REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT

FEASIBILITY STUDY ON

KARIAN MULTIPURPOSE DAM

CONSTRUCTION PROJECT

VOLUME— II: APPENDIX

JULY 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

JICA
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ABBREVIATIONS

(1) Local Terms

BAPPENAS	= Badan Perencanaan Pembangunan Nasional	:	National Development Planning Agency
BIMAS	= Bimbingan Massal	:	Mass Guidance for Self-sufficiency in Food
BKPM-D		:	Investment Coordination Board of the Province of West Java
BPAM		:	Provincial Water Management Unit
BPS	= Biro Pusat Statistik	:	Central Bureau of Statistics
BULOG	= Badan Urusan Logistik	:	National Food Logistics Agency
BUUD	= Badan Usaha Unit Desa	:	Village Unit Executive Body
CIPTA KARYA		:	Directorate General of Housing, Building, Planning and Urban Development
Danau		:	Lake
DBPP		:	Directorate of Planning and Programming
Desa		:	Village
DGWRD		:	Directorate General of Water Resources Development
DIPERTA	= Dinas Pertanian Pakyat	:	Ministry of Agriculture
DOLOG	= Depot Logistik	:	Provincial Food Depot of BULOG
DPMA	= Direktorat Penyelidikan Masalah Air	:	Directorate of Hydraulic Engineering
DPU	= Departmen Pekerjaan Umum	:	Ministry of Public Works
DPUP	= Dinas Pekerjaan Umum	:	Provincial Department Office of Public Works
DSE		:	Directorate of Sanitary Engineering
Gunung		:	Mountain
IKK	= Ibu Kota Kecamatan	:	Sub-district town
INMAS	= Intensifikasi Massal	:	Mass Intensification
Kabupaten		:	Regency
Kampung		:	Settlement

K-C-C area		:	Kopo-Cikande-Carenang area
Kecamatan		:	Sub-district
Kotamadya		:	Municipality
KUD	= Koperasi Unit Desa	:	Village Unit Cooperative
Lama		:	Old
LEKNAS-LIPI		:	National Institute of Economic and Social Research
Palawija		:	Upland Crops
P3SA	= Proyek Perancang Pengembangan Sumber-Sumber Air	:	Water Resources Development Planning Project Division
PDAM		:	Regional Water Supply Enterprise
PELITA	= Pembangunan Lima Tahun	:	Five Year Development
PLN	= Perusahan Listrik Nagara	:	Public Cooperation of Electricity
PMA	= Penyelidikan Masalah Air	:	Hydraulic Engineering (Subdivision)
PMG	= Pusat Meteorogi Dan Geofisika	:	Meteorological and Geophysical Center
PPA		:	Nature Conservation and Wildlife Management
PPL	= Penyuluh Pertanian Lapangan	:	Agricultural Field Extension Worker
PPM	= Penyuluh Pertanian Madya	:	Agricultural Extension Officer
PPS	= Penyuluh Pertanian Spesialis	:	Agricultural Extension Specialist
PROSIDA	= Proyek Irigasi IDA	:	IDA Irrigation Project Division
P.T.	= Perusahaan Terbatas	:	Private Estate Enterprise
REPELITA	= Rencana Pembangunan Lima Tahun	:	Five Year Development Plan
Wilayah		:	Region

(2) International or Foreign Organization

ADB	:	Asian Development Bank
FAO	:	Food and Agriculture Organization of the United Nations
IBRD	:	International Bank for Reconstruction and Development

IDA	:	International Development Association
JICA	:	Japan International Cooperation Agency
UK	:	United Kingdom
UNESCO	:	United Nations Educational, Scientific, and Cultural Organization
US or USA	:	United States of America

(3) Others

B	:	Benefit
C	:	Cost
EIRR	:	Economic Internal Rate of Return
El.	:	Elevation above mean sea level
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
GRDP	:	Gross Regional Domestic Product
NPV	:	Net Present Value
O & M	:	Operation and Maintenance
PVC	:	Polyvinyl Chloride
TSP	:	Triple Super Phosphate

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
lit = liter
m^3 = cubic meter

Weight

mg = milligram
g = gram
kg = kilogram
ton = metric ton

Time

s = second
min = minute
h = hour
d = day
y = year

Electrical Measures

V = volt
A = ampere
W = watt
kW = kilowatt
MW = megawatt
GW = gigawatt

Other Measures

% = percent
PS = horsepower
° = degree
' = minute
" = second
°C = degree centigrade
10^3 = thousand
10^6 = million
10^9 = billion (milliard)
ppm = parts per million
pH = scale for acidity

Derived Measures

m^3/sec = cubic meter per second
micromhos/cm = scale for electrical conductivity
kWh = kilowatt hour
MWh = megawatt hour
GWh = gigawatt hour
kWh/y = kilowatt hour per year
kVA = kilovolt ampere

Money

Rp. = Rupiah
US$ = US dollar (US$1 = Rp. 1,050, as of November 1984)
¥ = Japanese Yen (¥100 = Rp. 440, as of November 1984)

APPENDIX - A

SOCIO-ECONOMY

APPENDIX - A

SOCIO-ECONOMY

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APPENDIX-A

SOCIO-ECONOMY

1. GENERAL

1.1 National Background

With holding approximate 165 million people and a territory of 1.9 million km^2, corresponding to the world 5th largest population and 14th largest land area, Indonesia rejoices in the possession of ample manpower, sunny tropical climate and abundant natural resources including petroleum. So far, the Indonesian economy had been fairly progressed centering aroud primary industrial sectors, particularly marked a significant mean real economic growth rate of 8% per annum in 1970s and deemed by the World Bank as a semi-developed country with per capita Gross National Product (GNP) of over US$500 effective 1981. On the contrary, under a prolonged depression in the world trading since the 2nd oil crisis, such her economic attitude distorted in export of primary products and raw materials was forced wavering low. The drastic setback of oil export in both quantity and market price, which shares some 70% of the nation's total export and national revenue respectively, and slump of other export have come into existence in succession as per Table A-1 and resulted to devaluate the exchange rate of Rupiah 38.5% downward in March 1984.

The Gross Domestic Product (GDP) grew from Rp. 12,600 million in 1975 to Rp. 21,100 million in 1983 at the 1975 constant price, equivalent to the growth of about 5.6 times at the current price as shown in Tables A-2 and A-3. At the trend of this economic growth, it is observed high in infrastructures and constructions as 16.3 - 10.9% per annum (p.a.); followed by manufacturing industry as 12.3% p.a.; and low in mining, quarrying and agriculture as 1.6 - 3.8% p.a. as well as declining in their shares respectively down to 7.6% and 29.8%. Nevertheless, because of an inevitable gradient to the national economy by these primary industries, they are still ranked as the mainstay in the industrial structures.

Thus in the current Indonesian economy, yet involved are higher population growth and hidden underemployment; earning and economic differentials in region, urban/rural, industrial sectors and workers; uneven distribution of industrial structure; and foreign exchange deficit.

For viable long-term economic growth, the Fourth Five Years Development Plan (REPELITA IV) for 1984/85 - 1988/89 has been released by the Government of Indonesia to implement provided with the following aims.

Objective

(1) To level up the living, intellectual and welfare standards of the people, and

(2) To place a strong and firm foundation for a prospective feature of the nation development. Thereupon the feature means taking off to the fruitful national economy during the forthcoming REPELITA V and achievement of prosperity and justice of the country based on GBHN "Pancasila" (Five principals on basic line of the nation) by the end of REPELITA IV.

Strategy:

(1) Fair and harmonic improvement among the respective development fields and sectors,

(2) Potential development centering around autarky of foods and intensification of machine industry,

(3) Improvement of physical and mental welfare, parity allotment of development fruits and expansion of working opportunity, and

(4) Fulfillment of the unsolved problems in the course of REPELITA III.

Guideline:

(1) Equity of developments with sharing of their fruits:

relevant to diffusion of provisions, materials and houses necessary for living of all citizen; educational and hygienic opportunity; allotment of earning; working opportunity; business opportunity; participation of young age and female group to development program; extension of development program into each district of the country; and appreciation of justice,

(2) Sustainable economic growth, and

(3) Sound and dynamic stability of the nation.

As per the summary in Table A-4, it sets forth the target of average annual growth rates as real economic growth of 5%, infration of 8% and nominal economic growth of 13.4%, provided with the population growth of 2.0% per annum at the end of the period.

To achieve such targets, an aggressive investment from Rp. 19,100 billion in 1984/85 to Rp. 40,000 billion in 1988/89 at annual growth rate of 19.1% is required. Namely, a sum of Rp. 145,200 billion or 26% of total GNP for the overall period is scheduled to be invested out of the governmental saving, foreign development aid, private and other funds.

As the development budget of the government for 1984/85 consisting of the above saving and foreign aid, Rp. 10,500 million will be disbursed proportionally in the order of 14.4% for health and education, 13.4% for agriculture and irrigation, 13.3% for transportation and communication, 12.4% for mining and quarrying, 7.7% for regional and urban development, 6.7% for national security, 6.5% for labour and remigration, 6.2% for manufacturing industry and so forth. Hence, the industrial structure will also vary through the period between 1984/85 and 1988/89. Notably, the share of manufacturing sector in total GDP will increase from 15.8% to 19.4% at the growth rate of 9.5% per annum, while that of agriculture will decline from 29.7% to 26.4% at annual growth rate of 3%, as similar to that of mining and quarrying sector as from 7.4% to 6.6% with annual growth of 2.4%.

In addition, REPELITA IV describes general development programs for each sector. Among them, agriculture is emphasized to be developed with the first priority for the purpose of autarky of provisions, supply of raw materials for manufacturing industry, expantion of export, betterment of farmers' income, improvement of working opportunity, rural development, acceleration of remigration, etc. Throughout the period, reclamation of irrigation net, tertiary net and rehabilitation of irrigation net are scheduled to the extent of 600, 720 and 360 thousand hectares, respectively. As a consequence, the paddy production is aiming to increase at average growth rate of 4% from 23.462 million tons in 1983/84 to 28.624 million tons in 1988/89 corresponding to the harvest area of 9.726 million hectares with the production yield of 2.94 tons per hectare. Manufacturing industry plays an important role for improvement of industrial structure and international trade balance of the country. The development scope is centering around machine manufacturing and also includes heavy, chemical, light and home industries for provision of employment opportunity and expansion of export and import-substitute. Thus and so, the Karian multipurpose dam project is quite conformable to every respect of the stipulations for the prospective economic development of the Indonesia.

1.2 Regional Background

The island of Java comprises the national capital region (DKI. Jakarta), the ancient capital (D.I. Yogyakarta) and provinces of West, Central and East Java. According to the national census in 1980, it has so much population of 91.3 million within an area of 132 thousand km^2, equivalent to 61.9% of total population within 6.9% of total area of the Indonesia. That means very high population density throughout the world, especially in urban areas of Jakarta, Surabaya and Bandung because of the immigration. Even in rural areas, the population growth rate was higher than that of the national average. During the period between 1975 and 1982, the Gross Regional Domestic Product (GRDP) of West Java Province has marked annual average growth rate of 8.5% from Rp. 1,730 million to Rp. 3,060 million at the 1975 constant price as shown in Tables A-2 and A-3. The industrial structure of such DRGP has been similar as agriculture on the top and followed by manufacturing sector but a little higher in their growth, when compared with the national level.

Under the circumstances, the regional development principals of West Java is so released in the REPELITA IV to conform substantially to that of the nation, provided with a certain regional characteristics. In principle, the subjects remain pursuant in respects of impartial advancement in living, intellectual and welfare standards of the inhabitants and economic development of the region. And it includes qualitative improvement of manpower, expansion of employment opportunity in rural area, institutional supports for economic structure aiming at annual average GRDP growth rate of 5% and conservation of natural resources and environment.

In relation with agriculture as the prime industrial sector, REPELITA IV indicates the potential development of water resources and irrigation. The sites of irrigation are deemed to determine in accordance with physical properties; farmers' habituation and willingness for paddy cultivation; location and access infrastructures to the market, together with due consideration for supplement to municipal and inustrial water supply and flood control. Furthermore, the emphases concerned to the study area of this project are extended to development and improvement of wetland agriculture and fishery with irrigation canal in North Banten area; development of dryland agriculture with natural resources conservation in Bojonegara and Central Banten area, extention of steel and its relevant manufacturing industry in Cilegon; development of middle or small scale simple irrigation, handicraft manufacturing and clean water supply in Banten area; and development and improvement of roads and Cigading port facilities.

2. ADMINISTRATION

The study area for this socio-economic study is so called North Banten and is situated in the northwestern corner of the Province of West Java. The area covers a jurisdiction of whole or a part of Kabupatens of Serang, Lebak and Pandeglang, taking account of the catchment of the relevant rivers and the prospective beneficiaries of this water resources. The governance is so composed in the order of province (Daerah Tingkat I), regency (Kabupaten or Kab.), sub-district (Kecamatan or Kec.) and village (Desa). Hence, the administrative district of the area consists of 39 Kecamatans or 523 Desas including overall 26 Kecamatans in Kab. Serang, 10 out of 15 Kecamatans in Kab. Labak and 3 out of 16 Kecamatans in Kab. Pandeglang as well as the capital town of each Kabupaten; Serang, Rangkasbitung and Pandeglang. Areawise, it holds a territory of 3,623 km^2 equivalent to about 8% of that of West Java Province and is shared by 1,876 km^2 (52%) in Serang, 1,573 km^2 (43%) in Lebak and 175 km^2 (5%) in Pandeglang, respectively. Out of the industrial structure and population distribution, majority of the area belongs to rural, while the urban area is merely less 10% of the total.

3. POPULATION

3.1 Population Statistics

Population censuses of Indonesia were duly made on 31st October 1961, 24th September 1971 and 31st October 1980 as the last. The numbers of population in these years are given in Table A-5 with classification by the whole Indonesia, Java Island, Province of West Java, Banten (the overall Kabupatens of Serang, Lebak and Pandeglang) and the study area. According to the 1980 census, the population in the study area had 1,109,186 in Kab. Serang, 411,825 in Kab. Lebak and 132,593 in Kab. Pandeglang, equivalent to 1,653,604 in total or about 6% of the Province total population.

3.2 Population Density

The population density of the study area was 456 persons/km^2 in 1980 and apparently lower than the mean densities of 593 and 690 persons/km^2 in each of the Province and Java Island as shown in Table A-5. As per the breakdown by Kecamatan in Table A-6, the excessive densities than the said averages in Province and Island level were found in 9 Kecamatans. They are the centers of manufacturing industry, trading, transportation and/or administration, and have rapidly increased for the last decade. In general, the population is relatively dense in northern coastal part and coarse in southern hilly part of the area.

3.3 Population Growth

The annual average growth rates of the population in the study area are estimated by integration as 1.86% during 1961 to 1971, 2.75% during 1971 to 1981 and 2.28% throughout the period between 1961 and 1981. Such trend in population growth as low in 1960s and high in 1970s has been commonly appeared in every administration level of Indonesia. It is assumed that these facts have been caused mainly by diffusion of medical care and welfare, but would not be expected forever in view of the prospective economic growth and marginal employment. The popuration growth rate in the study area is dominantly close to that of national average and some lower than that in the Province.

3.4 Population Distribution

Based on the population censuses in 1961, 1971 and 1980, the population distribution by Kecamatan in the study area is given in Table A-6. Comparing with the average population of 42,400 persons/Kecamatan in 1980, higher figures were recorded in the administration and trading center of each Kabupaten as 111,000 in Kec.Serang, 104,000 in Kec.Rangkasbitung and 49,000 in Kec.Pandeglang. They were followed by 90,000 in Kec.Pulomerak and 51,000 in Kec.Cilegon both as the manufacturing industry zone. In the course of the vital statistics, irregularly high or low growth of the population in these Kecamatans is attributed essentially to such external factors as impacts of economic productivity and immigration. By the way, urbanization in the study area in 1980 was far low as 10% than either 21% in West Java Province, 24% in Java Island or 22% of the national average as per Table A-7.

Table A-8 shows the population distribution by age and sex in 1980 in each of the study area, West Java Province and Indonesia. Comparing the overall share of younger generations, both age groups of under 9 years and 14 years in the study area were far more than those in the Province and whole Indonesia. Concurrently in the study area, the female inhabitants far outnumbered the male. So far, it appeared likely that some male adult workers have been out of the study area for seeking the job or better income.

3.5 Labour Force

The labour force and employment by industrial origin in 1980 by Indonesia, Java, West **Java** Province and Banten region are summarized in Table A-9. In the study area, the population of 10 years and over age was 1,109,894 (male 528,509 and femal 581,385) in 1980. Though its breakdown is unknown, an assumption is made proportionally in accordance with the above composition to be labour force of 510,000 (male 350,000 and female 160,000) and 500,000 in employment including 330,000 for agriculture sector. By the way, approximate 70% of total householeds in the study area was shared by farmers as per Table A-10.

As pointed out by REPELITA IV, unfavourable quality of manpower and underemployment are involved in the regional economy. Because of the existing majority of under 20 years of age in the inhabitants, further expension of labour-incentive industrial sectors and educational approach to the labour force would be urgently required.

3.6 Population Projection

The population growth on national level has ever marked so high as 2.39% p.a. in average throughout 1970s. Such growth is, however, duly requested to slow down to 2% p.a. by the end of REPELITA IV for the sake of the sustainable economic growth of the nation. As outlined by the government authorities, the population projection is extrapolated far more extent to Kecamatan level until 2005 and summarized as per Table A-5.

4. INFRASTRUCTURES AND INDUSTRIAL SECTORS

4.1 Transportation and Communication

Transportation in the study area depends mainly on road, comprising 73 km of nationl roads 125 km of provincial roads and about 600 km of regional and canal-inspection roads. As an artery to connect Java and Sumatra, a two-lane national road runs between Jakarta and Merak across the northern part of the study area passing through the major towns of Serang and Cilegon. Furthermore, the construction of a new highway as a part of "Asian Highway" is now progressing in parallel with the route to dissolve the current traffic congestion. So as to frame in addition, provincial roads with asphalt pavement are stretched out between Cilegon and Anyer, Serang and Bogor through Pandeglang and Rangkasbitung and some more extents from Pandeglang and Rangkasbitung to the southern Banten. Other than those, small roads are generally poor and not functioning for the total road network, especially in the rainy seasons. Such poor condition of the roads is one of the major constraints for the rural development of the area. A single-line railway of about 115 km long in the study area runs from Jakarta to Merak via Rangkasbitung, Serang and Cilegon with branches to Labuan through Pandeglang and to Anyer. Those terminal ends are respectively connected to passenger, cargo or fishing port. The railway facility and its function are some old and rigid, however, they are still an essential means for routine cargo and inhabitants' daily traffic.

A number of port are gathered on the northwest end of the study area. Among them, Merak is the largest and most active as a ferry liner terminal to and from Sumatra. Cigading and other neighbouring ports are well facilitated for handling of fuel, raw materials and products of P.T. Krakatau Steel and others in Cilegon.

Communication system is still primitive in all over the study area and the telephone sets are also prevailing merely in urhan areas for office and commercial uses.

4.2 Electric Power Supply

Interstate electric power supply system is organized under the control of the Public Corporation of Electricity (PLN) and its substructures. In the Province of West Java, the power generation and consumption in 1983 were 1,729 and 1,448 GWh, in which Banten region shared only 2% as 35 and 29 GWh respectively. At present, the study area has no hydroelectric power station but a latest thermal power station with extra-high-tension power transmission line under staged construction aiming at final output of 2,800 MW. The current power service is so limited to the extent of major towns and those vicinities. The power generated at the outside of the area is delivered through a Bogor-Rangkasbitung-Pandeglang-Serang 70 Kv power transmission system. In addition, regional power supply by 6 diesel power plants of 120 KW in total is available in Karanghantu, Kragian, Petir, Warunggunung, Batubantar and Cipanas. Besides above PLN utilities, P.T. Krakatau Steel Works have their own power plant with ample capacity of 400 MW. Small to medium size generators are also prevailing into many other factories and even some households for their own consumption.

4.3 Water Supply

The urban water supply system is managed by the Regional Water Supply Enterprise (PDAM) in each Kabupaten. The towns of Serang, Pandeglang and Rangkasbitung are provided with the piped water supply systems from water supply sorces of dug well, spring and river. Under the agreements with P.T.Krakatau Steel Works, treated water supply systems from their Krenceng treatment plant are progressing for the town of Cilegon and PLN Suralaya complex. In the rural area, there is no particular water supply system, except hand-operated pumping facilities for each communal faucet. Such potable groundwater out of the dug well is used for dringking and cooking while the river or canal water is for washing and laundry of the inhabitants.

As for industrial water supply, P.T.Krakatau Steel Works have their own complete system. The raw water out of the Cidanau dam is pumped up and conveyed by a steel pipe line (27.2 km long, 1.4 m in diameter

and 2.5 m^3/s in conveyance capacity) to the raw water reservoir (2.5 and 1.45 million m^3 in gross and effective capacities respectively) of the Krenceng treatment plant. Upon purifing, the treated water feeds to their steel milling and for living.

4.4 Tourism

The study area lies within easy driving distance of people who live in the metropolitan areas such as Jakarta, Bogor and Bandung. Together with improvement of highways, the study area may offer a wide diversity of tourism and recreational opportunities such as beach activities at the Anyer and Merak areas, and visits of natural reserve in the piedmont of the Gunung Karang and histrorical sites in the old Banten near the estuary of the Cibanten river. Tourism development of the study area can be expected in the context of West Java circuit and also on tour to Sumatra through the study area from the said metropolitan areas.

4.5 Industrial Sectors

With ample potential advantages, Cilegon/Merak region has been rapidly developed and is most active in manufacturing industry. Centering around P. T.Krakatau Steel Works, the Indonesian first integrated steel mill founded in 1971, several factories started the operation i.e. P.T. Satya Raya Indah Woodbased industries in Anyer, Pertamina Petro-chaemical and P.T.Statomer PVC Resin Factory in Merak. The Cilegon Industrial Estate, which has an area of 550 ha with public utilities, is prepared for further extention of steel related industry including boiler, machine tool, tin plate, chemical products, tyre, carbon black and so forth. Many other small scale manufacturing or home-industries for brick, tile, sawmill, food processing, bamboo and wood handicraft are located through, out the study area, especially alongside trunk roads and in villages.

In parallel with such trend of heavy manufacturing industries and infrastructures, the sectors of construction and transportation have also marked a significant progress. Besides agriculture as the key industrial sector in the study area, trade and service such as wholesale, retail, restaurant and others are still sharing rather bigger portion under closed relation with the inhabitants and community.

5. ECONOMIC INDICES

5.1 Gross Regional Domestic Product

Since no direct information to exactly cover the study area is found available, the most equivalent and reliable trends and indicies are obtained on the basis of Banten region. In this connection, Banten region comprises whole of the relevant 3 Kabupatens of the study area and the occupancy ratios are 1.5 : 1 in population and 2.1 : 1 in area.

Table A-2 shows GRDP for the Banten region in comparison with GRDP for the Province of West Java and GDP of Indonesia. GRDP for the Banten region was about Rp. 489 billion in 1982 at current prices. This amount corresponds to 4.3 times of that in 1975. For the same period, the growths in GRDP of West Java and GDP of Indonesia were 4.4 times and 4.7 times, respectively. While, the real growth rate of GRDP for the Banten region was about 10.6% per annum on an average during the period of 1975 to 1982. This figure is higher than 8.5% for West Java and 7.0% for the whole country for the same period. It means that the increases in prices in the Province of West Java and the whole country are much higher than that in the Banten region.

Table A-3 shows the shares and the growth rates of GRDP by the industrial origin for the Banten region, West Java and Indonesia. In the Banten region, the share of agricultural sector decreased from 51.2% in 1975 to 35.8% in 1982. A decreasing tendency of the GRDP share for the agricultural sector coincides with that of the labour force share. It seems to be the general trend of Indonesia, judging from the share by the industrial origin for West Java and the entire country.

Since 1975, the economic growth in the Banten region is very high, that is, the average annual growth rate of GRDP was 10.6% for the period of 1975 to 1982. Of the whole industries, the average annual growth rate of GRDP for the same period were 5.1% for the agricultural sector and 40.4% for the construction sector which had the highest growth.

5.2 Regional Income

The per capita income for the Banten region was about Rp. 188,500 in 1982 at current prices as shown in Table A-11. This amount is about 56% of that for the whole country and 71% of that for the Province of West Java. The average real growth rate of the per capita income for the Banten region was 8.1% per annum during the period of 1975 to 1982. This is much higher than 4.3% for the whole country and 5.9% for the Province. However, the per capita income in 1982 at the 1975 constant prices for the Banten region is 81% of that for the whole country and 84% of that for West Java. Such a low income for the Banten region is mainly caused by the fact that nearly 70% of all the workers are engaged in the agricultural sector of which the per capita income is relatively low among industries.

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15. STATISTIK KEUANGAN 1981/82 - 1982/83, Biro Pusat Statistik, Jakarta

16. STATISTIK KEUANGAN DESA, JAWA DAN MADURA 1979/1980, Biro Pusat Statistik, Jakarta

Table A-1 BALANCES OF TRADE AND PAYMENT OF INDONESIA (1979-1983)

(Unit: US$.10^6)

Description	1978		1979		1980		1981		1982		1983	
	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
A. Trade												
Export		11,634		15,590		23,950		25,165		22,328		21,223
Import	6,690		7,202		10,834		13,272		16,859		19,120	
Balance:		4,953		8,388		13,116		11,892		5,469		2,103
B. Payment												
Current		1,434	952		2,754			816		6,114		4,711
S.D.R			64		65		62					
Private capital	333			611		630	148		1,561		6,030	
Transfer	1,491		1,725		2,204		2,009		4,057		246	
Balance	390		2,130		4,393		1,403			496	1,575	
C. Foreign exchange reserve	2,580		4,145		6,480		6,085		4,154		5,135	
D. Reference												
Turnover ratio of import:												
Foreign reserve/ monthly import (month)	4.1		5.2		6.2		4.3		2.0		3.6	
Exchange rate, central (Rp/US$)	634		632		634		643		692		994	

Source: Refs. 1, 11, 12 and 15

Table A-2 GDP OF INDONESIA AND GRDP OF WEST JAVA AND BANTEN REGION (1975-1983)

(Unit: $Rp.10^9$)

Region	GDP and GRDP									Average annual growth rate
	1975	1976	1977	1978	1979	1980	1981	1982	1983/1	1975-1982 (%)
A. at current price										
Indonesia	12,642.5	15,466.7	19,010.7	22,746,0	32,025.4	45,445.7	54,027.0	59,632.6	72,214.7	24.8
West Java	1,726.5	2,135.7	2,419.7	3,015.0	4,003.6	5,651.6	6,938.5	7,643.1		23.7
Baten/2	114.9	143.3	160.1	197.2	251.3	318.8	432.4	488.8		23.0
B. at 1975 constant price										
Indonesia	12,642.5	13,513.1	14,697.1	15,711.7	16,694.5	18,343.9	19,798.1	20,242.8	21,091.6	7.0
West Java	1,726.5	1,913.1	2,010.8	2,261.2	2,364.5	2,633.9	2,933.7	3,057.2		8.5
Banten12	114.9	136.1	140.7	164.2	164.7	182.0	217.1	232.2		10.6

Remarks: /1: Estimated

/2 Banten region includes three Kabupatens of Serang, Lebak and Pandeglang.

Sources: Refs. 1,3,12,13 and 15

Table A-3 SHARE AND AVERAGE ANNUAL GROWTH RATES OF GDP AND GRDP BY INDUSTRIAL ORIGIN (1975 and 1982)

(Unit: %)

Industrial Origin	Indonesia			West Java			Banten		
	Share		Average annual growth rate	Share		Average annual growth rate	Share		Average annual growth rate
	1975	1982	1975-1982	1975	1982	1975-1982	1975	1982	1975-1982
1. Agriculture	36.8	29.8	3.8	34.6	27.9	5.2	51.2	35.8	5.1
2. Mining and Quarrying	10.9	7.6	1.6	10.6	8.2	4.6	0.4	0.5	14.2
3. Manufacturing Industries	11.1	15.6	12.3	8.0	10.2	12.3	2.5	8.7	32.1
4. Electricity, Gas and Water Supply	0.5	0.9	16.3	0.5	0.7	13.8	0.2	0.2	10.6
5. Construction	4.8	6.2	10.9	3.3	8.3	23.8	2.7	14.4	40.4
6. Transportation and Communication	4.0	5.8	12.8	4.3	4.3	8.5	3.8	5.0	15.0
7. Trade, Financing and Other Services	31.9	34.1	8.0	38.7	40.4	9.2	39.2	35.4	9.0
8. Whole Industries	100.0	100.0	7.0	100.0	100.0	8.5	100.0	100.0	10.6

Source : Refs. 1-3 and 11-13

Table A-4 SUMMARY OF THE FOURTH FIVE YEARS DEVELOPMENT PLAN OF INDONESIA

Description	PELITA III	REPELITA IV					
	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	Average annual growth rate (%) 1983-1988
Population (10^6)	158.1	161.6	165.2	168.7	172.2	175.6	
Annual growth rate to previous year (= 100)	-	2.2	2.2	2.1	2.1	2.0	2.1
GNP (Rp. 10^9)/1	73,692	84,465	96,579	109,624	123,515	138,127	13.4
Per Capita GNP (Rp. 10^3)/1	446	553	584.6	650	717	787	12.0
Composition of GDP/2: (%)		100.0				100.0	5.0
Agriculture		29.2				26.4	3.0
Mining		7.4				6.6	2.4
Manufacturing		15.8				19.4	9.5
Construction		6.3				6.3	5.0
Transportation & communication		6.0				6.0	5.2
Others		35.3				35.3	5.0
Inflation rate (%)							8
Trade current balance (US$10^6)	-4,711	-4,669	-4,572	-4,082	-3,770	-3,231	
Export	19,310	19,875	22,433	25,332	28,223	31,116	10.0
Import	-17,103	-17,287	-18,979	-20,844	-22,906	-24,799	7.7
Services	-6,918	-7,257	-8,026	-8,570	-9,087	-9,548	
Government finance/1 (Rp. 10^9)							
National revenue		16,149	19,794	24,252	29,582	35,660	21.9
Current expenditure		10,101	12,043	14,582	17,725	21,520	20.8
Government saving		6,048	7,751	9,700	11,857	14,140	23.7
Foreign aid		4,411	5,098	5,715	6,687	7,203	13.0
Fiscal resource for development		10,459	12,849	15,415	18,543	21,343	19.5
Other investments/1 (Rp. 10^9)	7,482	8,657	10,684	12,922	15,668	18,684	20.1
Total investment/1 (Rp. 10^9)	16,678	19,116	23,533	28,337	34,211	40,027	19.1
Total investment/GNP (%)	22.6	22.6	24.4	25.8	27.7	29.0	

Remarks: /1 : At current price
/2 : At 1975 constant price

Source: Refs. 10-12

Table A-5 POPULATION CENSUSES IN 1961, 1971 & 1980, AND PROJECTION BY REGION AND AREA

(Unit : person)

Description	Land area	Population census			Distribution in 1980	Population density per km²			Average annual growth rate (%)			Polulation projection				
		Oct.31,1961	Sep.24,1971	Oct.31,1980		1961	1971	1980	1961/1971	1971/1980	1961/1980	1985	1990	1995	2000	2005 /1
	(km^2)				(%)							(10^3 person)				
Indonesia	1,919,443	97,085,348	119,208,229	147,490,298	100.00	51	62	77	2.07	2.39	2.23	165,154	183,457	202,764	222,753	244,734
J a v a	132,187	63,059,575	76,086,327	91,269,528	61.88	447	576	690	1.90	2.04	1.97	100,621	110,930	122,296	134,826	148,640
West Java	46,300	17,614,555	21,623,529	27,453,525	18.61	100.00 380	467	593	2.07	2.69	2.36	30,968	34,728	38,783	43,517	48,828
3 Kabupatens:	7,609	1,588,184	1,978,459	2,486,813	1.69	9.06 209	260	327	2.22	2.57	2.39	2,783	3,108	3,464	3,875	4,335
Serang	1,876	720,169	859,467	1,109,186		4.04 384	458	591	1.78	2.87	2.30	1,247	1,403	1,580	1,783	2,014
Lebak	3,120	427,802	546,364	682,868		2.49 137	175	219	2.48	2.51	2.49	762	847	938	1,043	1,159
Pandeglang	2,611	440,213	572,628	694,759		2.53 169	219	266	2.66	2.17	2.43	774	858	946	1,049	1,162
Study Area:	3,623	1,077,271	1,295,200	1,653,604	(100.00)	6.02 297	357	456	1.86	2.75	2.28	1,856	2,084	2,342	2,637	2,969
Serang	1,876	720,169	859,467	1,109,186	(68.08)	4.04 384	458	591	1.78	2.87	2.30	1,247	1,403	1,580	1,783	2,014
Lebak	1,572	270,749	333,003	411,825	(24.90)	1.50 172	212	262	2.09	2.39	2.23	460	515	576	645	721
Pandeglang	175	86,353	102,730	132,593	(8.02)	0.48 493	587	758	1.75	2.88	2.28	149	166	186	209	234

Remarks : /1 Estimates in this study

Source : Refs. 1-10

Table A-6 POPULATION DISTRIBUTION BY KECAMATAN IN STUDY AREA IN 1961, 1971 AND 1980

Kacamatan		Population			Average Annual Growth Rate (%)			Population Density per km² in '80
		1961	1971	1980	61/71	71/80	61/80	
Kab.Serang								
Anyer	95.56	23,355	27,836	37,947	1.79	3.47	2.58	394
Baros	39.35	18,253	21,326	25,119	1.58	1.82	1.69	638
Bojonegara	68.40	29,203	33,782	40,444	1.48	2.00	1.73	591
Carenang	54.93	31,771	34,521	40,666	0.84	1.82	1.31	740
Cikande	82.68	35,819	42,749	52,265	1.80	2.23	2.01	632
Cikeusal	98.93	41,120	48,003	60,620	1.58	2.60	2.06	613
Cilegon	42.19	27,775	34,402	51,200	2.18	4.47	3.29	1,214
Cinangka	128.41	24,088	29,674	36,992	2.13	2.45	2.28	288
Ciomas	50.54	15.363	18,269	22,431	1.77	2.28	2.01	444
Ciruas	37.62	24,821	28,855	32,970	1.53	1.48	1.51	876
Kasemen	60.56	22,901	30,573	42,326	2.96	3.64	3.29	699
Kopo	85.18	28,634	33,500	43,440	1.60	2.90	2.22	510
Klagilan	45.63	23,994	29,955	34,676	1.18	2.81	1.96	760
Kramatwatu	48.94	17,545	21,726	28,614	2.18	3.07	2.61	585
Mancak	94.01	17,579	20,241	25,654	1.43	2.64	2.01	273
Pabuaran	76.82	20,342	24,291	30,324	1.81	2.47	2.12	395
Padaringcang	74.40	24,424	33,978	41,240	3.39	2.15	2.80	554
Pamarayan	73.44	29,058	32,974	41,085	1.29	2.45	1.84	559
Petir	94.77	39,208	41,542	53,957	0.59	2.92	1.69	569
Pontang	74.31	25,335	29,288	33,124	1.48	1.36	1.42	446
Pulomerak	92.80	44,600	58,655	89,628	2.81	4.77	3.74	966
Serang	90.65	61,476	79,675	111,278	3.34	3.78	3.17	1,228
Taktakan	61.49	19,069	21,732	28,131	1.33	2.88	2.07	457
Tirtayasa	90.64	37,490	40,461	49,251	0.77	2.18	1.45	543
Waringinkurung	65.86	14,765	17,193	20,969	1.55	2.21	1.86	318
Walantaka	47.89	22,181	27,266	34,798	2.11	2.72	2.40	727
Total or Average	1,876.00	720,169	859,467	1,109,186	1.78	2.87	2.30	591
Kab. Lebak								
Bojongmanik	162.33	19,213	24,785	28,117	2.61	1.40	2.02	173
Cileles	149.45	16,635	22,490	27,563	3.09	2.26	2.69	184
Cimarga	221.91	22,658	27,589	32,384	2.01	1.78	1.90	146
Cipanas	139.90	22,603	29,819	38,513	2.84	2.85	2.84	275
Leuwindamar	172.51	20,192	22,144	25,137	0.94	1.40	1.16	146
Maja	106.51	28,205	34,211	42,767	1.97	2.48	2.22	402
Muncang	191.07	25,297	31,426	35,899	2.22	1.47	1.86	188
Rangkasbitung	223.00	64,013	78,685	103,690	2.11	3.08	2.57	465
Sajira	107.52	16,667	20,053	25,771	1.89	2.80	2.32	240
Warunggunung	98.39	35,266	41,801	51,984	1.73	2.42	2.06	528
Total or Average	1,572.59	270,749	333,003	411,825	2.11	2.36	2.23	262
Kab.Pandeglang								
Banjar	75.16	28,602	33,997	41,062	1.74	2.12	1.92	546
Cadasari	63.62	28,025	33,183	42,877	1.70	2.89	2.26	674
Pandeglang	35.90	29,726	35,550	48,654	1.81	3.55	2.63	1,355
Total or Average	174.68	86,353	102,730	132,593	1.75	2.88	2.28	758
Study Area Grand Total Or Average	3,623.27	1,077,271	1,295,200	1,653,604	1.86	2.75	2.28	456

Source: Refs. 1-7

Table A-7 POPULATION DISTRIBUTION IN 1980
BY AGE GROUP AND URBAN/RURAL

(Unit: person)

Description	Urban	Rural	Total	Ratio (%) Urban / Rural / Total		
Indonesia :	33,005,511	114,484,787	147,490,298	22.38	77.62	100.00
below 9	8,754,888	33,667,711	42,422,599	5.94	22.83	28.76
10 - 19	8,026,630	24,875,639	32,902,269	5.44	16.87	22.31
20 - 39	10,028,968	31,033,075	41,062,043	6.80	21.04	27.84
40 - 59	4,578,305	17,792,316	22,370,621	3.10	12.06	15.17
Over 60	1,616,720	7,116,046	8,732,766	1.10	4.82	5.92
Java :	22,068,076	69,201,452	91,269,528	14.96	46.92	61.88
				(24.18	75.82	100.00)
West Java :	5,716,594	21,736,931	27,453,525	3.88	14.74	18.61
				(20.82	79.18	100.00)
3 Kabupatens :	194,771	2,292,042	2,486,813	(7.83	92.17	100.00)
Serang	121,641	987,545	1,109,186	(10.97	89.03	100.00)
Lebak	25,869	656,999	682,868	(3.79	96.21	100.00)
Pendeglang	47,261	647,498	694,759	(6.80	93.20	100.00)
Study Area :	160,877	1,492,727	1,653,604	(9.73	90.27	100.00)
Serang	121,641	987,545	1,109,186	(10.97	89.03	100.00)
Lebak	25,869	385,956	411,825	(6.28	93.72	100.00)
Pendeglang	13,367	119,226	132,593	(10.08	89.92	100.00)

Source : Refs. 1-7

Table A-8 POPULATION DISTRIBUTION BY AGE AND SEX IN 1980

Age Group	Male		Female		Total	
	Number	%	Number	%	Number	%
(1) Indonesia						
0 - 4	10,555,575	14.4	10,163,963	13.7	20,719,538	14.1
5 - 9	10,817,738	14.8	10,410,441	14.1	21,228,179	14.4
10 - 14	9,403,712	12.8	8,765,011	11.8	18,168,623	12.3
15 0 24	13,433,455	18.4	15,027,980	20.3	28,461,435	19.3
25 - 49	20,973,173	28.6	21,408,258	28.9	42,381,431	28.8
50 and More	8,051,397	11.0	8,321,220	11.2	16,372,617	11.1
Total	73,234,950	100.0	74,096,873	100.0	147,331,823	100.0
(2) West Java						
0 - 4	2,081,578	15.2	2,021,354	14.7	4,102,932	15.0
0 - 9	2,099,252	15.4	2,029,619	14.7	4,128,861	15.0
10 - 14	1,741,377	12.7	1,602,200	11.6	3,343,577	12.2
15 - 24	2,317,126	17.0	2,738,921	19.9	5,056,047	18.4
25 - 49	3,951,788	28.9	3,973,987	28.8	7,925,775	28.9
50 and More	1,473,458	10.8	1,419,190	10.3	2,892,648	10.5
Total	13,664,569	100.0	13,785,271	100.0	27,449,840	100.0
(3) Study Area						
0 - 4	135,390	17.0	141,178	16.4	276,568	16.7
5 - 9	131,875	16.6	135,267	15.8	267,142	16.1
10 - 14	104,791	13.2	98,022	11.4	202,813	12.3
15 - 24	126,124	15.8	164,622	19.2	290,746	17.6
25 - 49	244,172	28.2	245,301	28.6	469,473	28.4
50 and More	73,422	9.2	73,440	8.6	146,862	8.9
Total	795,774	100.0	857,830	100.0	1,653,604	100.0

Source: Refs. 1 - 7

Table A-9 LABOR FORCE AND EMPLOYMENT IN 1980 BY INDUSTRIAL ORIGIN

Description	Indonesia	Composition (%)	Java	Composition (%)	West Java	Composition (%)	Batern/1	Composition (%)
1. Total population	147,490,298		91,269,528		27,453,525		2,486,813	
2. Population of 10 years and over of age:	104,352,470	100.00	66,129,298	100.00	19,112,706	100.00	1,646,163	100.00
a. Labor force	52,421,245	50.23	33,590,449	50.80	8,678,165	45.41	756,537	45.96
Employment/2	51,553,122	49.40	33,025,828	49.94	8,500,943	44.48	744,466	45.22
Unemployment	868,123	0.83	564,621	0.85	177,222	0.93	12,071	0.73
b. Economically inactive:	51,931,325	49.77	32,538,759	49.20	10,474,541	54.59	889,626	54.04
Student	18,770,941	17.99	11,303,147	17.09	3,249,149	17.01	289,177	17.38
House keeping ete.	22,175,508	21.25	14,323,782	21.66	4,846,993	25.36	386.158	23.46
Others	10,984,876	10.53	6,911,830	10.45	2,337,399	12.23	217,291	13.20
3. Classified component by industrial origin/2	51,553,122	100.00	33,025,828	100.00	8,500.943	100.00		
Agriculture	28,834,041	55.93	16,602,160	50.27	4,062,242	47.79		
Mining	387,251	0.75	192,872	0.58	68,117	0.80		
Manufacturing	4,680,051	9.08	3,574,146	10.82	891,560	10.49		
Public utilities	66,089	0.13	46,243	0.14	12,122	0.14		
Construction	1,657,148	3.21	1,174,913	3.56	353,474	4.16		
Transportation	1,468,419	2.85	1,019,870	3.09	302,479	3.56		
Financing	302,345	0.59	196,894	0.60	52,670	0.62		
Public services	7,144,523	13.86	4,962,416	15.03	1,320,324	15.53		
Others	344,303	0.65	230,889	0.70	86,064	1.01		

Remark: /1 Banten includs Kabupaten of Serang, Lebak and Pandeglang.
/2 The figures include the employment working at least one hour in the preseding week or temporary not working.
Source: Refs. 1 - 4 and 14

Table A-10 NUMBER OF FARM HOUSEHOLDS IN STUDY AREA, BANTEN REGION AND WEST JAVA IN 1980

Region	Number of Household		Ratio (%)
	Farmer (1)	Total (2)	(1)/(2) x 100
1. West Java	3,246,164	6,100,713	53.2
2. Banten			
Kabupaten Serang	150,568	231.022	65.2
Kabupaten Pandegland	110,423	144,117	76.6
Kabupaten Lebak	122,423	145,394	84.2
Total	383,414	520,533	73.7
3. Study Area			
Kabupaten Serang	150,568	231,022	65.2
Kabupaten Pandeglang	17,043	24,414	69.8
Kabupaten Lebak	70,030	88,314	79.3
Total	237,641	343,750	69.1

Source: Ref. 4, 5 and 6

Table A-11 NATIONAL AND REGIONAL INCOME PER CAPITA (1975-1981)

(Unit: 10^3 RP)

Region	Income								Average annual growth rate (%)
	1975	1976	1977	1978	1979	1980	1981	1982	1975-1982
A. At Current Price									
Indonesia	82.29	99.76	118.79	138.54	189.78	265.36	312.93	337.72	22.3
West Java	71.31	86.14	95.30	115. 93	150.30	207.72	248.34	266.38	20.7
Banten/1	52.05	63.46	69.31	83.45	103.97	129.29	170.97	188.48	20.5
B. At 1975 Constant Price									
Indonesia	82.29	86.10	91.28	94.61	96.37	102.99	110.29	110.72	4.3
West Java	71.31	77.16	79.19	86.95	88.77	96.81	105.00	106.55	5.9
Banten/1	52.05	60.29	60.92	69.51	68.13	73.80	85.86	89.55	8.1

Remarks: /1 = Banten consists of Kabupatens of Serang, Lebak and Pandeglang

Source: Refs. 1-3 and 11-15

APPENDIX-B

HYDROLOGY

APPENDIX - B

HYDROLOGY

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APPENDIX-B

HYDROLOGY

1. WATERSHED

The study area occupies a total area of about 2,320 km^2 including the objective irrigation area in the northern coastal plain. The main rivers running through the study area are the Ciujung river and the Cibeureum river. The latter is a tributary of the Cidurian river system. The general basin is shown in Fig. B-1.

1.1 Ciujung River

The Ciujung river has a total catchment area of 1,850 km^2 at its estuary. The river splits into three main tributaries in the upstream basin at or near Rangkasbitung where the catchment area comes to 1,383 km^2, comprising 594 km^2 of the upper Ciujung, 331 km^2 of the Ciberang and 458 km^2 of the Cisimeut river basins.

In the Ciujung river basin upstream from Rangkasbitung, the present land use will be briefly classified as follows:-

- the natural forest covers 124 km^2, or only 9.0% of the catchment area, mainly the Ciberang and the Cisimeut basins,
- the plantation and the shrub forest cover 417 km^2, or 30.1% of the catchment area, mainly in the Cisimeut and the upper Ciujung basins,
- the upland crop field covers 703 km^2, or 50.8% of the Catchment area, and
- the wet paddy field covers 139 km^2, or 10.1% of the catchment area.

1.2 Cibeureum River

The Cibeureum river has a catchment area of 255 km^2 at the confluence of the Cidurian river. The present land use in the basin will be briefly classified as follows:-

- the natural forest covers 11 km^2, or only 4.3% of the catchment area,
- the plantation and the shrub forest cover 61 km^2, or 23.9% of the catchment area,
- the upland crop field covers 135 km^2, or 52.9% of the catchment area,
- the wet paddy field covers 43 km^2, or 16.9% of the catchment area, and
- the grass land covers 5 km^2, or 2.0% of the catchment area.

2. HYDROLOGIC STATIONS

2.1 Observation Stations

2.1.1 Raingauge stations

It is reported that the rainfall observation was started in late 1870's at Serang and over 60 stations were installed by 1920 in the North Banten region. Presently, about 100 raingauge stations are operated in and around the North Banten region under the management of P3SA and the Meteorology and Geophysics Center (PMG). Of them, 19 stations are equipped with automatic rain recorders. Taking the availability of observed data into account, 85 stations will be selected for the study. Their locations are shown in Fig. B-2.

Most of the data on these 85 stations are useful for arranging the daily and the monthly rainfall data. Their data keeping condition is summarized in Table B-1.

Two groups of raingauge grid networks spacing at 2 km haye been installed in 1978 by P3SA, one near Ciruas in the northern coastal plain, the other near Leuwidamar in the upper Ciujung catchment. The object of these raingauge grid networks is to investigate the rainfall patterns in the coastal and the hill areas and their effects on floods. The accumulated data to date in the grid networks are insufficient yet for processing into the daily and the monthly rainfall data for the present study, however, the hourly rainfall data by some automatic rain recorders in the networks will be useful for the flood runoff analysis.

2.1.2 Meteorologic stations

In the North Banten region PMG installed a meteorologic station at Serang in 1949, which has been the principal station in the region. Besides, P3SA installed four meteorologic stations in 1978 at Padarincang, Cadasari, Cikadu and Cileles. Their locations are shown in Fig. B-2 and observation period are listed in Table B-3.

2.1.3 Water level gauging stations

As shown in Table B-4, 14 water level gauging stations were installed in the Project Area. As the Cileuksa, Pariuk and Parigi gauging stations were closed down, there are 11 gauging stations working at present. Rangkasbitung, Sajira and Leuwidamar gauging stations located along the Ciujung river have lost their automatic recorders during the flood in November 1981. Since then three daily readings have been taken by using staff gauges at these stations, however, a new automatic recorder was installed recently at Rangkasbitung.

The station holding the longest observation record is the Rangkasbitung gauging station run by DPMA. The amount of missing data is small, and the data are filed and arranged in good order. Although P3SA has improved its water level observation network and has performed water level measurement since 1978, the period of observation is still short and the accumulated data are still insufficient to conduct the reliable hydrologic analyses.

2.2 Rainfall Data

2.2.1 Isohyetal map

The annual rainfall in the study area varies, according to the location and the topography, ranging from around 1,500 mm in the northern coastal plain to about 5,000 mm in the southern mountainous region near Gunung Endut and Gunung Halimun. The mid-range area inbetween, around Pamarayan and Rangkasbitung, receives 2,000 to 2,500 mm. Gunung Karang affects the local pattern with richer rainfall of 2,500 to 3,500 mm on its southern foothills near Pandeglang. The upper Ciujung catchment southwest of Rangkasbitung lies in a rain shadow between two mountain areas and receives less rainfall than the Ciberang and the Cisimeut catchments.

An isohyetal map of the annual rainfall is presented in Fig. B-3 which was prepared by the M/P Study Team taking account of the average annual rainfall data from 1942 through 1980 at selected stations in and around the study area.

The seasonal variation of the rainfall in the study area is also notable corresponding with the monsoons. The northern coastal plain receives only about 15% of the annual rainfall during the period from June through September or the months of east monsoon, whereas about 60% of the annual rainfall during the period from December through March or the months of west monsoon, and the rest of 25% during the months of transitions. The mid-range area around Pamarayan and Rangkasbitung receives about 20% of the annual rainfall during the period from June through September , whereas about 45% of the annual rainfall during the period from December through March, and the rest of 35% during the months of transitions.

The typical pattern of monthly rainfall in the study area are illustrated in Fig. B-4, which are prepared based on the observed data at nine typical gauging stations in the northern coastal plain, the mid-range area and the mountainous region.

2.2.2 Probable daily catchment rainfall

Probability calculations are conducted by using the annual maximum daily rainfall data of the available gauging stations within the study area. It is decided that the Gumbel Method which permits relatively

simple calculation, will be used for probability calculations. Table shows the results of probable daily rainfall calculations made at the respective gauging stations. Meanwhile, for the assessment of the daily catchment rainfall, the Thiessen Polygon method is used. Table B-5 shows the area percentages of the respective gauging stations' occupation in relation to the respective catchment basins. The percentages are obtained from Fig. B-5. The probable daily catchment rainfall is obtained from the governing area and the probable rainfall of each catchment area as shown in Table B-8.

2.3. Water Level Data

Presently, seven water level gauging stations on the Ciujung river system and five water level gauging staions on the Cidurian river system are operated, as listed in Table B-4. Two stations on the main stem of the Ciujung river, Rangkasbitung and Kragilan are under operation by the Directorate of Hydraulic Engineering (DPMA) since 1970 and 1969, respectively. The available gauging data at Pamarayan weir, since 1975, are kept by the Serang Regional Office, Provincial Public Works Departement (DPUP). P3SA has been operationg three stations on the tributaries of the Ciujung river since around 1978-1980, at Sajira on the Ciberang river, at Cileles on the upper Ciujung river and at Leuwidamar on the Cisimeut river.

New automatic gauging station at Sabagi and Gadeg, on the Ciberang river and Cibeureum river, were installed by DPMA in June 1984. Sabagi station is located at downstream from the Karian dam site near Sabagi village and Gadeg station is installed downstream from the Cilawang dam site near by the existing Gadeg staff gauging station.

For the DPMA gauging stations at Rangkasbitung and Kragilan on the Ciujung river, the discharge rating curves have already been prepared by DPMA and the daily discharge tables are also ready to use. The Rangkasbitung gauging station will be the key station in the Ciujung catchment, which gives the well arranged discharge data for a fairly long observation period since 1972 to date.

On the P3SA gauging stations, a series of discharge measurement have been carried out since the year of installation to date and the measurement data are usable for drawing up the discharge rating curves. The discharge rating curves and their formulae were prepared by the Feasibility Study Team for the estimation of discharges at each gauging station. At Sajira gauging station on the Ciberang river, the observed data show some inconsistency affected by simple intake facilities located immediately downstream from the guaging station. Therefore the data will not be used for the study.

Presently, the Cibeureum river has one water level gauging station at Gadeg, however, five water level gauging stations are operated on the main stem of the Cidurian river. Two gauging stations at Parigi and Kopomaja are under operation managed by DPMA since around 1969 to 1975 at Parigi and to date at Kopomaja, P3SA has been operating two gauging stations at Rancasumur and Tanjung since around 1978 to date. The Kopomaja gauging station will be the key station because of its fairly long observation period.

3. CLIMATE

A typical monsoon climate prevails in the study area with well marked wet and dry seasons corresponding with the monsoons. The west monsoon dominates the area with abundant rainfall from December through March, and the east monsoon appears with less rainfall from June through September. April to May and October to November belong to the transitions. Mean meteorologic observation data at Serang and Cikadu are shown in Tables B-9 and B-10. By these data, the climate in and around the Project area will be briefly classified as follows.

The precipitation in the Project area is rich with the areal average of about 2,500 mm per annum. The annual rainfall varies according to the location and the topography ranging from about 1,500 mm in the northern coastal plain to about 5,000 mm in the southern mountainous region near Gunung Endut and Gunung Halimun. The seasonal variation of the rainfall is also notable with marked wet and dry periods. The northern coastal plain receives less than 30% of the annual rainfall during the dry period from May through October, or the months of east monsoon and its neighbours. The mid-range area around Pamarayan and Rangkasbitung receives about 40% of the annual rainfall during the same period as above.

The monthly mean air temperature will be principally a function of elevation. However, at Serang in the northern coastal plain, the monthly mean air temperature varies little throughout the year ranging between 26°C and 27°C.

The relative humidity is generally high ranging from 80% to 85% almost throughout the year with some decline to about 75% around September and its neighbouring months.

The monthly mean wind velocity at Serang ranges between 3.8 knots and 4.7 knots or 2.0 m/s and 2.4 m/s.

The monthly mean sunshine duration at Serang ranges between five and six hours daily in the dry season, whereas between three and four hours daily in the wet season.

4. RIVER FLOW

4.1 Discharge Measurement and Rating Curve

The discharge measurement is being carried out at each gauging station. At the Kragilan and Rangkashitung gauging stations, the rating curves are drawn up by DPMA based on the observed discharge. As for the other gauging stations managed by P3SA the discharge measurement has been carried out since 1978 and its results are shown in Table B-10. Most of these observed data are usable to draw the rating curves.

The discharge rating curve is derived from the relation between the water level and discharge of the river at the time of discharge measurement. Fig. B-6 shows the relation between water level and discharge obtained at each gauging station and portrays the optimum curves asymptotic to the observed data.

4.2 Monthly Mean Discharge at Gauging Stations

The discharge rating curve of each P3SA's gauging station is shown in Fig. B-6. For reasons relating to the accuracy of discharge measurement, no discharge conversion from the water level was performed at the Sajira gauging station. Meanwhile, at the Kragilan and Rangkashitung gauging stations belonging to DPMA, daily discharge data have already been put in fine order by using the discahrge rating curves obtained from discharge measurement. Further, as for the monthly mean flow at the Pamarayan weir which has already been put in fine order by DPUP in Serang are utilized.

The monthly mean discharge and the annual runoff at each water level gauging station on the Ciujung river and the Cidurian river are summarized in Table B-12. The annual runoff of the Ciujung river is accordingly estimated at about 3.08×10^9 m^3 at Kragilan (C.A. = 1,812 km^2), about 3.55×10^9 m^3 at the Pamarayan weir (C.A. = 1,451 km^2) and about 3.05×10^9 m^3 at Rangkasbitung (C.A. = 1,383 km^2) on average during each observation period. The Cibeureum river has Gadeg gauging station at

present, but availability of observed data is not sufficient. Making reference to the main stem of the Cidurian river, the annual runoff at Kopomaja (C.A. = 304 km^2) is estimated at about $0.72 \times 10^9 m^3$.

The flow regime of the Ciujung river has a similar monthly pattern to that of the rainfall, which is characterized generally by the rich flow during the period from December through May and the less flow during the period from June through November. July and August belong to the months of drought flow. The Cidurian river has an approximately similar monthly flow pattern, however, usually the rich flow appears from January through May.

4.3 Correlation of Monthly Mean Discharge

Rainfall in the Project Area bears strongly localized characteristics, sometimes with scarce rainfall in the location several kilometers distant. Thus the outflow at each gauging station shows different characteristics uniquely of its own.

From the results of a study made on the correlation of monthly mean discharge at major gauging stations, the correlative coefficients are found as shown in Table B-13, which shows the correlation of Rangkasbitung-Kragilan to be excellent and the correlation of Rangkasbitung-Kopomaja to be relatively good.

Accordingly, considering the nearby location and a fairly long observation period, the Rangkasbitung gauging station will be chosen as the key gauging station on hydrologic analyses for both the Karian dam and the Cilawang dam.

4.4 Discharge at dam site and weir site

The estimation of 10-day mean daily discharge at each proposed dam site and weir site will be done as follows and the results are given in Table B-15.

- Karian dam site

Because of the low accuracy of observed data at Sajira gauging station and no available data from newly installed Sabagi gauging station on the Ciberang river, and relatively short observation periods at P3SA's gauging stations on other tributaries, the 10-day mean daily discharge at Karian dam site will be estimated based upon the daily discharge data at DPMA's Rangkasbitung gauging station, which gives well arranged data for a fairly long period from 1972 through 1983.

However, cosidering the non-uniformity of rainfall distribution within the river basin upstream from Rangkasbitung, being richer in the Ciberang catchment, the estimation of discharge at Karian dam site will be made taking account of the annual rainfall and catchment loss in the basin together with its catchment area.

- Pamarayan weir site

The 10-day mean daily discharge at Pamarayan weir site will be similarly derived from the daily discharge data at Rangkasbitung gauging station. Also the annual rainfall and catchment loss together with its catchement area will be taken into account.

- Cilawang dam site and Gadeg weir site

P3SA's staff gauge at Gadeg on the Cibeureum river has proyided with only fragmentary data on daily discharge since its installation in 1982. DPMA's newly installed automatic water level recorder at Gadeg gives no available data by the time of the Study yet.

DPMA's Kopomaja gauging station, with staff gauge, has the longest observation period among the gauging stations on the main stem of the Cidurian river. It provides with year round daily discharge data from 1970 through 1979, however, recently giving only fragmentary data since 1980.

Considering the above-mentioned unsatisfactory condition of gauging stations on the Cibeureum and the Cidurian rivers, the 10-day mean daily discharge at Cilawang dam site and Gadeg weir site will be estimated based upon the well arranged daily discharge data at Rangkasbitung gauging station from 1972 through 1983.

5. SPILLWAY INFLOW DESIGN FLOOD

PMP-type rainfall will be used for the design storm rainfall to estimate the spillway inflow design flood at each proposed dam site. Hershfield's PMP approach will be employed for the analysis with storm rainfall data at principal raingauge stations in and around the Ciberang and the Cibeureum river basins.

Six gauging stations are selected for analysis. Where annual series of maximum daily rainfall data are available for fairly long observation periods of around 25 to 30 years.

The point PMP referring to these stations, in terms of daily rainfall, are calculated by Hershfield's approach in the range between 490 and 720 mm.

The highest recorded storm rainfall among these six stations are reported to have occurred in different months or years. The estimated PMP above may be expected not to occur in the same date.

Accordingly, considering the effective area assumed for each gauging station, the weighted average point PMP for the objective catchments are estimated at 610 mm with application of Thiessen polygon. The estimated PMP of 610 mm will be used as the point PMP for both the Ciberang and the Cibeureum basins.

The estimated point PMP of 610 mm is higher than the experienced highest daily rainfall of 340 mm in the upper Ciujung basin at Sampang Peundeuy by 80 % and those of 475 mm in the Banten region (BMG) at Mandalawangi and Cigeulis by 28%.

The catchment PMP for Karian and Cilawang dam sites will be estimated by applying the area-reduction factor of 0.82 and 0.92 to the above PMP-value of 610 mm respectively, which are derived from the storm rainfall depth-area curve on the July 1939 storm over the Malang area, East Java. Thus the catchment PMP, in terms of daily rainfall, are estimated at 500 mm for the Karian catchment and 570 mm for the Cilawang catchment.

Based upon the observed hourly rainfall data at P3SA's automatic rain recorders during the 1981 November storm, the hourly distribution of the design storm rainfall is assumed to have a rainfall duration of eight hours with a peak rainfall in the middle as shown in Fig. B-7.

Employing the adopted rainfall distribution and the storage function, the hydrographs of PMF or the spillway inflow design flood for the Karian and the Cilawang dams will be obtained as shown in Fig. B-7.

Thus the peak spillway inflow design floods for the Karian and the Cilawang dams are estimated at 3,400 m^3/s and 1,700 m^3/s respectively, which correspond to around the Creager 90 floods. Corresponding specific discharges are estimated at 11.8 $m^3/s/km^2$ and 18.3 $m^3/s/km^2$ respectively.

6. RIVER MAINTENANCE FLOW

The river maintenance flow will be defined as the required river discharge at the time of drought flow, which is kept in view of maintaining the normal function of a river such as the river transportation, fisheries, prevention of salinity intrusion and estuary blockage, protection of river control facilities, maintenance of water quality and ground water table, preservation of animals and plants, and scenic view.

In any water resources development plan, the river maintenance flow will have to be taken into account together with relevant irrigation and other water utilization right.

It is difficult to define the commonly applicable amount of river maintenance flow clearly, however, in most cases it would be desirable to guarantee the flow corresponding to the 10-year average of 355-day discharge or to the specific discharge of around 1 m^3/s per 100 km^2.

The river miantenance flow at each dam and intake weir site in this Study will be estimated as follows:

- Pamarayan weir

The river maintenance flow at the Pamarayan weir will be estimated considering the aforementioned normal function of the river and the discharge data in the low-water stage.

The 355-day discharges at Kragilan gauging station, during eight years of observation in 1970 and from 1972 through 1978, lie in the range between 2.40 m^3/s and 31.40 m^3/s (Ref. Table B-16). It will be considered to be the sum of the actual discharge from the Pamarayan weir and the local inflow downstream thereof. In other words, above figures will include some amount of river maintenance flow presently discharged from the weir, if any.

Accordingly, taking the average of observed 355-day discharge into account, the river maintenance flow at the Pamarayan weir will be estimated at 9.70 m^3/s. The specific discharge will be 0.67 m^3 per 100 km^2.

- Other dam and intake sites

The river maintenance flow at Karian, Cilawang dam sites and Gadeg, Cicinta intake sites will be estimated in the same way, however, discharge data at Rangkasbitung gauging station will be used for the estimation.

The 355-day discharges at Rangkasbitung gauging station, during twelve years of observation from 1972 through 1983, lie in the range between 3.80 m^3/s and 43.30 m^3/s. The lowest 5-year data lie in the range between 3.80 m^3/s and 14.50 m^3/s, and the next 5-year data between 17.20 m^3/s and 32.80 m^3/s.

Taking account of the average of 355-day discharges for the lower ten years, the river miantenance flow will be estimated at 3.50 m^3/s at Karian dam, 1.10 m^3/s at Cilawang dam, 1.40 m^3/s at Gadeg intake and 0.40 m^3/s at Cicinta intake, respectively. The specific discharge at each site will be 1.20 m^3/s per 100 km^2.

7. SEDIMENTATION

7.1 Sediment Rating Curve

A series of measurement of suspended sediment load were previously conducted by P3SA on the Ciberang river at Sajira gauging station. The results of measurement are shown in Fig. B-8 with a sediment rating curve which is derived from the measurement data as follows:

$$Q_S = 12.296 \times Q_W^{1.387}$$

where,

Q_S: Suspended sediment load in ton/day

Q_W: River discharge in m^3/s

7.2 Sediment Transport

The annual mean discharge at Sajira gauging station is estimated at 26.26 m^3/s based on the discharge data at Rangkasbitung gauging station. The corresponding suspended sediment discharge is estimated at 1,144 ton/day on the sediment rating curve in Fig. B-8. Thus the specific annual suspended sediment transport at Sajira (C.A: 244 km^2) will be estimated at 1,711 ton/km^2.

The bed load is reported commonly to lie in the 5 to 25 percent range of the suspended load. Assuming 10% of suspended sediment transport for the bed load, i.e. 171 ton/km^2 annually, the total specific annual sediment transport into the reservoirs will be estimated at 1,882 ton/km^2.

7.3 Sediment Trapped in Reservoir

Storage capacities, annual inflows and capacity-inflow ratios at proposed Karian and Cilawang reservoirs will be summarized as follows:

	Karian	Cilawang
Storage capacity (10^6 m^3)	219.0	62.0
Annual inflow (10^6 m^3)	881.0	236.4
Capacity-inflow ratio	0.25	0.26

Applying the above figures to Brune's reservoir-trap efficiency curve, the trapped sediment percent will be estimated at a range between 88% and 98%, and around 95% on the median curve. Taking the median value, the trapped specific suspended load will be estimated at 1,625 ton/km^2.

7.4 Storage Volume Occupied by Sediment

Generally the specific weight of settled sediment seems to vary with the age of the deposit and the character of the sediment, however, with an average of about 1.0 ton/m^3 for fresh sediment and about 1.3 ton/m^3 for old sediment. Assuming the specific weight of settled sediment at 1.10 ton/m^3, the specific volume occupied by settled sediment will be estimated at around 1,700 m^3/km^2 annually.

Thus the storage volume occupied by 100-year sediment transport in the proposed reservoirs will be estimated at about 49 x 10^6 m^3 at Karian dam and about 16 x 10^6 m^3 at Cilawang dam.

8. WATER QUALITY AND RIVER BED MATERIAL

8.1 Water Quality

For water quality analysis, water sample was taken at 8 places during the two seasons in 1984, i.e. dry season sample in July and wet

season sample in October. The location of water sampling is shown in Fig. B-9.

The analysis of water quality was conducted by the Water Quality Laboratory, DPMA. The results of water quality analyses on the 16 samples taken at 8 sites are shown in Tables B-18 and B-19. In both dry and wet season, the water has no problem for agricultural use. However, when it comes to dringking water, if strict judgement is made, the water is not adequate to be used as it is. If the raw water is purified, it can be used as drinking water.

8.2 River Bed Material

Riverbed material analysis was carried out along the main stem of the Ciujung river in September 1984. The material was sampled at 11 places, locations of which are shown in Fig. B-10. The results of river bed material analysis are shown in Table B-19, and the particle size distribution is shown in Table B-20.

Table B-1 EXISTING CONDITION OF MONTHLY RAINFALL DATA

BANTEN

NO	STATION NAME	1944 2	1944 3	1944 4	1944 5	1944 6	1944 7	1944 8	1944 9	1945 0	1945 1	1945 2	1945 3	1945 4	1945 5	1945 6	1945 7	1945 8	1945 9	1946 0	1946 1	1946 2	1946 3	1946 4	1946 5	1946 6	1946 7	1946 8	1946 9	1947 0	1947 1	1947 2	1947 3	1947 4	1947 5	1947 6	1947 7	1947 8	1947 9	1948 0	1948 1	1948 2	1948 3	1948 4
8	MAJAU								△	△																																
9	BOJONG DATAR										○	○				○																												
10	SANGIANG DAMAR											△	○	○	○	△	○	△		△	○	○		○	△	△	○		○	○	○	△	○	○	○	○	△		△				
10 a	BOJONG	○	○	○							○	○	△	○	△		△	△	○	△							○	○	△	○	○	○	○	○	○	△	△	△				
10 b	KADUMLATI											△	○	○	△						○		△	△																		
11 b	RANGKAS	○	○	○	○	△					○	○	△	○	○	△		△	○	○	△	△	○	△	○	○	○	○	○	○	○	○	○	○	○	○	△	△	○				
12	CIBALIUNG	○	○	△	△	△					○	△	○	△	○	○	○		△	△	△					△	△	△	○	△	○	○	○		○	○	○					
13	CIMANGGU	○	○	○	△						○	○	○	○	△	△			△		△	△							△		○	○	△		△	△	△					
14	CILEGON	△	○	○							○		△	○	△	○	○	△	○	○	△	○	△	△	△		△			△			△	○	△	○	△	○					
14 a	BAJANEGARA	△	○	○	△						○	○	○	○	○		○	△	△	○	○	○	○	△	△		△			△	○	△	△	△	△	△	△	△	△				
14 c	KRAMATWATU	△	○	○	△																																		△	△	△			
14 d	CILEGON B.P.M.U.																			△	○	△	△																○				
17	GUNUNG KUPAK																									○	○	△	○	○	○	○	△	○									
18	CIOMAS	○	○	○	△						△	○	○	○	○	△	○	○	○	○	○	○	○	△			△		△	○	△	△	○	△		△	△	△	○				
19	PABUARAN	○	○	○	△																								△	○	△	○		△	△		△	△	△	△				
20 a	GUNUNG KARANG	○	○	○	△	△										△	△	△											△									△					
21	MANDALAWANGI	○	○	○	○	○					○	○	○	○	○	△	△	○	○	○	○	○	○	△	○	○	○	○	○		○	△	△		○	○	○	○	△	△	△	△	
22	CIMAUK	○	○	○	△	○	△				△	○	○	○	○	○	○	○	○	○	○	○	○	○	△			△	△	○	○		○	○	○	○	△	△	△	△	△		
23	SERANG		○	△	△				△	○	○	○	○	○	○		○	○	○	△	△	○		○	△			△		○	○	○	○	○	○	○	△	△				
23 a	SERANG (IRR)	△	○	○	△				△								○	△	△	○		○	△			△		○	○	△	○	○	○	△								
23 b	CIMIOENG	○	○	△	○																																						
23 c	KRAMATRETAN	△	○	○	△				△	○	○	○	○	○	○	△	△	○	○	○	○	○	○	△	△	○	○	○	○	○	△	△	○		○	△	○	○	△	△			
23 d	SOEKALILA	○	○	△								○	○	○	○	○	△																										
23 e	SINGAMERTA (K.P)	○	○	○	△								△	○					△	○	○		△		○		○	△	○	○	○	△	○						△	○			
23 f	CIRUAS										○	○	○	○	○	○	○	△	△	○	○	○	○	○	△	△	○		△	○	○	○						△	△	△			
23 g	KALENPENTUNG										○	○	○	○	○	○	○	○	○	○	○	○	○	△	△	○			△	○	○							△	△	△	△		
24	BAROS		○	○	△	△					○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	△		○	○	○	○	△		○	○	○	○	△	△	○	
24 a	NYAPAH													○	△	○	○	○	○	○	○	△	△	○			△	○	○	○									○	○	△			
24 b	PETIR																																										
26	PANDEGLANG		○	○	○			△		△	○	○	○	○	○	△	△	△	△	△	△	○	○	△		△	○	○	○	○	○	○	△	△	○	○	○	○	△	○	○		
26 a	CIKARET														○	△	○	○	△		○									○	△	△	△										
26 b	CILELES		○	△	△	△					△	△	○	△	△	○	○	△	○		△	△	○	△	△						△	○	△		△	○							
26 c	WARUNGGUNUNG		○	○	○	△					○	△	○	○	○	○	○	○	○	○	○	○	○	△		△	△	○	○	△	△	○	○	○	○	△						
27	GUNUNG KENCANG		○	○	△	△					△	○	○	○	○	○	△	△	○	△	○	△	△	△		△	△	○	○	○	○	△	○	○		△						
28	MUNJUL		○	○	○	○					○	○	○	○	○	○	○	△	○	△	○	△	○	△				△														
29	GUNUNG KENDENG		○	○	○	△					○	○	○	○	○																	△										
30	CIKEUSIK	△	△								○	○	○	○	○	△	△	○	○	△		○	△	△			○	○	△												○		
31	MALINGPING		○	○	○	△					△	○	△	○	○	○	○	○	○	○	○	○	○	○	△			○		△	○	○	△	△	○	△	○	○	○	△			
31 a	KANDANG SAPI		○	○	○	△																											△									
32	TANARA												○	○	△																											
32 a	JEUNGJING		○	○	○	○	○			○	○	○	○	○	○	○	○	○	△	○	○	○	△	△	○			△	○	○	○	△											
32 b	KEMAJUNGAN		○	○	△	△						○	△	○	△																											
32 c	RAGASILIR												○	○	○	○	○	○	○	△	○	○	○	○	○	△	△	○		△	○	○	○									
33	PARIGI / CIKANDE		△	△	○							○	○	○	○	○	○	△	○	○	○	○	△	○	○	△	○	○	○	○	○		△	○	○	○	○	○					
35	PAMARAYAN		△	○	○	△				○	○	○	○	○	○	○	○	○	○	△	○	○	○	○	○	△	○	○	○	○	○		○	△	○	○		△	△	○	△			
36 a	MAJA																												○	○	○	△	△	○									
37	RANGKASBITUNG		○	○	△	○	○	△			○	○	○	○	○	○	○	○	○	○	○	○	○	○	△			△	○	○	○	○	○	○	○	○	○					
37 b	CIKADU										○	○	○	○	○	○	○	○	△	○	○	○	△	○				○	○	○	○	○	△	△			○					
37 c	CIMARGA					○						○																	○			△									
37 e	CIMARGA	△	△								△		○	△	○	○	○	△	△									△	△	○	○	○	△	△	△	○	△					
37 f	CISALAK BARU										○	○	△	○	△	△	○	○	○	○	○	○	○	○	△	○	○	○	○	○	○	△	△	○	○	△					
37 g	JINIHNIH											○	○	○	△	○	△	○	△		○	○	○	△																		
37 h	PANANCANGAN											○	○	○	○	○	△		○	△	○	○	○	○	△	○		○	△	○	△											
38	LEUWIDAMAR		○	○	○		△				○	○	○	△	○	○	△									○		△				△										
38 a	SAMPANG PEUNDEUY													△	△	○	○	△	△	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	△						
38 b	WANTI				△																									△												
38 c	CIKOPEK (PASIR KOPPO)														○	○	○		○	△	△	○	○	△	○																		
38 d	GUNUNG RUNGGAL											○	○	○	○	○	△				△	○	○	△	○			△														
38 e	BANTAR JAYA																								○		△	○	○		○	○										
39	CICARUNGEUN		○	○	△																																					
40	BOJONG MANIK		○	○	○	△	△				△	○	○	○	△		△	△		△		○	△	○			△		○	△	○	△	○	○	△	○	△					
41	PASIR AJUNAN														○	○	○	○	○	○	△	△	○	△				△	○	△	○	△	○	○	△							
42 a	SAJIRA		○	○	△	○	○				○	○	○	△	○	△	△	△	△	○	△		○	○					△	○	○			△	○	△	△					
43	MUNCANG		○	○	○	△	○				○	△																	△	○				○								
43 a	PANGGARANGAN		○	○	○						○	○	△	○	○	○	○	△	○	○	○	○	△	△	△	△	○	○	△	○	○	○	○	○	○	○	△	○				
43 b	CILAKI											○	○	○	○	○	○	○	○	○	○	△	○	○	△			○	△	○	○	○	○	○	○	○	○	○					
44	CIPANAS		○	○	△	△					○	○	○	○	○	○	△	○	○	○	○	△	△	△	△	△		△			○	△	△	△	△	○						
44 a	BANJAR IRIGASI											○	○		○	△			○	△	○	○	○	○	△	○		△	△	○		○	○	○	○	○	△					
45	LEBAK PARAY																										△															
45 a	CIROTAN																														○									○		
	BAYAH (EAST)																																							○		

JAKARTA

2	JASINGA									○	○	○	○	○	○	○	○	△			△	○		○	△	○	○	△	○	○	○	○	△	○	○	△	△	△					
2 a	PERK. CIKOPO MAJAK									△	○	○	○	○	○		○	△	○	○	△	△	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	△	△	○		
2 b	PINTU AIR JENGKIL																																										
3	KEC. PABUARAN																																										
5	KARANG BOJONG																																										
5 a	CURUG										○																																
6 a	CIMARACA					△					○	△	○	○	○	○	○	○	△			△																	△	△		
11	CISARUA																																								△		
12	CIPEUNDEUY KIARAPANDA																													○	○	○	○								△	△		
14	TOGE									○	○	△	○	○	○	○	○	○	○	△	△		○	△	△	△		△	△	△	○	○	○	△			△	△		△			
15	CIRANGSAO	△																																									
16	CIKASUNGKA (CIGUDEG)									○	○	○	○	○	○	○	○	○	○	○	△	○	○	△		△		○														
21	PROV. KELAPA CIHUNI	△		△	△																																		△			
21 a	PERKEBUNAN CIANTEN									○	○		○	○	○	○	○	○	○	○	○	○	○	○	△		○	△	○	△	○	○	○	○					△				
21 b	PLTA KRACAK	○			△					○	○	○		○	○	○	○	○	○	○	○	○	○	○	○	△	△	○	○	○	○	△	○	○	○			○				
25	KOMP. KEC. MAUK		△	△	○						△	△	○	○	○	○	○	○	○	△	△	○																				
25 a	KRESEK		○	○	△						○	○	○	○	○	○	○	○	○	○	○	○																				
25 b	BALARAJA		○	○	○						○	△	○	○	○	○	△	△	○	○	△	○	△	△	△	○	○	△	○	○	△	○	○	○	○	○	○	○	△	△		
25 e	BUMIAYU																																										
25 f	HAL. KANTOR PS. KEMIS																																										
25 g	SPATAN																																										
25 h	LONTAR BENYAWAKAN																																										
25 i	KARANG KOMBONG																																										
25 j	CIBOJONG																																										
25 k	BOJONG JAKARTA																																										
30 a	CURUG (BPMD)		○	○	△			△	○	○	○	△	△		△	△	○		○	○	△	△	○			○	△	○			○	△	○									
30 b	TIGA RAKSA		△	○	△	△					△	○		○	△	△	○							△	○	○	△		△													△	
30 c	PARUNG PANJANG		○	○	△	○		△			△	○		○	○	△	△		△	○	○	△	○	△	△	○	○	○	○	○		○	○	○	○		△	△	△	△			
31 a	PONDOK JAGUNG										○	○		○	○	△	△	○	○	△		○	○	△																	△		

Remarks; ○ Available Data

△ Partially Available Data

Table B-2 AVERAGE MONTHLY RAINFALL

Unit: mm

Station Name	No.		Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Des.	Annual Mean Max/Min
Cipanas	44	Ave.	417	374	440	444	397	258	219	255	257	299	314	338	4237
		Max.	1058	612	858	790	975	729	527	849	595	658	516	636	6245
		Min.	161	195	145	140	100	22	21	0	33	52	207	82	2886
			(26)	(25)	(24)	(25)	(24)	(24)	(20)	(24)	(24)	(25)	(23)	(22)	(15)
Cileles	266	Ave.	326	313	331	248	248	105	95	133	159	198	260	282	2600
		Max.	612	568	1037	593	607	247	283	405	543	401	585	526	3216
		Min.	137	38	37	28	45	0	0	0	0	36	94	66	1799
			(18)	(19)	(19)	(21)	(19)	(22)	(19)	(17)	(17)	(17)	(16)	(15)	(8)
Rangkasbitung	37	Ave.	325	215	224	214	156	111	126	118	140	163	171	189	2180
		Max.	654	338	371	483	336	246	304	450	298	423	434	457	2996
		Min	99	97	40	105	21	12	2	0	2	31	52	45	1603
			(29)	(29)	(29)	(29)	(30)	(30)	(29)	(29)	(29)	(28)	(28)	(27)	(26)
Pamarayan	35	Ave.	292	235	221	182	173	108	106	91	109	167	171	190	2031
		Max.	624	385	368	376	413	262	293	279	322	375	290	510	2489
		Min.	12	92	28	49	39	0	1	0	0	25	33	15	843
			(29)	(28)	(28)	(27)	(27)	(29)	(29)	(28)	(29)	(29)	(27)	(26)	(24)
Jeungjing	32a	Ave.	322	268	220	122	71	64	52	49	48	61	98	145	1411
		Max.	782	609	885	323	225	270	198	172	229	191	257	397	2141
		Min.	75	54	52	0	0	0	0	0	0	0	0	12	1121
			(28)	(28)	(28)	(28)	(26)	(25)	(27)	(25)	(27)	(26)	(27)	(25)	(22)
Serang	23	Ave.	285	235	185	116	104	79	66	64	63	90	123	185	1621
		Max.	647	606	403	229	354	194	238	256	219	196	355	482	2033
		Min.	65	42	58	13	28	0	0	0	0	0	0	0	1029
			(23)	(23)	(23)	(24)	(23)	(23)	(22)	(23)	(23)	(22)	(21)	(22)	(18)

(to be continued)

Station Name	No.		Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Des.	Annual Mean Max/Min
		Ave.	281	213	162	115	88	69	87	49	41	47	107	156	1340
Cilegon	14	Max.	576	460	492	225	194	250	300	155	188	154	402	515	2152
		Min.	22	13	1	0	4	0	0	0	0	0	7	4	123
			(20)	(21)	(20)	(19)	(20)	(21)	(21)	(20)	(19)	(20)	(21)	(21)	(12)
		Ave.	389	325	277	224	176	101	109	118	118	178	245	266	2440
Soekadana/ Ciomas	18	Max.	733	726	626	503	385	234	310	459	338	377	583	905	3601
		Min.	103	100	86	68	52	0	0	0	0	0	8	8	1674
			(24)	(24)	(26)	(26)	(26)	(24)	(25)	(24)	(22)	(23)	(23)	(21)	(17)
		Ave.	330	246	234	230	202	124	121	131	164	199	250	255	2567
Pandeglang	26	Max.	586	447	402	371	586	382	277	312	378	472	466	583	3685
		Min.	92	105	81	77	74	13	0	0	0	47	127	103	1652
			(27)	(30)	(30)	(29)	(29)	(30)	(31)	(29)	(31)	(31)	(30)	(30)	(19)

Table B-3 LIST OF METEOROLOGIC STATIONS

Station	Installed by	Period of Observation
Serang	PMG	1972 - 1983
Padarincang	P3SA	1978 - 1983
Cikadu	P3SA	1978 - 1983
Cadasari	P3SA	1978 - 1983
Cileles	P3SA	1978 - 1983

Table B-4 WATER LEVEL ROCORDERS AND STAFF GAUGES

River	Location	Catchment Area (Km2)	Type	Installed by	Established Date	Water Level Data
Ciberang	Cileuksa	58	A	T.A	1929	1929,1934
Ciberang	Sajira	233	S	P3SA	1977	1978-1983
Ciberang	Sabagi	233	S	DPMA	1984	-
Cisimeut	Leuwidamar	183	A & S	P3SA	1979	1980-1983
Cisimeut	Pariuk	458	S	P3SA	1977	1978-1979
Ciujung	Cileles	216	A & S	P3SA	1978	1978-1983
Ciujung	Rangkasbitung	1.383	A & S	DPMA	1969/1970	1972-1983
Ciujung	Pamarayan	1.451	S	DPU	-	1975-1983
Ciujung	Kragilan	1.812	A & S	DPMA	1969	1970,1972-1975,1978-1983
Cibeureum	Gadeg	117	A & S	DPMA(A) & P3SA(S)	1982 (S), 1984 (A)	1983 (S)-(A)
Cidurian	Tanjung	265	S	P3SA	1978	1978-1983
Cidurian	Kopomaja	304	S	DPMA	1969	1970-1983
Cidurian	Rancasumur	-	A & S	P3SA	1978	1979-1983
Cidurian	Parigi	649	A	DPMA	1969	1970-1975

Remarks ;

A; Automatic recorder

S; Staff gauge

Table B-5 (1) DAILY MAXIMUM RAINFALL

Unit: mm/day

Year	Menes (5)		Labuhan (6)		Pasir Waringin (7a)		Sangiang Damar (10)		Rangkas (11b)		Bajanegara (14a)	
	Month	RF	Month	RF	Month	RF	Month	RF	Month	RF	Month	RF
1942	11	117	12	190					4	200	12	63
1943	2	120	2	188					1	325	11	111
1944	2	99	2	130					4	125	5	60
1945	2	112	2	127					12	134	8	64
1946	12	114							11	132		
1947	2	107										
1948												
1949												
1950									5	170		
1951	12	148	6	93					1	100	2	76
1952	5	151	2	148			5	118	5	107	3	82
1953	3	165	3	199	3	164	5	192	5	175	12	67
1954	1	178	11	238	12	143	6	90	7	179	7	83
1955	2	164	2	156	11	183	11	199	7	131	7	177
1956	7	159	12	127	12	155	10	113				
1957	12	220	12	159	12	207	6	151			3	91
1958	2	125	2	176	2	198	10	170	2	163	7	129
1959	5	150	11	121	12	140			3	145	2	84
1960	12	150	1	168	1	150	1	114	2	127	1	103
1961	12	141	5	163	4	189	3	448	3	168	5	61
1962	11	100	3	92	3	115	11	121	1	145	2	93
1963	4	131	3	118	1	98			1	152	1	75
1964	11	100	3	106	11	223	11	120	10	118	11	80
1965	3	137	12	100	12	198			12	76	2	145
1966	12	115	12	150	3	142	4	200	1/12	60	3	64
1967	12	107	3	175	5	161	2	183	2	86		
1968	12	286	12	275	12	221			5	114		
1969	11	117	12	195	11	154	12	115	12	100		
1970					4	145	4	130	12	127	5	90
1971	3	121	1	83	2	150	10	140	10	156		
1972	1	122	2	305	1	170	1	169	1	210		
1973	11	206	6	330	4	245	5	150	6	180	2	100
1974	1	210	10	185			9	170	2	240	2	95
1975	12	250	12	150	12	230	12	168			1/2	85
1976	12	200	12	360	12	245	3	137	12	191	1	75
1977	2	191	1	149	2	195	1	138	1	148	1	184
1978	6	120	3	137	1	294	1	137	1	145	1	110
1979	4	110	11	129					1	117		

RF.; Rainfall

Table B-5 (2) DAILY MAXIMUM RAINFALL

Unit:mm/day

Year	Ciomas (18)		Mandalawangi (21)		Cimanuk (22)		Serang (23)		Kramatwetan (23c)		Ciruas (23f)	
	Month	RF	Month	RF	Month	RF	Month	RF	Month	RF	Month	RF
1942	3	163	5	245	10	185			12	74		
1943	1	132	1	256		271	1	88	1	120		
1944	12	128	12	203	2	107	1	82	9	58		
1945	5	71	2	364	2	208	3	67	2	92		
1946			11	475	1	305	1	89				
1947					2	153	3	73				
1948							3	80				
1949							6	53	5	76		
1950					12	87	4	62	12	94		
1951			2	115	9	85	9	51	2	59	6	60
1952	8	105	10	130	7	95	8	88	3	69	6	84
1953	3	100	3	116	1/2	105	1	99	5	65	5	90
1954	1	139	12	135	11	117	12	93	11	61	12	61
1955	7	100	7	175	2	161	6	110	6	67	11	115
1956	12	159	12	130	12	146	1	115	6	72	12	75
1957	1	98	1	154	12	107			1	83	1	93
1958	2	195	2	230	2	350	12	141	1	93	2	96
1959	3	125	12	117	12	120	3	92	3	134	5	124
1960	8	114	4	172	11	122	1	109	2	74	2	116
1961	1	100	4	140	4	140	5	122	5	74	11	162
1962	10	128	11	206	11	100	4	79	4	74	12	125
1963	1	100	2	105	2	89	1	107	7	75	1	117
1964	4	98	4	90	10	85	3	80	8	74	4	99
1965	1/2	125	2/12	75	1	97			1	75	1	40
1966	1	175	1	145	1	95			7	74	2/3	45
1967			1	110			2	86	12	82	4	45
1968							10	78	5	90		
1969					5	90			5	115		
1970	3	150	5	76					12	82		
1971			11	89	1	92			3	63	10	95
1972	4	76	1	120	5	138	7	82	2	58	1	97
1973	2	110							1	73	.2	125
1974	7	72	4	150			12	107				
1975	2	60	1	150	12	120	12	144	6	59		
1976	3	99	11	136	1	197	1	96	1	118		
1977	1	150	3	160	2	85	2	60				
1978			12	125	10/12	107	6	66	8	66	1	88
1979	3	60	1	93	1	60	11	176	3	95	1	175

RF.; Rainfall

Table B-5 (3) DAILY MAXIMUM RAINFALL

Unit:mm/day

Year	Baros (24)		Pandeglang (26)		Cileles (26b)		Warunggunung (26c)		G. Kencang (27)		Malingping (31)	
	Month	RF	Month	RF	Month	RF	Month	RF	Month	RF	Month	RF
1942	1	110	8	88	5	131	5	76	1	92	4	101
1943	1/7	107	1	130	2	173	1	139	1	116	2	85
1944	1	92	4	71	10	110	3	133	2	104	5	100
1945	9	80			3	155	5	128	3	113	3	57
1946											11	114
1947			4	64								
1948												
1949												
1950			9	113							12	86
1951	3	84	4	161	1	50	8	116	6	112	4	93
1952	1	68	1	91	12	117	2	90	10	111	3	110
1953	1	65	3	75	2	109	10	73	2	130	11	79
1954	10	84	11	89	1	105	7	90	1	126	1	94
1955	7	128	10	106	11	135	7	165	11	124	8	134
1956	1	86	9	95	12	135	8	132	10	138	7	246
1957	2	78	12	89	5	95	2	167	5	110	12	126
1958	2	150	2	200	3	156	2	153	12	139	10	114
1959	1	82	5	90	1	225	10	85	2	115	7	86
1960	7	70	10	94			12	84	8	139	1	140
1961	5	82	1	87	5	126	5	93	3	129	1	110
1962	10	57	9	91			6	108	4	171	1	94
1963	1	70	5	143	11	240	10	130	12	78	12	100
1964	10	39	10	100	1	75	2	101	1	125	6	109
1965	1	27	2	74	10	58	10	80	1	82	3	84
1966	3	47							1	170		
1967	1	50	5	102					3	70		
1968			6	137							7	139
1969			5	90			3	116	12	108		
1970	5	76	7	97			4	100	4	108	3	110
1971	3	75	1	96			1	110	3	150	2	170
1972	12	92	3	90	3	150	3	82	1	130	2	109
1973	5	75	9	104	9	209	9	86	1	150	9	156
1974	9	73	12	115	4	100	12	86	3	135	1	117
1975			4	86			7	87	12	135		
1976	1	65	1	71	5	34	12	93	3	165	11	134
1977	2	99	1	88	2	68	1	85	1	81	1	129
1978	1	81	8	110			4/8	68	1/2	100	12	90
1979	1	108	5	71			1	106			11	134

RF.; Rainfall

Table B-5 (4) DAILY MAXIMUM RAINFALL

Unit:mm/day

Year	Cipucang Pare (31c)		Jeungjing (32a)		Parigi (33)		Pamarayan (35)		Maja (36a)		Rangkas-bitung (37)	
	Month	RF	Month	RF	Month	RF	Month	RF	Month	RF	Month	RF
1942			8	90	10	53	11	76			3	75
1943			1	80	1	75	2	105			2	105
1944			1	116	3	76	4	72			4	100
1945			3	96			9	95			5	72
1946			12	78							1	97
1947											1	69
1948												
1949			11	150			3	127				
1950			2	75			3	104				
1951			2	71	12	127	8	104	8	89	8	198
1952	3	108	12	63	11	83	1	107	5	85	10	65
1953	3/5	76	6	62	5	80	11	63	3	73	2	63
1954	1	165	4	67	11	96	8	85	5	105	1	75
1955	4	180	3	67	12	171	9	92	2	86	10	84
1956	7	134	9	52	12	79	12	166	12	96	4	103
1957	1	86	1	124	8	62	12	75	3	87	7	86
1958	2	182	1	73	2	82	2	109	8	69	4	112
1959	1	106	1	70	5	87	3	131	1	60	10	80
1960	1	185	1	76	1	110	4	76	3	65	4	140
1961	1	156	1	55	12	65	5	104	11	85	3	75
1962	4	91	2	55	2	91	4	98	4	108	8	96
1963	2	90	2	75	1	85	1	82	11	97	2	99
1964	6	116	11	90	2	67	7	85	12	75	1	85
1965	3	70	4	100	11	75	1	114	5	106	1	118
1966			3	73	6	87	9	130	3	72		
1967					2	130	2	115				
1968	2	65			2	65			4	75		
1969					2	100	11	50	9	105	5	58
1970			2	87	11	146	4	103	4	68		
1971			5	87			10	99	10	100	12	94
1972	10	145	3	79	4	75			4	80	3	86
1973	11	150	11	144	2	89	1	90			10	61
1974	12	160			1/9	135					1	100
1975	1	80			12	82					1	62
1976	11	185			11	90					1	150
1977	6	105			6	85					4	76
1978	12	102	1	88			3	92	3	113	12	95
1979	4	125	1	114	4	65	1	245	1	173	1	128

RF.; Rainfall

Table B-5 (5) DAILY MAXIMUM RAINFALL

Unit :mm/day

Year	Cisalak Baru (37f)		Sampang Peundeuy (38a)		Pangarangan (43a)		Cilaki (43b)		Cipanas (44)	
	Month	RF	Month	RF	Month	RF	Month	RF	Month	RF
1942					9	81			11	85
1943					1	145			2	145
1944					11	76			10	110
1945									4	121
1946										
1947										
1948										
1949										
1950					11	95				
1951	7	120			4	110			8	128
1952	1	89			11	175	4	70	9	104
1953	12	65	2	100	5	136	3	116	3	147
1954	1	80	8	152	1	147	5	73	5	140
1955	-	-	11	110	7	107	1	70	11	135
1956	8	160	11	110	8	160	4	70	12	125
1957	3	97	1	86	-	-	5	67	10/11	105
1958	3	77	3	160	4	229	2	61	6	175
1959	1	70	5	129	11	92	5	64	5	185
1960	12	88	8	168	6	142	8	173	7	145
1961	5	92	3	95	4	120	2	165	3	141
1962	4	79	10	110	3	110	4	179	4	177
1963	2	120	1/9	110	3	77	12	70	11	91
1964	11	98	5	120	2	300	4	111	6	161
1965	10	80	3	100	12	86	1	128	6	145
1966	4	87	12	117	10	120	-	-	1	90
1967	2	73	2	93	1	100	5	99	4	147
1968	7	77	12	101	1	60	-	-	-	-
1969	6	86	4	90	5	100	9	63	-	-
1970	5	110	4	151	11	127	2	55	3	125
1971	10	117	10	110	3	125	-	-	-	-
1972	2	87	1	137	1	92	12	31	-	-
1973	11	169	11	160	11	121	9	114	-	-
1974	7	94	4	105	1/12	109	1	86	-	-
1975	1	81	7	137	3	122	2	114	4	120
1976	1	119	1	103	11	135	6	65	3	122
1977	11	75	2	137	6	150	3/5/12	65	5	128
1978	7	85	10	94	12	112	8	70	3	112
1979	8/9	75	2	67	11	128	11	53	11	114

RF.; Rainfall

Table B-6 COEFFICIENT OF THIESSEN POLYGON

Rainfall Station No.	Karian Dam	Cibeureum	Cisimeut	Upper Ciujung	Rangkas Bitung	Kragilan	Cilawang Dam	Gadeg Weir	Confluence of Cidurian	Cicinta Weir
5										
6										
7a										
10										
11b										
14a										
18				0.005	0.002	0.033				
21				0.010	0.004					
22				0.104	0.043					
23										
23c						0.089				
23f						0.007				
24						0.232				
26				0.102	0.042	0.081				
26b				0.253	0.105					
26c				0.126	0.052	0.094				
27				0.094	0.039					
31				0.001	0.001					
31c										
32a										
33						0.052			0.066	
35						0.259			0.003	
36a	0.020	0.018			0.004	0.043	0.081	0.193	0.520	0.968
37			0.043	0.018	0.022	0.050				
37f	0.077	0.177	0.073		0.068	0.060			0.018	
38a			0.251	0.157	0.153					
43a										
43b	0.254	0.226	0.633	0.130	0.328					
44	0.649	0.579			0.137		0.919	0.807	0.393	0.032
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table B-7 PROBABLE DAILY RAINFALL BY GUMBEL METHOD

Unit:mm/day

Rainfall Gauging Station		Return Period						
		1/200	1/100	1/50	1/25	1/20	1/10	1/5
No. 5	Menes	340	312	285	256	247	219	189
No. 6	Labuhan	452	411	370	328	314	271	227
No. 7a	Pasirwaringin	375	347	318	289	280	250	220
No. 10	Sangiang Damar	461	417	373	329	314	268	221
No. 11b	Rangkas	379	346	312	279	268	233	197
No. 14a	Bajanegara	233	212	192	172	165	145	123
No. 18	Ciomas	263	242	220	198	191	169	146
No. 21	Mandalawangi	515	463	411	359	342	288	232
No. 22	Cimanuk	421	379	337	295	282	238	194
No. 23	Serang	186	172	158	143	139	124	109
No. 23c	Kramatwetan	160	148	136	124	121	109	96
No. 23f	Ciruas	249	226	204	182	175	152	128
No. 24	Baros	186	170	155	139	134	118	101
No. 26	Pandeglang	217	200	183	165	160	142	124
No. 26b	Cileles	361	326	292	257	246	210	173
No. 26c	Warunggunung	222	205	187	170	165	147	128
No. 27	G. Kencang	230	214	198	182	177	160	143
No. 31	Malingping	259	238	216	195	188	166	144
No. 31c	Cipucangpare	296	271	246	221	213	187	159
No. 32a	Jeungjing	189	174	158	143	138	122	106
NO. 33	Parigi	204	187	171	154	148	131	113
No. 35	Pamarayan	254	232	210	188	180	158	134
No. 36a	Maja	192	177	162	147	142	127	111
No. 37	Rangkasbitung	219	201	182	164	158	139	119
No. 37f	Cisalak Balu	201	185	170	154	149	133	116
No. 38a	Sampang Peundeuy	228	212	195	179	173	157	139
No. 43a	Panggarangan	317	288	260	232	223	184	163
No. 43b	Cilaki	256	232	207	183	175	150	123
No. 44	Cipanas	240	224	208	192	187	170	153

Table B-8 PROBABLE DAILY RAINFALL

Unit : mm/day

River and Point		Return Period						
		1/200	1/100	1/50	1/25	1/20	1/10	1/5
Ciberang	Karian Dam	255	236	217	198	192	172	152
Ciberang	Confluence to Ciujung	250	231	212	194	188	168	148
Cisiment	Confluence to Ciberang	243	222	200	179	172	150	126
Upper Ciujung	Rangkasbitung	287	261	236	211	203	177	149
Ciujung	Rangkasbitung	260	237	215	193	186	163	139
Ciujung	Kragilan	214	196	179	161	155	137	118
Cibeureum	Cilawang	236	220	204	188	183	167	150
Cibeureum	Gadeg Weir	231	215	199	183	178	162	145
Cibeureum	Confluence to Cidurian	212	196	181	165	160	144	128
Cicinta	Cicinta Weir	194	179	159	148	143	128	112

Table B-9 (1) METEOROLOGIC DATA AT SERANG

MEAN TEMPERATURE

Unit: °C

Year	J	F	M	A	M	J	J	A	S	O	N	D
1971	-	-	-	-	-	-	26.2	26.5	26.1	-	-	26.6
1972	25.6	26.5	25.8	26.8	26.7	27.0	26.2	26.5	27.1	-	-	26.6
1973	-	-	-	-	-	-	-	-	-	-	-	-
1974	25.8	-	26.8	27.4	27.7	27.0	27.6	27.3	27.0	27.4	27.2	-
1975	27.4	27.0	27.0	26.9	26.7	26.4	25.9	26.3	26.6	26.4	26.8	26.3
1976	25.5	25.9	26.1	26.3	26.8	26.3	26.2	26.6	26.9	27.2	27.2	27.2
1977	26.5	26.6	26.5	27.1	27.3	26.4	26.6	26.4	26.7	27.8	27.6	26.7
1978	26.6	26.9	26.8	27.1	27.5	27.1	26.4	26.6	26.7	26.7	26.9	26.5
1979	26.4	26.6	26.8	27.0	27.2	26.5	26.2	26.4	26.9	27.3	27.1	26.4
1980	26.2	26.5	26.7	27.1	27.4	26.9	26.5	25.9	27.0	27.0	-	26.5
1981	25.9	26.2	26.7	26.9	27.0	26.7	26.3	26.6	26.8	-	26.7	26.7
1982	25.6	26.5	26.4	26.7	27.1	26.6	25.9	26.2	26.4	27.7	27.9	27.4
1983	26.8	28.4	27.5	27.8	27.5	27.5	26.6	26.8	27.3	27.5	26.7	26.6
Average	26.2	26.7	26.6	27.0	27.2	26.8	26.4	26.5	26.9	27.2	27.1	26.7

MEAN RELATIVE HUMIDITY AT SERANG

Unit : %

Year	J	F	M	A	M	J	J	A	S	O	N	D
1971	-	-	-	-	-	-	81	77	77	-	-	81
1972	86	82	86	81	83	77	81	77	77	-	-	81
1973	-	-	-	-	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	-	-	-	-	-	-	-
1975	-	-	-	-	83	80	80	80	80	81	79	81
1976	85	82	84	83	81	80	77	78	73	75	77	79
1977	84	82	84	83	81	83	77	76	76	72	77	81
1978	81	80	83	80	79	80	80	79	78	80	78	84
1979	85	85	84	83	80	81	82	79	78	78	81	84
1980	87	86	84	83	82	80	80	79	78	78	-	83
1981	83	83	83	83	83	81	82	79	79	78	80	81
1982	86	81	81	83	80	81	80	76	71	69	74	79
1983	83	83	81	81	81	78	77	74	-	77	80	79
Average	84	83	83	82	81	80	80	78	77	76	78	81

Table B-9 (2) METEOROLOGIC DATA AT SERANG

MEAN DURATION OF SUNSHINE

Unit: %/8hr/day

Year	J	F	M	A	M	J	J	A	S	O	N	D
1971	-	-	-	-	-	-	-	-	-	-	-	-
1972	-	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-	-	-	-
1974	-	-	58	62	55	67	69	67	63	55	48	-
1975	42	32	50	57	43	61	56	49	63	35	57	10
1976	30	41	30	49	67	69	75	67	64	59	51	48
1977	34	28	37	45	35	23	75	77	73	-	-	53
1978	38	-	60	63	47	41	40	57	-	-	-	-
1979	-	43	53	66	64	66	75	75	74	72	45	49
1980	33	50	64	63	75	76	74	72	65	57	-	33
1981	32	44	67	67	62	60	71	81	65	67	42	52
1982	23	55	60	63	69	70	76	89	92	89	75	50
1983	52	55	65	62	65	82	82	89	85	58	42	56
Avarege (%)	36	44	54	60	63	62	69	72	72	62	51	44
(Hours/day)	2.9	3.5	4.3	4.8	5.0	5.0	5.5	5.8	5.8	5.0	4.1	3.5

MEAN WIND VELOCITY

Unit: knots

Year	J	F	M	A	M	J	J	A	S	O	N	D
1971	-	-	-	-	-	-	5	5	5	-	-	6
1972	5	5	5	5	5	6	5	5	5	-	-	6
1973	-	-	-	-	-	-	-	-	-	-	-	-
1974	3	3	3	3	3	3	3	4	4	3	4	-
1975	4	-	4	3	4	4	4	4	4	5	5	5
1976	3	4	3	3	4	4	3	5	3	3	2	3
1977	2	3	2	3	3	2	3	3	3	3	3	3
1978	4	3	3	3	3	3	3	3	3	3	4	3
1979	4	6	5	3	3	3	2	2	3	3	3	3
1980	3	3	3	3	3	3	3	3	5	6	-	5
1981	6	6	6	6	6	5	6	6	6	-	6	6
1982	5	6	5	5	5	5	5	6	6	5	5	5
1983	5	5	5	5	5	5	4	5	-	5	5	4
Avarege (knots)	4.0	4.4	4.0	3.8	4.0	3.9	3.8	4.2	4.3	4.0	4.7	4.5
(m/s)	2.06	2.26	2.06	1.95	2.06	2.01	1.95	2.16	2.21	2.06	2.42	2.31

Table B-10 (1) METEOROLOGIC DATA AT CIKADU

MEAN TEMPERATURE

Unit : °C

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	-	-	-	-	-	-	24.7	25.1	24.5	25.1	25.4	24.8
1979	25.5	25.3	25.9	26.2	26.2	26.6	25.9	26.2	26.7	27.9	27.1	27.7
1980	27.3	28.6	28.7	29.7	29.9	30.0	29.5	29.4	29.9	30.1	29.8	-
1981	29.9	29.8	30.7	-	32.3	32.1	30.9	31.3	31.4	31.7	32.4	32.8
1982	31.2	31.7	31.9	32.9	34.1	34.2	-	33.5	33.7	34.1	27.9	27.8
1983	27.5	27.8	28.0	27.9	27.9	28.7	28.9	28.5	-	-	-	27.7
Average	28.3	28.6	29.0	29.2	30.1	30.3	28.0	29.0	29.2	29.8	28.5	28.1

MEAN RELATIVE HUMIDITY

Unit : %

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	-	-	-	-	-	-	84.3	82.1	82.5	-	-	-
1979	86.8	87.8	86.1	84.6	83.4	80.4	78.9	79.4	80.4	77.8	81.8	80.7
1980	84.1	81.6	79.6	80.8	78.1	77.8	76.6	77.1	82.9	82.8	85.6	-
1981	81.7	81.4	77.9	-	80.9	85.9	83.8	85.7	88.9	86.1	89.6	88.9
1982	96.4	91.2	91.2	89.9	86.1	82.1	-	77.9	79.9	79.8	80.7	81.5
1983	84.9	85.4	81.3	86.4	83.2	81.0	81.9	76.9	-	-	-	88.7
Average	86.8	85.5	83.2	87.9	82.3	81.4	81.1	79.9	82.9	81.6	84.4	85.1

Table B-10 (2) METEOROLOGIC DATA AT CIKADU

MEAN SUNSHINE

Unit: hours/day

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	-	-	-	-	-	-	4.4	4.0	5.0	5.2	5.0	2.6
1979	3.3	4.1	4.1	5.3	5.1	5.5	6.4	6.5	5.2	6.5	5.3	4.2
1980	2.4	4.1	5.4	4.5	6.5	7.0	6.5	6.5	5.3	5.5	4.5	3.3
1981	2.4	4.0	4.5	6.1	6.2	5.1	5.1	6.3	5.3	6.5	3.3	4.3
1982	2.2	4.5	4.7	5.1	6.5	6.0	-	6.3	-	7.3	5.8	4.5
1983	4.7	5.5	6.2	6.4	5.1	3.1	-	7.7	-	-	-	3.9
Average	3.0	4.4	5.0	5.5	5.9	5.3	5.9	6.2	5.2	7.3	4.8	3.8

MEAN WIND VELOCITY

Unit: km/day

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	-	67.9	61.8	57.5	58.8	67.8	78.0	89.6	102.0	77.4	88.8	75.1
1979	83.2	77.1	105.0	81.0	87.0	60.8	63.3	70.0	75.7	79.8	71.6	102.0
1980	80.4	68.7	80.7	37.9	36.5	32.3	40.6	50.2	44.2	56.5	70.0	77.4
1981	62.6	84.2	53.1	51.8	41.6	46.3	37.1	35.2	40.5	34.9	80.3	58.7
1982	32.7	51.1	28.3	22.7	10.6	13.1	-	13.7	35.9	40.9	38.8	45.3
1983	33.1	-	42.6	40.6	31.7	30.9	46.8	24.1	-	-	-	20.1
Avarage (km/day)	58.4	69.8	61.9	48.6	44.4	41.9	53.2	47.1	59.7	57.9	69.9	63.1
(m/s)	0,68	0,81	0,72	0,56	0,51	0,48	0,62	0,55	0,69	0,69	0,81	0,73

Table B-10 (3) METEOROLOGIC DATA AT CIKADU

MEAN PAN-EVAPORATION

Unit: mm/day

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	2.1	4.9	3.4	4.5	4.1	3.9	4.1	4.8	4.5	4.8	5.6	3.1
1979	3.3	3.2	3.8	4.3	4.9	4.8	4.8	5.1	4.8	5.9	5.0	4.7
1980	2.3	3.5	4.2	3.4	4.3	4.9	4.5	4.3	3.6	4.0	3.6	2.6
1981	2.8	3.1	3.8	4.1	4.7	5.1	4.6	4.6	4.0	4.3	2.8	4.3
1982	2.9	3.0	4.5	3.3	4.8	4.8	-	5.5	4.9	5.2	4.7	3.8
1983	3.4	3.9	4.0	3.4	3.6	4.8	5.2	5.0	-	-	-	4.5
Average	2.8	3.6	4.0	3.8	4.4	4.7	4.6	4.9	4.9	4.8	4.3	3.8

Table B-11 (1) DISCHARGE MEASUREMENT RECORD

Cibeureum River, Gadeg Station

No.	Date	Discharge m^3/Sec	Water Level m
1.	17/09/1980	5.52	0.60
2.	16/10/1980	8.65	0.80
3.	27/11/1980	7.48	0.72
4.	20/12/1980	4.34	0.42
5.	12/06/1981	5.05	0.60
6.	11/09/1981	10.61	1.11
7.	21/10/1981	1.55	0.28
8.	20/11/1981	3.24	0.40
9.	19/12/1981	0.91	0.00
10.	20/04/1982	5.86	0.65
11.	8/07/1982	0.94	0.01
12.	11/08/1982	2.52	0.22
13.	18/01/1983	9.96	1.03
14.	24/02/1983	2.99	0.19
15.	29/03/1983	13.66	1.22
16.	28/04/1983	3.19	0.26
17.	3/06/1983	1.61	0.09
18.	13/02/1984	4.65	0.50
19.	4/04/1984	4.52	0.34
20.	2/05/1984	15.45	1.42
21.	29/05/1984	1.65	0.04
22.	22/06/1984	1.06	0.04

Ciujung River, Rangkasbitung Station

No.	Date	Discharge m^3/Sec	Water Level m
1.	4/01/1981	110.88	1.84
2.	12/02/1981	66.29	1.43
3.	7/03/1981	93.00	1.72
4.	15/03/1981	64.89	1.37
5.	22/03/1981	103.84	1.90
6.	22/05/1981	114.76	1.97
7.	25/05/1981	56.45	1.37
8.	27/05/1981	47.31	1.28
9.	28/05/1981	41.38	1.12
10.	26/06/1981	56.91	1.40
11.	24/08/1981	94.03	1.84
12.	11/09/1981	122.10	2.27
13.	18/09/1981	55.00	1.34
14.	30/11/1981	68.75	1.40
15.	15/02/1982	34.59	1.36
16.	12/01/1983	145.39	2.63

Table B-11 (2) DISCHARGE MEASUREMENT RECORD

Ciujung River, Kragilan Station

No.	Date	Water Level m	Discharge m^3/Sec
1.	1/02/1981	1.82	88.22
2.	3/03/1981	1.66	95.44
3.	7/03/1981	1.91	116.00
4.	30/03/1981	1.64	77.22
5.	22/05/1981	2.34	146.92
6.	27/05/1981	0.90	32.58
7.	14/06/1981	1.37	84.20
8.	14/07/1981	0.68	19.43
9.	14/08/1981	0.53	18.57
10.	25/08/1981	2.45	174.09
11.	10/10/1981	2.71	231.10
12.	3/11/1981	2.31	159.58
13.	19/11/1981	3.01	246.02
14.	2/12/1981	2.35	161.29
15.	18/02/1981	1.56	87.32
16.	8/04/1982	1.58	102.17
17.	10/04/1982	0.86	34.86
18.	26/04/1982	2.11	158.35
19.	20/10/1982	0.60	28.37
20.	30/10/1982	0.18	6.17
21.	23/12/1982	0.73	28.07
22.	13/01/1983	1.26	62.42

Cidurian River, Kopomaja Station

No.	Date	Water Level m	Discharge m^3/Sec
1.	14/01/1981	2.20	31.18
2.	1/02/1981	1.81	19.44
3.	8/03/1981	2.18	27.68
4.	11/03/1981	1.82	19.70
5.	22/03/1981	1.85	21.48
6.	3/04/1981	2.67	43.64
7.	21/05/1981	2.37	33.21
8.	14/06/1981	2.19	29.89
9.	1/07/1981	1.26	6.24
10.	14/08/1981	1.26	6.96
11.	25/08/1981	2.66	44.23
12.	17/09/1981	1.98	22.59
13.	27/10/1981	2.10	25.24
14.	18/11/1981	2.09	25.12
15.	19/11/1981	1.71	19.23
16.	1/12/1981	1.23	6.61
17.	6/12/1981	1.09	4.37
18.	15/02/1982	3.01	60.22
19.	10/04/1982	1.60	16.28
20.	30/10/1982	0.91	2.47
21.	13/01/1983	1.52	11.83

Table B-11 (3) DISCHARGE MEASUREMENT RECORD

Ciujung River, Cileles Station.

No.	Date	Discharge m^3/S	Water Level m
1.	6/10/1978	2.20	0.58
2.	27/10/1978	18.13	1.08
3.	14/11/1978	6.96	0.84
4.	29/12/1978	36.29	-
5.	29/03/1979	14.06	-
6.	27/04/1979	13.59	-
7.	25/05/1979	3.48	-
8.	25/06/1979	1.73	0.30
9.	24/07/1979	2.26	0.32
10.	16/08/1979	1.18	0.24
11.	26/09/1979	3.62	0.43
12.	25/10/1979	3.29	0.40
13.	29/11/1979	9.06	0.60
14.	29/12/1979	8.15	0.54
15.	28/01/1980	9.66	0.86
16.	27/08/1980	2.72	0.33
17.	18/09/1980	18.26	-
18.	14/10/1980	12.25	0.63
19.	24/12/1980	60.43	1.89
20.	18/02/1981	22.32	0.89
21.	28/03/1981	14.20	0.74
22.	14/06/1981	8.91	0.56
23.	9/09/1981	16.21	0.78
24.	20/12/1981	8.80	0.57
25.	18/02/1982	9.93	0.61
26.	4/06/1982	2.18	0.33
27.	11/08/1982	0.78	0.19
28.	14/09/1982	0.00	0.09
29.	24/02/1983	6.97	0.48
30.	29/03/1983	4.12	0.36
31.	4/05/1984	31.40	1.23
32.	4/05/1984	28.80	1.19
33.	27/07/1984	3.76	0.36
34.	27/07/1984	3.85	0.37

Table B-11 (4) DISCHARGE MEASUREMENT RECORD

Ciberang River, Sajira Station

No.	Date	Discharge m^3/S	Water Level m
1.	24/07/1978	8.77	0.65
2.	3/10/1978	8.00	0.56
3.	24/10/1978	13.56	1.16
4.	22/11/1978	8.99	0.96
5.	5/12/1978	10.42	-
6.	9/01/1979	7.21	-
7.	16/02/1979	20.12	1.62
8.	26/03/1979	20.82	1.66
9.	24/04/1979	20.84	1.67
10.	22/05/1979	7.90	0.36
11.	21/06/1979	5.97	0.29
12.	25/07/1979	6.66	0.30
13.	14/08/1979	8.52	0.42
14.	25/09/1979	11.88	1.01
15.	20/10/1979	5.65	1.06
16.	26/11/1979	19.72	1.04
17.	26/12/1979	16.32	0.90
18.	26/08/1980	7.77	0.30
19.	17/09/1980	34.32	1.07
20.	16/10/1980	13.11	0.98
21.	1/12/1980	14.49	0.49
22.	20/12/1980	33.64	1.14
23.	19/02/1981	14.04	0.50
24.	30/03/1981	20.51	0.62
25.	9/05/1981	25.29	0.66
26.	21/10/1981	11.42	0.98
27.	20/11/1981	14.03	0.50
28.	23/01/1982	36.37	0.85
29.	17/02/1982	20.29	0.59
30.	12/03/1982	10.42	0.32
31.	8/07/1982	7.28	0.26
32.	11/08/1982	6.60	0.22
33.	14/09/1982	3.65	0.09
34.	5/06/1982	18.75	0.53
35.	27/10/1982	16.27	0.44
36.	18/01/1983	21.60	0.76
37.	27/04/1983	15.82	0.40
38.	4/06/1983	14.41	0.44
39.	4/06/1983	15.37	0.46
40.	1/07/1983	2.97	0.10
41.	26/07/1983	5.95	0.24
42.	26/07/1983	6.16	0.26
43.	26/07/1983	5.55	0.22
44.	25/08/1983	2.55	0.10
45.	28/09/1983	3.15	0.90
46.	28/09/1983	2.97	0.89
47.	28/09/1983	1.41	0.86
48.	13/02/1984	3.63	0.93
49.	4/04/1984	26.49	0.64

Cisimeut River, Leuwidamar Station

No.	Date	Discharge m^3/S	Water Level m
1.	23/07/1978	3.89	-
2.	4/10/1978	4.33	-
3.	25/11/1978	3.50	-
4.	28/12/1978	27.79	-
5.	25/02/1979	15.69	-
6.	24/03/1979	17.51	-
7.	26/04/1979	17.51	-
8.	23/05/1979	5.57	-
9.	25/06/1979	2.67	-
10.	26/07/1979	3.31	-
11.	22/08/1979	2.77	-
12.	25/09/1979	12.87	-
13.	23/10/1979	9.35	-
14.	27/11/1979	12.89	-
15.	5/01/1980	18.24	0.95
16.	26/08/1980	4.76	0.85
17.	18/09/1980	20.66	1.18
18.	15/10/1980	15.99	1.10
19.	1/01/1980	6.67	0.94
20.	21/12/1980	23.62	1.23
21.	16/01/1981	28.96	1.36
22.	19/02/1981	24.69	1.28
23.	11/09/1981	21.53	1.21
24.	20/11/1981	21.02	1.20
25.	19/12/1981	8.54	0.99
26.	23/01/1982	20.45	1.19
27.	17/02/1982	13.31	1.06
28.	12/03/1982	10.94	1.03
29.	21/04/1982	10.78	1.03
30.	4/06/1982	5.49	0.93
31.	8/07/1982	4.01	0.81
32.	11/08/1982	2.37	0.71
33.	14/09/1982	1.35	0.44
34.	26/10/1982	2.28	0.71
35.	19/01/1983	7.59	0.83
36.	24/02/1983	8.37	1.01
37.	28/04/1983	7.75	0.83
38.	4/04/1984	13.72	0.90
39.	29/05/1984	9.50	0.90
40.	22/06/1984	6.31	0.84
41.	26/07/1984	5.55	0.80
42.	26/07/1984	6.02	0.82

Table B-12 RECORDED MONTHLY MEAN DISCHARGE (1/2)

Unit: m^3/s

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Average	Annual Run-off ($10^6 m^3$)
(1)	Kragilan Station (Catchment Area = 1,812km2)													
1969	-	-	-	-	-	-	-	-	-	40.6	38.2	42.7	-	-
1970	78.1	204.3	132.4	164.7	193.6	133.8	40.0	18.4	40.9	48.1	115.7	225.5	116.3	3,667
1971	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1972	308.0	159.4	184.9	90.2	127.6	24.2	87.9	15.8	17.1	7.4	25.6	34.1	90.2	2,844
1973	196.6	146.8	165.7	183.9	71.1	111.8	43.8	61.1	123.0	124.0	135.4	136.2	133.3	4,203
1974	276.9	196.0	64.6	101.1	155.4	59.0	84.9	110.7	271.5	100.6	112.5	79.7	134.4	4,238
1975	73.5	169.3	150.4	134.0	120.8	32.4	56.3	48.0	145.5	74.6	91.9	191.9	107.4	3,386
1976	398.4	120.9	144.0	80.6	37.0	19.6	10.2	10.9	4.5	26.4	64.5	28.6	78.8	2,485
1977	186.1	146.0	198.3	150.4	125.2	78.7	15.0	5.0	5.1	5.0	11.0	38.4	80.4	2,535
1978	190.7	91.5	163.5	111.5	68.5	49.0	51.3	65.6	85.8	92.5	116.9	93.6	98.4	3,103
1979	236.7	160.6	45.2	129.4	62.1	30.2	28.5	14.5	21.1	21.2	95.4	-	(76.8)	(2,422)
1980	290.2	147.3	79.2	98.2	84.4	24.0	29.5	90.7	63.3	47.6	87.9	123.3	97.1	3,063
1981	275.5	166.6	149.6	103.6	119.1	-	120.5	60.1	87.1	93.5	175.0	131.5	(134.7)	(4,248)
1982	314.5	118.6	56.0	118.6	39.6	26.4	7.9	5.0	7.8	5.0	-	-	(69.9)	(2,205)
1983	-	55.6	64.4	64.2	52.3	25.0	15.3	4.5	1.3	-	-	102.5	-	-
1984	158.2	167.5	165.6	-	-	-	-	-	-	-	-	-	-	-
Average	229.5	146.5	126.0	117.7	104.4	51.2	45.5	41.6	67.2	52.8	89.2	102.3	97.8	3,084
(2)	Pamarayan weir station (catchment Area = 1.451 km^2)													
1975	90.1	75.4	67.8	162.6	148.8	88.7	122.8	178.8	370.0	120.6	157.0	489.5	172.7	5,446
1976	959.0	376.5	268.9	114.9	70.2	45.1	21.5	21.9	15.0	38.3	72.7	54.5	171.5	5,408
1977	157.3	110.1	164.6	191.6	129.7	83.7	31.9	14.4	15.2	13.0	34.8	29.5	80.5	2,539
1978	158.1	83.3	151.4	97.6	77.0	51.7	41.9	76.3	81.0	29.2	-	72.4	83.6	2,636
1979	124.9	-	102.7	151.2	21.9	28.0	41.9	18.8	37.7	30.9	-	53.6	61.1	1,927
1980	287.1	196.4	58.5	76.3	121.5	100.2	78.8	95.0	93.5	77.0	61.7	148.5	116.2	3,665
1981	162.4	178.9	136.7	116.0	140.8	139.0	161.8	101.5	98.5	99.9	123.7	104.7	130.4	4,051
1982	277.4	112.0	59.2	122.3	67.6	49.8	24.6	10.5	-	-	80.0	62.5	86.6	2,693
1983	94.8	57.9	54.2	47.6	74.3	26.8	14.3	12.8	15.5	-	-	-	-	-
Average	256.8	148.8	118.2	120.0	94.6	68.2	539.5	58.9	90.8	58.4	86.7	126.9	112.8	-
(3)	Rangkasbitung Station (Catchment Area = 1.383 km^2)													
1969	-	-	-	-	-	-	-	-	-	-	52.8	63.4	-	-
1970	73.6	201.1	211.1	223.2	143.9	132.2	90.2	30.5	(72.0)	51.7	113.5	208.5	129.3	4,078
1971	177.7	263.9	166.1	91.2	-	-	-	-	-	-	120.7	90.2	-	-
1972	260.0	141.3	187.0	80.8	103.5	24.2	13.5	23.7	6.7	9.3	34.1	63.2	78.9	2,488
1973	166.4	110.8	139.0	172.8	188.8	105.9	48.5	63.6	124.8	109.0	101.0	130.9	121.9	3,844
1974	169.5	143.3	149.7	115.4	127.5	58.2	65.6	91.0	184.1	96.1	80.0	88.2	115.7	3,649
1975	102.8	162.3	105.8	55.4	70.7	42.4	62.0	90.8	135.3	74.8	129.5	198.8	102.6	3,236
1976	281.0	99.6	129.9	94.9	61.9	37.7	23.4	24.3	15.0	43.9	76.0	50.4	78.2	2,466
1977	(158.4)	110.9	155.7	144.4	(133.8)	73.9	29.8	21.8	15.5	(24.6)	27.4	46.5	(78.6)	2,479
1978	182.9	89.4	134.9	85.8	(70.0)	(69.1)	61.1	83.5	71.9	78.8	94.6	91.4	(92.8)	2,927
1979	132.5	150.7	123.6	164.5	63.6	40.4	44.6	26.4	32.7	33.1	96.7	81.0	82.5	2,602
1980	183.2	127.8	66.2	100.2	89.7	46.9	51.2	88.1	89.3	69.7	96.0	124.9	94.4	2,977
1981	191.1	127.3	142.5	106.7	123.2	149.7	127.8	90.1	108.2	103.3	(143.2)	(124.0)	(128.1)	4,033
1982	237.0	87.7	45.2	84.6	59.8	25.8	21.3	8.9	6.0	15.7	84.8	103.4	65.0	2,047
1983	128.8	99.4	90.4	80.3	106.3	60.6	43.3	32.5	33.5	64.0	147.6	(128.8)	84.6	2,668
1984	162.4	167.2	-	-	-	-	-	-	-	-	-	-	-	-
Average	175.2	138.8	142.1	114.3	103.3	74.4	52.5	51.9	68.8	59.5	93.2	99.3	96.4	3,038

Table B-12 RECORDED MONTHLY MEAN DISCHARGE (2/2)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Average	Annual Run-off ($10^6 m^3$)
(4) Kopomaja Station (Catchment Area = 304 km^2)														
1969	-	-	-	-	-	-	-	-	-	-	21.5	12.4	-	-
1970	22.7	36.4	22.5	20.8	39.6	19.2	7.5	7.2	18.3	7.5	28.8	14.3	20.4	643
1971	21.3	49.2	24.5	28.7	16.5	18.3	13.4	14.2	6.3	26.7	14.0	19.3	21.0	662
1972	61.9	31.5	48.5	27.3	32.6	9.7	2.3	7.7	1.6	4.7	12.4	25.9	22.2	700
1973	27.8	47.6	30.9	51.2	32.9	23.6	15.4	17.6	42.7	27.3	18.8	23.4	29.9	943
1974	49.2	32.3	23.3	29.4	35.3	17.0	15.5	22.9	55.7	24.9	20.4	11.3	28.1	886
1975	24.9	32.8	20.3	32.7	37.9	15.7	14.9	25.5	32.7	21.4	22.3	14.8	24.7	779
1976	83.1	29.0	28.8	25.2	19.1	10.6	4.3	8.6	6.1	19.7	22.4	11.9	22.4	706
1977	51.0	34.0	33.4	45.5	42.8	22.2	11.9	4.4	7.6	7.6	15.0	25.4	25.1	792
1978	37.4	18.2	32.9	20.4	12.5	13.1	12.9	14.5	26.2	21.6	18.2	20.2	20.7	653
1979	35.8	24.4	26.8	32.3	15.3	15.4	17.4	14.5	11.4	18.0	47.6	17.8	23.1	728
1980	47.2	31.0	19.0	24.1	33.8	-	-	16.5	28.1	19.1	27.4	22.9	-	-
1981	41.1	20.7	33.3	36.2	-	-	-	-	-	-	19.2	36.8	-	-
1982	48.9	-	-	-	22.8	10.0	5.5	2.4	1.7	5.4	-	-	-	-
1983	-	20.7	20.7	19.4	20.7	8.3	6.9	3.6	6.2	15.1	23.1	11.6	(14.2)	-
1984	24.5	23.0	22.8	27.7	-	-	-	-	-	-	-	-	-	-
Average	41.2	30.8	27.7	30.1	27.8	15.3	10.7	12.3	18.8	16.8	22.2	19.1	22.7	716
(5) Cileles Station (Catchment Area = 216 km^2)														
1978	-	-	-	-	5.8	4.9	4.0	-	4.0	8.6	9.2	13.1	-	-
1979	-	-	-	-	7.1	5.3	5.5	1.9	4.0	3.6	15.1	11.3	-	-
1980	33.6	-	-	-	-	-	-	-	-	-	-	19.7	-	-
1981	31.4	22.5	15.1	10.4	7.5	-	-	-	8.5	13.4	-	-	-	-
1982	13.1	14.4	9.0	9.1	4.8	2.9	2.4	1.0	-	0.4	6.3	6.8	(6.4)	-
1983	10.5	8.6	1.1	6.0	9.8	3.9	2.3	0.2	0.8	3.8	20.7	13.4	6.8	214
1984	18.0	16.1	25.2	20.6	19.0	-	-	-	-	-	-	-	-	-
Average	21.3	15.4	12.6	11.5	9.0	4.3	3.6	1.0	4.3	6.0	12.8	12.1	9.6	300
(6) Leuwidamar Station (Catchment Area = 183 km^2)														
1980	19.7	14.2	6.3	20.7	17.3	4.8	9.6	13.1	-	19.2	11.1	23.3	(14.5)	-
1981	36.5	25.4	24.0	-	-	30.4	-	22.5	29.9	38.1	41.7	28.3	-	-
1982	32.1	21.4	9.3	11.2	6.7	13.2	2.5	1.8	2.1	2.7	11.9	21.9	11.4	360
1983	13.1	6.1	7.4	7.4	4.7	2.9	2.5	1.5	1.1	5.3	17.6	9.6	6.6	208
1984	8.6	13.8	17.4	15.1	16.7	-	-	-	-	-	-	-	-	-
Average	22.0	16.2	12.9	13.6	11.4	12.8	4.9	9.7	11.4	16.3	20.6	20.8	14.4	454

Remark: The figures in parenthesis contain some missing data.

Table B-13 CORRELATIVE COEFFICIENTS OF MONTHLY MEAN DISCHARGE

	Gadeg	Kopomaja	Leuwidamar	Cileles	Rangkasbitung	Pamarayan
Kiragilan	0.719 (7)	0.808 (144)	0.695 (41)	0.856 (44)	0.894 (144)	0.753 (95)
Pamarayan	0.386 (7)	0.716 (86)	0.625 (39)	0.805 (41)	0.742 (93)	
Rangkasbitung	0.803 (10)	0.765 (143)	0.697 (43)	0.804 (46)		
Cileles	0.622 (13)	0.701 (42)	0.648 (35)			
Leuwidamar	0.192 (13)	0.704 (36)				
Kopomaja	0.879 (9)					

Remark: The figures in parenthesis show the number of data used for calculation.

Table B-14 MEAN DAILY DISCHARGE OF 10-DAY PERIOD AT RANGKASBITUNG (1/2)

Unit : m^3/s

Year	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min
1969	Early	-	-	-	-	-	-	-	-	-	-	61.05	41.76	
	Middle	-	-	-	-	-	-	-	-	-	-	42.86	61.13	-
	Late	-	-	-	-	-	-	-	-	-	-	54.48	85.18	
1970	Early	83.24	280.18	145.76	129.67	112.52	126.4	80.22	29.25	-	48.81	50.16	82.03	
	Middle	38.06	175.15	307.23	199.7	214.89	141.56	71.98	30.04	60.1	49.13	116.84	244.10	-
	Late	97.05	134.68	182.93	340.31	107.82	128.53	115.90	32.15	83.94	56.64	173.55	291.15	
1971	Early	108.65	322.90	157.09	89.11	74.76	-	-	-	-	-	163.41	86.62	
	Middle	241.23	276.29	255.32	104.77	-	-	-	-	-	68.58	140.51	91.69	-
	Late	182.82	174.86	93.30	79.95	-	-	-	95.24	80.78	217.93	58.24	92.09	
1972	Early	369.45	182.84	233.65	65.89	116.44	28.30	18.51	16.36	6.76	3.11	32.15	61.69	
	Middle	212.90	112.20	196.42	49.85	87.55	24.35	11.48	17.60	7.59	7.86	39.23	45.15	3.11
	Late	202.58	127.60	135.41	126.55	106.20	19.75	10.76	34.37	5.83	16.24	30.87	80.85	
1973	Early	186.20	113.06	95.27	159.10	218.90	180.86	54.62	54.76	114.66	91.84	96.09	115.38	
	Middle	155.12	97.8	176.94	168.60	248.28	83.66	49.52	83.96	84.36	70.02	42.90	101.25	42.05
	Late	158.57	124.29	144.13	190.60	107.44	53.32	42.05	53.05	175.30	160.05	163.88	172.02	
1974	Early	342.70	151.23	238.91	95.05	138.26	57.40	66.41	80.09	173.10	129.90	41.49	149.62	
	Middle	190.14	132.04	97.16	180.00	172.20	45.39	87.85	95.39	234.20	92.89	123.92	66.26	41.49
	Late	49.74	147.33	116.45	71.02	76.99	71.78	44.77	96.80	145.00	68.18	74.69	52.26	
1975	Early	102.24	93.12	113.23	61.84	42.21	54.60	35.29	132.06	126.04	60.17	190.91	164.94	
	Middle	88.58	265.4	77.18	70.17	57.50	47.96	66.50	56.34	154.90	63.07	118.60	317.70	24.54
	Late	116.01	119.78	125.20	34.09	108.52	24.54	82.27	84.63	124.90	98.75	79.04	121.57	
1976	Early	183.22	137.35	196.40	62.59	108.75	61.34	35.33	22.96	16.84	55.44	37.67	36.83	
	Middle	337.90	57.38	99.57	94.04	49.51	34.13	14.56	17.25	10.16	58.04	129.97	69.84	10.16
	Late	318.18	104.43	97.05	128.00	30.56	17.57	20.56	32.00	17.96	20.63	60.46	44.99	

Remark: ( ) covered the deficit from Kragiran

Table B-14 MEAN DAILY DISCHARGE OF 10-DAY PERIOD AT RANGKASBITUNG (2/2)

Unit: m^3/s

Year	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min
1977	Early	88.03	92.80	237.8	172.95	(181.75)	89.09	44.52	14.93	9.99	21.30	36.69	34.78	
	Middle	105.26	120.81	80.78	132.85	158.63	60.18	19.55	14.70	21.72	(23.59)	21.22	42.34	9.99
	Late	(270.62)	121.15	149.07	127.45	67.55	72.43	25.81	34.59	14.79	(28.49)	24.28	61.00	
1978	Early	71.93	117.13	141.23	97.05	(113.91)	(52.50)	58.18	82.43	70.05	60.91	130.29	73.24	
	Middle	142.41	50.90	141.61	43.93	(59.54)	63.89	55.00	93.07	52.36	66.38	115.40	64.93	38.05
	Late	320.45	102.75	122.91	116.51	(39.67)	91.04	69.17	75.81	93.39	106.31	38.05	131.85	
1979	Early	83.43	161.60	135.29	201.80	93.89	67.56	31.84	21.93	23.50	42.17	84.04	72.64	
	Middle	173.54	110.97	120.69	137.50	34.48	35.91	80.44	35.85	34.64	20.82	134.79	60.64	17.84
	Late	139.75	186.84	115.71	154.30	62.50	17.84	23.59	22.01	39.81	36.12	71.24	107.01	
1980	Early	123.63	138.92	77.17	110.32	111.57	66.50	37.72	80.58	86.1	52.14	85.40	75.75	
	Middle	229.10	154.27	72.01	98.95	80.16	38.44	58.74	154.94	104.64	87.41	109.98	92.77	34.12
	Late	195.55	86.19	50.85	91.23	78.55	35.65	56.19	34.12	77.28	69.59	92.48	198.73	
1981	Early	148.32	145.20	107.06	90.74	111.67	139.70	55.18	84.75	131.73	96.21	71.74	(92.21)	
	Middle	247.90	113.21	175.16	116.38	174.32	212.20	124.34	75.75	106.04	61.29	(266.21)	(77.19)	55.18
	Late	178.36	122.71	145.00	113.06	87.27	97.16	197.02	108.07	86.92	147.96	(91.75)	(195.59)	
1982	Early	219.22	92.20	68.52	60.54	80.4	24.14	13.37	12.93	4.07	5.69	118.59	41.05	
	Middle	307.11	96.58	40.89	111.92	59.71	36.70	8.86	7.71	7.65	16.60	69.36	122.67	4.07
	Late	189.51	71.00	28.05	81.23	41.00	16.42	39.82	6.18	6.30	24.08	66.42	142.60	
1983	Early	134.20	87.21	100.36	105.24	91.02	74.44	39.17	37.12	26.60	39.47	127.03	(160.56)	
	Middle	165.80	114.61	78.95	65.54	103.30	75.96	33.81	40.62	32.94	60.98	97.51	(107.41)	20.86
	Late	90.14	95.70	91.88	70.08	123.01	31.46	55.55	20.86	41.03	89.04	218.13	(119.44)	
1984	Early	230.90	161.22											
	Middle	133.20	165.47											
	Late	126.55	175.78											

Remark: ( ) covered the deficit from Kragiran

Table B-15 ESTIMATED MEAN DAILY DISCHARGE OF 10-DAY PERIOD AT KARIAN DAM SITE (1/5)

Year	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min
1972	Early	110.28	54.40	69.75	19.67	34.76	8.45	5.53	4.88	2.02	0.93	9.60	18.42	
	Middle	63.55	33.49	58.63	14.88	26.13	7.27	3.43	5.25	2.27	2.35	11.71	13.48	0.93
	Late	60.47	38.09	40.42	37.78	31.70	5.90	3.21	10.26	1.74	4.85	9.22	24.13	
1973	Early	55.58	33.75	28.44	47.49	65.34	53.99	16.30	16.35	34.23	27.42	28.68	34.44	
	Middle	46.30	29.19	52.82	50.39	74.11	24.97	14.78	25.06	25.18	20.90	12.81	30.22	12.55
	Late	47.33	37.10	43.02	56.90	32.07	15.92	12.55	15.84	52.33	47.78	48.92	51.35	
1974	Early	102.30	45.14	71.31	28.37	41.27	17.13	19.82	23.91	51.67	38.78	12.39	44.66	
	Middle	56.76	39.42	29.00	53.73	51.40	13.55	26,22	28.47	69.91	27.73	36,99	19.78	12.39
	Late	14.85	43.98	34.76	21.20	22.98	21.43	13.36	28.90	43.28	20.35	22.30	15.60	
1975	Early	30.52	27.80	33.80	18.46	12.60	16.30	10.53	39.42	37.62	17.96	56.99	49.24	
	Middle	26.44	79.22	23.04	20.95	17.16	14.32	19.85	16.82	46.24	18.83	35.40	94.84	7.33
	Late	34.63	35.76	37.37	10.18	32.39	7.33	24.56	25.26	37.28	29.48	23.59	36.29	
1976	Early	54.69	41.00	58.63	18.68	32.46	18.31	10.55	6.85	5.03	16.55	11.24	10.99	
	Middle	100.87	17.13	29.72	28.07	14.78	10.19	4.35	5.15	3.03	17.33	38.80	20.85	3.03
	Late	94.98	31.17	28.97	38.21	9.12	5.24	6.14	9.55	5.36	6.16	18.05	13.43	
1977	Early	26.28	27.70	70.99	51.63	54.25	26.59	13.29	4.46	2.98	6.36	10.95	10.38	
	Middle	31.42	36.06	24.11	39.66	47.35	17.96	5.84	4.39	6.48	7.04	6.33	12.64	2.98
	Late	(80.78)	36.16	44.50	38.05	20.16	21.62	7.70	10.33	4.42	8.50	7.25	18.21	
1978	Early	21.47	34.96	42.16	28.97	34.00	15.67	17.37	24.61	20.91	18.18	38.89	21.86	
	Middle	42.51	15.19	42.27	13.11	17.77	19.07	16.42	27.78	15.63	19.82	34.45	19.38	11.36
	Late	95.66	30.67	36.69	34.78	11.84	27.18	20.65	22.63	27.88	31.73	11.36	39.36	
1979	Early	24.90	48.24	40.39	60.24	28.03	20.17	9.50	6.55	7.01	12.59	25.09	21.68	
	Middle	51.80	33.13	36.03	41.05	10.29	10.72	24.01	10.70	10.34	6.21	40.24	18.10	5.33
	Late	41.72	55.77	34.54	46.06	18.66	5.33	7.04	6.57	11.88	10.78	21.27	31.94	
1980	Early	36.90	41.47	23.04	32.93	33.30	19.85	11.26	24.05	25.70	15.56	25.49	22.61	
	Middle	68.39	46.05	21.50	29.54	23.93	11.47	17.53	46.25	31.24	26.09	32.83	27.69	10.19
	Late	58.37	25.73	15.18	27.23	23.45	10.64	16.77	10.19	23.07	20.77	27.61	59.32	
1981	Early	44.28	43.34	31.96	27.09	33.33	41.70	16.47	25.30	39.32	28.72	21.42	27.53	
	Middle	74.00	33.79	52.29	34.74	52.04	63.34	37.12	22.61	31.65	18.30	79.47	23.04	16.47
	Late	53.24	36.63	43.28	33.75	26.05	29.00	58.81	32.26	25.95	44.17	27.39	58.39	
1982	Early	65.44	27.52	20.45	18.07	24.00	7.21	3.99	3.86	1.21	1.70	35.40	12.25	
	Middle	91.68	28.83	12.21	33.41	17.82	10.96	2.64	2.30	2.28	4.96	20.70	36.62	1.21
	Late	56.57	21.19	8.37	24.25	12.24	4.90	11.89	1.84	1.88	7.19	19.83	42.57	
1983	Early	40.06	26.03	29.96	31.42	27.17	22.22	11.69	11.08	7.94	11.78	37.92	47.93	
	Middle	49.49	34.21	23.57	19.56	30.84	22.67	10.09	12.13	9.83	18.20	29.11	32.06	6.23
	Late	26.91	28.57	27.43	20.92	36.72	9.39	16.58	6.23	12.25	26.58	65.11	35.65	
1984	Early	68.93	48.13											
	Middle	39.76	49.39											
	Late	37.78	52.47											

Table B-15 ESTIMATED MEAN DAILY DISCHARGE OF 10-DAY PERIOD AT PAMARAYAN WEIR (2/5)

Year	Priod	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min
1972	Early	378.78	186.84	239.55	67.55	119.38	29.01	18.98	16.77	6.93	3.19	32.96	63.25	
	Middle	218.28	115.03	201.38	51.11	89.76	24.97	11.77	18.04	7.78	8.06	40.22	46.29	3.19
	Late	207.70	130.82	138.83	129.75	108.88	20.25	11.03	35.24	5.98	16.65	31.65	82.89	
1973	Early	190.90	115.92	97.68	163.12	224.43	185.43	56.00	56.14	117.56	94.16	98.52	118.29	
	Middle	159.04	100.27	181.41	173.06	254.55	85.77	50.77	86.08	86.49	71.79	43.98	103.81	43.11
	Late	162.58	127.43	147.77	195.41	110.15	54.67	43.11	54.39	179.73	164.09	168.02	176.37	
1974	Early	351.36	155.05	244.94	97.45	141.75	58.85	68.09	82.11	177.47	133.18	42.54	153.40	
	Middle	194.94	135.38	99.61	184.55	176.55	46.54	90.07	97.80	240.12	95.24	127.05	67.93	42.54
	Late	51.00	151.05	119.39	72.81	78.93	73.59	45.90	99.25	148.66	69.90	76.58	53.58	
1975	Early	104.82	95.47	116.09	63.40	43.28	55.98	36.18	135.40	129.22	61.69	195.73	169.11	
	Middle	90.82	272.10	79.13	71.94	58.95	49.17	68.18	57.76	158.81	64.66	121.60	325.73	25.16
	Late	118.94	122.81	128.36	34.95	111.26	25.16	84.35	86.77	128.05	101.24	81.04	124.64	
1976	Early	187.85	140.82	201.36	64.17	111.50	62.90	36.22	23.54	17.27	56.84	38.62	37.76	
	Middle	346.44	58.83	102.09	96.42	50.76	34.99	14.93	17.69	10.42	59.51	133.25	71.60	10.42
	Late	326.22	107.07	99.50	131.23	31.33	18.01	21.08	32.81	18.41	21.15	61.99	46.13	
1977	Early	90.25	95.14	243.81	177.32	186.34	91.34	45.64	15.31	10.24	21.84	37.62	35.66	
	Middle	107.92	123.86	82.82	136.21	162.64	61.70	20.04	15.07	22.27	24.19	21.76	43.41	10.24
	Late	277.46	124.21	152.84	130.67	69.26	74.26	26.46	35.46	15.16	29.21	24.89	62.54	
1978	Early	73.75	120.09	144.80	99.50	116.79	53.83	59.65	84.51	71.82	62.45	133.58	75.09	
	Middle	146.01	52.19	145.19	45.04	61.04	65.50	56.39	95.42	53.68	68.06	118.32	66.57	39.01
	Late	328.54	105.35	126.01	119.45	40.67	93.34	70.92	77.72	95.75	109.00	39.01	135.18	
1979	Early	85.54	165.68	138.71	206.90	96.26	69.27	32.64	22.48	24.09	43.24	86.16	74.47	
	Middle	177.92	113.77	123.74	140.97	35.35	36.82	82.47	36.76	35.52	21.35	138.19	62.17	18.29
	Late	143.28	191.56	118.63	158.20	64.08	18.29	24.19	22.57	40.82	37.03	73.04	109.71	
1980	Early	126.75	142.43	79.12	113.11	114.39	68.18	38.67	82.62	88.27	53.46	87.56	77.66	
	Middle	234.89	158.17	73.83	101.45	82.18	39.41	60.22	158.85	107.28	89.62	112.76	95.11	34.98
	Late	200.49	88.37	52.13	93.53	80.53	36.55	57.61	34.98	79.23	71.35	94.82	203.75	
1981	Early	152.07	148.87	109.76	93.03	114.49	143.23	56.57	86.89	135.06	98.64	73.55	94.54	
	Middle	254.16	116.07	179.58	119.32	178.72	217.56	127.48	77.66	108.72	62.84	272.93	79.14	56.57
	Late	182.87	125.81	148.66	115.92	89.47	99.61	202.00	110.80	89.12	151.70	94.07	200.53	
1982	Early	224.76	94.53	70.25	62.07	82.43	24.75	13.71	13.26	4.17	5.83	121.59	42.09	
	Middle	314.87	99.02	41.92	114.75	61.22	37.63	9.08	7.90	7.84	17.02	71.11	125.77	4.17
	Late	194.30	72.79	28.76	83.28	42.04	16.83	40.83	6.34	6.46	24.69	68.10	146.20	
1983	Early	137.59	89.41	102.90	107.90	93.32	76.32	40.16	38.06	27.27	40.47	130.24	164.62	
	Middle	169.99	117.51	80.94	67.20	105.91	77.88	34.66	41.65	33.77	62.52	99.97	110.12	21.39
	Late	92.42	98.12	94.20	71.85	126.12	32.25	56.95	21.39	42.07	91.29	223.64	122.46	
1984	Early	236.73	165.29											
	Middle	136.56	169.65											
	Late	129.75	180.22											

Table B-15 ESTIMATED MEAN DAILY DISCHARGE OF 10-DAY PERIOD AT CILAWANG DAM SITE (3/5)

Year	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min
1972	Early	29.59	14.60	18.72	5.28	9.33	2.27	1.48	1.31	0.54	0.25	2.58	4.94	
	Middle	17.05	8.99	15.73	3.99	7.01	1.95	0.92	1.41	0.61	0.63	3.14	3.62	0.25
	Late	16.23	10.22	10.85	10.14	8.51	1.58	0.86	2.75	0.47	1.30	2.47	6.48	
1973	Early	14.91	9.06	7.63	12.74	17.53	14.49	4.38	4.39	9.18	7.36	7.70	9.24	
	Middle	12.43	7.83	14.17	13.52	19.89	6.70	3.97	6.73	6.76	5.61	3.44	8.11	3.37
	Late	12.70	9.96	11.54	15.27	8.61	4.27	3.37	4.25	14.04	12.82	13.13	13.78	
1974	Early	27.45	12.11	19.14	7.61	11.07	4.60	5.32	6.42	13.82	10.40	3.32	11.98	
	Middle	15.23	10.58	7.78	14.42	13.79	3.64	7.04	7.64	18.76	7.44	9.93	5.31	3.32
	Late	3.98	11.80	9.33	5.69	6.17	5.75	3.59	7.75	11.61	5.46	5.98	4.19	
1975	Early	8.19	7.46	9.07	4.95	3.38	4.37	2.83	10.58	10.10	4.82	15.29	13.21	
	Middle	7.10	21.26	6.18	5.62	4.61	3.84	5.33	4.51	12.41	5.05	9.50	25.45	1.97
	Late	9.29	9.59	10.03	2.73	8.69	1.97	6.59	6.78	10.00	7.91	6.33	9.74	
1976	Early	14.68	11.00	15.73	5.01	8.71	4.91	2.83	1.84	1.35	4.44	3.02	2.95	
	Middle	27.07	4.60	7.98	7.53	3.97	2.73	1.17	1.38	0.81	4.65	10.41	5.59	0.81
	Late	25.49	8.36	7.77	10.25	2.45	1.41	1.65	2.56	1.44	1.65	4.84	3.60	
1977	Early	7.05	7.43	19.05	13.85	14.56	7.14	3.57	1.20	0.80	1.71	2.94	2.79	
	Middle	8.43	9.68	6.47	10.64	12.71	4.82	1.57	1.18	1.74	1.89	1.70	3.39	0.80
	Late	21.68	9.70	11.94	10.21	5.41	5.80	2.07	2.77	1.18	2.28	1.94	4.89	
1978	Early	5.76	9.38	11.31	7.77	9.12	4.21	4.66	6.60	5.61	4.88	10.44	5.87	
	Middle	11.41	4.08	11.34	3.52	4.77	5.12	4.41	7.45	4.19	5.32	9.24	5.20	3.05
	Late	25.67	8.23	9.85	9.33	3.18	7.29	5.54	6.07	7.48	8.52	3.05	10.56	
1979	Early	6.68	12.94	10.84	16.16	7.52	5.41	2.55	1.76	1.88	3.38	6.73	5.82	
	Middle	13.90	8.89	9.67	11.01	2.76	2.88	6.44	2.87	2.77	1.67	10.80	4.86	1.43
	Late	11.19	14.97	9.27	12.36	5.01	1.43	1.89	1.76	3.19	2.89	5.71	8.57	
1980	Early	9.90	11.13	6.18	8.84	8.94	5.33	3.02	6.45	6.90	4.18	6.84	6.07	
	Middle	18.35	12.36	5.77	7.93	6.42	3.08	4.71	12.41	8.38	7.00	8.81	7.43	2.73
	Late	15.66	6.90	4.07	7.31	6.29	2.86	4.50	2.73	6.19	5.57	7.41	15.92	
1981	Early	11.88	11.63	8.58	7.27	8.94	11.19	4.42	6.79	10.55	7.71	5.75	7.39	
	Middle	19.86	9.07	14.03	9.32	13.96	17.00	9.96	6.07	8.49	4.91	21.32	6.18	4.42
	Late	14.29	9.83	11.61	9.06	6.99	7.78	15.78	8.66	6.96	11.85	7.35	15.67	
1982	Early	17.56	7.39	5.49	4.85	6.44	1.93	1.07	1.04	0.33	0.46	9.50	3.29	
	Middle	24.60	7.74	3.28	8.96	4.78	2.94	0.71	0.62	0.61	1.33	5.56	9.83	0.33
	Late	15.18	5.69	2.25	6.51	3.28	1.32	3.19	0.50	0.50	1.93	5.32	11.42	
1983	Early	10.75	6.99	8.04	8.43	7.29	5.96	3.14	2.97	2.13	3.16	10.18	12.86	
	Middle	13.28	9.18	6.32	5.25	8.27	6.08	2.71	3.25	2.64	4.88	7.81	8.60	1.67
	Late	7.22	7.67	7.36	5.61	9.85	2.52	4.45	1.67	3.29	7.13	17.47	9.57	
1984	Early	18.50	12.91											
	Middle	10.67	13.25											
	Late	10.14	14.08											

Table B-15 ESTIMATED MEAN DAILY DISCHARGE OF 10-DAY PERIOD AT GADEG WEIR (4/5)

Year	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min
1972	Early	35.56	17.60	22.49	6.34	11.21	2.72	1.78	1.57	0.65	0.30	3.09	5.94	
	Middle	20.49	10.80	18.91	4.80	8.43	2.34	1.10	1.69	0.73	0.76	3.78	4.35	0.30
	Late	19.50	12.28	13.03	12.18	10.22	1.90	1.04	3.31	0.56	1.56	2.97	7.78	
1973	Early	17.92	10.88	9.17	15.31	21.07	17.41	5.26	5.27	11.04	8.84	9.25	11.11	
	Middle	14.93	9.41	17.03	16.25	23.90	8.05	4.77	8.08	8.12	6.74	4.13	9.75	4.05
	Late	15.26	11.96	13.87	18.35	10.34	5.13	4.05	5.11	16.87	15.40	15.77	16.56	
1974	Early	32.98	14.56	22.99	9.15	13.31	5.52	6.39	7.71	16.66	12.50	3.99	14.40	
	Middle	18.30	12.71	9.35	17.33	16.57	4.37	8.46	9.18	22.54	8.94	11.93	6.38	3.99
	Late	4.79	14.18	11.21	6.84	7.41	6.91	4.31	9.32	13.96	6.56	7.19	5.03	
1975	Early	9.84	8.96	10.90	5.95	4.06	5.26	3.40	12.71	12.13	5.79	18.38	15.88	
	Middle	8.53	25.54	7.43	6.75	5.53	4.62	6.40	5.42	14.91	6.07	11.42	30.58	2.36
	Late	11.17	11.53	12.05	3.28	10.45	2.36	7.92	8.15	12.02	9.50	7.61	11.70	
1976	Early	17.63	13.22	18.90	6.02	10.47	5.90	3.40	2.21	1.62	5.34	3.63	3.54	
	Middle	32.52	5.52	9.58	9.05	4.77	3.29	1.40	1.66	0.98	5.59	12.51	6.72	0.98
	Late	30.62	10.05	9.34	12.32	2.94	1.69	1.98	3.08	1.73	1.99	5.82	4.33	
1977	Early	8.47	8.93	22.89	16.65	17.49	8.57	4.29	1.44	0.96	2.05	3.53	3.35	
	Middle	10.13	11.63	7.78	12.79	15.27	5.79	1.88	1.41	2.09	2.27	2.04	4.08	0.96
	Late	26.05	11.66	14.35	12.27	6.50	6.97	2.48	3.33	1.42	2.74	2.34	5.87	
1978	Early	6.92	11.27	13.59	9.34	10.96	5.05	5.60	7.93	6.74	5.86	12.54	7.05	
	Middle	13.71	4.90	13.63	4.23	5.73	6.15	5.29	8.96	5.04	6.39	11.11	6.25	3.66
	Late	30.84	9.89	11.83	11.21	3.82	8.76	6.66	7.30	8.99	10.23	3.66	12.69	
1979	Early	8.03	15.55	13.02	19.42	9.04	6.50	3.06	2.11	2.26	4.06	8.09	6.99	
	Middle	16.70	10.68	11.62	13.23	3.32	3.46	7.74	3.45	3.33	2.00	12.97	5.84	1.72
	Late	13.45	17.98	11.14	14.85	6.02	1.72	2.27	2.12	3.83	3.48	6.86	10.30	
1980	Early	11.90	13.37	7.43	10.62	10.74	6.40	3.63	7.76	8.29	5.02	8.22	7.29	
	Middle	22.05	14.85	6.93	9.52	7.72	3.70	5.65	14.91	10.07	8.41	10.59	8.93	3.28
	Late	18.82	8.30	4.89	8.78	7.56	3.43	5.41	3.28	7.44	6.70	8.90	19.13	
1981	Early	14.28	13.98	10.30	8.73	10.75	13.45	5.31	8.16	12.68	9.26	6.90	8.88	
	Middle	23.86	10.90	16.86	11.20	16.78	20.42	11.97	7.29	10.21	5.90	25.62	7.43	5.31
	Late	17.17	11.81	13.96	10.88	8.40	9.35	18.96	10.40	8.37	14.24	8.83	18.83	
1982	Early	21.10	8.87	6.60	5.83	7.74	2.32	1.29	1.24	0.39	0.55	11.41	3.95	
	Middle	29.56	9.30	3.94	10.77	5.75	3.53	0.85	0.74	0.74	1.60	6.68	11.81	0.39
	Late	18.24	6.83	2.70	7.82	3.95	1.58	3.83	0.59	0.61	2.32	6.39	13.73	
1983	Early	12.92	8.39	9.66	10.13	8.76	7.16	3.77	3.57	2.56	3.80	12.23	15.45	
	Middle	15.96	11.03	7.60	6.31	9.94	7.31	3.25	3.91	3.17	5.87	9.39	10.34	2.01
	Late	8.68	9.21	8.84	6.75	11.84	3.03	5.35	2.01	3.95	8.57	21.00	11.50	
1984	Early	22.22	15.52											
	Middle	12.82	15.93											
	Late	12.18	16.92											

Table B-15 ESTIMATED MEAN DAILY DISCHARGE OF 10-DAY PERIOD AT CICINTA WEIR (5/5)

Year	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min
1972	Early	6.72	3.32	4.25	1.20	2.12	0.51	0.34	0.30	0.12	0.06	0.58	1.12	
	Middle	3.87	2.04	3.57	0.91	1.59	0.44	0.21	0.32	0.14	0.14	0.71	0.82	0.06
	Late	3.68	2.32	2.46	2.30	1.93	0.36	0.20	0.62	0.11	0.30	0.56	1.47	
1973	Early	3.39	2.06	1.73	2.89	3.98	3.29	0.99	1.00	2.08	1.67	1.75	2.10	
	Middle	2.82	1.78	3.22	3.07	4.51	1.52	0.90	1.53	1.53	1.27	0.78	1.84	0.76
	Late	2.88	2.26	2.62	3.47	1.95	0.97	0.76	0.96	3.19	2.91	2.98	3.13	
1974	Early	6.23	2.75	4.34	1.73	2.51	1.04	1.21	1.46	3.15	2.36	0.75	2.72	
	Middle	3.46	2.40	1.77	3.27	3.13	0.83	1.60	1.73	4.26	1.69	2.25	1.20	0.75
	Late	0.90	2.68	2.12	1.29	1.40	1.30	0.81	1.76	2.64	1.24	1.36	0.95	
1975	Early	1.86	1.69	2.06	1.12	0.77	0.99	0.64	2.40	2.29	1.09	3.47	3.00	
	Middle	1.61	4.82	1.41	1.28	1.05	0.87	1.21	1.02	2.82	1.15	2.16	5.78	0.45
	Late	2.11	2.18	2.28	0.62	1.97	0.45	1.50	1.54	2.27	1.80	1.44	2.21	
1976	Early	3.33	2.50	3.57	1.14	1.98	1.12	0.64	0.42	0.31	1.01	0.68	0.67	
	Middle	6.14	1.04	1.81	1.71	0.90	0.62	0.26	0.31	0.18	1.06	2.36	1.27	0.18
	Late	5.78	1.90	1.76	2.33	0.56	0.32	0.37	0.58	0.33	0.38	1.10	0.82	
1977	Early	1.60	1.69	4.32	3.14	3.30	1.62	0.81	0.27	0.18	0.39	0.67	0.63	
	Middle	1.91	2.20	1.47	2.42	2.88	1.09	0.36	0.27	0.39	0.43	0.39	0.77	0.18
	Late	4.92	2.20	2.71	2.32	1.23	1.32	0.47	0.63	0.27	0.52	0.44	1.11	
1978	Early	1.31	2.13	2.57	1.76	2.07	0.95	1.06	1.50	1.27	1.11	2.37	1.33	
	Middle	2.59	0.93	2.57	0.80	1.08	1.16	1.00	1.69	0.95	1.21	2.10	1.18	0.69
	Late	5.83	1.87	2.23	2.12	0.72	1.66	1.26	1.38	1.70	1.93	0.69	2.40	
1979	Early	1.52	2.94	2.46	3.67	1.71	1.23	0.58	0.40	0.43	0.77	1.53	1.32	
	Middle	3.15	2.02	2.19	2.50	0.63	0.65	1.46	0.65	0.63	0.38	2.45	1.10	0.32
	Late	2.54	3.40	2.10	2.81	1.14	0.32	0.43	0.40	0.72	0.66	1.30	1.95	
1980	Early	2.25	2.53	1.40	2.01	2.03	1.21	0.69	1.46	1.57	0.95	1.55	1.38	
	Middle	4.17	2.80	1.30	1.80	1.46	0.70	1.07	2.82	1.90	1.59	2.00	1.69	0.62
	Late	3.56	1.57	0.92	1.66	1.43	0.65	1.02	0.62	1.40	1.27	1.68	3.61	
1981	Early	2.70	2.64	1.95	1.65	2.03	2.54	1.00	1.54	2.39	1.75	1.30	1.68	
	Middle	4.51	2.06	3.18	2.12	3.17	3.86	2.26	1.38	1.93	1.11	4.84	1.40	1.00
	Late	3.24	2.23	2.64	2.06	1.59	1.77	3.58	1.96	1.58	2.69	1.67	3.56	
1982	Early	3.99	1.68	1.25	1.10	1.46	0.44	0.24	0.24	0.07	0.10	2.16	0.75	
	Middle	5.58	1.76	0.74	2.03	1.09	0.67	0.16	0.14	0.14	0.30	1.26	2.23	0.07
	Late	3.45	1.29	0.51	1.48	0.75	0.30	0.72	0.11	0.11	0.44	1.21	2.59	
1983	Early	2.44	1.59	1.82	1.91	1.65	1.35	0.71	0.67	0.48	0.72	2.31	2.92	
	Middle	3.01	2.08	1.44	1.19	1.88	1.38	0.61	0.74	0.60	1.11	1.77	1.95	0.38
	Late	1.64	1.74	1.67	1.27	2.24	0.57	1.01	0.38	0.75	1.62	3.97	2.17	
1984	Early	4.20	2.93											
	Middle	2.42	3.01											
	Late	2.30	3.20											

Table B-16 355-DAY DISCHARGE

Units: m^3/s

	Kragilan	Rangkasbitung
1970	11.3	-
1971	-	-
1972	6.0	3.8
1973	21.8	34.6
1974	31.4	32.8
1975	7.4	24.0
1976	2.4	10.4
1977	2.4	10.6
1978	14.2	26.9
1979	-	14.5
1980	-	23.0
1981	-	43.3
1982	-	4.3
1983	-	17.2

Lab. No. : PKA 84/113

Location : .....

.....

Table B-17 (1) RESULT ON WATER QUALITY ANALYSES (DRY SEASON)

Substances	Units	Results of Analyses			
		5	6	7	8
PHISICAL					
Temperature	°C	-	-	-	-
Colour	Unit PtCo	25	15	15	20
Odour		-	-	-	-
Taste		-	-	-	-
Turbidity	ppm SiO^2	325	115	270	120
Disolved solid	ppm	38	52	48	31
Conductivity	umho/cm	54	78	68	46
CHEMICAL					
pH		6.7	7.1	6.9	6.9
Calcium (Ca)	ppm	6.6	7.3	6.6	4.4
Magnesium (Mg)	"	0.73	1.1	1.6	0.97
Hardness		1.1	1.3	1.3	0.84
Sodium (Na)	"	2.3	4.5	3.0	2.1
Potasium (K)	"	1.5	2.0	2.1	1.2
Nickel (Ni)	"	ud	ud	ud	ud
Iron (Fe)	"	2.1	1.5	2.6	1.2
Mangan (Mn)	"	ud	ud	ud	ud
Copper (Cu)	"	ud	ud	ud	ud
Zink (Zn)	"	ud	ud	ud	ud
Krom hexavalen (Cr)	"	ud	ud	ud	ud
Kadmium (Cd)	"	ud	ud	ud	ud
Mercury (Hg)	"	-	-	-	-
Lead (Pb)	"	ud	ud	ud	ud
Cyanide (CN)	"	-	-	-	-
Sulfide (S)	"	-	-	-	-
Fluoride (F)	"	ud	ud	ud	ud
Chloride (Cl)	"	3.6	3.3	3.0	3.5
Sulfate (SO4)	"	6.7	6.8	4.8	4.7
Amonia (NH4)	"	-	-	-	-
Nitrat (NO3)	"	-	-	-	-
Nitrit (NO2)	"	-	-	-	-
Bikarbonat (HCO3)	"	17	31	29	13
Detergent	"	-	-	-	-
Phenolic Substances	"	-	-	-	-
Grease and Oil	"	-	-	-	-
Boron (B)	"	ud	ud	ud	ud
Permanganat number	ppm KMnO4	-	-	-	-
BAKTERIOLOGY :					
E. Coli	MPN/100 ml	-	-	-	-
% Na		19	28	20	21
SAR		0.23	0.42	0.27	0.23
RSC		0	0.04	0.01	0

Note : ud : undetectable

5. Ciberang Karian 31-7-1984
6. Bd Pamarayan 1-8-1984
7. Canal Kanan -
8. Cibuereum 31-7-1984

Lab. No. : PKA 84/113

Location : BANTEN

Table B-17 (2) RESULT ON WATER QUALITY ANALYSES (DRY SEASON)

Substances	Units	Results of Analyses			
		1	2	3	4
PHISICAL					
Temperature	°C	-	-	-	-
Colour	Unit PtCo	20	15	25	20
Odour		-	-	-	-
Taste		-	-	-	-
Turbidity	ppm SiO^2	160	150	150	110
Disolved solid	ppm	58	76	42	58
Conductivity	umho/cm	90	110	65	86
CHEMICAL					
pH		7.6	7.5	7.3	7.0
Calcium (Ca)	ppm	10	11	6.7	8.1
Magnesium (Mg)	"	1.2	2.9	2.0	1.1
Hardness		1.7	2.2	1.4	1.4
Sodium (Na)	"	5.1	5.6	2.5	5.4
Potasium (K)	"	2.5	1.9	1.7	2.1
Nickel (Ni)	"	ud	ud	ud	ud
Iron (Fe)	"	2.0	1.4	1.7	2.1
Mangan (Mn)	"	ud	ud	ud	ud
Copper (Cu)	"	ud	ud	ud	ud
Zink (Zn)	"	ud	ud	ud	ud
Krom hexavalen (Cr)	"	ud	ud	ud	ud
Kadmium (Cd)	"	ud	ud	ud	ud
Mercury (Hg)	"	-	-	-	-
Lead (Pb)	"	ud	ud	ud	ud
Cyanide (CN)	"	-	-	-	-
Sulfide (S)	"	-	-	-	-
Fluoride (F)	"	ud	ud	ud	ud
Chloride (Cl)	"	3.8	3.5	3.1	3.8
Sulfate (SO4)	"	7.8	6.7	6.0	9.6
Amonia (NH4)	"	-	-	-	-
Nitrat (NO3)	"	-	-	-	-
Nitrit (NO2)	"	-	-	-	-
Bikarbonat (HCO3)	"	36	49	25	31
Detergent	"	-	-	-	-
Phenolic Substances	"	-	-	-	-
Grease and Oil	"	-	-	-	-
Boron (B)	"	0.03	0.03	0.02	ud
Permanganat number	ppm KMnO4	-	-	-	-
BAKTERIOLOGY :					
E. Coli	MPN/100 ml	-	-	-	-
% Na		26	22	17	30
SAR		0.40	0.38	0.22	0.48
RSC		0	- 0.01	0	0.01

Note : ud : Undetectable

1. Ciujung Rangkasbitung 31-7-1984.
2. Ciujung sebelum pertemuan 31-7-1984.
3. Cisimeut Cirende 31-7-1984.
4. Canal Padaleman 31-7-1984.

Lab. No. : .PKA.84/140.....

Location : .....

.....

Table B-18 (1) RESULT ON WATER QUALITY ANALYSES (WET SEASON)

Substances	Units	Results of Analyses			
		5	6	7	8
PHISICAL					
Temperature	°C	-	-	-	-
Colour	Unit PtCo	15	15	20	15
Odour		-	-	-	-
Taste		-	-	-	-
Turbidity	ppm SiO^2	55	90	200	65
Disolved solid	ppm	106	58	96	48
Conductivity	umho/cm	166	82	128	67
CHEMICAL					
pH		7,4	7,3	7,2	7,3
Calcium (Ca)	ppm	14	5,6	9,7	5,1
Magnesium (Mg)	"	5,4	4,4	6,3	2,9
Hardness		3,2	1,8	2,8	1,4
Sodium (Na)	"	6,9	2,4	3,9	2,0
Potasium (K)	"	2,8	1,7	3,1	1,4
Nickel (Ni)	"	ud	ud	ud	ud
Iron (Fe)	"	1,8	1,7	2,9	1,2
Mangan (Mn)	"	0,02	0,01	0,02	0,02
Copper (Cu)	"	ud	ud	ud	ud
Zink (Zn)	"	0,05	0,07	0,03	0,11
Krom hexavalen (Cr)	"	ud	ud	ud	ud
Kadmium (Cd)	"	ud	ud	ud	ud
Mercury (Hg)	"	-	-	-	-
Lead (Pb)	"	ud	ud	ud	ud
Cyanide (CN)	"	-	-	-	-
Sulfide (S)	"	-	-	-	-
Fluoride (F)	"	ud	ud	ud	ud
Chloride (Cl)	"	5,8	3,8	4,5	3,6
Sulfate (SO4)	"	8,5	9,4	9,4	7,0
Amonia (NH4)	"	-	-	-	-
Nitrat (NO3)	"	-	-	-	-
Nitrit (NO2)	"	-	-	-	-
Bikarbonat (HCO3)	"	68	27	54	23
Detergent	"	-	-	-	-
Phenolic Substances	"	-	-	-	-
Grease and Oil	"	-	-	-	-
Boron (B)	"	0,03	ud	ud	0,04
Permanganat number	ppm KMnO4	-	-	-	-
BAKTERIOLOGY :					
E. Coli	MPN/100 ml	-	-	-	-
% Na		20	13	14	14
SAR		0,40	0,18	0,24	0,18
RSC		0	0	0	0

Note : ud : Undetectable

5. Ciujung atas 10 - 10 - 1984
6. Cisimeut 10 - 10 - 1984
7. Canal serdang 11- 10 - 1984
8. Ciberang 10- 10 - 1984

Lab. No. : PKA 84/140

Location : BANTEN

Table B-18 (2) RESULT ON WATER QUALITY ANALYSES (WET SEASON)

Substances	Units	Results of Analyses			
		1	2	3	4
PHISICAL					
Temperature	°C	-	-	-	-
Colour	Unit PtCo	20	15	15	15
Odour		-	-	-	-
Taste		-	-	-	-
Turbidity	ppm SiO^2	480	40	120	112
Disolved solid	ppm	35	74	105	58
Conductivity	umho/cm	50	103	145	96
CHEMICAL					
pH		7,3	7,2	7,3	7,4
Calcium (Ca)	ppm	4,0	9,6	12	8,5
Magnesium (Mg)	"	1,6	3,8	5,7	3,5
Hardness		0,92	2,2	3,0	2,0
Sodium (Na)	"	1,9	4,4	6,9	3,2
Potasium (K)	"	1,7	1,9	2,8	2,0
Nickel (Ni)	"	ud	ud	ud	ud
Iron (Fe)	"	2,7	1,4	1,9	2,2
Mangan (Mn)	"	0,01	0,01	0,01	0,02
Copper (Cu)	"	ud	ud	ud	ud
Zink (Zn)	"	0,06	0,05	0,03	0,04
Krom hexavalen (Cr)	"	ud	ud	ud	ud
Kadmium (Cd)	"	ud	ud	ud	ud
Mercury (Hg)	"	-	-	-	-
Lead (Pb)	"	ud	ud	ud	ud
Cyanide (CN)	"	-	-	-	-
Sulfide (S)	"	-	-	-	-
Fluoride (F)	"	ud	ud	ud	ud
Chloride (Cl)	"	3,5	4,3	5,5	4,3
Sulfate (SO4)	"	7,9	6,0	7,3	7,1
Amonia (NH4)	"	-	-	-	-
Nitrat (NO3)	"	-	-	-	-
Nitrit (NO2)	"	-	-	-	-
Bikarbonat (HCO3)	"	12	46	64	40
Detergent	"	-	-	-	-
Phenolic Substances	"	-	-	-	-
Grease and Oil	"	-	-	-	-
Boron (B)	"	0,04	0,03	0,03	0,01
Permanganat number	ppm KMnO4	-	-	-	-
BAKTERIOLOGY :					
E. Coli	MPN/100 ml	-	-	-	-
% Na		18	19	21	16
SAR		0,20	0,30	0,41	0,23
RSC		0	0	0	0

Note : ud: undetectable

1. Cibeureum 10-10-1984
2. Pamarayan 11-10-1984
3. Ciujung Rangkasbitung 10 - 10 - 1984
4. Canal Kanan 11 - 10 - 1984

Table B-19 RESULTS OF ANALYSIS FOR PHISICAL

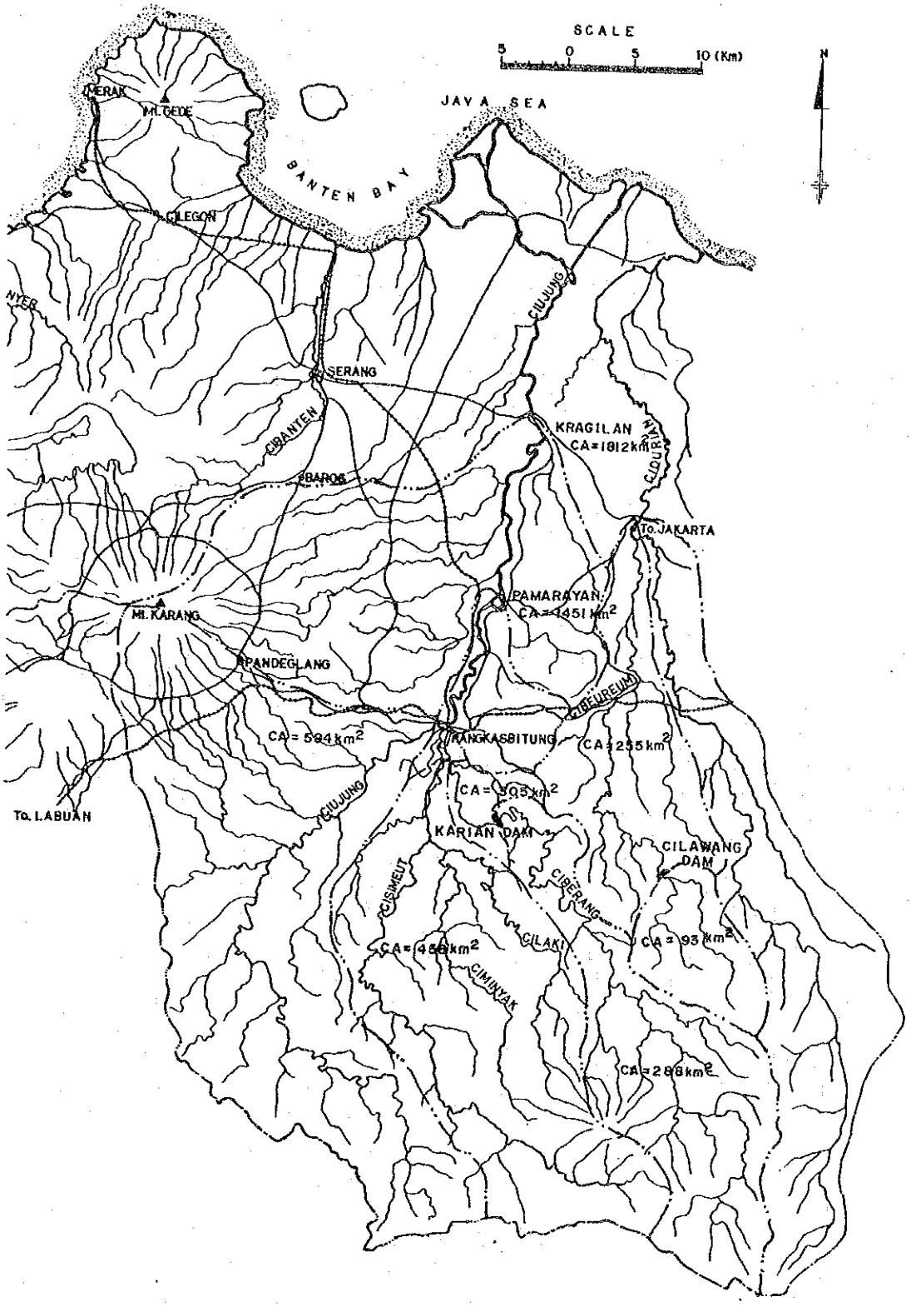
RIVER BED MATEREAL

No.	Sampling River	Specific Gravity (gr/cm^3)	Water Content Ratio (%)	Porosity	Void Ratio
CS - 1	Cisimeut	2.69	20.46	0.538	0.350
CS - 2	"	2.69	26.10	0.699	0.411
CB - 1	Ciberang	2.81	14.75	0.422	0.297
CB - 2	"	2.72	14.95	0.408	0.290
CB - 3	"	2.69	27.48	0.726	0.421
CU - 1	Ciujung	2.73	23.98	0.655	0.396
CU - 2	"	2.75	25.32	0.688	0.408
CU - 3	"	2.74	21.45	0.575	0.365
CU - 4	"	2.69	13.23	0.450	0.259
CU - 5	"	2.68	11.34	0.295	0.228
CU - 6	"	2.64	16.35	0.422	0.297

Table B-20 PARTICLE SIZE DISTRIBUTION

Sampling No.	River	Parcent passing 15.00	10.00	5.00	2.00	1.00	0.50	0.25	0.125	0.063	0.053	Average Diameter (mm)
CU - 1	Cisimeut	-	100,	89,24	64.35	44.19	17,89	2,23	0,07	0,03	0,01	3.070
CU - 2	Cisimeut	-	-	100	96,98	92,15	83,91	17,95	4,38	0,37	0,29	0,698
CB - 1	Ciberang	-	100	90,57	76,71	60,03	22,89	1,57	0,05	-	-	2,451
CB - 2	Ciberang	100	96,36	85,95	68,94	46,82	23,45	5,78	0,74	0,02	-	3,212
CB - 3	Ciberang	-	100	97,58	93,74	85,67	69,47	11,31	0,37	0,01	-	1,076
CU - 1	Ciujung	-	-	100	98,24	90,84	62,31	14,10	0,90	0,05	-	0,796
CU - 2	Ciujung	-	-	100	99,05	94,82	76,14	28,91	4,12	0,31	0,21	0,621
CU - 3	Ciujung	-	-	100	98,42	93,00	55,60	8,76	0,89	0,01	-	0,816
CU - 4	Ciujung	-	100	96,68	84,67	48,73	12.55	2,04	0,52	0,04	0,01	2,070
CU - 5	Ciujung	-	100	95,56	89,25	40,05	5,04	0,73	0,12	-	-	2,116
CU - 6	Ciujung	-	-	-	100	96,54	85,81	27,78	1,80	-	-	0,533

Fig.B-1



LEGEND

- Dam Site
- Catchment Boundary
- CA Catchment Area

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River Basin around the Project Area

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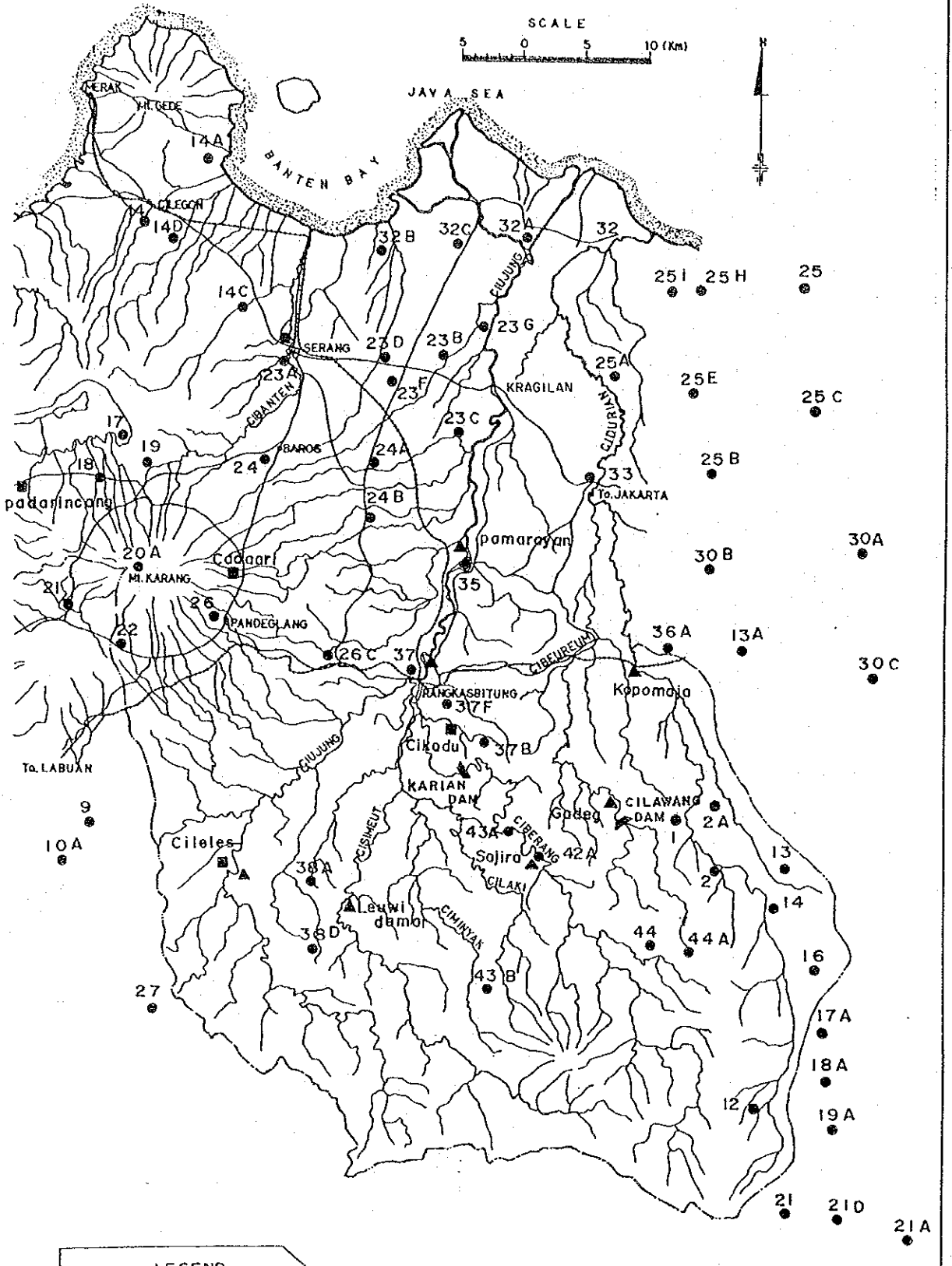
Fig.B-2



LEGEND

- DAM SITE
- CATCHMENT BOUNDARY
- RAINFALL GAUGING ST.
- WATER LEVEL GAUGING ST.
- METEOROLOGIC OVSERVATION ST.

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Location of Hydrologic Observation Stations

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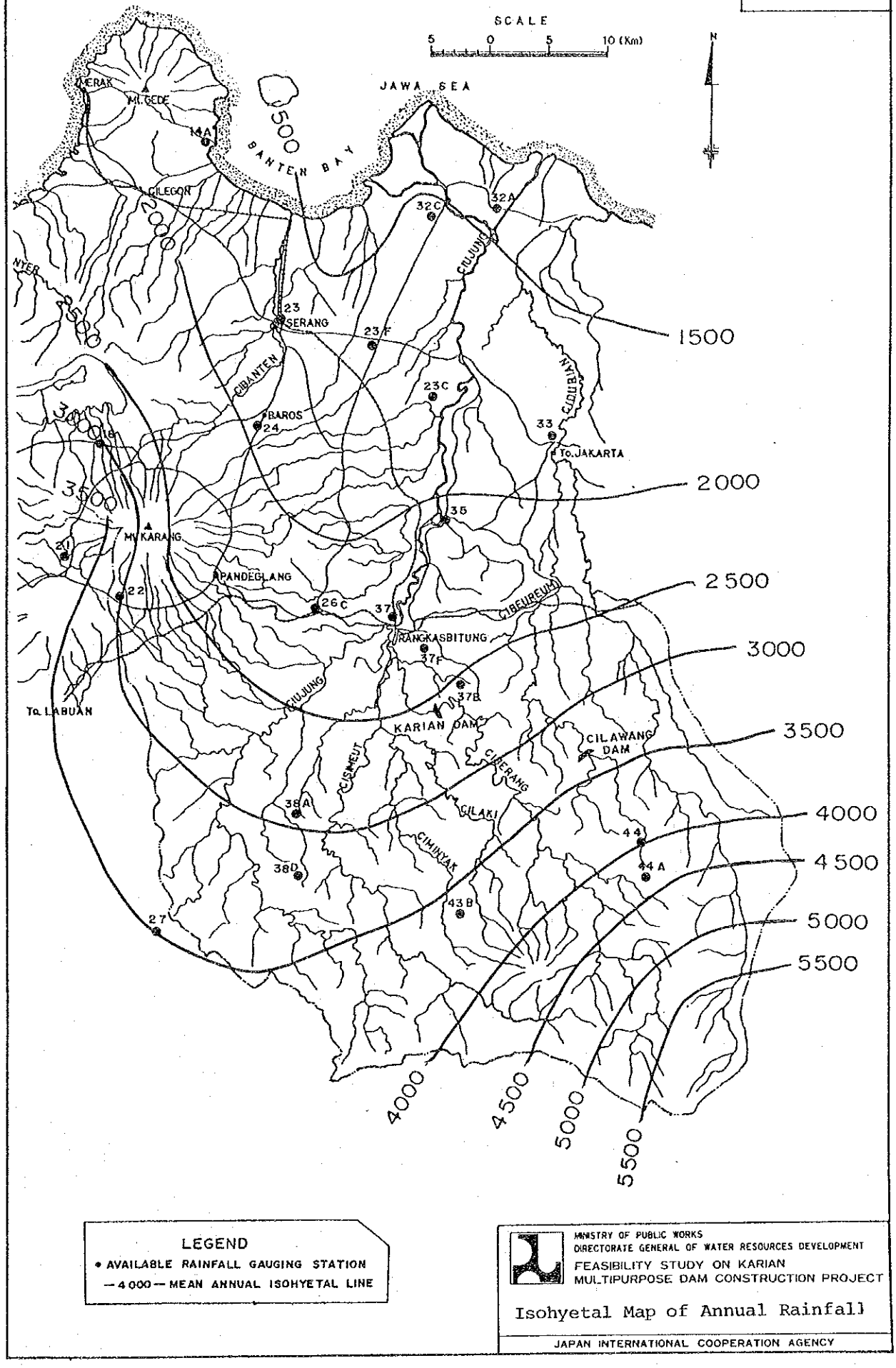
Fig.B-3



LEGEND

- AVAILABLE RAINFALL GAUGING STATION
- —4000— MEAN ANNUAL ISOHYETAL LINE

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Isohyetal Map of Annual Rainfall

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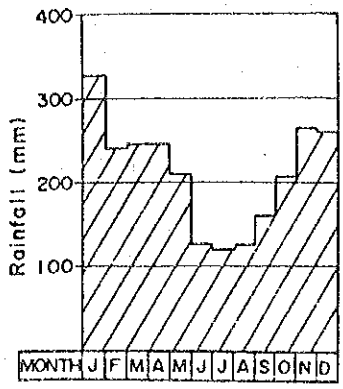
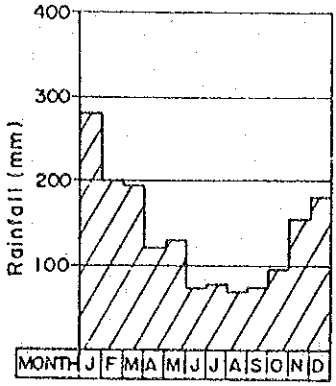
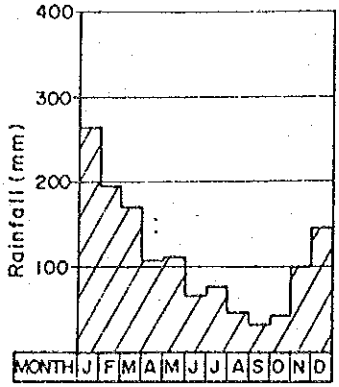
Fig.B-4



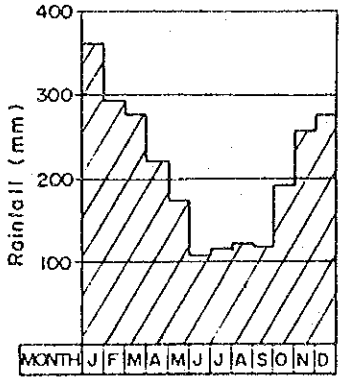
PANDEGLANG (No.26)



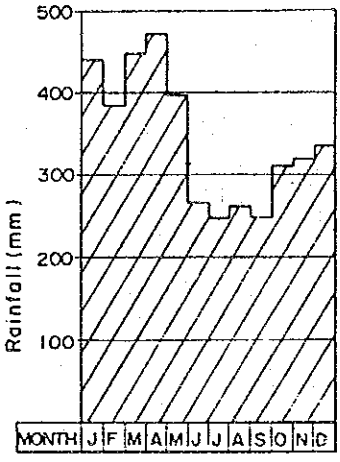
SERANG (No.23)



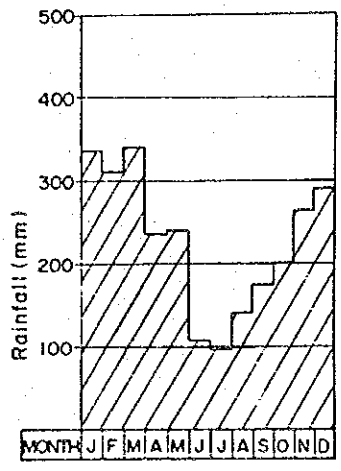
CILEGON (No.14)



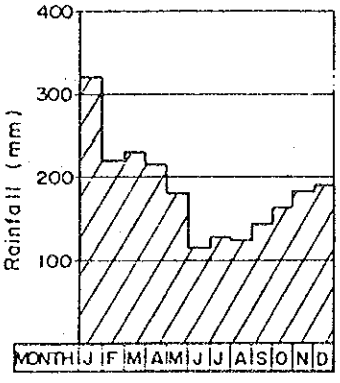
CIOMAS (No.18)



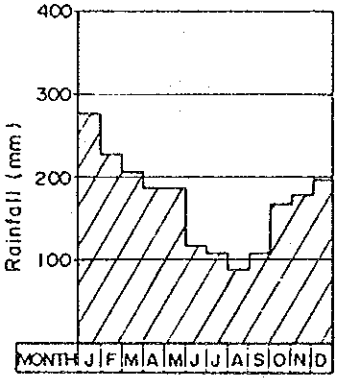
CIPANAS (No.44)



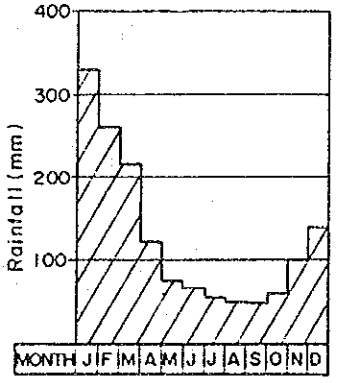
CILELES (No.266)



RANGKASBITUNG (No.37)



PAMARAYAN (No.35)



JEUNGJING (No.32A)

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Annual Pattern of Average
Monthly Rainfall

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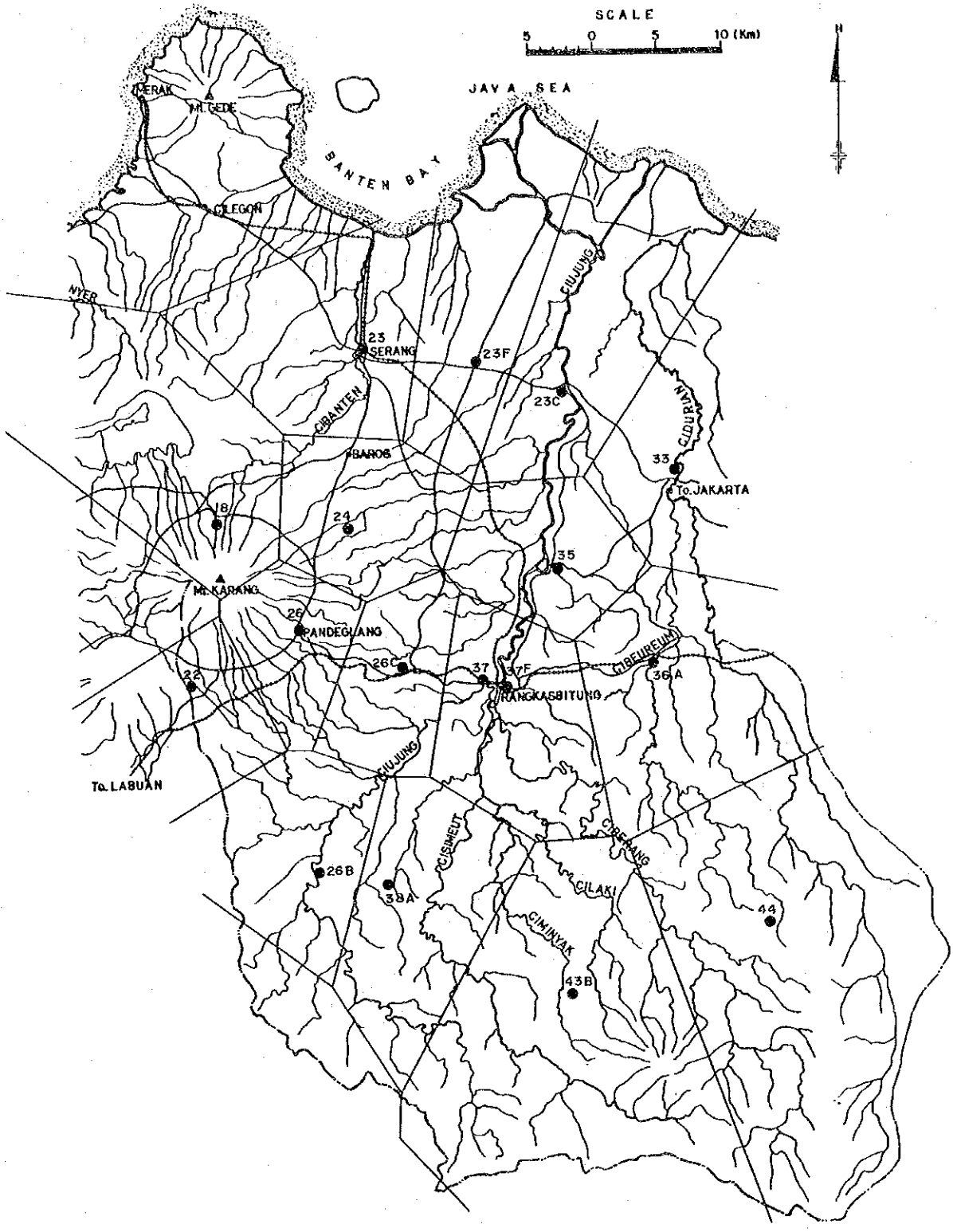
Fig.B-5



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Thiessen Polygon

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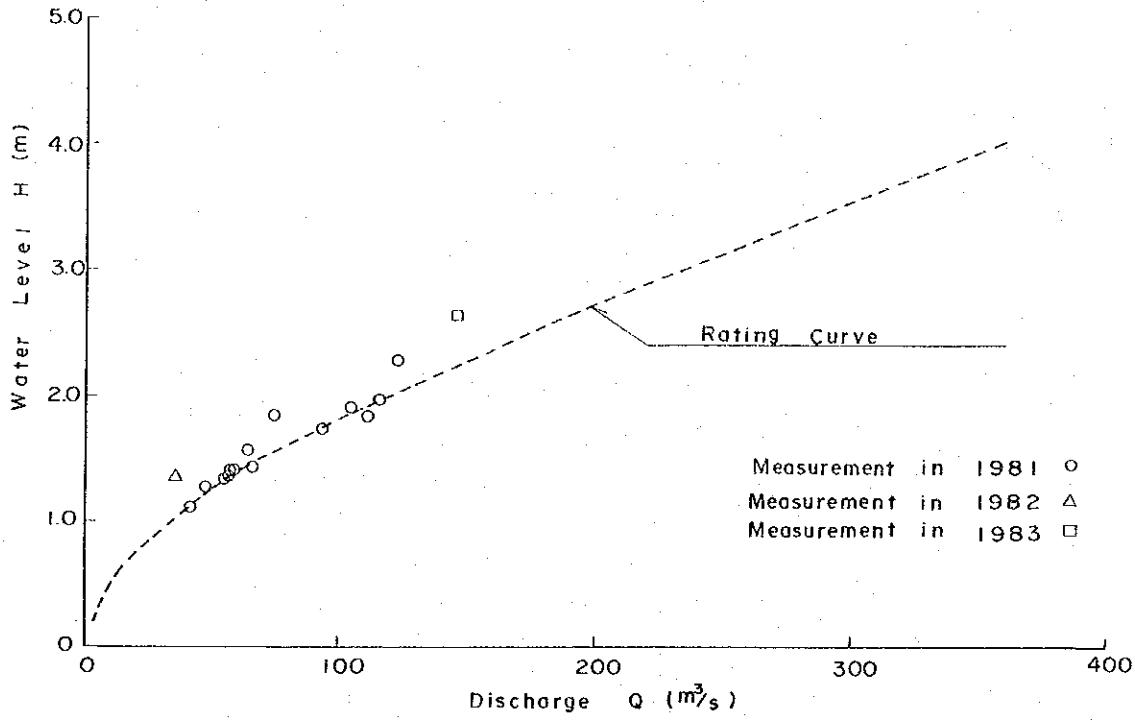
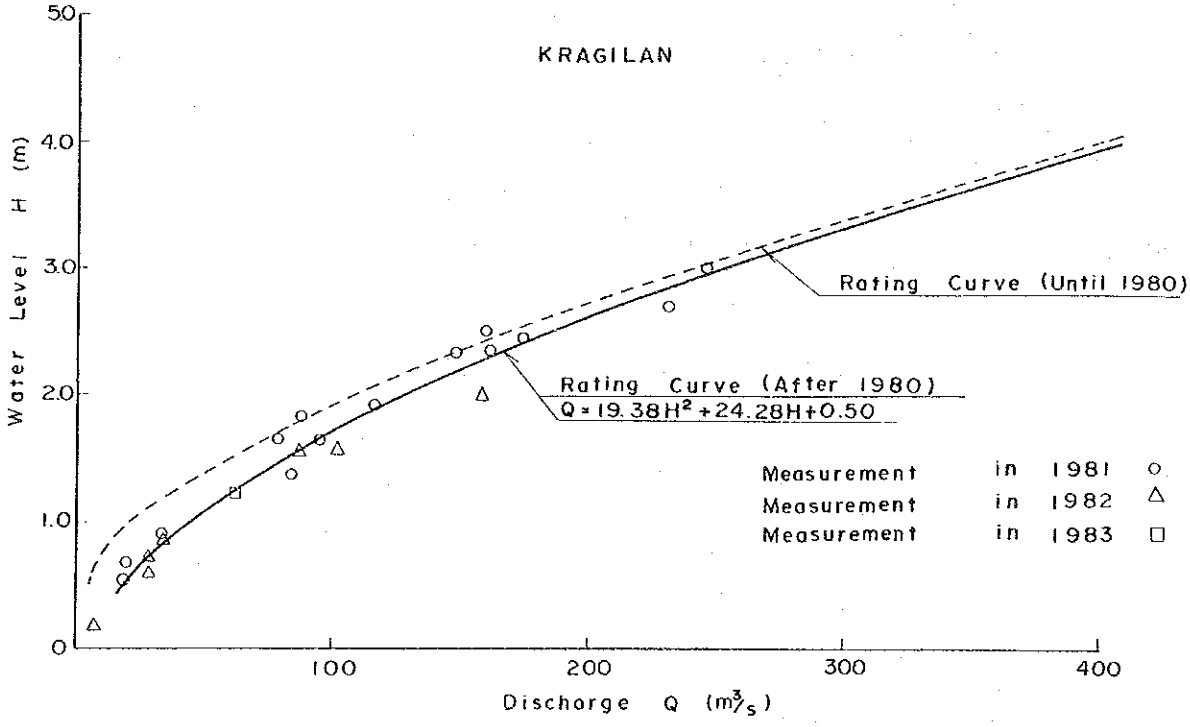
Fig.B-6(1)

RANGKASBITUNG



KRAGILAN



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MULTIPURPOSE DAM CONSTRUCTION PROJECT

Discharge Rating Curve

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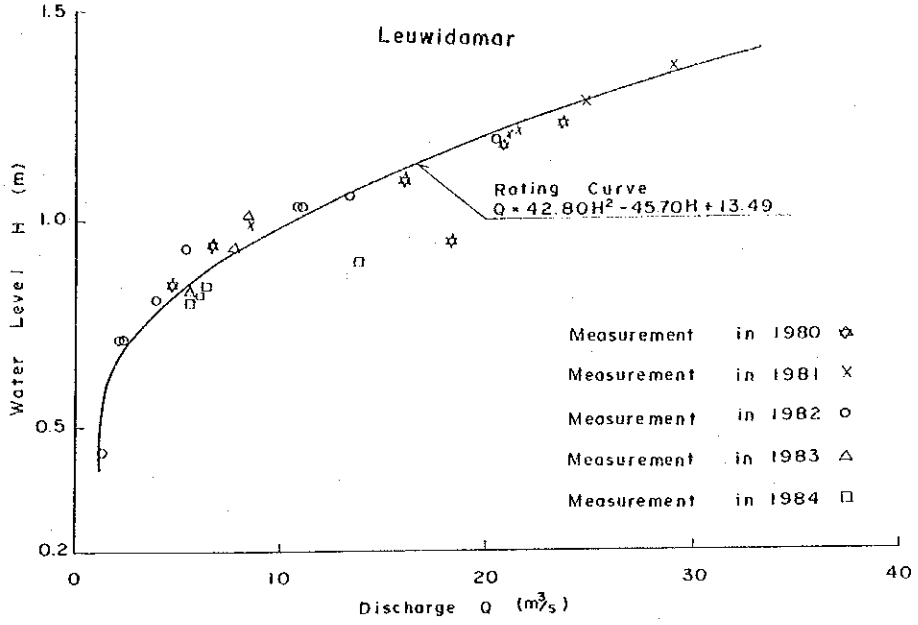
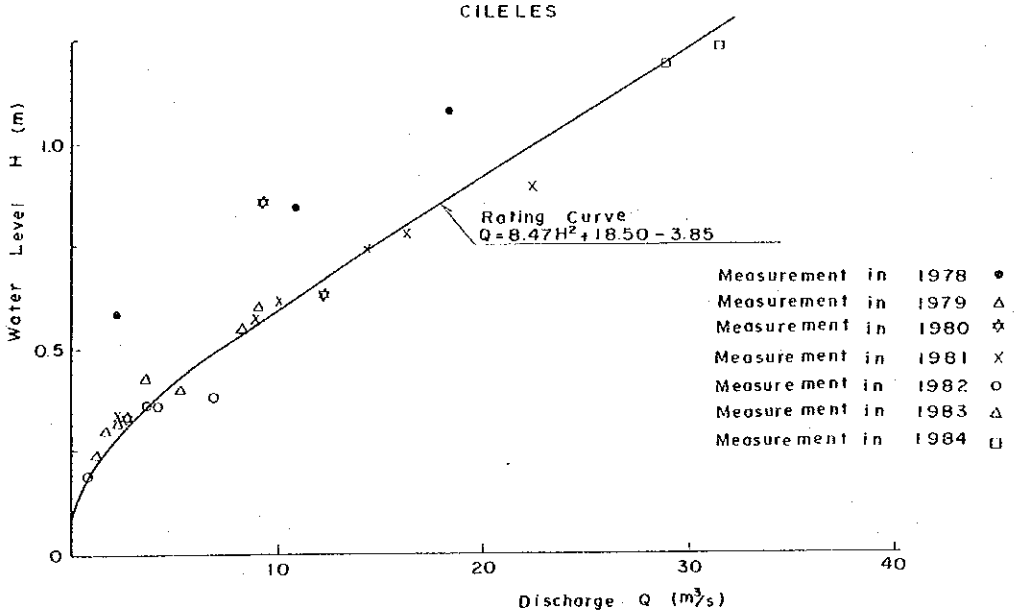
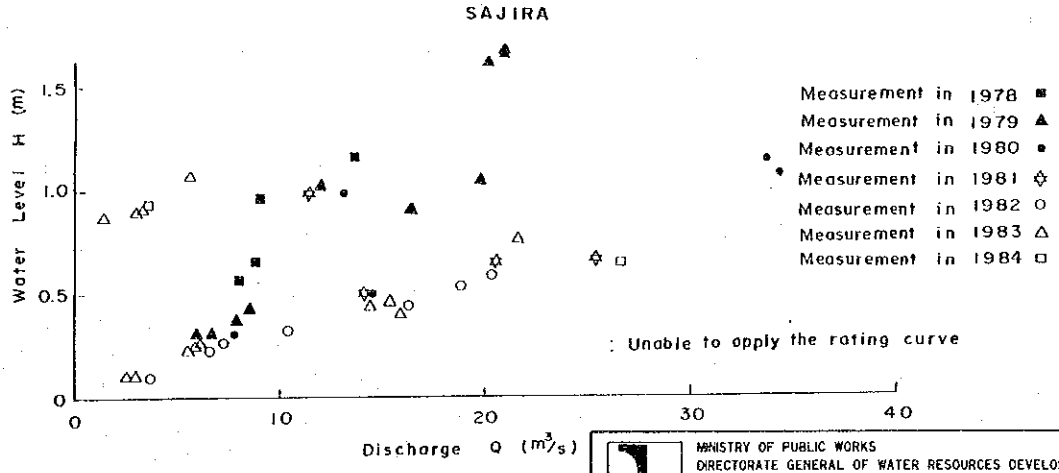
Fig.B-6(2)







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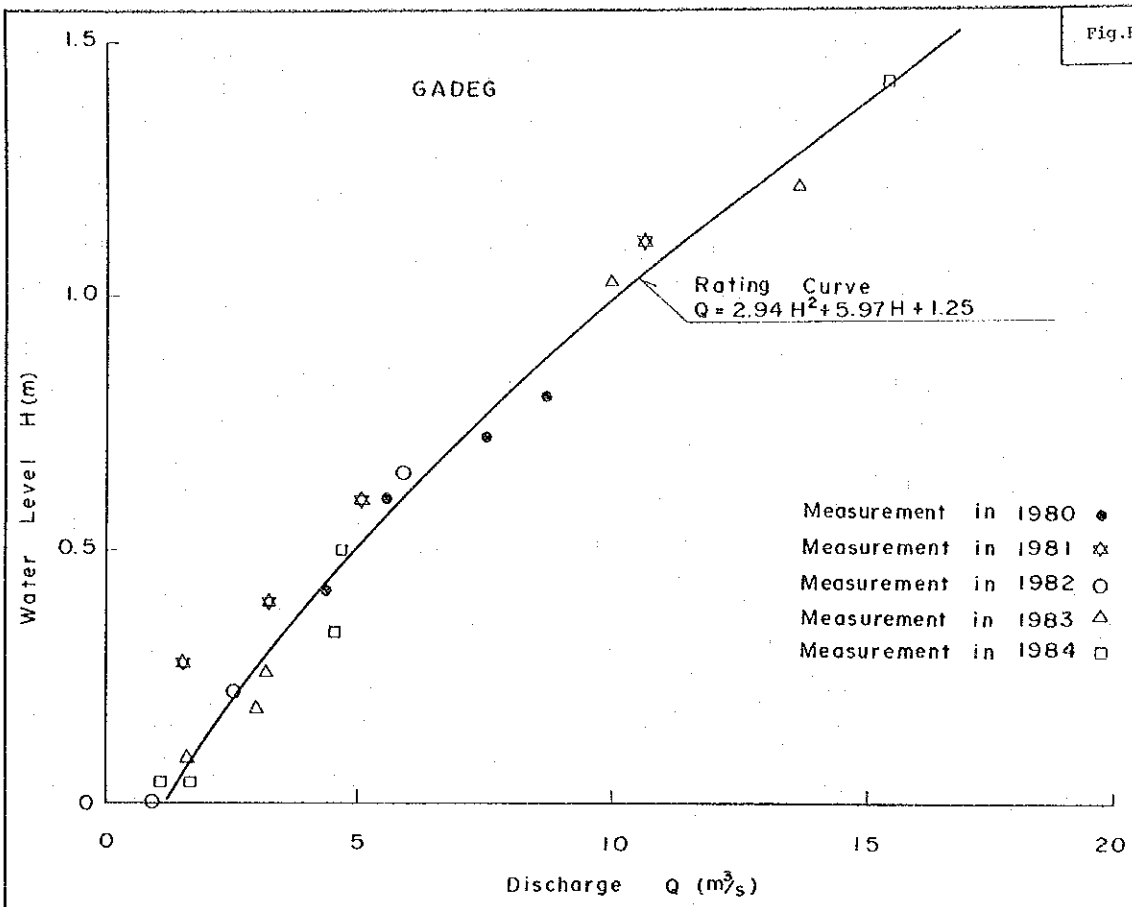
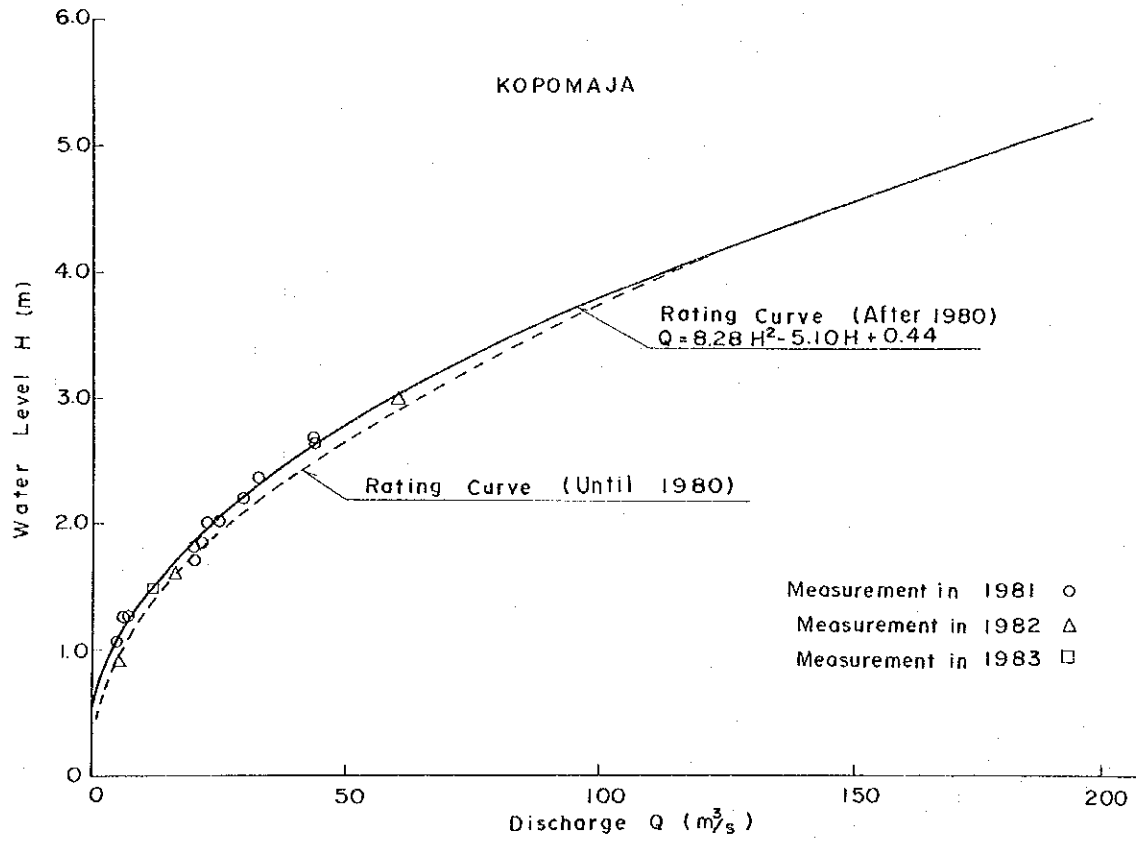
FEASIBILITY STUDY ON KARIAN
MULTIPURPOSE DAM CONSTRUCTION PROJECT

Discharge Rating Curve

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.B-6(3)





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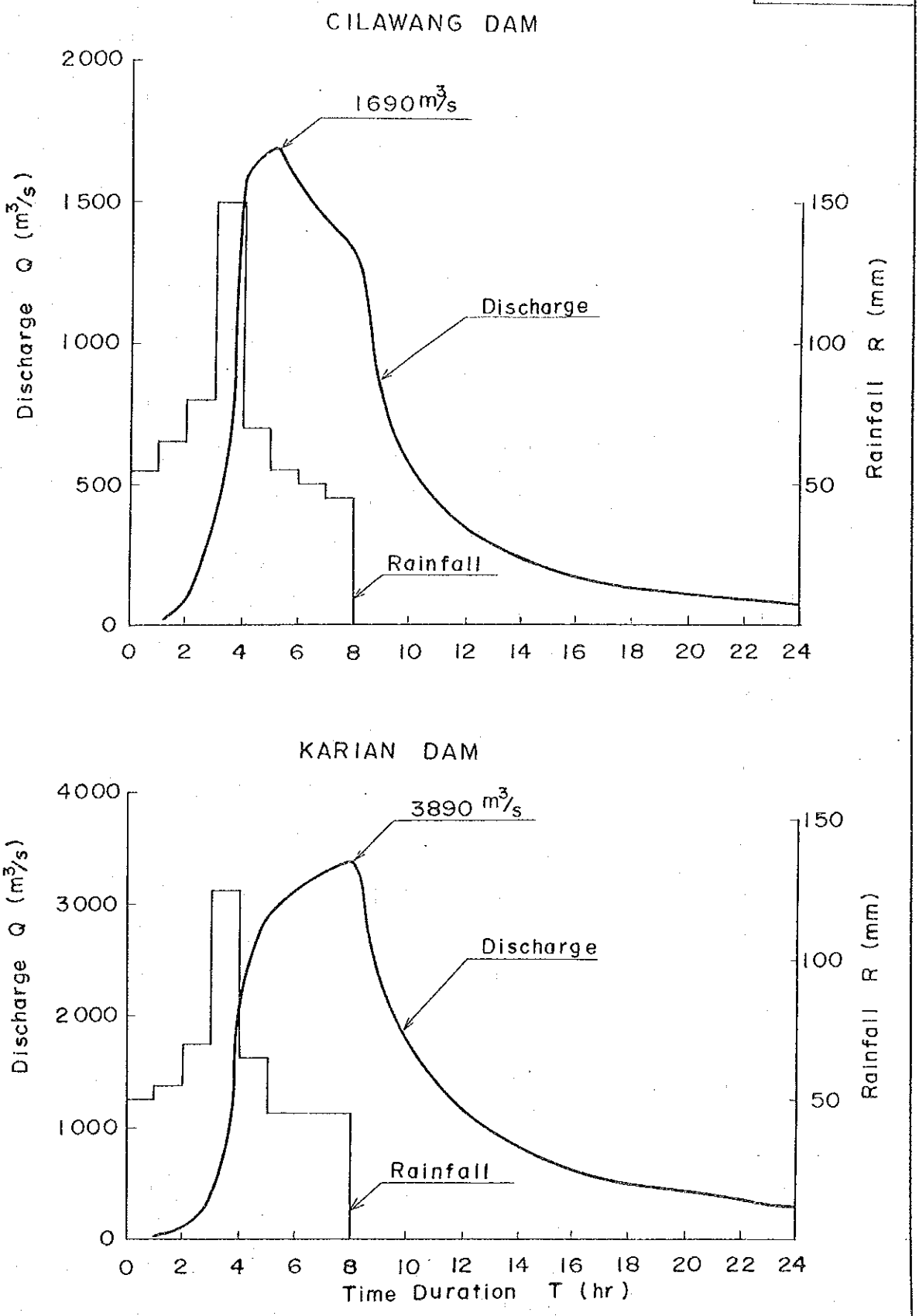
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
FEASIBILITY STUDY ON KARIAN
MULTIPURPOSE DAM CONSTRUCTION PROJECT

Discharge Rating Curve

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig.B-7



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FEASIBILITY STUDY ON KARIAN MULTIPURPOSE DAM CONSTRUCTION PROJECT

Spillway Inflow Design Flood

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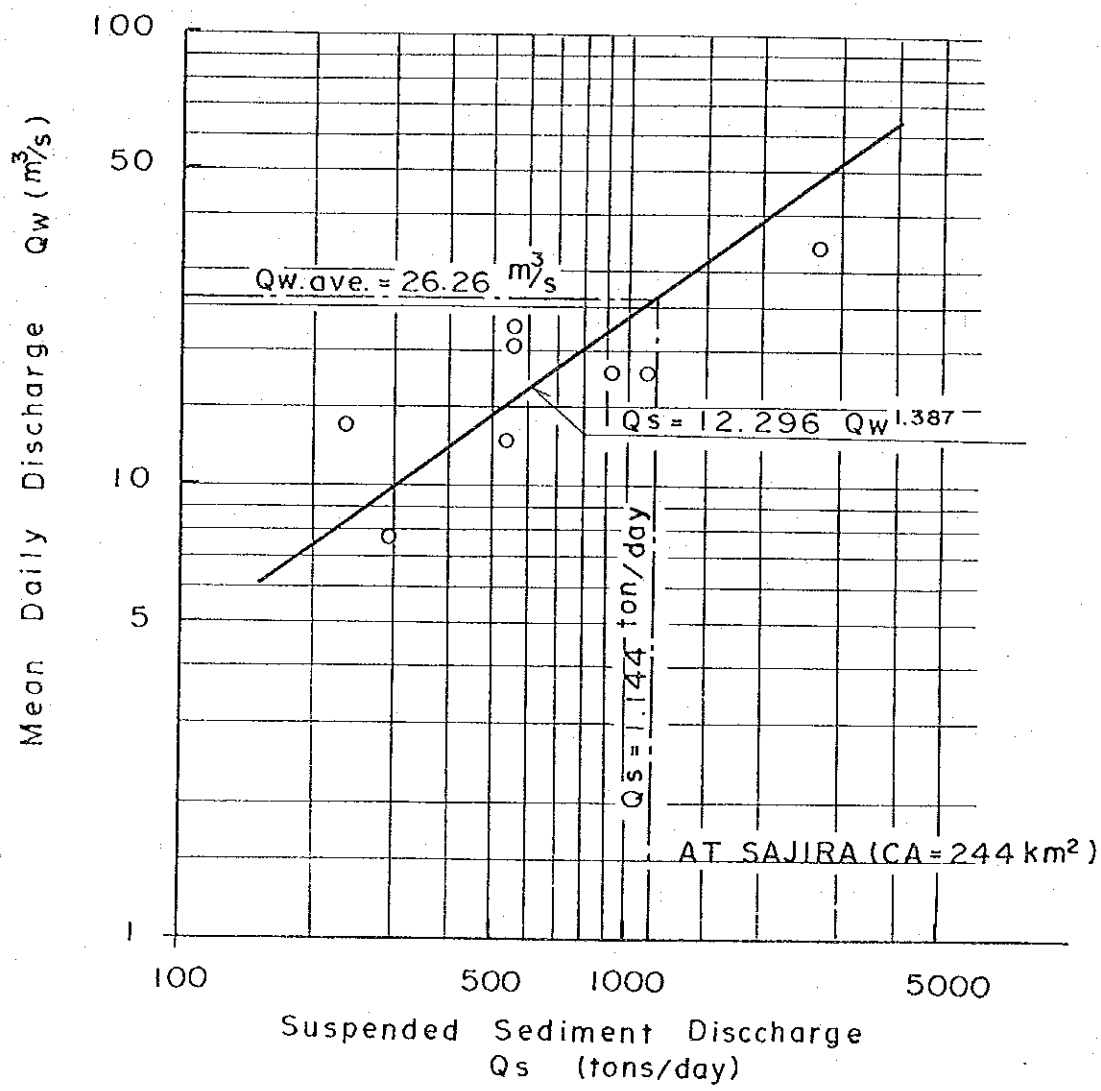
Fig.B-8



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MULTIPURPOSE DAM CONSTRUCTION PROJECT

Rating Curve of Suspended Load

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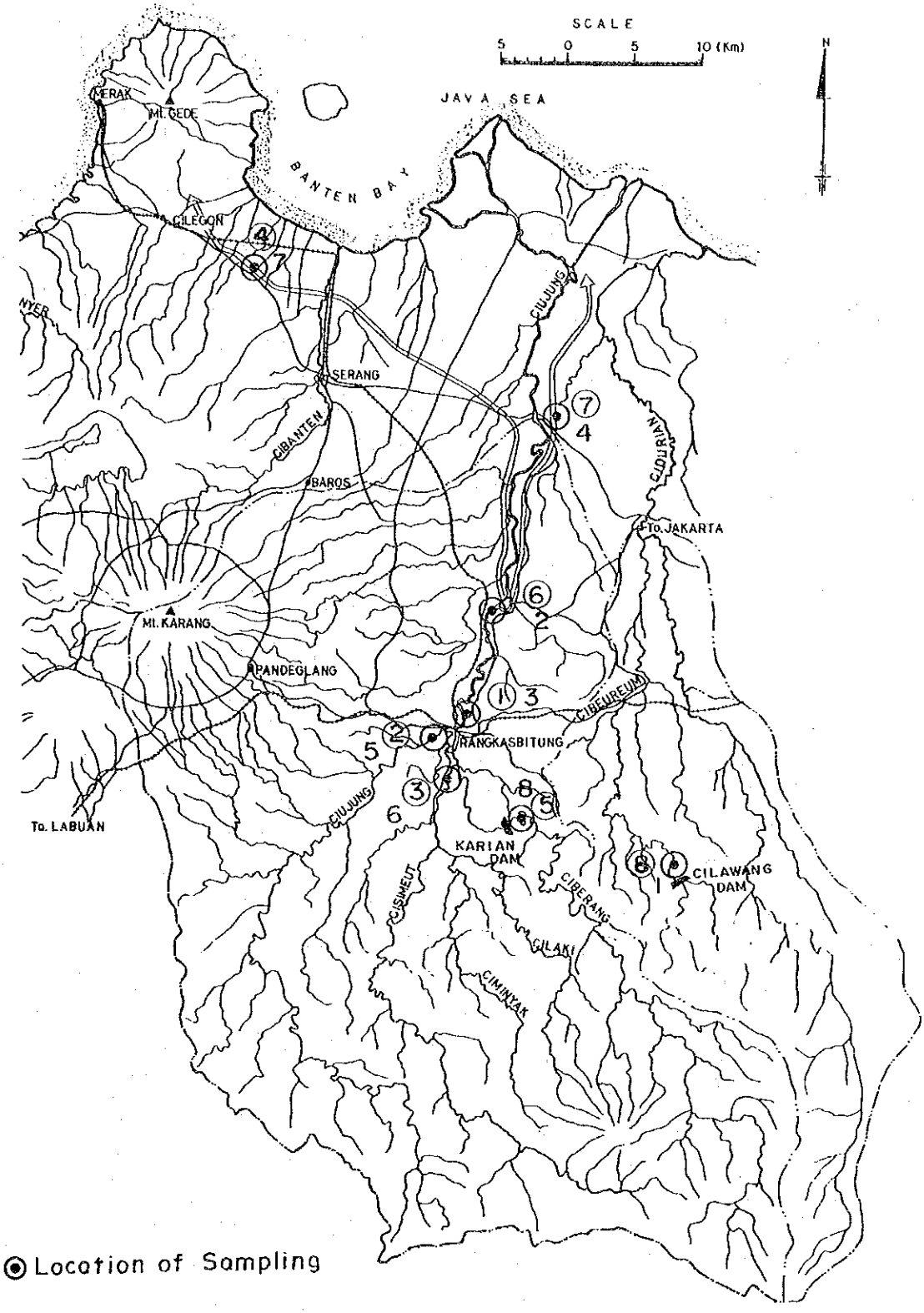
Fig.B-9



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FEASIBILITY STUDY ON KARIAN
MULTIPURPOSE DAM CONSTRUCTION PROJECT

Location Map of Water Sampling

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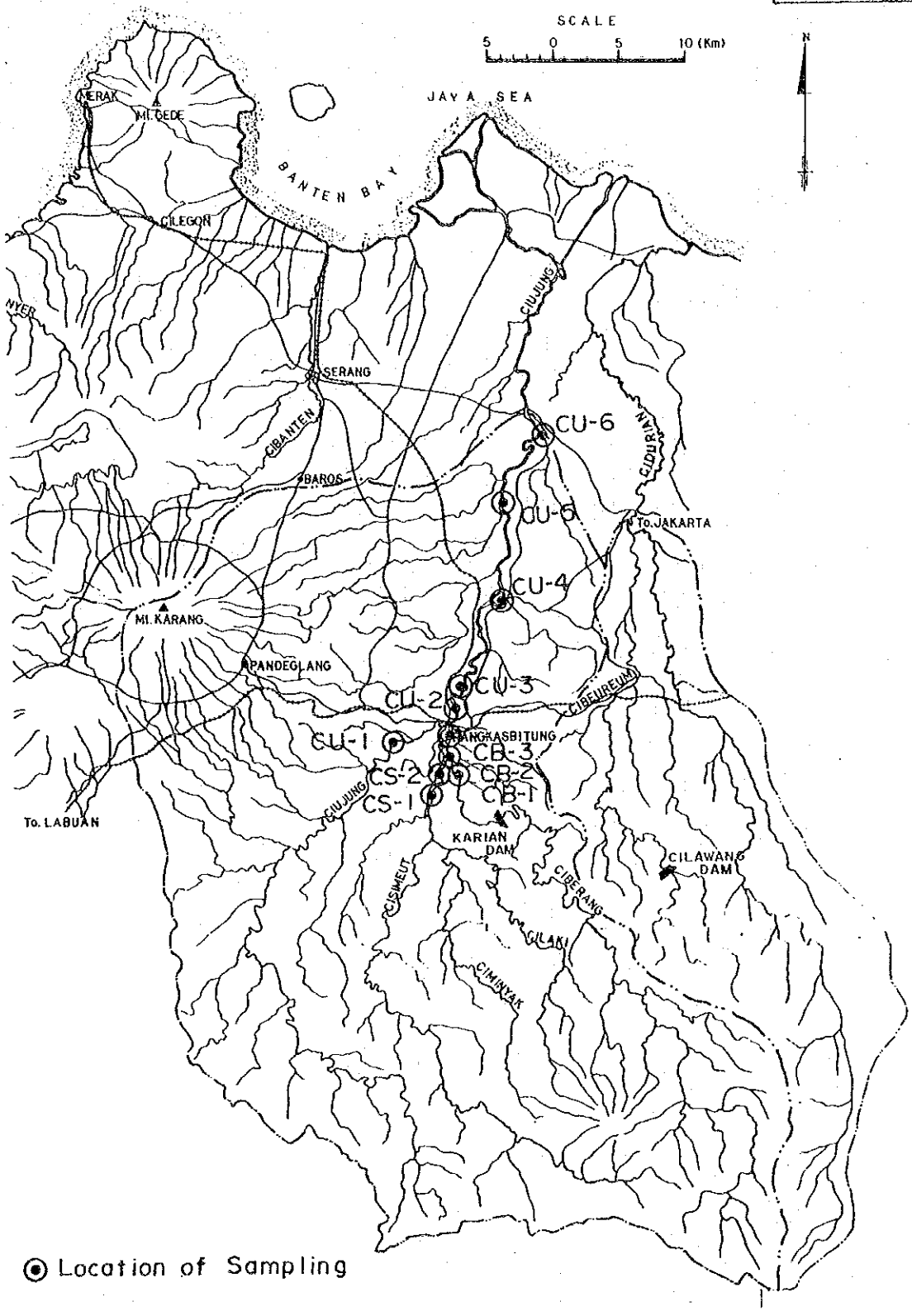
Fig.B-10



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FEASIBILITY STUDY ON KARIAN MULTIPURPOSE DAM CONSTRUCTION PROJECT
Location of Riverbed Material Sampling
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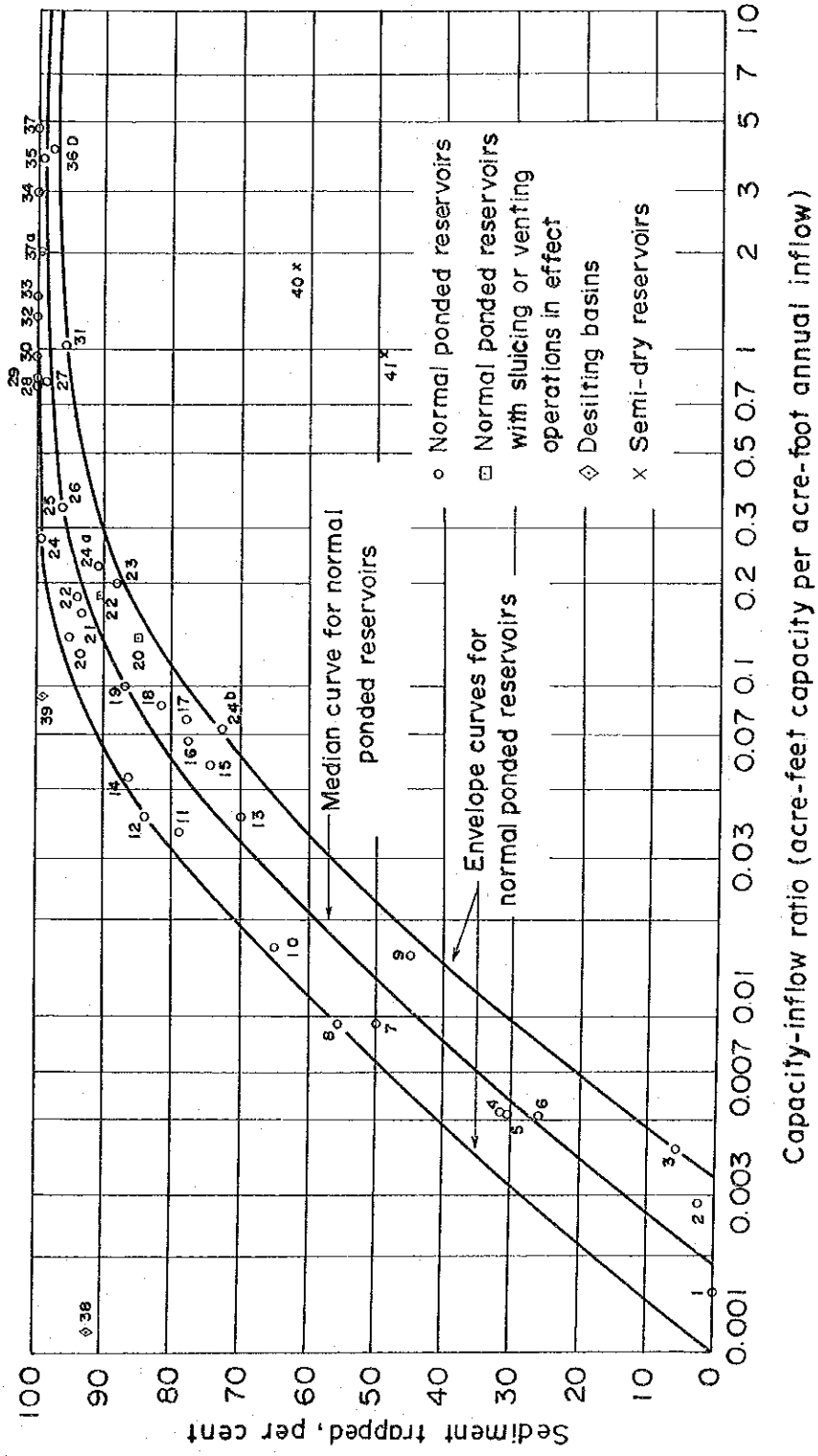
Fig.B-11



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FEASIBILITY STUDY ON KARIAN
MULTIPURPOSE DAM CONSTRUCTION PROJECT

Reservoir-trap efficiency Curve (Brune's)

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APPENDIX-C

GEOLOGY

APPENDIX-C

GEOLOGY

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ANNEX Log Sheet

APPENDIX-C

GEOLOGY

1. INTRODUCTION

1.1 Purpose of Survey

The purpose of the survey is to understand engineering geology and stratigraphy of the study area. The field work was carried out for five months from the middle of July to the middle of December 1984.

The geological data and information collected for the study consist of comprehensive engineering study reports, photographs of drilling core samples, drilling logs, drilling core samples, records of seismic survey, records of permeability test, and drawings. Inventory of these information referred in the report are shown in the list of references.

The drilling work was carried out by the local contractors in cooperation with JICA Team's expert. The drilling work consists of core drilling, standard penetration test and field permeability test. Seismic exploration was also performed to grasp the main features of the unconsolidated deposits and weathered layer and measurement of from surface down fresh rock and also to assess a scale of hardness of rock.

1.2 Previous Geological Investigation

Geological investigation of the Karian dam site was made in 1982 about 500 m upstream from the present dam site by DGWRD. In the same year, the JICA Master Plan Study Team investigated the downstream reach and selected the present dam site judging from the topographical and geological viewpoints.

At the Karian dam site and on the trans-basin tunnel route, the initial geological investigation was carried out by 11 bore holes by the local contractor in 1982. Subsequent drilling programs of Cilawang dam site and trans-basin tunnel route, Gadeg diversion works and two quarry sites were undertaken by the Bina. Program Jen. Pengairan in 1983 and 1984 (Ref. 1-7. and 9). These programs included 57 core borings, the depths of which ranged from 13 m to 60 m. The core from all the drill holes was logged. A summary of existing core boring and seismic surveys are shown in Table C-1. The locations of existing core borings are shown on the each geologic map of the dam site.

The seismic survey works were made at the Karian dam site and on the Ciuyah trans-basin tunnel route in 1982 and 1983 to supplement drilling information by boring core. These survey works consisted of 15 survey lines and 4,788 m long in total. The locations of existing seismic survey works are shown on the geologic map of the respective site.

2. SURVEY WORKS

2.1 Field Reconnaissance

2.1.1 General Geology

The geology of the project area consists of the alluvial of Holocene, terrace deposit of Pleistocene, tuffaceous sedimentary rocks of Pliocene to Miocene, and southern volcanics of Miocene. The general geological condition in and around the project area is shown on Figure C-1 (Ref. 8), and the stratigraphy of the project area is shown in Table C-2.

The sedimentary formations of Miocene to Pleistocene are divided into several formations which are superposed monoclinically from south to north and from lower to upper horizons in order. They are mainly composed of fine to coarse tuffaceous sandstone and pumice tuffs with interbedding of lapilli tuffs which belong to the Genteng Formation of Pliocene in the project area. The southern volcanic mountains were formed by basalt, volcanic breccia (G.Alung) and andesite (G. Guradog, G. Sendi), which are erupted and/or intruded along the faulting zones in Miocene. In general, beddings are dipping in low angles and gently folded. Most of lineaments and fault lines with NW-SE trend and NE-SW trend are marked on aerial photographs.

2.1.2 Rock Types and Characteristics

The geology clarified by surface geological mapping, core drilling and seismic survey result is summarized as follows:

(1) Genteng Formation

The Genteng Formation consists of tuffaceous sedimentary facies, which are composed of sandstone, pumice tuff, lapilli tuff, welded tuff, claystone, and conglomerate. The outcrops of the Genteng Formation are observed at several places at the river side of the Ciberang river and the Cibeureum river. The Genteng Formation occupies the most part of the project area. This formation belongs to Pliocene age of