3	267.8	298.2	251.3
1968	107.6	72.6	76.9	63.1	39.2	47.2	64.8	30.5	160.2	130.9	179.0	173.3	95.4
1969	353.2	462.4	259.5	539.1	139.4	427.1	284.9	143.5	166.3	136.7	222.4	104.6	269.9
1970	185.2	183.6	166.8	113.1	113.6	303.1	291.9	177.6	207.9	196.4	93.9	258.7	191.0
1971	604.0	348.2	486.3	352.9	347.9	450.9	356.3	174.4	194.1	229.9	78.8	59.2	306.9
1972	99.2	404.5	220.4	175.7	58.3	177.6	189.2	568.7	558.4	417.9	258.6	300.1	285.7
1973	275.3	307.3	152.4	150.6	227.3	417.9	374.5	748.3	612.5	259.8	189.8	164.8	323.4
1974	374.0	344.9	469.7	165.4	88.2	125.4	254.9	107.8	277.5	114.2	117.5	66.4	208.8
1975	138.2	109.3	229.7	103.1	110.0	139.4	109.5	307.5	599.0	612.8	278.9	637.2	281.2
1976	353.5	166.4	323.3	135.3	293.2	465.8	215.9	444.0	253.2	198.0	(174.3)	389.8	284.4
1977	460.2	368.7	273.6	239.0	93.7	70.9	95.2	400.7	163.3	642.3	385.6	173.3	280.5
1978	153.1	138.3	219.3	60.8	45.6	57.5	117.2	100.6	251.6	151.6	172.2	284.9	146.1
1979	107.4	69.6	78.6	109.7	403.4	131.3	142.0	134.5	196.6	726.3	421.5	349.2	239.2
1980	239.3	167.6	383.4	142.7	123.4	118.6	391.7	585.4	519.4	323.7	303.5	702.3	333.4
1981	383.7	283.9	139.7	99.2	78.0	67.1	91.1	73.4	122.2	171.0	169.7	271.2	162.5
1982	109.8	373.3	212.1	130.2	110.4	236.4	315.1	212.6	131.5	362.9	747.6	340.0	273.5
1983	405.7	434.0	583.2	270.3	766.0	673.0	2,026.3	723.6	503.2	322.5	241.0	400.7	612.5
1984	216.3	172.8	234.3	181.7	227.3	396.4	310.3	1,133.8	321.8	335.6	379.0	208.6	343.2
1985	110.7	349.3	164.3	275.2	124.5	72.4	115.5	56.3	113.8	116.5	171.0	41.5	142.6
1986	62.6	151.0	112.8	120.8	58.0	91.0	62.3	77.5	154.0	(274.6)	(337.8)	(419.7)	160.2
1987	(427.5)	450.6	122.1	115.5	444.6	294.2	201.3	251.1	169.9	436.5	128.0	97.6	261.6
1988	148.0	167.9	126.6	123.3	508.6	261.0	117.7	69.2	166.3	205.3	96.8	67.3	171.5
Mean	200.0	255.6	220.1	152.9	169.7	188.7	210.5	255.5	274.8	296.2	220.3	197.3	220.1

Remarks:
Values in parenthese show monthly mean discharges interporated by using daily data at Apiuna.

Table I.3.9 MONTHLY MEAN DISCHARGE AT BRUSQUE

(Unit : cu.m/s)

Year	Month												Mean
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1934	-	-	-	-	-	-	-	-	-	-	-	25.8	-
1935	24.3	18.8	27.7	29.9	12.2	26.2	15.6	32.6	33.3	64.3	23.6	17.8	27.2
1936	34.2	22.5	12.6	15.4	14.5	35.3	25.2	72.2	57.2	47.4	26.1	18.3	31.7
1937	17.5	22.9	32.4	39.0	37.0	17.6	15.4	25.4	22.7	40.8	29.0	25.4	27.1
1938	31.2	33.2	26.6	28.0	28.2	32.6	20.8	15.5	14.5	23.0	20.8	19.6	24.5
1939	17.2	28.2	20.5	15.8	23.7	21.2	17.9	12.0	31.3	29.5	64.6	36.0	26.5
1940	49.4	43.0	25.7	22.1	27.1	13.0	25.7	38.4	19.3	31.3	27.1	29.1	29.3
1941	22.0	30.2	24.8	17.9	21.5	32.1	12.4	27.4	20.2	18.9	33.9	21.0	23.5
1942	20.0	37.2	19.5	19.2	17.4	20.7	16.6	14.0	12.1	12.2	9.8	18.2	18.1
1943	12.7	14.3	12.2	9.4	12.5	22.8	20.8	51.7	36.0	32.6	19.1	15.2	21.6
1944	29.0	23.7	24.3	17.0	11.0	10.9	10.3	11.4	11.7	10.7	19.3	9.0	15.7
1945	9.4	38.0	14.5	17.3	11.7	9.5	11.7	8.1	17.6	16.9	9.1	12.8	14.7
1946	16.2	39.8	31.2	20.8	19.4	27.4	38.3	26.7	18.0	22.8	18.7	15.7	24.6
1947	19.8	33.8	29.8	13.7	14.1	14.0	16.3	21.5	29.5	50.9	27.1	35.6	25.5
1948	27.7	36.9	36.0	25.9	51.5	25.5	32.8	61.9	22.0	20.6	18.9	12.7	31.0
1949	13.0	16.0	33.6	31.3	16.5	28.4	14.2	20.0	21.1	15.7	13.4	10.8	19.5
1950	27.1	29.6	44.3	19.2	17.2	15.5	11.9	23.1	18.5	34.4	14.1	20.0	22.9
1951	24.3	24.7	25.8	12.0	9.1	8.6	11.4	7.6	6.8	26.6	14.1	17.1	15.7
1952	18.7	15.7	11.9	8.0	7.6	11.8	14.3	8.0	16.1	28.6	23.4	12.1	14.7
1953	20.0	14.8	11.8	7.5	7.9	7.4	7.5	7.0	9.7	27.6	25.5	13.5	13.4
1954	16.9	21.5	21.3	33.1	37.1	27.4	37.7	15.5	29.5	62.5	23.3	20.0	28.8
1955	16.1	18.9	16.0	17.9	24.1	19.7	36.9	22.4	29.9	14.0	14.9	22.3	21.1
1956	28.6	25.9	15.3	14.8	23.7	15.2	14.0	15.1	36.8	22.2	22.9	27.1	21.8
1957	22.8	25.5	15.5	19.3	24.0	17.3	42.9	81.3	87.7	42.1	44.8	27.2	37.5
1958	22.9	27.0	43.2	25.6	17.1	26.4	18.5	21.7	36.0	29.1	37.7	23.8	27.4
1959	21.0	29.0	21.5	30.8	19.7	16.6	12.4	22.6	36.4	21.3	18.2	19.2	22.4
1960	28.3	56.7	51.4	24.5	19.1	15.8	17.0	44.8	24.0	26.1	36.9	26.4	30.9
1961	19.5	31.0	28.9	23.9	21.3	23.7	19.5	12.8	52.2	42.1	88.1	57.1	35.0
1962	31.3	34.5	43.4	22.0	27.3	21.0	25.7	14.5	29.9	24.5	27.0	23.6	27.1
1963	37.3	54.5	39.3	27.8	14.4	14.8	14.3	13.6	37.0	52.8	45.6	25.8	31.4
1964	19.4	15.1	16.7	15.1	17.6	12.6	13.5	15.4	22.8	23.4	(13.5)	17.0	16.8
1965	15.5	14.2	(16.3)	25.7	29.1	16.2	22.3	23.5	29.3	24.4	25.7	32.5	22.9
1966	37.6	68.2	34.0	31.9	23.3	(35.1)	(21.1)	(19.7)	(66.8)	(39.8)	(20.3)	(30.4)	35.7
1967	38.9	51.6	39.9	24.5	21.4	20.9	19.1	19.4	39.0	26.5	22.2	25.5	29.1
1968	16.6	13.9	12.2	10.8	8.8	9.4	9.3	8.2	14.5	14.6	19.4	14.6	12.7
1969	32.8	23.9	34.1	43.3	14.4	37.2	30.6	18.6	18.3	16.5	29.7	18.2	26.5
1970	23.3	22.9	26.5	19.1	15.8	22.6	25.5	19.2	16.2	15.5	13.9	22.4	20.2
1971	36.4	21.7	43.9	43.4	32.5	31.6	30.1	20.1	29.9	25.9	13.2	10.7	28.3
1972	15.5	40.7	17.5	11.6	8.9	16.3	17.3	60.4	43.8	33.2	31.0	45.0	28.4
1973	41.3	35.5	21.3	19.5	20.4	(31.0)	(31.6)	(57.9)	47.2	30.5	28.9	23.0	32.3
1974	42.7	42.1	58.6	26.5	16.7	18.3	22.4	15.2	36.0	12.2	18.1	10.1	26.6
1975	15.9	10.8	13.8	10.1	12.1	13.7	14.0	30.1	65.4	68.7	34.3	74.7	30.3
1976	47.6	28.5	37.0	20.0	40.6	51.0	36.3	58.4	29.3	22.5	27.2	31.2	35.8
1977	38.5	55.4	27.1	25.6	12.3	9.2	10.7	51.0	29.0	63.8	53.3	26.2	33.5
1978	25.3	21.2	22.5	9.5	8.1	10.3	12.6	8.8	22.8	17.8	18.6	38.2	18.0
1979	14.3	12.3	10.2	23.3	31.8	15.6	14.9	12.8	22.9	61.7	35.7	22.7	23.2
1980	20.9	16.9	24.7	19.3	12.6	10.7	31.4	47.0	40.1	36.3	30.0	62.2	29.3
1981	34.3	23.3	21.4	16.1	13.2	12.3	13.1	10.9	11.1	33.0	23.8	28.5	20.1
1982	16.9	44.0	25.0	19.8	17.2	23.2	22.8	20.7	15.0	28.7	49.1	25.5	25.7
1983	52.9	50.1	57.8	37.4	83.8	66.7	196.6	83.3	54.7	36.5	30.7	59.1	67.5
1984	38.0	33.7	27.7	22.7	22.6	30.5	30.8	(153.6)	(47.3)	(37.2)	(31.4)	27.1	41.9
1985	20.6	28.3	20.1	24.5	18.9	11.7	15.3	8.9	12.8	13.7	21.5	10.0	17.2
1986	5.0	9.3	4.2	4.8	2.5	2.7	1.8	2.8	5.5	19.2	10.0	14.6	6.9
1987	22.8	24.6	6.9	5.9	21.6	12.6	9.2	12.5	8.1	26.3	6.0	5.0	13.5
1988	10.7	7.2	3.6	2.9	10.0	7.2	2.2	0.6	5.8	3.7	1.0	0.7	4.6
1989	24.6	15.7	9.9	7.4	15.4	-	-	-	-	-	-	-	-
Mean	25.2	28.7	25.3	20.5	20.4	20.5	22.8	28.3	28.7	30.1	26.0	24.2	25.1

Remarks:
Values in parenthese show monthly mean discharges interporated by using daily data at Apiuna.

Table I.3.10 ANNUAL MAXIMUM FLOOD PEAK DISCHARGES IN THE ITAJAI RIVER BASIN (1/2)

Year	Rio do Sul		Apiuna		Indaial		Ituporanga	
	Date	Discharge (cms)	Date	Discharge (cms)	Date	Discharge (cms)	Date	Discharge (cms)
1934	-	-	Feb. 25	1,111	Apr.26	1,037	-	-
1935	-	-	Sep.24	1,914	Sep.24	2,684	Sep.19	262
1936	-	-	Aug.6	1,507	Aug. 6	1,913	Aug.5	500
1937	-	-	Oct.16	950	Oct.16	1,279	Oct.15	400
1938	-	-	Jun.27	1,111	Jun.27	1,995	Feb.12	208
1939	-	-	Nov.26	1,742	Nov.26	2,590	Nov.26	606
1940	-	-	Aug.26	1,033	Aug.26	1,256	Aug.25	332
1941	-	-	Nov.17	918	Nov.18	996	Nov.17	197
1942	Mar.31	465	Feb.8	881	Feb.20	1,410	Mar.31	85
1943	Aug.2	1,090	Aug.3	1,960	Aug. 3	2,220	Aug.2	930
1944	Mar.14	324	Mar.14	495	Mar.14	645	Mar.13	205
1945	Feb.19	270	Feb.20	566	Feb.20	849	Apr.12	110
1946	Aug.29	801	Aug.29	1,280	Feb. 2	1,755	Aug.29	494
1947	Oct.26	645	Sep.2	1,100	Oct.26	1,256	Oct.25	370
1948	Aug.2	1,080	May 17	2,250	Aug. 2	2,372	May 17	775
1949	Jun.12	338	Apr.3	702	Jun.12	760	Jun.11	197
1950	Oct.17	992	Oct.17	1,680	Oct.17	2,308	Oct.16	540
1951	Oct.19	675	Oct.19	1,260	Oct.19	1,545	Oct. 18	340
1952	Sep.7	518	Sep.7	909	Sep. 7	1,332	Jan.25	271
1953	Oct.31	780	Nov.1	1,620	Nov. 1	2,724	Oct.31	350
1954	Oct.22	1,470	Oct.22	2,630	May.18	1,845	Oct.21	1,090
1955	Jul.7	846	May 19	1,890	May.19	3,060	Jul.6	920
1956	Jan.31	730	Sep.20	881	Sep.20	1,079	Sep.24	450
1957	Aug.19	1,190	Aug.18	3,090	Aug.18	5,468	Aug.18	800
1958	Mar.19	666	Mar.19	1,220	Mar.19	1,545	Nov.17	740
1959	Sep.5	535	Sep.2	936	Sep. 2	1,126	Apr.26	775
1960	Aug.18	682	Aug.18	1,240	Aug.18	1,425	Aug.18	560
1961	Nov.3	1,020	Nov.2	2,160	Nov. 2	2,468	Nov.1	800
1962	Sep.20	801	Sep.20	1,550	Sep.20	1,740	Sep.21	472
1963	-	-	Sep.29	1,750	Sep.29	2,010	Sep.27	1,060
1964	-	-	May 2	648	May. 2	795	Oct.8	231
1965	-	-	Aug.21	1,460	Aug.21	1,965	-	-
1966	Feb.16	1,180	Feb.17	1,830	Feb.10	2,180	Feb.15	516
1967	Sep.22	441	Feb.26	859	Feb.27	1,256	Mar.28	280
1968	Dec.25	532	Dec.25	562	Dec.25	760	Dec.24	342
1969	Feb.19	750	Apr.5	1,730	Feb.20	1,560	Apr.4	538
1970	Jul.2	637	Jul.2	1,020	Jul. 2	1,338	Jul.1	599
1971	Jun.9	1,000	Jun.9	2,030	Jun. 9	2,356	Jul.4	472
1972	Aug.28	1,210	Aug.28	2,210	Aug.28	2,340	Aug.4	750
1973	Jul.22	1,120	Aug.29	2,310	Aug.29	2,900	Jul.22	725
1974	Feb.25	458	Sep.1	951	Jan. 9	1,244	Sep.6	216
1975	Oct.3	1,050	Oct.3	2,760	Oct. 2	2,980	Oct.2	494
1976	Aug.10	638	May 29	1,575	May.29	1,830	Jan.13	261
1977	Aug.18	969	Aug.17	1,764	Nov.12	1,995	Nov.11	305
1978	Dec.26	750	Dec.26	2,156	Dec.26	2,840	Sep.15	197
1979	Oct.9	668	May 9	1,847	Oct. 9	2,308	Oct.13	213
1980	Dec.21	1,290	Dec.21	3,086	Dec.21	3,700	Aug.22	418
1981	Jan.01	432	Dec.23	927	Dec.23	1,197	Jan.4	161
1982	Nov.15	677	Nov.15	1,539	Nov.15	1,920	Nov.6	229
1983	Jul.12	2,560	Jul.12	4,327	Jul. 9	4,790	Jul.10	800
1984	Aug.7	2,370	Aug.7	4,314	Aug. 7	5,030	Aug.7	1,066
1985	-	-	Feb.15	836	Jun.16	1,380	Jul.7	159
1986	Nov.6	823	Nov.6	1,307	-	-	Nov.5	490
1987	May 15	703	May 21	1,297	May 24	1,560	May 14	503
1988	-	499	-	1,297	May 21	1,680	-	189
1989	-	720	-	1,450	Jan. 5	1,070	-	309

Table I.3.10 ANNUAL MAXIMUM FLOOD PEAK DISCHARGES IN THE ITAJAI RIVER BASIN (2/2)

Year	Taio		Ibirama		Timbó		Brusque	
	Date	Discharge (cms)	Date	Discharge (cms)	Date	Discharge (cms)	Date	Discharge (cms)
1934	Jan.25	322	-	-	-	-	-	-
1935	Sep.24	377	Sep.24	1,342	Sep.24	542	Aug.20	195
1936	Aug.28	269	Aug.6	625	Aug.28	310	Sep.24	218
1937	Oct.15	258	Nov.17	619	Apr.15	509	Oct. 7	152
1938	Jun.27	269	Jun.27	797	Jan.29	379	Jun.27	122
1939	Jun.29	309	Nov.26	1,250	Nov.19	525	Nov.18	239
1940	Jan.27	252	Aug.26	271	Oct.22	392	Oct.22	175
1941	Mar.15	281	Oct.10	263	May 28	141	May 28	285
1942	Feb.8	188	Feb.8	566	Feb.8	408	Feb. 7	128
1943	Aug.3	348	Aug.3	649	Aug.22	332	Aug. 2	239
1944	Mar.13	261	Jan.13	236	Nov.26	445	Jan.21	123
1945	Feb.18	167	Jul.10	474	Jul.9	331	Sep.16	101
1946	Feb.2	325	Jun.23	804	Feb.2	668	Aug.29	153
1947	Sep.2	227	Sep.25	592	Oct.25	332	Oct.25	197
1948	May 18	394	May 27	981	May 17	625	Aug. 6	216
1949	Apr.2	185	Apr.2	438	Apr.2	258	Mar.27	151
1950	Oct. 17	347	Oct. 17	675	Mar.2	559	Oct.17	173
1951	Oct.19	332	Oct.19	556	Oct.19	220	Oct.19	160
1952	Sep.7	285	Oct.19	393	Jun.17	256	Oct.19	133
1953	Nov.1	329	Oct.31	726	Dec.31	474	Oct.31	202
1954	Oct.22	444	Oct.21	897	Oct.22	486	Oct.22	335
1955	May 19	305	May 19	969	May 19	424	May 19	128
1956	Jan.30	230	Jan.30	566	Apr.28	240	Sep.20	119
1957	Aug.19	430	Aug.18	1,300	Aug.18	486	Aug. 2	211
1958	Mar.17	351	Mar.26	526	Feb.21	448	Mar.15	194
1959	Sep.4	168	Sep.2	520	Sep.2	210	Sep. 2	112
1960	Oct.127	309	Nov.11	487	Nov.28	527	Aug.18	205
1961	Sep.12	370	Sep.12	897	Nov.1	587	Nov. 1	304
1962	Sep.20	282	Sep.20	582	Sep.21	217	Mar. 2	159
1963	Feb.1	470	Nov.10	510	Jan.30	432	Sep.28	208
1964	May 1	186	-	-	May 1	210	Oct. 9	85
1965	Aug.21	267	May 15	708	May 15	733	-	-
1966	Feb.14	380	Feb.11	998	Jan.5	217	-	-
1967	Feb.26	283	Feb.18	477	-	-	-	-
1968	Dec.25	201	Dec.25	298	Jan.12	339	-	-
1969	Feb.20	378	Apr.8	872	-	-	Apr. 5	198
1970	Dec.31	213	Jul.2	483	-	-	Jul. 2	135
1971	Jun.9	353	Jun.9	1,040	Jan.6	339	Jul. 5	157
1972	Aug.29	345	Aug.28	1,010	-	-	Aug. 4	360
1973	Jul.22	248	Jun.25	1,240	Aug.28	604	Aug.28	240
1974	Feb.24	217	Sep.1	697	Mar.23	770	Jan. 9	234
1975	Oct.3	322	Oct.2	1,406	Oct.2	580	Oct. 3	296
1976	Dec.1	295	Aug.10	801	Jun.11	292	Aug.10	248
1977	Aug.18	312	Oct.17	741	Nov.12	429	Nov.12	277
1978	Dec.26	225	Dec.26	1,002	Dec.26	559	Dec.26	600
1979	May 9	248	May 9	1,090	-	-	Oct.14	220
1980	Dec.21	334	Dec.21	2,500	Dec.21	687	Jul.30	356
1981	Jan.1	202	Dec.23	589	Jan.5	289	Oct.29	296
1982	Nov.6	240	Nov.15	490	Nov.15	396	Feb. 5	214
1983	Jul.10	560	Jul.8	2,415	Jul.12	930	Jul.12	580
1984	Aug.7	240	Aug.6	2,125	Aug.7	854	Aug. 8	990
1985	Nov.4	238	Apr.6	349	Apr.6	263	Nov.21	180
1986	Nov.6	270	Nov.6	365	Sep.21	248	Nov. 7	226
1987	Jan.17	259	May 21	725	Feb.14	429	May 15	214
1988	-	261	-	823	-	-	Sep.21	74
1989	-	265	-	834	Jan.5	647	Jan. 6	146

Table I.3.11 SEDIMENT CONCENTRATION RECORDS IN THE ITAJAI RIVER BASIN (1/2)

(1) Apiuna

Date	Gage Height (m)	Discharge (cms)	Sediment Concentration (ppm)	Sediment Yield (ton/day)
Mar.20 '81	0.58	62.3	49.9	268.6
Jun.16	0.50	44.7	45.8	176.9
Sep.22	0.58	56.2	37.8	183.5
Dec.27	1.30	280.0	52.5	1270.1
Jan.16 '82	0.58	64.6	29.9	166.9
Mar.17	0.69	84.3	9.1	66.3
Jul.8	0.90	142.0	50.3	617.1
Sep.8	0.85	129.0	35.8	399.0
Nov.19	1.90	553.0	31.6	1509.8
Apr.25 '83	1.36	298.0	68.8	1771.4
Jun.22	1.58	344.0	39.1	1162.1
Oct.21	1.12	208.0	180.9	3251.0
Jan.20 '84	1.06	177.0	244.7	3742.1
Mar.2	1.48	317.0	144.0	3944.0
Jul.21	1.50	351.0	56.5	1713.4
Jan.25 '85	0.62	67.0	41.0	237.3
Oct.15	1.08	178.0	81.8	1258.0
Jan.18 '86	0.56	51.8	22.0	98.5
Jul.27	0.50	48.6	43.0	180.6
Oct.11	2.37	773.0	156.0	10418.8
Apr.25 '87	0.61	89.8	10.0	77.6
Jul.16	0.99	191.0	83.0	1369.7
Oct.21	2.33	811.0	66.0	4624.6
Jan.15 '88	0.72	96.4	8.0	66.6
Apr.30	0.93	171.0	24.0	354.6

(2) Barra do Prata

Date	Gage Height (m)	Discharge (cms)	Sediment Concentration (ppm)	Sediment Yield (ton/day)
May.19 '79	1.55	35.8	15.6	48.3
Mar.19 '81	0.97	8.0	109.0	75.3
Jun.9 '81	0.81	4.0	53.2	18.4
Sep.27	1.63	43.4	268.5	1006.8
Dec.26	1.48	28.8	18.9	47.0
Jan.12 '82	1.37	23.1	43.8	87.4
Mar.23	1.50	28.7	93.3	231.4
Sep.15	1.18	14.9	44.2	56.9
Nov.31	2.03	89.0	49.2	378.3
Apr.29 '83	1.35	24.1	22.4	46.6
Jun.29	1.94	61.5	46.4	246.6
Oct.23	1.88	62.0	251.3	1346.2
Jan.17 '84	1.20	14.5	108.4	135.8
Jan.22	1.26	16.5	138.5	197.4
Apr.23	1.30	19.4	18.1	30.3
Jul.20	0.90	5.1	13.1	5.8
Jul.21	1.52	34.4	28.4	84.4
Oct.17	1.26	17.7	18.4	28.1
Jan.17 '85	1.20	14.5	108.0	135.3
Apr.23	1.30	19.4	18.0	30.2
Jul.20	0.90	5.1	13.0	5.7
Jul.25 '86	0.86	5.3	10.0	4.6
Oct.26	1.44	28.0	25.0	60.5
Jan.23 '87	1.44	35.9	13.0	40.3
Apr.27	0.91	6.1	6.0	3.2
Jul.18	1.21	19.5	4.0	6.7
Oct.18	1.54	45.0	16.0	62.2
Jan.16 '88	1.00	7.1	27.0	16.6
May 1	1.03	9.7	84.0	70.4

(3) Brusque

Date	Gage Height (m)	Discharge (cms)	Sediment Concentration (ppm)	Sediment Yield (ton/day)
Apr.22 '77	1.31	19.5	23.7	39.9
Aug.29	1.47	27.0	46.0	107.3
Oct.19	2.36	71.6	183.1	1132.7
Aug.7 '78	0.98	7.8	20.2	13.6
Oct.6	1.05	10.1	29.3	25.6
Dec.8	1.21	15.8	53.0	72.4
Mar.8 '79	0.99	8.1	64.7	45.3
Feb.21 '81	1.41	24.0	159.7	331.2
May.12	1.09	11.9	44.2	45.4
Aug.24	0.99	7.9	78.1	53.3
Nov.27	1.14	11.8	43.7	44.6
Feb.19 '82	1.54	32.0	253.0	699.5
Jun.11	1.19	14.6	43.9	55.4
Aug.6	1.18	15.2	38.4	50.4
Oct.8	2.90	125.0	820.8	8864.6
Dec.4	1.63	43.2	136.3	508.7
Dec.22 '83	2.28	81.2	203.9	1430.5
Feb.21 '84	1.41	22.1	21.3	40.7
May.12	1.26	15.9	42.8	58.8
May.25	2.30	64.7	169.1	945.3
Nov.23	1.71	38.1	80.6	265.3
May.23 '85	1.04	16.6	32.8	47.0
Aug.25	0.78	9.0	23.6	18.4
Feb.26 '86	1.12	23.4	292.0	590.4
May 24	0.82	7.3	32.0	20.2
Nov.22	0.79	11.8	6.0	6.1
Feb.18 '87	2.00	57.6	164.0	816.2
May 15	2.00	60.9	292.0	1536.4
Aug.20	1.30	32.2	68.0	189.2
Nov.24	0.84	15.3	7.0	9.3
Feb.25 '88	0.80	12.6	3.0	3.3
May 21	1.05	20.6	3.0	5.3

(4) Rio do Sul Novo

Date	Gage Height (m)	Discharge (cms)	Sediment Concentration (ppm)	Sediment Yield (ton/day)
Feb.26 '79	0.87	22.3	91.2	175.7
May.5	1.68	82.4	25.1	178.7
Mar.17 '81	1.06	32.3	57.1	159.4
Jun.11	1.06	32.3	65.9	183.9
Sep.23	1.68	82.4	35.1	249.9
Dec.10	1.40	57.7	54.7	272.7
Jan.14 '82	1.14	38.0	18.2	59.8
Mar.24	2.22	122.0	90.2	950.8
Sep.9	1.45	62.7	176.8	957.8
Nov.22	3.72	303.0	58.4	1528.9
Jan.24 '83	1.80	92.0	26.4	209.8
Mar.15	1.17	43.3	32.9	123.1
Apr.26	2.30	126.0	63.2	688.0
Jun.27	4.39	433.0	32.3	1208.4
Jul.17	3.70	268.0	83.6	1935.8
Oct.23	2.40	130.0	120.6	1354.6
Oct.9 '84	5.70	522.0	324.3	14626.2
Jan.15 '85	1.08	34.3	70.1	207.7
Oct.16	0.9	25.3	39.0	85.3
Jan.16 '86	0.82	21.2	85.0	155.7
Jul.19	1.06	36.4	51.0	160.4
Oct.15	2.08	120.0	62.0	642.8
Jan.20 '87	4.68	499.0	95.0	4095.8
Apr.23	1.28	52.9	5.0	22.9
Jul.16	2.06	107.0	31.0	286.6
Oct.21	5.03	503.0	60.0	2607.6
Apr.28 '88	2.96	209.0	167.0	3015.6

Table I.3.11 SEDIMENT CONCENTRATION RECORDS IN THE ITAJAI RIVER BASIN (2/2)

(5) Indaial

Date	Gage Height (m)	Discharge (cms)	Sediment Concentration (ppm)	Sediment Yield (ton/day)
Aug.12 '76	3.04	803.0	120.0	8325.5
Oct.27	1.75	223.0	79.9	1539.4
Dec.9	3.15	849.0	282.0	20685.7
Dec.12	3.04	784.0	120.4	8155.6
May.17 '77	1.27	84.0	35.2	255.5
Jul.26	1.72	239.0	261.0	5389.5
Sep.21	1.49	138.0	45.8	546.1
Jul.18 '78	1.14	63.9	47.0	259.5
Sep.13	1.45	134.0	29.0	335.8
Nov.17	1.26	82.0	23.2	164.4
May 29 '79	1.56	161.0	22.5	313.0
Mar.22 '81	1.30	90.0	57.8	449.5
Jun.17	1.16	72.0	62.8	390.7
Sep.20	1.06	50.0	37.5	162.0
Dec.5	1.47	140.0	37.5	453.6
Jan.9 '82	1.40	123.0	33.9	360.3
Mar.16	1.44	132.0	15.8	180.2
Sep.22	1.30	106.0	62.2	569.7
Nov.18	3.05	854.0	71.6	5283.0
Apr.18 '83	1.98	312.0	105.3	2838.6
Jun.15	2.40	485.0	113.8	4768.7
Oct.20	2.10	348.0	104.2	3133.0
Jan.18 '84	1.70	212.0	459.7	8420.2
Mar.24	1.98	310.0	96.0	2571.3
Jul.23	2.29	398.0	224.3	7713.0
Oct.22	1.62	181.0	116.0	1814.1
Jan.26 '85	1.26	70.5	86.1	524.5
Jul.11	1.45	135.0	109.4	1276.0
Jan.15 '86	1.06	46.3	73.0	292.0
Jul.15	1.06	46.1	43.0	171.3
Oct.10	2.90	676.0	164.0	9578.6
Apr.23 '87	1.45	190.0	9.0	147.7
Jul.22	1.70	240.0	30.0	622.1
Oct.20	3.34	1159.0	116.0	11616.0
Jan.14 '88	1.38	103.0	30.0	267.0
Apr.28	1.96	361.0	70.0	2183.3
Dec.12	1.06	48.8	12.1	51.0
Dec.13	1.09	52.7	13.0	59.2
Dec.14	1.10	54.0	10.6	49.5
Dec.15	1.32	95.4	10.0	82.4
Dec.16	1.24	78.0	8.6	58.0
Jan. 2 '89	1.38	112.0	22.0	212.9
Jan. 3	1.35	104.0	23.1	207.6
Jan. 4	1.41	119.0	24.4	250.9
Jan. 5	3.05	790.0	158.6	10825.4
Jan. 6	2.66	300.0	163.7	4243.1
Jan.30	3.06	795.0	288.0	19782.1
Jan.31	3.34	961.0	197.7	16415.1
Feb. 1	3.31	943.0	411.9	33559.6
Feb. 2	3.57	1096.0	297.9	28209.5
Feb. 3	2.93	732.0	267.7	16930.6
Feb.27	2.31	445.0	82.3	3164.3
Feb.28	1.98	311.0	64.4	1730.5
Mar. 1	2.41	494.0	111.4	4754.7
Mar. 2	2.14	382.0	140.1	4624.0
Mar. 3	1.98	311.0	131.0	3520.0
Jul.17	1.24	78.0	6.3	42.7
Jul.18	1.23	76.0	4.1	26.7
Jul.19	1.23	76.0	3.8	25.0
Aug. 2	1.77	230.0	49.7	988.3
Aug. 3	1.66	193.0	23.3	389.1
Aug. 4	1.58	168.0	13.7	198.4

Table I.3.12 MONTHLY SEDIMENT DISCHARGE AT INDAIAL

(Unit : thousand cu.m)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	-	-	7.1	95.0	12.4	4.8	10.4	14.8	15.7	56.7	7.1	11.1	-
1935	6.6	4.6	17.2	2.6	1.1	5.0	8.4	44.2	233.9	419.3	17.8	17.0	777.7
1936	113.6	8.1	5.3	3.2	7.1	102.1	16.7	295.9	164.7	100.9	15.5	10.6	843.7
1937	11.5	15.0	56.5	77.9	15.4	5.5	3.0	32.7	7.8	114.6	66.8	9.9	416.6
1938	97.7	83.6	18.8	50.8	60.5	192.6	93.5	11.0	6.8	7.3	6.8	6.0	635.4
1939	16.4	16.5	46.6	14.9	25.1	55.6	25.9	3.2	56.8	27.9	378.6	169.4	836.9
1940	85.0	31.8	23.6	20.4	14.1	3.7	19.9	120.2	10.9	34.4	9.4	21.2	394.6
1941	30.4	47.0	39.3	7.9	26.1	48.8	9.6	77.7	26.2	41.3	71.8	28.0	454.1
1942	10.8	158.8	44.3	47.5	27.6	59.5	25.1	26.4	17.2	14.8	6.5	11.8	450.3
1943	9.1	12.6	3.8	2.1	18.7	100.2	55.8	306.6	61.8	31.9	17.3	8.3	628.2
1944	45.2	12.7	48.6	6.2	1.9	2.2	2.0	7.2	6.1	3.5	26.4	4.3	166.3
1945	1.8	51.1	8.6	5.6	1.5	2.0	19.5	2.4	12.3	30.6	3.4	6.5	145.3
1946	45.3	241.9	145.5	31.8	14.8	116.3	111.8	89.8	20.2	56.0	13.0	26.8	913.2
1947	24.2	76.6	36.6	4.9	9.2	15.8	26.5	49.8	191.9	185.8	47.1	41.2	709.6
1948	55.5	102.0	81.9	55.6	285.3	17.2	55.2	317.0	15.3	15.6	20.2	3.3	1,024.1
1949	9.8	1.8	12.3	49.2	6.3	46.7	5.7	25.0	31.8	11.7	5.6	6.2	212.1
1950	48.3	29.3	111.6	8.9	13.3	8.8	5.0	38.1	19.0	216.9	7.7	15.7	522.6
1951	42.8	145.0	69.6	8.1	3.0	2.7	7.5	1.3	2.0	181.2	28.0	12.9	504.1
1952	21.1	9.3	4.1	2.1	1.7	21.4	19.9	3.0	88.0	132.9	70.6	12.1	386.2
1953	29.0	40.7	15.5	4.6	5.0	3.1	4.0	4.2	22.6	126.2	233.1	24.8	512.8
1954	25.8	40.8	103.5	44.4	186.3	82.9	135.4	17.0	102.3	636.3	14.7	6.7	1,396.1
1955	6.0	9.9	16.8	16.9	192.3	59.5	225.6	38.0	102.2	10.8	9.1	26.8	713.9
1956	78.9	54.3	13.5	34.4	89.6	16.1	14.0	28.3	151.2	47.0	14.3	10.3	551.9
1957	19.7	22.7	27.6	34.8	34.2	48.3	274.3	1,287.4	556.2	109.5	35.7	18.4	2,468.8
1958	15.4	63.7	263.2	23.4	12.0	66.7	12.6	54.5	129.4	77.3	57.0	75.9	851.1
1959	36.6	45.2	12.7	39.2	26.5	8.4	5.3	23.2	127.4	17.6	5.9	6.0	354.0
1960	8.7	43.6	39.7	23.4	9.5	7.4	2.9	120.3	35.8	93.8	144.2	30.5	559.8
1961	21.5	61.2	113.6	19.2	10.8	19.8	11.2	3.6	389.6	299.8	457.2	95.2	1,502.7
1962	19.3	19.1	44.9	6.8	26.8	8.9	19.3	6.6	129.2	51.7	26.0	10.7	369.3
1963	112.5	237.1	209.8	25.3	4.8	2.6	3.9	4.8	162.7	244.5	178.4	57.9	1,244.3
1964	8.9	21.5	11.4	17.1	39.8	12.1	14.4	27.7	51.8	47.1	15.2	7.5	274.5
1965	5.6	5.3	15.2	18.3	135.8	15.2	87.7	199.0	107.8	76.1	60.1	161.6	887.7
1966	84.7	691.8	126.9	48.5	21.2	128.5	39.5	25.6	151.4	96.3	46.3	70.2	1,530.9
1967	44.2	171.4	108.4	21.9	9.3	40.3	25.5	31.3	125.2	56.8	76.7	92.2	803.2
1968	11.8	5.8	6.8	4.6	1.9	2.9	5.8	1.2	38.7	23.9	35.0	52.7	191.1
1969	115.8	181.2	62.1	282.0	19.1	172.0	85.9	25.8	25.2	17.9	44.1	11.6	1,042.7
1970	38.6	29.7	28.3	13.5	14.0	85.5	99.3	35.7	39.2	35.4	9.4	85.2	513.8
1971	302.5	90.5	170.3	121.1	119.2	216.6	145.8	29.4	34.2	54.5	6.5	4.2	1,294.8
1972	12.4	167.5	45.3	33.8	3.8	46.3	35.2	371.0	224.8	147.6	54.3	94.2	1,236.2
1973	67.8	70.3	21.7	24.2	53.9	244.1	160.4	561.0	250.5	57.4	32.1	25.2	1,568.6
1974	122.5	100.3	160.8	27.8	8.0	15.4	99.5	12.1	83.7	16.3	14.4	5.5	666.3
1975	19.4	12.6	46.1	10.9	15.6	18.6	14.0	108.8	252.8	355.3	79.1	292.1	1,225.3
1976	103.6	23.8	88.1	17.2	134.8	179.7	50.2	172.4	64.1	38.7	32.1	136.1	1,040.8
1977	190.1	107.9	61.5	53.5	9.2	5.3	12.6	205.4	23.9	327.8	151.5	28.3	1,177.0
1978	24.6	16.7	51.8	4.1	2.5	4.0	23.1	13.8	64.5	35.7	30.7	170.7	442.2
1979	14.7	5.1	8.1	14.0	190.3	16.4	21.0	22.0	35.9	380.3	136.7	106.7	951.2
1980	51.6	27.2	127.0	22.3	15.0	18.3	149.7	285.3	209.5	85.8	81.9	471.2	1,544.8
1981	113.6	59.7	18.9	11.4	6.6	5.0	11.0	6.4	16.5	34.6	29.2	82.2	395.1
1982	13.0	102.7	41.6	18.7	16.3	64.0	97.1	41.4	17.2	117.0	385.8	93.7	1,008.5
1983	141.4	132.5	334.3	61.6	503.6	298.5	2,515.6	471.1	273.5	82.1	47.6	134.8	4,996.6
1984	39.0	27.4	51.7	27.9	51.0	163.9	79.4	1,141.5	91.9	102.9	112.9	38.7	1,928.2
1985	12.7	104.5	25.9	74.3	16.6	5.5	16.3	3.6	14.1	15.8	39.1	2.1	330.5
1986	4.9	20.4	13.6	17.2	3.8	10.4	4.6	8.0	29.0	82.1	123.7	134.6	452.3
1987	177.5	138.1	14.4	13.1	192.2	94.1	34.9	57.8	26.7	165.7	15.0	10.5	940.0
1988	21.9	26.1	16.9	16.4	202.1	56.6	13.6	5.2	41.0	49.0	9.3	5.2	463.3
Mean	51.7	74.6	60.0	31.7	53.2	55.5	92.2	125.8	94.4	107.3	66.6	56.4	878.7

Table 1.3.13 RESULT OF WATER QUALITY ANALYSIS CARRIED OUT BY DNAEE (1/4)

Location : Taio in the Itajai do Oeste River

No.	Analysed Item	Unit	Date							
			1986	1987				1988	1989	
			Apr. 9	Jan.20	Apr.21	Jul.20	Oct.20	Jan.18	Jan.12	Apr.18
(1)	Alcalinity	mg/l	14.6	10	19	17	12	16	39.4	20
(2)	Aldrin	Ug/l	ND	ND	ND	ND	ND	ND	-	-
(3)	Detergent	mg/l	0.05	0.03	0.02	0.05	0.03	0.01	-	-
(4)	Cadmium	mg/l	0.005	-	-	-	ND	ND	0.002	ND
(5)	Carbonate	mg/l	-	-	-	-	-	-	-	-
(6)	Lead	mg/l	0.02	-	0.01	-	ND	ND	ND	ND
(7)	Fecal Coliform	NMP/100ml	12	2400	290	150	44	29	220000	28000
(8)	Total Coliform	NMP/100ml	-	-	-	-	440	-	220000	22000
(9)	Conductivity	UMHO/cm	-	28.4	50.6	51.6	31.2	46.5	0.035	0.035
(10)	Colour	mgPt/l	25	100	45	35	105	125	25	20
(11)	BOD (5days)	mg/l	-	0.8	0.8	1.6	1	0.5	40	39
(12)	COD	mg/l	14	7.8	7.6	6.1	9.3	10.4	-	-
(13)	Hardness	mg/l	10.4	11	17	20	15	13	-	-
(14)	Phenol	mg/l	5	0.007	0.003	-	0.006	0.003	ND	ND
(15)	Phosphate	mg/l	-	0.07	0.1	0.07	0.04	0.13	ND	0.002
(16)	Phosphoric ion	mg/l	0.05	-	-	-	-	-	-	-
(17)	Mercury	mg/l	0.001	0.0277	-	-	0.2	ND	ND	ND
(18)	Nitrogen Nitrate	mg/l	0.7	2	1.1	1.5	2.8	2.1	0.49	0.005
(19)	Nitrogen Nitrite	mg/l	0.02	0.012	0.019	0.036	0.011	0.026	0.015	0.008
(20)	Nitrogen Amonium	mg/l	0.1	-	0.2	-	0.1	0.3	1.4	0.5
(21)	Oil and Grease	mg/l	10	10	10	10	10	10	35	6.6
(22)	DO	mg/l	7.3	6.8	5.9	8.3	8.6	8.9	5.74	9
(23)	pH		6.2	6.8	6.4	6.7	7.4	6	5.5	5.32
(24)	Suspended Solid	mg/l	-	44.6	2.1	20	53.6	83.6	20	18
(25)	Total Solid	mg/l	20	-	-	-	-	-	-	-
(26)	Water Temperature	° C	-	24	22	11	16	25	19	21
(27)	Air Temperature	° C	-	30	24	14	19	27	21	23
(28)	Turbidity	UFT	32	55	13	12	56	62	27	7.3

Location : Ibirama in the Norte River

	Analysed Item	Unit	Date							
			1986	1987				1988	1989	
			Apr. 2	Jan.21	Apr.22	Jul.20	Oct.19	Jan.19	Jan.12	Apr.18
(1)	Alcalinity	mg/l	19.7	14	15	18	13	13	39.4	20
(2)	Aldrin	Ug/l	ND	ND	ND	ND	ND	ND	-	-
(3)	Detergent	mg/l	ND	0.02	0.03	0.07	ND	0.02	-	-
(4)	Cadmium	mg/l	0.005	-	0.001	-	ND	ND	0.002	ND
(5)	Carbonate	mg/l	-	-	-	-	-	-	-	-
(6)	Lead	mg/l	0.02	0.01	0.02	-	0.01	ND	ND	ND
(7)	Fecal Coliform	NMP/100ml	120	2400	1100	290	1100	-	220000	28000
(8)	Total Coliform	NMP/100ml	-	-	-	-	1100	-	220000	22000
(9)	Conductivity	UMHO/cm	-	34.4	52.8	57.9	38.7	42.9	0.035	0.035
(10)	Colour	mgPt/l	375	50	70	75	175	175	25	20
(11)	BOD (5days)	mg/l	-	0.6	0.8	1.4	2	0.8	40	39
(12)	COD	mg/l	12	7.9	10.9	10.8	20.4	13.7	-	-
(13)	Hardness	mg/l	10	12	17	22	14	12	-	-
(14)	Phenol	mg/l	5	0.004	0.004	-	0.002	0.003	ND	ND
(15)	Phosphate	mg/l	-	0.08	0.14	0.04	0.05	0.16	ND	0.002
(16)	Phosphoric ion	mg/l	0.05	-	-	-	-	-	-	-
(17)	Mercury	mg/l	0.001	0.023	-	0.0001	0.5	ND	ND	ND
(18)	Nitrogen Nitrate	mg/l	0.6	2.7	2	2	3.5	2.7	0.49	0.005
(19)	Nitrogen Nitrite	mg/l	0.02	0.009	0.015	0.031	0.008	0.035	0.015	0.008
(20)	Nitrogen Amonium	mg/l	0.1	-	-	-	0.1	0.1	1.4	0.5
(21)	Oil and Grease	mg/l	10	10	10	10	10	10	35	6.6
(22)	DO	mg/l	7.5	9.3	-	8.5	9.2	-	5.74	9
(23)	pH		7.8	7.4	7.9	6.9	6.8	-	5.5	5.32
(24)	Suspended Solid	mg/l	-	6.6	38.2	42.4	12.4	112	20	18
(25)	Total Solid	mg/l	15	-	-	-	-	-	-	-
(26)	Water Temperature	°C	-	25	23	18	17.5	28	19	21
(27)	Air Temperature	°C	-	30	25	13	19	32	21	23
(28)	Turbidity	UFT	100	45	60	32	117	140	27	7.3

Note : ND; not detected

Table 1.3.13 RESULT OF WATER QUALITY ANALYSIS CARRIED OUT BY DNAEE (2/4)

Location : Timbo in the Benedito River

No.	Analysed Item	Unit	Date										
			1986				1987				1988	1989	
			Mar.19	Apr. 1	Jul.10	Oct.27	Jan.14	Apr.21	Jul.15	Oct.19	Jan.19	Jan.12	Apr.18
(1)	Alcalinity	mg/l	19.6	19.6	20	14	9	18	16	12	6	31.5	42
(2)	Aldrin	Ug/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-
(3)	Detergent	mg/l	0.05	0.05	0.04	0.06	0.01	0.03	0.06	0.1	0.03	-	-
(4)	Cadmium	mg/l	0.005	0.005	ND	ND	0.001	-	-	ND	ND	ND	ND
(5)	Carbonate	mg/l	-	-	-	-	-	-	-	-	-	-	-
(6)	Lead	mg/l	0.02	0.02	0.01	ND	-	0.01	0.01	ND	ND	ND	ND
(7)	Fecal Coliform	NMP/100ml	2400	2400	2400	2400	2400	1100	1100	-	-	920000	28000
(8)	Total Coliform	NMP/100ml	-	-	-	-	-	-	-	-	-	1600000	28000
(9)	Conductivity	UMHO/cm	-	-	47	18	26.4	48	41.8	33.7	33.1	0.023	0.035
(10)	Colour	mgPt/l	250	250	35	75	350	45	35	105	175	25	20
(11)	BOD (5days)	mg/l	-	-	-	1.4	1.6	0.8	0.8	1.8	0.8	55.7	82.6
(12)	COD	mg/l	9	9	6.3	9.2	29.2	10.6	6.3	17.2	18.2	-	-
(13)	Hardness	mg/l	13.8	13.8	15	11	9	14	24	15	8	-	-
(14)	Phenol	mg/l	5	5	0.003	-	0.005	0.001	0.001	0.002	0.003	ND	ND
(15)	Phosphate	mg/l	-	0.29	0.08	0.06	0.44	0.13	0.04	0.12	0.1	0.0011	0.0025
(16)	Phosphoric ion	mg/l	0.29	-	0.16	-	-	-	-	-	-	-	-
(17)	Mercury	mg/l	0.001	0.001	ND	ND	-	0.0001	-	0.2	0.0005	ND	ND
(18)	Nitrogen Nitrate	mg/l	0.5	0.5	0.5	1.3	1.4	1.3	1	1.3	1.7	0.29	14.4
(19)	Nitrogen Nitrite	mg/l	0.02	0.02	0.012	0.015	0.011	0.03	0.011	0.013	0.021	0.0025	0.0052
(20)	Nitrogen Amonium	mg/l	0.1	0.1	0.2	0.2	0.1	0.2	0.1	0.1	0.3	1.4	0.26
(21)	Oil and Grease	mg/l	98	98	35.6	10	10	10	10	10	10	94	13
(22)	DO	mg/l	7.3	7.3	8.3	8	7.5	7.4	9.5	9.2	-	4.38	3.38
(23)	pH		7	7	6.3	7.4	6.3	6.6	5.9	6.6	-	6	6
(24)	Suspended Solid	mg/l	-	12	2.6	3.4	146	14.9	10	2	83.2	8	116
(25)	Total Solid	mg/l	12	-	-	-	-	-	-	-	-	-	-
(26)	Water Temperature	° C	-	27	18	25	24	22	18	18	27	22	23
(27)	Air Temperature	° C	-	-	18	25	27	24	22.5	19.5	33	25	23
(28)	Turbidity	UFT	13	13	6.1	15	154	13	8	56	62	15.5	88

Location : Brusque in the Itajai Mirim River

	Analysed Item	Unit	Date			
			1987	1988	1989	
			Nov.24	Feb.23	Jan.12	Apr.18
(1)	Alcalinity	mg/l	18	17	42	20
(2)	Aldrin	Ug/l	ND	ND	-	-
(3)	Detergent	mg/l	0.09	0.07	-	-
(4)	Cadmium	mg/l	1	ND	ND	ND
(5)	Carbonate	mg/l	-	-	-	-
(6)	Lead	mg/l	ND	ND	ND	ND
(7)	Fecal Coliform	NMP/100ml	-	30	28000	54000
(8)	Total Coliform	NMP/100ml	-	-	28000	54000
(9)	Conductivity	UMHO/cm	53.9	56	0.035	0.035
(10)	Colour	mgPt/l	35	45	20	27.5
(11)	BOD (5days)	mg/l	1.6	-	82.6	49
(12)	COD	mg/l	3.2	17.3	-	-
(13)	Hardness	mg/l	15	16	-	-
(14)	Phenol	mg/l	0.003	0.003	ND	0.003
(15)	Phosphate	mg/l	0.05	0.06	0.0025	0.002
(16)	Phosphoric ion	mg/l	-	-	-	-
(17)	Mercury	mg/l	ND	0.0002	ND	ND
(18)	Nitrogen Nitrate	mg/l	0.6	0.6	14.4	0.01
(19)	Nitrogen Nitrite	mg/l	0.008	0.01	0.0052	0.012
(20)	Nitrogen Amonium	mg/l	0.1	ND	0.26	ND
(21)	Oil and Grease	mg/l	10	10	13	4.1
(22)	DO	mg/l	8.1	7.8	3.38	9.8
(23)	pH		7.8	5.4	6	6.58
(24)	Suspended Solid	mg/l	5.6	12.8	116	104
(25)	Total Solid	mg/l	-	-	-	-
(26)	Water Temperature	°C	23	25	23	22
(27)	Air Temperature	°C	23	28	23	22.5
(28)	Turbidity	UFT	8.7	14	88	7

Note: ND; not detected

Table I.3.13 RESULT OF WATER QUALITY ANALYSIS CARRIED OUT BY DNAEE (3/4)

Location : Ituporanga in the Itajai do Sul River

No.	Analysed Item	Unit	Date 1986 Apr. 8	1987 Jan.19	1987 Apr.22	1987 Jul.15	1987 Oct.19	1989 Jan.12	1989 Apr.18
(1)	Alcalinity	mg/l	23	10	20	15	17	57.8	31.5
(2)	Aldrin	Ug/l	ND	ND	ND	ND	ND	-	-
(3)	Detergent	mg/l	0.05	0.02	0.4	0.09	ND	-	-
(4)	Cadmium	mg/l	0.005	-	-	-	-	ND	ND
(5)	Carbonate	mg/l	-	-	-	-	-	-	-
(6)	Lead	mg/l	0.02	0.01	0.01	0.01	ND	ND	ND
(7)	Fecal Coliform	NMP/100ml	3	2400	1100	1100	-	540000	240000
(8)	Total Coliform	NMP/100ml	-	-	-	-	-	920000	240000
(9)	Conductivity	UMHO/cm	-	42.5	-	56.4	45.1	0.058	0.06
(10)	Colour	mgPt/l	375	350	35	130	225	27.5	20
(11)	BOD (5days)	mg/l	-	1.1	0.4	1.2	2.2	62	60.4
(12)	COD	mg/l	19	12.2	7.8	15.7	22	-	-
(13)	Hardness	mg/l	20.5	14	21	23	18	-	-
(14)	Phenol	mg/l	ND	0.012	0.006	0.002	0.007	ND	ND
(15)	Phosphate	mg/l	-	0.05	0.07	0.12	0.09	ND	0.002
(16)	Phosphoric ion	mg/l	0.05	-	-	-	-	-	-
(17)	Mercury	mg/l	0.001	0.0346	-	-	0.1	ND	ND
(18)	Nitrogen Nitrate	mg/l	0.7	2.8	1.9	2.6	4.2	21.23	0.008
(19)	Nitrogen Nitrite	mg/l	0.02	0.01	0.013	0.013	0.023	0.01	0.0035
(20)	Nitrogen Amonium	mg/l	0.4	-	0.1	0.1	0.1	1.4	0.3
(21)	Oil and Grease	mg/l	6	10	10	10	11.1	17	8.7
(22)	DO	mg/l	6.4	9.7	7.5	8.9	9.2	4.74	9.2
(23)	pH		7.1	6.2	6.8	5.7	7.1	6.0	6.9
(24)	Suspended Solid	mg/l	-	230	20.2	1.2	328	18	72
(25)	Total Solid	mg/l	125	-	-	-	-	-	-
(26)	Water Temperature	° C	-	22	21	19	16	21	22
(27)	Air Temperature	° C	-	29	24.5	23	18	23	24
(28)	Turbidity	UFT	130	246	13	92	108	18.5	13

Location : Rio do Sul

	Analysed Item	Unit	Date 1986 Apr. 7	1986 Jun.17	1987 Jan.19	1987 Apr.22	1987 Jul.15	1987 Oct.19	1988 Jan.18	1989 Jan.12	1989 Apr.18
(1)	Alcalinity	mg/l	22.1	23	9	17	15	10	13	42	27
(2)	Aldrin	Ug/l	ND	ND	ND	ND	ND	ND	ND	-	-
(3)	Detergent	mg/l	0.05	0.01	0.05	0.03	0.1	0.01	0.02	-	-
(4)	Cadmium	mg/l	0.005	ND	-	0.001	-	ND	ND	ND	ND
(5)	Carbonate	mg/l	-	-	-	-	-	-	-	-	-
(6)	Lead	mg/l	0.02	0.01	-	0.02	0.01	ND	10	ND	ND
(7)	Fecal Coliform	NMP/100ml	35	93	2400	1100	-	460	15	540000	160000
(8)	Total Coliform	NMP/100ml	-	-	-	-	-	460	-	540000	160000
(9)	Conductivity	UMHO/cm	-	78	35.3	59.1	49.1	39.2	48.4	-	0.047
(10)	Colour	mgPt/l	312	90	250	45	130	175	175	23.3	25
(11)	BOD (5days)	mg/l	-	-	0.7	0.8	2.6	1.8	2	78.7	30
(12)	COD	mg/l	18	18.8	6.1	9.3	14.1	15.7	10.4	-	-
(13)	Hardness	mg/l	15.3	18	11	18	25	16	14	-	-
(14)	Phenol	mg/l	ND	0.009	0.011	0.001	0.004	0.003	0.004	ND	0.002
(15)	Phosphate	mg/l	-	0.06	0.05	0.21	0.04	0.12	0.25	0.0023	0.002
(16)	Phosphoric ion	mg/l	0.05	0.35	-	-	-	-	-	-	-
(17)	Mercury	mg/l	0.001	ND	0.031	-	-	0.3	0.0006	ND	ND
(18)	Nitrogen Nitrate	mg/l	0.8	0.9	2.7	2.1	2.7	5	2.1	3.76	0.007
(19)	Nitrogen Nitrite	mg/l	0.02	0.074	0.013	0.052	0.036	0.026	0.047	0.035	ND
(20)	Nitrogen Amonium	mg/l	0.4	0.1	-	0.4	0.1	0.1	0.2	0.56	ND
(21)	Oil and Grease	mg/l	6	11.3	10	12.7	10	11.7	10	3	7
(22)	DO	mg/l	6	1.4	7.8	5.7	6.6	9.3	6.3	3.7	7.9
(23)	pH		7.6	6.4	6.3	6.6	5.5	7.3	5.9	6	6.9
(24)	Suspended Solid	mg/l	-	9.6	83	110	68.8	21.6	210.8	60	32
(25)	Total Solid	mg/l	55	-	-	-	-	-	-	-	-
(26)	Water Temperature	°C	-	17.5	24	21	19	17	26.5	21	22
(27)	Air Temperature	°C	-	16.5	27	25	25	19	28	24	25
(28)	Turbidity	UFT	67	24	154	20	88	111	150	50	12

Notes : ND; not detected

Table I.3.13 RESULT OF WATER QUALITY ANALYSIS CARRIED OUT BY DNAEE (4/4)

Location : Emilio Baumgarten bridge site in Indaial

Analysed Item	Unit	Date 1986 Mar.19	1986 Jun.18	1986 Sep.10	1987 Jan.14	1987 Jul.15	1987 Oct.20	1988 Jan.19	1989 Jan.12	1989 Apr.18
(1) Alcalinity	mg/l	18.3	22	19	4	15	11	15	36.7	33.3
(2) Aldrin	Ug/l	ND	ND	ND	ND	ND	ND	ND	-	-
(3) Detergent	mg/l	0.005	0.01	0.03	0.01	0.08	0.01	0.01	-	-
(4) Cadmium	mg/l	0.005	ND	0.003	0.001	-	1	ND	ND	ND
(5) Carbonate	mg/l	-	-	-	-	-	-	-	-	-
(6) Lead	mg/l	0.02	0.01	0.01	0.02	0.01	-	ND	ND	0.02
(7) Fecal Coliform	NMP/100ml	460	150	93	2400	1100	150	-	33000	2800
(8) Total Coliform	NMP/100ml	-	-	-	-	-	150	-	33000	2800
(9) Conductivity	UMHO/cm	-	78	20	32.5	50.7	37	51	0.035	0.035
(10) Colour	mgPt/l	312	35	45	700	100	250	175	20	32
(11) BOD (5days)	mg/l	-	-	-	1.2	0.8	1.6	0.8	102.6	45
(12) COD	mg/l	14	9.5	9.4	32.2	14.1	24.8	1.5	-	-
(13) Hardness	mg/l	14.3	16	15	10	24	16	13	-	-
(14) Phenol	mg/l	5	0.003	0.007	0.006	0.002	0.008	0.001	ND	0.001
(15) Phosphate	mg/l	-	0.05	0.13	0.53	0.08	0.29	0.21	0.018	0.002
(16) Phosphoric ion	mg/l	0.31	0.12	-	-	-	-	-	-	-
(17) Mercury	mg/l	0.001	0.0003	0.0002	-	-	0.1	0.0007	ND	ND
(18) Nitrogen Nitrate	mg/l	0.9	1.7	2.2	2.2	3.4	3.9	2.9	16.39	0.01
(19) Nitrogen Nitrite	mg/l	0.02	0.021	0.066	0.017	0.029	0.026	0.065	0.0025	0.017
(20) Nitrogen Amonium	mg/l	0.1	0.2	ND	0.1	0.1	0.1	0.1	2.1	ND
(21) Oil and Grease	mg/l	94	16.8	15.4	10	10	10	10	43	3.4
(22) DO	mg/l	7.5	8.8	8.2	7.2	9.3	9.5	-	5.4	9.7
(23) pH		6.6	7.6	7.4	6.4	5.8	7.4	-	5.5	6.47
(24) Suspended Solid	mg/l	-	2.6	2	379	22	150.8	156.3	98	50
(25) Total Solid	mg/l	41	-	-	-	-	-	-	-	-
(26) Water Temperature	°C	-	19	20	25.5	18	18.5	29	23	25
(27) Air Temperature	°C	-	19	28	32	20	19	34	23.5	27.5
(28) Turbidity	UFT	78	14	17	410	58	100	125	79	22

Note : ND ; not detected

Table I.4.1 MONTHLY MEAN DISCHARGE AT SALTO PILAO (1) AND (2)
(Schemes 1 and 2)

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1941	87.5	146.8	99.2	40.6	70.5	105.3	45.2	142.1	81.2	93.5	133.3	77.9	93.6
1942	39.5	133.4	88.3	95.1	75.2	75.3	66.2	73.2	70.5	58.6	27.2	35.2	69.8
1943	31.1	53.7	23.3	18.3	57.6	195.6	117.8	278.8	144.7	91.6	67.9	38.5	93.3
1944	114.0	42.7	105.3	32.4	18.9	23.2	22.8	20.7	26.8	28.0	51.1	16.6	41.9
1945	10.2	63.5	29.6	25.5	14.1	20.2	31.2	22.4	58.3	66.8	24.6	30.2	33.0
1946	86.5	228.7	170.3	60.8	61.5	142.3	192.1	114.0	70.5	108.0	53.9	63.6	112.7
1947	61.1	138.1	82.7	27.1	33.1	54.7	64.1	101.0	248.1	222.2	98.5	85.0	101.3
1948	69.4	130.2	119.5	98.7	241.2	59.4	119.5	294.0	58.5	56.2	69.1	23.8	111.6
1949	35.6	17.9	37.5	70.0	31.0	92.3	36.0	87.5	104.3	64.2	28.9	27.2	52.7
1950	98.4	82.9	113.4	34.3	44.8	36.0	32.3	108.5	75.4	203.0	44.3	62.9	78.0
1951	118.6	242.6	145.2	42.1	22.3	20.2	37.7	15.6	15.2	186.5	90.4	50.4	82.2
1952	72.0	49.8	23.0	20.2	16.8	58.3	96.6	34.0	151.2	203.6	151.5	54.2	77.6
1953	74.9	115.7	56.9	27.9	23.6	19.3	24.4	24.7	75.8	140.0	183.0	73.7	70.0
1954	73.2	70.4	117.3	76.7	182.4	167.0	249.0	70.1	251.1	375.1	65.8	34.0	144.4
1955	31.1	53.4	65.8	71.8	125.1	109.7	261.2	114.0	141.3	52.4	48.0	76.1	95.8
1956	167.1	155.0	56.5	110.4	132.3	58.9	53.1	93.4	228.0	137.7	65.7	56.0	109.5
1957	59.1	66.7	74.5	79.2	72.9	56.9	226.6	541.6	457.7	193.6	89.7	48.6	163.9
1958	43.3	73.3	206.9	53.1	32.8	99.7	51.0	120.9	221.2	167.3	146.8	126.0	111.9
1959	63.1	108.4	51.0	85.9	76.6	40.8	28.4	58.5	178.5	59.8	26.3	35.2	67.7
1960	31.2	80.1	80.4	65.9	31.4	27.0	18.6	161.1	99.9	139.8	169.2	88.1	82.7
1961	71.5	126.3	163.3	78.8	43.0	48.0	55.5	21.8	354.8	346.0	341.9	172.4	151.9
1962	72.5	71.5	89.1	38.9	93.7	56.3	80.3	42.7	161.4	109.8	83.6	56.9	79.7
1963	177.4	244.6	226.2	83.7	40.4	23.9	26.5	30.7	122.8	289.6	211.3	113.1	132.5
1964	38.1	61.1	40.2	56.6	82.1	44.6	50.5	75.0	111.6	89.9	44.3	40.1	61.2
1965	33.3	23.1	50.7	48.6	139.6	51.8	126.3	162.9	215.8	113.8	93.8	173.6	102.8
1966	172.6	542.6	192.2	97.2	67.8	137.8	74.3	73.5	213.9	162.1	96.1	141.2	164.3
1967	100.3	209.2	132.5	59.4	43.8	83.5	67.0	72.3	230.2	139.8	119.6	115.9	114.4
1968	37.6	24.9	26.0	21.2	11.6	18.2	26.4	11.8	65.9	60.3	98.1	79.4	40.1
1969	168.7	240.1	137.8	245.7	53.0	147.3	126.2	62.2	70.5	53.9	94.7	39.6	120.0
1970	82.7	72.9	74.6	45.8	55.9	155.9	134.1	99.9	116.8	103.1	39.8	114.6	91.3
1971	263.3	159.1	252.6	226.1	195.2	248.7	193.2	90.5	109.1	101.5	31.2	22.0	157.7
1972	52.4	246.4	103.3	81.5	30.7	107.0	97.8	339.5	308.7	197.5	129.5	122.5	151.4
1973	127.5	138.0	71.7	61.4	122.8	186.1	204.4	348.1	305.9	104.4	76.3	60.0	150.6
1974	135.4	147.4	164.1	44.5	30.5	53.1	85.6	40.9	124.0	58.6	68.7	28.7	81.8
1975	66.9	51.3	136.6	43.0	51.5	74.0	38.4	151.4	394.7	333.1	96.7	329.0	147.2
1976	188.7	70.5	153.5	49.0	137.3	204.5	88.7	250.5	130.1	98.4	69.8	261.6	141.9
1977	301.1	272.3	133.5	93.4	48.6	31.1	38.8	272.4	95.9	303.9	217.5	83.1	157.6
1978	72.3	59.1	88.0	25.7	17.3	26.0	57.0	37.2	123.1	49.6	96.6	130.0	65.2
1979	53.2	31.2	41.1	48.5	142.4	66.0	60.8	64.4	77.5	380.4	180.1	133.0	106.5
1980	108.5	54.9	189.1	62.7	67.6	59.0	178.6	346.3	273.8	162.0	134.9	356.2	166.1
1981	187.1	117.9	49.1	43.0	33.5	31.8	46.4	36.1	73.1	73.5	64.5	104.1	71.7
1982	46.2	200.9	105.5	57.6	43.7	94.6	132.0	105.3	61.6	178.6	379.2	149.5	129.6
1983	203.8	197.7	283.6	141.3	362.7	361.1	1,037.9	379.1	231.7	144.3	130.5	194.4	305.7
1984	118.1	78.3	114.3	91.1	118.0	220.0	186.5	539.3	170.2	190.4	188.4	107.4	176.8
1985	62.2	238.6	100.5	118.8	62.6	35.7	63.0	29.9	51.5	58.9	96.5	16.9	77.9
1986	23.8	89.2	53.0	44.8	32.8	51.0	30.2	43.7	74.9	134.4	207.6	210.6	83.0
1987	249.3	208.3	61.1	59.7	250.2	135.7	120.7	148.3	89.5	275.7	72.0	51.3	143.5
Mean	97.5	128.3	106.0	68.2	79.6	89.7	110.7	135.1	151.4	148.1	108.5	96.0	109.9

Table I.4.2 MONTHLY MEAN DISCHARGE AT IBIRAMA (Scheme 3)

(Unit : cu.m/s)

Year	Month												Mean
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1934	155.6	380.6	136.5	216.0	90.0	50.8	68.7	88.5	83.8	147.0	59.6	75.1	129.3
1935	52.9	36.8	83.0	29.1	18.2	41.2	47.7	131.8	295.5	574.8	100.8	89.8	125.1
1936	213.6	63.3	39.8	33.6	47.2	225.9	100.7	450.8	326.5	243.8	91.5	69.7	158.9
1937	61.4	72.0	135.3	158.4	64.5	41.6	31.5	107.5	61.7	246.3	171.0	71.2	101.9
1938	150.3	213.1	85.2	128.8	177.4	260.8	194.7	75.5	54.9	53.4	50.7	44.0	124.1
1939	71.2	87.5	156.6	83.3	109.8	140.5	100.9	38.8	151.5	105.1	419.7	311.9	148.1
1940	209.4	133.8	94.3	80.5	77.4	40.7	80.2	232.8	74.5	119.4	61.6	94.4	108.3
1941	133.9	177.1	158.0	64.6	112.5	167.7	72.0	226.3	129.3	149.0	212.4	124.1	143.9
1942	67.5	257.6	142.1	155.1	128.4	145.0	116.6	120.8	103.0	88.7	44.4	58.1	119.0
1943	48.0	78.1	37.8	25.2	65.6	246.7	165.4	426.4	201.9	127.8	90.9	58.9	131.1
1944	143.6	64.8	129.6	46.5	25.4	28.6	27.8	28.0	45.0	38.2	75.0	30.4	56.9
1945	15.5	118.7	46.8	33.5	19.3	24.2	58.2	29.1	66.7	81.0	29.4	35.9	46.5
1946	108.6	352.2	270.5	108.9	84.4	230.2	286.4	170.4	102.9	161.9	78.3	105.8	171.7
1947	85.0	184.5	114.8	40.3	47.9	79.9	90.6	150.4	374.5	317.9	143.1	132.7	146.8
1948	126.5	191.1	195.7	164.3	370.4	96.3	156.8	416.9	91.5	84.0	111.8	36.4	170.1
1949	49.9	25.4	60.2	128.0	49.7	138.0	50.4	117.1	133.3	78.5	43.4	40.2	76.2
1950	144.4	126.7	189.5	56.2	62.3	54.0	44.6	131.5	98.0	299.1	68.5	87.0	113.5
1951	159.0	317.9	204.0	65.5	35.5	32.6	51.8	23.5	24.5	292.8	134.2	81.7	118.6
1952	86.2	67.0	35.0	25.8	20.1	77.0	105.2	40.8	207.9	283.8	196.1	77.0	101.8
1953	126.3	148.9	84.0	43.0	38.3	34.7	37.4	38.7	105.7	227.8	268.8	109.6	105.3
1954	112.1	118.1	199.6	100.4	293.8	235.6	335.7	104.1	283.2	545.2	93.3	55.6	206.4
1955	47.7	70.1	82.2	98.6	206.7	180.7	376.8	167.3	227.5	79.7	68.9	114.5	143.4
1956	195.3	183.2	79.5	139.2	209.6	90.7	86.7	140.3	326.8	179.8	91.8	72.9	149.6
1957	90.8	94.8	114.8	113.0	110.3	114.6	389.4	843.2	705.6	261.5	147.3	80.3	255.5
1958	70.6	123.9	355.6	95.6	61.0	177.6	82.3	177.6	301.6	227.6	187.8	202.9	172.0
1959	111.2	144.7	71.8	117.1	114.6	63.7	47.8	103.5	281.0	96.3	48.3	47.6	104.0
1960	47.1	123.8	110.7	88.6	52.0	50.1	29.7	253.3	137.6	219.0	268.4	124.7	125.4
1961	98.7	158.6	233.6	105.5	63.9	86.1	77.1	36.0	543.9	495.7	531.1	246.1	223.0
1962	100.4	101.4	148.7	58.5	106.4	75.3	108.4	60.0	235.3	181.6	129.5	68.3	114.5
1963	209.4	389.7	360.5	119.2	48.6	31.9	38.3	48.8	195.7	461.6	336.8	180.1	201.7
1964	67.1	110.3	73.4	90.2	130.8	71.2	80.4	119.6	177.8	143.2	70.5	63.9	99.9
1965	53.1	36.8	80.8	77.4	222.4	82.5	201.3	276.8	284.2	220.6	190.5	355.3	173.5
1966	255.8	801.7	284.5	142.8	105.1	246.7	136.5	108.0	326.1	265.5	175.6	217.7	255.5
1967	157.0	327.9	239.8	97.5	62.9	114.7	101.0	97.7	300.1	175.5	175.6	210.8	171.7
1968	64.8	45.1	51.7	43.0	25.0	27.5	41.9	22.3	98.8	83.7	121.4	99.9	60.4
1969	217.3	298.6	173.7	361.0	89.6	288.5	195.6	99.4	106.7	88.6	123.4	65.9	175.7
1970	124.5	94.6	103.2	71.6	81.7	248.1	212.3	136.7	171.2	152.5	55.9	165.1	134.8
1971	415.7	252.2	326.7	299.1	281.0	365.1	280.8	127.8	144.2	157.6	51.7	39.5	228.5
1972	74.8	328.9	159.4	120.5	40.9	140.0	144.9	426.9	433.8	317.9	181.7	183.4	212.8
1973	176.7	179.8	104.5	90.5	170.3	285.0	275.8	527.6	421.3	174.7	123.5	105.0	219.6
1974	228.7	214.0	262.5	84.6	47.8	88.0	170.6	72.3	204.2	83.1	88.2	40.8	132.1
1975	90.1	70.6	162.9	63.9	72.6	100.2	72.5	219.5	473.8	475.4	169.3	440.0	200.9
1976	254.9	107.3	196.2	86.0	211.9	325.9	144.3	332.8	189.6	141.8	133.3	313.9	203.2
1977	374.5	280.3	189.2	169.7	65.1	47.2	65.6	333.1	130.5	460.4	272.4	128.6	209.7
1978	104.5	90.6	138.1	39.9	29.4	39.0	92.2	75.8	180.4	109.6	132.5	203.5	103.0
1979	79.0	46.9	53.3	76.2	302.9	98.4	105.1	104.9	153.9	568.2	290.1	247.8	177.2
1980	167.5	93.3	275.2	103.1	95.6	89.4	319.2	480.4	394.8	234.9	204.6	550.0	250.7
1981	266.6	185.6	77.0	63.6	51.2	44.7	65.0	53.6	96.6	108.6	111.4	185.5	109.1
1982	74.6	261.6	146.8	83.4	67.1	170.1	238.3	163.2	97.1	278.1	569.9	251.6	200.2
1983	292.3	308.4	430.5	194.3	571.5	535.0	1,680.3	596.7	373.3	222.9	178.0	284.0	472.3
1984	150.6	112.7	161.7	124.7	153.1	311.8	247.9	811.9	234.8	253.1	263.3	135.0	246.7
1985	83.5	287.5	134.8	191.9	90.2	49.7	86.5	39.9	75.7	77.4	116.9	24.3	104.9
1986	34.2	114.2	86.0	86.1	46.8	70.6	43.8	64.4	112.5	181.5	265.7	330.3	119.7
1987	335.7	282.4	86.6	79.9	358.2	226.5	164.3	198.9	123.1	355.5	95.9	70.1	198.1
Mean	137.4	172.8	151.3	100.9	116.9	137.3	161.5	195.9	211.2	219.8	159.6	142.7	158.4

Table I.4.3 MONTHLY MEAN DISCHARGE AT SUBIDA (Scheme 4)

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	157.4	385.0	138.0	218.5	91.0	51.4	69.5	89.6	84.7	148.6	60.3	76.0	130.8
1935	53.5	37.2	84.0	29.4	18.4	41.6	48.3	133.3	298.9	581.5	102.0	90.8	126.6
1936	216.0	64.0	40.3	34.0	47.7	228.5	101.9	456.0	330.3	246.6	92.5	70.5	160.7
1937	62.1	72.8	136.9	160.2	65.3	42.1	31.9	108.7	62.4	249.1	172.9	72.0	103.0
1938	152.0	215.6	86.2	130.2	179.4	263.8	196.9	76.3	55.5	54.0	51.3	44.5	125.5
1939	72.0	88.5	158.4	84.3	111.1	142.1	102.1	39.2	153.3	106.3	424.5	315.5	149.8
1940	211.8	135.3	95.3	81.5	78.3	41.2	81.2	235.5	75.4	120.8	62.3	95.5	109.5
1941	135.4	179.1	159.8	65.4	113.8	169.7	72.9	229.0	130.8	150.8	214.9	125.5	145.6
1942	68.3	260.6	143.7	156.9	129.9	146.6	118.0	122.2	104.2	89.7	44.9	58.8	120.3
1943	48.6	79.0	38.3	25.4	66.3	249.6	167.4	431.3	204.3	129.3	92.0	59.6	132.6
1944	145.3	65.6	131.1	47.0	25.7	28.9	28.1	28.3	45.5	38.7	75.9	30.8	57.6
1945	15.7	120.1	47.3	33.8	19.5	24.5	58.9	29.4	67.5	81.9	29.8	36.3	47.1
1946	109.9	356.3	273.6	110.2	85.4	232.9	289.7	172.4	104.1	163.8	79.2	107.0	173.7
1947	86.0	186.6	116.2	40.8	48.5	80.8	91.7	152.1	378.9	321.6	144.8	134.2	148.5
1948	127.9	193.3	198.0	166.2	374.7	97.5	158.6	421.8	92.5	84.9	113.1	36.8	172.1
1949	50.5	25.7	60.9	129.5	50.2	139.6	51.0	118.5	134.9	79.4	43.9	40.7	77.1
1950	146.0	128.1	191.6	56.9	63.0	54.7	45.1	133.0	99.1	302.6	69.3	88.0	114.8
1951	160.8	321.6	206.4	66.2	36.0	33.0	52.4	23.8	24.8	296.1	135.7	82.6	120.0
1952	87.2	67.8	35.4	26.1	20.3	77.9	106.4	41.3	210.3	287.1	198.4	77.9	103.0
1953	127.7	150.6	84.9	43.5	38.8	35.1	37.8	39.1	106.9	230.4	271.9	110.9	106.5
1954	113.4	119.4	201.9	101.6	297.2	238.3	339.6	105.3	286.5	551.5	94.4	56.2	208.8
1955	48.3	71.0	83.2	99.8	209.1	182.8	381.2	169.2	230.1	80.6	69.7	115.8	145.0
1956	197.5	185.3	80.4	140.8	212.0	91.8	87.7	141.9	330.6	181.9	92.8	73.7	151.4
1957	91.9	95.9	116.2	114.3	111.5	116.0	393.9	852.9	713.7	264.5	149.0	81.3	258.4
1958	71.4	125.3	359.7	96.7	61.7	179.7	83.3	179.7	305.1	230.2	190.0	205.2	174.0
1959	112.5	146.3	72.6	118.5	116.0	64.4	48.4	104.7	284.3	97.5	48.9	48.1	105.2
1960	47.6	125.2	112.0	89.7	52.6	50.7	30.1	256.2	139.2	221.5	271.5	126.2	126.9
1961	99.9	160.4	236.3	106.7	64.6	87.0	78.0	36.4	550.2	501.4	537.2	248.9	225.6
1962	101.5	102.6	150.4	59.2	107.6	76.2	109.6	60.7	238.0	183.7	131.0	69.1	115.8
1963	211.8	394.2	364.7	120.6	49.2	32.3	38.8	49.4	197.9	467.0	340.7	182.2	204.0
1964	67.9	111.5	74.2	91.2	132.3	72.0	81.4	121.0	179.9	144.9	71.3	64.7	101.0
1965	53.7	37.2	81.7	78.3	225.0	83.5	203.6	279.9	287.5	223.2	192.7	359.4	175.5
1966	258.7	810.9	287.8	144.4	106.3	249.6	138.0	109.2	329.9	268.6	177.7	220.2	258.4
1967	158.8	331.7	242.5	98.6	63.6	116.1	102.2	98.8	303.6	177.6	177.7	213.2	173.7
1968	65.6	45.6	52.3	43.5	25.3	27.9	42.4	22.6	100.0	84.6	122.8	101.0	61.1
1969	219.8	302.0	175.7	365.2	90.6	291.8	197.8	100.5	108.0	89.7	124.8	66.6	177.7
1970	125.9	95.7	104.4	72.4	82.6	250.9	214.8	138.2	173.1	154.2	56.6	167.0	136.3
1971	420.5	255.1	330.5	302.6	284.3	369.3	284.1	129.3	145.9	159.4	52.3	39.9	231.1
1972	75.7	332.7	161.3	121.8	41.4	141.6	146.5	431.9	438.8	321.6	183.8	185.5	215.2
1973	178.7	181.9	105.8	91.6	172.3	288.3	279.0	533.7	426.2	176.7	124.9	106.2	222.1
1974	231.4	216.5	265.5	85.6	48.4	89.0	172.6	73.2	206.6	84.1	89.3	41.3	133.6
1975	91.1	71.4	164.7	64.7	73.5	101.3	73.4	222.0	479.3	480.8	171.3	445.1	203.2
1976	257.9	108.5	198.5	87.0	214.3	329.7	145.9	336.6	191.7	143.4	134.9	317.5	205.5
1977	378.9	283.5	191.4	171.7	65.8	47.7	66.3	336.9	132.0	465.7	275.5	130.0	212.1
1978	105.8	91.7	139.7	40.4	29.8	39.4	93.2	76.6	182.5	110.9	134.0	205.8	104.1
1979	79.9	47.4	53.9	77.1	306.4	99.6	106.3	106.1	155.7	574.7	293.4	250.6	179.3
1980	169.5	94.4	278.4	104.3	96.7	90.4	322.8	486.0	399.4	237.6	207.0	556.3	253.6
1981	269.7	187.8	77.9	64.3	51.8	45.2	65.7	54.2	97.7	109.9	112.7	187.7	110.4
1982	75.5	264.6	148.5	84.4	67.9	172.1	241.1	165.1	98.2	281.3	576.5	254.5	202.5
1983	295.7	312.0	435.4	196.6	578.1	541.2	1,699.7	603.6	377.6	225.5	180.1	287.3	477.7
1984	152.3	114.0	163.6	126.1	154.9	315.4	250.7	821.2	237.5	256.0	266.4	136.6	249.6
1985	84.4	290.8	136.4	194.1	91.3	50.2	87.5	40.4	76.5	78.3	118.3	24.6	106.1
1986	34.6	115.5	87.0	87.0	47.3	71.4	44.3	65.2	113.8	183.5	268.8	334.1	121.0
1987	339.6	285.6	87.6	80.8	362.4	229.1	166.2	201.2	124.5	359.6	97.0	71.0	200.4
Mean	138.9	174.7	153.0	102.1	118.2	138.9	163.3	198.1	213.6	222.4	161.4	144.4	160.2

Table I.4.4 MONTHLY MEAN DISCHARGE AT ASCURRA (Scheme 5)

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	164.9	403.4	144.6	229.0	95.3	53.8	72.8	93.8	88.8	155.7	63.1	79.6	137.1
1935	56.1	39.0	88.0	30.8	19.3	43.6	50.6	139.7	313.2	609.2	106.9	95.1	132.6
1936	226.3	67.1	42.2	35.7	50.0	239.4	106.8	477.7	346.0	258.4	97.0	73.8	168.4
1937	65.0	76.3	143.4	167.9	68.4	44.1	33.4	113.9	65.3	261.0	181.2	75.4	108.0
1938	159.3	225.8	90.3	136.5	188.0	276.4	206.3	80.0	58.2	56.6	53.7	46.7	131.5
1939	75.4	92.7	165.9	88.3	116.4	148.9	107.0	41.1	160.6	111.4	444.8	330.6	156.9
1940	221.9	141.8	99.9	85.3	82.0	43.1	85.0	246.7	79.0	126.6	65.2	100.1	114.7
1941	141.9	187.7	167.5	68.5	119.2	177.8	76.4	239.9	137.1	158.0	225.1	131.5	152.5
1942	71.5	273.0	150.6	164.4	136.0	153.6	123.6	128.1	109.2	94.0	47.1	61.6	126.1
1943	50.9	82.7	40.1	26.7	69.5	261.5	175.3	451.9	214.0	135.4	96.4	62.4	138.9
1944	152.2	68.7	137.4	49.3	27.0	30.3	29.5	29.7	47.7	40.5	79.5	32.2	60.3
1945	16.5	125.8	49.6	35.5	20.4	25.7	61.7	30.8	70.7	85.9	31.2	38.1	49.3
1946	115.1	373.3	286.6	115.4	89.5	244.0	303.5	180.6	109.1	171.6	83.0	112.1	182.0
1947	90.1	195.5	121.7	42.7	50.8	84.6	96.1	159.4	396.9	336.9	151.7	140.6	155.6
1948	134.0	202.5	207.5	174.1	392.6	102.1	166.1	441.9	97.0	89.0	118.5	38.6	180.3
1949	52.9	27.0	63.8	135.6	52.6	146.2	53.4	124.1	141.3	83.2	46.0	42.6	80.7
1950	153.0	134.2	200.8	59.6	66.1	57.3	47.3	139.4	103.8	317.0	72.6	92.2	120.3
1951	168.5	336.9	216.2	69.4	37.7	34.5	54.9	24.9	26.0	310.3	142.2	86.6	125.7
1952	91.4	71.0	37.1	27.4	21.3	81.6	111.5	43.2	220.4	300.8	207.9	81.6	107.9
1953	133.8	157.8	89.0	45.6	40.6	36.8	39.6	41.0	112.0	241.4	284.9	116.2	111.5
1954	118.8	125.1	211.5	106.5	311.4	249.7	355.8	110.3	300.2	577.8	98.9	58.9	218.7
1955	50.6	74.3	87.2	104.5	219.1	191.5	399.4	177.3	241.1	84.4	73.0	121.3	152.0
1956	206.9	194.1	84.2	147.6	222.1	96.2	91.9	148.7	346.3	190.6	97.3	77.3	158.6
1957	96.3	100.5	121.7	119.8	116.9	121.5	412.7	893.6	747.8	277.1	156.1	85.1	270.8
1958	74.8	131.3	376.8	101.3	64.6	188.3	87.3	188.3	319.7	241.2	199.1	215.0	182.3
1959	117.9	153.3	76.1	124.1	121.5	67.5	50.7	109.7	297.8	102.1	51.2	50.4	110.2
1960	49.9	131.2	117.4	93.9	55.1	53.1	31.5	268.5	145.8	232.1	284.4	132.2	132.9
1961	104.6	168.1	247.6	111.8	67.7	91.2	81.7	38.2	576.4	525.3	562.9	260.8	236.3
1962	106.4	107.5	157.6	62.0	112.7	79.8	114.8	63.6	249.4	192.5	137.3	72.4	121.3
1963	221.9	413.0	382.1	126.4	51.5	33.8	40.6	51.7	207.4	489.2	356.9	190.9	213.8
1964	71.1	116.9	77.8	95.5	138.6	75.4	85.2	126.8	188.5	151.8	74.7	67.8	105.8
1965	56.3	39.0	85.6	82.0	235.7	87.5	213.3	293.3	301.2	233.8	201.9	376.5	183.8
1966	271.1	849.6	301.5	151.3	111.4	261.5	144.6	114.4	345.6	281.4	186.1	230.7	270.8
1967	166.3	347.5	254.1	103.3	66.7	121.6	107.1	103.5	318.0	186.0	186.1	223.4	182.0
1968	68.7	47.8	54.8	45.6	26.5	29.2	44.4	23.6	104.7	88.7	128.7	105.8	64.0
1969	230.3	316.4	184.1	382.6	94.9	305.7	207.3	105.3	113.1	93.9	130.8	69.8	186.2
1970	131.9	100.3	109.4	75.9	86.6	262.9	225.0	144.8	181.4	161.6	59.3	174.9	142.8
1971	440.6	267.2	346.2	317.0	297.8	386.9	297.6	135.4	152.8	167.1	54.8	41.8	242.1
1972	79.3	348.6	169.0	127.7	43.3	148.4	153.5	452.5	459.8	336.9	192.6	194.3	225.5
1973	187.3	190.6	110.8	96.0	180.5	302.1	292.3	559.1	446.5	185.1	130.9	111.3	232.7
1974	242.4	226.8	278.2	89.7	50.7	93.2	180.8	76.7	216.4	88.1	93.5	43.2	140.0
1975	95.4	74.8	172.6	67.8	77.0	106.2	76.9	232.6	502.2	503.8	179.5	466.3	212.9
1976	270.2	113.7	208.0	91.1	224.5	345.4	152.9	352.7	200.9	150.3	141.3	332.7	215.3
1977	396.9	297.0	200.5	179.9	69.0	50.0	69.5	353.0	138.3	487.9	288.7	136.2	222.2
1978	110.8	96.1	146.3	42.3	31.2	41.3	97.7	80.3	191.2	116.2	140.4	215.6	109.1
1979	83.7	49.7	56.5	80.8	321.0	104.3	111.4	111.2	163.1	602.2	307.4	262.6	187.8
1980	177.6	98.9	291.7	109.3	101.3	94.7	338.2	509.1	418.4	249.0	216.8	582.9	265.7
1981	282.6	196.7	81.6	67.4	54.2	47.4	68.9	56.8	102.4	115.1	118.1	196.6	115.7
1982	79.1	277.2	155.5	88.4	71.1	180.3	252.6	173.0	102.9	294.7	604.0	266.6	212.1
1983	309.8	326.8	456.2	205.9	605.7	567.0	1,780.8	632.4	395.6	236.2	188.7	301.0	500.5
1984	159.6	119.5	171.4	132.1	162.3	330.5	262.7	860.4	248.9	268.3	279.1	143.1	261.5
1985	88.5	304.7	142.9	203.4	95.6	52.6	91.7	42.3	80.2	82.0	123.9	25.8	111.1
1986	36.3	121.0	91.1	91.2	49.6	74.8	46.5	68.3	119.2	192.3	281.6	350.1	126.8
1987	355.8	299.3	91.8	84.6	379.7	240.1	174.1	210.8	130.5	376.7	101.6	74.3	209.9
Mean	145.6	183.1	160.3	106.9	123.9	145.5	171.1	207.6	223.8	233.0	169.1	151.2	167.8

Table I.4.5 MONTHLY MEAN DISCHARGE AT INDAIAL (Scheme 6)

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	-	-	102.2	323.1	108.7	66.8	91.8	112.8	120.8	213.1	77.8	102.4	-
1935	75.5	59.4	120.8	45.4	27.8	56.5	64.5	176.4	395.8	780.3	137.5	127.2	172.3
1936	357.7	89.4	65.5	51.8	72.5	286.8	130.5	577.9	446.9	333.3	125.3	98.5	219.7
1937	101.1	129.8	223.8	251.7	120.3	68.2	50.2	156.7	84.1	354.7	241.3	97.1	156.6
1938	252.4	321.1	130.0	204.1	235.3	386.3	274.2	101.6	80.0	81.1	75.5	71.7	184.4
1939	106.7	122.7	236.1	122.2	152.4	190.9	137.0	52.4	244.4	162.0	614.9	452.0	216.2
1940	310.8	194.1	138.6	136.0	111.5	57.9	110.1	320.2	102.4	172.8	96.3	145.7	158.0
1941	174.2	249.0	204.7	85.9	163.0	231.7	95.8	271.7	157.2	192.1	274.1	175.8	189.6
1942	96.9	413.1	204.6	227.3	170.4	211.7	160.0	161.9	135.6	118.3	74.5	101.4	173.0
1943	81.9	114.9	56.7	40.8	91.1	357.4	221.6	551.1	277.8	187.5	127.4	83.7	182.7
1944	209.5	111.6	207.0	73.7	39.8	41.8	38.6	52.2	65.1	53.2	139.6	57.7	90.8
1945	34.2	212.8	85.4	64.5	33.8	39.7	99.8	43.4	104.6	151.7	53.9	73.7	83.1
1946	199.2	583.5	427.4	171.2	116.5	314.2	372.4	234.5	138.4	221.4	113.4	147.7	253.3
1947	150.5	319.2	194.7	68.2	88.1	120.1	137.3	219.6	492.1	486.1	226.3	212.6	226.2
1948	227.9	349.2	305.6	229.2	464.4	134.7	208.2	571.0	127.7	118.1	143.6	52.5	244.3
1949	85.1	40.0	105.2	192.6	73.8	195.3	72.5	154.5	180.0	108.9	71.9	69.6	112.5
1950	221.4	187.2	309.7	94.5	98.9	89.4	63.7	160.4	128.4	405.2	87.5	120.8	163.9
1951	217.0	448.2	279.2	88.2	50.3	45.7	74.2	32.3	37.1	392.1	173.1	111.4	162.4
1952	124.2	93.8	59.7	40.5	31.7	114.1	130.3	50.2	264.9	357.8	264.9	107.3	136.6
1953	173.8	207.2	121.5	63.9	61.2	50.4	52.8	51.0	133.0	315.0	426.3	151.6	150.6
1954	153.2	170.2	300.9	188.0	398.5	307.1	418.1	132.3	343.6	789.5	122.9	77.6	283.5
1955	68.9	100.6	117.1	130.7	298.7	238.8	481.3	204.9	294.5	102.0	91.5	144.6	189.5
1956	247.8	250.5	115.8	189.2	298.2	129.3	118.5	173.9	401.3	235.6	117.7	94.1	197.7
1957	131.1	145.2	159.8	166.3	186.5	173.7	553.3	1,244.5	940.5	339.5	204.7	139.3	365.4
1958	115.8	238.8	520.7	158.7	105.1	246.2	111.0	215.7	389.0	283.5	253.5	295.8	244.5
1959	201.6	234.4	113.1	177.5	155.0	89.4	70.0	134.5	377.3	135.4	74.6	72.9	153.0
1960	87.2	221.5	194.7	136.0	87.4	75.6	50.0	346.7	182.2	290.1	409.9	177.2	188.2
1961	145.7	272.3	326.3	143.2	101.5	130.7	102.8	56.1	668.3	626.8	694.5	326.9	299.6
1962	143.7	146.9	203.9	81.5	136.2	93.5	134.2	76.7	288.2	233.6	163.8	96.7	149.9
1963	278.2	513.7	479.8	157.2	65.7	48.0	52.6	61.4	255.7	589.2	439.6	247.4	265.7
1964	89.9	144.0	104.2	126.1	176.5	105.8	114.1	161.4	248.1	226.5	117.5	81.3	141.3
1965	67.4	69.6	115.3	128.4	367.0	122.5	308.9	372.3	361.1	280.4	242.0	451.4	240.5
1966	325.0	1,046.5	384.0	238.2	151.7	343.9	191.2	142.9	414.4	337.5	223.1	276.6	339.6
1967	228.3	478.0	358.2	148.3	93.1	189.0	158.9	154.4	391.0	250.3	267.8	298.2	251.3
1968	107.6	72.6	76.9	63.1	39.2	47.2	64.8	30.5	160.2	130.9	179.0	173.3	95.4
1969	353.2	462.4	259.5	539.1	139.4	427.1	284.9	143.5	166.3	136.7	222.4	104.6	269.9
1970	185.2	183.6	166.8	113.1	113.6	303.1	291.9	177.6	207.9	196.4	93.9	258.7	191.0
1971	604.0	348.2	486.3	352.9	347.9	450.9	356.3	174.4	194.1	229.9	78.8	59.2	306.9
1972	99.2	404.5	220.4	175.7	58.3	177.6	189.2	568.7	558.4	417.9	258.6	300.1	285.7
1973	275.3	307.3	152.4	150.6	227.3	417.9	374.5	748.3	612.5	259.8	189.8	164.8	323.4
1974	374.0	344.9	469.7	165.4	88.2	125.4	254.9	107.8	277.5	114.2	117.5	66.4	208.8
1975	138.2	109.3	229.7	103.1	110.0	139.4	109.5	307.5	599.0	612.8	278.9	637.2	281.2
1976	353.5	166.4	323.3	135.3	293.2	465.8	215.9	444.0	253.2	198.0	174.3	389.8	284.4
1977	460.2	368.7	273.6	239.0	93.7	70.9	95.2	400.7	163.3	642.3	385.6	173.3	280.5
1978	153.1	138.3	219.3	60.8	45.6	57.5	117.2	100.6	251.6	151.6	172.2	284.9	146.1
1979	107.4	69.6	78.6	109.7	403.4	131.3	142.0	134.5	196.6	726.3	421.5	349.2	239.2
1980	239.3	167.6	383.4	142.7	123.4	118.6	391.7	585.4	519.4	323.7	303.5	702.3	333.4
1981	383.7	283.9	139.7	99.2	78.0	67.1	91.1	73.4	122.2	171.0	169.7	271.2	162.5
1982	109.8	373.3	212.1	130.2	110.4	236.4	315.1	212.6	131.5	362.9	747.6	340.0	273.5
1983	405.7	434.0	583.2	270.3	766.0	673.0	2,026.3	723.6	503.2	322.5	241.0	400.7	612.5
1984	216.3	172.8	234.3	181.7	227.3	396.4	310.3	1,133.8	321.8	335.6	379.0	208.6	343.2
1985	110.7	349.3	164.3	275.2	124.5	72.4	115.5	56.3	113.8	116.5	171.0	41.5	142.6
1986	62.6	151.0	112.8	120.8	58.0	91.0	62.3	77.5	154.0	274.6	337.8	419.7	160.2
1987	427.5	450.6	122.1	115.5	444.6	294.2	201.3	251.1	169.9	436.5	128.0	97.6	261.6
1988	148.0	167.9	126.6	123.3	508.6	261.0	117.7	69.2	166.3	205.3	96.8	67.3	171.5
Mean	200.0	255.6	220.1	152.9	169.7	188.7	210.5	255.5	274.8	296.2	220.3	197.3	220.1

Table I.4.6 MONTHLY MEAN DISCHARGE AT DARBERGIA (Scheme 7)

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1935	15.8	14.6	30.9	9.0	4.7	12.2	12.1	44.3	129.8	249.8	30.3	27.5	48.4
1936	98.9	20.9	13.4	10.3	17.5	71.1	24.5	156.5	113.5	61.6	32.6	21.7	53.5
1937	23.2	20.4	44.1	50.7	21.2	18.3	11.2	34.8	17.7	89.4	82.4	20.6	36.2
1938	70.8	78.1	26.4	63.8	88.1	129.2	85.7	28.9	23.4	23.0	14.6	13.5	53.8
1939	16.7	20.0	40.1	27.5	42.8	47.5	27.9	11.3	46.9	33.4	157.1	134.0	50.4
1940	42.0	23.0	16.0	25.7	17.2	11.2	17.7	53.4	16.6	27.0	12.6	21.4	23.6
1941	38.6	35.9	34.2	15.5	29.1	50.4	18.0	66.1	33.8	56.6	67.2	39.7	40.4
1942	21.2	109.7	52.8	56.4	42.3	65.5	44.9	44.9	33.3	26.8	17.8	19.3	44.6
1943	18.3	17.7	10.1	6.6	13.2	63.3	55.0	130.9	59.4	32.7	21.9	16.7	37.1
1944	38.2	16.9	29.8	10.7	6.4	6.3	5.7	9.4	12.9	9.9	27.5	11.5	15.4
1945	4.4	34.0	14.6	7.6	5.7	7.0	27.2	7.6	13.2	20.3	7.7	8.3	13.1
1946	29.7	146.6	107.5	43.9	22.1	96.8	97.8	56.2	32.5	62.3	26.2	47.4	64.1
1947	25.8	55.9	27.7	11.8	15.9	30.7	30.8	51.3	145.4	101.4	44.3	40.1	48.4
1948	52.3	67.4	66.1	65.7	116.8	35.4	41.6	122.4	31.4	26.2	37.8	11.4	56.2
1949	14.3	7.0	18.4	58.6	17.9	49.5	14.1	30.7	33.6	16.6	12.8	9.9	23.6
1950	51.5	43.8	70.0	19.9	18.9	17.5	13.6	24.7	22.7	100.9	19.3	26.9	35.8
1951	36.2	94.9	66.2	18.6	11.4	10.5	14.8	6.4	6.7	104.6	40.0	19.6	35.8
1952	11.4	11.2	6.2	3.3	2.4	22.5	15.5	6.7	66.3	96.8	55.9	23.5	26.8
1953	42.0	42.5	24.4	14.0	15.9	12.8	11.3	11.5	31.5	96.1	83.2	22.8	34.0
1954	34.8	39.5	82.9	22.0	119.9	68.8	97.5	29.9	55.2	140.7	26.2	14.7	61.0
1955	8.1	14.6	19.3	24.8	77.3	75.6	127.4	50.2	79.7	19.0	14.0	28.0	44.8
1956	49.3	34.7	19.7	33.5	79.9	26.9	26.7	43.7	87.3	38.9	19.4	9.5	39.1
1957	15.2	27.7	37.8	30.0	25.5	51.7	157.7	267.2	240.6	66.7	45.2	23.5	82.4
1958	18.9	45.9	131.8	30.8	19.5	76.8	25.5	54.8	89.1	57.0	36.0	78.9	55.4
1959	37.2	38.6	14.6	26.4	38.5	15.6	11.3	44.5	100.6	27.9	15.5	12.2	31.9
1960	14.1	30.2	21.6	18.3	16.4	19.2	8.0	92.1	32.2	84.5	108.8	34.8	40.0
1961	24.5	38.6	71.1	26.4	18.4	34.6	22.9	10.9	188.3	159.3	136.7	70.6	66.9
1962	22.3	25.8	54.1	16.1	18.5	14.8	18.5	10.6	80.9	62.0	43.7	13.4	31.7
1963	51.4	66.4	73.3	34.8	9.9	6.1	7.2	8.4	47.3	124.8	108.7	77.2	51.3
1964	16.8	39.4	26.9	27.4	54.4	25.4	32.0	58.1	81.5	76.0	51.9	53.6	45.3
1965	21.0	17.9	34.0	29.9	143.5	44.4	116.6	125.4	78.9	108.1	65.9	181.4	80.6
1966	81.3	239.5	68.5	36.4	30.4	100.8	51.0	35.1	89.6	116.1	73.2	60.9	81.9
1967	44.4	125.1	82.3	35.0	16.8	38.0	34.0	22.0	91.0	44.1	64.9	86.9	57.1
1968	26.5	16.2	19.5	23.2	8.1	7.6	11.5	7.6	22.2	23.0	26.5	26.4	18.2
1969	55.7	55.6	43.4	116.5	39.8	103.7	68.2	38.6	43.6	38.6	35.6	21.0	55.0
1970	32.1	23.4	23.6	18.2	30.2	89.7	76.2	34.4	47.5	56.0	19.0	55.7	42.2
1971	164.9	84.2	78.1	90.4	88.4	121.4	83.6	32.5	28.4	56.0	17.8	16.4	71.8
1972	20.1	81.9	55.0	42.2	15.2	43.7	44.8	176.6	140.0	118.5	43.9	45.7	69.0
1973	48.6	43.7	22.6	30.7	54.1	118.9	81.6	174.2	136.0	73.3	40.6	41.8	72.2
1974	93.9	81.9	99.3	35.0	19.7	35.7	88.0	28.3	77.4	24.4	21.9	11.4	51.4
1975	26.1	20.7	36.9	19.0	25.5	31.4	24.8	79.5	111.9	149.6	59.7	140.2	60.4
1976	70.3	32.5	62.0	36.1	77.6	137.7	55.4	112.5	78.5	52.5	62.3	79.1	71.4
1977	102.3	35.1	60.1	63.2	19.5	14.1	21.2	58.9	31.6	148.1	77.2	39.0	55.9
1978	23.3	21.0	59.4	12.0	9.5	14.1	40.0	34.7	66.9	40.0	42.4	78.0	36.8
1979	25.6	16.6	14.9	26.7	146.4	39.4	48.2	38.1	73.4	219.0	123.9	108.6	73.4
1980	68.3	45.1	95.7	38.2	34.2	35.2	139.7	139.7	138.2	80.7	73.4	222.9	92.6
1981	94.8	74.7	33.7	24.6	20.1	17.4	23.6	20.6	30.4	39.0	47.4	88.4	42.9
1982	33.4	81.5	56.8	32.6	28.6	74.8	93.8	69.5	42.8	98.3	215.4	111.8	78.3
1983	99.9	113.2	157.7	63.5	215.1	194.5	632.8	149.6	126.5	85.0	48.5	83.2	164.1
1984	37.6	33.4	57.9	40.5	49.9	102.2	76.8	250.8	79.2	74.3	94.3	39.1	78.0
1985	27.0	72.8	37.6	79.8	30.2	17.6	28.7	12.6	26.9	17.3	29.3	8.5	32.4
1986	13.8	31.3	36.7	47.8	18.2	20.5	13.9	23.2	38.3	57.3	77.8	146.6	43.8
1987	111.6	94.8	28.6	26.0	142.6	106.4	57.3	68.7	45.5	103.8	33.7	27.7	70.6
Mean	42.8	51.0	47.5	33.5	42.5	50.6	56.9	62.3	67.9	73.9	52.7	50.4	52.7

Table I.4.7 MONTHLY MEAN DISCHARGE AT BARRA DA PRATINHA (Scheme 8)

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1935	7.4	6.8	14.4	4.2	2.2	5.7	5.6	20.6	60.3	116.1	14.1	12.8	22.5
1936	46.0	9.7	6.2	4.8	8.1	33.1	11.4	72.7	52.8	28.6	15.2	10.1	24.9
1937	10.8	9.5	20.5	23.6	9.9	8.5	5.2	16.2	8.2	41.6	38.3	9.6	16.8
1938	32.9	36.3	12.3	29.7	41.0	60.1	39.9	13.4	10.9	10.7	6.8	6.3	25.0
1939	7.8	9.3	18.6	12.8	19.9	22.1	13.0	5.2	21.8	15.5	73.1	62.3	23.4
1940	19.5	10.7	7.4	12.0	8.0	5.2	8.2	24.9	7.7	12.5	5.9	10.0	11.0
1941	17.9	16.7	15.9	7.2	13.5	23.5	8.4	30.7	15.7	26.3	31.3	18.4	18.8
1942	9.9	51.0	24.5	26.2	19.7	30.4	20.9	20.9	15.5	12.4	8.3	9.0	20.7
1943	8.5	8.2	4.7	3.1	6.1	29.5	25.6	60.8	27.6	15.2	10.2	7.8	17.3
1944	17.8	7.8	13.8	5.0	3.0	2.9	2.7	4.4	6.0	4.6	12.8	5.4	7.2
1945	2.0	15.8	6.8	3.5	2.7	3.2	12.6	3.5	6.1	9.4	3.6	3.9	6.1
1946	13.8	68.1	50.0	20.4	10.3	45.0	45.5	26.1	15.1	29.0	12.2	22.1	29.8
1947	12.0	26.0	12.9	5.5	7.4	14.3	14.3	23.9	67.6	47.1	20.6	18.6	22.5
1948	24.3	31.3	30.7	30.5	54.3	16.5	19.3	56.9	14.6	12.2	17.6	5.3	26.1
1949	6.6	3.2	8.6	27.2	8.3	23.0	6.5	14.3	15.6	7.7	6.0	4.6	11.0
1950	23.9	20.4	32.6	9.2	8.8	8.1	6.3	11.5	10.6	46.9	9.0	12.5	16.6
1951	16.8	44.1	30.8	8.7	5.3	4.9	6.9	3.0	3.1	48.6	18.6	9.1	16.7
1952	5.3	5.2	2.9	1.5	1.1	10.5	7.2	3.1	30.8	45.0	26.0	10.9	12.5
1953	19.5	19.8	11.4	6.5	7.4	6.0	5.2	5.4	14.7	44.7	38.7	10.6	15.8
1954	16.2	18.4	38.6	10.2	55.7	32.0	45.3	13.9	25.7	65.4	12.2	6.9	28.4
1955	3.8	6.8	9.0	11.5	35.9	35.1	59.2	23.4	37.1	8.8	6.5	13.0	20.8
1956	22.9	16.1	9.2	15.6	37.2	12.5	12.4	20.3	40.6	18.1	9.0	4.4	18.2
1957	7.1	12.9	17.6	13.9	11.9	24.0	73.3	124.3	111.8	31.0	21.0	10.9	38.3
1958	8.8	21.3	61.3	14.3	9.1	35.7	11.9	25.5	41.4	26.5	16.7	36.7	25.8
1959	17.3	17.9	6.8	12.3	17.9	7.3	5.3	20.7	46.8	13.0	7.2	5.7	14.8
1960	6.5	14.0	10.1	8.5	7.6	8.9	3.7	42.8	15.0	39.3	50.6	16.2	18.6
1961	11.4	17.9	33.1	12.3	8.6	16.1	10.6	5.1	87.5	74.1	63.5	32.8	31.1
1962	10.4	12.0	25.2	7.5	8.6	6.9	8.6	4.9	37.6	28.8	20.3	6.2	14.8
1963	23.9	30.9	34.1	16.2	4.6	2.8	3.3	3.9	22.0	58.0	50.6	35.9	23.9
1964	7.8	18.3	12.5	12.7	25.3	11.8	14.9	27.0	37.9	35.4	24.1	24.9	21.1
1965	9.8	8.3	15.8	13.9	66.7	20.7	54.2	58.3	36.7	50.2	30.6	84.3	37.5
1966	37.8	111.4	31.8	16.9	14.1	46.9	23.7	16.3	41.7	54.0	34.1	28.3	38.1
1967	20.7	58.2	38.2	16.3	7.8	17.7	15.8	10.2	42.3	20.5	30.2	40.4	26.5
1968	12.3	7.5	9.1	10.8	3.7	3.5	5.4	3.5	10.3	10.7	12.3	12.3	8.5
1969	25.9	25.8	20.2	54.2	18.5	48.2	31.7	17.9	20.2	17.9	16.6	9.7	25.6
1970	14.9	10.9	11.0	8.5	14.0	41.7	35.4	16.0	22.1	26.0	8.8	25.9	19.6
1971	76.7	39.1	36.3	42.0	41.1	56.5	38.9	15.1	13.2	26.0	8.3	7.6	33.4
1972	9.3	38.1	25.6	19.6	7.1	20.3	20.8	82.1	65.1	55.1	20.4	21.2	32.1
1973	22.6	20.3	10.5	14.3	25.2	55.3	37.9	81.0	63.2	34.1	18.9	19.4	33.6
1974	43.7	38.1	46.2	16.3	9.2	16.6	40.9	13.2	36.0	11.4	10.2	5.3	23.9
1975	12.1	9.6	17.1	8.8	11.9	14.6	11.5	37.0	52.0	69.5	27.7	65.2	28.1
1976	32.7	15.1	28.8	16.8	36.1	64.0	25.8	52.3	36.5	24.4	29.0	36.8	33.2
1977	47.6	16.3	28.0	29.4	9.1	6.5	9.9	27.4	14.7	68.9	35.9	18.1	26.0
1978	10.8	9.8	27.6	5.6	4.4	6.5	18.6	16.1	31.1	18.6	19.7	36.3	17.1
1979	11.9	7.7	6.9	12.4	68.1	18.3	22.4	17.7	34.1	101.8	57.6	50.5	34.1
1980	31.8	21.0	44.5	17.8	15.9	16.4	64.9	64.9	64.3	37.5	34.1	103.6	43.1
1981	44.1	34.7	15.6	11.5	9.3	8.1	11.0	9.6	14.1	18.1	22.1	41.1	19.9
1982	15.5	37.9	26.4	15.2	13.3	34.8	43.6	32.3	19.9	45.7	100.2	52.0	36.4
1983	46.5	52.6	73.3	29.5	100.0	90.4	294.2	69.5	58.8	39.5	22.6	38.7	76.3
1984	17.5	15.5	26.9	18.9	23.2	47.5	35.7	116.6	36.8	34.5	43.8	18.2	36.3
1985	12.5	33.9	17.5	37.1	14.0	8.2	13.3	5.9	12.5	8.0	13.6	4.0	15.0
1986	6.4	14.6	17.0	22.2	8.5	9.5	6.4	10.8	17.8	26.7	36.2	68.1	20.4
1987	51.9	44.1	13.3	12.1	66.3	49.5	26.7	31.9	21.2	48.3	15.6	12.9	32.8
Mean	19.9	23.7	22.1	15.6	19.7	23.5	26.5	29.0	31.6	34.3	24.5	23.4	24.5

Table I.4.8 MONTHLY MEAN DISCHARGE AT BARRA DAS POMBAS (Scheme 9)

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1935	5.3	4.9	10.3	3.0	1.6	4.1	4.1	14.8	43.4	83.4	10.1	9.2	16.2
1936	33.0	7.0	4.5	3.4	5.8	23.7	8.2	52.3	37.9	20.6	10.9	7.3	17.9
1937	7.7	6.8	14.7	16.9	7.1	6.1	3.7	11.6	5.9	29.9	27.5	6.9	12.1
1938	23.7	26.1	8.8	21.3	29.4	43.2	28.6	9.7	7.8	7.7	4.9	4.5	18.0
1939	5.6	6.7	13.4	9.2	14.3	15.9	9.3	3.8	15.7	11.1	52.5	44.7	16.8
1940	14.0	7.7	5.3	8.6	5.7	3.7	5.9	17.9	5.5	9.0	4.2	7.2	7.9
1941	12.9	12.0	11.4	5.2	9.7	16.8	6.0	22.1	11.3	18.9	22.5	13.3	13.5
1942	7.1	36.6	17.6	18.8	14.1	21.9	15.0	15.0	11.1	8.9	6.0	6.4	14.9
1943	6.1	5.9	3.4	2.2	4.4	21.2	18.4	43.7	19.8	10.9	7.3	5.6	12.4
1944	12.8	5.6	9.9	3.6	2.1	2.1	1.9	3.1	4.3	3.3	9.2	3.9	5.2
1945	1.5	11.3	4.9	2.5	1.9	2.3	9.1	2.5	4.4	6.8	2.6	2.8	4.4
1946	9.9	49.0	35.9	14.7	7.4	32.3	32.7	18.8	10.9	20.8	8.7	15.8	21.4
1947	8.6	18.7	9.3	4.0	5.3	10.3	10.3	17.1	48.6	33.9	14.8	13.4	16.2
1948	17.5	22.5	22.1	21.9	39.0	11.8	13.9	40.9	10.5	8.7	12.6	3.8	18.8
1949	4.8	2.3	6.2	19.6	6.0	16.5	4.7	10.2	11.2	5.5	4.3	3.3	7.9
1950	17.2	14.6	23.4	6.6	6.3	5.8	4.5	8.3	7.6	33.7	6.4	9.0	12.0
1951	12.1	31.7	22.1	6.2	3.8	3.5	5.0	2.1	2.2	34.9	13.3	6.5	12.0
1952	3.8	3.7	2.1	1.1	0.8	7.5	5.2	2.2	22.1	32.3	18.7	7.8	9.0
1953	14.0	14.2	8.2	4.7	5.3	4.3	3.8	3.9	10.5	32.1	27.8	7.6	11.4
1954	11.6	13.2	27.7	7.4	40.0	23.0	32.6	10.0	18.4	47.0	8.7	4.9	20.4
1955	2.7	4.9	6.4	8.3	25.8	25.2	42.5	16.8	26.6	6.4	4.7	9.4	15.0
1956	16.5	11.6	6.6	11.2	26.7	9.0	8.9	14.6	29.2	13.0	6.5	3.2	13.1
1957	5.1	9.3	12.6	10.0	8.5	17.3	52.7	89.3	80.4	22.3	15.1	7.8	27.5
1958	6.3	15.3	44.0	10.3	6.5	25.7	8.5	18.3	29.8	19.1	12.0	26.3	18.5
1959	12.4	12.9	4.9	8.8	12.9	5.2	3.8	14.9	33.6	9.3	5.2	4.1	10.7
1960	4.7	10.1	7.2	6.1	5.5	6.4	2.7	30.7	10.8	28.2	36.4	11.6	13.4
1961	8.2	12.9	23.7	8.8	6.2	11.6	7.6	3.6	62.9	53.2	45.7	23.6	22.3
1962	7.5	8.6	18.1	5.4	6.2	5.0	6.2	3.5	27.0	20.7	14.6	4.5	10.6
1963	17.2	22.2	24.5	11.6	3.3	2.0	2.4	2.8	15.8	41.7	36.3	25.8	17.1
1964	5.6	13.2	9.0	9.1	18.2	8.5	10.7	19.4	27.2	25.4	17.3	17.9	15.1
1965	7.0	6.0	11.4	10.0	47.9	14.8	38.9	41.9	26.3	36.1	22.0	60.6	26.9
1966	27.2	80.0	22.9	12.2	10.1	33.7	17.0	11.7	29.9	38.8	24.5	20.3	27.4
1967	14.8	41.8	27.5	11.7	5.6	12.7	11.4	7.4	30.4	14.7	21.7	29.0	19.1
1968	8.8	5.4	6.5	7.7	2.7	2.5	3.9	2.5	7.4	7.7	8.8	8.8	6.1
1969	18.6	18.6	14.5	38.9	13.3	34.6	22.8	12.9	14.5	12.9	11.9	7.0	18.4
1970	10.7	7.8	7.9	6.1	10.1	30.0	25.5	11.5	15.9	18.7	6.4	18.6	14.1
1971	55.1	28.1	26.1	30.2	29.5	40.6	27.9	10.9	9.5	18.7	6.0	5.5	24.0
1972	6.7	27.3	18.4	14.1	5.1	14.6	15.0	59.0	46.8	39.6	14.7	15.3	23.0
1973	16.2	14.6	7.5	10.3	18.1	39.7	27.2	58.2	45.4	24.5	13.6	14.0	24.1
1974	31.4	27.3	33.2	11.7	6.6	11.9	29.4	9.5	25.9	8.2	7.3	3.8	17.2
1975	8.7	6.9	12.3	6.4	8.5	10.5	8.3	26.6	37.4	50.0	19.9	46.8	20.2
1976	23.5	10.9	20.7	12.1	25.9	46.0	18.5	37.6	26.2	17.5	20.8	26.4	23.8
1977	34.2	11.7	20.1	21.1	6.5	4.7	7.1	19.7	10.6	49.5	25.8	13.0	18.7
1978	7.8	7.0	19.8	4.0	3.2	4.7	13.3	11.6	22.4	13.3	14.2	26.0	12.3
1979	8.6	5.5	5.0	8.9	48.9	13.2	16.1	12.7	24.5	73.2	41.4	36.3	24.5
1980	22.8	15.1	32.0	12.8	11.4	11.8	46.7	46.7	46.2	27.0	24.5	74.5	30.9
1981	31.7	24.9	11.2	8.2	6.7	5.8	7.9	6.9	10.1	13.0	15.8	29.5	14.3
1982	11.1	27.2	19.0	10.9	9.6	25.0	31.3	23.2	14.3	32.8	72.0	37.4	26.1
1983	33.4	37.8	52.7	21.2	71.9	65.0	211.4	50.0	42.2	28.4	16.2	27.8	54.8
1984	12.6	11.1	19.3	13.5	16.7	34.1	25.7	83.8	26.5	24.8	31.5	13.1	26.1
1985	9.0	24.3	12.6	26.7	10.1	5.9	9.6	4.2	9.0	5.8	9.8	2.9	10.8
1986	4.6	10.5	12.2	16.0	6.1	6.8	4.6	7.7	12.8	19.1	26.0	49.0	14.6
1987	37.3	31.7	9.6	8.7	47.6	35.5	19.1	22.9	15.2	34.7	11.2	9.3	23.6
Mean	14.3	17.0	15.9	11.2	14.2	16.9	19.0	20.8	22.7	24.7	17.6	16.8	17.6

Table I.4.9 MONTHLY MEAN DISCHARGE AT TIMBO (Scheme 10)

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	-	-	-	-	-	-	-	-	-	-	6.8	11.1	-
1935	8.6	9.6	13.9	7.2	4.1	6.2	5.3	10.8	28.6	51.1	11.9	13.1	14.2
1936	45.9	10.3	9.7	7.7	8.5	18.1	6.5	38.1	33.2	20.1	13.1	10.5	18.5
1937	13.2	25.4	31.5	39.0	25.3	11.4	7.3	13.0	9.1	30.3	24.9	10.3	20.1
1938	37.9	24.3	17.1	23.7	23.5	28.0	20.9	10.6	10.4	11.3	8.7	12.4	19.1
1939	12.5	10.1	24.0	15.8	14.8	10.4	6.3	4.8	26.0	15.7	59.5	37.4	19.8
1940	28.7	15.4	13.1	15.9	9.2	5.7	6.2	16.1	5.7	15.9	10.0	13.6	13.0
1941	12.3	20.3	12.4	8.2	13.6	14.0	6.7	9.1	8.1	10.8	18.8	19.4	12.8
1942	9.4	56.6	21.3	22.6	17.3	21.0	15.2	13.7	12.1	9.9	13.4	17.4	19.1
1943	11.6	12.4	8.7	6.3	10.0	27.2	19.0	33.9	19.8	22.0	13.0	9.2	16.1
1944	19.8	18.0	26.6	11.7	6.3	5.3	4.3	9.9	7.5	5.9	24.0	13.0	12.7
1945	9.1	33.3	14.5	13.0	6.5	6.2	15.3	5.8	14.9	27.2	10.6	15.4	14.3
1946	34.2	77.5	49.2	21.2	11.5	24.6	20.3	17.9	9.8	17.9	8.7	13.5	25.5
1947	22.8	47.9	26.0	11.0	15.4	14.8	18.0	22.2	40.8	50.9	29.1	32.5	27.6
1948	41.0	55.4	34.9	22.3	37.5	12.3	13.7	29.5	12.2	10.9	12.8	5.7	24.0
1949	10.8	5.6	16.2	24.2	8.4	17.5	7.7	11.9	15.3	11.4	11.0	12.3	12.7
1950	22.7	18.5	36.5	14.9	13.4	12.9	7.0	6.2	8.3	21.7	7.3	12.8	15.2
1951	18.8	39.3	21.1	9.1	5.7	4.7	6.6	3.2	4.5	27.2	14.8	12.3	13.9
1952	11.7	9.9	9.6	5.5	3.5	11.6	7.1	4.1	14.0	19.9	21.9	11.7	10.9
1953	19.3	18.2	14.0	8.4	8.9	5.8	5.4	4.6	8.2	30.7	31.6	17.0	14.3
1954	14.2	22.1	28.3	33.1	40.0	19.7	19.9	9.5	15.6	42.3	9.2	6.2	21.7
1955	7.8	8.4	12.9	12.5	29.3	18.7	29.6	11.7	23.0	8.1	8.7	10.5	15.1
1956	22.0	17.8	12.5	17.2	25.4	12.9	12.0	11.7	16.7	18.5	9.2	6.9	15.2
1957	13.6	15.1	16.5	15.9	26.5	18.6	48.7	56.5	58.4	21.2	21.5	21.6	27.8
1958	15.6	43.3	57.8	20.8	14.0	24.3	9.8	11.7	23.4	16.3	20.3	22.5	23.3
1959	33.1	24.4	13.8	17.5	12.1	7.7	6.8	9.3	23.9	13.1	6.9	7.4	14.7
1960	16.9	27.6	25.8	14.5	10.4	8.2	6.3	26.2	13.0	16.0	42.4	18.5	18.8
1961	16.0	37.7	32.6	11.8	12.4	12.0	8.7	6.0	36.2	29.6	52.2	17.6	22.7
1962	11.6	14.1	17.9	8.6	9.2	6.7	7.9	5.7	15.9	14.4	11.6	10.6	11.2
1963	22.6	37.9	35.8	13.4	7.2	5.6	6.2	4.4	18.8	30.9	30.5	25.0	19.9
1964	8.8	12.6	12.2	11.8	16.0	11.9	11.5	14.2	21.4	16.9	11.5	11.9	13.4
1965	26.0	13.5	9.6	16.0	44.5	15.5	24.6	28.4	21.0	24.1	26.8	35.9	23.8
1966	37.0	39.9	18.2	34.2	13.2	17.3	14.4	9.1	24.2	23.2	28.1	14.1	22.7
1967	26.3	57.7	36.9	10.0	6.0	11.3	15.2	8.8	16.5	12.9	21.9	33.2	21.4
1968	14.7	9.7	8.5	9.3	3.7	4.3	2.9	2.5	13.4	19.3	10.1	7.6	8.8
1969	16.3	25.5	19.7	42.1	15.5	47.4	24.5	13.1	11.8	13.2	31.7	10.1	22.6
1970	16.1	19.5	18.7	14.3	9.4	20.1	26.9	13.4	13.2	16.7	11.6	30.1	17.5
1971	51.5	26.9	43.7	22.4	21.7	27.6	19.5	12.3	17.1	29.2	9.2	6.5	24.0
1972	8.9	23.1	20.6	16.6	7.7	12.5	12.4	40.2	27.1	32.3	24.9	35.1	21.8
1973	36.5	36.2	15.8	19.5	17.8	29.3	23.7	49.5	41.2	30.0	20.2	17.7	28.1
1974	35.1	28.0	80.3	22.1	13.1	11.6	21.6	12.5	17.7	9.4	7.8	6.7	22.2
1975	14.0	10.6	16.9	12.0	10.7	11.4	10.4	21.7	32.2	43.5	35.7	54.7	22.8
1976	27.7	23.2	38.2	16.1	27.0	33.2	19.1	24.4	18.5	16.0	15.8	17.9	23.1
1977	26.9	24.2	30.3	25.9	12.7	8.9	7.4	13.3	9.4	45.0	27.6	18.0	20.8
1978	16.1	19.7	28.2	8.2	5.7	6.2	7.9	9.5	17.2	12.2	13.1	22.5	13.9
1979	8.7	7.1	9.0	11.8	32.2	11.4	12.3	9.2	14.0	38.8	32.9	24.4	17.6
1980	21.5	26.1	27.3	14.7	10.0	8.8	26.5	27.5	27.6	25.7	26.9	51.5	24.5
1981	38.2	33.8	20.5	14.8	10.5	7.3	9.8	6.4	7.1	20.7	21.3	28.9	18.3
1982	14.1	33.3	24.9	16.7	16.1	20.6	21.4	15.9	11.3	24.9	42.8	26.0	22.3
1983	35.7	37.9	43.1	22.8	57.1	45.2	118.2	42.8	40.0	30.1	21.5	40.0	44.5
1984	20.8	17.4	24.0	20.2	19.9	22.6	19.5	68.3	25.4	22.7	34.7	15.3	25.9
1985	10.8	22.4	16.2	29.8	12.1	8.8	8.0	5.6	11.7	11.1	18.4	7.0	13.5
1986	10.8	20.5	10.4	12.7	7.2	6.6	7.0	8.7	18.9	22.3	17.0	31.2	14.4
1987	38.1	53.9	16.0	13.8	25.7	24.5	14.5	15.9	18.7	23.2	11.6	11.4	22.3
Mean	21.2	26.0	23.5	16.8	16.0	15.4	15.7	16.8	19.0	22.3	20.4	18.8	19.3

Table I.4.10 MONTHLY MEAN DISCHARGE AT BENEDITO NOVO (Scheme 11)

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	-	-	-	-	-	-	-	-	-	-	5.1	8.4	-
1935	6.5	7.3	10.5	5.4	3.1	4.6	4.0	8.1	21.5	38.4	8.9	9.8	10.7
1936	34.5	7.8	7.3	5.8	6.4	13.6	4.9	28.7	24.9	15.1	9.8	7.9	13.9
1937	10.0	19.1	23.7	29.3	19.1	8.5	5.5	9.8	6.8	22.8	18.7	7.8	15.1
1938	28.5	18.3	12.9	17.8	17.6	21.1	15.7	8.0	7.8	8.5	6.5	9.4	14.3
1939	9.4	7.6	18.1	11.9	11.1	7.8	4.8	3.6	19.5	11.8	44.8	28.2	14.9
1940	21.6	11.6	9.9	12.0	6.9	4.3	4.7	12.1	4.3	12.0	7.5	10.2	9.7
1941	9.3	15.2	9.4	6.2	10.2	10.5	5.0	6.8	6.1	8.1	14.2	14.6	9.6
1942	7.1	42.6	16.0	17.0	13.0	15.8	11.4	10.3	9.1	7.4	10.1	13.1	14.4
1943	8.7	9.4	6.5	4.8	7.5	20.5	14.3	25.5	14.9	16.6	9.8	6.9	12.1
1944	14.9	13.5	20.0	8.8	4.7	4.0	3.2	7.4	5.6	4.4	18.0	9.8	9.5
1945	6.8	25.0	10.9	9.8	4.9	4.7	11.5	4.4	11.2	20.5	8.0	11.5	10.8
1946	25.7	58.3	37.0	15.9	8.7	18.5	15.3	13.5	7.4	13.4	6.5	10.2	19.2
1947	17.2	36.0	19.6	8.3	11.6	11.1	13.5	16.7	30.7	38.3	21.9	24.4	20.8
1948	30.9	41.6	26.3	16.8	28.2	9.3	10.3	22.2	9.1	8.2	9.6	4.3	18.1
1949	8.1	4.2	12.2	18.2	6.3	13.2	5.8	9.0	11.5	8.5	8.3	9.3	9.5
1950	17.1	13.9	27.4	11.2	10.1	9.7	5.3	4.7	6.2	16.3	5.5	9.7	11.4
1951	14.1	29.5	15.8	6.8	4.3	3.6	5.0	2.4	3.4	20.5	11.1	9.3	10.5
1952	8.8	7.5	7.3	4.1	2.7	8.7	5.3	3.1	10.5	15.0	16.5	8.8	8.2
1953	14.5	13.7	10.5	6.3	6.7	4.4	4.1	3.4	6.1	23.1	23.8	12.8	10.8
1954	10.7	16.7	21.3	24.9	30.1	14.8	14.9	7.1	11.7	31.8	7.0	4.7	16.3
1955	5.8	6.3	9.7	9.4	22.1	14.1	22.3	8.8	17.3	6.1	6.5	7.9	11.3
1956	16.6	13.4	9.4	12.9	19.1	9.7	9.0	8.8	12.6	13.9	6.9	5.2	11.5
1957	10.2	11.4	12.4	12.0	19.9	14.0	36.6	42.5	44.0	15.9	16.2	16.2	20.9
1958	11.7	32.6	43.5	15.6	10.5	18.2	7.4	8.8	17.6	12.3	15.3	16.9	17.5
1959	24.9	18.4	10.4	13.1	9.1	5.8	5.1	7.0	17.9	9.8	5.2	5.6	11.0
1960	12.7	20.8	19.4	10.9	7.8	6.2	4.7	19.7	9.8	12.0	31.9	13.9	14.1
1961	12.1	28.4	24.5	8.8	9.4	9.0	6.5	4.5	27.2	22.2	39.3	13.2	17.1
1962	8.7	10.6	13.5	6.5	7.0	5.1	5.9	4.3	12.0	10.8	8.7	8.0	8.4
1963	17.0	28.5	26.9	10.1	5.4	4.2	4.7	3.3	14.2	23.2	22.9	18.8	14.9
1964	6.6	9.5	9.1	8.9	12.1	8.9	8.7	10.7	16.1	12.7	8.7	8.9	10.1
1965	19.6	10.1	7.2	12.0	33.5	11.7	18.5	21.4	15.8	18.1	20.1	27.0	17.9
1966	27.8	30.0	13.7	25.7	9.9	13.0	10.8	6.8	18.2	17.4	21.1	10.6	17.1
1967	19.8	43.4	27.8	7.5	4.5	8.5	11.4	6.6	12.4	9.7	16.5	25.0	16.1
1968	11.1	7.3	6.4	7.0	2.8	3.3	2.1	1.9	10.1	14.5	7.6	5.7	6.7
1969	12.2	19.2	14.8	31.7	11.7	35.6	18.4	9.9	8.8	9.9	23.9	7.6	17.0
1970	12.1	14.7	14.1	10.7	7.1	15.1	20.2	10.1	10.0	12.6	8.7	22.6	13.2
1971	38.7	20.2	32.9	16.9	16.4	20.7	14.7	9.3	12.8	22.0	7.0	4.9	18.0
1972	6.7	17.4	15.5	12.5	5.8	9.4	9.3	30.3	20.4	24.3	18.7	26.4	16.4
1973	27.4	27.2	11.9	14.7	13.4	22.0	17.8	37.2	31.0	22.5	15.2	13.3	21.1
1974	26.4	21.1	60.4	16.6	9.9	8.7	16.2	9.4	13.3	7.1	5.8	5.0	16.7
1975	10.5	8.0	12.7	9.0	8.0	8.6	7.8	16.4	24.2	32.7	26.9	41.1	17.2
1976	20.8	17.4	28.7	12.1	20.3	25.0	14.4	18.4	13.9	12.0	11.9	13.5	17.4
1977	20.2	18.2	22.8	19.5	9.6	6.7	5.6	10.0	7.1	33.9	20.8	13.5	15.6
1978	12.1	14.8	21.2	6.2	4.3	4.7	6.0	7.2	12.9	9.1	9.9	16.9	10.4
1979	6.5	5.4	6.7	8.9	24.2	8.6	9.2	6.9	10.5	29.2	24.7	18.4	13.3
1980	16.2	19.6	20.5	11.1	7.5	6.6	19.9	20.6	20.7	19.4	20.2	38.7	18.4
1981	28.7	25.5	15.4	11.1	7.9	5.5	7.4	4.8	5.4	15.5	16.0	21.7	13.7
1982	10.6	25.0	18.7	12.5	12.1	15.5	16.1	12.0	8.5	18.7	32.2	19.5	16.8
1983	26.8	28.5	32.4	17.1	43.0	34.0	88.9	32.2	30.0	22.6	16.2	30.0	33.5
1984	15.6	13.1	18.0	15.2	14.9	17.0	14.7	51.4	19.1	17.1	26.1	11.5	19.5
1985	8.1	16.8	12.2	22.4	9.1	6.6	6.0	4.2	8.8	8.4	13.8	5.3	10.1
1986	8.1	15.4	7.8	9.5	5.4	5.0	5.3	6.5	14.2	16.8	12.8	23.5	10.9
1987	28.7	40.6	12.1	10.4	19.3	18.4	10.9	12.0	14.1	17.4	8.7	8.5	16.8
Mean	16.0	19.6	17.6	12.6	12.0	11.6	11.8	12.6	14.3	16.8	15.3	14.1	14.5

Table I.4.11 MONTHLY MEAN DISCHARGE AT ALTO BENEDITO NOVO (Scheme 12)

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	-	-	-	-	-	-	-	-	-	-	4.1	6.8	-
1935	5.3	5.9	8.5	4.4	2.5	3.8	3.2	6.6	17.5	31.2	7.2	8.0	8.7
1936	28.0	6.3	5.9	4.7	5.2	11.0	4.0	23.3	20.2	12.3	8.0	6.4	11.3
1937	8.1	15.5	19.2	23.8	15.5	6.9	4.5	8.0	5.5	18.5	15.2	6.3	12.2
1938	23.1	14.8	10.4	14.5	14.3	17.1	12.7	6.5	6.3	6.9	5.3	7.6	11.6
1939	7.7	6.2	14.6	9.7	9.0	6.4	3.9	2.9	15.8	9.6	36.3	22.8	12.1
1940	17.5	9.4	8.0	9.7	5.6	3.5	3.8	9.8	3.5	9.7	6.1	8.3	7.9
1941	7.5	12.4	7.6	5.0	8.3	8.6	4.1	5.5	5.0	6.6	11.5	11.8	7.8
1942	5.8	34.5	13.0	13.8	10.5	12.8	9.2	8.3	7.4	6.0	8.2	10.6	11.7
1943	7.1	7.6	5.3	3.9	6.1	16.6	11.6	20.7	12.1	13.4	8.0	5.6	9.8
1944	12.1	11.0	16.2	7.1	3.8	3.2	2.6	6.0	4.6	3.6	14.6	8.0	7.7
1945	5.5	20.3	8.9	7.9	4.0	3.8	9.3	3.5	9.1	16.6	6.5	9.4	8.7
1946	20.9	47.3	30.0	12.9	7.0	15.0	12.4	10.9	6.0	10.9	5.3	8.3	15.6
1947	13.9	29.2	15.9	6.7	9.4	9.0	11.0	13.5	24.9	31.1	17.7	19.8	16.8
1948	25.0	33.8	21.3	13.6	22.9	7.5	8.4	18.0	7.4	6.7	7.8	3.5	14.6
1949	6.6	3.4	9.9	14.7	5.1	10.7	4.7	7.3	9.3	6.9	6.7	7.5	7.7
1950	13.9	11.3	22.2	9.1	8.2	7.9	4.3	3.8	5.0	13.2	4.4	7.8	9.3
1951	11.5	23.9	12.8	5.6	3.5	2.9	4.1	2.0	2.7	16.6	9.0	7.5	8.5
1952	7.1	6.1	5.9	3.4	2.2	7.1	4.3	2.5	8.6	12.2	13.4	7.1	6.6
1953	11.8	11.1	8.5	5.1	5.4	3.5	3.3	2.8	5.0	18.7	19.3	10.4	8.7
1954	8.7	13.5	17.3	20.2	24.4	12.0	12.1	5.8	9.5	25.8	5.6	3.8	13.2
1955	4.7	5.1	7.9	7.6	17.9	11.4	18.1	7.1	14.0	4.9	5.3	6.4	9.2
1956	13.4	10.8	7.7	10.5	15.5	7.9	7.3	7.1	10.2	11.3	5.6	4.2	9.3
1957	8.3	9.2	10.1	9.7	16.1	11.3	29.7	34.4	35.6	12.9	13.1	13.2	17.0
1958	9.5	26.4	35.3	12.7	8.5	14.8	6.0	7.1	14.3	10.0	12.4	13.7	14.2
1959	20.2	14.9	8.4	10.7	7.4	4.7	4.1	5.7	14.6	8.0	4.2	4.5	8.9
1960	10.3	16.8	15.7	8.9	6.4	5.0	3.8	16.0	7.9	9.8	25.8	11.3	11.5
1961	9.8	23.0	19.9	7.2	7.6	7.3	5.3	3.6	22.1	18.0	31.8	10.7	13.9
1962	7.1	8.6	10.9	5.3	5.6	4.1	4.8	3.5	9.7	8.8	7.1	6.5	6.8
1963	13.8	23.1	21.8	8.2	4.4	3.4	3.8	2.7	11.5	18.8	18.6	15.3	12.1
1964	5.3	7.7	7.4	7.2	9.8	7.2	7.0	8.7	13.1	10.3	7.0	7.2	8.2
1965	15.9	8.2	5.9	9.8	27.2	9.5	15.0	17.3	12.8	14.7	16.3	21.9	14.5
1966	22.6	24.3	11.1	20.9	8.0	10.6	8.8	5.6	14.7	14.1	17.1	8.6	13.9
1967	16.1	35.2	22.5	6.1	3.7	6.9	9.3	5.4	10.1	7.9	13.4	20.3	13.0
1968	9.0	5.9	5.2	5.7	2.3	2.6	1.7	1.5	8.2	11.8	6.2	4.7	5.4
1969	9.9	15.5	12.0	25.7	9.5	28.9	14.9	8.0	7.2	8.0	19.4	6.2	13.8
1970	9.8	11.9	11.4	8.7	5.8	12.2	16.4	8.2	8.1	10.2	7.1	18.3	10.7
1971	31.4	16.4	26.7	13.7	13.3	16.8	11.9	7.5	10.4	17.8	5.6	4.0	14.6
1972	5.4	14.1	12.5	10.1	4.7	7.7	7.6	24.5	16.5	19.7	15.2	21.4	13.3
1973	22.2	22.1	9.7	11.9	10.9	17.9	14.4	30.2	25.1	18.3	12.3	10.8	17.1
1974	21.4	17.1	49.0	13.5	8.0	7.1	13.2	7.6	10.8	5.8	4.7	4.1	13.5
1975	8.6	6.5	10.3	7.3	6.5	7.0	6.4	13.3	19.7	26.6	21.8	33.4	13.9
1976	16.9	14.1	23.3	9.8	16.4	20.3	11.6	14.9	11.3	9.8	9.7	10.9	14.1
1977	16.4	14.8	18.5	15.8	7.8	5.4	4.5	8.1	5.7	27.5	16.8	11.0	12.7
1978	9.8	12.0	17.2	5.0	3.5	3.8	4.8	5.8	10.5	7.4	8.0	13.7	8.5
1979	5.3	4.4	5.5	7.2	19.7	7.0	7.5	5.6	8.5	23.6	20.0	14.9	10.8
1980	13.1	15.9	16.7	9.0	6.1	5.4	16.2	16.7	16.8	15.7	16.4	31.4	14.9
1981	23.3	20.6	12.5	9.0	6.4	4.5	6.0	3.9	4.4	12.6	13.0	17.6	11.1
1982	8.6	20.3	15.2	10.2	9.8	12.6	13.0	9.7	6.9	15.2	26.1	15.8	13.6
1983	21.8	23.1	26.3	13.9	34.8	27.6	72.1	26.1	24.4	18.4	13.1	24.4	27.2
1984	12.7	10.6	14.6	12.3	12.1	13.8	11.9	41.6	15.5	13.8	21.2	9.3	15.8
1985	6.6	13.7	9.9	18.2	7.4	5.4	4.9	3.4	7.1	6.8	11.2	4.3	8.2
1986	6.6	12.5	6.3	7.7	4.4	4.0	4.3	5.3	11.5	13.6	10.4	19.1	8.8
1987	23.3	32.9	9.8	8.4	15.7	14.9	8.9	9.7	11.4	14.1	7.1	6.9	13.6
Mean	12.9	15.9	14.3	10.3	9.7	9.4	9.6	10.3	11.6	13.6	12.4	11.4	11.7

Table I.4.12 MONTHLY MEAN DISCHARGE AT DOUTOR PEDRINHO
(Scheme 13)

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	-	-	-	-	-	-	-	-	-	-	1.5	2.4	-
1935	1.9	2.1	3.0	1.6	0.9	1.3	1.1	2.3	6.2	11.0	2.6	2.8	3.1
1936	9.9	2.2	2.1	1.7	1.8	3.9	1.4	8.2	7.1	4.3	2.8	2.3	4.0
1937	2.9	5.5	6.8	8.4	5.5	2.4	1.6	2.8	2.0	6.5	5.4	2.2	4.3
1938	8.2	5.2	3.7	5.1	5.1	6.0	4.5	2.3	2.2	2.4	1.9	2.7	4.1
1939	2.7	2.2	5.2	3.4	3.2	2.2	1.4	1.0	5.6	3.4	12.8	8.1	4.3
1940	6.2	3.3	2.8	3.4	2.0	1.2	1.3	3.5	1.2	3.4	2.2	2.9	2.8
1941	2.7	4.4	2.7	1.8	2.9	3.0	1.4	2.0	1.7	2.3	4.1	4.2	2.8
1942	2.0	12.2	4.6	4.9	3.7	4.5	3.3	2.9	2.6	2.1	2.9	3.7	4.1
1943	2.5	2.7	1.9	1.4	2.2	5.9	4.1	7.3	4.3	4.7	2.8	2.0	3.5
1944	4.3	3.9	5.7	2.5	1.4	1.1	0.9	2.1	1.6	1.3	5.2	2.8	2.7
1945	2.0	7.2	3.1	2.8	1.4	1.3	3.3	1.3	3.2	5.9	2.3	3.3	3.1
1946	7.4	16.7	10.6	4.6	2.5	5.3	4.4	3.9	2.1	3.8	1.9	2.9	5.5
1947	4.9	10.3	5.6	2.4	3.3	3.2	3.9	4.8	8.8	11.0	6.3	7.0	6.0
1948	8.8	11.9	7.5	4.8	8.1	2.7	3.0	6.3	2.6	2.4	2.8	1.2	5.2
1949	2.3	1.2	3.5	5.2	1.8	3.8	1.7	2.6	3.3	2.4	2.4	2.7	2.7
1950	4.9	4.0	7.9	3.2	2.9	2.8	1.5	1.3	1.8	4.7	1.6	2.8	3.3
1951	4.0	8.5	4.5	2.0	1.2	1.0	1.4	0.7	1.0	5.9	3.2	2.7	3.0
1952	2.5	2.1	2.1	1.2	0.8	2.5	1.5	0.9	3.0	4.3	4.7	2.5	2.3
1953	4.2	3.9	3.0	1.8	1.9	1.3	1.2	1.0	1.8	6.6	6.8	3.7	3.1
1954	3.1	4.8	6.1	7.1	8.6	4.3	4.3	2.0	3.4	9.1	2.0	1.3	4.7
1955	1.7	1.8	2.8	2.7	6.3	4.0	6.4	2.5	5.0	1.7	1.9	2.3	3.3
1956	4.7	3.8	2.7	3.7	5.5	2.8	2.6	2.5	3.6	4.0	2.0	1.5	3.3
1957	2.9	3.3	3.6	3.4	5.7	4.0	10.5	12.2	12.6	4.6	4.6	4.7	6.0
1958	3.4	9.3	12.5	4.5	3.0	5.2	2.1	2.5	5.0	3.5	4.4	4.8	5.0
1959	7.1	5.3	3.0	3.8	2.6	1.7	1.5	2.0	5.1	2.8	1.5	1.6	3.2
1960	3.6	5.9	5.6	3.1	2.2	1.8	1.4	5.6	2.8	3.4	9.1	4.0	4.1
1961	3.5	8.1	7.0	2.5	2.7	2.6	1.9	1.3	7.8	6.4	11.2	3.8	4.9
1962	2.5	3.0	3.9	1.9	2.0	1.5	1.7	1.2	3.4	3.1	2.5	2.3	2.4
1963	4.9	8.2	7.7	2.9	1.5	1.2	1.3	1.0	4.1	6.7	6.6	5.4	4.3
1964	1.9	2.7	2.6	2.5	3.5	2.6	2.5	3.1	4.6	3.6	2.5	2.6	2.9
1965	5.6	2.9	2.1	3.4	9.6	3.3	5.3	6.1	4.5	5.2	5.8	7.7	5.1
1966	8.0	8.6	3.9	7.4	2.8	3.7	3.1	2.0	5.2	5.0	6.1	3.0	4.9
1967	5.7	12.4	8.0	2.2	1.3	2.4	3.3	1.9	3.6	2.8	4.7	7.2	4.6
1968	3.2	2.1	1.8	2.0	0.8	0.9	0.6	0.5	2.9	4.2	2.2	1.6	1.9
1969	3.5	5.5	4.2	9.1	3.3	10.2	5.3	2.8	2.5	2.8	6.8	2.2	4.9
1970	3.5	4.2	4.0	3.1	2.0	4.3	5.8	2.9	2.9	3.6	2.5	6.5	3.8
1971	11.1	5.8	9.4	4.8	4.7	5.9	4.2	2.7	3.7	6.3	2.0	1.4	5.2
1972	1.9	5.0	4.4	3.6	1.7	2.7	2.7	8.7	5.8	7.0	5.4	7.6	4.7
1973	7.9	7.8	3.4	4.2	3.8	6.3	5.1	10.7	8.9	6.5	4.3	3.8	6.1
1974	7.6	6.0	17.3	4.8	2.8	2.5	4.7	2.7	3.8	2.0	1.7	1.4	4.8
1975	3.0	2.3	3.6	2.6	2.3	2.5	2.2	4.7	6.9	9.4	7.7	11.8	4.9
1976	6.0	5.0	8.2	3.5	5.8	7.2	4.1	5.3	4.0	3.4	3.4	3.9	5.0
1977	5.8	5.2	6.5	5.6	2.7	1.9	1.6	2.9	2.0	9.7	5.9	3.9	4.5
1978	3.5	4.2	6.1	1.8	1.2	1.3	1.7	2.1	3.7	2.6	2.8	4.9	3.0
1979	1.9	1.5	1.9	2.5	6.9	2.5	2.6	2.0	3.0	8.4	7.1	5.3	3.8
1980	4.6	5.6	5.9	3.2	2.2	1.9	5.7	5.9	5.9	5.5	5.8	11.1	5.3
1981	8.2	7.3	4.4	3.2	2.3	1.6	2.1	1.4	1.5	4.5	4.6	6.2	3.9
1982	3.0	7.2	5.4	3.6	3.5	4.4	4.6	3.4	2.4	5.4	9.2	5.6	4.8
1983	7.7	8.2	9.3	4.9	12.3	9.7	25.5	9.2	8.6	6.5	4.6	8.6	9.6
1984	4.5	3.8	5.2	4.4	4.3	4.9	4.2	14.7	5.5	4.9	7.5	3.3	5.6
1985	2.3	4.8	3.5	6.4	2.6	1.9	1.7	1.2	2.5	2.4	4.0	1.5	2.9
1986	2.3	4.4	2.2	2.7	1.6	1.4	1.5	1.9	4.1	4.8	3.7	6.7	3.1
1987	8.2	11.6	3.5	3.0	5.5	5.3	3.1	3.4	4.0	5.0	2.5	2.4	4.8
Mean	4.6	5.6	5.1	3.6	3.4	3.3	3.4	3.6	4.1	4.8	4.4	4.0	4.2

Table I.4.13 MONTHLY MEAN DISCHARGE AT
TROMBUDO CENT TROMBUDO CENTRAL (1) (Scheme 14)

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	11.3	19.5	7.7	10.6	5.5	2.0	2.4	4.2	4.0	8.1	2.4	4.3	6.8
1935	2.2	1.5	5.2	0.9	0.5	2.2	2.7	5.8	12.5	25.8	3.0	4.0	5.5
1936	10.1	2.7	1.6	1.2	2.3	11.6	4.1	16.6	14.2	10.6	4.2	4.1	6.9
1937	2.6	3.1	9.7	9.3	2.5	1.7	1.1	4.0	2.7	11.7	9.4	6.1	5.3
1938	10.1	10.3	3.3	6.1	7.8	12.8	8.4	3.1	1.9	2.0	1.5	2.4	5.8
1939	4.7	7.7	10.9	4.9	4.3	9.0	4.2	1.5	9.6	5.2	17.6	13.5	7.7
1940	9.9	5.4	7.8	3.1	3.0	1.7	3.0	10.0	2.8	6.6	3.7	4.8	5.1
1941	6.8	13.6	14.1	2.9	3.9	6.3	2.4	9.8	4.6	6.5	7.1	4.3	6.9
1942	1.8	8.6	7.9	7.4	5.7	5.0	3.9	5.6	5.2	3.5	1.4	1.8	4.8
1943	2.6	4.2	1.2	1.0	4.2	15.9	8.3	15.8	8.2	6.0	5.5	2.3	6.3
1944	8.0	2.6	11.7	2.4	1.1	1.3	1.1	1.3	1.6	1.6	3.8	1.3	3.2
1945	0.7	4.9	2.1	1.0	0.6	0.8	1.7	1.0	3.4	5.7	1.2	1.6	2.1
1946	5.5	16.5	14.5	3.9	2.9	8.2	10.0	5.4	2.8	7.3	3.6	5.7	7.2
1947	4.5	12.7	5.9	1.7	1.6	3.7	3.5	7.3	16.3	13.8	5.9	4.9	6.8
1948	4.8	9.4	7.4	5.6	13.9	3.0	4.2	12.5	2.3	2.9	3.6	1.2	5.9
1949	2.1	0.9	2.2	4.8	1.4	5.9	1.5	4.0	5.8	3.9	1.6	1.5	3.0
1950	8.0	7.4	8.2	1.5	2.2	2.4	1.4	5.6	3.9	13.3	2.5	3.3	5.0
1951	10.7	19.7	8.3	2.1	1.1	1.2	2.2	0.7	1.0	15.5	6.3	3.4	6.0
1952	3.8	2.3	1.0	1.1	0.9	3.8	3.9	0.9	10.2	14.2	9.4	2.6	4.5
1953	5.4	10.4	3.4	1.3	1.5	0.9	1.0	1.4	3.4	10.5	13.3	5.7	4.8
1954	4.2	3.7	7.8	6.9	11.4	10.4	12.5	3.2	14.7	21.0	2.4	1.1	8.3
1955	1.2	4.9	5.2	4.5	8.5	8.4	14.1	5.9	8.9	2.4	2.9	5.7	6.1
1956	11.5	7.7	4.1	7.0	8.0	3.2	3.0	5.5	12.7	7.7	4.0	2.8	6.4
1957	3.6	2.8	7.2	6.6	5.0	4.4	15.7	27.8	27.4	9.3	4.3	2.5	9.7
1958	2.6	8.4	18.3	2.6	2.0	5.2	3.1	7.8	13.3	9.9	6.0	8.1	7.3
1959	4.1	8.8	3.6	4.0	3.1	2.1	1.4	3.3	9.3	3.4	1.3	1.6	3.8
1960	1.9	5.9	4.9	4.9	3.1	2.0	1.1	8.2	4.7	14.7	15.7	8.1	6.3
1961	6.5	10.4	11.6	5.8	2.5	4.1	3.8	1.3	25.2	22.1	16.2	9.4	9.9
1962	4.9	6.4	9.2	2.4	5.4	2.1	3.3	2.5	9.8	8.6	5.5	2.7	5.2
1963	13.5	24.5	23.6	4.2	1.3	1.1	1.2	1.4	8.7	22.1	18.6	6.8	10.6
1964	2.3	5.5	3.6	5.0	5.6	2.3	3.1	5.1	6.0	4.2	1.8	2.4	3.9
1965	1.7	1.1	3.9	2.9	8.9	3.5	6.9	8.6	9.9	7.6	7.6	14.4	6.4
1966	11.5	33.7	10.1	5.9	3.3	7.4	3.9	3.6	13.1	12.4	6.7	9.1	10.1
1967	6.4	22.1	9.6	3.8	2.3	4.4	3.4	4.0	12.7	7.1	8.9	7.7	7.7
1968	2.3	1.1	2.4	1.8	0.7	1.0	1.6	0.7	4.5	4.1	6.1	5.0	2.6
1969	7.8	19.9	8.8	15.4	3.2	10.8	6.5	2.8	3.2	2.7	4.6	1.9	7.3
1970	3.6	4.1	4.9	3.6	3.6	9.1	6.7	3.8	5.6	5.4	2.2	8.9	5.1
1971	18.6	14.7	15.4	11.9	9.6	13.2	8.1	4.2	5.0	4.8	1.3	0.9	9.0
1972	3.2	17.4	8.7	5.7	1.3	5.6	3.8	15.5	19.5	12.7	8.7	5.6	9.0
1973	7.9	8.5	5.6	4.3	6.9	8.2	10.2	19.0	17.7	5.9	4.7	3.4	8.5
1974	9.6	11.7	13.5	3.4	1.6	3.4	5.8	2.4	7.9	3.4	1.9	1.7	5.5
1975	5.9	4.3	12.9	3.0	4.5	5.4	2.5	8.3	24.5	20.8	6.1	20.6	9.9
1976	11.7	5.6	10.6	3.0	9.1	14.1	4.4	10.5	7.8	6.4	5.3	16.0	8.7
1977	20.2	10.5	11.0	6.9	2.4	1.8	2.0	13.8	4.9	21.9	9.2	4.6	9.1
1978	4.5	3.1	6.8	1.4	0.9	1.2	3.8	2.8	7.6	4.9	5.1	7.2	4.1
1979	2.7	1.9	4.6	3.6	14.9	4.2	4.1	4.5	6.1	24.3	11.3	10.0	7.7
1980	6.4	3.7	17.1	3.1	3.7	3.7	11.0	17.6	14.7	9.2	6.8	22.1	9.9
1981	11.7	9.3	3.1	2.9	1.9	1.9	2.5	2.3	5.4	4.7	4.9	8.1	4.9
1982	3.3	17.9	10.9	5.0	4.2	8.0	10.6	7.3	4.3	12.9	28.0	11.2	10.3
1983	16.6	17.9	16.1	7.7	23.2	20.8	55.6	22.4	14.2	9.4	8.6	11.8	18.7
1984	6.4	4.5	9.6	7.3	9.1	12.6	6.6	28.7	8.1	10.1	14.5	7.0	10.4
1985	3.9	15.7	6.2	8.9	3.9	1.4	2.2	1.4	2.6	2.8	7.2	1.1	4.8
1986	1.3	6.8	5.0	3.7	2.4	2.4	1.8	3.6	7.8	8.7	11.8	19.7	6.2
1987	17.0	15.6	3.3	2.0	13.3	7.7	4.9	5.6	3.6	17.6	3.3	1.7	8.0
Mean	6.5	9.1	8.0	4.4	4.8	5.6	5.7	7.1	8.7	9.7	6.8	6.1	6.9

Table I.4.14 MONTHLY MEAN DISCHARGE AT
TROMBUDO CENT TROMBUDO CENTRAL (2) (Scheme 15)

(Unit : cu.m/s)

Year	Month												Mean
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
1934	4.5	7.7	3.1	4.2	2.2	0.8	1.0	1.7	1.6	3.2	0.9	1.7	2.7
1935	0.9	0.6	2.1	0.3	0.2	0.9	1.1	2.3	4.9	10.2	1.2	1.6	2.2
1936	4.0	1.1	0.6	0.5	0.9	4.6	1.6	6.6	5.6	4.2	1.7	1.6	2.8
1937	1.0	1.2	3.9	3.7	1.0	0.7	0.4	1.6	1.1	4.7	3.7	2.4	2.1
1938	4.0	4.1	1.3	2.4	3.1	5.1	3.4	1.2	0.8	0.8	0.6	1.0	2.3
1939	1.9	3.0	4.3	1.9	1.7	3.6	1.7	0.6	3.8	2.1	7.0	5.3	3.1
1940	3.9	2.1	3.1	1.2	1.2	0.7	1.2	4.0	1.1	2.6	1.5	1.9	2.0
1941	2.7	5.4	5.6	1.2	1.6	2.5	0.9	3.9	1.8	2.6	2.8	1.7	2.7
1942	0.7	3.4	3.1	2.9	2.3	2.0	1.5	2.2	2.0	1.4	0.6	0.7	1.9
1943	1.0	1.6	0.5	0.4	1.6	6.3	3.3	6.2	3.2	2.4	2.2	0.9	2.5
1944	3.2	1.0	4.7	1.0	0.4	0.5	0.5	0.5	0.6	0.6	1.5	0.5	1.3
1945	0.3	1.9	0.8	0.4	0.2	0.3	0.7	0.4	1.3	2.2	0.5	0.6	0.8
1946	2.2	6.5	5.8	1.6	1.1	3.3	4.0	2.2	1.1	2.9	1.4	2.3	2.9
1947	1.8	5.0	2.4	0.7	0.6	1.5	1.4	2.9	6.5	5.5	2.3	1.9	2.7
1948	1.9	3.7	2.9	2.2	5.5	1.2	1.7	5.0	0.9	1.2	1.4	0.5	2.3
1949	0.8	0.4	0.9	1.9	0.5	2.4	0.6	1.6	2.3	1.6	0.6	0.6	1.2
1950	3.2	2.9	3.2	0.6	0.9	0.9	0.6	2.2	1.5	5.3	1.0	1.3	2.0
1951	4.2	7.8	3.3	0.8	0.4	0.5	0.9	0.3	0.4	6.1	2.5	1.4	2.4
1952	1.5	0.9	0.4	0.4	0.3	1.5	1.6	0.4	4.1	5.6	3.7	1.1	1.8
1953	2.1	4.1	1.3	0.5	0.6	0.3	0.4	0.6	1.4	4.1	5.3	2.3	1.9
1954	1.7	1.5	3.1	2.7	4.5	4.1	5.0	1.3	5.8	8.3	1.0	0.4	3.3
1955	0.5	1.9	2.1	1.8	3.4	3.4	5.6	2.3	3.5	1.0	1.1	2.3	2.4
1956	4.6	3.1	1.6	2.8	3.2	1.3	1.2	2.2	5.0	3.1	1.6	1.1	2.6
1957	1.4	1.1	2.9	2.6	2.0	1.8	6.2	11.0	10.9	3.7	1.7	1.0	3.9
1958	1.0	3.3	7.3	1.0	0.8	2.1	1.2	3.1	5.3	3.9	2.4	3.2	2.9
1959	1.6	3.5	1.4	1.6	1.2	0.8	0.6	1.3	3.7	1.4	0.5	0.6	1.5
1960	0.7	2.3	2.0	2.0	1.2	0.8	0.4	3.3	1.8	5.8	6.2	3.2	2.5
1961	2.6	4.1	4.6	2.3	1.0	1.6	1.5	0.5	10.0	8.8	6.4	3.7	3.9
1962	2.0	2.5	3.6	0.9	2.1	0.8	1.3	1.0	3.9	3.4	2.2	1.1	2.1
1963	5.4	9.7	9.3	1.7	0.5	0.4	0.5	0.6	3.4	8.8	7.4	2.7	4.2
1964	0.9	2.2	1.4	2.0	2.2	0.9	1.2	2.0	2.4	1.7	0.7	1.0	1.6
1965	0.7	0.4	1.5	1.2	3.5	1.4	2.7	3.4	3.9	3.0	3.0	5.7	2.5
1966	4.6	13.4	4.0	2.3	1.3	2.9	1.5	1.4	5.2	4.9	2.7	3.6	4.0
1967	2.5	8.8	3.8	1.5	0.9	1.8	1.4	1.6	5.0	2.8	3.5	3.1	3.1
1968	0.9	0.4	0.9	0.7	0.3	0.4	0.6	0.3	1.8	1.6	2.4	2.0	1.0
1969	3.1	7.9	3.5	6.1	1.3	4.3	2.6	1.1	1.3	1.1	1.8	0.7	2.9
1970	1.4	1.6	1.9	1.4	1.4	3.6	2.7	1.5	2.2	2.1	0.9	3.5	2.0
1971	7.4	5.8	6.1	4.7	3.8	5.2	3.2	1.6	2.0	1.9	0.5	0.4	3.6
1972	1.3	6.9	3.5	2.2	0.5	2.2	1.5	6.2	7.7	5.0	3.5	2.2	3.6
1973	3.2	3.4	2.2	1.7	2.8	3.2	4.1	7.5	7.0	2.4	1.9	1.3	3.4
1974	3.8	4.7	5.3	1.3	0.6	1.4	2.3	1.0	3.2	1.4	0.8	0.7	2.2
1975	2.4	1.7	5.1	1.2	1.8	2.2	1.0	3.3	9.7	8.2	2.4	8.2	3.9
1976	4.7	2.2	4.2	1.2	3.6	5.6	1.7	4.1	3.1	2.5	2.1	6.3	3.5
1977	8.0	4.2	4.4	2.7	0.9	0.7	0.8	5.5	1.9	8.7	3.7	1.8	3.6
1978	1.8	1.2	2.7	0.6	0.4	0.5	1.5	1.1	3.0	1.9	2.0	2.8	1.6
1979	1.1	0.8	1.8	1.4	5.9	1.7	1.6	1.8	2.4	9.6	4.5	3.9	3.0
1980	2.5	1.5	6.8	1.2	1.5	1.5	4.4	7.0	5.8	3.7	2.7	8.8	3.9
1981	4.7	3.7	1.2	1.2	0.8	0.7	1.0	0.9	2.1	1.9	1.9	3.2	1.9
1982	1.3	7.1	4.3	2.0	1.6	3.2	4.2	2.9	1.7	5.1	11.1	4.4	4.1
1983	6.6	7.1	6.4	3.1	9.2	8.2	22.0	8.9	5.6	3.7	3.4	4.7	7.4
1984	2.5	1.8	3.8	2.9	3.6	5.0	2.6	11.4	3.2	4.0	5.7	2.8	4.1
1985	1.5	6.2	2.5	3.5	1.5	0.6	0.9	0.6	1.0	1.1	2.9	0.4	1.9
1986	0.5	2.7	2.0	1.5	0.9	0.9	0.7	1.4	3.1	3.5	4.7	7.8	2.5
1987	6.7	6.2	1.3	0.8	5.3	3.1	2.0	2.2	1.4	7.0	1.3	0.7	3.2
Mean	2.6	3.6	3.2	1.7	1.9	2.2	2.2	2.8	3.5	3.8	2.7	2.4	2.7

Table I.4.15 MONTHLY MEAN DISCHARGE AT BOTUVERA (Scheme 16)

(Unit : cu.m/s)

Year	Month												
	Jan.	Feb.	Mar	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1934	-	-	-	-	-	-	-	-	-	-	-	13.2	-
1935	12.4	9.6	14.2	15.3	6.2	13.4	8.0	16.7	17.0	32.9	12.1	9.1	13.9
1936	17.5	11.5	6.5	7.9	7.4	18.1	12.9	37.0	29.3	24.3	13.4	9.4	16.3
1937	9.0	11.7	16.6	20.0	18.9	9.0	7.9	13.0	11.6	20.9	14.8	13.0	13.9
1938	16.0	17.0	13.6	14.3	14.4	16.7	10.6	7.9	7.4	11.8	10.6	10.0	12.5
1939	8.8	14.4	10.5	8.1	12.1	10.9	9.2	6.1	16.0	15.1	33.1	18.4	13.6
1940	25.3	22.0	13.2	11.3	13.9	6.7	13.2	19.7	9.9	16.0	13.9	14.9	15.0
1941	11.3	15.5	12.7	9.2	11.0	16.4	6.3	14.0	10.3	9.7	17.4	10.8	12.0
1942	10.2	19.0	10.0	9.8	8.9	10.6	8.5	7.2	6.2	6.2	5.0	9.3	9.3
1943	6.5	7.3	6.2	4.8	6.4	11.7	10.6	26.5	18.4	16.7	9.8	7.8	11.1
1944	14.8	12.1	12.4	8.7	5.6	5.6	5.3	5.8	6.0	5.5	9.9	4.6	8.0
1945	4.8	19.5	7.4	8.9	6.0	4.9	6.0	4.1	9.0	8.7	4.7	6.6	7.5
1946	8.3	20.4	16.0	10.6	9.9	14.0	19.6	13.7	9.2	11.7	9.6	8.0	12.6
1947	10.1	17.3	15.3	7.0	7.2	7.2	8.3	11.0	15.1	26.1	13.9	18.2	13.1
1948	14.2	18.9	18.4	13.3	26.4	13.1	16.8	31.7	11.3	10.5	9.7	6.5	15.9
1949	6.7	8.2	17.2	16.0	8.4	14.5	7.3	10.2	10.8	8.0	6.9	5.5	10.0
1950	13.9	15.2	22.7	9.8	8.8	7.9	6.1	11.8	9.5	17.6	7.2	10.2	11.7
1951	12.4	12.6	13.2	6.1	4.7	4.4	5.8	3.9	3.5	13.6	7.2	8.8	8.0
1952	9.6	8.0	6.1	4.1	3.9	6.0	7.3	4.1	8.2	14.6	12.0	6.2	7.5
1953	10.2	7.6	6.0	3.8	4.0	3.8	3.8	3.6	5.0	14.1	13.1	6.9	6.8
1954	8.7	11.0	10.9	16.9	19.0	14.0	19.3	7.9	15.1	32.0	11.9	10.2	14.8
1955	8.2	9.7	8.2	9.2	12.3	10.1	18.9	11.5	15.3	7.2	7.6	11.4	10.8
1956	14.6	13.3	7.8	7.6	12.1	7.8	7.2	7.7	18.8	11.4	11.7	13.9	11.2
1957	11.7	13.1	7.9	9.9	12.3	8.9	22.0	41.6	44.9	21.6	22.9	13.9	19.2
1958	11.7	13.8	22.1	13.1	8.8	13.5	9.5	11.1	18.4	14.9	19.3	12.2	14.0
1959	10.8	14.8	11.0	15.8	10.1	8.5	6.3	11.6	18.6	10.9	9.3	9.8	11.5
1960	14.5	29.0	26.3	12.5	9.8	8.1	8.7	22.9	12.3	13.4	18.9	13.5	15.8
1961	10.0	15.9	14.8	12.2	10.9	12.1	10.0	6.6	26.7	21.6	45.1	29.2	17.9
1962	16.0	17.7	22.2	11.3	14.0	10.8	13.2	7.4	15.3	12.5	13.8	12.1	13.9
1963	19.1	27.9	20.1	14.2	7.4	7.6	7.3	7.0	18.9	27.0	23.3	13.2	16.1
1964	9.9	7.7	8.6	7.7	9.0	6.5	6.9	7.9	11.7	12.0	6.9	8.7	8.6
1965	7.9	7.3	8.3	13.2	14.9	8.3	11.4	12.0	15.0	12.5	13.2	16.6	11.7
1966	19.3	34.9	17.4	16.3	11.9	18.0	10.8	10.1	34.2	20.4	10.4	15.6	18.3
1967	19.9	26.4	20.4	12.5	11.0	10.7	9.8	9.9	20.0	13.6	11.4	13.1	14.9
1968	8.5	7.1	6.2	5.5	4.5	4.8	4.8	4.2	7.4	7.5	9.9	7.5	6.5
1969	16.8	12.2	17.5	22.2	7.4	19.0	15.7	9.5	9.4	8.4	15.2	9.3	13.6
1970	11.9	11.7	13.6	9.8	8.1	11.6	13.1	9.8	8.3	7.9	7.1	11.5	10.4
1971	18.6	11.1	22.5	22.2	16.6	16.2	15.4	10.3	15.3	13.3	6.8	5.5	14.5
1972	7.9	20.8	9.0	5.9	4.6	8.3	8.9	30.9	22.4	17.0	15.9	23.0	14.6
1973	21.1	18.2	10.9	10.0	10.4	15.9	16.2	29.6	24.2	15.6	14.8	11.8	16.6
1974	21.9	21.6	30.0	13.6	8.6	9.4	11.5	7.8	18.4	6.2	9.3	5.2	13.6
1975	8.1	5.5	7.1	5.2	6.2	7.0	7.2	15.4	33.5	35.2	17.6	38.2	15.5
1976	24.4	14.6	18.9	10.2	20.8	26.1	18.6	29.9	15.0	11.5	13.9	16.0	18.3
1977	19.7	28.4	13.9	13.1	6.3	4.7	5.5	26.1	14.8	32.7	27.3	13.4	17.2
1978	13.0	10.9	11.5	4.9	4.1	5.3	6.5	4.5	11.7	9.1	9.5	19.6	9.2
1979	7.3	6.3	5.2	11.9	16.3	8.0	7.6	6.6	11.7	31.6	18.3	11.6	11.9
1980	10.7	8.7	12.6	9.9	6.5	5.5	16.1	24.1	20.5	18.6	15.4	31.8	15.0
1981	17.6	11.9	11.0	8.2	6.8	6.3	6.7	5.6	5.7	16.9	12.2	14.6	10.3
1982	8.7	22.5	12.8	10.1	8.8	11.9	11.7	10.6	7.7	14.7	25.1	13.1	13.1
1983	27.1	25.7	29.6	19.1	42.9	34.2	100.7	42.6	28.0	18.7	15.7	30.3	34.5
1984	19.5	17.3	14.2	11.6	11.6	15.6	15.8	78.6	24.2	19.0	16.1	13.9	21.4
1985	10.5	14.5	10.3	12.5	9.7	6.0	7.8	4.6	6.6	7.0	11.0	5.1	8.8
1986	2.6	4.8	2.2	2.5	1.3	1.4	0.9	1.4	2.8	9.8	5.1	7.5	3.5
1987	11.7	12.6	3.5	3.0	11.1	6.5	4.7	6.4	4.1	13.5	3.1	2.6	6.9
1988	5.5	3.7	1.8	1.5	5.1	3.7	1.1	0.3	3.0	1.9	0.5	0.4	2.4
1989	12.6	8.0	5.1	3.8	7.9	-	-	-	-	-	-	-	-
Mean	12.9	14.7	13.0	10.5	10.4	10.5	11.7	14.5	14.7	15.4	13.3	12.4	12.8

Table I.5.1 PROBABLE FLOOD DISCHARGES AT KEY GAUGES

	Name of Station	Catchment Area (sq.km)	Return Period (year) 2	5	10	20	50	100	200
a)	Probable flood peak discharge (cu.m/s)								
	Taio	1,585	290	450	600	800	1,200	1,500	1,900
	Ituporanga	1,461	460	790	1,100	1,400	1,800	2,100	2,400
	Rio do Sul	5,230	780	1,300	1,700	2,200	2,900	3,500	4,200
	Ibirama	3,341	680	1,100	1,400	1,800	2,200	2,700	3,100
	Apiuna	9,487	1,400	2,200	2,900	3,600	4,600	5,500	6,400
	Timbo	1,450	410	580	690	810	950	1,100	1,200
	Indaial	11,491	1,700	2,800	3,600	4,500	5,900	7,100	8,400
	Brusque	1,220	190	300	390	490	670	820	1,000
b)	Specific probable flood peak discharge (cu.m/s/sq.km)								
	Taio	1,585	0.18	0.28	0.38	0.50	0.76	0.95	1.20
	Ituporanga	1,461	0.31	0.54	0.75	0.96	1.23	1.44	1.64
	Rio do Sul	5,230	0.15	0.25	0.33	0.42	0.55	0.67	0.80
	Ibirama	3,341	0.20	0.33	0.42	0.54	0.66	0.81	0.93
	Apiuna	9,487	0.15	0.23	0.31	0.38	0.48	0.58	0.67
	Timbo	1,450	0.28	0.40	0.48	0.56	0.66	0.76	0.83
	Indaial	11,491	0.15	0.24	0.31	0.39	0.51	0.62	0.73
	Brusque	1,220	0.16	0.25	0.32	0.40	0.55	0.67	0.82

Table I.5.2 PROBABLE FLOOD DISCHARGES AT THE PROJECT SITES

(Unit : cu.m/sec)

No.	Name of Scheme	Catchment Area (sq.km)	Return Period (year) 2	5	10	20	50	100	200
1.	Salto Pilao (1)	5,597	1,100	1,800	2,700	3,200	4,300	4,800	5,700
2.	Salto Pilao (2)	5,597	1,100	1,800	2,700	3,200	4,300	4,800	5,700
3.	Ibirama	9,041	1,500	2,400	3,600	4,300	5,700	6,400	7,600
4.	Subida	9,147	1,500	2,400	3,600	4,300	5,800	6,500	7,700
5.	Ascurra	9,586	1,500	2,500	3,700	4,500	5,900	6,700	7,900
6.	Indaial	11,493	1,700	2,800	4,100	5,000	6,600	7,400	8,800
7.	Dalbergia	3,212	770	1,300	2,000	2,300	3,100	3,500	4,100
8.	Barra da Pratinha	1,405	470	780	1,200	1,400	1,900	2,100	2,500
9.	Barra das Pombas	979	380	630	1,000	1,200	1,500	1,700	2,000
10.	Timbo	765	330	540	810	1,000	1,300	1,500	1,800
11.	Benedito Novo	586	280	460	690	900	1,100	1,300	1,500
12.	Alto Benedito Novo	473	250	410	610	800	1,000	1,100	1,300
13.	Doutor Pedrinho	161	130	220	320	380	510	600	680
14.	Trombudo Central (1)	293	190	310	460	550	730	900	1,000
15.	Trombudo Central (2)	117	110	180	270	320	420	500	560
16.	Botuvera	625	290	480	720	860	1,200	1,300	1,600

Table I.5.3 ANNUAL MAXIMUM BASIN MEAN 4 AND 7 DAYS RAINFALL

Year	4-day Rainfall Date	4-day Rainfall (mm)	7-day Rainfall Date	7-day Rainfall (mm)	4-day Rainfall / 7-day Rainfall (%)
1951	Oct. 15 to 18	90	Oct. 14 to 20	145	62.1
1952	Sep. 3 to 6	87	Oct. 13 to 19	103	84.5
1953	Oct. 28 to 31	93	Oct. 27 to Nov.2	101	92.1
1954	Mar. 31 to Apr.3	101	Oct. 16 to 22	137	73.7
1955	May 16 to 19	115	May 15 to 21	126	91.3
1956	Sep. 16 to 19	56	Sep. 14 to 20	94	59.6
1957	Aug. 16 to 19	118	Aug. 13 to 19	133	88.7
1958	Mar. 13 to 16	121	Mar. 13 to 19	152	79.6
1959	Aug. 30 to Sep.2	88	Aug. 29 to Sep.4	124	71.0
1960	Jul. 31 to Aug.3	89	Jul. 30 to Aug.5	97	91.8
1961	Sep. 9 to 12	138	Sep. 6 to 12	193	71.5
1962	Sep. 18 to 21	89	Sep. 17 to 23	100	89.0
1963	Sep. 26 to 29	138	Sep. 25 to Oct.1	176	78.4
1964	Apr. 28 to May 1	57	Oct. 20 to 26	66	86.4
1965	Aug. 16 to 19	91	Aug. 16 to 22	104	87.5
1966	Feb. 9 to 12	121	Feb. 9 to 15	166	72.9
1967	Sep. 18 to 21	56	Sep. 18 to 24	86	65.1
1968	Dec. 22 to 25	103	Dec. 20 to 26	115	89.6
1969	Feb. 16 to 19	93	Mar. 30 to Apr.5	110	84.5
1970	Feb. 2 to 5	69	Feb. 1 to 7	96	71.9
1971	May 5 to 8	66	Apr. 16 to 22	100	66.0
1972	Aug. 25 to 28	146	Aug. 22 to 28	165	88.5
1973	Aug. 26 to 29	108	Aug. 22 to 28	149	72.5
1974	Jul. 22 to 25	99	Jul. 19 to 25	115	86.1
1975	Sep. 30 to Oct.3	102	Sep. 27 to Oct.3	127	80.3
1976	May 26 to 29	90	May 23 to 29	108	83.3
1977	Aug. 15 to 18	125	Aug. 13 to 19	137	91.2
1978	Dec. 25 to 28	118	Dec. 24 to 30	122	96.7
1979	May 7 to 10	106	May 8 to 14	141	75.2
1980	Dec. 19 to 22	151	Dec. 18 to 24	164	92.1
1981	Dec. 21 to 24	99	Dec. 21 to 27	102	97.1
1982	Feb. 3 to 6	96	Feb. 4 to 10	111	86.5
1983	Jul. 6 to 9	216	Jul. 6 to 12	324	66.7
1984	Aug. 5 to 8	213	Aug. 2 to 8	259	82.2

Source : Itajai River Basin Flood Control Project

Table I.5.4 ANNUAL MAXIMUM 4-DAY RAINFALL

Year	Trombudo Central		Ibirama		Timbó		Brusque	
	Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)
1929	-	-	-	-	Jan. 24 to 27	143.2	-	-
1930	-	-	-	-	Feb. 7 to 10	102.7	-	-
1931	-	-	-	-	Sep. 10 to 13	141.5	-	-
1932	-	-	-	-	Nov. 22 to 25	135.0	-	-
1933	-	-	-	-	Oct. 2 to 5	150.2	-	-
1934	-	-	Aug. 29 to May 1	94.6	-	-	-	-
1935	-	-	Sep. 21 to 24	175.1	Jan. 13 to 16	160.5	-	-
1936	-	-	Jan. 1 to 4	162.3	Aug. 5 to 8	123.0	-	-
1937	-	-	Apr. 2 to 5	148.2	Mar. 7 to 10	153.6	-	-
1938	-	-	Jan. 26 to 29	251.5	Jan. 26 to 29	134.0	-	-
1939	-	-	Nov. 16 to 19	193.5	Nov. 16 to 19	215.7	-	-
1940	-	-	Aug. 24 to 27	143.3	Oct. 19 to 22	103.1	-	-
1941	-	-	Nov. 4 to 7	90.8	Nov. 4 to 7	69.8	Nov. 12 to 15	106.6
1942	-	-	Dec. 11 to 14	103.6	Feb. 17 to 20	171.2	Feb. 6 to 9	114.8
1943	-	-	Jan. 18 to 21	108.2	Aug. 21 to 24	91.1	Jul. 31 to Aug.3	154.3
1944	-	-	Aug. 29 to Sep.1	107.1	Jan. 9 to 12	132.8	Mar. 18 to 21	121.8
1945	-	-	Feb. 16 to 19	154.0	Feb. 17 to 20	123.8	Apr. 10 to 13	116.8
1946	Feb. 13 to 16	95.0	Oct. 17 to 20	104.8	Mar. 11 to 14	125.1	Oct. 17 to 20	121.8
1947	Oct. 22 to 25	92.2	Feb. 5 to 8	101.9	Jan. 12 to 15	123.3	Mar 1 to 4	82.7
1948	Feb. 12 to 15	80.3	May 16 to 19	150.1	May 16 to 19	178.9	May 16 to 19	124.5
1949	Mar. 3 to 6	110.6	Apr. 24 to 27	77.8	Apr. 1 to 4	92.3	Mar 27 to 30	120.9
1950	Mar. 2 to 5	192.8	Mar. 1 to 4	112.3	Mar. 1 to 4	187.1	Dec. 1 to 4	85.4
1951	Oct. 18 to 21	131.9	Oct. 15 to 18	120.6	Oct. 18 to 21	80.2	Oct. 18 to 21	83.9
1952	Jan. 23 to 26	102.2	Dec. 28 to 31	82.6	Jan. 23 to 26	100.0	Jan. 23 to 26	122.2
1953	Oct. 28 to 31	124.2	Jan. 5 to 8	92.0	Nov. 11 to 14	92.6	Oct. 28 to 31	95.4
1954	Oct. 20 to 23	113.0	Jan. 11 to 14	114.9	Mar. 31 to Apr.3	145.6	Mar. 31 to Apr.3	232.5
1955	May 17 to 20	112.4	Dec. 1 to 4	140.9	May 17 to 20	151.2	May 17 to 20	148.9
1956	Sep. 23 to 26	89.8	Jan. 19 to 22	78.2	Jan. 26 to 29	87.6	Sep. 18 to 21	89.5
1957	Aug. 16 to 19	142.7	Aug. 16 to 19	136.8	Aug. 17 to 20	109.4	Nov. 14 to 17	143.9
1958	Mar. 14 to 17	135.2	Mar. 13 to 16	162.5	Feb. 18 to 21	210.9	Mar. 14 to 17	157.2
1959	Feb. 6 to 9	77.4	Apr. 4 to 7	76.8	Aug. 29 to Sep.1	87.8	Aug. 29 to Sep.1	124.3
1960	Jul. 31 to Aug.3	105.5	Aug. 1 to 4	93.0	Feb. 29 to 4	153.3	Aug. 1 to 4	114.6
1961	Sep. 9 to 12	274.3	Sep. 6 to 9	101.3	Oct. 31 to Nov.3	251.5	Oct. 30 to Nov.2	226.2
1962	May 20 to 23	82.3	May 20 to 23	83.6	Sep. 18 to 21	117.6	Sep. 19 to 22	139.4
1963	Sep. 26 to 29	157.8	Sep. 26 to 29	129.8	Sep. 26 to 29	141.3	Sep. 26 to 29	153.5
1964	Feb. 8 to 11	82.3	Dec. 1 to 4	55.7	Jun. 10 to 13	77.0	Apr. 28 to 31	85.8
1965	Aug. 18 to 21	114.5	Dec. 8 to 11	75.0	Apr. 28 to May 1	136.9	-	-
1966	Jun. 14 to 17	113.9	Jun. 4 to 7	94.5	Feb. 7 to 10	153.2	-	-
1967	Apr. 25 to 28	72.4	Nov. 26 to 29	74.9	Mar. 26 to 29	137.4	-	-
1968	Dec. 22 to 25	115.6	Dec. 21 to 24	128.8	Oct. 27 to 30	96.4	Dec. 22 to 25	100.4
1969	Mar. 19 to 22	108.6	Jun. 15 to 18	113.9	Jun. 22 to 25	97.1	May 23 to 26	140.0
1970	Dec. 9 to 12	115.2	Jan. 1 to 4	91.3	Feb. 2 to 5	182.1	Feb. 2 to 5	122.0
1971	Apr. 21 to 24	101.2	Jun. 5 to 8	94.9	Jun. 5 to 8	90.3	Feb. 22 to 25	103.7
1972	Aug. 25 to 28	183.0	Aug. 22 to 25	143.6	Aug. 25 to 28	223.9	Dec. 21 to 24	114.6
1973	Jul. 20 to 23	90.5	Aug. 26 to 29	113.2	Aug. 26 to 29	121.1	Jul. 22 to 25	153.2
1974	Jul. 21 to 24	71.1	Jul. 21 to 24	113.1	Jul. 21 to 24	144.0	Mar. 21 to 24	210.8
1975	Sep. 30 to Oct.3	102.4	Sep. 30 to Oct.3	115.8	Oct. 2 to 5	117.1	Jan. 6 to 9	187.0
1976	Dec. 20 to 23	139.6	May 26 to 29	96.7	Aug. 6 to 9	77.8	Jan. 21 to 24	146.8
1977	Aug. 15 to 18	161.4	Aug. 16 to 19	141.2	Jan. 16 to 19	152.2	Aug. 16 to 19	145.9
1978	Dec. 25 to 28	128.0	Nov. 20 to 23	101.4	Nov. 19 to 22	107.4	Dec. 25 to 28	147.6
1979	May 7 to 10	111.0	May 8 to 11	113.5	May 7 to 10	110.5	Aug. 17 to 20	97.5
1980	Dec. 19 to 22	136.4	Dec. 19 to 22	135.1	Dec. 19 to 22	146.5	Dec. 19 to 22	118.0
1981	Dec. 21 to 24	95.1	Dec. 21 to 24	192.9	Dec. 21 to 24	99.2	Oct. 27 to 30	199.4
1982	Nov. 3 to 6	124.3	Dec. 3 to 6	82.2	Feb. 4 to 7	138.4	Mar. 23 to 26	101.0
1983	Jul. 7 to 10	243.3	Jul. 6 to 9	189.0	Jul. 6 to 9	202.3	Jul. 6 to 9	189.6
1984	Aug. 5 to 8	256.1	Aug. 5 to 8	203.1	Aug. 6 to 9	223.1	Aug. 4 to 7	271.4
1985	Feb. 11 to 14	131.1	Feb. 12 to 15	120.2	Feb. 12 to 15	149.6	Nov. 21 to 24	193.9
1986	Nov. 3 to 6	144.7	Jan. 31 to Feb.3	95.8	Oct. 8 to 11	96.1	Oct. 8 to 11	117.0
1987	Jan. 11 to 14	114.4	Jun. 13 to 16	100.7	Feb. 14 to 17	185.7	-	-
1988	Sep. 20 to 23	87.5	May 21 to 24	86.1	Jan. 17 to 20	112.8	Jan. 30 to Feb.2	63.2
1989	-		Sep. 12 to 15	102.5	Jan. 4 to 7	172.4	Jan. 6 to 9	178.1

FIGURES

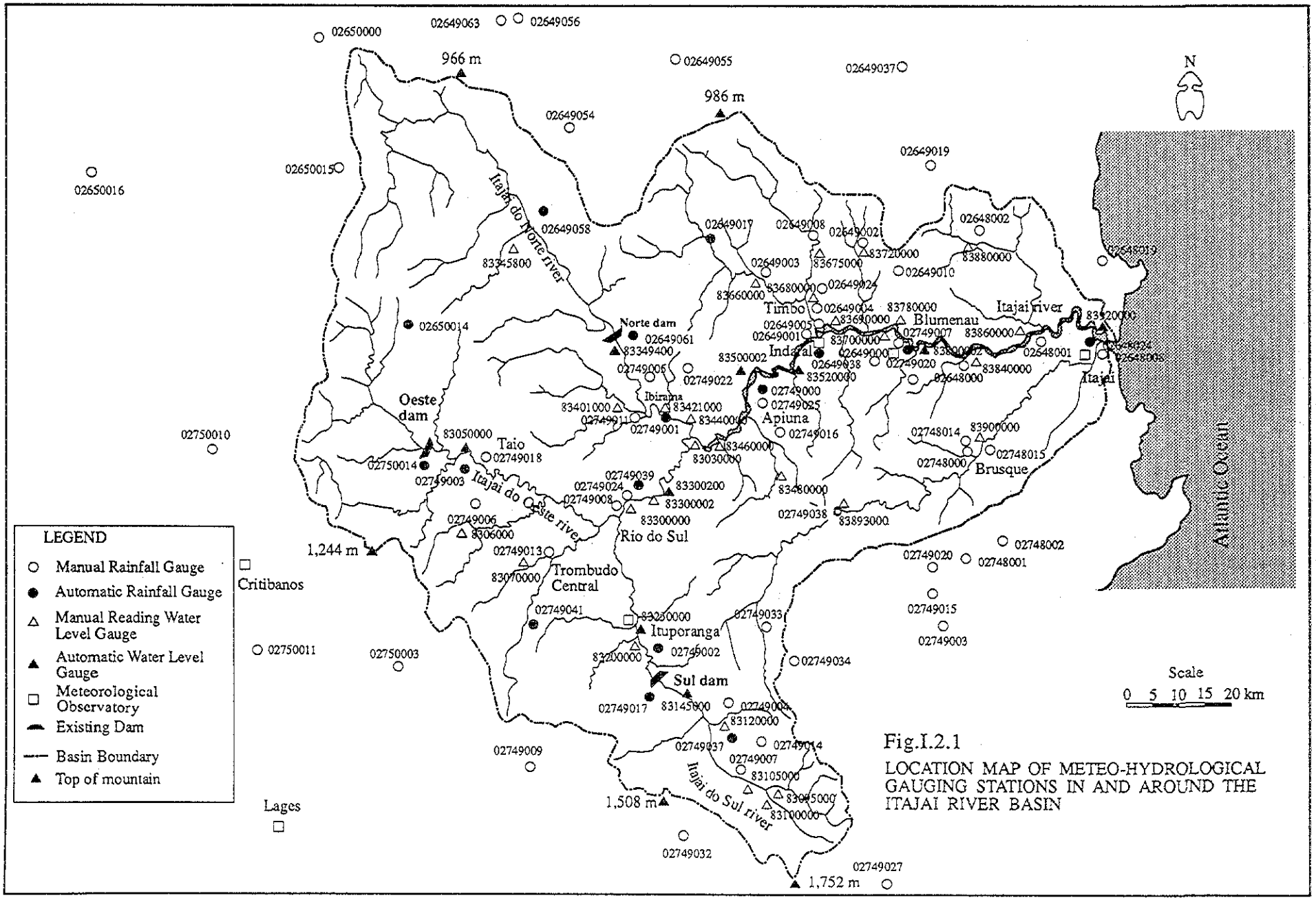
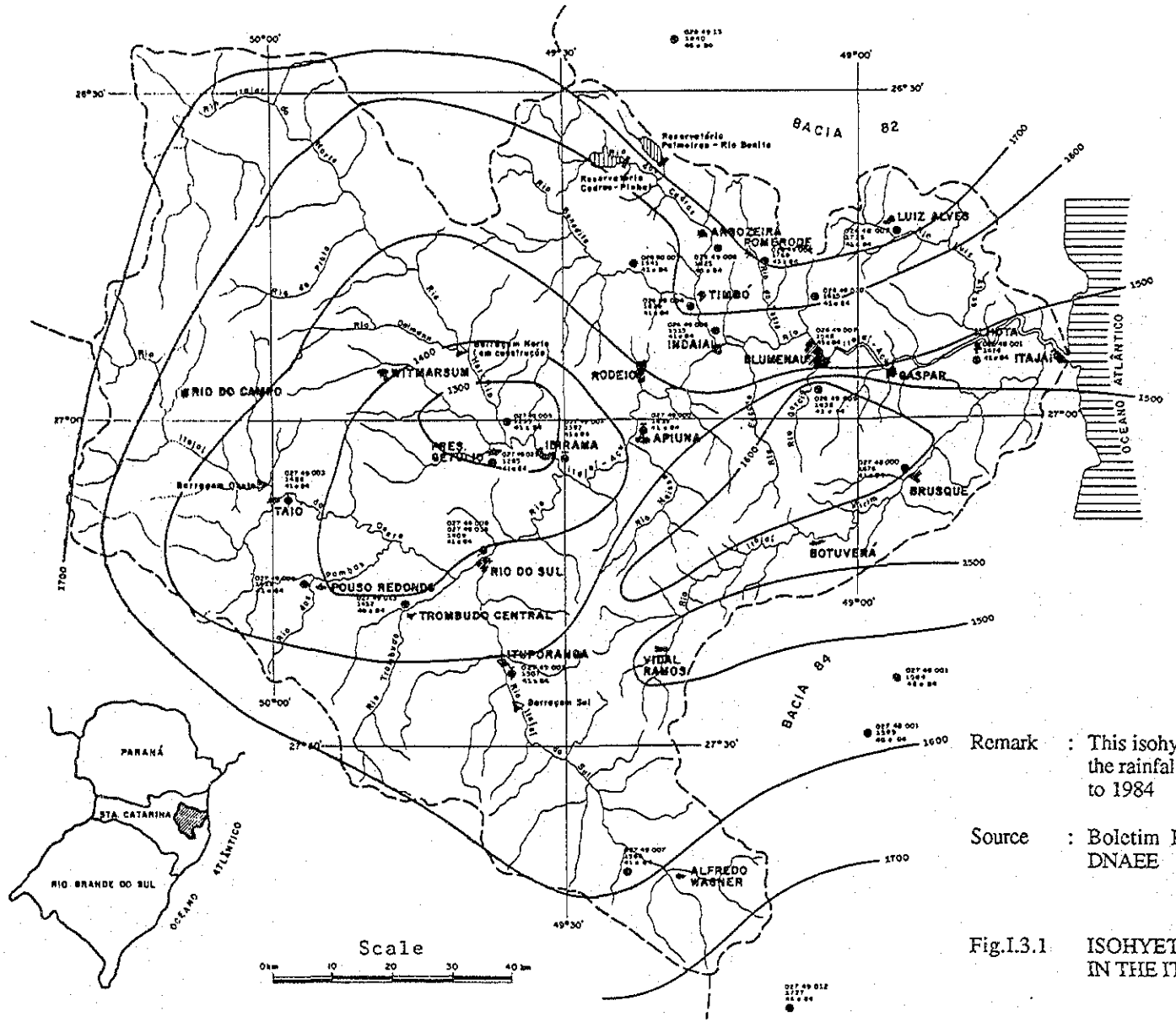


Fig.I.2.1
LOCATION MAP OF METEO-HYDROLOGICAL GAUGING STATIONS IN AND AROUND THE ITAJAI RIVER BASIN



Remark : This isohyetal map is prepared based on the rainfall data for the period from 1941 to 1984

Source : Boletim Pluviometrico P-8.01, 1985, DNAEE

Fig.I.3.1 ISOHYETAL MAP OF ANNUAL RAINFALL IN THE ITAJAI RIVER BASIN

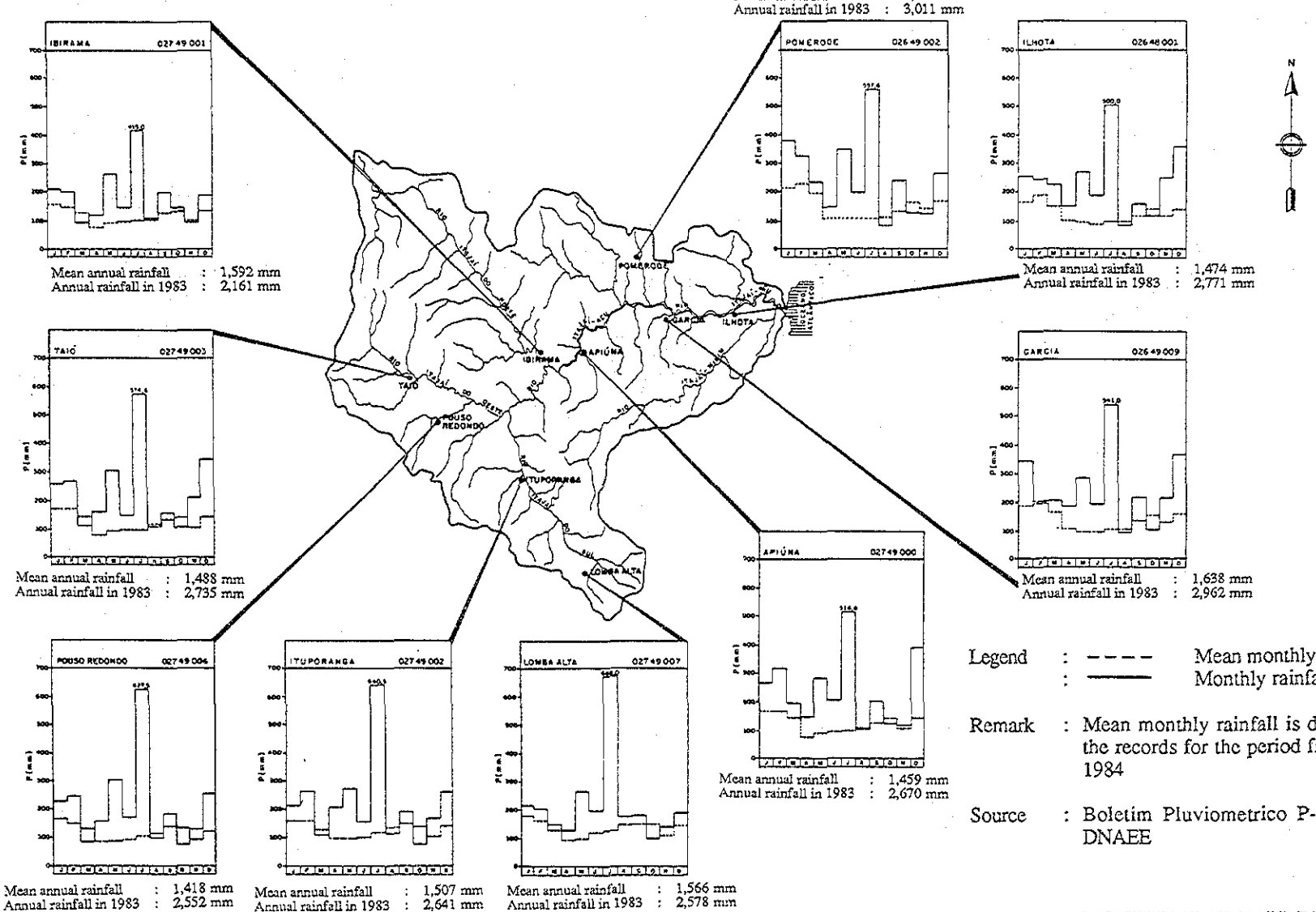
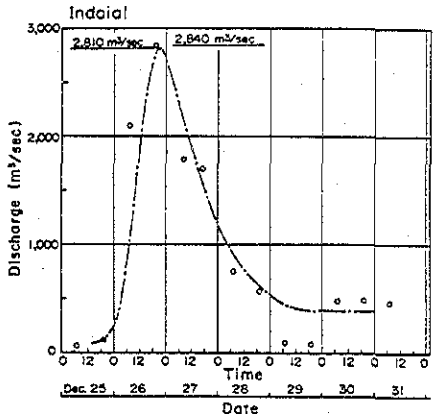
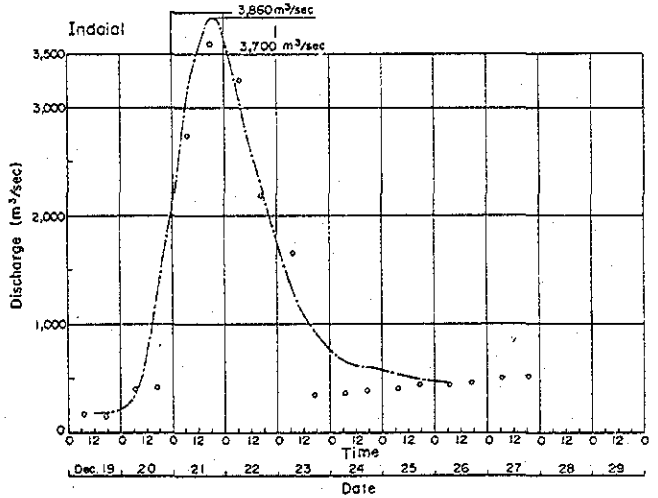


Fig.I.3.2 MONTHLY RAINFALL DISTRIBUTION IN THE ITAJAI RIVER BASIN

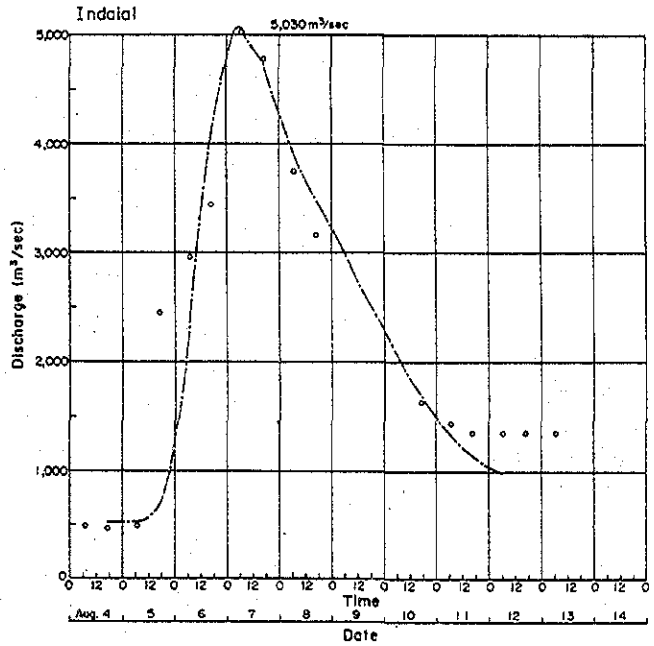
(1) December 1978



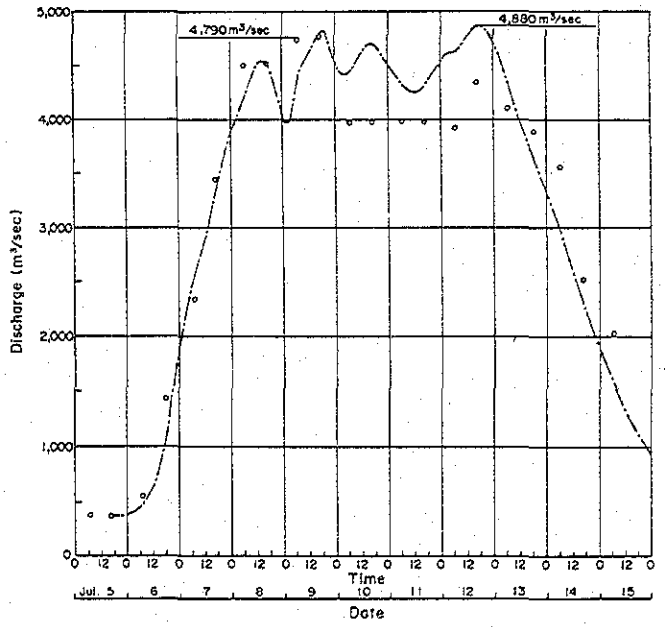
(2) December 1980



(3) July 1983



(4) August 1984



Legend

O Recorded flood hydrograph by mannual gauge reading

---- *Simulated flood hydrograph by Itajai River Basin flood Control Project*

Fig. I.3.3 RECORDED FLOOD HYDROGRAPHS AT INDAIAL IN DECEMBER 1978, DECEMBER 1980, JULY 1983 AND AUGUST 1984

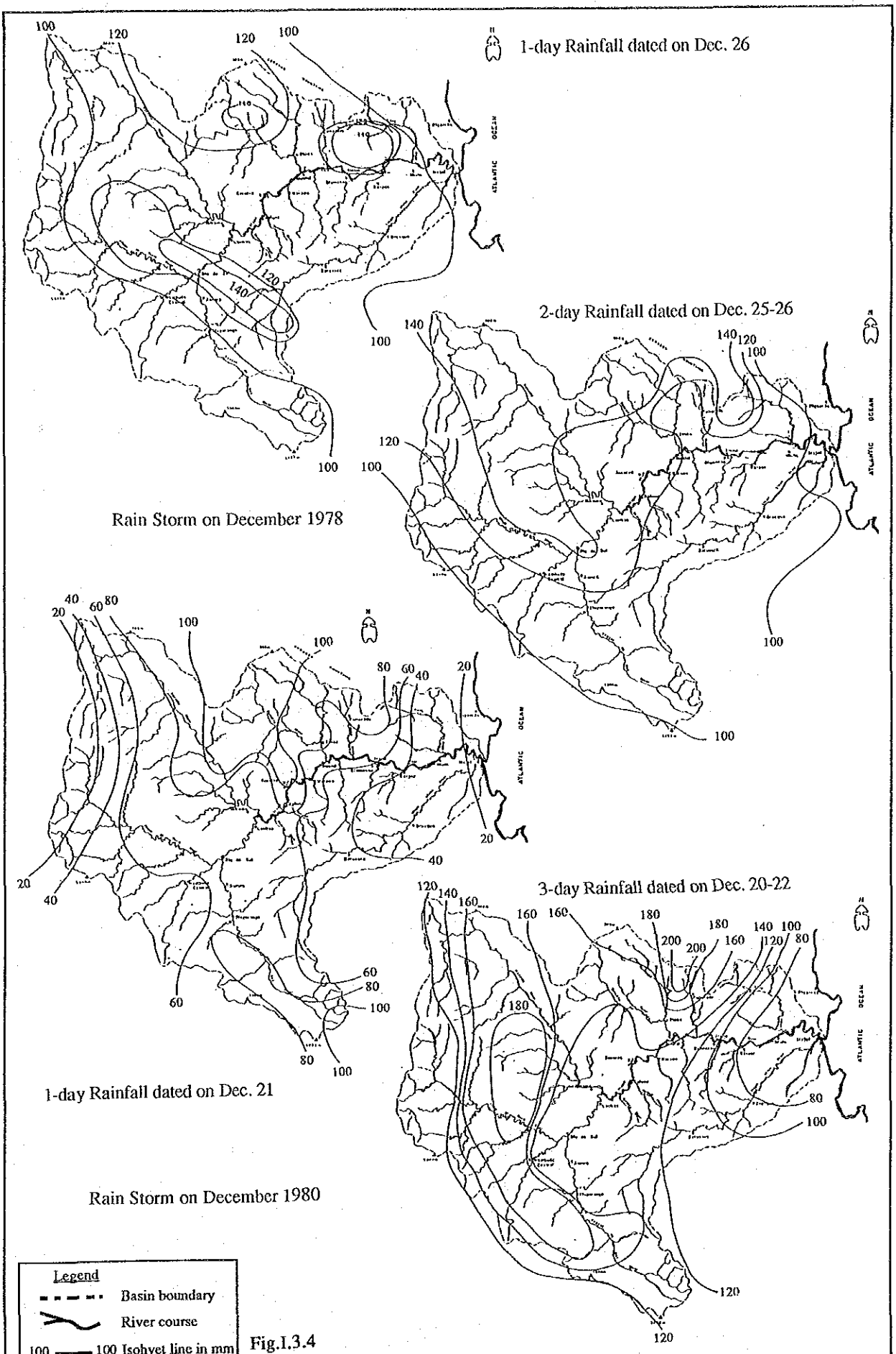
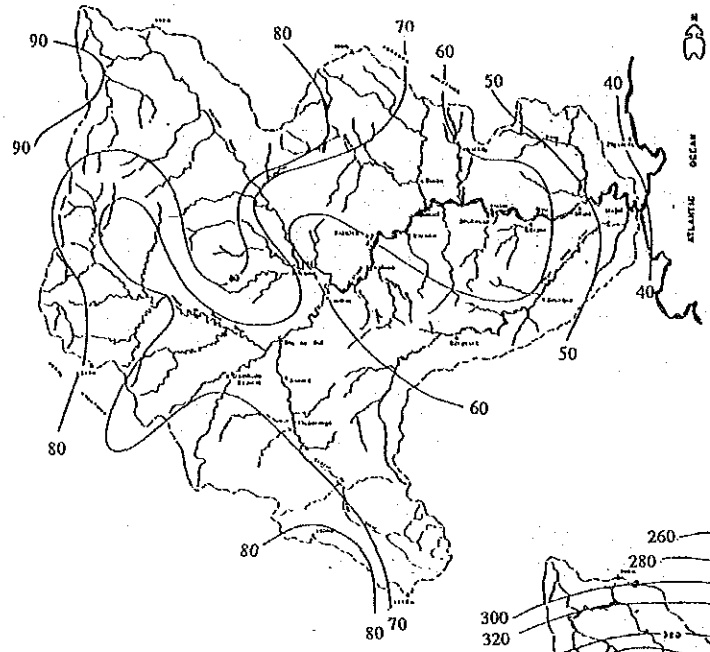
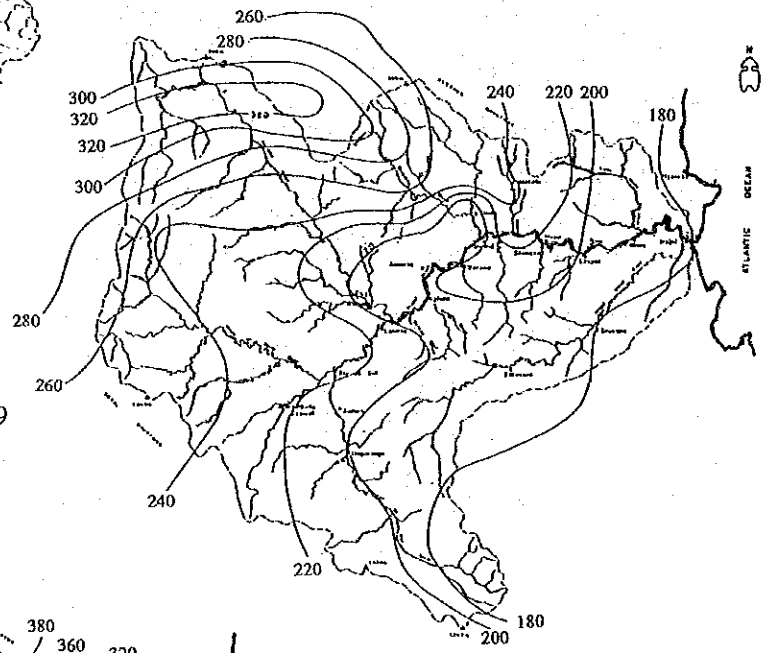


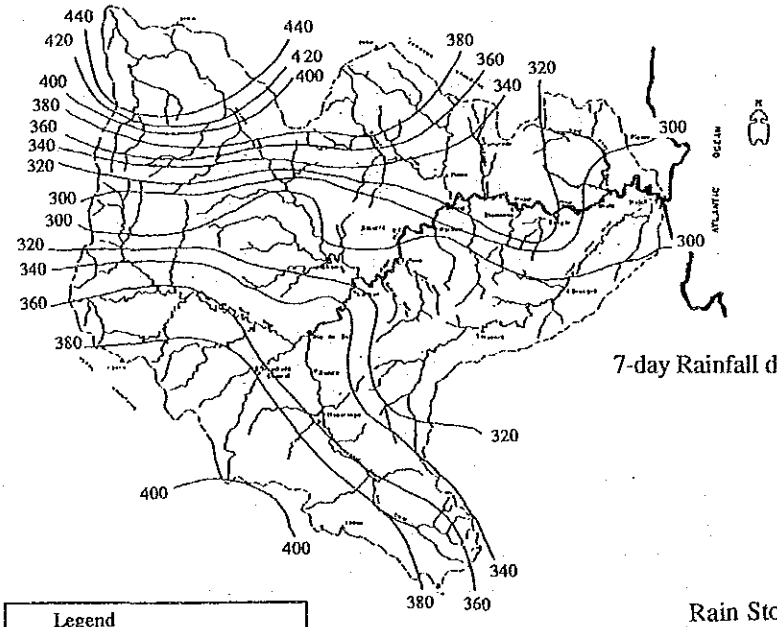
Fig.I.3.4
ISOHYETAL MAP OF RAIN STORM DURING THE FLOOD IN 1978 AND 1980



1-day Rainfall dated on July 7



4-day Rainfall dated on July 6-9



7-day Rainfall dated on July 6-12

Legend

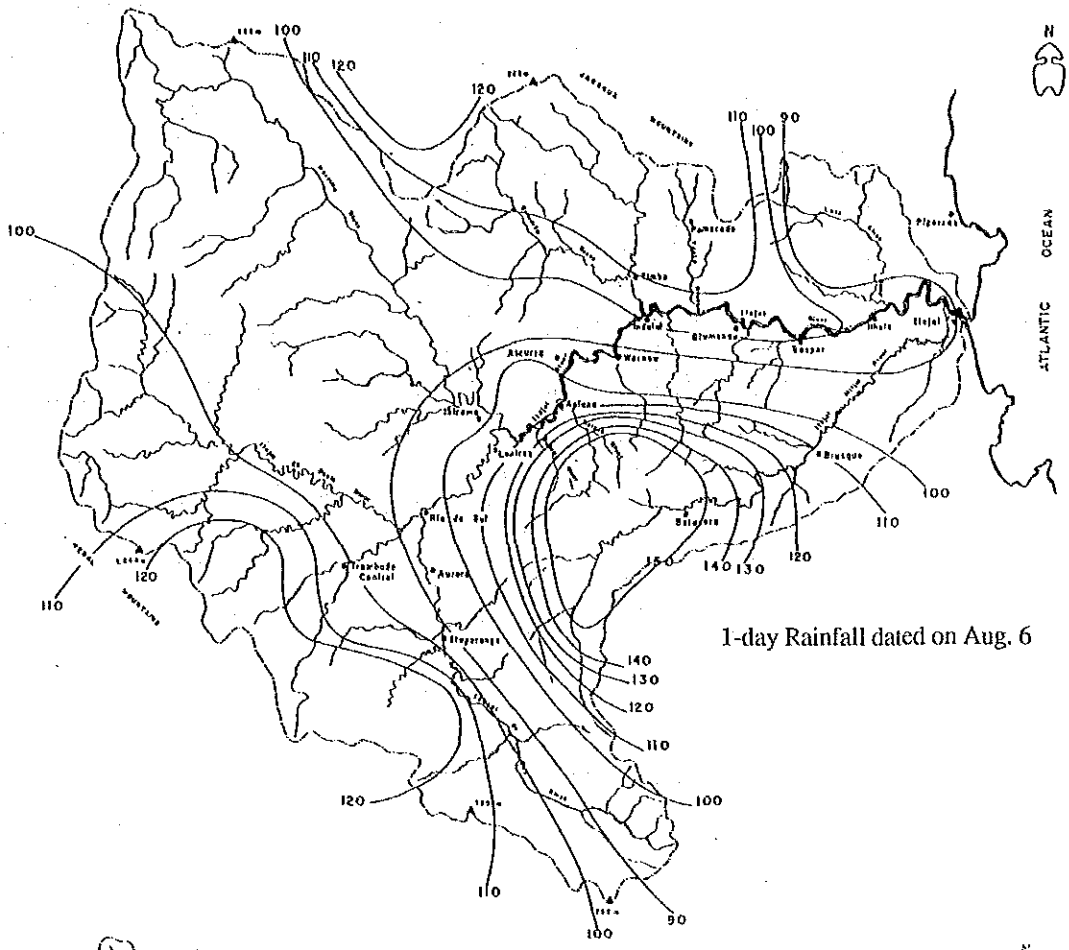
Basin boundary

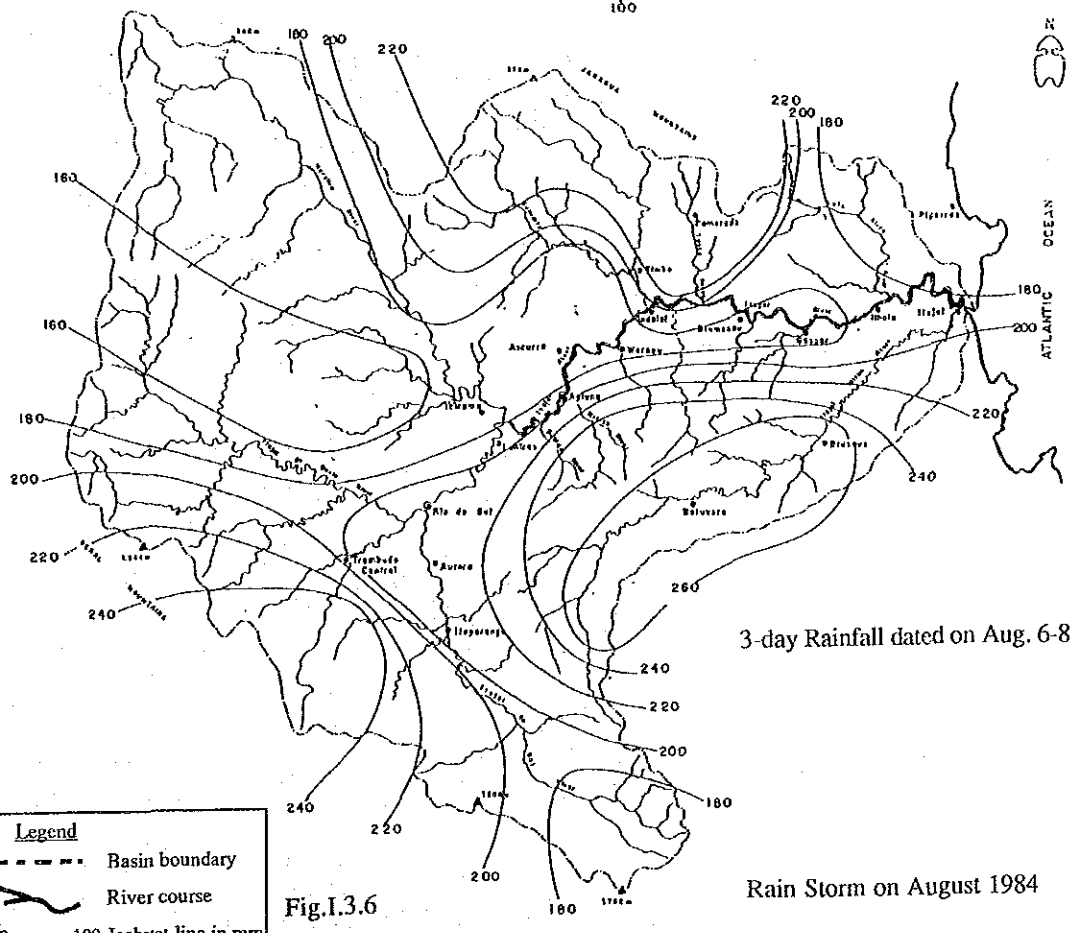
River course

100 100 Isohyet line in mm

Rain Storm on July 1983

Fig.I.3.5 ISOHYETAL MAP OF RAIN STORM DURING THE FLOOD IN 1983





Rain Storm on August 1984

Fig.I.3.6 ISOHYETAL MAP OF RAIN STORM DURING THE FLOOD IN 1984

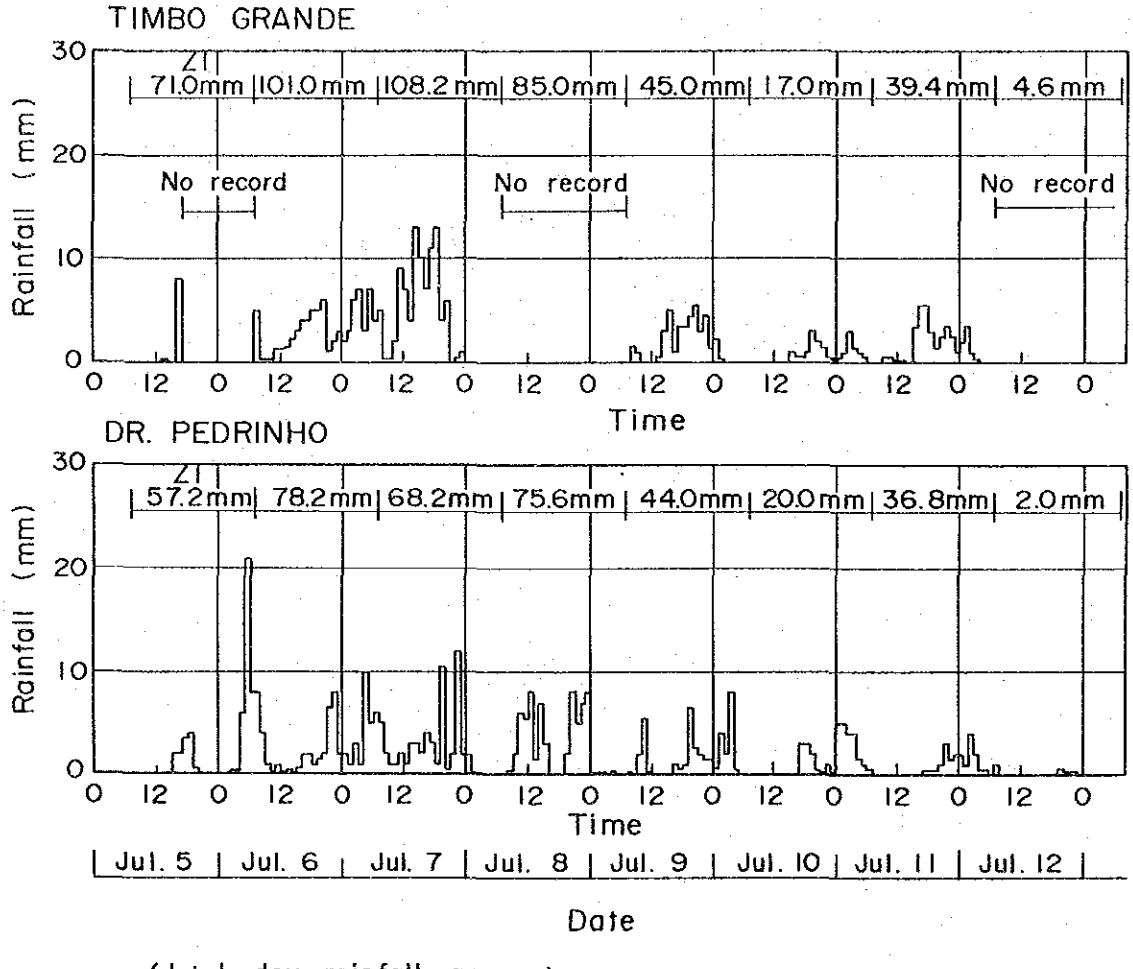


Fig. I.3.7 RECORDED HOURLY RAINFALL DISTRIBUTION OF RAIN STORM IN 1983

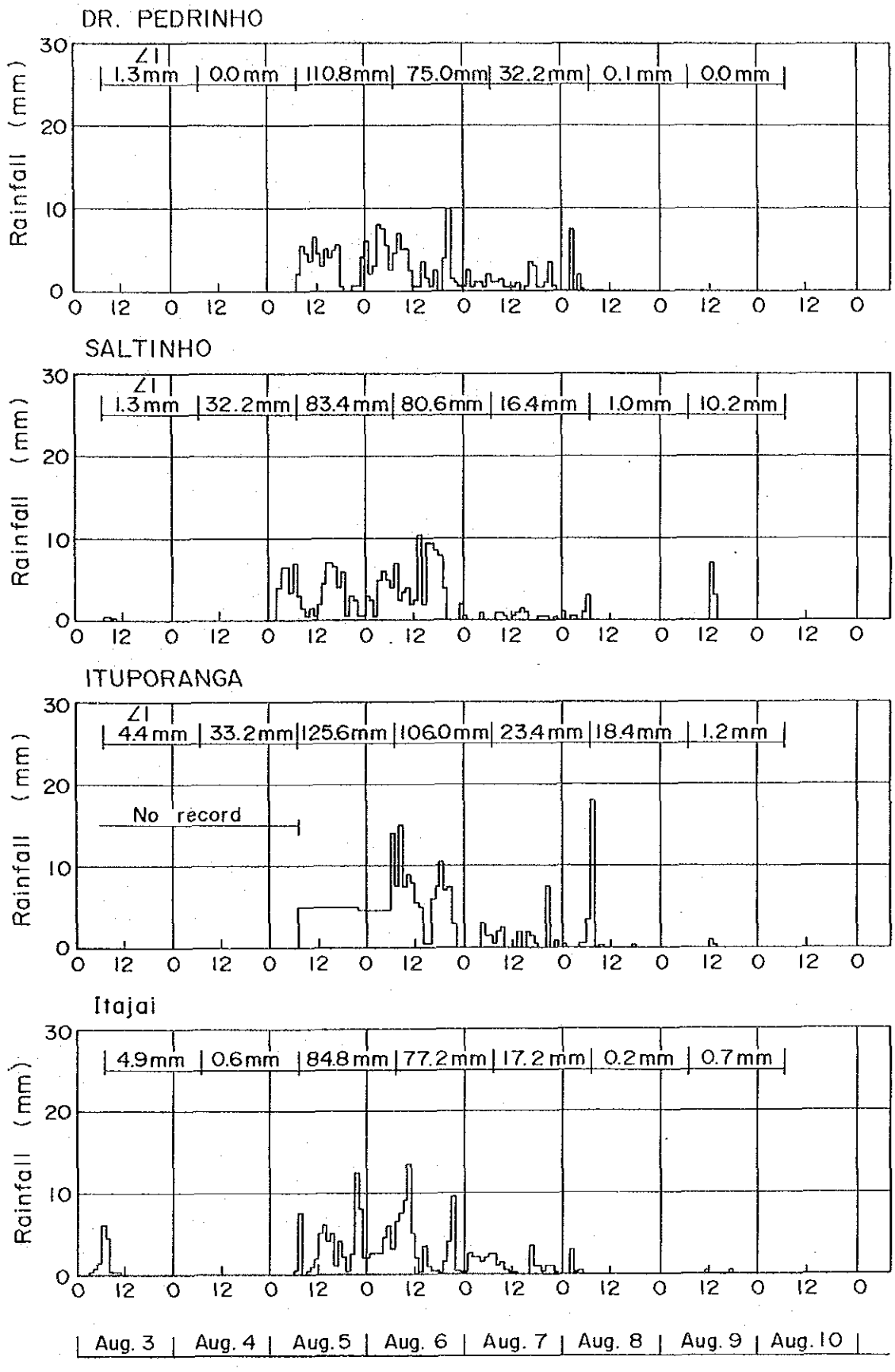


Fig. I.3.8 RECORDED HOURLY RAINFALL DISTRIBUTION OF RAIN STORM IN 1984 (1/2)