インドネシア共和国
水力調査
報告書

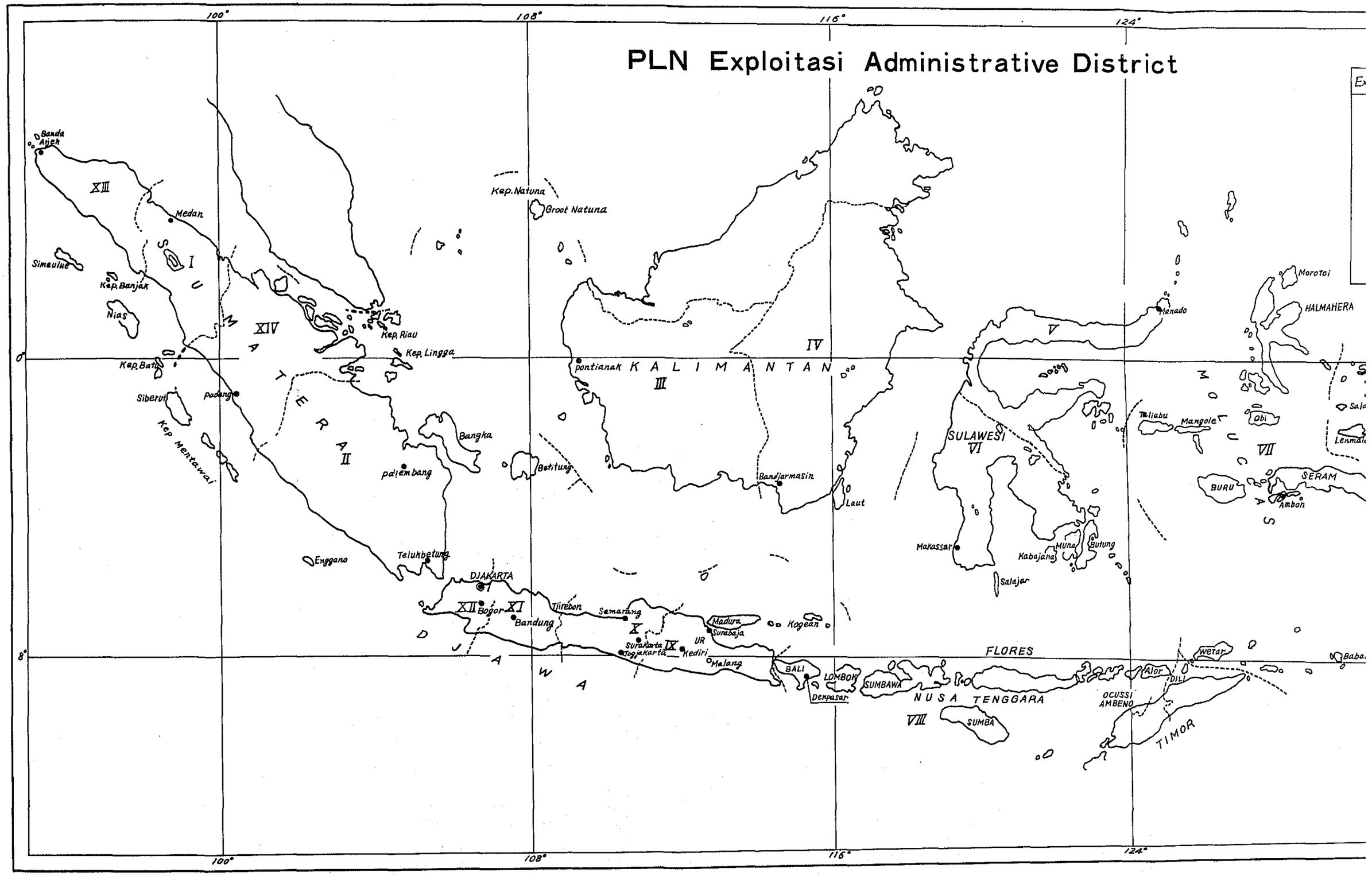
第III巻 資料編

昭和46年3月

海外技術協力事業団

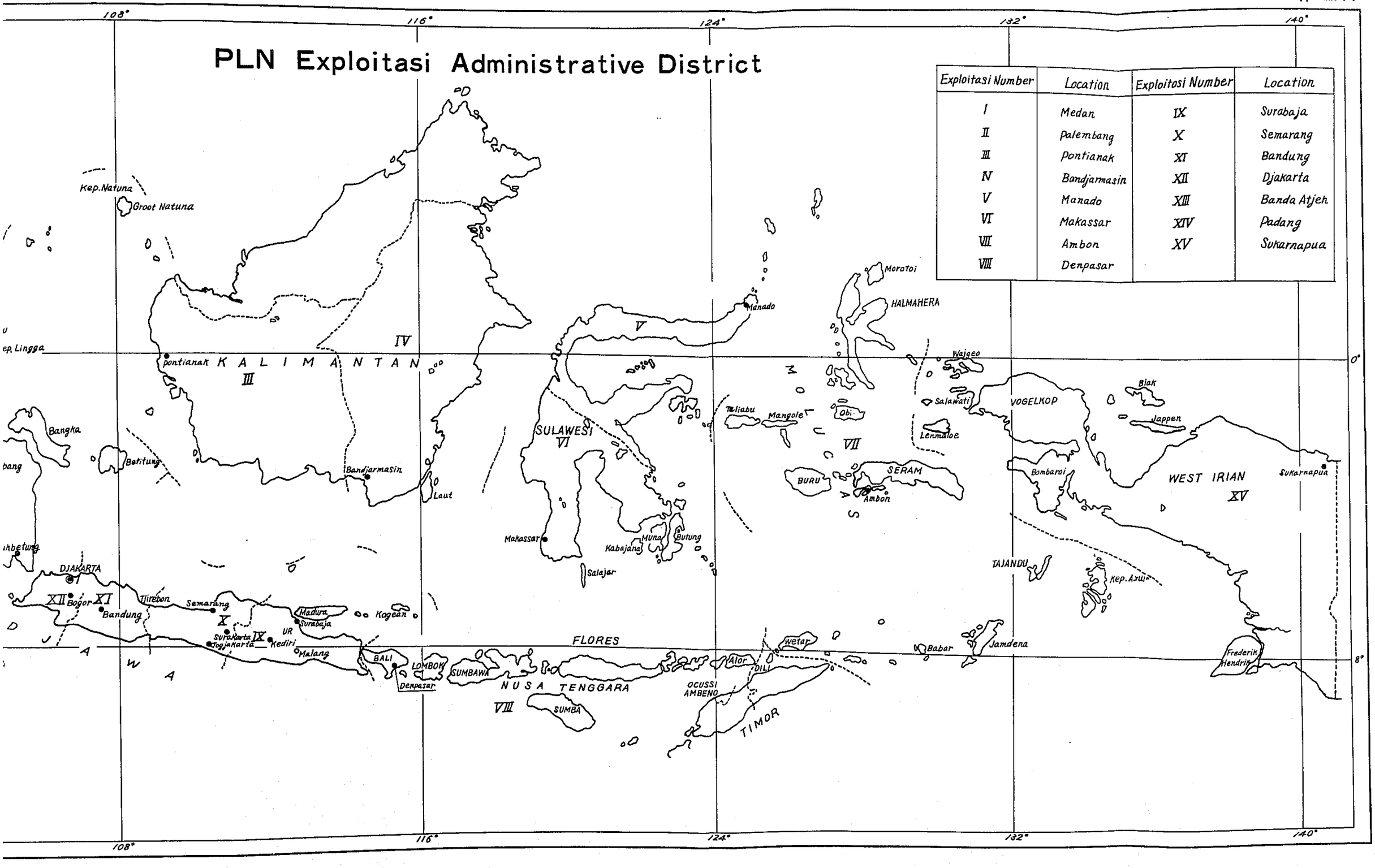
第III巻　資料編

PLN Exploitasi Administrative District



PLN Exploitasi Administrative District

Exploitasi Number	Location	Exploitosi Number	Location
I	Medan	IX	Surabaja
II	Palembang	X	Semarang
III	Pontianak	XI	Bandung
IV	Bandjarmasin	XII	Djakarta
V	Manado	XIII	Banda Atjeh
VI	Makassar	XIV	Padang
VII	Ambon	XV	Sukarnapua
VIII	Denpasar		



THE ESTIMATION OF THE HYDRO-POWER RESOURCES IN INDONESIA

Drs. C. H. Hutasoit of the Power Research Institute has prepared a report with the title of 'A study on the power resources in Indonesia' (originally 'Sebuah studi tentang sumber-sumber tenaga di Indonesia'), in 1968.

He dealt with the hydro-power resources in this report as well as other power resources and estimated the hydro-power potential to be 28,000MW in total. The basis of this estimation can be seen on the five maps annexed here.

The summary of the estimation method is as follows.

The author divided the territory of Indonesia into six districts, namely five big islands (Sumatera, Djawa, Kalimantan, Sulawesi and West Irian) and others (the Lesser Sundas and Moluccas) for the estimation of the hydro-power potential.

1. Sumatera; Some parts of this island have been surveyed and the estimation for the non-surveyed district is carried out by using the ratio of non-surveyed area to the surveyed area.

2. Djawa; The potential in this island estimated in Dutch time as the technically developable potential, and after the second world war, the potential of several rivers has been checked by the engineers of foreign countries or of the Indonesian Government.

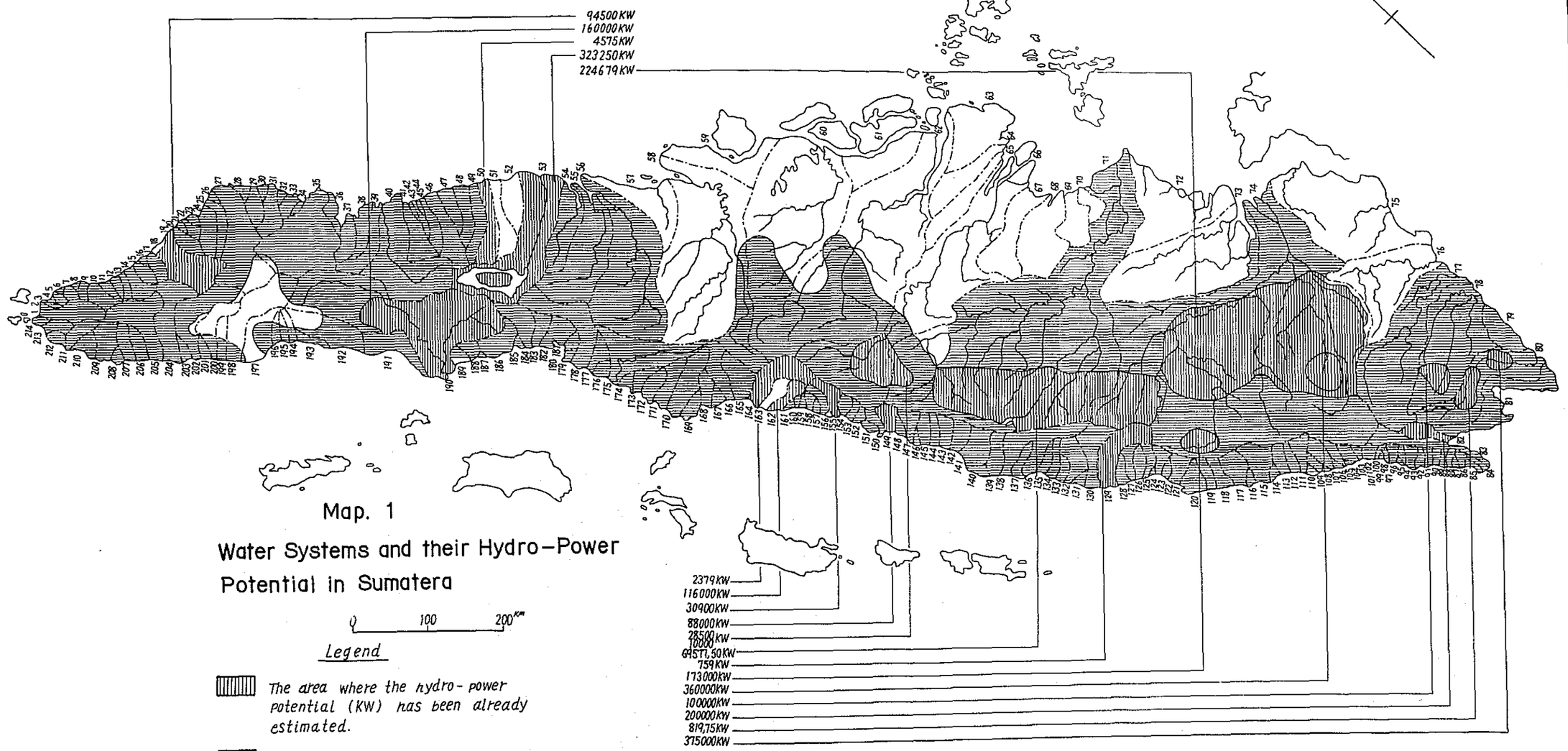
3. Kalimantan; The survey has been carried out only for Riam Kanan and Riam Kiri, so that the potential was estimated by the analogy with the result of Sumatera.

4. Sulawesi; The estimation was carried out likewise Sumatera.

5. West Irian: The estimation was carried out likewise Sumatera.

6. Lesser Sundas and Moluccas;
The estimation was carried out by only bold assumption.

Furthermore, this report mentioned about the survey of the basic data such as the topographical maps, precipitation data, run-off data and others.



Map. 1

Water Systems and their Hydro-Power Potential in Sumatera

0 100 200 Km

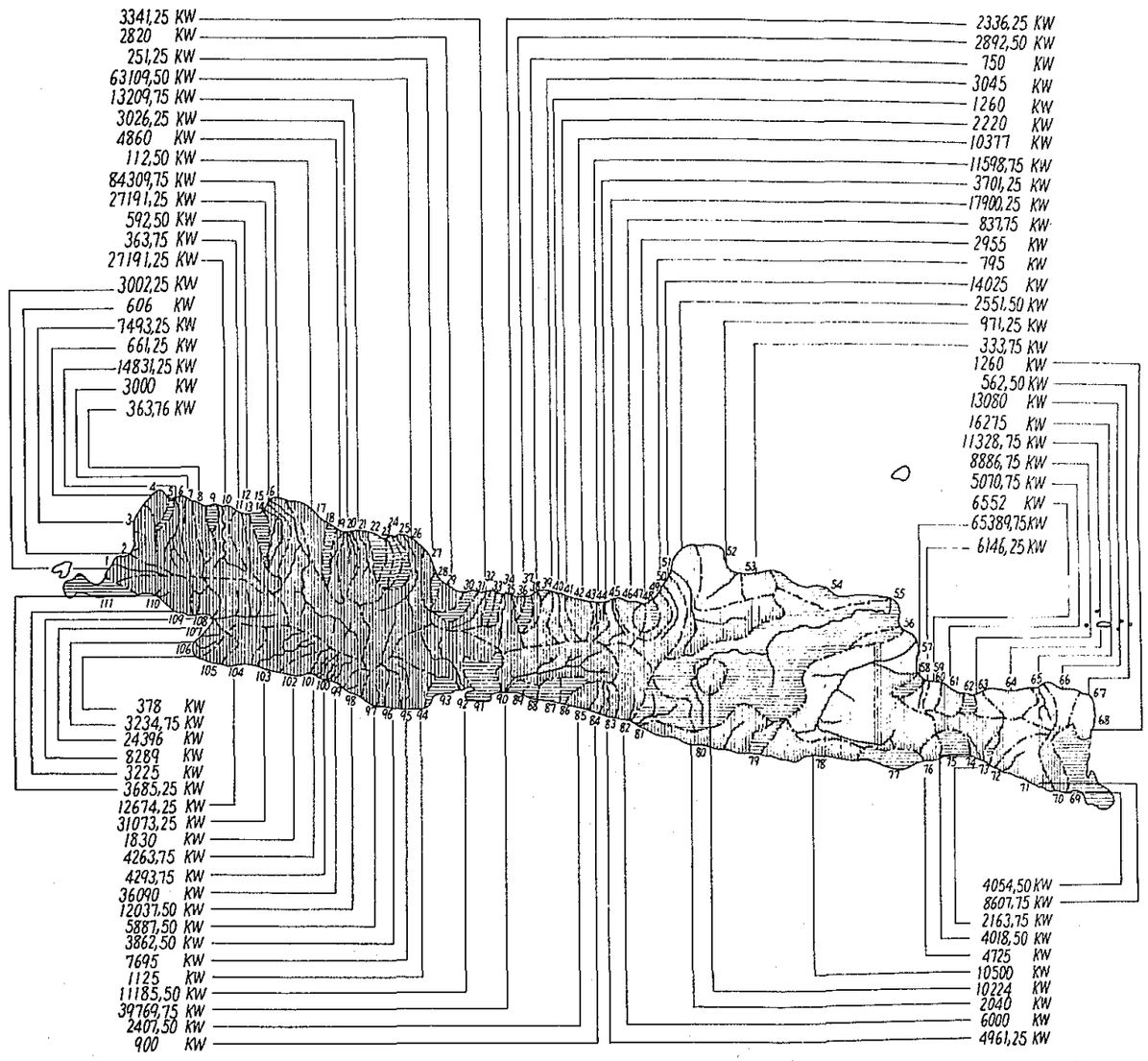
Legend

The area where the hydro-power potential (KW) has been already estimated.

The area where rain-fall stations exist.

The area where no rain-fall station exists.

Boundary line



Map. 2

Water Systems and their Hydro–Power Potential in Djawa

0 100 200 km

Legend

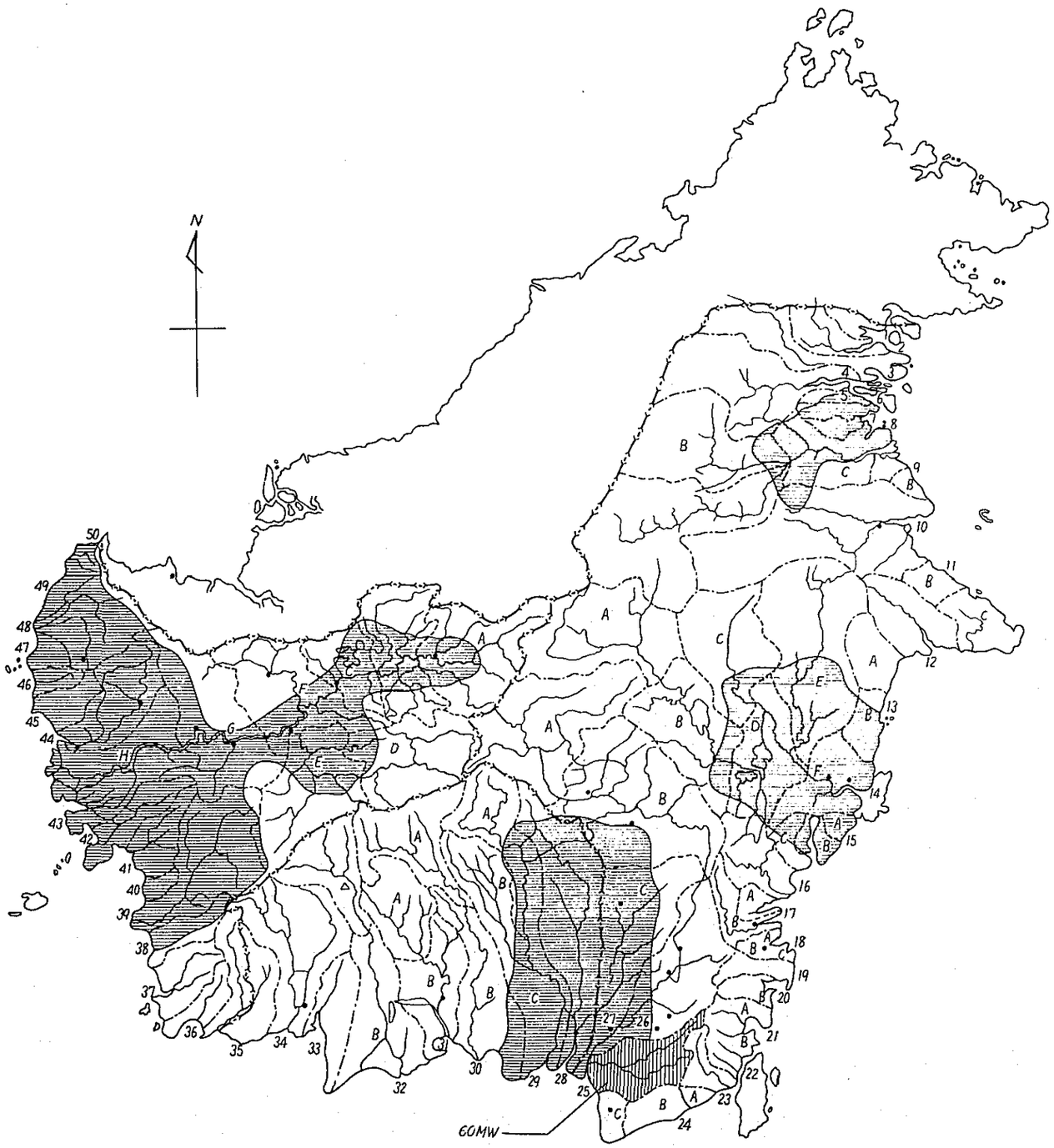
The area where the hydro-power potential (KW) has been already estimated.

The area where rain-fall stations exist.

The area where no rain-fall station exists.

Boundary line

N



Map. 3

Water Systems and their Hydro – Power Potential in Kalimantan

0 100 200 km

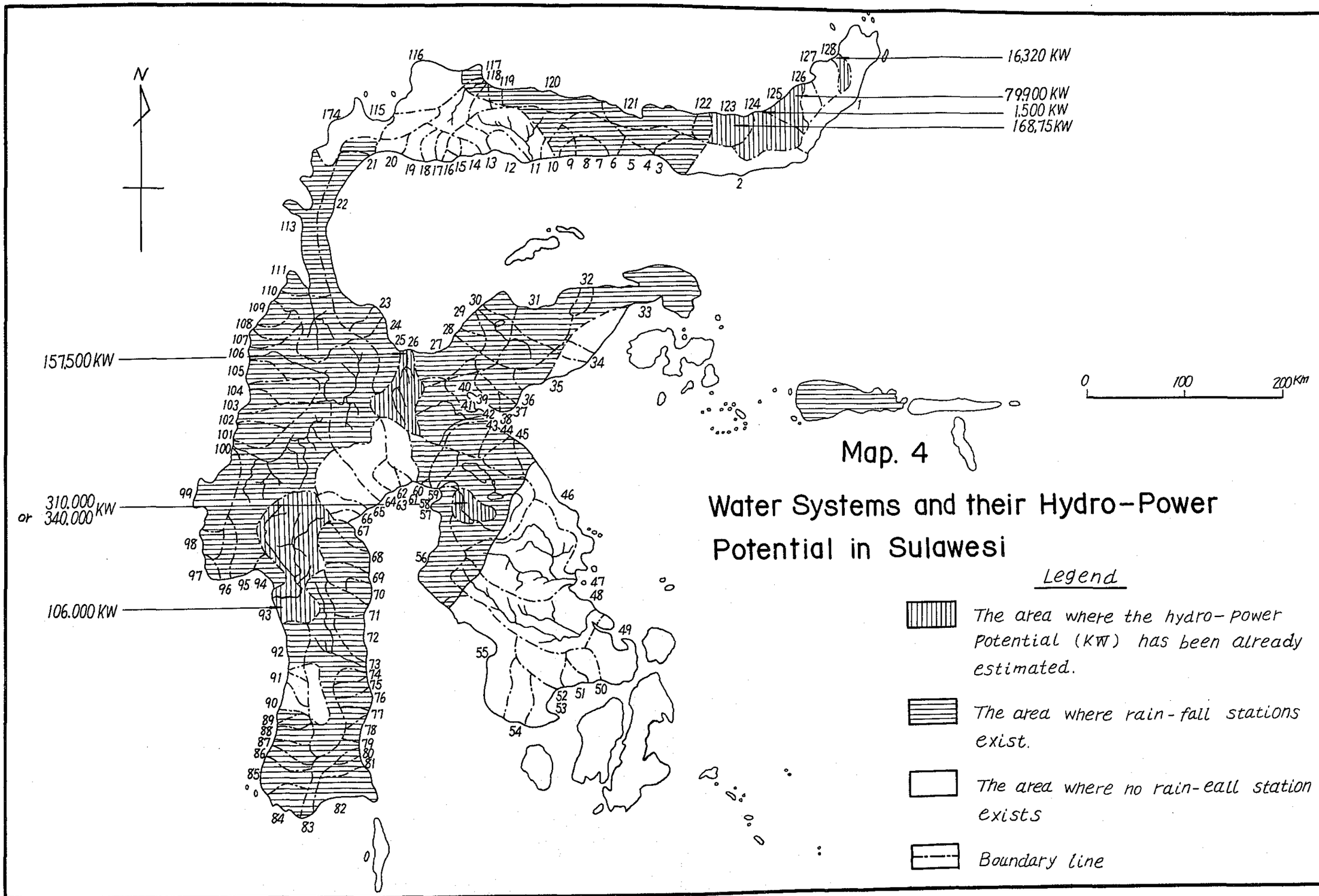
Legend

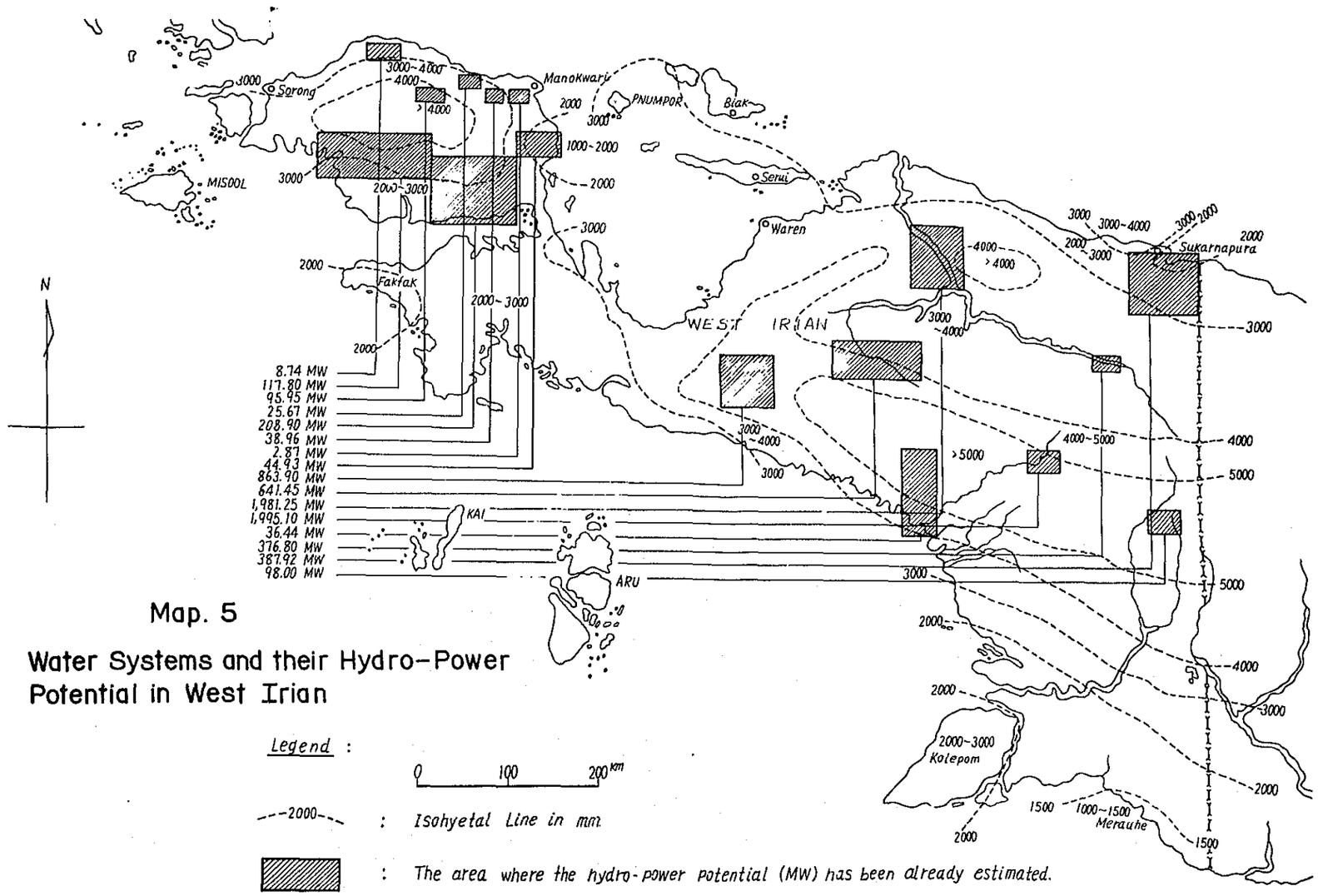
The area where the hydro-power potential (MW) has been already estimated.

The area where rain-fall stations exist.

The area where no rain-fall station exists.

Boundary line


N
16.320 KW
79.900 KW
1.500 KW
168,75 KW
157.500 KW
310.000 KW
or 340.000 KW
106.000 KW
0 100 200 Km
Map. 4
Water Systems and their Hydro-Power Potential in Sulawesi
Legend
The area where the hydro-power Potential (KW) has been already estimated.
The area where rain-fall stations exist.
The area where no rain-eall station exists
Boundary line



Map. 5

Water Systems and their Hydro-Power Potential in West Irian

Legend :

--2000-- : Isohyetal Line in mm

: The area where the hydro-power potential (MW) has been already estimated.

EXISTING REPORTS ON HYDRO-POWER DEVELOPMENT IN INDONESIA

(I) Sumatera

No.	Name of Report	Prepared by	Date	Requested by	Contents	Descriptions
I-1	Design report on the Batang Agam Project	PLN Project	Sept., 1962	The Indonesian Government	Design Report	Geology, Hydrology, Energy calculation, Construction cost, Transmission line.
I-2	Interim Report on the Asahan Aluminium Project in North Sumatera, Indonesia	Nippon Koei	Feb., 1968	ditto	Survey Report	Introduction, summary and recommendation, Power project (7 P.S. 1,030MW), Bauxite, Alumina and Aluminium project, Harbour. (Preliminary Report : April, 1958)
I-3	Report on the Asahan Aluminium Project	ditto	May, 1969	ditto	ditto	Introduction, Project area, Meteorology and Hydrology, Overall Hydro-electric development, Power station scheme (7 P.S. 1,030MW), Power market survey, Project feasibility.
I-4	Report on Sigura-Gura Hydro-electric Project (6 vols.)	Vattenbyggnads byran (VBB)	1957 – 1960	ditto	Several Stages	Reconnaissance, Contract drawings Sigura-Gura P.S. (145MW, 950 x 10^6 KWH)
I-5	Reconnaissance Report on the Electricity Development Project in West Sumatera	Nippon Koei	July, 1965	ditto	ditto	Utilization of 4 lakes, Manindjau No. 1-3 (86MW, 315 x 10^6 KWH) Atas No. 1-3 (142MW, 600 x 10^6 KWH) Singkarak No. 1-3 (88MW, 395 x 10^6 KWH) Anai (30MW) Batang Agam (10MW) along Kusutan River (may-be 160MW)

No.	Name of Report	Prepared by	Date	Requested by	Contents	Descriptions
I-6	Basic reconnaissance report on the overall plan in Lampung and South Sumatera Provinces	Nippon Koei	Aug., 1965		Reconnaissance Survey	Lampung area, 310 MW South Sumatera, 533 MW Total 843 MW (Others may be 500 MW) Sumatera-Djawa transmission line is recommended
I-7	Scheme of Power utilization of Asahan River (Vol. I - IV)	Hydro Project Moscow (USSR)	1964	The Indonesian Government	Survey Report	Simangkuk, 120 MW 630 x 10^6 KWH Simorea, 150 780 Sigura-Gura, 320 1,700 Tangga, 412 2,230 Tratak, 200 930 Total 1,202 MW 6,270 x 10^6 KWH Natural condition, Water power data, Structures.

(II) Djawa

No.	Name of Report	Prepared by	Date	Requested by	Contents	Descriptions
II-1	A Federal Development Project for the Western part of Djawa	Prof. Dr. W.J. Blommestein	Dec., 1948		Overall Development Plan	Multi-purpose scheme in West Djawa (Irrigation, Power generation, Flood control, Navigation, Water supply, Sewage disposal and Drainage system)
II-2	Tji Manuk Project	Coyne et Bellier	July, 1967	The Indonesian Government	Studies & Investigation	Topography, Geology and Hydrology
II-3	Garung Hydro-Power Plant	The Indonesian Government	June, 1961		Design Report	Kali Seraju, 9MW
II-4	Report on Overall Development Plan Bengawan Solo Project	Nippon Koei	Dec., 1966	The Indonesian Government	Overall Development Plan	Flood control, Irrigation, Watershed management, and Power generation (4 P.S. 29MW, 122 x 10^6 KWH)
II-5	Report on Predesign of Djipang Dam and Lower Solo Irrigation Project	ditto	Dec., 1966	ditto	Predesign	Djipang Dam and Lower Solo Project
II-6	Reconnaissance and comprehensive reports on Kali Brantas Project (2 vols. & 1 appendix)	ditto	Oct., 1959 Apr., 1961	ditto	Reconnaissance report	Reconnaissance of overall project. (Meteorology and Hydrology)
II-7	Reports on Kali Konto Project (8 vols.)	ditto	1961 – 1962	ditto	Several stages	Meteorology, Hydrology, Geology, Design Embankment type dam (height: 46m) Power station (capacity: 4.5MW)
II-8	Reports on Wlingi Dam and Power Station Project (9 vols.)	ditto	1963 – 1964	ditto	Overall	Meteorology, Hydrology, Geology, Design Combined type dam (height: 47m) Power station (capacity: 35MW)

No.	Name of Report	Prepared by	Date	Requested by	Contents	Descriptions
II-9	Preliminary report on sand arresting project along Kali Putih and Kali Bladak	Nippon Koei	Sept., 1963	The Indonesian Government	Preliminary Report	Sand arresting schedule on the tributaries of Kali Brantas
II-10	Reports on Karangkates Project	ditto	1959 – 1962	ditto	Several stages	Embankment type dam (height: 100m) Power station (capacity: 105MW)

(III) Kalimantan

No.	Name of Report	Prepared by	Date	Requested by	Contents	Descriptions
III-1	Reconnaissance report on the Barito River Basin Development Project	Nippon Koei	Aug., 1968	The Indonesian Government	Reconnaissance Report	Multi-purpose Development, Agriculture (2,200,000 ha), Power generation and Navigation Muaratuhup, 600 MW Muaradjuloi, 500 Lahai & Tewe, 125 Negara River, 75 Riam Kiwa 30 Total 1,330 MW
III-2	Reports on Riam Kanan Project	ditto	1961 – 1964	ditto	Several stages	Preliminary design, Hydraulic model test, Specifications, Power station (capacity: 30 MW)

(IV) Sulawesi

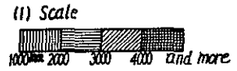
No.	Name of Report	Prepared by	Date	Requested by	Contents	Descriptions
IV-1	Reconnaissance report on the Larona Project in the Republic of Indonesia	OTCA Japan	May, 1964	The Indonesian Government	Reconnaissance Report	Utilization of three lakes, Larona No. 1-3 (340MW, 2,600 x 10^6 KWH) Expected for the treatment of nickel ore in Pomala and Soroako Area
IV-2	Reports on the Hydro-power development in Celebes	Japanese Engineers	1943		ditto	1,900 MW
IV-3	Reports on the Larona Project	ditto	ditto		ditto	370 MW
IV-4	Reports on the Mamasa River Project	ditto	ditto		ditto	163 MW
IV-5	Larona Project in Celebes	Nippon Koei	Jan., 1958	The Indonesian Government	Design Report	(1) Larona River Project No. 1-3 (310MW, 2,470 x 10^6 KWH) (2) Smelter Plan (Ferro-Nickel Smelter)

(V) West Irian

No.	Name of Report	Prepared by	Date	Requested by	Contents	Descriptions
V-1	Waterkracht Nederlands Nieuw Guinea	Netherlands	May, 1959		Paper Plan	54 sites for power station are planned, Reservoir type: 33 sites Run-of-river type: 21 sites Total MW: 6,837.4 MW Discharge is estimated from rain fall by following formula $Q=0.00761RF\ (m^3/s)$ where Q: discharge, R: rainfall in meter F: catchment area in km^2 Available head is assumed to be 98-90% of gross head Estimated capacity 0 – 50 MW 31 sites 50 – 100 8 100 – 500 11 500 – 1,000 3 1,000 – 1 Total 54 sites

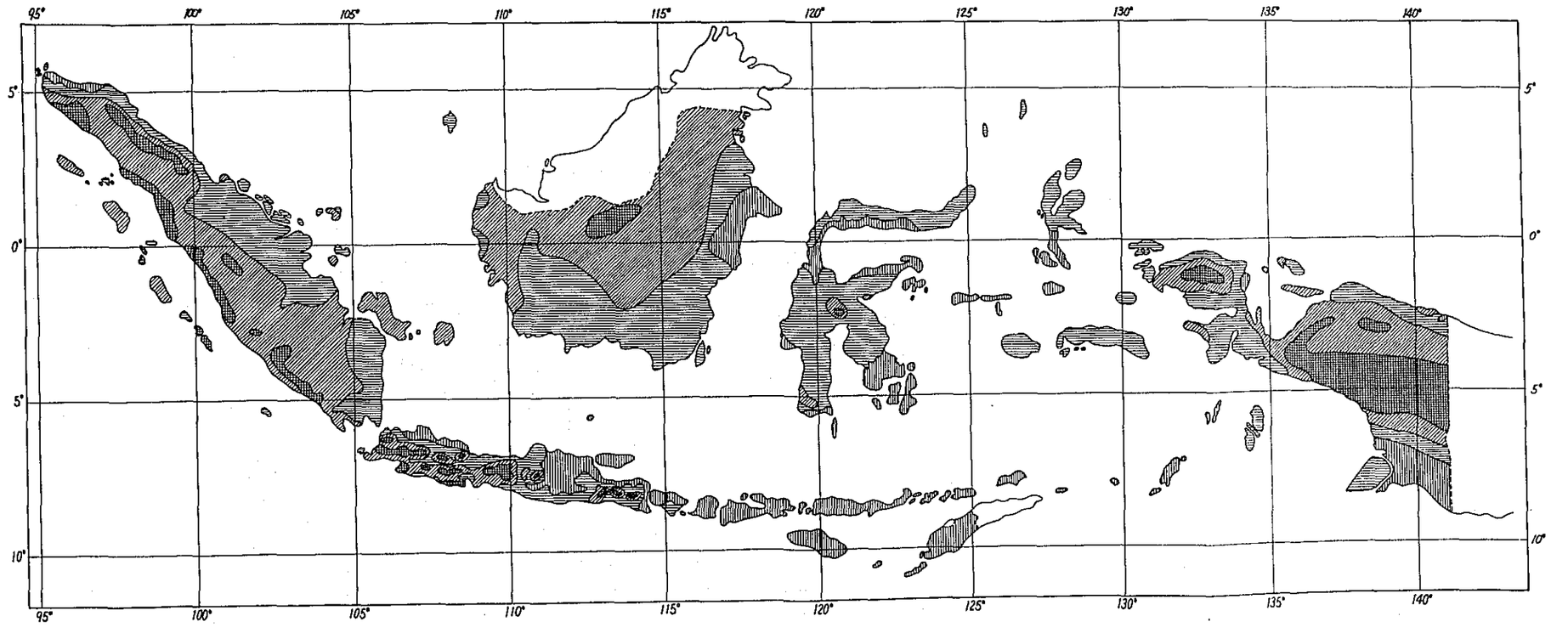
ANNUAL PRECIPITATION IN INDONESIA

NOTES : (1) Scale



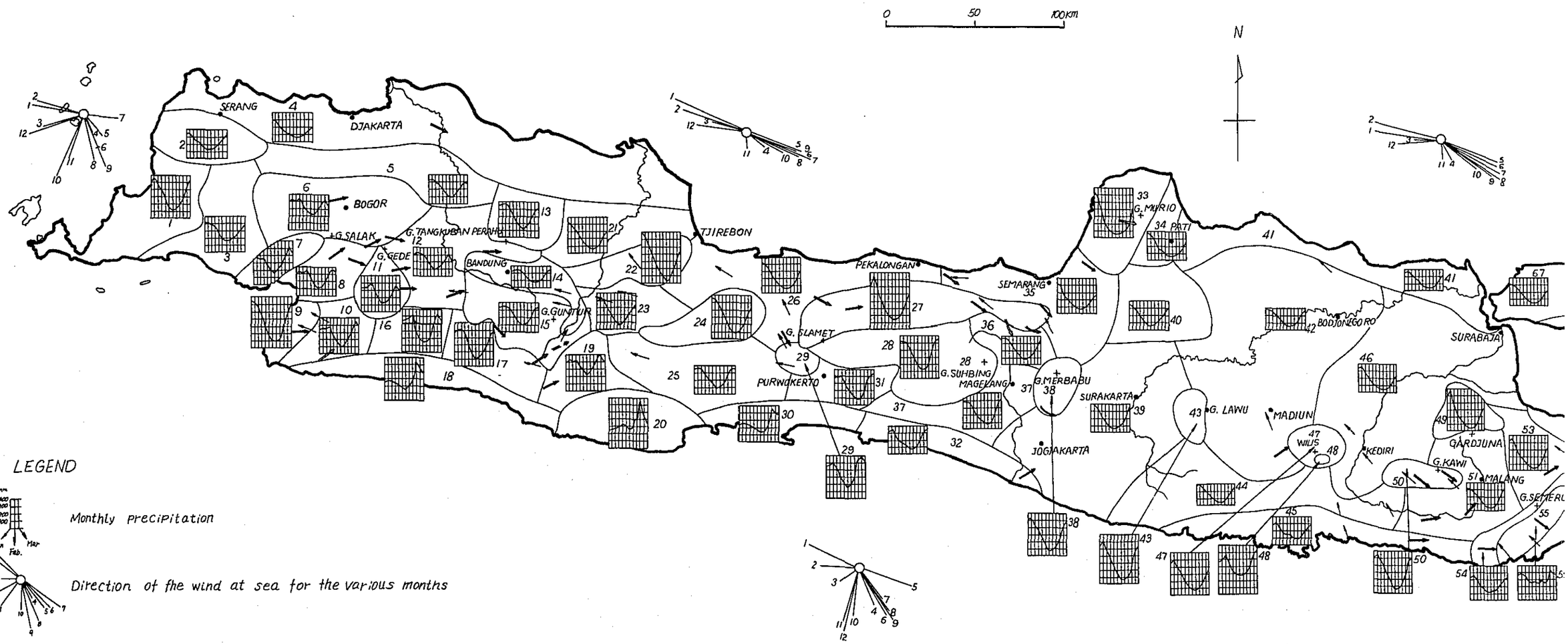
(2) Observation Period

Djawa	:	1879~1922
Sumatera	:	" ~1928
Sulawesi	:	" ~ "
Kalimantan	:	" ~ "
West Irian	:	~1959



RAINFALL TYPES IN INDONESIA

(Djawa and Madura)



LEGEND

Monthly precipitation

Direction of the wind at sea for the various months

Direction of East monsoon

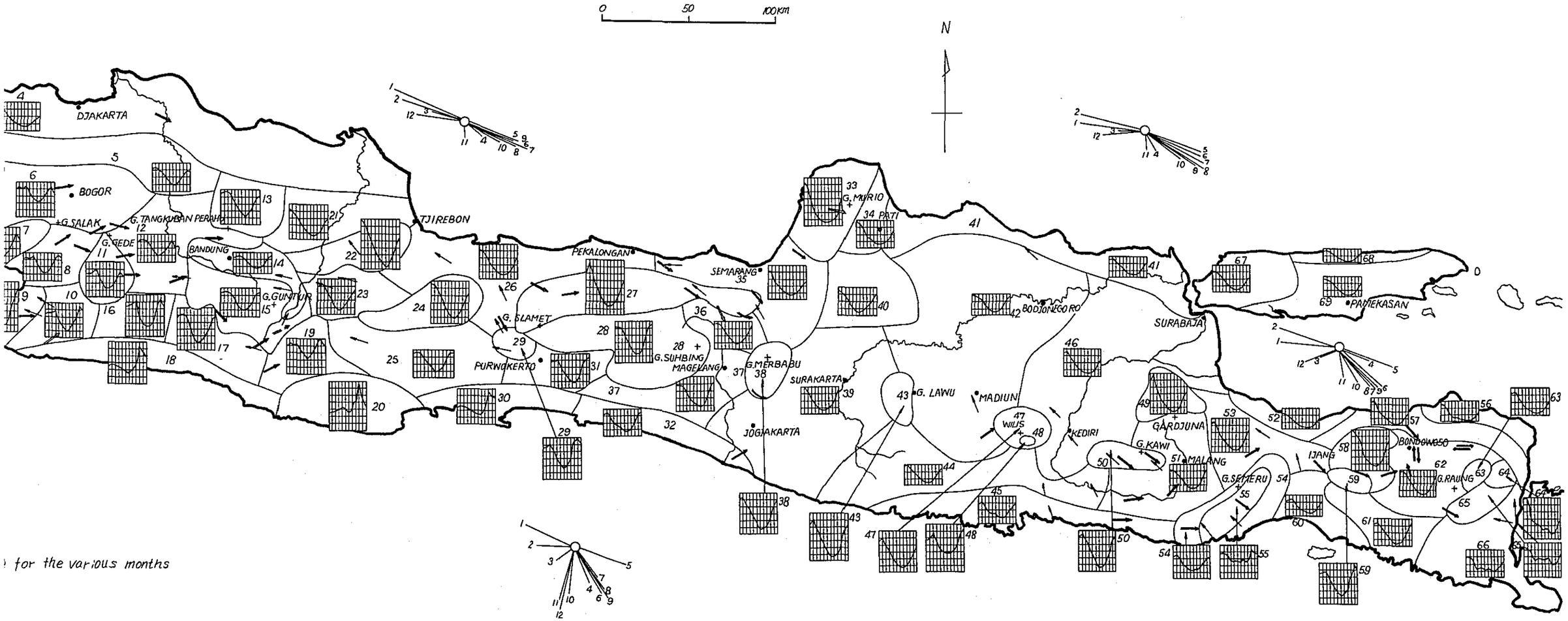
Direction of west monsoon

City / Town

Mountain

RAINFALL TYPES IN INDONESIA

(Djawa and Madura)



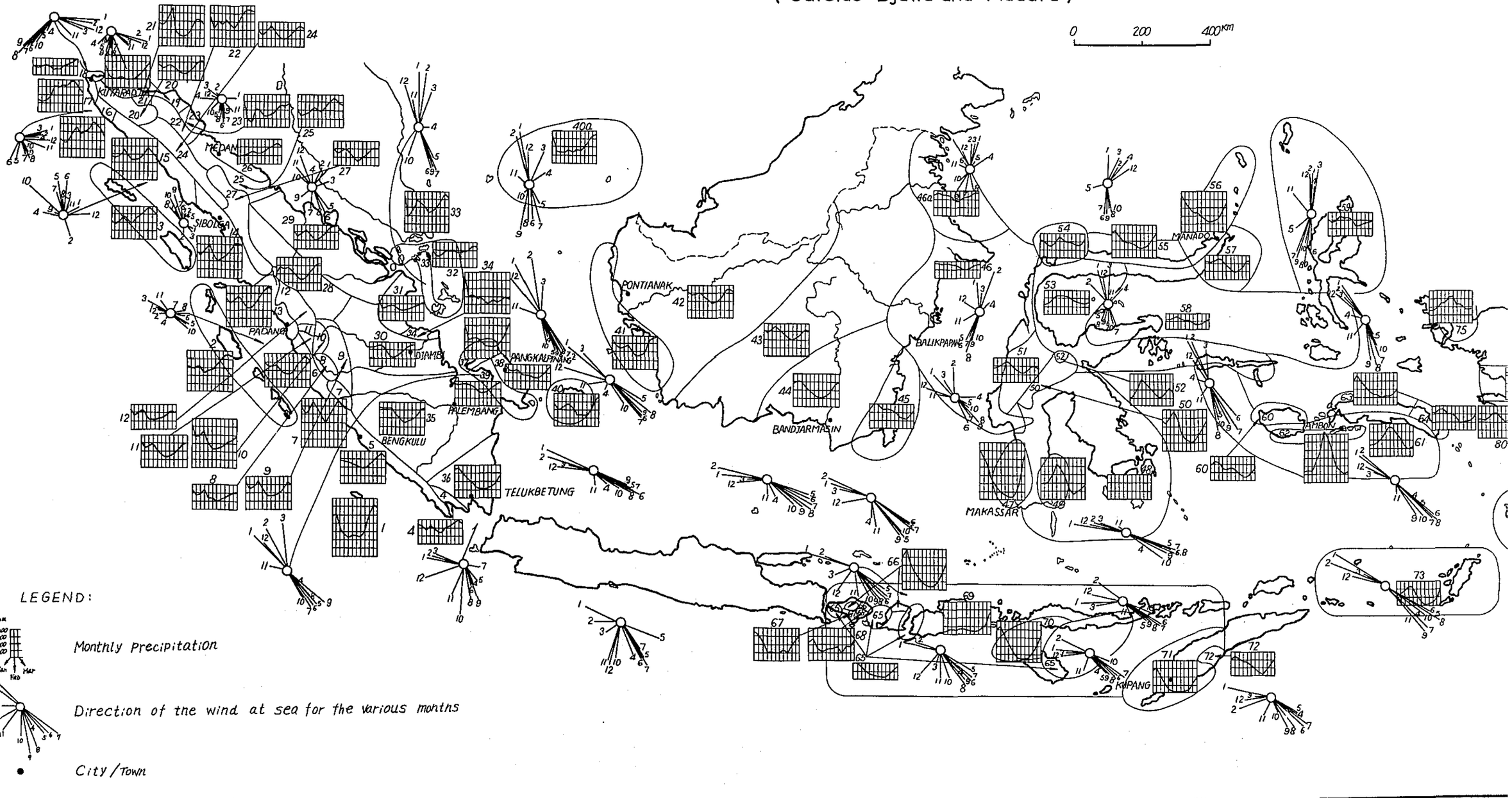
for the various months

on

on

RAINFALL TYPES IN INDONESIA

(Outside Djawa and Madura)



LEGEND:

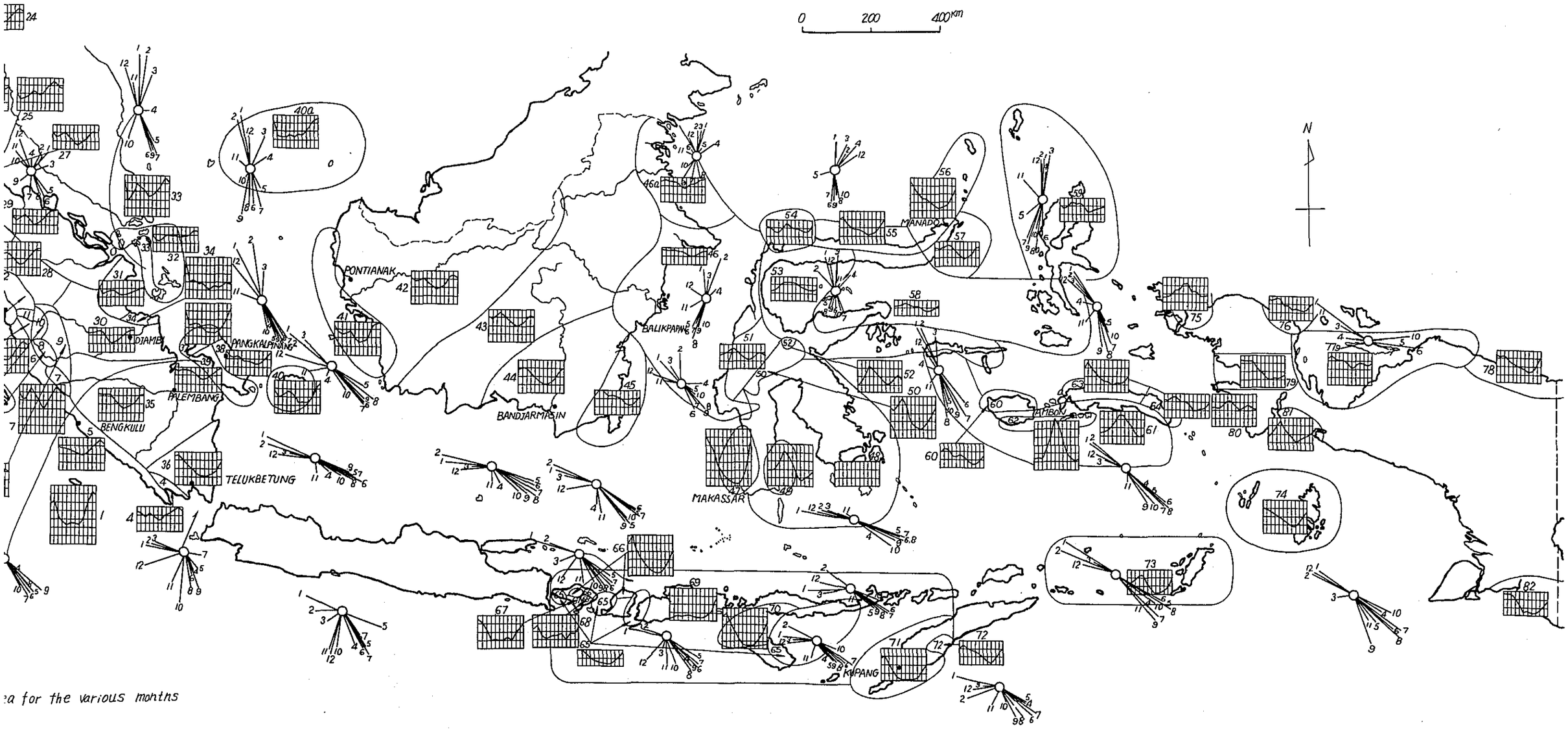
Monthly precipitation

Direction of the wind at sea for the various months

City / Town

RAINFALL TYPES IN INDONESIA

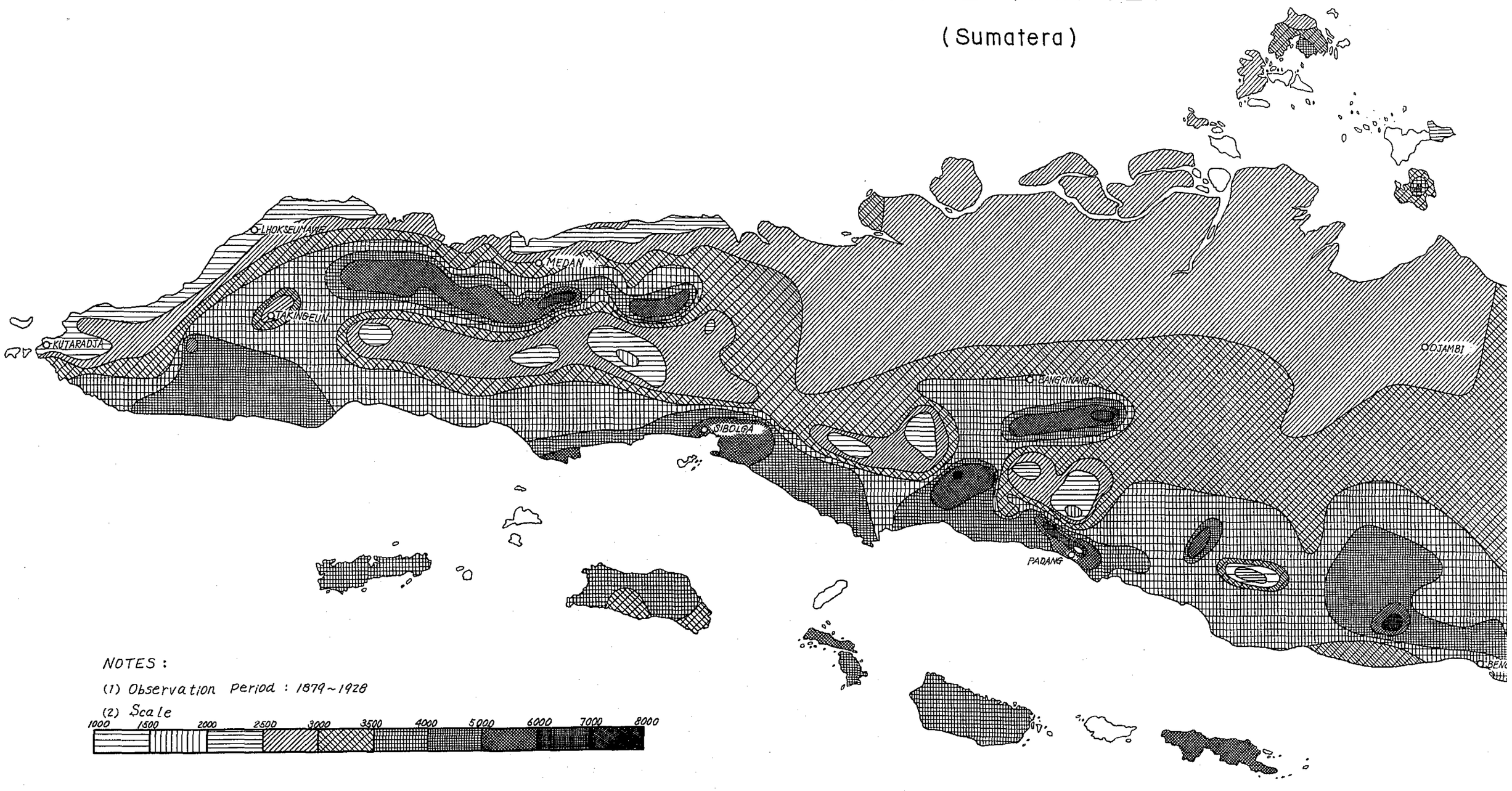
(Outside Djawa and Madura)



ea for the various months

ANNUAL ISOHYET

(Sumatera)



NOTES :

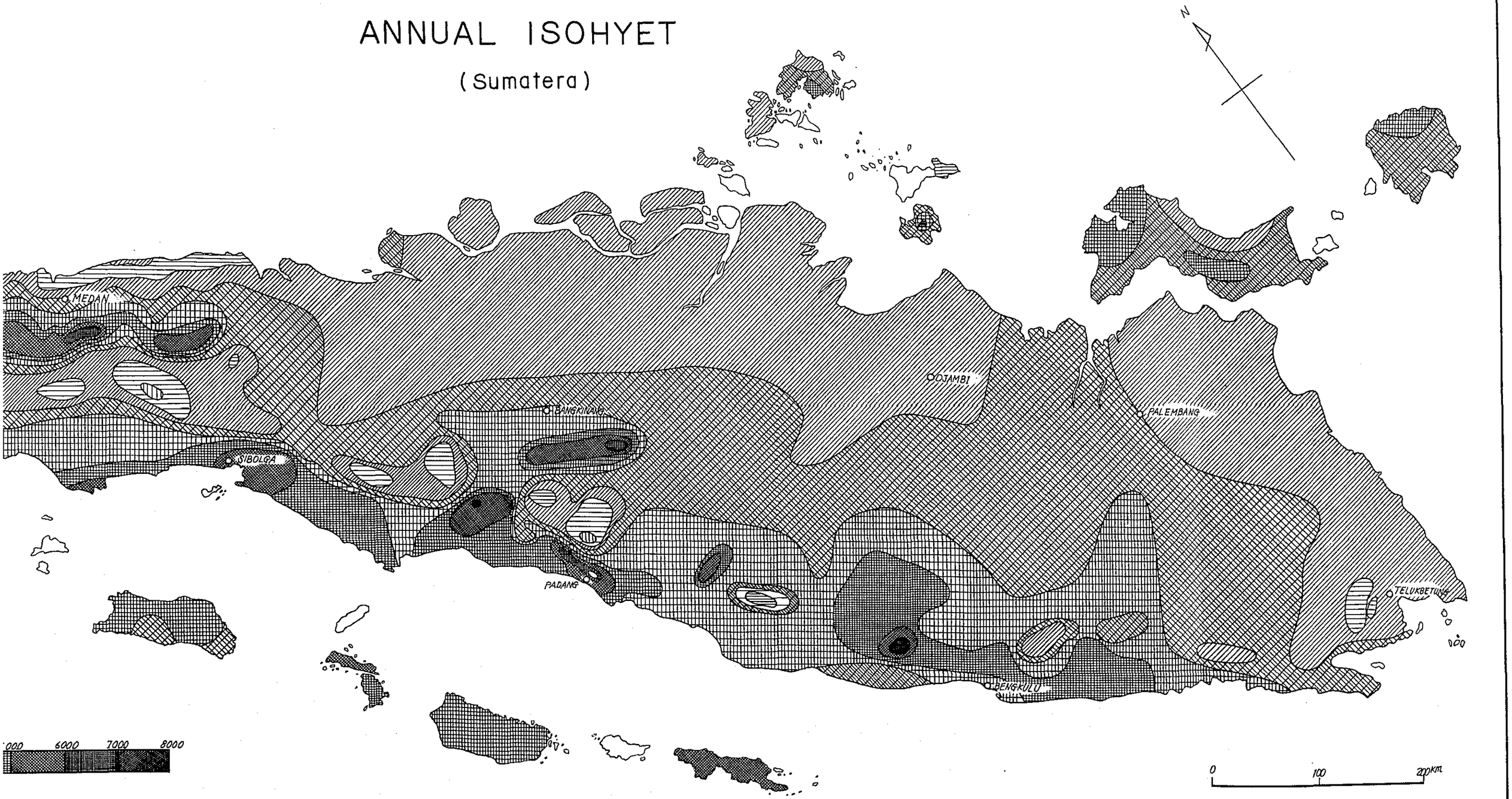
(1) Observation Period : 1879~1928

(2) Scale

1000 1500 2000 2500 3000 3500 4000 5000 6000 7000 8000

ANNUAL ISOHYET

(Sumatera)



ANNUAL ISOHYET

(Djawa and Madura)

NOTES :

(1) Observation Period : 1879 ~ 1922

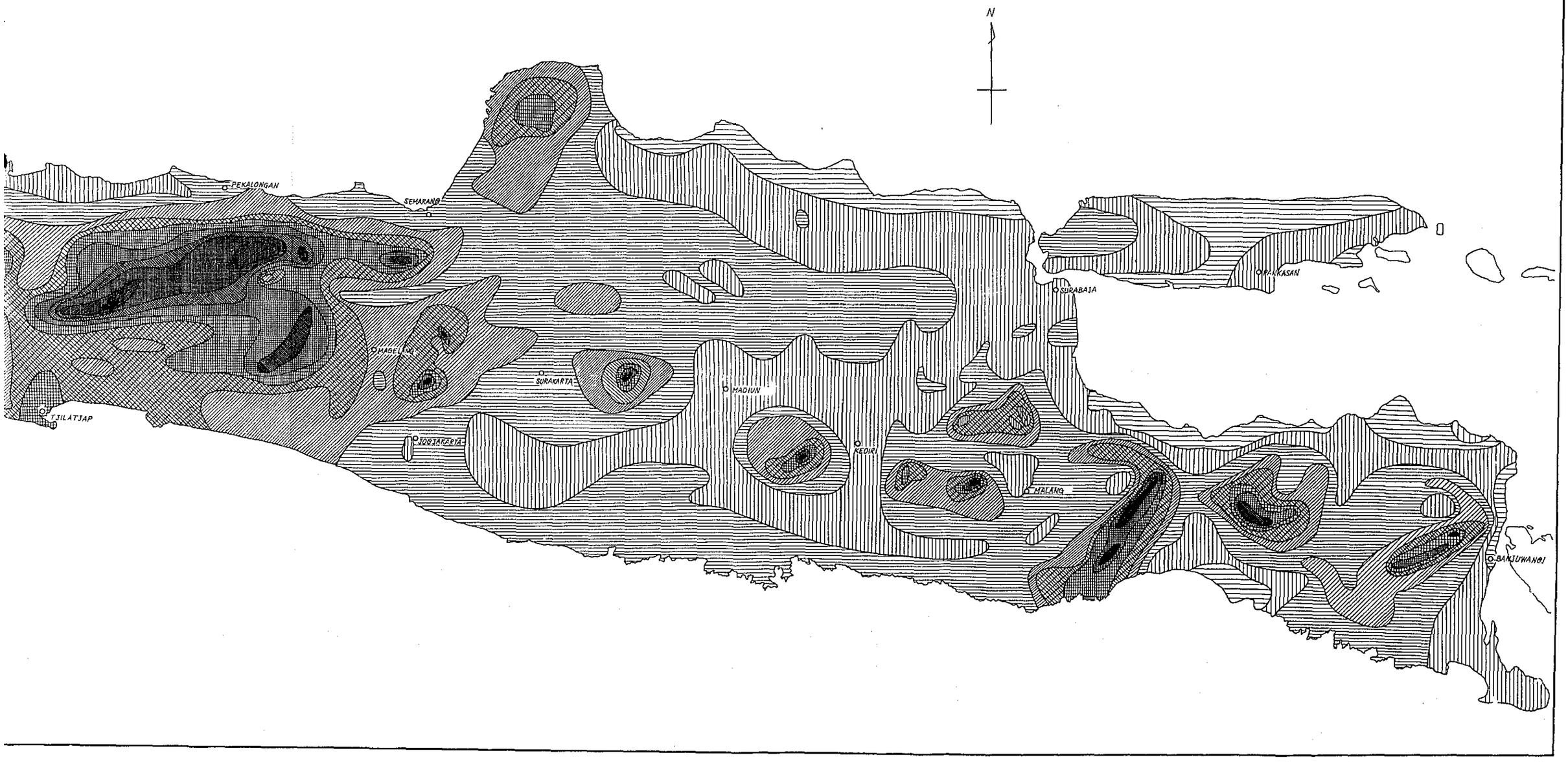
(2) Scale

500 1000 1500 2000 2500 3000 3500 4000 4500 5000 6000 7000 8000

0 25 50 Km

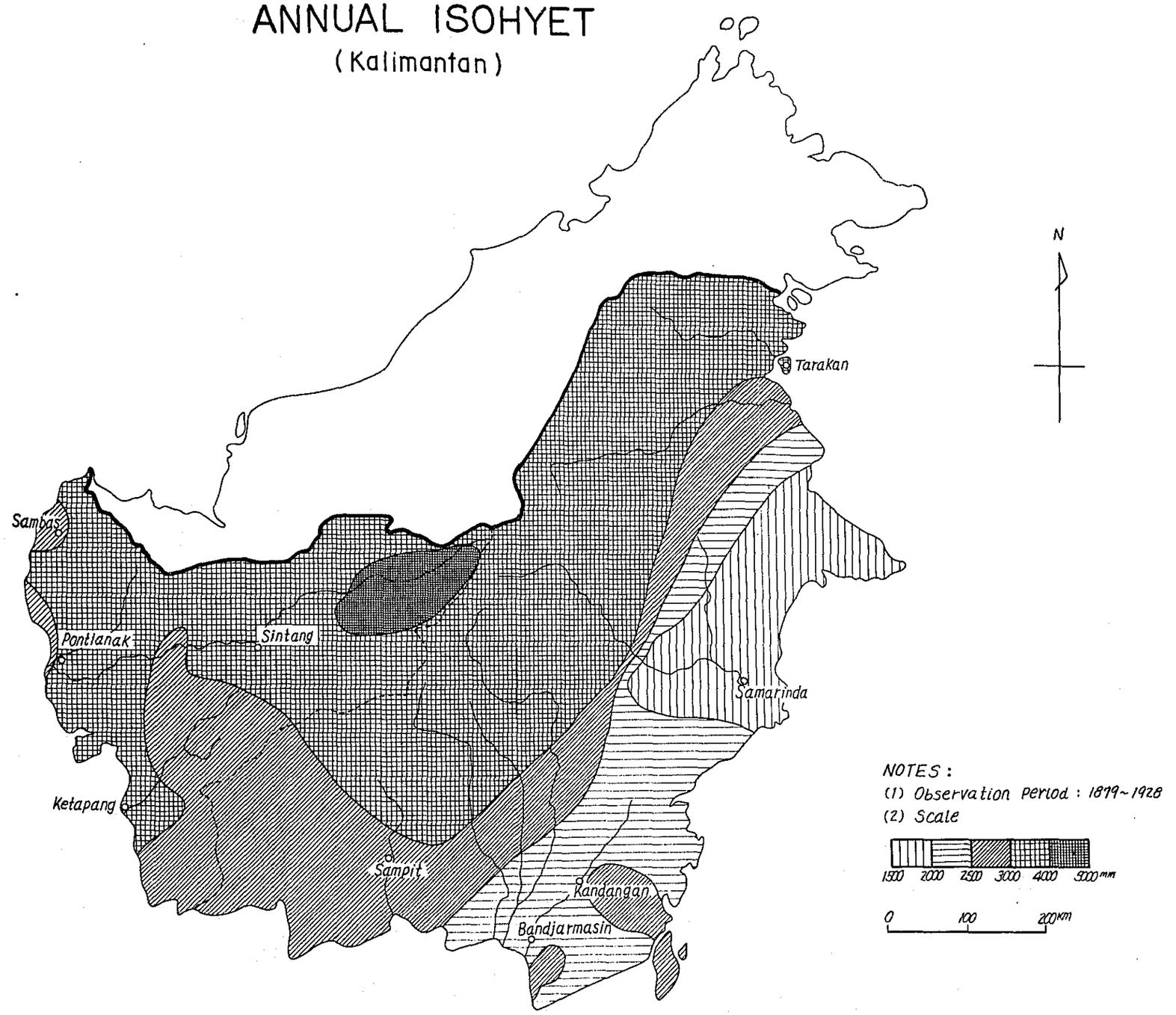
ANNUAL ISOHYET

(Djawa and Madura)



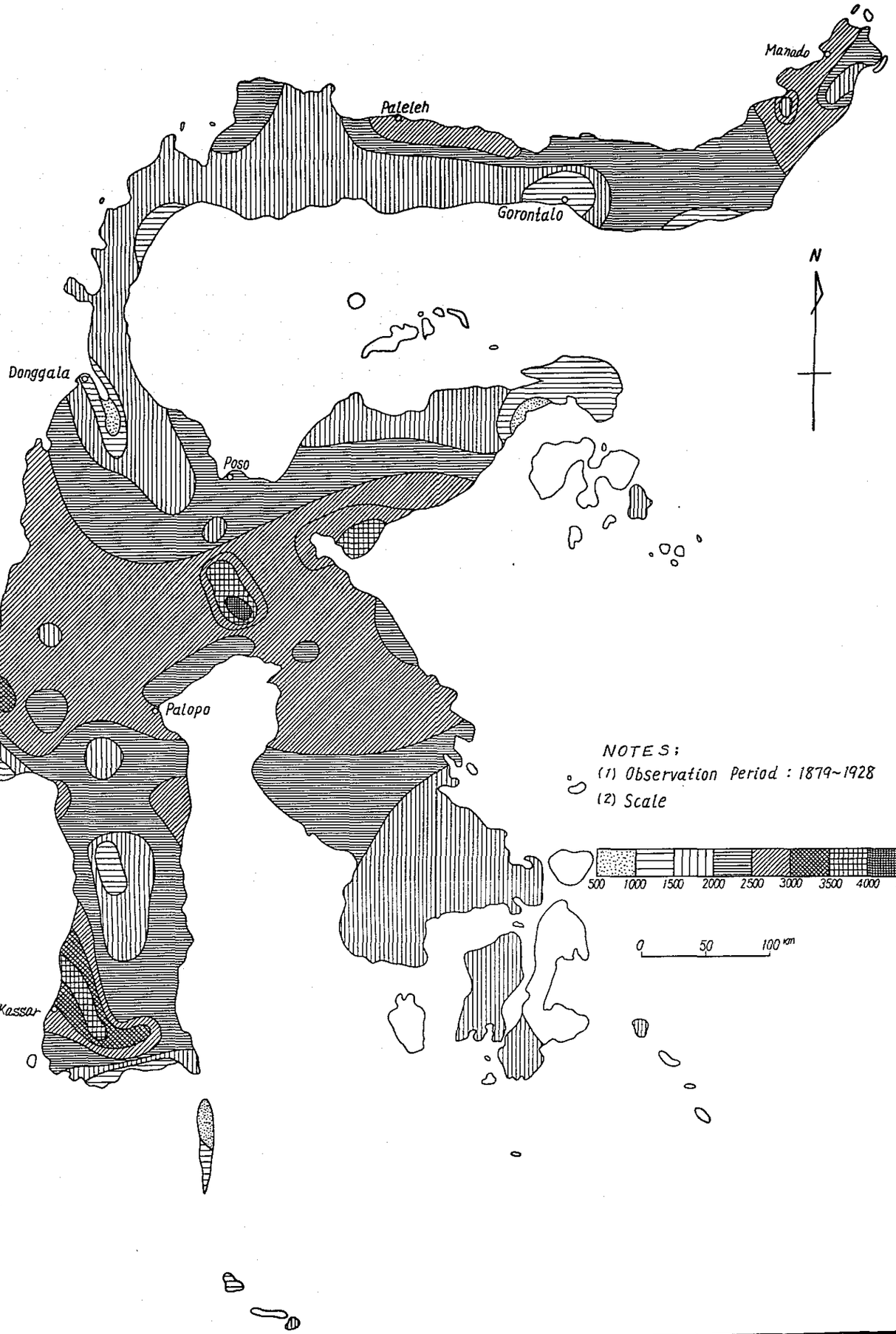
ANNUAL ISOHYET

(Kalimantan)



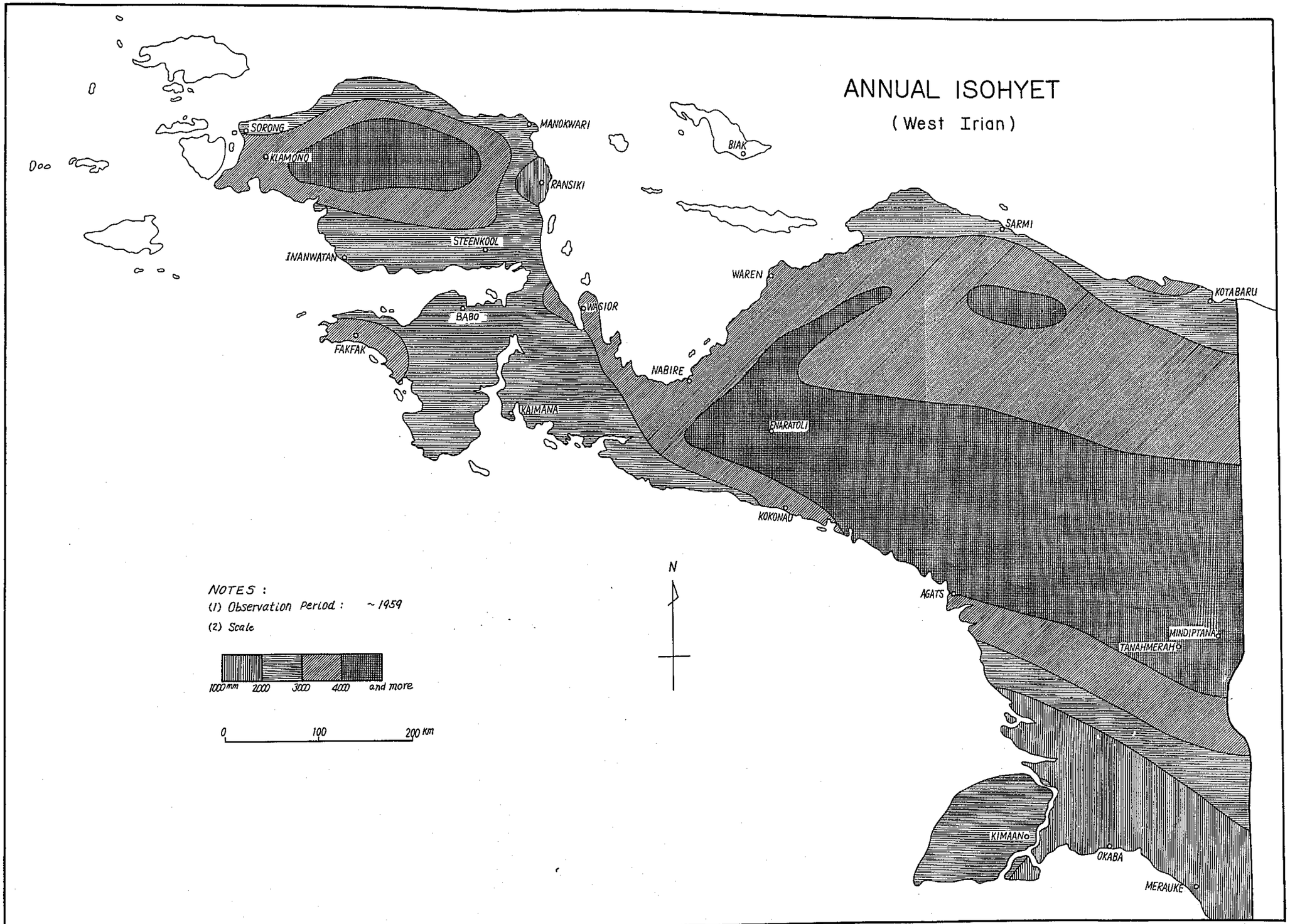
ANNUAL ISOHYET

(Sulawesi)

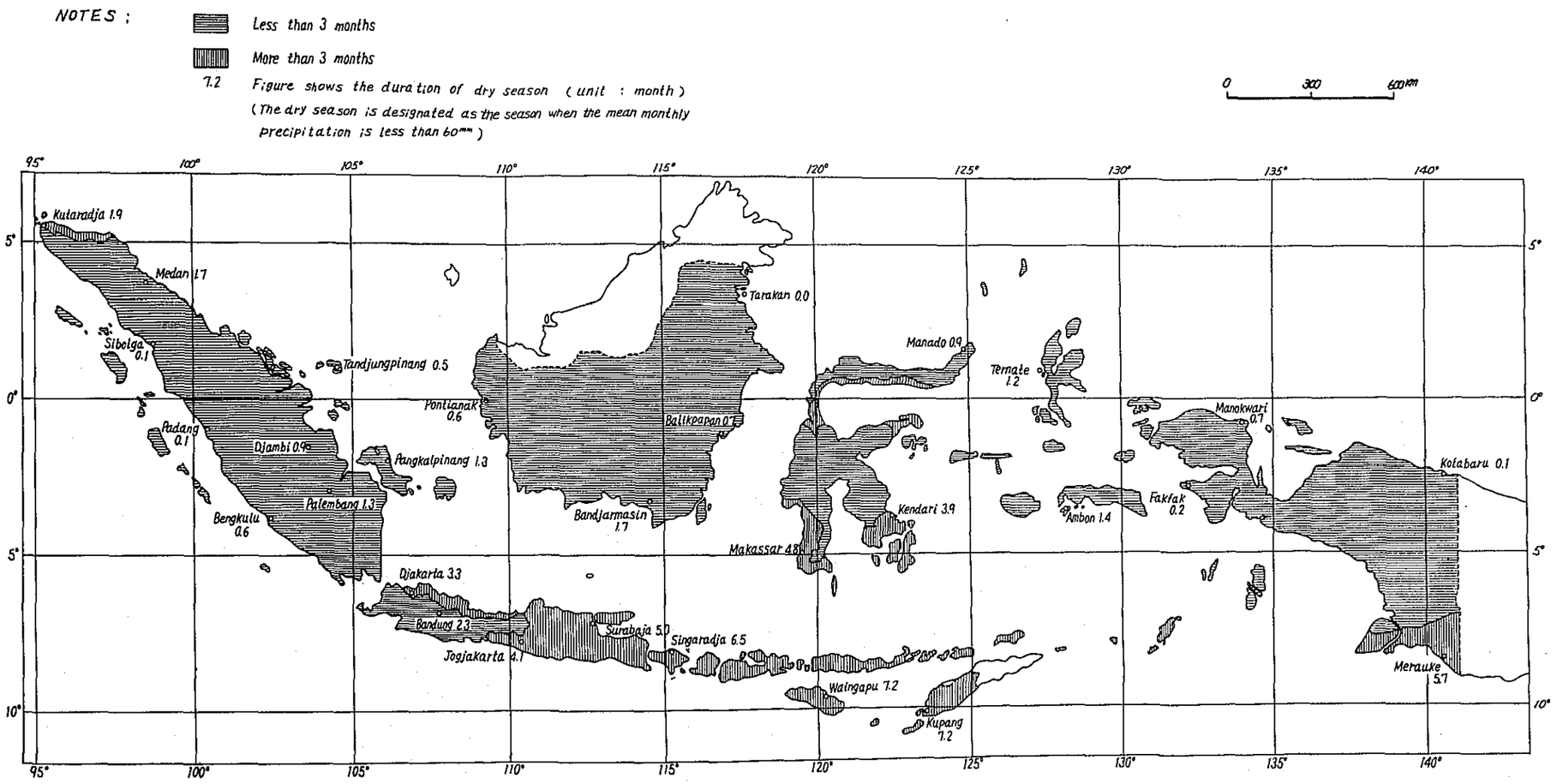


ANNUAL ISOHYET

(West Irian)



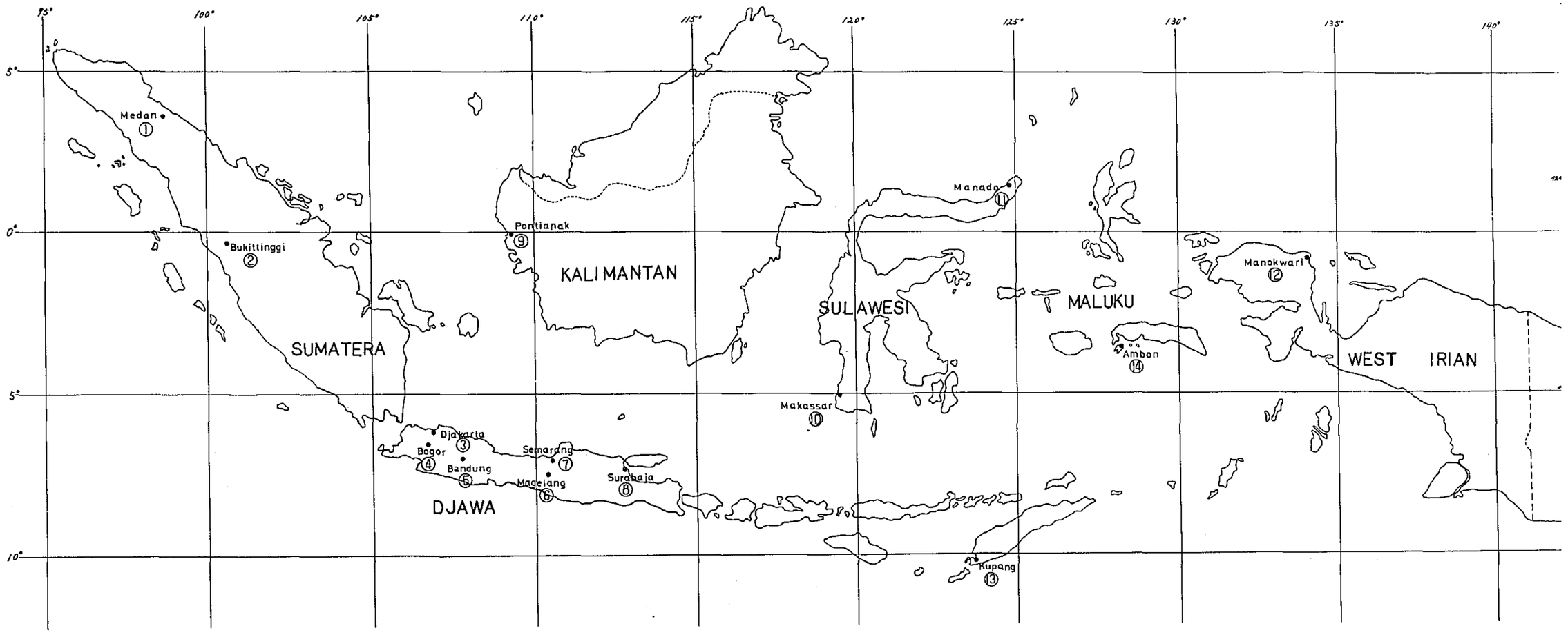
DURATION OF DRY SEASON IN INDONESIA



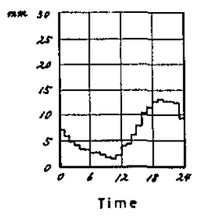
AVERAGE HOURLY RAINFALL IN INDONESIA

0 100 200 300 km

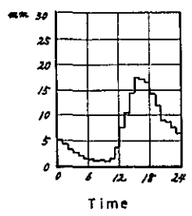
Note : Diagrams show average hourly rainfall totalized in one month.



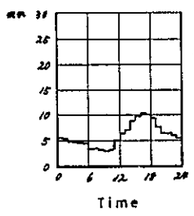
① Medan
(1910~1918, 1927~1932)



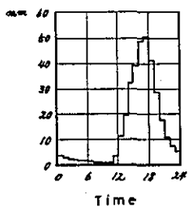
② Bukittinggi
(1913~1918, 1927~1932)



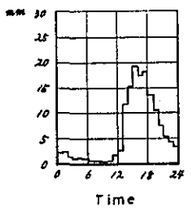
③ Djakarta
(1879~1935)



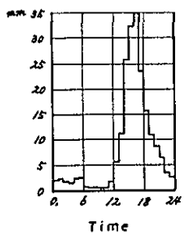
④ Bogor
(1905~1918, 1927~1932)



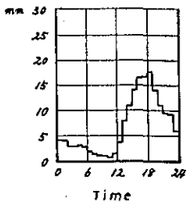
⑤ Bandung
(1912~1919, 1930~1932)



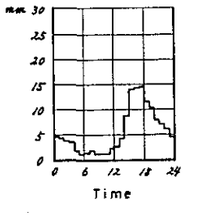
⑥ Magelang
(1931~1933)



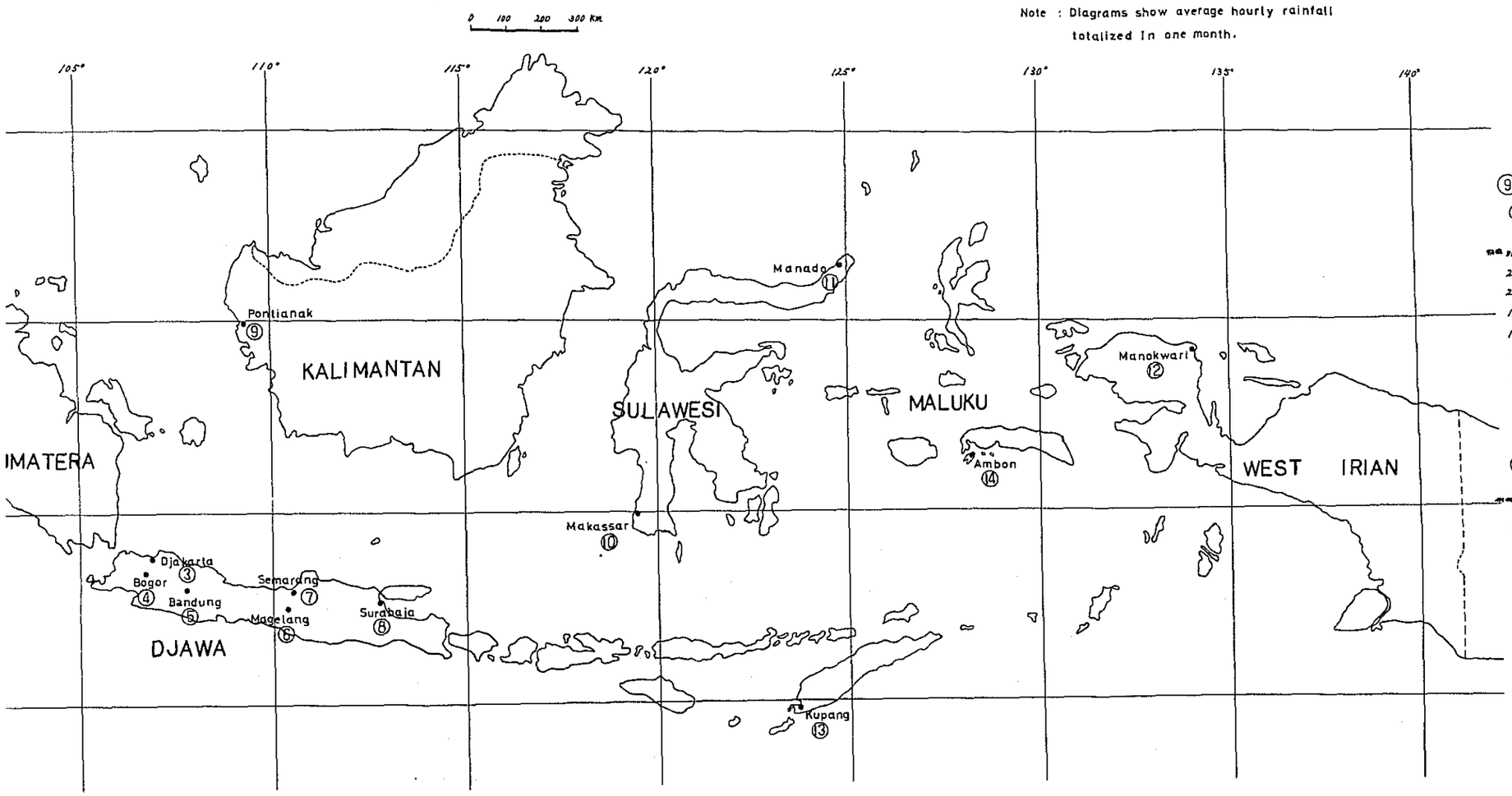
⑦ Semarang
(1919~1923)



⑧ Surabaja
(1920~1932)

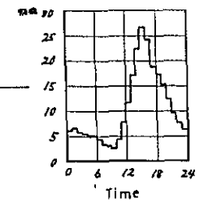


AVERAGE HOURLY RAINFALL IN INDONESIA

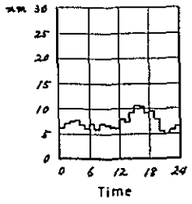


Note : Diagrams show average hourly rainfall totalized in one month.

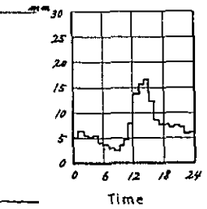
⑨ Pontianak (1906~1918, 1927~1932)



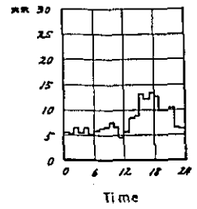
⑩ Makassar (1922 ~ 1932)



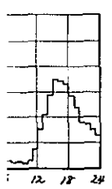
⑪ Manado (1913~1919, 1927~1932)



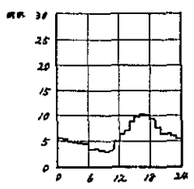
⑫ Manokwari (1914 ~ 1918)



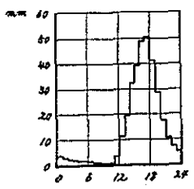
ttinggi (9/18, 1927 ~ 1932)



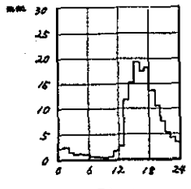
③ Djakarta (1879 ~ 1935)



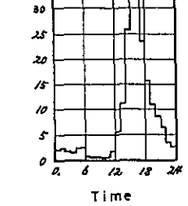
④ Bogor (1905~1918, 1927 ~1932)



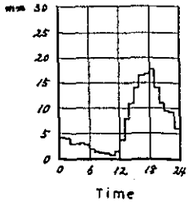
⑤ Bandung (1912~1919, 1930~1932)



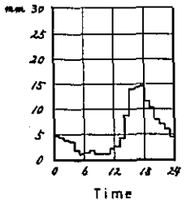
⑥ Magelang (1931 ~1933)



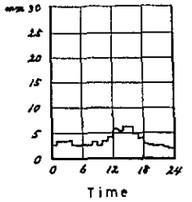
⑦ Semarang (1919 ~1923)



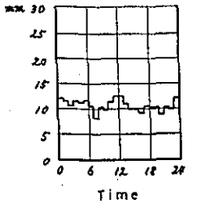
⑧ Surabaja (1928 ~1932)



⑬ Kupang (1913~1918, 1927 ~1932)



⑭ Ambon (1905~1919, 1925~1932)



RAINFALL STATIONS IN INDON

(Djawa and Madura)

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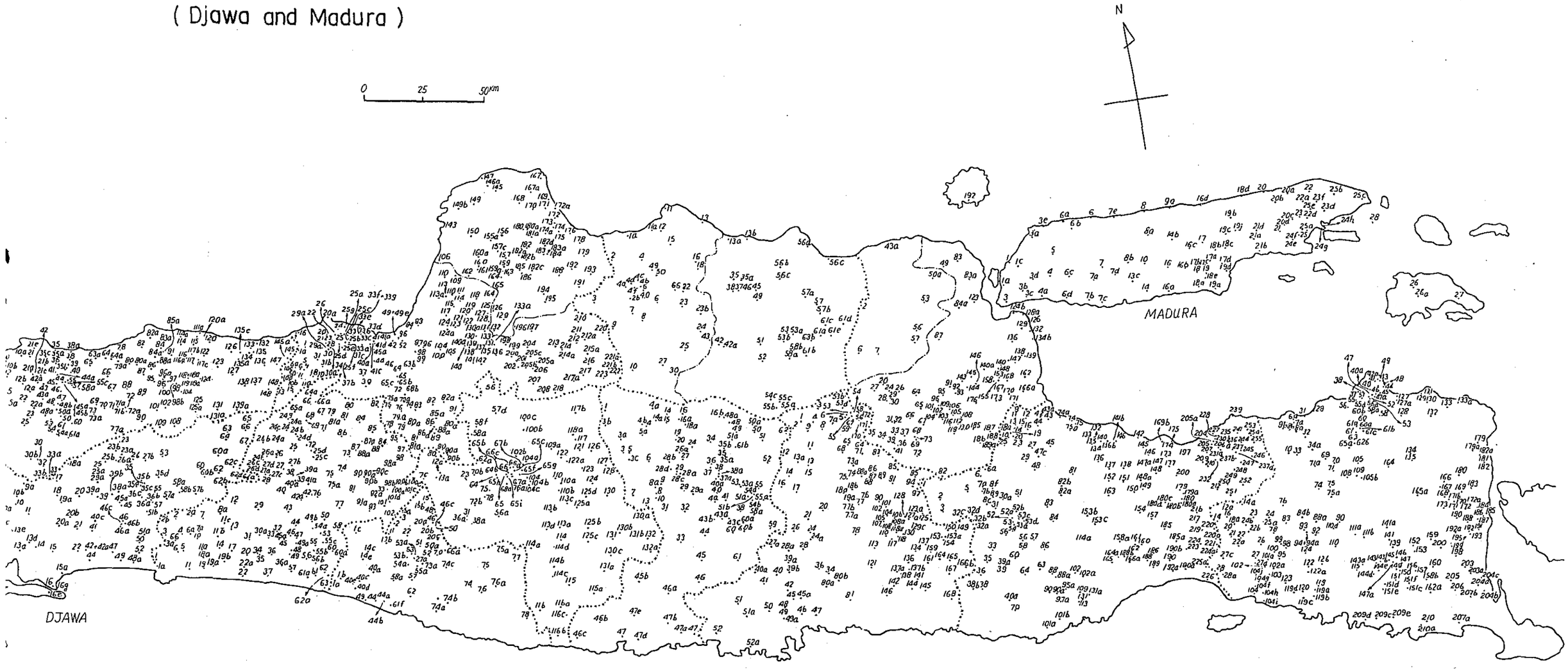
RAINFALL STATIONS IN INDONESIA

(Djawa and Madura)



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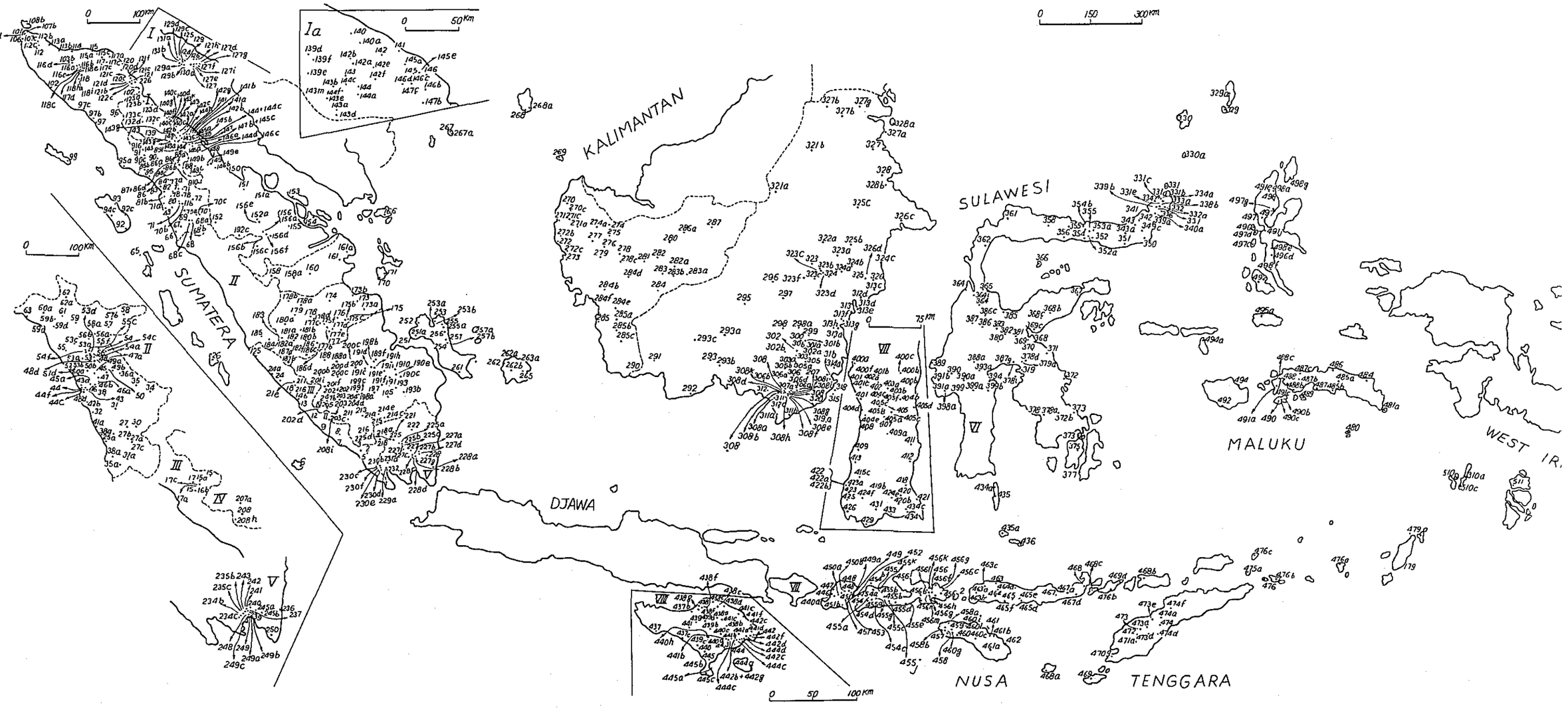

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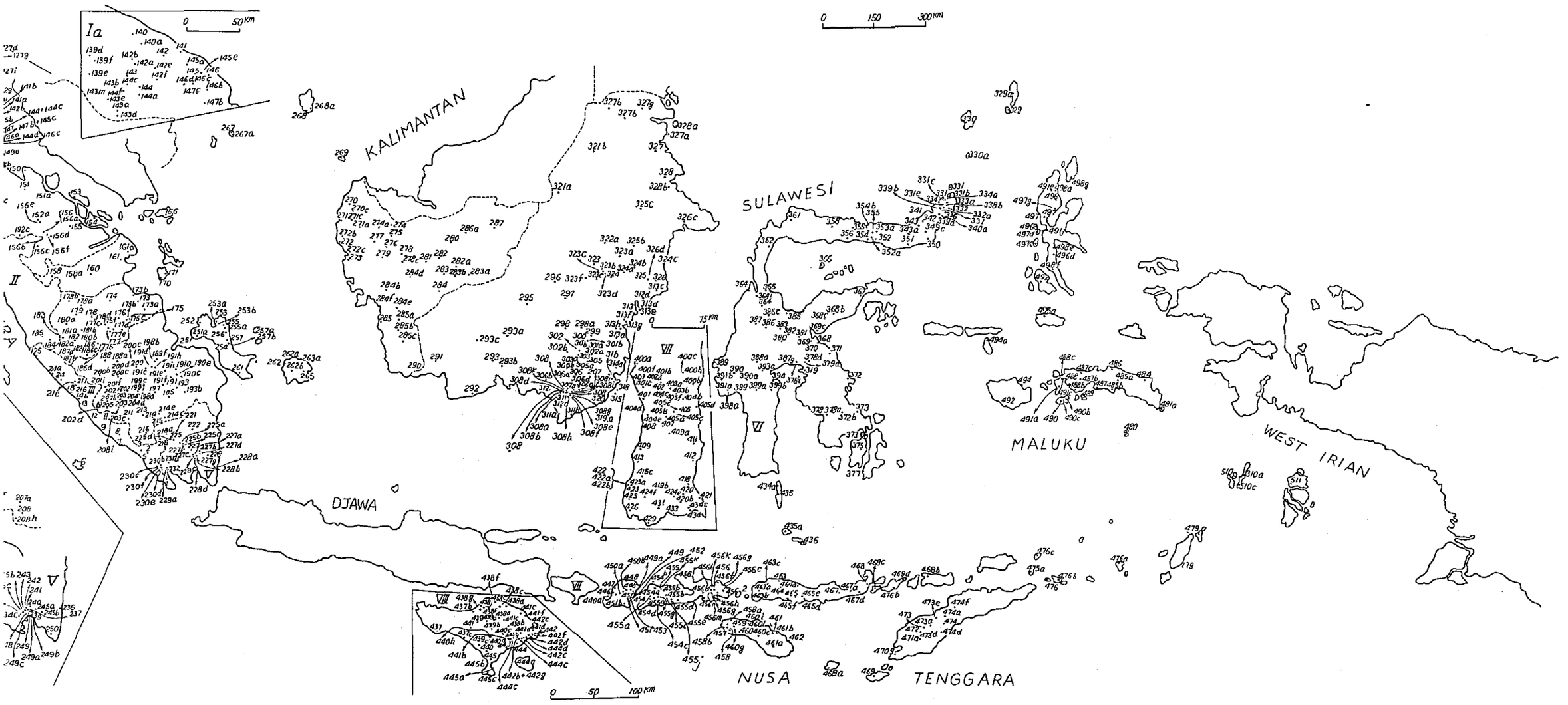


EXAMPLE OF RUN–OFF COEFFICIENT

(Kali Bogowonto basin in Djawa)

Name of Water System	Name of Gauging Station	Catchment Area (Km^2)	El. above Sea level (m)	Mean Annual run-off (m^3/sec)	Total rain-fall (m/m)	Run-off Coefficient
Kali Bogowonto	Bener	96.5	360	10.1	4,650(*1	0.7
	Anggapaten	188.3	98	14.8	3,050(*1	0.8

*Note (*1 : This figure is calculated by using the isohyetal map.*

Rain-fall and Run-off at Bener in Kali Bogowonto basin (1961 - 1969)

No.	Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
	Number of Rain-fall Station													(m/m)
1	38	606	569	643	548	269	138	127	84	87	310	489	706	4,576
2	39	562	565	567	515	244	154	107	103	80	298	523	731	4,151
3	39a	975	935	989	632	387	154	121	131	135	416	687	1,012	6,633
4	40a	789	653	549	578	298	168	121	66	74	287	559	777	5,251
5	41a	283	240	289	236	103	77	40	42	50	57	192	268	1,966
6	42	579	461	562	445	241	155	67	93	56	249	485	680	4,680
7	42a	574	546	602	573	213	141	69	61	45	224	489	729	4,267
Mean Rain-fall		638	567	586	504	251	141	96	83	75	263	489	700	4,504 (*2
Mean Run-off		14.1	14.5	16.7	16.5	12.0	8.5	6.2	5.2	2.4	5.0	7.3	12.7	10.1 (m^3/s)(*3

Rain-fall and Run-off at Anggapaten in Kali Bogowonto basin (1961 - 1969)

No.	Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
	Number of Rain-fall Station													(m/m)
1	41a	383	240	289	236	103	77	40	42	50	57	192	268	1,966
2	42	579	461	562	445	241	155	67	93	56	249	485	680	4,680
3	53	418	336	348	239	75	58	17	24	12	111	210	397	2,245
4	58	510	349	451	235	136	129	39	34	13	122	232	319	2,319
5	76	327	440	426	316	129	62	56	47	25	57	246	415	2,947
6	77	593	380	391	186	97	80	112	91	32	177	261	532	3,328
Mean Rain-fall		469	368	285	331	130	94	55	55	31	129	271	435	2,914 (*2
Mean Run-off		27.0	24.9	24.4	19.2	5.6	4.0	1.2	0.7	0.8	5.4	26.1	38.3	14.8 (m^3/s)(*3

*Note, (*2: This figure shows simple mean value.*
*(*3: " annual mean run-off.*

STANDARDS OF RUN-OFF GAUGING

(Hydro-power sector in Japan)

Chapter 1 General Rules

(Objective)
Article 1

The objective of the present standards is to provide matters relating to the measurement of run-off and the method and procedures to be followed in reporting the run-off gauging, thereby to contribute to the updating and consolidation of data and materials required for the formulation of hydro-power generation projects and for the construction, remodelling and operation of hydro-power plants.

(Definition)
Article 2

Definition of the following terms which appear in the present standards shall be as indicated below.

(1) "Run-off or Discharge" shall indicate the volume of water which flows past the cross-section of a stream in one second.

(2) "Gauging station" shall indicate the selected site on a stream which is intended for run-off gauging.

(3) "Statutory run-off observers" shall indicate those who are obligated to execute run-off gauging and other related activities under the provisions of the order of the Minister for International Trade and Industry.

(4) "Droughty water discharge" shall indicate the stream discharge which occurs on 355 days or more in a year.

(5) "Low water discharge" shall indicate the stream discharge which occurs on 275 days or more in a year.

(6) "Ordinary water discharge" shall indicate the stream discharge which occurs on 185 days or more in a year.

(7) "Plenty water discharge" shall indicate the stream discharge which occurs on 95 days or more in a year.

(8) "Thirty-five day discharge" shall indicate the stream discharge which occurs on 35 days or more in a year.

(9) "High water discharge" shall indicate the stream discharge which occurs two or three times in a year.

(10) "Flood discharge" shall indicate the largest recorded discharge of a stream.

(11) "Droughty water stage" shall indicate the water level coinciding with the droughty water discharge obtained from the discharge curve.

(12) "Low water stage" shall indicate the water level coinciding with the low water discharge obtained from the discharge curve.

(13) "Ordinary water stage" shall indicate the water level coinciding with the ordinary water discharge obtained from the discharge curve.

(14) "Plenty water stage" shall indicate the water level corresponding to the ninety-five-day discharge obtained from the discharge curve.

(15) "Flood water stage" shall indicate the water level coinciding with the flood discharge as obtained from the discharge curve or the traces of flood.

(Units and Rounding Off of Recorded Values)
Article 3

Units and rounding off of values to be entered in the record of run-off gauging shall be as prescribed in the table below.

Item	Unit	Rounding Off
Water Level	m	The value is to be rounded off to the second decimal point.
Mean Velocity	m/s	The value is to be rounded off to the third decimal point.
Cross-section	m^2	The value is to be rounded off to the second decimal point.
Discharge, Run-off	m^3/s	The value should have more than three significant digits, and should be rounded off to the second decimal point.

Chapter 2 Installation of Gauging Station and Others

(Installation of Gauging Station and Others)
Article 4

A gauging station shall be installed at a site designated by the Minister for International Trade and Industry.

Article 5

1. A statutory run-off observor wishing to establish a gauging station shall submit an application prepared in conformity to Form 1 to the Minister for International Trade and

Industry for his instructions through the Director of Regional Bureau of International Trade and Industry exercising jurisdiction over the area in which the applicant observer is located. This provision shall apply to the case where the statutory run-off observer wishes to alter the location or facilities of the existing gauging station or to abolish it.

2. Upon installation of the gauging station, the statutory run-off observer shall submit documents prepared in one original and one copy in conformity to Form 2 to the Minister for International Trade and Industry through the Director of the competent Regional Bureau of International Trade and Industry. This provision shall apply to the case where the observer wishes to alter any of the items prescribed in Form 2 or to abolish the gauging station.

(Location of Gauging Station)
Article 6

A gauging station shall be installed at a site satisfying the conditions given below to the maximum extent.

(1) Flow shall be neither rapid or slow excessively.

(2) The stream shall be subjected to the minimum course shifting and minimum changes in river-bed.

(3) The stream shall be free from undercurrent, reverse flow or standing water.

(4) Confluence of tributaries or diversion of branch rivers shall invite no extreme irregularities in the water level.

(Facilities of Gauging Station)
Article 7

A gauging station shall be equipped with the following facilities.

(1) Water level observation equipment (water-stage recorder or staff-gauge).

(2) Stream flow measurement equipment (traversing line, suspended gondola, boat, etc.)

(3) Grade post.

(4) Indication post.

(Facilities for Water Level Observation)
Article 8

1. Facilities for water level observation shall be installed at a site meeting the following conditions to the maximum extent.

(1) Facilities shall be free from movement, loss or damage by flood and stream flow.

(2) Appropriate water level observer shall be obtainable from near the installation site.

2. Installation of water-stage recorder shall conform to the following provisions.

(1) The water-stage recorder shall be of the type most suited to the flow condition at the site of the gauging station.

(2) The water-stage recorder shall be so installed that its accurate function is assured from the lowest to the highest water level.

(3) The water-stage recorder shall be installed with the staff-gauge for comparison of values obtained from both.

3. Installation of staff-gauge shall conform to the following provisions.

(1) The newel post shall be made of wooden log measuring 15 cm square or more or of other suitable materials, and shall be installed securely in a manner that assures freedom from the effects of driftage.

(2) The scale plate of the staff-gauge shall be the wooden board of fine quality painted after sufficient seasoning or the enamelled iron sheet or other materials equivalent to or surpassing them in quality, and shall be graduated in centimenters.

(3) In case the staff-gauge is required to be installed with an incline due to the form of river banks, arrangements shall be made to enable the observer to read the vertical height.

(4) In case the installation in several steps is required due to topographical reasons, each staff-gauge shall be installed on the same line of the gauging section.

(5) The zero point of the scale plate shall be set below the lowest water level and its elevation shall be determined by making use of the nearby bench mark as point of reference. If no bench mark is available, it shall be substituted by a rock or other immovable object which can be used as point of reference in determining the elevation of the said zero point.

(Facilities for Stream Flow Measurement)

Article 9

Installation of facilities for stream flow measurement shall be conducted in conformity to the following provisions.

(1) The line of measuring section shall be established together with the distance indicating line, provided, however, that in case a bridge is used as the line of measuring section, the distance indication may be made on the handrails of the bridge.

(2) In case a suspended gondola is to be used, it shall be suspended by two wire ropes, and shall be equipped with a rope for its movement across the river.

(3) In case a boat or a raft is to be used, it shall be provided with the main and auxiliary ropes.

(4) The wire rope used as the transversing line shall be so installed that it can be wound up or down as necessity arises at least between the lowest water level and the flood level.

(Grade Post)
Article 10

The grade post shall be installed at a suitable place upstream and downstream of the stream flow measurement site in conformity to the provisions of Paragraph 3 of Article 8 of the present standards.

(Indication Post)
Article 11

The indication post shall indicate the following items.

(1) No. of designation order given by the Ministry of International Trade and Industry.

(2) Name of the river system and of the gauging station.

(3) Catchment area (in km^2)

(4) Location (town or village, county or city, and prefecture)

(5) Date of approval for using the river area.

(6) Date of installation of the gauging station.

(7) Name of the person who installed the gauging station.

Chapter 3 Observation of Water Stage

(Cross-levelling)
Article 12

1. After installation of water stage observation facilities, the line of the gauging section passing them at right angle to the river course shall be established, with a bench mark above the flood level set up on either bank to indicate the line of the gauging section of the water stage observation station. However, if either bank of the stream is formed of rocks free from rupture or movement, a rock engraved with necessary information may substitute for the bench mark.

2. After establishment of the line of the gauging section provided for in the preceding paragraph, cross-levelling shall be conducted in accordance with the following provisions.

(1) Cross-levelling shall be conducted on either bank to a height substantially above the flood level.

(2) A measuring rod or a sounding lead shall be used in the river section, and a level shall be used in the land section.

(3) During the sounding work, the water level shall be constantly observed by means of the staff-gauge, and if a change is detected in the water stage, the results of sounding work shall be corrected accordingly.

(4) The horizontal distance between the sounding spots shall be held within the range from 1 to 4 m, and shall be increased if the cross-grade fluctuation of river-bed is small and decreased if the fluctuation is large.

3. Upon completion of the cross-levelling provided for in the preceding paragraph, the cross-sectional chart at the water-stage gauging station shall be prepared in accordance to Form 3.

4. In case the cross-section of a stream undergoes changes due to flood or other causes, cross-levelling shall be conducted immediately and the results shall be entered in the cross-sectional chart of the water-stage gauging station.

(Water Stage Observation)
Article 13

1. The statutory run-off observer who has installed a gauging station shall be obligated to appoint an exclusive water level observer from among persons satisfying the following requirements and shall assign the task of water stage observation to him.

(1) Persons having full knowledges about the handling of equipment for water stage observation.

(2) Persons capable of conducting observation continuously over a long period at a fixed time of every day, in case the staff-gauge is to be used.

2. The statutory run-off observer shall indicate to the water stage observer the high water stage to be observed as obtained from the past records or from the memory or legend of nearby inhabitants.

3. Water stage observation shall be conducted in conformity to the following provisions.

(1) Water stage recorder shall be used for water stage observation, provided, however, that staff-gauges may be employed in an unavoidable case.

(2) Attention shall be directed to the following in using the water stage recorder.

a. All equipment shall be handled and maintained in perfect working condition, with care taken to prevent from closing of the water inlet port by flown sand, dead leaves, dirts, etc.

b. In case there is a fear of loss or damage of equipment due to abnormal flood discharge, the water stage recorder shall be transferred to a safe place without delay and should be restored to its original installation place after the water level has declined.

c. In the event of inability to conduct observation due to the fault of equipment, flood discharge or any other accidents, the observer shall take appropriate provisional measures immediately and report to the Director of the supervising Regional Bureau of International Trade and Industry.

d. In replacing the recording paper, care shall be taken of the following.

a) The water stage on the new recording paper shall be coincided with that indicated by the staff gauge upon completion of replacement.

b) The recording pen of the water stage recorder shall be set correctly on the recording paper.

e. Date and time of replacement, water stage indicated by the staff gauge, No. of designation order, name of river system, and name of the gauging station shall be entered in this recording paper upon completion of replacement.

f. The starter of the water stage recorder shall be set to the standard time at all times, and shall be wound at a fixed time of each day if the equipment is one-day type or shall be wound a little earlier than it runs down if it is of eight-day type or long-term type.

g. The mean water stage shall correspond to the daily mean run-off, and shall be calculated by the formula obtained from the stage-discharge relation diagram.

(3) Attention shall be directed to the following in using the staff-gauge.

a. The water stage shall be observed daily to an accuracy of the order of 1 cm at 10:00 a.m. or at the time designated by the competent staff of the supervising Regional Bureau of International Trade and Industry.

b. Sufficient care shall be taken to prevent the movement, loss or damage of the staff-gauge, with suitable protective measures taken in case of flood discharge. Particular care shall be exerted not to tie boats, rafts, etc. together to the staff-gauge.

c. In the event of movement, loss or damage of the staff gauge, a temporary staff gauge shall be immediately installed for continued observation, and the situation shall be reported to the Director of the supervising Regional Bureau of International Trade and Industry.

d. In case of a high water discharge exceeding the water level indicated by the statutory run-off observer in accordance with the provision of the preceding paragraph, it shall be observed every 30 minutes or one hour. The water stage of the day of such high water discharge shall be the mean value of water level measurements on that day.

(4) In case a single water stage gauging station is manned by more than one observers, the name of a staff who has actually undertaken the observation shall be entered in the column for description and remarks of the monthly water level report and the daily report of high water stages.

(5) In the event of inability of the observer to execute his duties due to illness or other accidents, he shall let his previously appointed agent to perform his duties, and shall put down that effect in the column for description and remarks of the monthly water level report and the daily report of high water stages.

(Water Stage Observation of Frozen Stream)
Article 14

(Omitted)

(Recording of Water Stage Observations by Staff-Gauge)
Article 15

The water stage observer shall keep in record the results of his water stage observation by staff-gauge in accordance with the following provisions.

(1) He shall enter the observation results in his field note and shall prepare the monthly report of water level in conformity to Form 4.

(2) In case he has performed high-water stage observations, he shall prepare the daily report of high water stage in conformity to Form 5.

(3) He shall enter the following in the remarks column of the monthly water stage report.

a. Conditions of drift ice and driftwood, or the sailing conditions of boats or rafts.

b. Abnormalities of river-bed or embankment.

c. Abnormalities in the irrigation or drainage in the vicinity of his station.

(4) He shall enter the following in the remarks column of the daily report of high water stage.

a. General condition of weather during high water discharge, condition of the high water discharge, conditions and time of occurrence of damaging of embankment, inundation and other heavy disasters.

b. The highest water stage and the time of its occurrence.

Chapter 4 Measurement of Stream Flow

(Measurement of Stream Flow)
Article 16

1. The statutory run-off observer who has established a gauging station shall, in principle, be obligated to conduct the stream-flow measurement three times a month.

2. The stream-flow measurement, to be conducted for the purpose of preparing perfect stage-discharge relation diagram, shall be performed for different water stages from the approximate lowest water stage to the approximate highest water stage using the current-meter, provided, however, that the float-method, weir-method or slope method may be allowed to be used in an unavoidable case.

3. In conducting the stream-flow measurement, attention shall be directed to the following.

(1) Accurate water stage shall be obtained from the staff-gauge before and after the measurement.

(2) The surface slope shall be calculated for each measurement.

(3) The cross-levelling of a stream shall be conducted by the use of measuring rods with the horizontal distance between each two rods set at more than 1 m and less than 2 m, provided, however, that the said horizontal distance may be arbitrarily determined depending upon the river width and the changes in flow velocity.

(Current-Meter Method)

Article 17

1. The stream flow measurement using a current meter shall be conducted by the precision method, provided, however, that the simple method may be resorted to if the water level fluctuation is conspicuous or there are any other reasons beyond control.

2. Immediately upon completion of stream flow measurement, the flow velocity at the measuring point shall be determined from the flow velocity index table to calculate the mean velocity. In this case if the obtained mean velocity leaves room for doubt when reviewed with reference to the stage discharge relation diagram the measurement shall be conducted again.

Article 18

1. In employing the precision method, attention shall be directed to the following.

(1) The sounding points stipulated in Item 3, Paragraph 3 of Article 16 shall be alternately taken as the velocity measuring points at which the current meter shall be vertically lowered for velocity measurement. In this case, the current meter shall be lowered after its vane rotations become even, and the vane rotation for more than 40 seconds shall be adopted.

(2) Upon completion of the measurement, a vertical velocity curve shall be drawn in the field note to review the measurement results.

2. In the simple method, either of the following four methods shall be employed:

Three-point method (in which the velocity is measured at three points having two-tenths, six-tenths and eight-tenths respectively of total water depth from the surface), two-point method (in which the velocity is measured at two points having two-tenths and eight-tenths respectively of the total water depth from the surface), one-point method (in which the velocity is measured at a point of six-tenths of total water depth from the surface) and surface method (in which the surface velocity is measured).

(Current-Meter)

Article 19

1. The current-meter shall be of the type most suited to the conditions of respective gauging stations.

2. Before putting the current-meter to actual use, it shall be checked to confirm that it is in satisfactory working condition.

3. In the event of defect of the rotary wheel, vane and other major parts of the current-meter, repair shall be effected immediately.

4. The performance and function of the current-meter shall be examined once a year in accordance with the procedures stipulated in the Regulations for Examining Current-Meter Coefficient. The said procedures shall be observed in case repairs prescribed in the preceding paragraph have been effected.

(Float Method)

Article 20

1. The stream-flow measurement using the float method may be allowed only in case the use of current-meters is impossible due to flood or other causes.

2. The stream flow measurement using the float method shall be conducted in accordance with the following provisions.

(1) The measurement shall be conducted in the straight river course with approximately uniform cross-sections.

(2) The float shall be timed over a distance which is more than 30 m and larger than the river width.

(3) Two lines of measuring section shall be established at right angle to the river course within the distance in which the float is let ride on the water surface, and suitable sign posts shall be set up on them for mutual signalling between the observers.

(4) The float shall be thrown in the river at a point 10 m upstream of the upstream side section line, and shall be timed from the moment it passes the upstream side section line to the moment it reaches the downstream side section line.

(5) The distance in which the float is let ride on the water surface shall be divided into a suitable number of parts parallel to the river course, and the float shall be let ride down the river in each of the parts. The mean value of the time required for the float to flow down in each part of the fixed distance shall be taken as the flow-down time at the measuring point.

(6) In case a bridge or a ferry-boat is available near the throw-in point of the float, such bridge or ferry-boat shall be utilized. If there are no such facilities, a wire rope shall be

strung across the river with a movable float dropper set on it to throw the float in the desired portion of the river.

(7) The float for use at night shall be equipped with a lighting device.

(8) In case a surface float is to be employed, care shall be taken of the wind direction and wind velocity.

(9) In using the rod float, attention shall be directed to the following.

a. The length of the submerged portion of the rod shall be more than three-quarters of the total water depth.

b. Rods suited to different water depths shall be prepared in advance to meet their need instantly.

(10) In case a flood discharge occurs, cross-levelling shall be conducted after the water level has declined.

(11) The cross-sectional area of the river to be used for discharge calculation shall be the mean value of the sum of the cross-sectional areas at the lines of measuring section on the upstream and downstream sides, or the cross-sectional area at the section line established between the said two lines.

(Weir Method)

Article 21

1. The stream flow measurement by the weir method shall be allowed only in case the use of current-meters is not feasible due to the small discharge.

2. The stream flow measurement by the weir method shall be conducted in accordance with the following provisions.

(1) The weir shall be installed at a site whose upstream section has a quiet and slow flow, and shall be constructed level and at right angle to the river course.

(2) The weir shall be the sharp-crested weir with a rectangular opening, and shall be designed for leak-free construction.

(3) The head shall be more than 10 cm and less than 1 m, and shall be smaller than one quarter of the total depth of the watercourse.

(4) The width of the opening shall be more than three times the head, and that of the watercourse shall be more than nine times the head.

(5) The cross-sectional area at points upstream of the weir shall be more than seven times that of the opening.

(6) The head shall be measured at a point more than 2 m upstream of the weir.

(Slope Method)
Article 22

1. The stream flow measurement using the slope method shall be allowed only in case the use of current-meters is impossible due to flood or other causes and measurement by the float method is not practicable, either.

2. The stream flow measurement by the slope method shall be conducted in accordance with the following provisions.

(1) The measurement shall be conducted in the straight river course with uniform cross-sections and little fluctuations in the bed slope.

(2) The measurement of the surface slope shall involve the line of measuring section, and shall be conducted with accuracy over as long a distance as possible.

(3) The zero point of the grade-post and that of the staff-gauge shall have an identical elevation.

(4) Calculation of the mean flow velocity shall be made by the Manning's formula or the Kutter's formula.

(5) The cross-sectional area of the river to be used for discharge calculation shall be obtained by the method mentioned in Item 11, Paragraph 2 of Article 20.

(Stream Flow Measurement of Frozen Stream)
Article 23

(Omitted)

Chapter 5 Report on Run-off Gauging

(Report on Run-off Gauging)
Article 24

1. The statutory run-off observer shall prepare in each month the monthly water stage report as well as the monthly stream flow measurement report conforming to Form 6, and present the same by the 10th of the following month to the Director of the supervising Regional Bureau of International Trade and Industry.

2. The statutory run-off observer shall prepare for each year the following annual discharge graphs and tables accepting the examination by the Director of the supervising Regional Bureau of International Trade and Industry in advance, and shall submit the same through the said Director to the Minister for International Trade and Industry by the end of June of the following year.

(1) Transversal cross-section of the river at the water stage gauging station.

(2) Annual records of stream flow measurements (Form 7).

(3) Stage-discharge relation diagram (Form 8).

(4) Stage-discharge relation table (Form 9).

(5) Annual records of daily stage and discharge table (Form 10).

(6) Annual records of daily stage and discharge diagram (Form 11).

(7) Discharge duration table (Form 12).

(8) Discharge duration diagram (Form 13).

(9) Daily records of high-water discharge (Form 14).

3. The statutory run-off observer shall collect and put in order the monthly water stage reports, daily reports of high-water discharge, and water stage records for each year, and preserve the same for a period of not more than five years which shall be stipulated by the Director of the supervising Regional Bureau of International Trade and Industry.

(Transversal Cross-section at Water Stage Gauging Station)
Article 25

The transversal cross-section at a water stage gauging station shall be prepared in accordance with the following provisions.

(1) Geological formation of ground, installation sites of water stage recorder, staff-gauges and bench marks, and elevation of ordinary water stage, flood stage and zero point of staff-gauges shall be indicated in the cross-section.

(2) The cross-section shall be prepared as viewed from the upstream side.

(3) The scale of the cross-section shall be either one of 1/500, 1/200 and 1/100, and a same scale shall be employed each year.

(4) Changes in the cross-section shall be expressed in different colours on the original cross-section up to the third time unless the installation sites of water stage recorder and staff-gauges are shifted.

(Annual Records of Stream Flow Measurements)
Article 26

The annual records of stream flow measurements shall be prepared in accordance with the following provisions.

(1) The measurement numbers shall be given in the order of measurement for each calender year.

(2) The measurement results employed for stage discharge relation diagram plotting in a certain year shall be entered in the annual records of stream flow measurements of the preceding year. (The rest is omitted)

(3) The stream flow measurement method employed shall be entered in the column for measurement method. In case the current-meter method is employed, type of current-meters used and distinction between the precision method and simple method shall be entered in the said column together with the discrimination between the three-point method, two-point method, one-point method and surface method. If the float method is employed, distinction between the rod float and surface float shall be indicated in the said column.

(4) The following items shall be entered in the remarks column.

a. Conditions of flood damage and the period during which temporary staff-gauges were used.

b. Use of irrigation water and drifting of woods, etc.

c. Date of installation or removal of irrigation weirs and other structures which affect the river conditions.

d. (Omitted.)

(Stage-discharge relation diagram)
Article 27

The stage-discharge relation diagram shall be prepared in accordance with the following provisions.

(1) Plotting of the stage discharge relation diagram shall be conducted as hereunder provided for.

a. Unless there occurred changes in the river-bed topography, the discharge shall be expressed by a single curve even in case the measurement was conducted over two calender years.

b. In case the existing curve has shifted to a new one due to high-water discharge, the new curve shall apply as from the day of occurrence of such high-water discharge, and the old one shall apply up to the preceding day.

c. The curve shall be plotted after actual measurement of the droughty water stage and water stages higher than the plenty water stage.

d. In plotting the curve, due consideration shall be given to the results of past stream flow measurement larger than the plenty water discharge. If the gauging station is a newly installed one, measurement records of the existing gauging stations located in its vicinity shall be referred to in prevention of irrational plotting.

e. In case there are various data obtained by different measurement methods upon which plotting of the curve may be based, data prepared by the precise current-meter method shall be considered most reliable, followed by those prepared by the three-point method, two-point method, one-point method and surface method of the simple current-meter method, then by the float method, weir method and slope method.

f. The discharge-curve formula shall be prepared from either one of the three-point method, linear equation method, least square method and integration method.

g. In case a system of curve cannot be expressed by a single formula, the curve shall be divided suitably to obtain the formula. In this case, the two discharges at the joint of each two adjoining sections of the curve as calculated from the two formulas shall coincide with each other perfectly.

(2) The stage discharge curve preparation shall be conducted as hereunder provided for.

a. The scale of the curve shall be so determined that it can amply express the changes of the curve according to the water stage and discharge of the stream, allowing, at the same time, to enter the high-water stage measuring points.

b. The graph shall indicate all the measuring points employed during a year and up to the end of March of the following year, with measurement numbers attached to each of them. Where there are more than two curves, they shall be given sequential numbers ((1), (2), (3) and so forth), with formulas given in the upper part of the graph, and the period of their application and the observation numbers and dates of respective measuring points indicated in the lower part.

c. Measuring points for respective curves shall be given different marks (such as ○ ● ◓). Measuring points used during the following year shall be given a double circle mark (◎) or indicated in colours different from those for the current year.

d. Those parts of the curve obtained by actual measurement shall be expressed in solid line, and the upper and lower parts obtained by inference shall be expressed in dotted line.

e. In case a number of formulas are established for divided parts of the curve, ⊗ mark shall be given to the joints of parts.

(3) (Omitted)

(Stage-Discharge Relation Table)

Article 28

Stage discharge relation table shall be prepared as hereunder provided for.

(1) The water stage shall be entered from the lowest to the highest value measured in the column for water stage.

(2) The column for discharge shall be divided into parts according to the number of stage-discharge curves, with the number of discharge curve entered in the uppermost part of each section, and with the discharge for each water level obtained from the discharge curve formula given below it.

(Annual Records of Daily Stage and Discharge Table)
Article 29

Annual records of daily stage and discharge table shall be prepared as hereunder provided for.

(1) The water stage and discharge of the day when the discharge is measured shall be entered in red ink and in parentheses above the water stage of that day and the corresponding discharge. In case the high-water level observation is made, the highest water stage and largest discharge shall be entered between parentheses in the column for the day of observation and shall be marked with a circle (○) on their left.

(2) A red line shall be drawn under the maximum water stage and maximum discharge of each month, with two red lines likewise drawn under the minimum water stage and minimum discharge.

(3) In case the discharge curve shows a fluctuation, a red line shall be drawn above the water stage and discharge on the day of occurrence of fluctuation, with a red line vertically drawn from its righthand end to the top of the table and from its lefthand end to the bottom of the table. (The rest is omitted)

(4) Total annual discharge and the mean discharge throughout the year shall be entered in the lower right space of the table.

(Annual Records of Daily Stage and Discharge Diagram)
Article 30

The daily stage and discharge diagram shall be prepared as hereunder provided for.

(1) The scale of the water stage and discharge shall be such that it allows the curve for high-water stages occurring two or three times a year to run beyond the limit of the graph.

(2) The water stage and discharge of the day when the discharge is measured shall be marked with a circle (○) and shall be given the same measurement numbers as indicated in the annual records of stream flow measurements.

(3) The weather condition shall be indicated by terms fair (to be expressed in colourless), cloudy (red), rainy (blue) and snowy (green). If the weather changes from fair to cloudy, and so on, a diagnoal line shall be drawn and the shifting of weather condition shall be indicated in different colours.

(4) In case the stage-discharge relation curve is subjected to changes, a red line shall be drawn horizontally from the lefthand end to the righthand end of the graph, with an

arrow mark given at the position corresponding to the day of occurrence of discharge curve fluctuation, and with the number of discharge curve indicated on the centre of each part of the line.

(6) In case high-water stage observation is made, the highest water stage and largest discharge measured shall be marked with a red circle and a blue circle, respectively. In case the water stage and discharge go beyond the limit of the graph, the highest water stage and largest discharge shall be indicated in the upper space of the column for the day of observation, with a dotted line drawn to connect them with the mean water stage (observed water stage, in case a staff-gauge is employed) and the discharge of that day.

(7) In case the stage-discharge relation curve is not prepared due to natural disasters or accidents and the discharge is not clarified, the water stage alone shall be indicated with the description to that effect given in the blank space.

(8) The monthly mean discharge shall be expressed in dotted line (·····), and the annual mean discharge in dot-dash line (—·—·—).

(9) The water stage shall be reexamined if it shows an unnatural change. Where there are more than two gauging stations on a single stream or a single river system, water stages measured by respective stations shall be compared with one another to seek the relationship between simultaneous water stages and to correct and supplement the observation results.

(Discharge Duration Table)
Article 31

The discharge duration table shall be prepared as hereunder provided for.

(1) The discharges shown in the annual records of daily stage and discharge table shall be given successively from the minimum to the maximum value in the column for discharge.

(2) Frequencies of each discharge shall be entered in the column for frequencies.

(3) Numbers of days on which frequencies of same discharges are recorded shall be subtracted consecutively from the total number of days of a year and entered in the column for the number of days.

(4) A red line shall be drawn under discharges representing the 35-day discharge, plenty water discharge, ordinary water discharge, low water discharge and droughty water discharge.

(Discharge Duration Diagram)
Article 32

The discharge duration diagram shall be prepared as hereunder provided for.

(1) The scale of the discharge shall be such that it serves to indicate the discharge duration which shows the discharge less than that corresponding to 30 days.

(2) Discharges plotted for a number of days shall be connected with a broken line.

(3) 35-day discharge, plenty water discharge, ordinary water discharge, low water discharge and droughty water discharge obtained from the discharge duration table shall be indicated in their respective values, with the discharge for 100 km^2 of catchment area calculated and indicated in parentheses for each of the values.

(4) An arrow mark shall be given to the point plotted to indicate the maximum measured discharge, provided, however, that the value expressed by the point and the corresponding number of days shall be indicated outside the limit of the graph if the point runs beyond the limit.

(Daily Records of High-Water Discharge)
Article 33

The daily records of high-water discharge shall be prepared as hereunder provided for.

(1) The scale of the water stage and discharge shall in principle be the same each year.

(2) The discharge corresponding to the water stage shall be calculated from the discharge curve formula.

(3) The water stage observed by means of the grade post shall be indicated in the column for remarks.

Chapter 6 Guidance and Inspection

(Guidance and Inspection of Gauging Station)
Article 34

The Minister for International Trade and Industry shall, when he deems it necessary, give guidances on the run-off gauging or inspect its performance.

* * * * *

LIST OF RUN-OFF GAUGING STATIONS

1. The gauging stations established after the 2nd war, according to the data in 1965.

(Note) A: Automatic N: Non Automatic

Number of water system	Name of river	Number of station	Name of station	Type	Gauging period		Elevation (m)	Catchment area (Km^2)
					Beginning	Closing		
	I. DJAWA and MADURA (West Djawa)							
2	Tjibungur	2A1	Tjisata-Pasirsereh	N	23- 9-1957		40	46.5
		2A2	Tjilemer-Tjipadung	"	29- 9-1957		30	167.8
		2A3	Tjimojan-Pasirgadung	"	1-10-1957		30	71.9
10	Tjisadane	10B1	Tjianten-GP. Kratjak	"	9- 1-1961		575	98
		10B2	Tjianten-II Kratjak	A	12-10-1950		270	143
		10B3	Tjikluwung-Kratjak	N	9- 1-1961		480	26
		10B4	Sal. Tjianten	"	"		386	–
		10B5	Sal. Tjikluwung	"	"		390	–
		10B6	Sal. Tjanten (Inlat) Kr.	"	5- 1-1961		–	–
12	Tjiliwung	12B1	Tjiliwung-Rawadjati	"	20- 9-1955	1- 1-1964	16.6	318.1
16	Tjitarum	16C15	Tjisangkuj-Tjikalong	"	3- 4-1954	"	875	118.8
		16D5	Tjikapundung-Maribaja	A	25- 2-1952		1,012	76.6
		16D7	Tjigulung-Maribaja	"	28-10-1952		1,071	43.3
		16D8	Tjikapundung-Gandok	"	23-10-1957		746.5	100.8
		16I 1	Tjitarum-Tjipetir	"	26- 5-1962		132	4,150
		16M1	Tjitarum-Tjikaobandung	N	1- 1-1960	21- 4-1962	30	4,600
		16N1	Tjitarum-Mundjul	"	10-11-1956	1-10-1963	25	5,173
		16N2	Tjitarum-Tandjungpura	"	14- 1-1964	1- 1-1964	4.7	5,970
21	Tjipunagara	21C1	Tjipunagara-Pamanukan	"	1- 1-1956		6.0	1,249.2
92	Tjitanduj	92A2	Tjitanduj-Bandjar	"	1- 1-1957		25	1,314
107	Tjimandiri	107B1	Tjitjatih-Kebonrandu	"	1- 1-1964		260	486
		107B4	Sal. Tjitjatih-Babakan	"	"		–	–

Number of water system	Name of river	Number of station	Name of station	Type	Gauging period		Elevation (m)	Catchment area (Km^2)
					Beginning	Closing		
10	Tjisadane	10C	Tjisadane-Batubeulak	N	25- 9-1965		–	–
11	K. Angke	11B	K. Angke Pasarminggu	"	–		–	–
	K. Pasanggrahan	"	I.K. Pasan.-K. Djeruk	"	6-10-1965		–	–
12	K. Krukut	12B	K. Krukut Djl. Bintara	"	15-10-1965		–	–
	K. Grogol	"	2K. Grogol-Gandaria	"	9-10-1965		–	–
	K. Sekretario	"	3K. Sek.-Kp. Tanahkusir	"	16-10-1966		–	–
13	K. Tjipinang	13-I	K. Tjip.-Djatinegara	"	13-10-1965		–	–
	K. Sunter	13	K. Sun.-Kp. Kapitain	"	14-10-1965		–	–
	K. Tjakung	13-II	K. Tjak.-Rengasdjati	"	16-10-1965		–	–
26	Tjimanuk	26	Tjima.-Parakankondang	A			–	–
		–	Tjima.-Leuwigoong	"	-1965		–	–
		–	Tjima.-Tomo	"	26- 3-1965		–	–
		–	Tjima.-Djatibarang	"	16- 6-1965		–	–
		–	Tjima.-Dam Kamun	"	-1964		–	–
		–	Tjima.-Kiararambai	N	-1963		–	–
		–	Tjima.-Mondjot	N	-1963		–	–
		–	Tjima.-Indramaju	"	"		–	–
		–	Tjima.-Bangkir	"	"		–	–
		–	Tjima.-Rentang	"	"		–	–
		–	Tjipeles-Warungpeti	"	"		–	–
		–	Tjilutung-Kadipaten	"	"		–	–
	(Central Djawa)							
34	K. Pemali	34A2	K. Pemali-Bantarkawung	N	21- 9-1960		51	328.4
48	K. Baton	48A1	Penggaron-Bengkung	"	15- 2-1959		30	74.2
49	K. Djragung	49A1	Djragung-Ngipik	"	1-11-1955		30	116.3
50	Tuntang	50A4	Tuntang-Timokerep	"	1- 9-1957	1- 1-1964	200.5	311
55	B. Solo	55A1	B. Solo-Kedungarang	"	25-12-1959		108.5	6,936.5

Number of water system	Name of river	Number of station	Name of station	Type	Gauging period		Elevation (m)	Catchment area (Km^2)
					Beginning	Closing		
82	K. Progo	82A1	K. Progo-Kranggan	N	15- 5-1962		460	424.3
83	K. Bogowonto	83A1	Bogowonto-Bener	A	20- 9-1954		360	94
		83A3	Sungai-Glagahmalang	N	1- 6-1962		111	137.3
		83A4	Kodil-Anggapaten	"	5- 6-1962		98	167.4
90	Seraju	90A2	Seraju-Garung	A	18- 9-1954		1,040	58
		90A5	Seraju-Redjosari	N	30-11-1959		1,226.2	35.8
	K. Klakah	90A6	Klakah-Buntu	"	1-12-1959		1,265	4.1
	K. Logawa	90G1	Logawa-Kedungrandu	"	22- 6-1962		25	197.5
		90G2	Logawa Notog	"	26- 6-1962		19	215.5
	(East Djawa)							
54	K. Kemawing	54C1	Kemawing-Bata	N	3-10-1961	30- 4-1963	38	11.2
		54C2	Kemawing-Djadi	"	17- 4-1962	"	69	10.8
55	B. Solo	55J1	Sal. Pemb.-Giringan	"	1- 1-1962		–	–
		55J2	Sal. Bak.-Penam. Golang	"	"		–	–
		55J3	Sal. Pemb.-Golang	"	"		–	–
		55M1	K. Tjatur-Giringan	"	1- 1-1961		460	48.4
		55M2	Djuweh-Giringan	"	"		"	–
		55T1	B. Solo-Bodjonegoro	"	1-10-1960	1- 1-1965	20	2,669.1
		55W1	B. Solo-Plangwot	"	1- 1-1960	1- 1-1966	10	4,484.8
		55W2	B. Solo-Ngablak	"	14-12-1962	1-12-1963	3.4	15,200
		55X1	B. Solo-Karanggenang	"	7-10-1961	"	3.5	15,370
		55X14	B. Solo-Bandjarredjo	"	1- 1-1963	"	–	–
		55X2	B. Solo-Kr. Binangun	"	22- 2-1962	"	40	15,440
		55X3	B. Solo-Sembajat	"	18- 1-1963	"	–	–
57	K. Brantas	57C2	Brantas-Kr. Kates	"	1- 9-1956	19- 5-1964	190	1,977.3
		57C3	Brantas-Pohgadjih	"	"	1- 1-1966	172.5	2,176.2
		57M2	Konto-Kedungredjo	"	21- 1-1963		892	110
60	K. Redjoso	60A1	Redjoso-Redjoso	"	1- 3-1962	-1966	2.5	264.4

Number of water system	Name of river	Number of station	Name of station	Type	Gauging period		Elevation (m)	Catchment area (Km^2)
					Beginning	Closing		
76	K. Glidik	76A3	Andeman-Putjungsari	A	15- 5-1959		400	10.3
		76A5	Sbr. Bebek.-Sbr. Wangi	"	25- 5-1959		400	8.5
		76A6	Leb. Roto-Leb. Roto	"	22- 5-1959		466	10.5
		76A7	Mandjing-Sb. Tjuling	"	1- 6-1959		433	48
	(Madura)							
112M	K. Saroka	112M1	Saroka-Sirsiran/Djepun	N	14-10-1961		7	197.6
		112M2	Sumber Kermata Kiri	"	18- 8-1962		4.6	–
		112M3	Sumber Kermata Kanan	"	"		–	–
		112M4	Sumber Bintang	"	"		–	–
	II. SUMATERA							
	(South Sumatera)							
74	A. Musi	74-5	Lematang Udjanmas	N	14- 1-1962		197.2	4,016.3
	A. Musi	74-5	A. Musi-Batupantjeh	A	–		–	–
78	W. Seputih	78B1	W. Sep.-Negara Adjitua	"	–		–	–
	(West Sumatera)							
152	Batang Arau	152-I	Batang Arau-Lb. Bergalung	N	1- 8-1961		12	104
66	B. Ombilin	66B1	Batang Agam Titi	A	–		–	–
		66H1	Batang Ombilin-Ombilin	"	–		–	–
152	B. Arau	–	Lb. Pertemuan Bandarbuat	N	–		–	–
162	B. Antokan	162-I	B. Antokan Muko 2	A	–		–	–
	(North Sumatera)							
53	Bt. Asahan	53-3	A. Asahan-Porsea	N	–		–	–
	"	53-4	A. Asahan-Siruar	A	–		–	–
	"	53-5	A. Asahan-Simorea	N	–		–	–
	"	53-6	A. Asahan-Sigura-gura	"	–		–	–
19	Krueng-Peusangan	19-2	S. Peusangan-Takengon	"	–		–	–

Number of water system	Name of river	Number of station	Name of station	Type	Gauging period		Elevation (m).	Catchment area (Km^2)
					Beginning	Closing		
	III. SULAWESI							
83	Djene Ponto	83-1	Djene Kelara-Likupando	A	–		–	–
	"	83-2	Djene Kelara-Tumpuk Kelara	N	–		–	–
	"	83-3	S. Pamukulu-Mololo	"	–		–	–
89	Pangka Djene	89-1	Pangkadjene-Gategaterang	"	–		–	–
	IV. AMBON							
	S. Guru Besar	–	S. Guru-Besar-Kate	N	–		–	–
	S. Mamuka	–	S. Mamuka-Halong(A)	"	–		–	–
	"	–	S. Mamuka-Halong(B)	"	–		–	–
	S. Latta	–	S. Latta-Lapu	"	–		–	–
	S. Rikan	–	S. Rikan-Lateri	"	–		–	–
	S. Illa	–	S. Illa-Durianpatah	"	–		–	–
	V. WEST IRIAN							
		–	Near Kotabaru	A	-1952			

2. The gauging stations established before the 2nd war, according to the data in 1940.

(Note) A: Automatic N: Non automatic

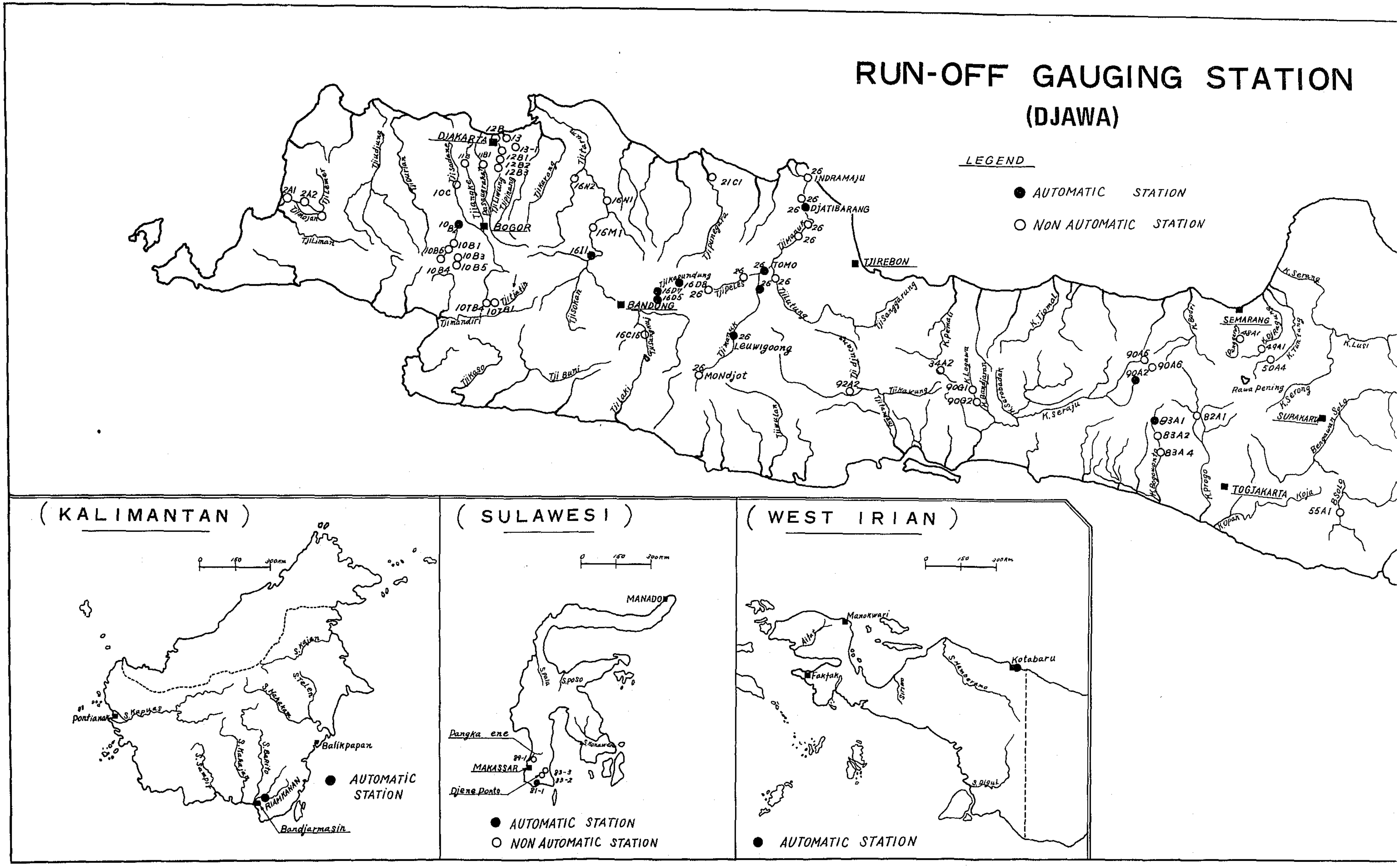
Number of water system	Name of river	Number of station	Name of station	Type	Gauging period		Elevation (m)	Catchment area (Km²)
					Beginning	Closing		
	I. DJAWA (West Djawa)							
3.	Tjidano	3 A 1	Tjidano-Tjurugbetung	A	11- 7-1915	15- 5-1937	82	201
6.	Tjiudjung	6 B 1	Tjiberang-Tjileuksa	A	24- 8-1929	15- 4-1934	416	58
10.	Tjisadane	10 A 1	Tjisadane-Masing	A	1- 9-1915	5- 4-1940	373	129
		10 B 1	Tjianten I-Kratjak	N	19- 8-1914	31-12-1942	373	98
		10 B 2	Tjianten II-Kratjak	A	11- 9-1915	31-12-1943	270	143
		10 B 3	Tjiklusung-Kratjak	N	15-11-1923	31-12-1943	402	26
16.	Tjitarum	16 B 1	Tjitarum-Wangisagara	N	16- 7-1918	1- 1-1930	690	154
		16 B 2	Tjitarum-Pagokan	A	30- 8-1928	1- 1-1933	1,039	65.3
		16 D 2	Tjitarum-Nandjung	A	1- 9-1918	13- 6-1935	654	1,718
		16 F 2	Tjitarum-Radjamandala	N	7- 7-1922	1- 3-1931	215	2,368
		16 E 1	Tjitarum-Palumbon	A	16- 6-1922	31-12-1943	132	4,150
		16 C 4	Tjisangkuj-Pangalengan	A	7-10-1918	31-12-1943	1,350	34
		16 C 5	Tjisarua-Riunggunung	A	15-11-1918	31-12-1943	1,327	46
		16 C 1	Tjisangkuj-Rantjagadog	A	25- 9-1915	31-12-1943	1,040	104
		16 D 5	Tjikapundung-Maribaja	A	6- 7-1928	1- 4-1934	927	76
		16 E 1	Tjiwidej-Tjukanghaur	A	1-10-1918	31- 1-1933	854	167
		16 E 2	Kawah Tjiwidej-Pos A	A	18-11-1930	31-12-1943	1,870	0.4
		16 E 3	Tjipadaruan-Pos B	A	20-11-1930	31-12-1943	1,714	3.0
		16 E 4	Tjiwidej-Pos C	A	21-11-1930	31-12-1943	1,502	10.8
		16 E 5	Tjisarua-Pos B	A	20-11-1930	31-12-1943	1,450	4.7
		16 E 6	Slibvang-Tjisarua-Pos	A	2-12-1930	31-12-1943	1,674	2.4
		16 C 1	Tjidadap-Tjidadap	N	1- 5-1920	1- 1-1933	990	85
		16 C 2	Tjisokan-Tjihondje	A	18- 6-1922	1- 1-1933	502	310
		16 H 1	Tjiandjur-Tjigantung	N	7- 3-1928	1- 1-1933	750	36
		16 I 2	Tjimeta-Djalindung	N	8- 7-1922	1- 1-1933	470	80

Number of water system	Name of river	Number of station	Name of station	Type	Gauging period		Elevation (m)	Catchment area (Km^2)
					Beginning	Closing		
21.	Tjipunagara	21 A 1	Tjipunagara-Kasomalang	N	18-10-1923	1- 1-1933	410	69
24.	Tjipetakan	24 A 1	Tjipanas-Leuwibunder	A	5- 5-1938	31-12-1942	68	62
26.	Tjimanuk	26 A 1	Tjimanuk-Bodjongloa	A	29- 1-1920	25- 6-1935	771	286
		26 B 1	Tjimanuk-Leuwigoong	A	18-10-1921	31-12-1943	585	751
		26 C 1	Tjimanuk-Wado	N	24- 9-1922	1- 4-1934	255	1,232
		26 C 2	Tjimanuk-Tjidjeungdjing	A	3-11-1938	31-12-1943	160	1,608
		26 D 2	Tjipeles-Sukatali	A	18- 8-1920	17- 4-1940	282	310
		26 E 1	Tjilutung-Talaga	N	16-10-1923	1- 1-1933	525	107
		26 E 2	Tjipeundeuj-Nunuk	A	5-10-1939	31-12-1943	102	0.5
		26 E 3	Tjidakon-Nunuk	A	1-10-1939	31-12-1943	163	0.4
		26 E 4	Tjipongporang-Nunuk	A	1-10-1939	31-12-1943	132	0.6
92.	Tjitanduj.	92 A 1	Tjitanduj-Indihiang	A	31- 5-1922	1- 1-1933	366	414
95.	Tjiwulan	95 A 1	Tjiwulan-Lengkongdjaja	A	9- 6-1922	1- 1-1933	484	151
		95 A 2	Tjikuraj-Wanasigra	N	28- 6-1922	1- 1-1933	785	29
96.	Tjilangla	96 A 2	Tjilangla-Tjikupa	A	2- 8-1928	1- 7-1934	160	205
		96 A 1	Tjidjalu-Bantarkalong	N	2- 6-1928	1- 1-1934	190	95
97.	Tjikaengan	97 A 1	Tjikaengan-Tablong	N	21- 8-1928	1- 1-1937	360	192
98.	Tjikandang	98 A 1	Tjikandang-Pakendjang	N	18- 1-1928	1- 1-1933	542	51
		98 A 3	Tjikandang-Bodjongrandu	A	23- 1-1928	22- 6-1933	267	216
		98 A 2	Tjibutarua-Pakendjang	A	17- 1-1928	21- 6-1933	560	212
		98 A 4	Tjiariman-Bodjongrandu	N	23- 1-1928	1- 4-1934	244	76
99.	Tjilaki	99 A 4	Tjilaki-Malabar	N	17- 9-1923	1- 6-1933	1,365	66
		99 A 3	Tjilaki-Dewilajung	A	24- 5-1922	23- 5-1933	904	121
		99 A 1	Tjilaki-Tjiheulang	A	4-10-1917	31-12-1943	640	163
		99 A 2	Tjilaki-Tjipitjung	A	4- 6-1922	1- 3-1933	317	347
103.	Tjibuni	103 A 1	Tjibuni-Tjipela	A	15- 8-1922	1- 1-1933	903	128
		103 A 2	Tjibuni-Tjitanggerang	A	20- 8-1922	1- 1-1933	221	288
104.	Tjikaso	104 B 1	Tjikaso-Tjisindang	A	13-10-1927	1- 1-1933	305	419
107.	Tjimandiri	107 B 5	Tjimandiri-Padabeunghar	N	1- 8-1918	16- 5-1932	200	529
		107 A 1	Tjidjurai-Tjidjurai	A	4- 8-1919	1- 1-1933	670	20
		107 B 1	Tjitjatih-Ubrug	A	30- 7-1917	31-12-1933	251	486
		107 C 1	Tjitarik-Tjikirai	A	28- 7-1918	11- 7-1935	235	196

Number of water system	Name of station	Number of station	Name of river	Type	Gauging period		Elevation (m)	Catchment area (Km^2)
					Beginning	Closing		
109.	Tjimadur	109 A 1	Tjimadur-Bantarkarang	A	15- 9-1938	31-12-1943	300	132
	(Central Djawa)							
34.	K. Pemali	34 A 1	Tjigunung-Gandoang	A	3-12-1927	1- 6-1933	279	142
42.	K. Pekalongan	42 A 1	K. Kupang-Batursari	A	26- 8-1939	31-12-1943	536	25
45.	K. Bodri	45 A 1	K. Lutut-Alihan	A	1-10-1923	23- 4-1936	145	178
		45 A 2	K. Logung-Alihan	N	26-10-1923	1- 4-1934	219	85
		45 A 3	K. Waringin-Djalinggo	N	27-10-1923	1- 4-1934	303	57
47.	K. Garang	47 A 1	K. Garang-Pudakpajung	A	1- 3-1920	1- 1-1933	192	59
50.	K. Tuntang	50 A 2	K. Tuntang-Tuntang	A	13- 6-1920	24- 2-1937	459	282
		50 A 3	K. Tuntang-Padasmalang	A	23- 8-1938	31-12-1943	300	291
55.	B. Solo	55 M 1	K. Tjatur-Giringan	A	1- 8-1912	31-12-1943	460	48
57.	K. Brantas	57 C 1	K. Brantas-Sengguruh	N	12- 6-1922	1- 7-1933	270	1,652
		57 M 2	K. Konto-Kd. Redjo	A	16- 7-1918	31-12-1943	892	110
		57M 1	K. Konto-Seloredjo	A	19- 6-1915	31-12-1940	575	235
59.	K. Golang	59 A 1	K. Wolang-Purwodadi	A	18- 6-1922	28- 9-1933	265	146
63.	K. Pekalen	63 A 1	K. Kedaton-Tiris	A	26-11-1927	11- 5-1934	495	60
	K. Kertosuko	63 A 2	K. Pandanlaras-Pandanlaras	A	15-10-1928	10- 5-1934	417	60
65.	K. Sampean	65 A 1	K. Sampean-Tanggarong	N	22- 2-1920	1- 1-1933	220	334
		65 C 1	K. Sampean-Pradjakan	N	26- 6-1920	1- 1-1933	75	1,005
		65 D 1	K. Sampean-Situbondo	N	1- 6-1913	1- 1-1933	60	1,120
70.	K. Baru	70 A 1	K. Baru-Krikilan	A	20- 7-1927	31-12-1943	308	136
74.	K. Bondojudo	74 C 1	K. Djatiroto-K. Duren	N	25- 6-1922	1- 1-1933	45	95
76.	K. Glidik	76 A 1	K. Lengkong-Gunungtriti	A	5- 7-1930	9- 7-1933	625	57
		76 A 3	K. Anderan-Putjungsari	A	3-12-1930	31-12-1945	400	10
		76 A 5	K. Sumberbebek-Sumberwangi	A	4-12-1930	31-12-1940	400	8.5
		76 A 6	K. Lebakroto-Lebakroto	A	8- 8-1930	31-12-1940	466	10.5
		76 A 7	K. Mandjing-Sumbertjuling	A	14-10-1939	31-12-1940	433	48.0
83.	K. Bogowonto	83 A 1	K. Bogowonto-Bener	A	31-10-1921	31-12-1943	360	94.0
		83 A 2	K. Bogowonto-Kedungtjarang	N	1- 6-1928	1- 5-1933	60	355
90.	K. Seraju	90 A 2	K. Seraju-Garung	A	28- 4-1928	31-12-1943	1,035	58.0
		90 A 4	K. Tulis-Sokaradja	A	1-10-1923	1- 1-1933	655	106
		90 B 1	K. Merawa-Siwaru (Tjidjarak)	N	24- 7-1918	25- 1-1922	345	225
		90 G 1	K. Bandjaran-Ketenger	N	17-10-1929	1- 1-1934	500	24

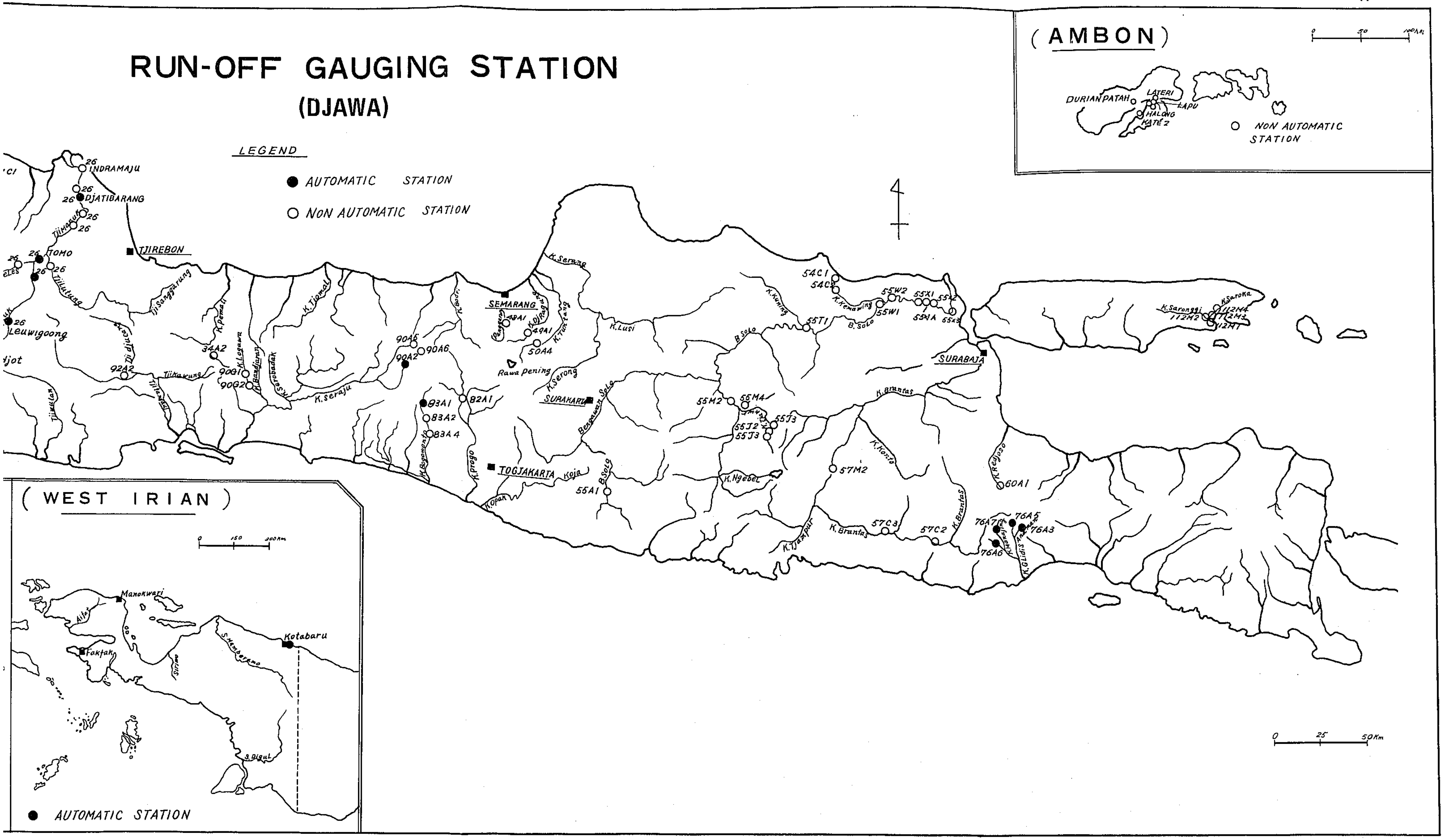
Number of water system	Name of river	Number of station	Name of station	Type	Gauging period		Elevation (m)	Catchment area (Km^2)
					Beginning	Closing		
	II. SUMATERA							
53.	B.A. Asahan	53 – 4	A. Asahan-Siruar	A	18- 6-1939	31-12-1940	900	3,782
66.	S. Kuantan	66 B 1	S. Agam-Titi	A	12- 8-1927	19- 5-1936	680	310
71.	Batanghari	71 – 1	B. Tabir-Muara Djernih	A	23- 9-1937	31-12-1940	–	910
		71 – 2	B. Tabir-Rantaupandjang	N	24- 9-1937	31-12-1940	–	1,040
		71 – 3	B. Tambesi-Muara Enum	A	27- 9-1937	31-12-1940	–	1,520
		71 – 4	B. Asam-Tebet	N	30- 9-1937	31-12-1940	–	240
		71 – 5	B. Djudjuhan-Rantau Ikil	N	29- 9-1937	31-12-1940	–	760
		71 C 1	B. Sangir-S. Tarab	A	29- 9-1928	6- 5-1936	600	285
		71 P 1	B. Merangin-Lubukpaku	A	12- 7-1929	31-12-1940	750	1,416
		71 P 2	B. Merangin-Banko	N	25- 9- 1937	31-12-1940	–	3,960
74.	Air Musi	74 – 3	Air Klingi-Lubuklinggau	A	17- 9-1935	31-12-1940	100	400
		74 – 4	A. Musi-Batupantjeh	–	13- 2-1940	31-12-1940	–	3,113
78.	W. Seputih	78 B 1	W. Seputih-Negaraadji	N	12- 9-1937	31-12-1940	–	500
		78 C 1	W. Penguburana Trimodadi	N	16- 9-1937	31-12-1940	–	180
		78 H 1	W. Rukun-Metro	N	13-11-1938	31-12-1940	–	45
		78 H 2	W. Limut-Metro	N	1938	–	–	–
		78 H 3	W. Batanghari-Metro	N	12-11-1938	31-12-1940	–	110
		78 H 4	W. Sukadana-Sukadana	N	1- 9-1939	31-12-1940	–	148
79.	W. Panet	79 A 1	W. Djepara-Djepara	A	21- 6-1938	31-12-1940	–	130
80.	Wai Sekampung	80 B 1	W. Tebu-Walisedjati	A	20-12-1938	31-12-1940	–	294
		80 C 1	W. Bulok-Bulokerto	A	21-12-1938	31-12-1940	–	797
		80 E 1	W. Sekampung-Tegineneng	A	1- 4-1937	31-12-1940	60	2,155
		80 F 1	W. Sekampung-Negeridjamanten (Agraguruh)	A	16- 8-1940	31-12-1940	–	2,508
129.	K. Ketahun	129 – 2	K. Ketahun-Karangdapo	A	5- 9-1929	31-12-1940	400	701
164.	B. A. Mesang	164 C 1	B. A. Mesang-Sipisang	A	20- 9-1928	1- 4-1936	281	458
165.	B. A. Pasaman	165 C 2	B. A. Parigi-Pinagar	N	3-10-1938	31-12-1940	–	8.1
164.	B. A. Mesang	164 B 1	B. A. Patimah-Kepundung	N	6-10-1938	1- 3-1940	–	265
165.		165 B 2	B. A. Kapar-Burian Sungkaj	N	23- 5-1938	31-12-1940	–	68.2
170.	B. A. Batahan	170 – 1	B. A. Batahan-Sileping	A	16- 4-1938	31-12-1940	–	310

Number of water system	Name of station	Number of station	Name of river	Type	Gauging period		Elevation (m)	Catchment area (Km^2)
					Beginning	Closing		
	III. SULAWESI							
26.	S. Poso	26 – 2	S. Poso-Ratugene	N	3-11-1924	1- 1-1933	440	1,357
57.	S. Larona	57 – 3	S. Larona-Larona	A	14- 5-1919	12-12-1932	291	2,300
		57 – 1	S. Larona-Mea	N	1-11-1918	1- 1-1933	4	2,723
61.	S. Kalaena	61 – 1	S. Kalaena-Mangkutana	N	1-12-1918	1- 1-1933	45	1,278
		61 – 3	S. Tomeni-Mala Iko	N	4-11-1937	31-12-1940	–	101
62.	Salo Lamo	62 – 1	S. Lamo-Bunga Didi	N	22-11-1937	31-12-1940	–	185
63.	Salo Bonebone	63 – 1	S. Bone2-Bone2	N	6-11-1937	31-12-1939	+	60
		63 – 2	S. Gandjiro-Pompo Langit	N	7-11-1937	31-12-1940	–	93
64.	Salo Balease	64 – 1	S. Balease-Lindu	N	6-11-1937	31-12-1940	–	770
65.	Salo Rengkong	65 – 1	S. Rengkong-Marebe	N	25-11-1937	31-12-1940	–	945
		65 – 3	S. Ampak-Walewale	N	17-10-1938	31-12-1940	–	–
		65 – 2	S. Baybonta-Baybonta	N	20-11-1937	31-12-1940	–	9
66.	Salo Makewa	66 – 2	S. Lemasi-Wates Tanduk	N	25-11-1937	31-12-1940	–	270
93.	Sungai Sadang	93 – 1	Sungai Mamesa-Garuku	A	1- 8-1920	24-12-1932	595	1,215
127.	Sungai Bimanga	127 – 1	Sungai Runte-Tintjep	N	1- 3-1923	1- 3-1933	–	53
		127 – 2	K. Melajun-Kinilow	N	7- 6-1931	1- 1-1935	560	14
128.	Sungai Tondano	128 – 2	S. Tondano-Tonsealama	A	28- 8-1922	1- 1-1933	677	244
		128 – 3	S. Tondano-Sawangan	N	5- 3-1923	1- 1-1933	220	317


RUN-OFF GAUGING STATION
(DJAWA)
LEGEND
AUTOMATIC STATION
NON AUTOMATIC STATION
DJAKARTA
BOGOR
BANDUNG
INDRAMAJU
DJATIBARANG
TJIREBON
SEMARANG
SURAKARTA
TOGJAKARTA
Leuwigoong
MONdjot
Rawa Pening
K.Serayu
K.Serang
K.Lusi
K.progo
Tji Buni
Tjimandiri
(KALIMANTAN)
Pontianak
Balikpapan
Bandjarmasin
AUTOMATIC STATION
(SULAWESI)
MANADO
Pangka ene
MAKASSAR
Djene Ponto
AUTOMATIC STATION
NON AUTOMATIC STATION
(WEST IRIAN)
Manokwari
Fakfak
Kotabaru
AUTOMATIC STATION

RUN-OFF GAUGING STATION

(DJAWA)

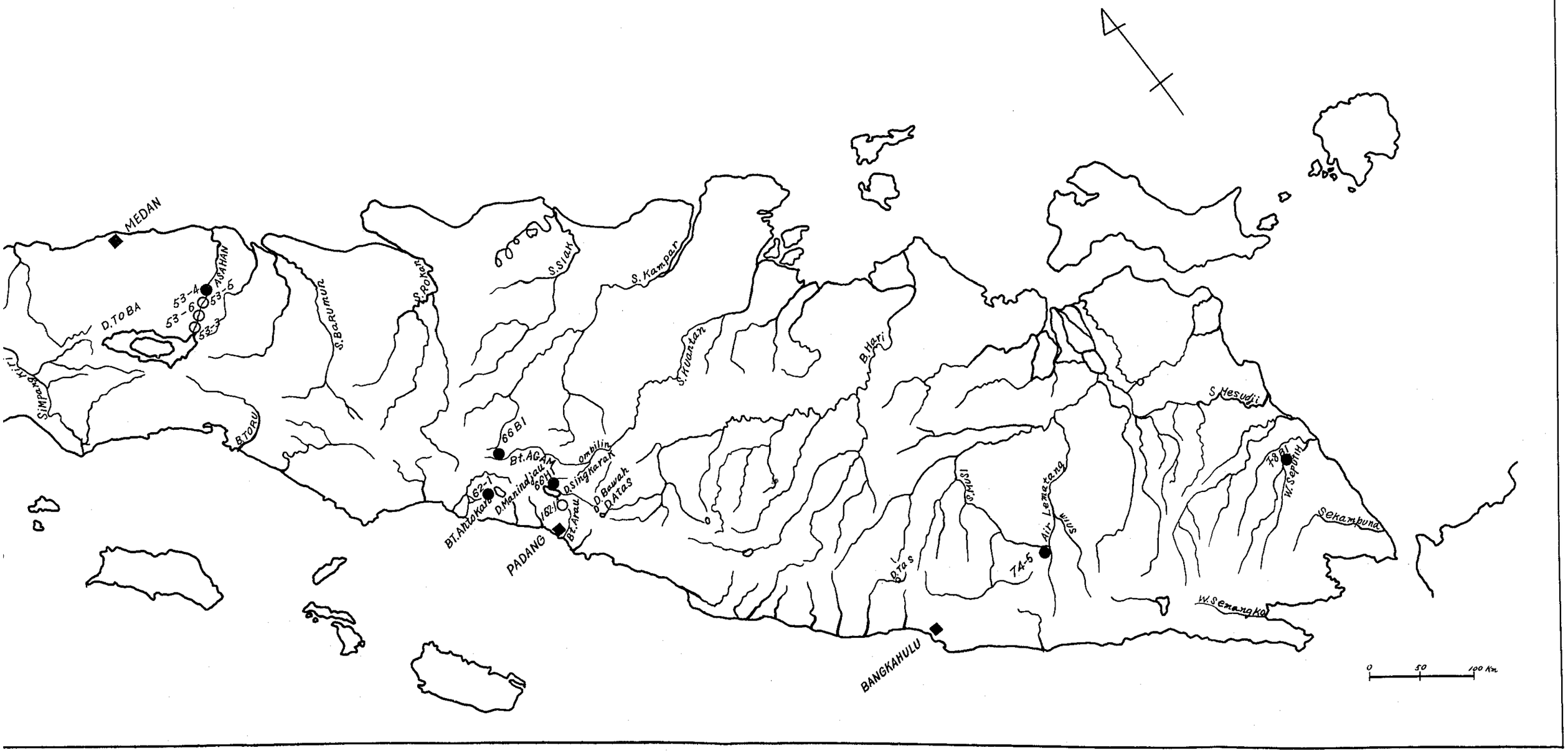


RUN-OFF GAUGING STATION

(SUMATERA)

RUN-OFF GAUGING STATION

(SUMATERA)



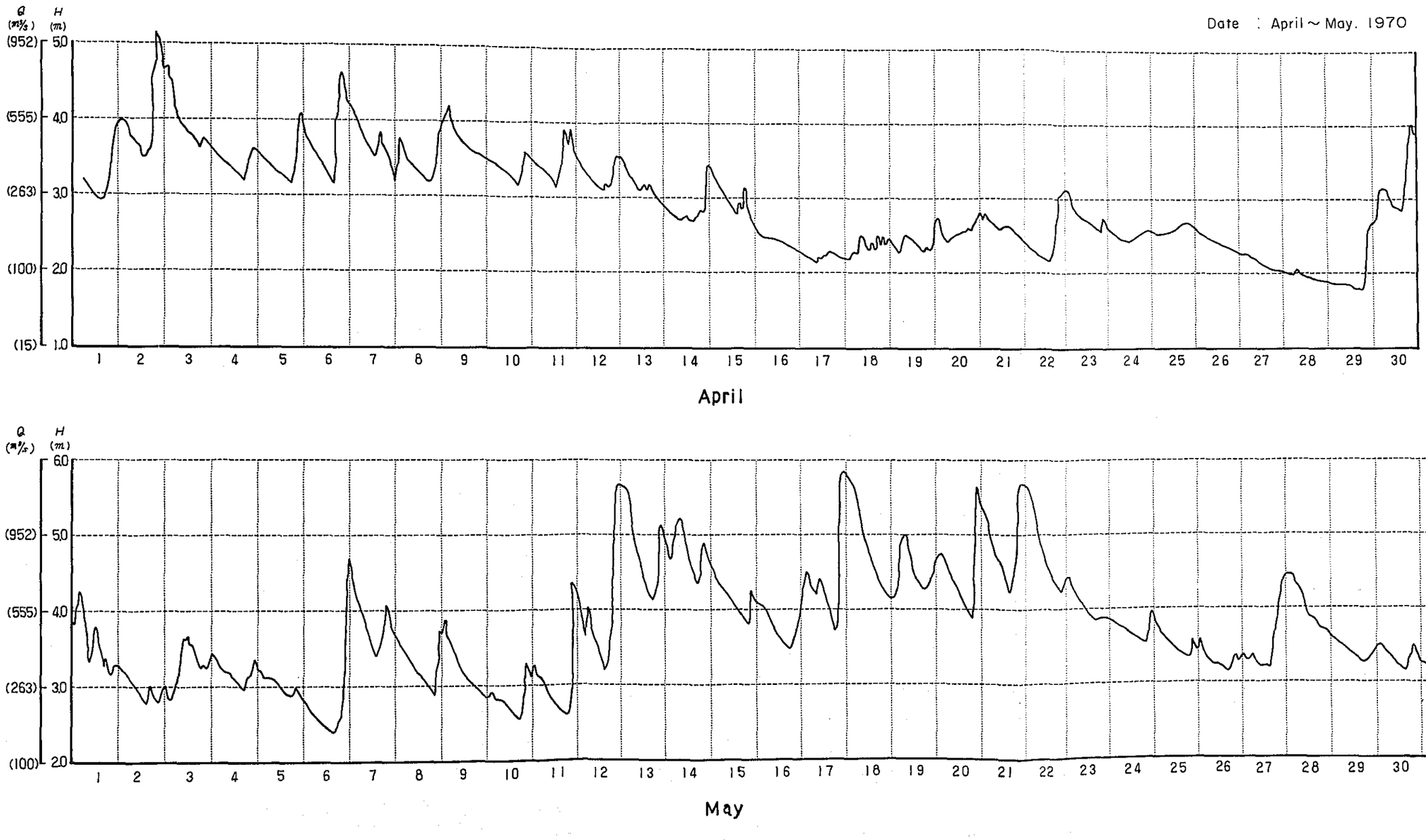
EXAMPLE OF WATER STAGE RECORD

(TJITARUM RIVER IN WEST DJAWA)

(Notes)

Place : Tjipetir

Date : April ~ May. 1970



NATURAL LAKES AND MARSHES IN INDONESIA

Note: See Appendix 4-4

No.	Number of water system	Name of river	Name of lake or marsh	Catchment area (Km^2)	High water level (m)	Water surface area (Km^2)	Total storage (m^3)
		(Sumatera)					
1.	19	Kr. Peusangan	D. Laut Tawar	236.87	1,165	56.40	
2.	53	B. Asahan	D. Toba	3,673	906	1,263	$3,924 \times 10^6$
3.	162	B. Antokan	D. Manindjau	245	463	98	
4.	66	B. Ombilin	D. Singkarak	1,152	363	115	
5.	66	B. Sumani	D. Bawah	30	1,450	11	
6.	71	B. Gumanti	D. Atas	39	1,525	13	
7.	71	B. Tebo Kanan	D. Gunung Tudjuh	25	1,991	9.4	
8.	74	S. Komering	D. Ranau	447.5	540	43.8	
9.	65	S. Serka	D. Gaung				
10.	129	S. Air Ketaun	D. Tes	153.12		1.87	
11.	74	S. Air Sitempur	D. Lebak diling				
12.	71	S. Batang Merangin	D. Kerintji	323.75	733	44.9	
		(Djawa)					
1.	3	Tjidano	Tjidano	90.72	82	1.5	
2.	16c		Tjileuntja	213	1,418	1.8	11×10^6
3.	16c		Tjipanundjang	4.30		0.01	22×10^6
4.	26		Situ Bagendit	452	702	1.25	
5.	50	Kali Tuntang	Rawa Pening	245	459	23	
6.	90		Telaga Mendjer	2.25	1,192	0.55	
7.	90		Telaga Mardede	0.87	1,940	0.38	
8.	55		Ngebel	20.95		1.38	
9.	56		Rawa Lamongan			0.38	
10.	–		Rawa Pakis			0.48	
11.	58		G. Kelud (Krates lake)	1.50		0.50	

No.	Number of water system	Name of river	Name of lake or marsh	Catchment area (Km^2)	High water level (m)	Water surface area (Km^2)	Total storage (m^3)
		(Kalimantan)					
1.	14	S. Mahakam	D. Kerohan Djempung			225	
2.	14	S. Mahakam	D. Pojan			548.5	
3.	14	S. Mahakam	D. Kerohan Senapang			236.3	
4.	27	S. Barito	D. Mutar			30	
5.	43	S. Kapuas	D. Belida			117.5	
6.	43	S. Kapuas	D. Sempa		59	97.5	
		(Sulawesi)					
1.	128	S. Tondano	D. Tondano	260	682	50	
2.	26	S. Poso	D. Poso	510	512.5	307	
3.	57	S. Larona	D. Towuti	1,580	322.7	572	54.5×10^6
4.	57	S. Larona	D. Matana	475	399	164	37×10^6
5.	57	S. Larona	D. Maharona	245	328.7	24	
6.	93	S. Watanae	D. Tempe	523.47	100	46.9	
7.	93	S. Matia	D. Sidenreng			31.2	
8.	112	S. Palu	D. Lindu	367.60	960	25.2	
9.	–	S. Bone	D. Lembotto	768.40	180	70	
10.		S. Poigar	D. Poigar	38.50	108.4	12	
11.		S. Poigar	D. Iloilo	85.30	840	0.6	

No.	Number of water system	Name of river	Name of lake or marsh	Catchment area (Km^2)	High water level (m)	Water surface area (Km^2)	Total storage (m^3)
		(Bali)					
1.			Danau Batur	100.4	1,031	15.6	
2.			Danau Bratan	16.4	1,231	2.6	
3.			Danau Bujan	18	1,214	3.6	
4.			Danau Tamblingan	10.4	1,214	1.2	
		(West Irian)					
1.	–	S. Membrano	D. Romhebai			135	
2.	–	S. Urumuka	D. Penai	1,800	1,742	145	
3.	–	S. Urumuka	D. Tigi		1,640	33	
4.	–	S. Urumuka	D. Tage		1,748	23.2	
5.	–	S. Owali	D. Anggi Gita	135	1,864	20	
6.	–	S. Owon's	D. Anggi Giji	135	1,921	21	
7.	–	S. Irai					
8.	–	S. Djafoeri	D. Sentani	585	72.5	94	
9.	–	S. Wanuni	D. Tanemot			15	
10.	–	S. Ilorong	D. Cielen		3,200	1.2	
11.	–	–	D. Makiri			7	
12.	–	S. Amaru	D. Ajamaru			10.4	
13.	–	–	D. Hain			4	
14.	–	–	D. Way Herber Hover			160	
15.	–	–	D. Grian			15	
16.	–	–	D. Mubula			20	
17.	–	–	D. Komakowalai			15	

EVAPOLATION DATA

1. Evaporation in Indonesia

(1944)

Place (Elevation in m) \ Month	1	2	3	4	5	6	7	8	9	10	11	12	Annual
Bandung (768)	1.9	2.5	2.1	1.9	2.2	3.1	3.4	4.0	4.3	4.3	2.5	2.3	2.9
	2.9	3.5	4.0	3.8	3.4	4.8	4.3	5.8	7.2	7.7	4.0	3.9	7.7
Djakarta (8)	1.1	1.2	1.3	1.5	1.7	2.1	2.1	2.5	2.6	2.1	1.6	1.4	1.8
	1.9	1.9	2.1	2.4	2.4	2.6	2.7	3.2	3.9	3.0	2.5	2.4	3.9
Djember (83)	2.3	2.3	2.3	2.3	2.1	2.0	2.3	2.7	3.0	2.7	2.5	2.3	2.4
	3.4	4.0	6.4	3.0	3.2	2.8	2.8	4.5	5.0	4.4	5.4	8.0	8.0
Karangsari (70)	1.5	1.5	1.8	1.6	2.0	2.3	2.4	2.7	3.3	2.9	2.3	1.8	2.2
	2.3	2.3	3.2	2.8	3.9	3.6	3.0	3.9	6.1	4.8	3.7	3.2	6.1
Klaten (200)	2.1	2.3	2.0	2.4	3.0	4.1	4.4	4.5	4.8	4.2	2.6	2.4	3.2
	4.2	4.0	4.0	3.5	4.5	5.1	5.0	5.3	5.4	5.5	5.0	4.0	5.5
Lembang (1,300)	1.2	1.9	1.6	1.7	2.1	2.7	2.7	3.1	3.3	3.3	1.6	1.2	2.2
	2.9	3.4	3.3	3.5	3.6	6.5	5.2	4.4	5.7	6.4	3.0	2.6	6.5
Malang (445)	0.9	1.1	1.1	1.2	1.4	1.9	2.2	2.7	3.1	3.2	2.0	1.1	1.8
	2.7	2.3	2.2	2.6	3.2	3.2	4.2	3.9	6.2	5.2	5.1	2.4	6.2
Modjopanggoong (90)	8.7	9.2	8.8	10.3	11.6	12.9	12.8	13.0	12.8	12.4	7.8	5.5	10.5
	12.9	13.3	17.0	13.0	15.2	18.2	16.2	17.0	19.4	18.8	15.8	15.8	19.4
Pasuruan (5)	2.1	1.9	2.0	2.3	2.4	3.4	4.0	4.1	4.4	4.3	3.8	2.0	3.1
	4.2	2.8	3.8	3.4	4.0	4.8	5.0	5.0	5.8	5.4	5.0	4.2	5.8
Tjibodas (1,400)	0.9	1.5	1.2	1.1	1.3	1.6	1.6	1.6	1.6	1.7	1.2	1.1	1.4
	1.6	3.2	2.0	2.2	2.2	2.6	3.6	2.6	3.0	3.0	2.0	2.2	3.6
Tjirebon (4)	2.0	2.0	1.7	2.8	3.0	3.6	4.6	5.2	5.2	4.7	3.4	1.8	3.3
	4.1	2.9	2.7	9.7	6.4	6.3	9.0	8.5	8.0	6.3	5.8	3.0	9.7
Tjiwidej (1,780)	0.6	0.9	0.7	0.7	0.8	0.9	1.4	1.4	1.5	1.1	0.7	0.8	1.0
	1.5	1.6	1.3	1.4	1.5	2.0	2.4	2.0	3.0	2.2	1.7	1.9	3.0

(Note) 1. The figure in the upper row shows the monthly mean value of daily evaporation in mm and the figure in the lower row shows the absolute daily maximum value in mm.

2. These data were measured by the evaporation pan with the area of 250 cm^2.

2. Evaporation in the mountainous area in Japan

(1912 - 1936)

Month / District	1	2	3	4	5	6	7	8	9	10	11	12	Annual
Kyushu (7)	1.0 - 2.4* 3.3 - 7.9	1.3 - 2.5 4.1 - 8.4	2.0 - 3.1 5.8 - 9.6	2.9 - 4.1 7.0 - 10.8	3.6 - 4.6 7.7 - 13.7	2.6 - 3.6 7.3 - 10.4	3.4 - 4.7 7.3 - 11.8	3.7 - 5.3 7.7 - 13.2	2.8 - 3.8 6.1 - 9.0	2.2 - 3.5 4.8 - 6.9	1.5 - 2.5 4.5 - 6.0	1.0 - 2.2 2.7 - 4.7	2.4 - 3.4 8.4 - 13.7
Shikoku (2)	1.4 - 1.9 3.2 - 3.9	1.6 - 2.2 4.0 - 5.9	2.2 - 3.1 6.0 - 7.1	3.0 - 3.8 6.3 - 9.4	3.5 - 4.0 7.0 - 9.1	3.1 - 3.6 7.5 - 8.5	3.5 - 4.2 8.6 - 8.9	3.5 - 4.1 7.6 - 8.9	2.5 - 3.1 6.6 - 7.7	2.0 - 2.8 4.8 - 6.1	1.5 - 2.2 3.3 - 5.6	1.3 - 1.9 2.7 - 3.9	2.4 - 3.1 8.9 - 9.4
Chugoku (5)	0.7 - 1.0 2.1 - 3.9	0.9 - 1.3 3.1 - 5.0	1.5 - 2.2 5.3 - 6.6	3.0 - 3.4 6.6 - 8.0	3.6 - 4.2 7.3 - 8.5	3.0 - 4.4 7.4 - 9.7	3.5 - 4.8 7.5 - 9.1	3.8 - 5.1 8.5 - 9.3	2.1 - 3.2 5.5 - 8.2	1.5 - 2.3 3.5 - 6.3	0.9 - 1.5 2.9 - 4.0	0.6 - 1.1 2.0 - 3.8	2.1 - 2.9 8.8 - 9.7
Kinki (4)	0.8 - 1.5 2.8 - 4.2	0.8 - 1.5 2.7 - 4.4	1.4 - 2.3 5.2 - 6.8	1.8 - 3.1 6.5 - 7.9	2.0 - 3.8 7.0 - 9.1	1.5 - 3.3 7.3 - 9.6	1.6 - 4.6 6.9 - 9.5	2.2 - 4.8 5.9 - 8.9	1.0 - 3.5 5.6 - 9.0	1.2 - 2.4 3.7 - 5.3	1.3 - 1.6 3.6 - 5.4	0.8 - 1.5 2.4 - 4.0	1.4 - 2.7 7.3 - 9.6
Chubu (9)	0.9 - 1.9 3.1 - 4.2	1.2 - 2.0 3.4 - 5.9	1.9 - 2.7 5.4 - 8.0	2.9 - 4.1 8.2 - 13.7	3.1 - 4.9 7.9 - 12.4	2.6 - 5.1 7.5 - 13.2	3.1 - 5.1 8.8 - 14.4	3.1 - 5.7 7.6 - 11.7	2.2 - 3.5 6.1 - 12.3	1.7 - 2.7 4.7 - 8.1	1.3 - 2.0 3.6 - 7.9	0.8 - 1.9 3.1 - 4.8	2.3 - 3.3 8.8 - 14.4
Kanto (4)	1.4 - 1.8 3.0 - 5.2	1.5 - 2.0 3.8 - 4.9	2.0 - 2.6 4.7 - 6.5	2.8 - 3.4 6.8 - 9.1	2.7 - 3.8 7.0 - 9.6	2.1 - 3.5 6.8 - 8.2	2.7 - 3.8 7.8 - 9.4	2.5 - 3.7 6.5 - 8.6	1.6 - 2.5 5.6 - 8.0	1.5 - 2.1 4.1 - 7.3	1.7 - 1.9 3.8 - 4.7	1.4 - 1.8 3.3 - 5.3	2.1 - 2.7 8.0 - 9.6
Tohoku (11)	0.6 - 1.6 1.9 - 3.8	0.6 - 1.8 2.4 - 6.0	1.0 - 2.7 3.9 - 7.4	2.5 - 3.9 6.8 - 12.3	3.3 - 4.8 7.0 - 13.1	3.4 - 4.7 6.8 - 13.1	3.6 - 5.2 8.2 - 11.6	3.9 - 5.1 8.3 - 10.4	2.2 - 3.4 6.5 - 9.5	1.6 - 2.5 3.7 - 7.8	0.9 - 2.1 2.7 - 8.3	0.6 - 1.7 1.8 - 7.5	2.1 - 2.9 8.9 - 13.1

(Note)

1. *The parenthesized figure shows the number of observation stations.*
2. *For example, 1.0 - 2.4 indicates that the monthly mean value of daily evaporation in mm measured at 7 observation stations are between 1.0 and 2.4 and 3.3 - 7.9 indicates that the absolute daily maximum value in mm measured at 7 observation stations are between 3.3 and 7.9.*
3. *The observation period of each data differs with the stations. These periods are between 4 and 23 years.*

RECORD OF SUSPENDED SEDIMENT ANALYSIS

by Institute of Hydraulic Engineering in Bandung

No.	Name of river	Place	Date of Sampling	Number of Samples	Remarks
1.	Tjitanduj	Tjirahang	21-11-1969	6	West Djawa
2.	Tjimuntur	Batu - nunggul	24-11-1969	6	Tributary of Tjitanduj ”
3.	Tjikawung	Tjimeli	30-11-1969	6	” ”
4.	Tjidjulang	Tjibentang	1-12-1969	3	” ”
5.	Tjikawung		2-12-1969	6	” ”
6.	Tjitanduj	Pataruman	5-12-1969	6	”
7.	Tjilutung	Kamun I – VI	14- 5-1969	11	Tributary of Tjimanuk ”
8.	Tjimanuk	Mendjet I – X	17- 5-1969	18	”
9.	Tjipeles	Warung Peti I – IV	19- 5-1969	8	Tributary of Tjimanuk ”
10.	Tjipelang	Rentang I – III	10- 5-1969	6	main irrigation canal of Tjipelang. ”
11.	Tjimanuk	Tomo I – IV	19- 5-1969	8	Tributary of Tjimanuk ”
12.	Tjisadane	–	23- 6-1969	30	”
13.	Way Tatajan	–	21- 8-1969	3	Lampung / Sumatera
14.	Way Seputih	–	23- 8-1969	6	”
15.	Way Tatajan	–	25- 8-1969	3	”
16.	Way Seputih	–	25- 8-1969	6	”

No.	Name of river	Place	Date of Sampling	Number of Samples	Remarks
17.	Way Seputih	Tomo I – IV	1- 9-1969	3	
18.	Way Seputih	–	1- 9-1969	3	main irrigation canal of Way Seputih
19.	Way Tatajan	–	1- 9-1969	3	Lampung / Sumatera
20.	K. Progo	Borobudur	3- 2-1970	5	Central Djawa
21.	K. Progo	Kranggan	10- 2-1970	5	"
22.	K. Progo	Duwet	19- 2-1970	3	"
23.	K. Progo	Srandakan	23- 2-1970	5	"
24.	K. Elo	Mendut	22- 1-1970	6	Tributary of K. Progo "
25.	K. Elo	Sorobajan	11- 2-1970	4	" "
26.	K. Serang	Durungan	24- 2-1970	2	" "
27.	K. Krasak	Djembatan	24- 2-1970	1	" "
28.	K. Opak	Karang semut	19- 3-1970	3	"
29.	K. Tangsi	Tegalarum	20- 3-1970	2	Tributary of K. Progo "
30.	K. Progo	Bandengan	20- 3-1970	3	"
31.	K. Opak	Kretek	19- 3-1970	4	"
32.	K. Progo	Sentolo	23- 3-1970	5	"
33.	K. Progo	Pistan	26- 3-1970	2	"
34.	K. Tingal	Kaloran	26- 3-1970	2	Tributary of K. Progo "
35.	K. Oja	Dogongan	–	3	Tributary of K. Opak "
36.	K. Opak	Djembatan Blungan	–	2	"

No.	Name of river	Place	Date of Sampling	Number of Samples	Remarks
37.	Tjitanduj	Tjikawung	25- 2-1970	3	West Djawa
38.	Tjikawung	Bantar	24- 2-1970	3	"
39.	Tjimuntur	Batununggul	20- 2-1970	3	"
40.	Tjitanduj Bbk.	Tjirahong	19- 2-1970	3	"
41.	Tjitanduj	Leuwi Tondjong	18- 2-1970	3	"

EXAMPLE OF ESTIMATION METHOD OF HYDRO-POWER POTENTIAL

(the contour line method)

(I) At Bener on Kali Bogowonto

No.	Range of El. (m)	Mean Height H (m)	H-360 ΔH (m)	Rain-fall x10^6 (m^3/year)	Σ RF x10^6 (m^3/year)	River Discharge Q (m^3/s)	ΔQ (m^3/s)	ΔP x 10^3 (kW)	ΣΔP x 10^3 (kW)
1	3,500 - 3,250	3,375	3,015	0.1	0.1	0	0	0	0
2	3,250 - 3,000	3,125	2,765	0.5	0.6	0.01	0.01	0.3	0.3
3	3,000 - 2,750	2,875	2,515	0.9	1.5	0.03	0.02	0.5	0.8
4	2,750 - 2,500	2,625	2,265	2.8	4.3	0.09	0.06	1.3	2.1
5	2,500 - 2,250	2,375	2,015	3.9	8.2	0.18	0.09	1.8	3.9
6	2,250 - 2,000	2,125	1,765	5.1	13.3	0.29	0.11	1.9	5.8
7	2,000 - 1,750	1,875	1,515	8.8	22.1	0.49	0.20	3.0	8.8
8	1,750 - 1,500	1,625	1,265	14.2	36.3	0.80	0.31	3.8	12.6
9	1,500 - 1,250	1,375	1,015	29.9	66.2	1.46	0.66	6.6	19.2
10	1,250 - 1,000	1,125	765	70.8	137.0	3.01	1.55	11.6	30.8
11	1,000 - 750	875	515	125.9	262.9	5.78	2.77	14.0	44.8
12	750 - 500	625	265	170.7	433.6	9.54	3.76	9.7	54.5
13	500 - 250	375	15	13.7	447.3	9.84	0.30	0.1	54.6

∴ Theoretical potential = 54,600 kW

Remarks:
1. El. above sea level at Bener 360 m
2. Catchment area of Bener 96.5 km^2.
3. Run-off coefficient of this river basin 0.7 (refer to Appendix 2-11.)
4. River discharge Q = Σ RF (Rain-fall) x 0.7/365 x 24 x 60 x 60
5. Theoretical potential ΔP = 9.8 x ΔQ x ΔH.

(II) At Anggapaten on Kali Bogowonto

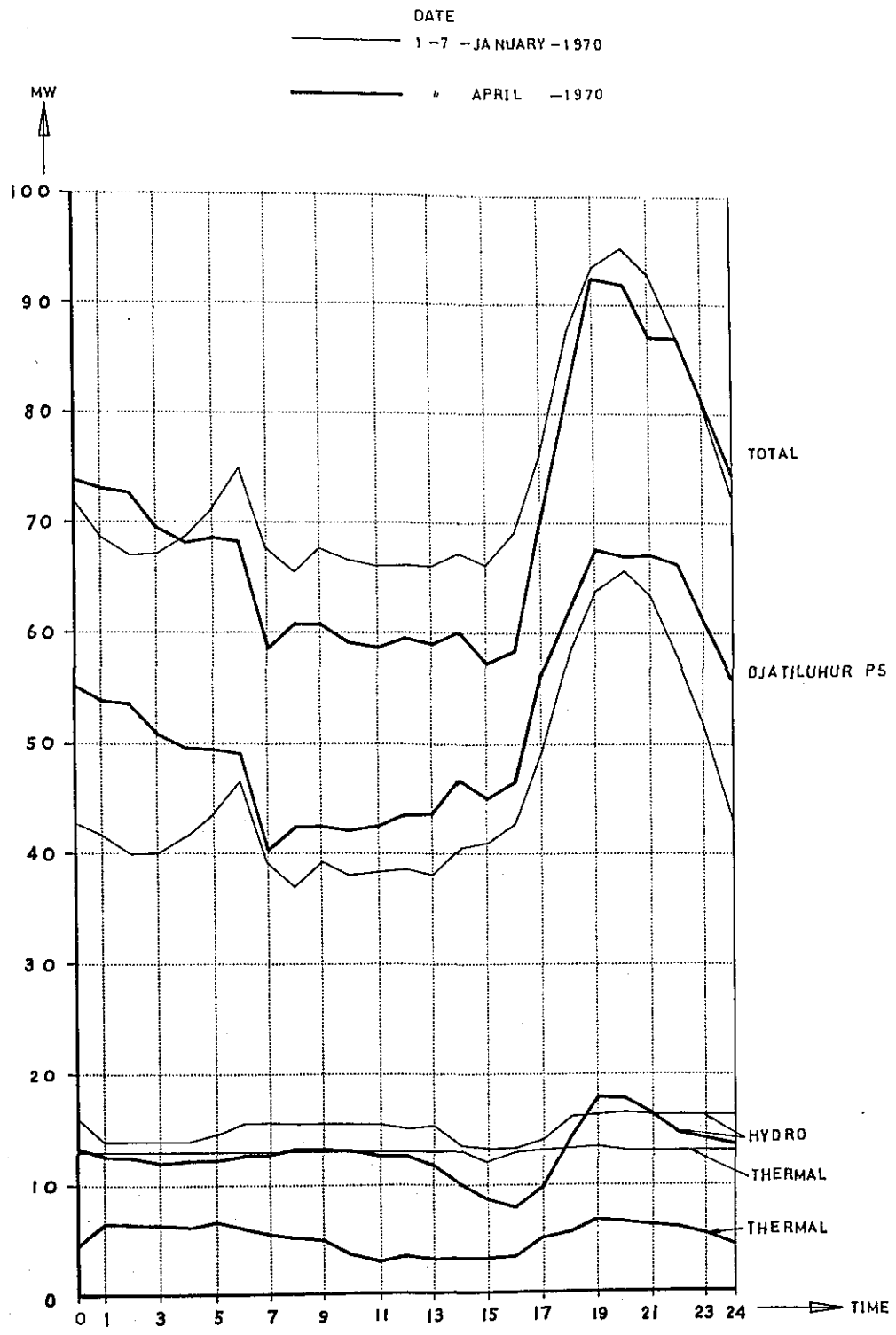
No.	Range of El. (m)	Mean Height H (m)	H - 98 ΔH (m)	Rain-fall x10^6 (m^3/year)	Σ RF x10^6 (m^3/year)	River Discharge Q (m^3/s)	ΔQ (m^3/s)	ΔP x 10^3 (kW)	ΣΔP x 10^3 (kW)
1	2,000 - 1,750	1,875	1,777	1.6	1.6	0	0	0	0
2	1,750 - 1,500	1,625	1,527	3.0	4.6	0.12	0.12	1.8	1.8
3	1,500 - 1,250	1,375	1,277	8.9	13.5	0.34	0.22	2.8	4.6
4	1,250 - 1,000	1,125	1,027	22.1	35.6	0.89	0.55	5.5	10.1
5	1,000 - 750	875	777	36.1	71.7	1.79	0.90	6.9	17.0
6	750 - 500	625	527	137.3	209.0	5.23	3.44	17.8	34.8
7	500 - 250	375	277	274.9	483.9	12.10	6.87	18.6	53.4
8	250 - 0	125	27	88.9	572.8	14.32	2.22	0.6	54.0

∴ Theoretical potential = 54,000 kW

Remarks:
1. El. above sea level at Anggapaten 98 m.
2. Catchment area of Anggapaten 188.3 km^2.
3. Run-off coefficient of this river basin 0.8 (refer to Appendix 2-11)

AVERAGE DAILY LOAD CURVE

EXPLOITASI XII (WEST DJAWA)



PLN PUSAT
URUSAN OPERASI

AVERAGE DAILY LOAD CURVE

EXPLOITASI XII (WEST DJAWA)

DATE

1 – 6 – JANUARY – 1969

1 – 7 – APRIL – 1969

PLN PUSAT
URUSAN OPERASI

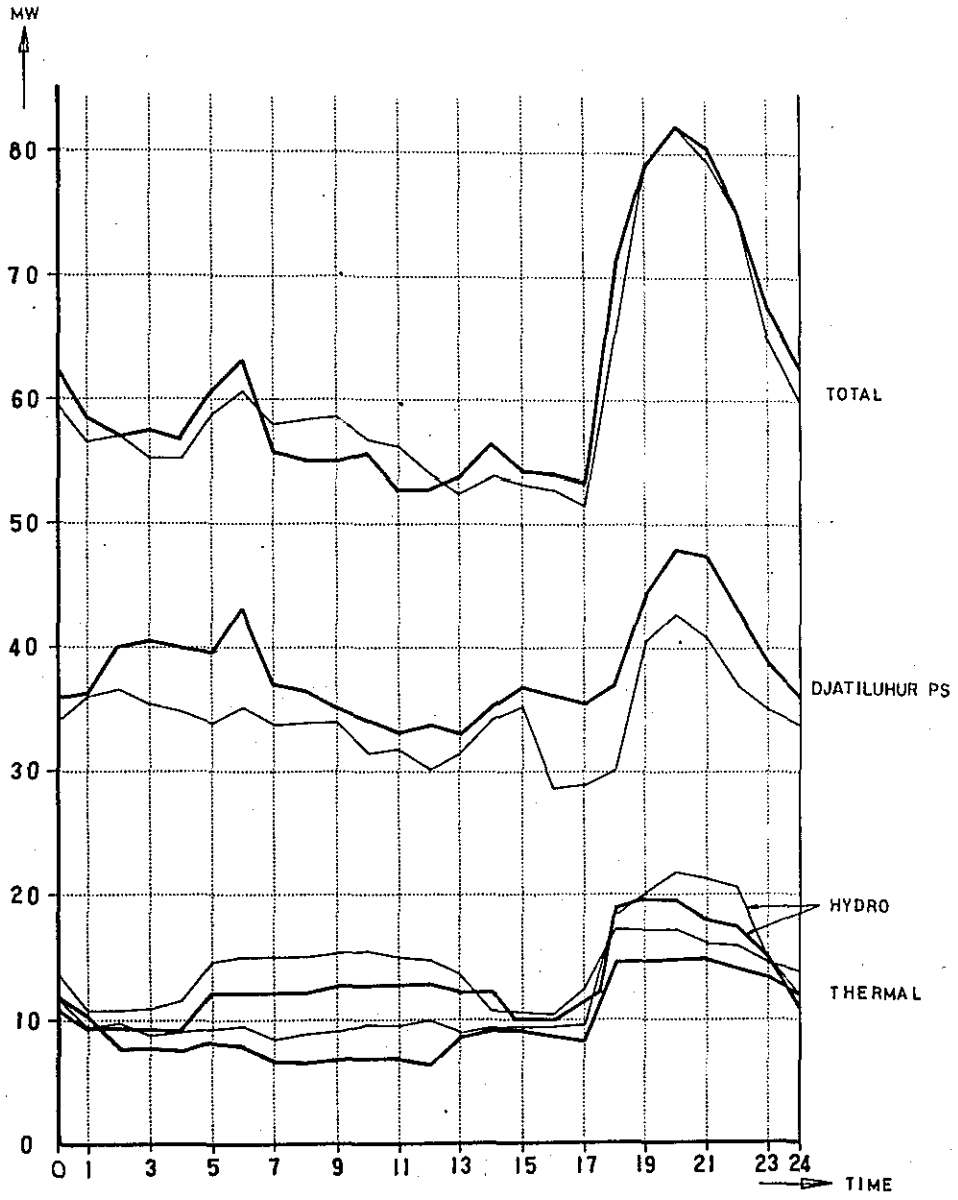
AVERAGE DAILY LOAD CURVE

EXPLOITASI XII (WEST DJAWA)

DATE

22–27–JANUARY –1968

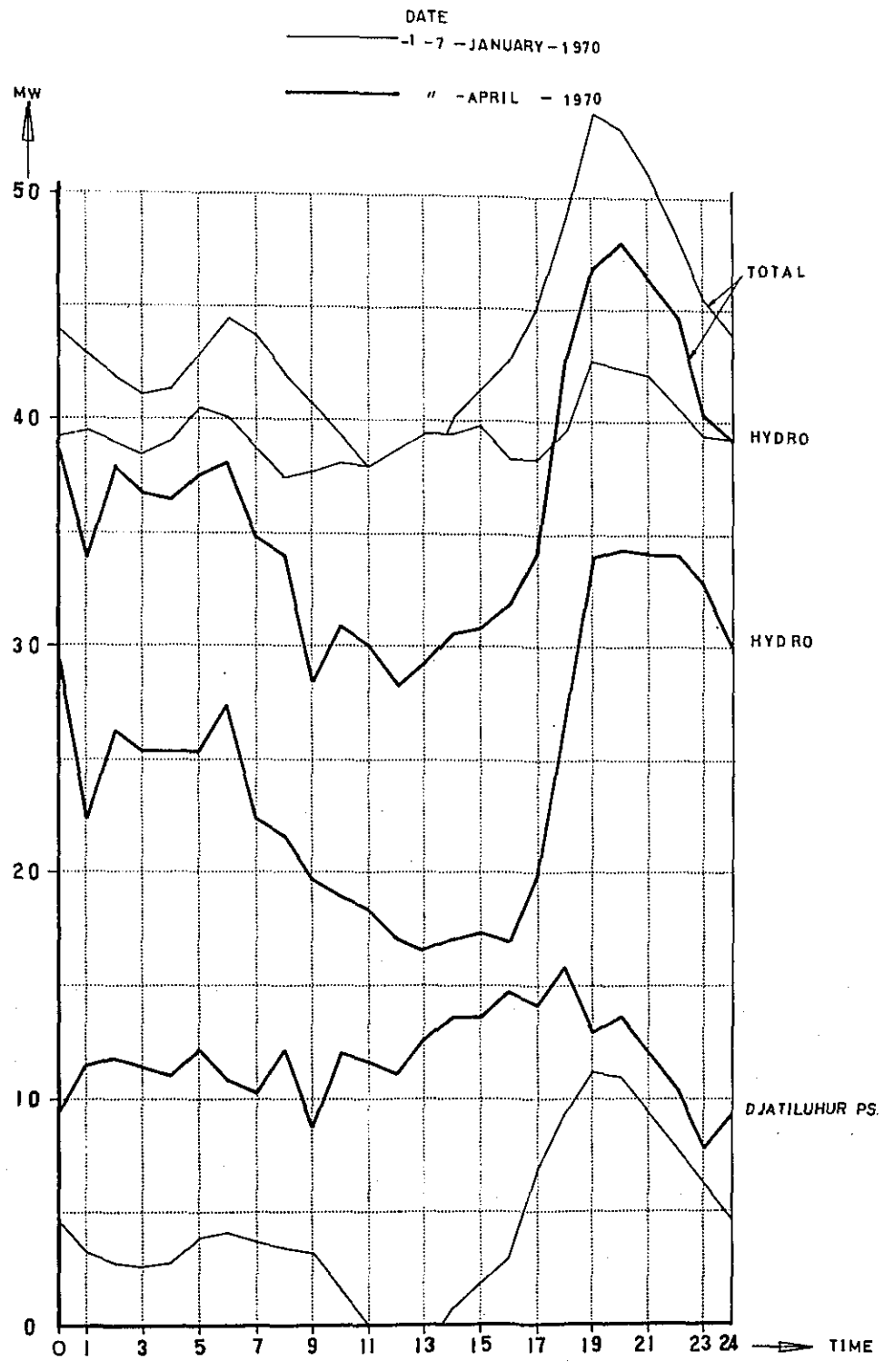
1 – 6 –APRIL –1968



PLN PUSAT
URUSAN OPERASI

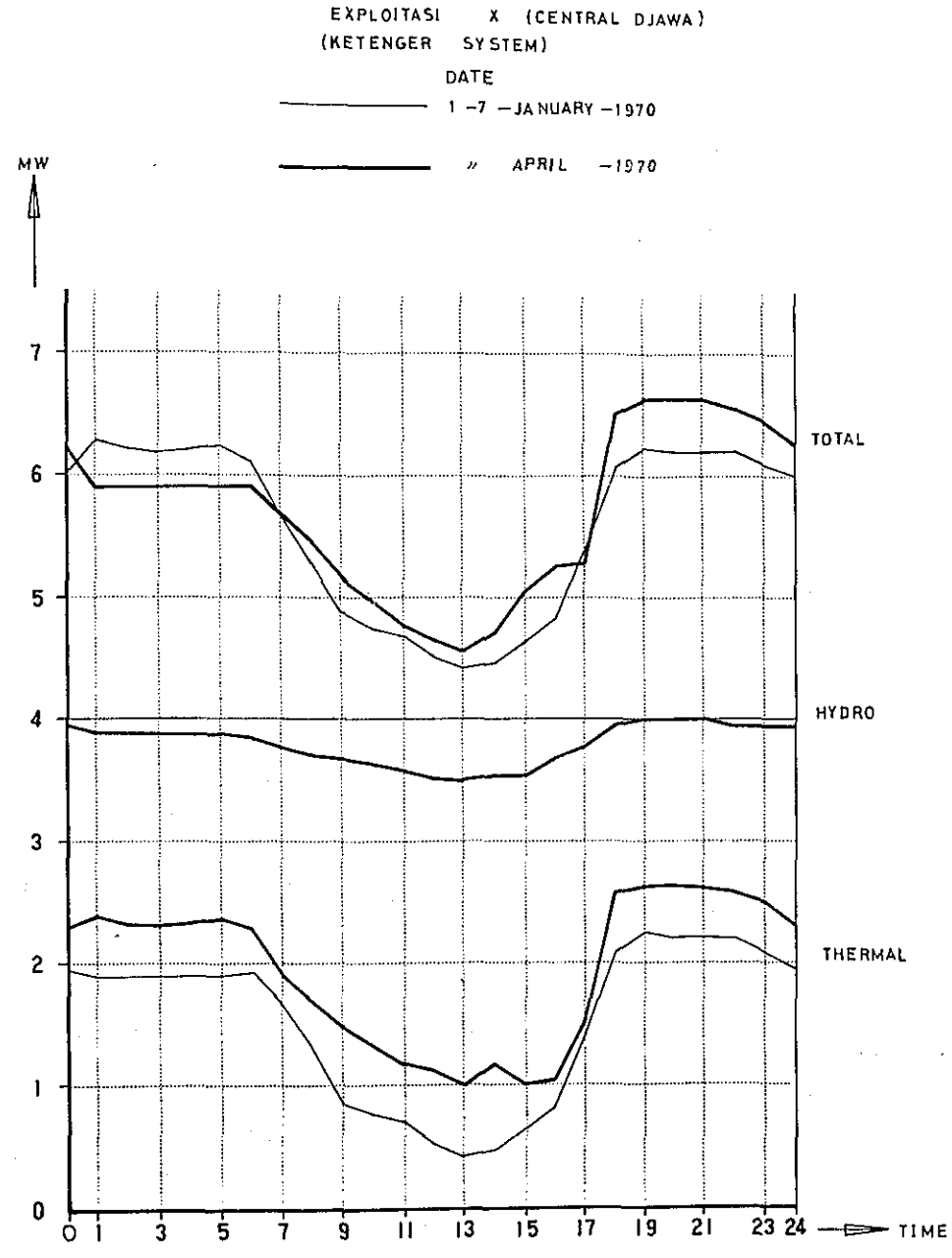
AVERAGE DAILY LOAD CURVE

EXPLOITASI XI (WEST DJAWA)



PLN PUSAT
URUSAN OPERASI

AVERAGE DAILY LOAD CURVE



PLN PUSAT
URUSAN OPERASI

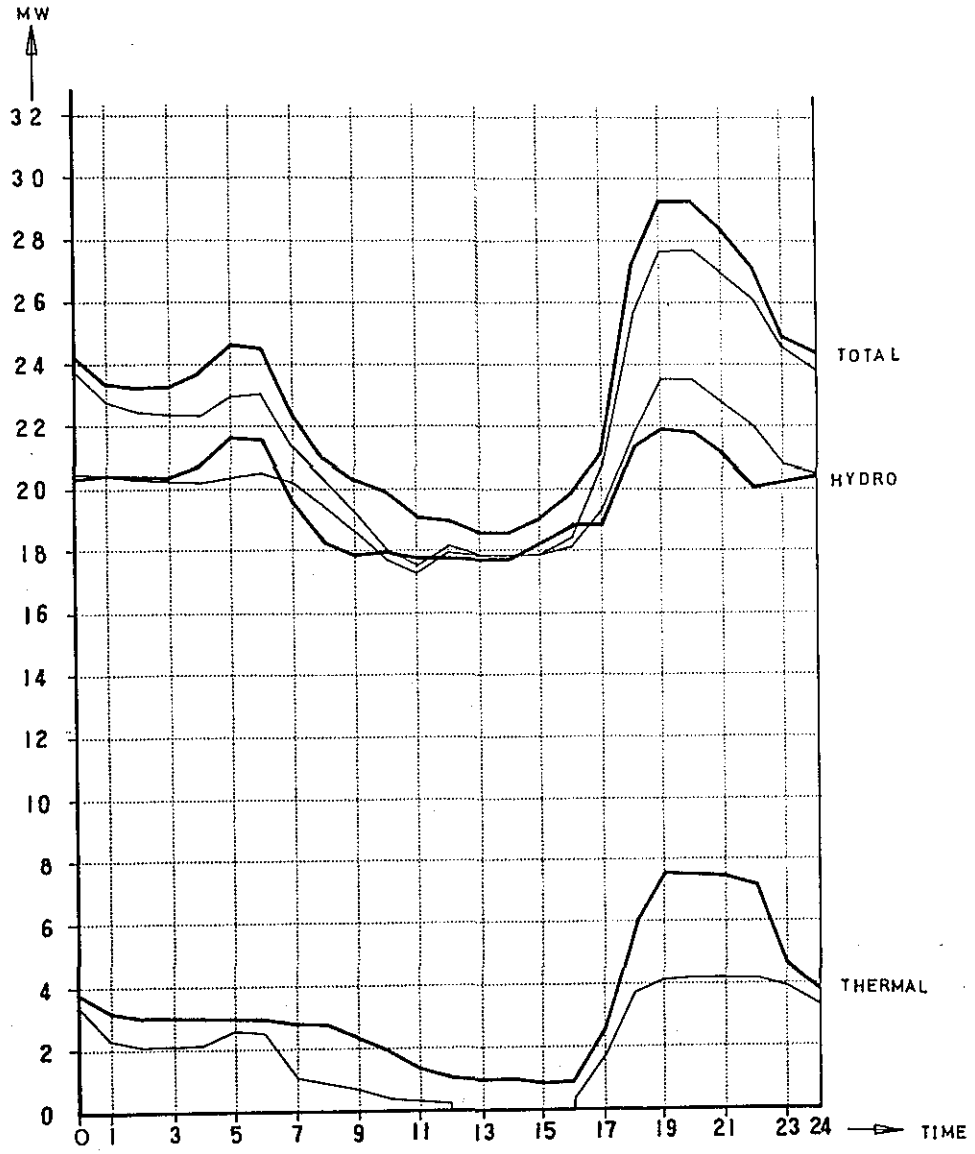
AVERAGE DAILY LOAD CURVE

EXPLOITASI X (CENTRAL DJAWA)
(TUNTANG SYSTEM)

DATE

1 -7 -JANUARY -1970

" APRIL -1970



PLN PUSAT
URUSAN OPERASI

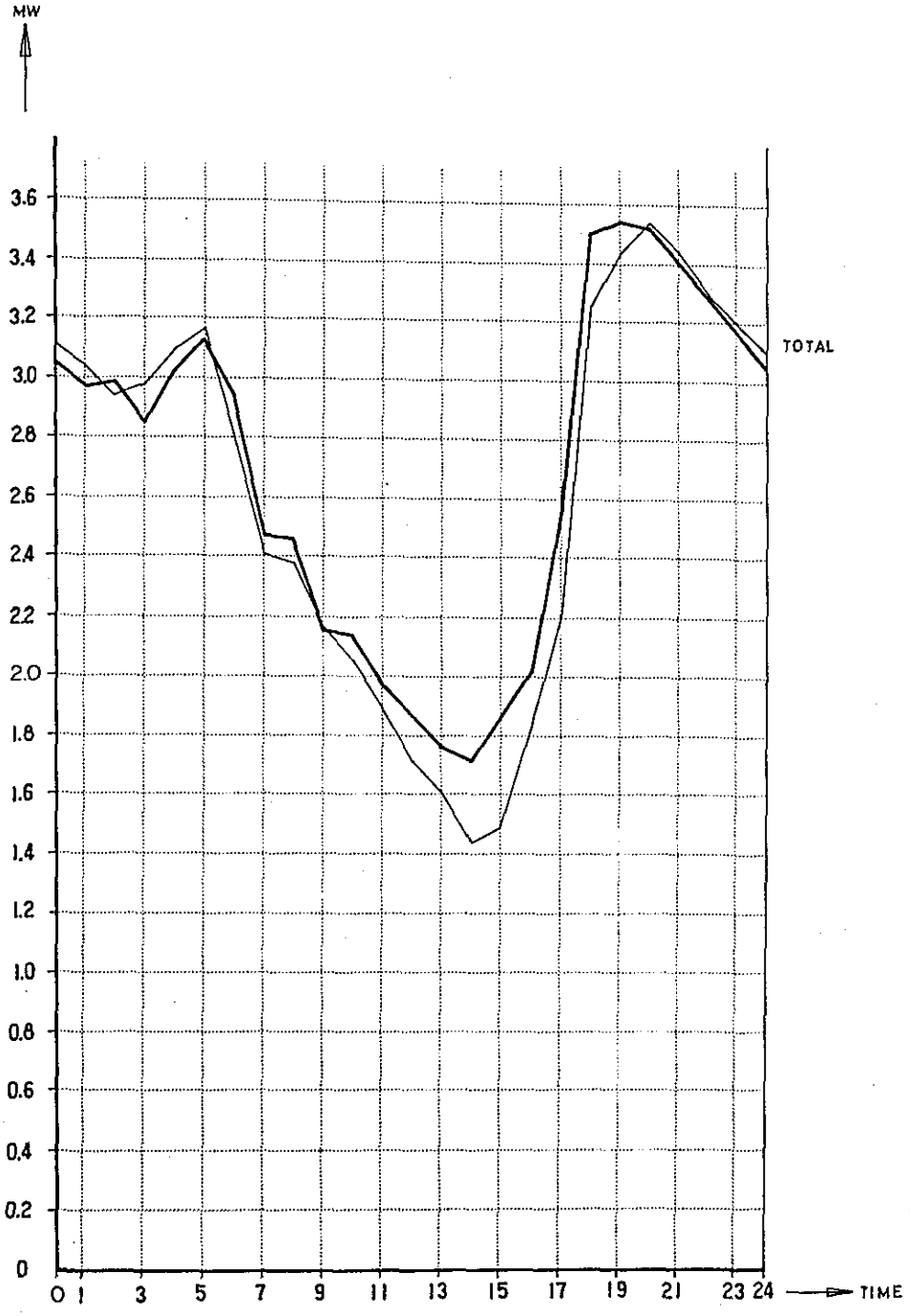
AVERAGE DAILY LOAD CURVE

EXPLOITASI IX (EAST DJAWA)
(MADIUN SYSTEM)

DATE

——— 1 – 7 – JANUARY – 1970

——— " APRIL – 1970



PLN PUSAT
URUSAN OPERASI

AVERAGE DAILY LOAD CURVE

EXPLOITASI IX (EAST DJAWA)
(KALIKONT SYSTEM)

DATE

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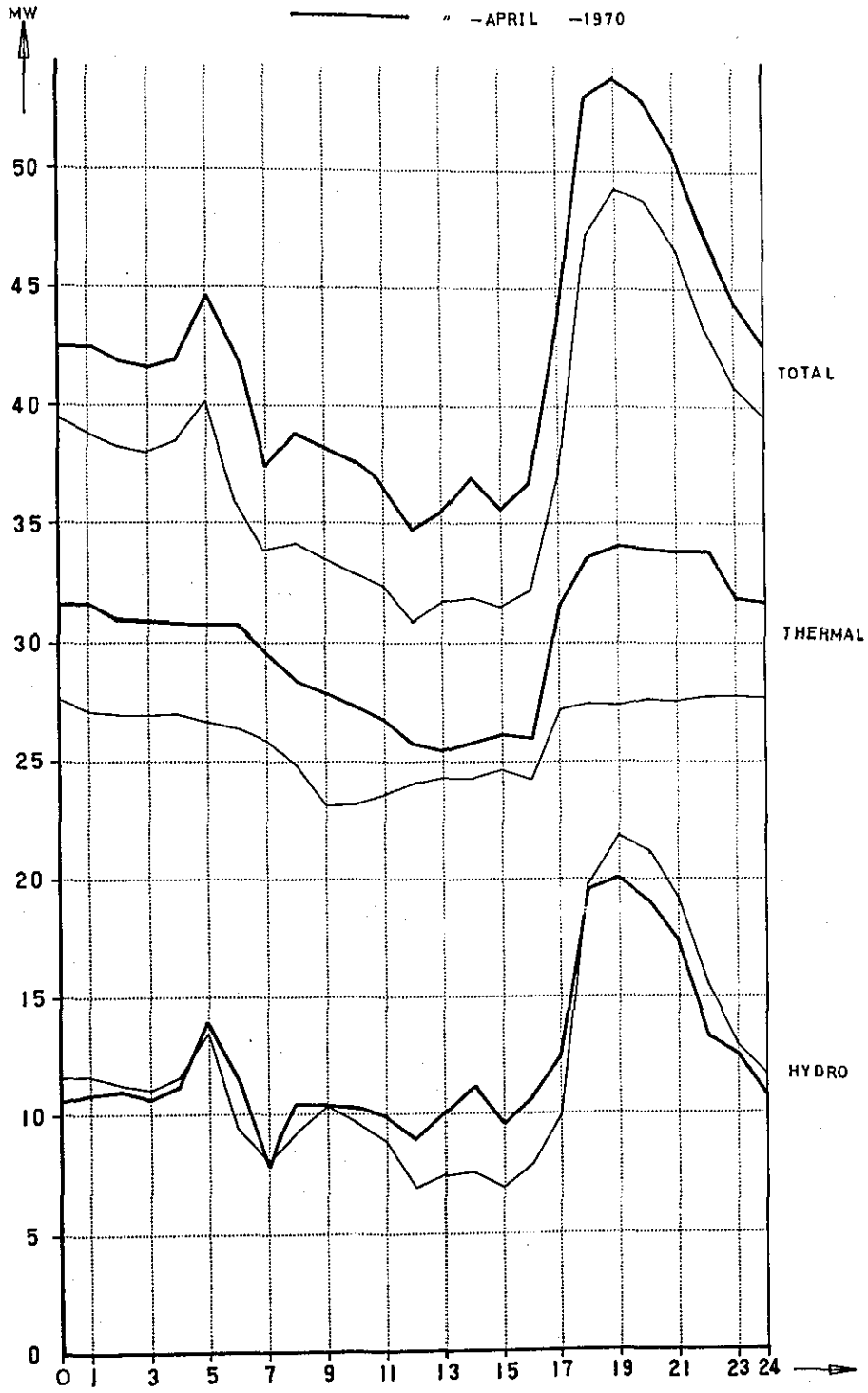
" -APRIL -1970



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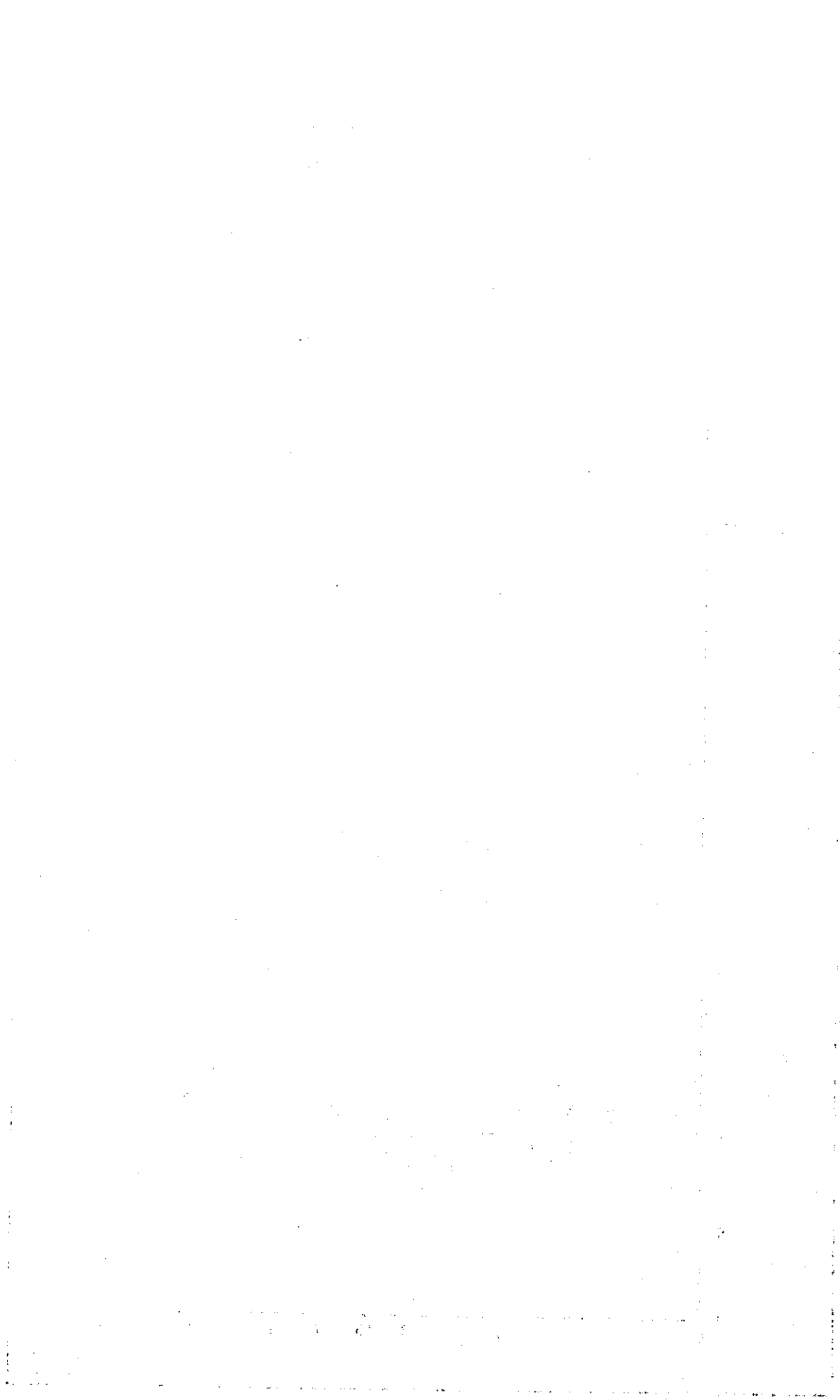


EXISTING POWER STATIONS IN INDONESIA (Jan. 1970)

PLN. Exploitasi	Total		Diesel P.S.		Thermal P.S.		Hydro P.S.		Gas Turbine P.S.	
	Number	Installed Capacity (kw)	Number	Installed Capacity (kw)	Number	Installed Capacity (kw)	Number	Installed Capacity (kw)	Number	Installed Capacity (kw)
I	21	40,181	19	26,061	–	–	1	120	1	14,000
II	11	38,666	9	23,346	–	–	1	1,320	1	14,000
III	8	6,590	8	6,590	–	–	–	–	–	–
IV	10	10,908	10	10,908	–	–	–	–	–	–
V	12	7,734	11	3,294	–	–	1	4,440	–	–
VI	9	13,929	9	13,929	–	–	–	–	–	–
VII	6	3,487	6	3,487	–	–	–	–	–	–
VIII	23	7,005	23	7,005	–	–	–	–	–	–
IX	25	114,798	17	19,826	1	50,000	7	44,972	–	–
X	29	77,888	22	21,588	–	–	6	42,300	1	14,000
XI	10	60,566	4	2,614	–	–	6	57,952	–	–
XII	12	130,848	7	34,948	2	62,200	3	33,700	–	–
XIII	9	4,422	9	4,422	–	–	–	–	–	–
XIV	22	15,447	20	14,545	1	832	1	70	–	–
XV	17	9,201	17	9,201	–	–	–	–	–	–
Total	224	541,670	191	201,764	4	–	26	–	3	42,000

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	B. Medan	1	PLTG. Medan	1	14,000	12,500
		2	PLTD. Medan	8	16,654	2,100
		3	PLTD. Brastagi	8	986	310
		4	PLTD. Sidikalang	3	238	125
2.	B. Bindjei	1	PLTD. Tdg. Pura	4	415	191
3.	B. Siantar	1	PLTD. Pem. Siantar	2	1,000	–
		2	PLTD. Rant. Prapat	2	550	230
		3	PLTD. Tebing Tinggi	7	1,090	450
		4	PLTD. Tdj. Tiram	4	275	106
		5	PLTD. Kisaran	4	865	247
		6	PLTD. Tdj. Balai	6	935	133
		7	PLTD. Prapat	4	318	109
		8	PLTD. Lab. Bilik	2	61	45
4.	B. Sibolga	1	PLTD. Sibolga	4	1,152	400
		2	PLTD. Porsea	2	133	46
		3	PLTD. Balige	5	508	245
		4	PLTD. Siborongborong	2	200	58
		5	PLTD. Tarutung	2	256	171
		6	PLTA. Tarutung	2	120	35
		7	PLTD. Sipirok	2	225	51
		8	PLTD. G. Sitoli	2	200	98

(Note) *PLTD: Diesel power station*
PLTU: Thermal power station
PLTA: Hydro power station
PLTG: Gas turbine power station

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	B. Palembang	1	PLTG. Palembang	1	14,000	8,700
		2	PLTD. Palembang	7	14,635	4,700
		3	PLTD. Kaju Agung	2	200	130
		4	PLTD. Batu Radja	4	428	258
2.	B. Tdj. Karang	1	PLTD. Tdj. Karang	6	4,198	2,830
		2	PLTD. Metro	4	220	135
		3	PLTD. Kota Bumi	2	350	320
3.	B. Djambi	1	PLTD. Djambi	5	3,040	2,090
4.	B. Bengkulu	1	PLTD. Bengkulu	1	25	–
		2	PLTA. Tea	2	1,320	1,160
5.	B. Lahat	1	PLTD. Lb. Linggau	1	250	150

Exploitasi III.

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	B. Ponti-anak	1	PLTD. Pontia-nak	7	4,400	2,470
		2	PLTD. Mempa-wah	1	50	42
2.	B. Singka-wang	1	PLTD. Singka-wang	4	1,212	710
		2	PLTD. Sambas	2	200	88
3.	B. Kapuas	1	PLTD. Sintang	2	200	112
		2	PLTD. Putusi-ban	2	200	45
		3	PLTD. Sanggau	2	128	104
		4	PLTD. Kota-pang	2	200	112

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	B. Bandjarmasin	1	PLTD. Bandjarmasin	7	5,680	1,790
		2	PLTD. Bandjarbaru	3	675	273
		3	PLTD. Martapura	6	823	220
		4	PLTD. Kotabaru	1	275	275
		5	PLTD. Palengka Raja	2	200	176
		6	PLTD. Amuntai	1	275	275
		7	PLTD. Kuala Kapuas	1	100	100
2.	B. Balik Papan	1	PLTD. Balik Papan	2	1,000	565
		2	PLTD. Tdj. Selor	2	200	43
3.	B. Samarinda	1	PLTD. Samarinda	4	1,680	1,250

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	B. Menado	1	PLTA. Tonsea Lama	1	4,440	4,060
		2	PLTD. Menado	4	1,176	650
		3	PLTD. Bitung	2	550	148
		4	PLTD. Langoan	1	64	37
		5	PLTD. Tahuna	1	100	29
		6	PLTD. Kakas	1	64	–
		7	PLTD. Kawang-Koan	1	64	22
2.	B. Gorontalo	1	PLTD. Gorontalo	4	546	298
		2	PLTD. Telaga	3	174	50
3.	B. Poso	1	PLTD. Poso	2	200	115
		2	PLTD. Palu	1	256	96
		3	PLTD. Toli- toli	1	100	59

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	B. Makas-sar	1	PLTD. Makas-sar	10	12,259	6,630
		2	PLTD. Tello	1	256	–
		3	PLTD. Watam-pone	1	275	223
		4	PLTD Palopo	1	275	232
		5	PLTD. Seng-kang	1	160	149
		6	PLTD. Boun-thain	1	160	120
		7	PLTD. Bulu-kumba	1	160	100
		8	PLTD. Madjene	1	160	97
		9	PLTD. Kendari	2	224	130

Exploitasi VII.

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	B. Ambon	1	PLTD. Ambon	4	2,100	1,370
		2	PLTD. Tulehu	1	50	36
		3	PLTD. Masohi	2	200	80
		4	PLTD. Tual	2	100	40
2.	B. Terna-te	1	PLTD. Ternate	9	937	300
		2	PLTD. Soa-Siu	2	100	45

Exploitasi VIII.

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	B. Den Pasar	1	PLTD. Den Pasar	4	1,460	930
		2	PLTD. Negara	3	338	152
		3	PLTD. Gianjar	2	108	48
		4	PLTD. Klungkung	1	50	45
		5	PLTD. Tabanan	2	130	52
		6	PLTD. Bangli	1	64	45
		7	PLTD. Karangasem	1	64	44
2.	B. Singaradja	1	PLTD. Singaradja	4	1,605	415
3.	B. Ampenan	1	PLTD. Ampenan	6	744	536
		2	PLTD. Selong	1	64	53
		3	PLTD. Praja	1	64	60
4.	B. Sumbawa	1	PLTD.Sumbawa Besar	3	290	141
		2	PLTD. Bima	2	124	60
		3	PLTD. Raba	2	128	42
		4	PLTD. Dompu	2	100	37
		5	PLTD. Waingapu	2	139	72
		6	PLTD. Waikabubak	1	50	30
		7	PLTD. Endeh	5	483	144
		8	PLTD. Maumere	2	200	55
5.	B. Kupang	1	PLTD. Kupang	2	500	220
		2	PLTD. Kefamenamu	2	100	32
		3	PLTD. Atambua	2	100	30
		4	PLTD. So-e	2	100	15

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	S. Kali Konto	1	PLTU. Tdj. Perak	2	50,000	27,500
		2	PLTD. Ngagel	8	8,000	4,700
		3	PLTD. Malang	3	1,176	700
		4	PLTD. Mendalan	4	23,000	17,000
		5	PLTA. Siman	3	10,800	7,800
		6	PLTA. Sengguruh	1	2,970	2,600
2.	S. Madiun	1	PLTD. Madiun	4	2,217	850
		2	PLTA. Giringan	3	3,200	1,800
		3	PLTA. Golang	3	2,700	2,340
		4	PLTA. Ngebel	1	2,250	1,900
3.	B. Madiun	1	PLTD. Patjitan	2	200	100
4.	B. Situbondo	1	PLTD. Situbondo	4	876	540
5.	B. Djember	1	PLTD. Djember	7	2,650	1,890
		2	PLTD. Bondowoso	2	100	35
		3	PLTD. Rambipudji	2	103	62
		4	PLTD. Lumadjang	3	443	340
5.	B. Banjuwangi	1	PLTD. Banjuwangi	3	1,616	913
		2	PLTA. Kontjing	1	52	39
6.	B. Pamekasan	1	PLTD. Pamekasan	5	1,106	505
		2	PLTD. Bangkalan	5	576	300
		3	PLTD. Sumenep	4	488	304
		4	PLTD. Ketapang	1	48	32
		5	PLTD. Sampang	2	147	111
		6	PLTD. Blega	1	32	27
		7	PLTD. Pasongan	1	48	25

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	B. Semarang	1	PLTD. Weleri	2	275	92
		2	PLTD. Djepara	3	144	142
		3	PLTD. Purwodadi	4	230	150
2.	B. Tjepu	1	PLTD. Tjepu	5	1,596	1,065
		2	PLTD. Tuban	3	510	258
		3	PLTD. Lasem	2	406	234
3.	B. Jogjakarta	1	PLTD. Wates	3	72	54
		2	PLTD. Wonosari	2	120	39
4.	B. Surakarta	1	PLTD. Sragen	2	189	161
		2	PLTD. Karanganjar	1	60	45
		3	PLTD. Sukohardjo	2	120	53
		4	PLTD. Wonogiri	2	120	55
		5	PLTD. Tawangmangu	1	60	–
5.	S. Buntang	1	PLTG. Pandean Lamper	1	14,000	13,500
		2	PLTD. Kalisari	6	6,020	2,800
		3	PLTD. Wirabradjan	4	4,060	3,000
		4	PLTD. Kudua	2	1,120	1,000
		5	PLTA. Djelok	4	20,480	13,000
		6	PLTA. Susukan	3	2,400	–
		7	PLTA. Timo	3	12,000	10,500
6.	S. Ketenger	1	PLTD. Tjilatjap	4	1,696	1,250
		2	PLTD. Tegal	4	3,112	1,800
		3	PLTD. Pekalongan	3	1,392	500
		4	PLTA. Ketenger	2	7,040	4,000
7.	B. Tegal	1	PLTD. Bumiaju	1	95	84
8.	B. Purwokerto	1	PLTD. Wonosobo	2	96	65
		2	PLTA. Wonosobo	1	124	105
		3	PLTD. Madjenang	1	95	80
		4	PLTA. Bandjarnegara	1	256	210

Exploitasi XI.

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	B. Tjirebon	1	PLTD. Indramaju	2	336	–
2.	S. Tjirebon	1	PLTD. Kebon Baru	4	2,064	900
		2	PLTA. Parakan Kondang	4	10,000	7,200
3.	S. Priangan	1	PLTA. Bengkok /Dago	4	3,850	2,800
		2	PLTA. Plengan	4	5,150	4,100
		3	PLTA. Lumadjang	3	19,200	12,000
		4	PLTA. Tjikalong	3	19,200	17,000
4.	B. Purwakarta	1	PLTD. Bekasi	2	48	48
		2	PLTD. Pemanukan	2	166	166
5.	B. Tjiandjur	1	PLTA. Tjidjedil	4	552	616

Exploitasi XII.

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	S. Djakarta	1	PLTU. Gambir	4	12,200	3,000
		2	PLTD. Antjol	12	12,000	2,160
		3	PLTD. Karet	10	10,000	1,500
		4	PLTD. Kebajoran	5	12,600	8,100
2.	PLTU. Priok	1	PLTU. Priok	2	50,000	20,500
3.	S. Bogor	1	PLTA. Ubrug	3	17,100	11,000
		2	PLTA. Kratjak	3	16,575	10,000
4.	B. Bogor	1	PLTA. Tjbinong	1	25	24
5.	B. Sukabumi	1	PLTD. Pelabuhan Ratu	2	56	52
		2	PLTD. Djampang Kulon	2	48	48
6.	B. Banten	1	PLTD. Labuhan	2	96	64
		2	PLTD. Menes	2	148	42

Exploitasi XIII.

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	B. Atjeh	1	PLTD. Banda Atjeh	7	1,895	1,586
		2	PLTD. Sigli	6	553	178
		3	PLTD. Bireun	2	200	140
		4	PLTD. Take-ngon	2	200	105
		5	PLTD. Lhok Seu mawe	2	200	166
		6	PLTD. Langsa	5	810	375
		7	PLTD. Kuala Simpang	2	204	90
		8	PLTD. Meula-boh	2	160	160
		9	PLTD. Tapak Tuan	2	200	100

Exploitasi XIV.

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	B. Padang	1	PLTD. Simpang Haru	5	5,130	2,180
		2	PLTD. Painan	2	188	95
		3	PLTD. Pariaman	3	250	172
		4	PLTD. Solok	4	318	204
		5	PLTD. Batu Sangkar	2	183	157
		6	PLTD. Sidjundjung	1	50	27
		7	PLTD. Sungai Penuh	2	128	192
		8	PLTA. Sungai Penuh	1	70	
2.	B. Bukit Tinggi	1	PLTU. Bukit Tinggi	3	832	–
		2	PLTD. Bukit Tinggi	7	3,250	1,500
		3	PLTD. Paja Kumbuh	2	280	–
		4	PLTD. Lubuk Sikaping	2	160	95
		5	PLTD. Padang Pandjang	2	130	–
3.	B. Pakan Baru	1	PLTD. Pakan Baru	5	2,404	2,195
		2	PLTD. Bengat	4	363	235
		3	PLTD. Teluk Kuantan	1	75	57
		4	PLTD. Bengkalis	2	200	170
		5	PLTD. Bangkinang	1	100	80
		6	PLTD. Bagan Si api	5	381	234
		7	PLTD. Tembilahan	1	100	87
		8	PLTD. Tdg. Pinang	7	480	265
		9	PLTD. Dumai	3	375	264

Exploitasi XV.

No.	Sector/Branch	No.	Name of power station	Installations		Available maximum output (KW)
				Unit	Capacity (KW)	
1.	B. Djaja-pura	1	PLTD. Jarmoch	6	3,080	1,600
		2	PLTD. Sentani	3	136	70
		3	PLTD. Ifar	4	164	70
		4	PLTD. Wamena	3	49.6	20
2.	B. Biak	1	PLTD. Biak	6	1,256	720
		2	PLTD. Serui	2	35.2	60
		3	PLTD. Nabire	2	24	–
3.	B. Manok-wari	1	PLTD. Manok-wari	6	1,472	650
		2	PLTD. Ransiki	2	24	–
4.	B. Sorong	1	PLTD. Sorong Darat	5	1,508	550
		2	PLTD. Sorong Doom	4	156	80
		3	PLTD. Jefman	3	120	15
5.	B. Fak-Fak	1	PLTD. Fak-fak	4	192	192
		2	PLTD. Kaimana	1	32	–
6.	B. Meranke	1	PLTD. Meranke	6	288	240
		2	PLTD. Kelapa lima	4	640	
		3	PLTD. Tanah Merah	2	24	12

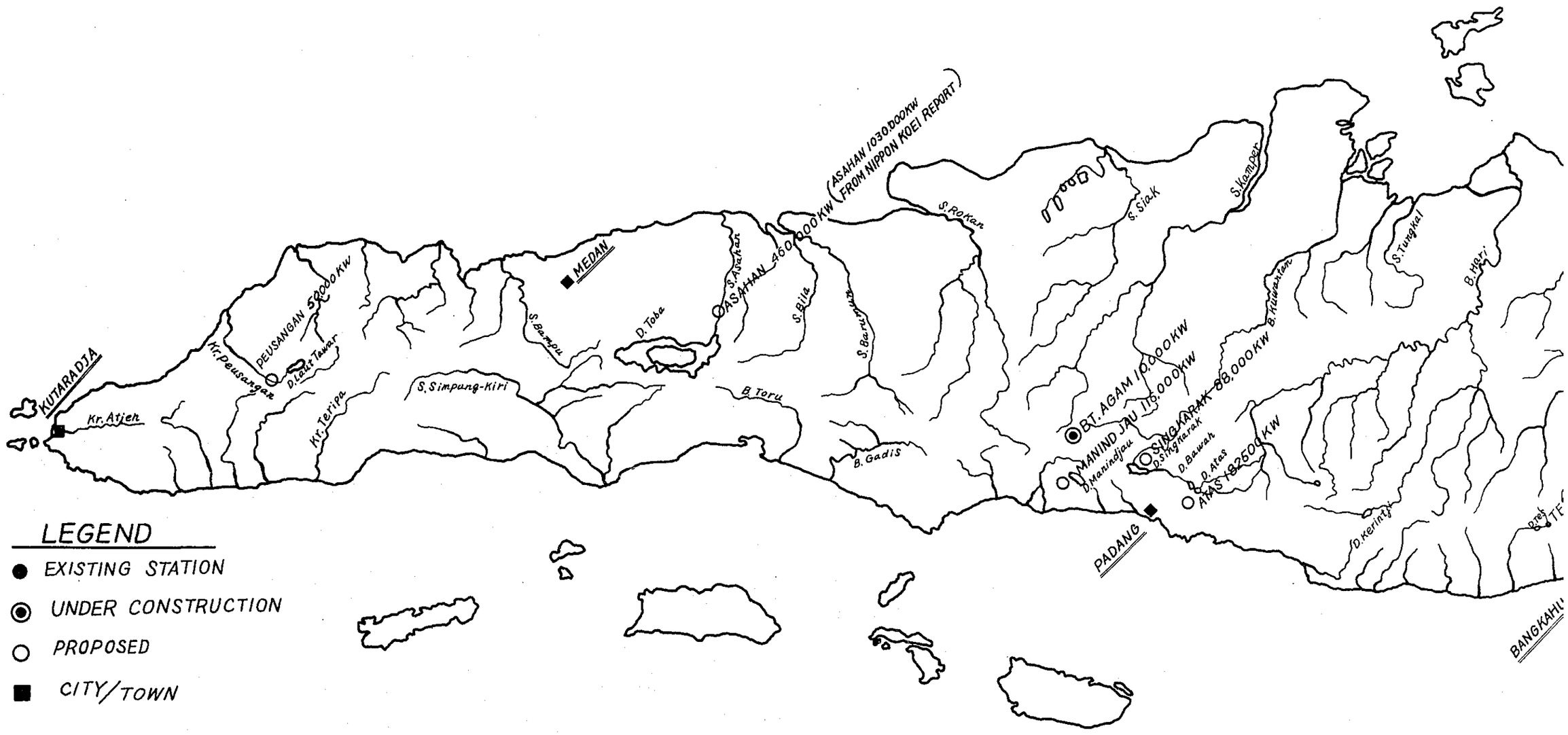
EXISTING HYDRO-POWER STATIONS IN INDONESIA (Jan. 1970)

No.	Name of Station (District*)	Name of River/Lake	Type	Installed Capacity (KW)	Unit Number	Maximum Discharge (M^3/S)	Effective Head (M)	Effective Storage of Reservoir $X10^3(M^3)$	Year of Completion	Year of Rehabilitation or Additional Installation
1	Parakan Kondang	Tjimanuk	Run of River	10,000	4	24	52.0		1955	–
2	Plengan (W.J)	Tjilaki	Reservoir	5,150	4	7.8	90.0	33,000.0	1922	1962
3	Lamadjan (W.J)	"	Daily Pondage	19,200	3	11.7	210.0	48.0	1924	1935
4	Tjikalong (W.J)	"	"	19,200	3	16.5	140.0	60.0	1960	–
5	Bengkok/Dago (W.J)	Tjikapundung	"	3,150/700	3/1	4.1/2.25	44.0	25.0	1923	1925
6	Tjidjedil (W.J)	Tjisokan	Run of River	552	4	1.3	36.0		1923	1931
7	Ubrug (W.J)	Tjitjatih	Daily Pondage	17,100	3	31.0	68.0	220.0	1924	1951
8	Kratjak (W.J)	Tjiliwung+Tjianten	"	16,575	3	21.5	106.0	220.0	1928	1958
9	Tjidjedil (W.J)	Tjidjedil	Run of River	122/154	2/2				1923	1931
10	Djatiluhur (W.J)	Tjitarum	Reservoir	125,000	5	225	(50-80)	3,000,000.0	1967	–
11	Djelok (C.J)	D. Rawapening	Run of River	20,480	4	17.6	144.0		1938	1962
12	Susukan (C.J)	"	"	2,400	3	3.6	75.0		1917	1920, 1923
13	Timo (C.J)	"	"	12,000	3	14.0	115.0		1962	1963
14	Ketenger (C.J)	Tjab. Kali Seraju	Daily Pondage	7,040	2	3.2	270.0	20.0	1938	–
15	Wonosobo (C.J)	Seraju	Rain of River	124	1				1940	–
16	Bandjarnegara (C.J)		"	256	1				1949	–
17	Mendalan (E.J)	K. Konto	Daily Pondage	23,000	4	21	149.0	140.0	1930	–
18	Siman (E.J)	K. Konto	"	10,800	3	13.5	88.0		1931	1955
19	Sengguruh (E.J)	K. Brantas	"	2,970	1	15	21.5		1951	–
20	Giringan (E.J)	K. Djuweh	"	3,200	3	1.7	101.0	12.0	1957	–
21	Golang (E.J)	K. Djuweh	"	2,700	3	4.0	85.0	20.0	1959	–
22	Ngebel (E.J)	K. Ngebel	"	2,250	1				1969	–
23	Klontjing (E.J)		Run of River	52	1				1927	–
24	Tarutung (N.Sum)	Batang Toru	"	120	2				1929	–
25	Sungai Penuh (W.Sum)	Batang Siula	"	70	1				1957	–
26	Tes (S.Sum)	Air Ketaun (D.Tes)		1,320	2	3.7	43.5		1959	–
27	Tonsea Lama (N.Sul)	Tondano		4,440	1	7.3	85.0		1950	–

* *W.J : West Djawa, C.J. : Central Djawa, E.J. : East Djawa*
N. Sum : North Sumatera, W. Sum : West Sumatera
S. Sum : South Sumatera, N. Sul : North Sulawesi

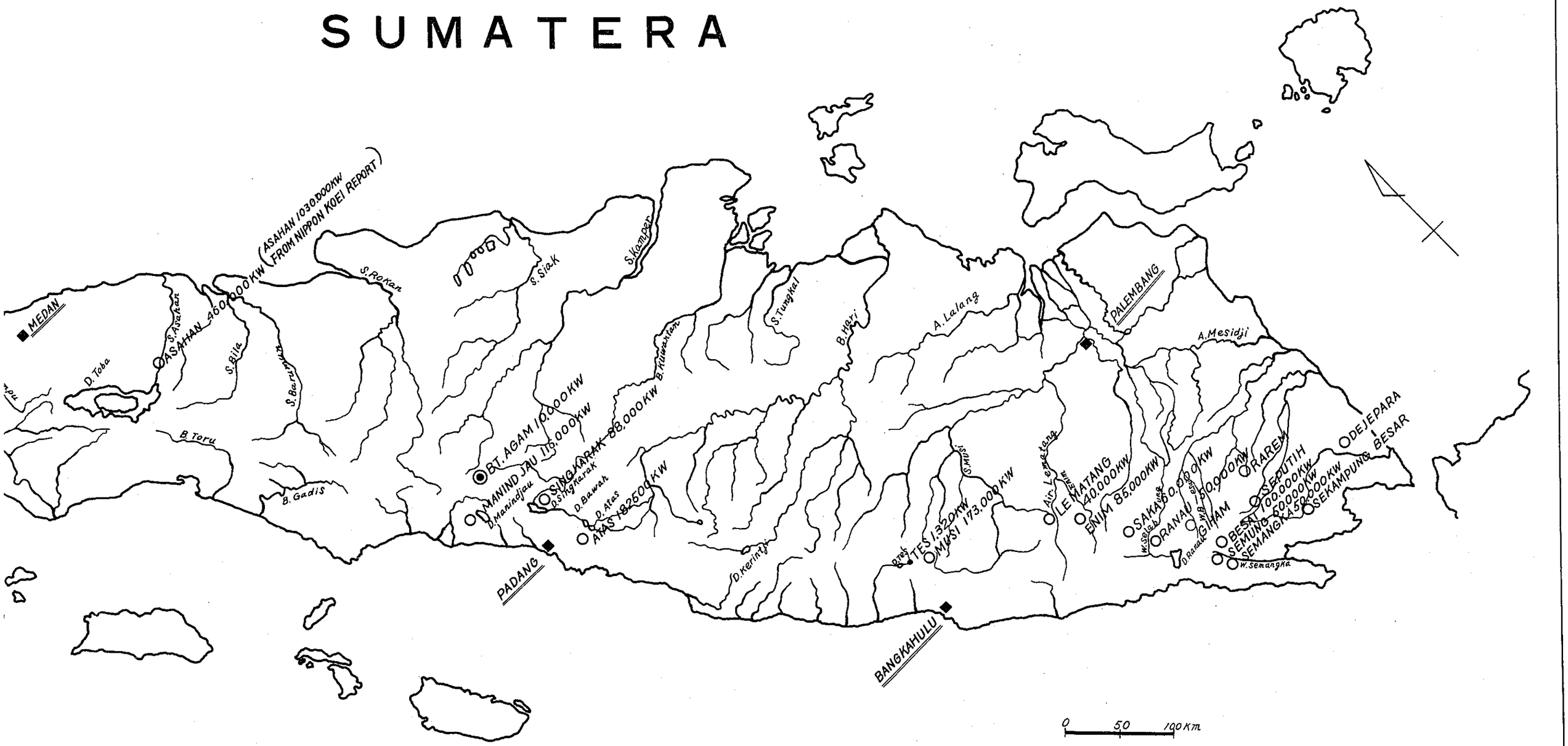
DEVELOPMENT OF HYDRO-POWER STATION

S U M A T E R A



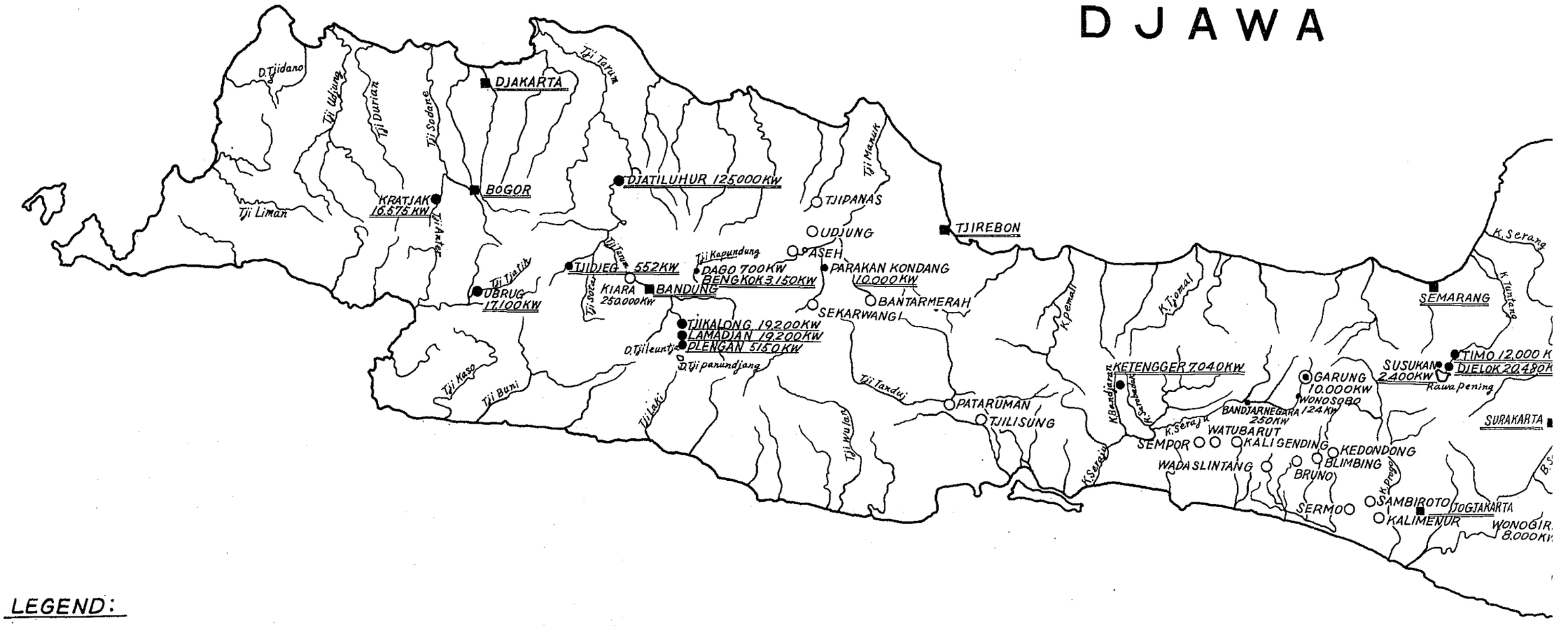
DEVELOPMENT OF HYDRO-POWER STATION

SUMATERA



DEVELOPMENT OF HYDRO-POWER STATIO

D J A W A

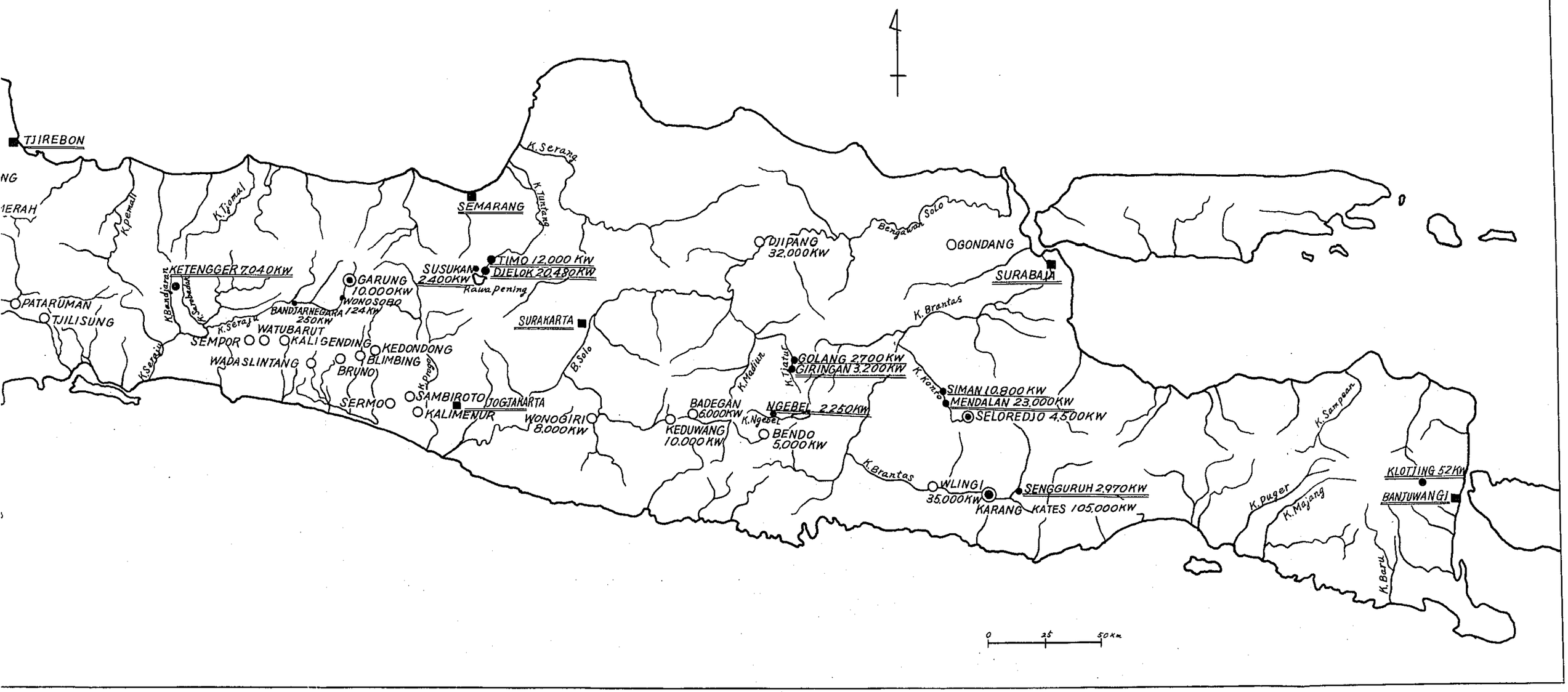


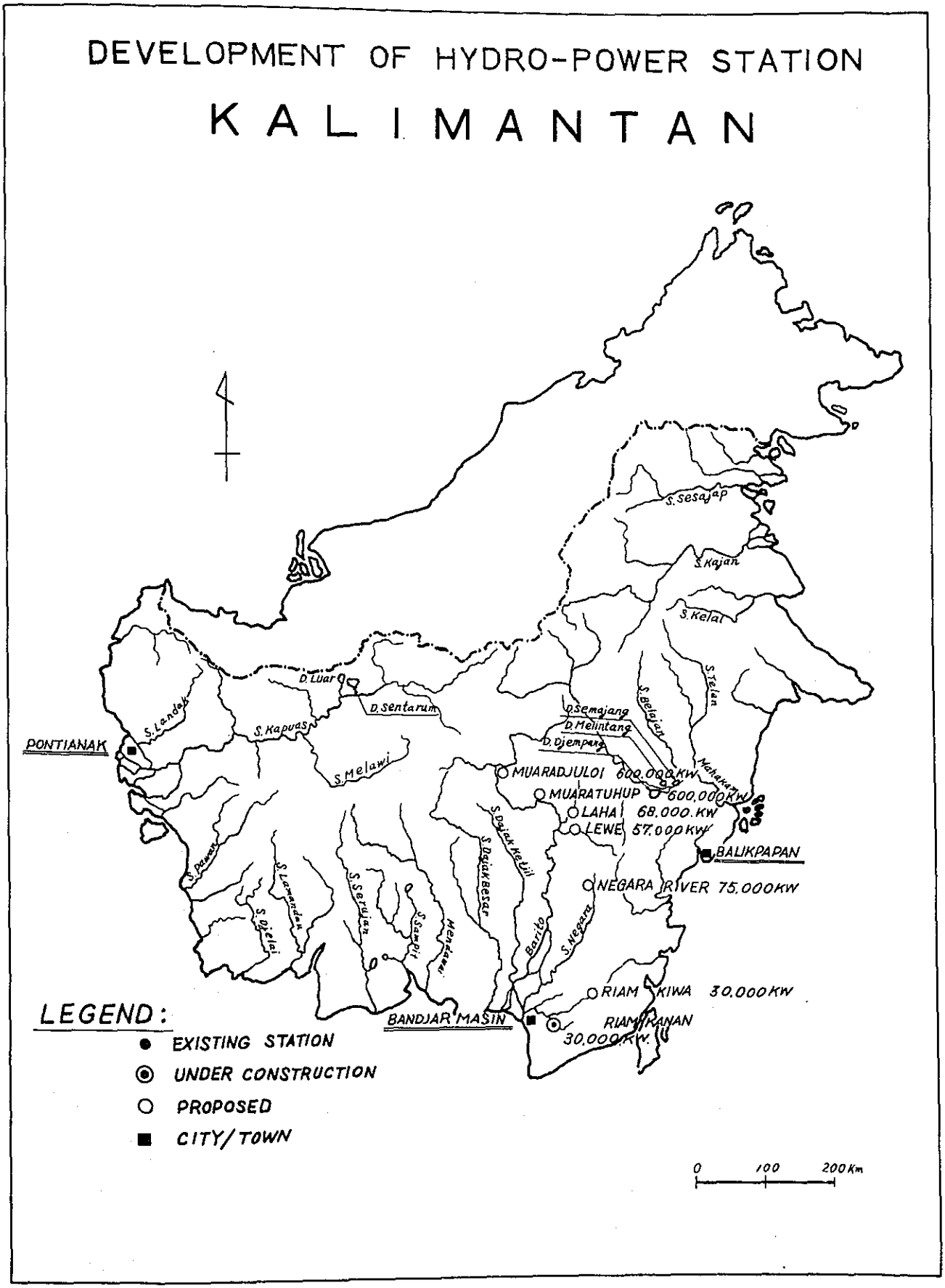
LEGEND:

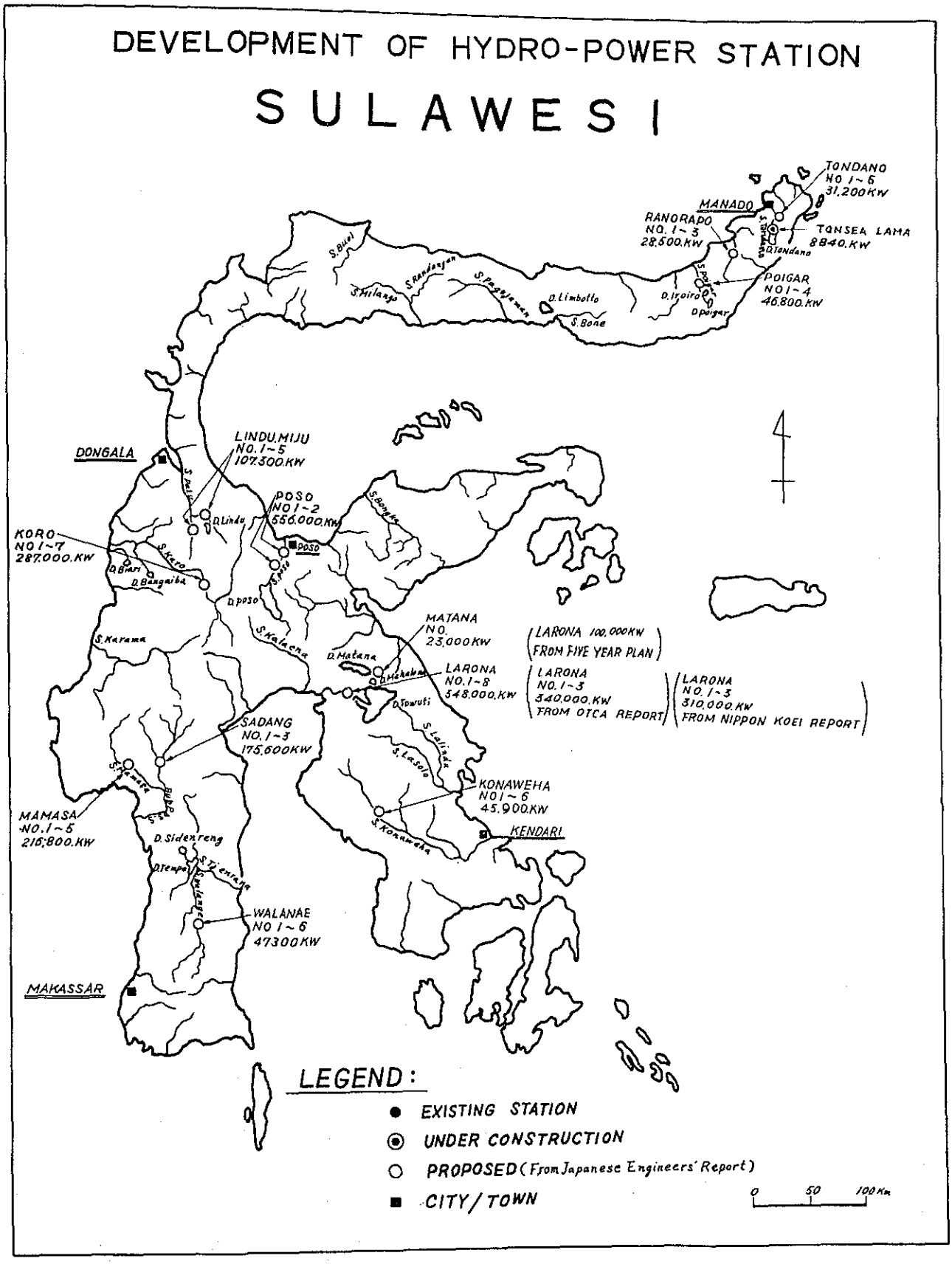
- ● EXISTING STATION.
- ◉ UNDER COSTRUCTION.
- ○ PROPOSED.
- ■ CITY/TOWN

OPMENT OF HYDRO-POWER STATION

D J A W A

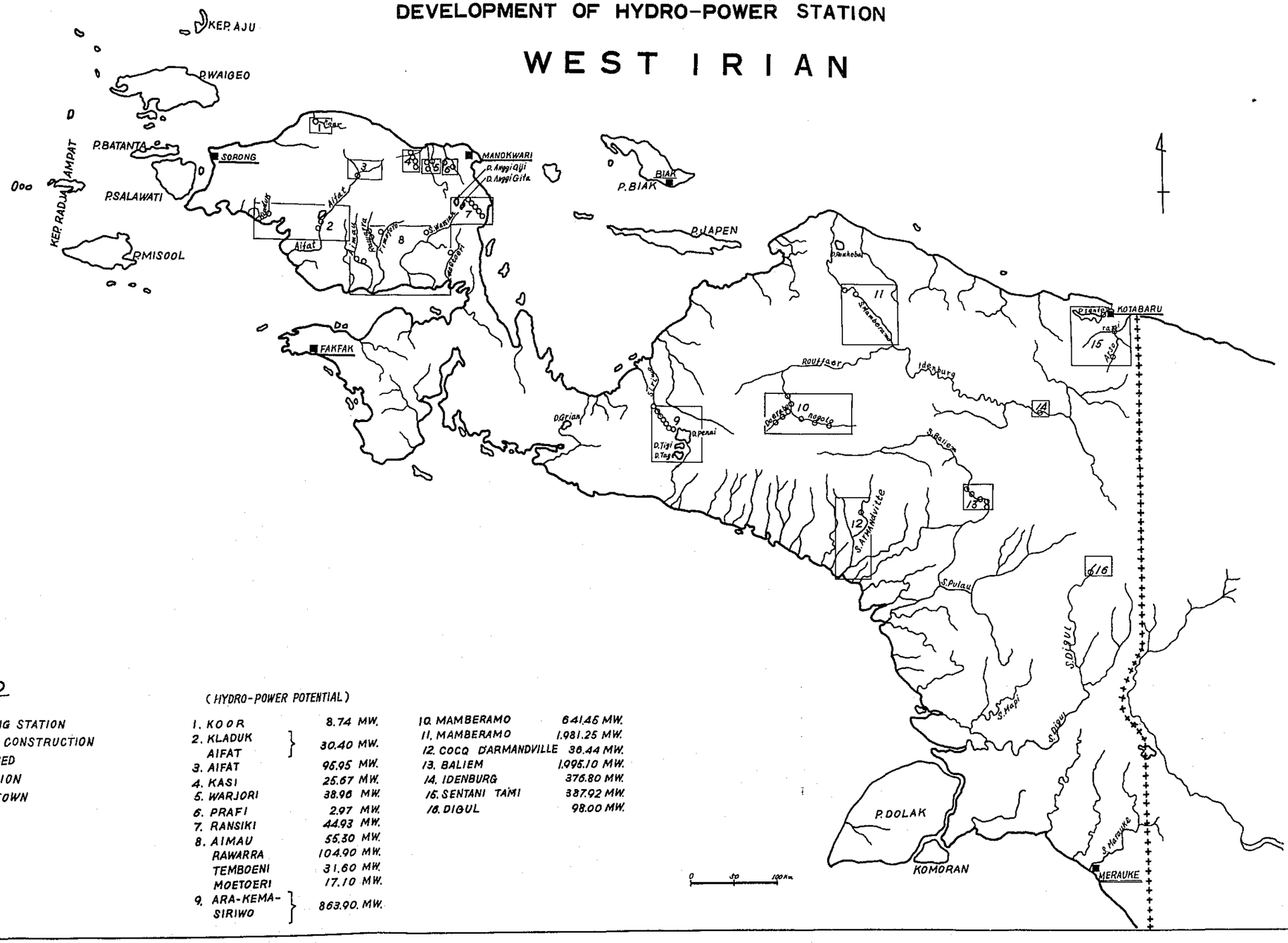



DEVELOPMENT OF HYDRO-POWER STATION
KALIMANTAN
S. Sesajap
S. Kajan
S. Kelai
S. Telen
S. Belajan
D. Luar
D. Sentarum
S. Landak
S. Kapuas
S. Melawi
PONTIANAK
D. Semajang
D. Melintang
D. Djempang
MUARADJULOI 600.000 KW
MUARATUHUP 600.000 KW
LAHAI 68.000 KW
LEWE 57.000 KW
Mahakam
BALIKPAPAN
S. Pawan
S. Lamandau
S. Seruyan
S. Sampit
S. Mentaya
S. Dajak Kecil
S. Dajak Besar
Barito
S. Negara
NEGARA RIVER 75.000 KW
RIAM KIWA 30.000 KW
BANDJAR MASIN
RIAM KANAN 30.000 KW
LEGEND:
EXISTING STATION
UNDER CONSTRUCTION
PROPOSED
CITY/TOWN
0 100 200 Km


DEVELOPMENT OF HYDRO-POWER STATION
SULAWESI
TONDANO
NO 1~6
31.200KW
MANADO
RANORAPO
NO. 1~3
28.500.KW
TONSEA LAMA
8840.KW
POIGAR
NO 1~4
46.800.KW
S. Buol
S. Randangan
S. Pagaya-man
S. Milango
D. Limbotto
S. Bone
D. Tondano
D. Poigar
DONGALA
LINDU.MIJU
NO.1~5
107.300.KW
KORO
NO 1~7
287.000.KW
POSO
NO 1~2
556.000.KW
S. Bongka
S. Karama
S. Kalaena
MATANA
NO.
23.000KW
LARONA
NO.1~8
548.000.KW
(LARONA 100.000KW
FROM FIVE YEAR PLAN)
(LARONA
NO.1~3
340.000.KW
FROM OTCA REPORT)
(LARONA
NO.1~3
310.000.KW
FROM NIPPON KOEI REPORT)
SADANG
NO.1~3
175.600KW
KONAWEHA
NO1~6
45.900KW
KENDARI
MAMASA
NO.1~5
216.800.KW
WALANAE
NO 1~6
47300KW
MAKASSAR
LEGEND:
EXISTING STATION
UNDER CONSTRUCTION
PROPOSED (From Japanese Engineers' Report)
CITY/TOWN
0 50 100 Km

DEVELOPMENT OF HYDRO-POWER STATION

WEST IRIAN



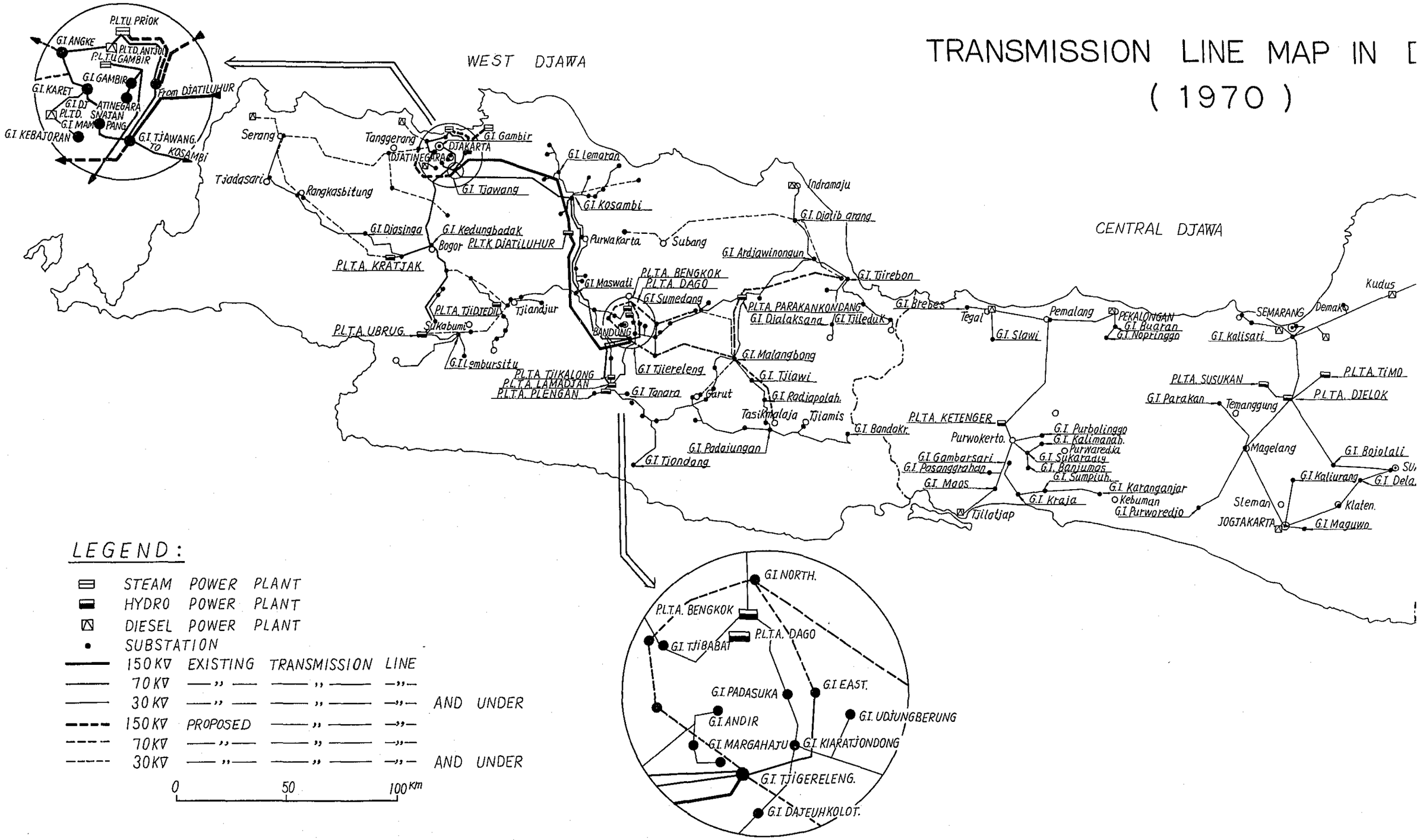
LEGEND

- ● EXISTING STATION
- ◉ UNDER CONSTRUCTION
- ○ PROPOSED
- [7] LOCATION
- ■ CITY/TOWN

(HYDRO-POWER POTENTIAL)

1. KOOR	8.74 MW.	
2. KLADUK AIFAT	30.40 MW.	
3. AIFAT	96.95 MW.	
4. KASI	25.67 MW.	
5. WARJORI	38.96 MW.	
6. PRAFI	2.97 MW.	
7. RANSIKI	44.93 MW.	
8. AIMAU	55.30 MW.	
RAWARRA	104.90 MW.	
TEMBOENI	31.60 MW.	
MOETOERI	17.10 MW.	
9. ARA-KEMA-SIRIWO	863.90 MW.	
10. MAMBERAMO	641.45 MW.	
11. MAMBERAMO	1.981.25 MW.	
12. COCQ D'ARMANDVILLE	36.44 MW.	
13. BALIEM	1.995.10 MW.	
14. IDENBURG	376.80 MW.	
15. SENTANI TAMI	387.92 MW.	
16. DIGUL	98.00 MW.	

TRANSMISSION LINE MAP IN [
(1970)

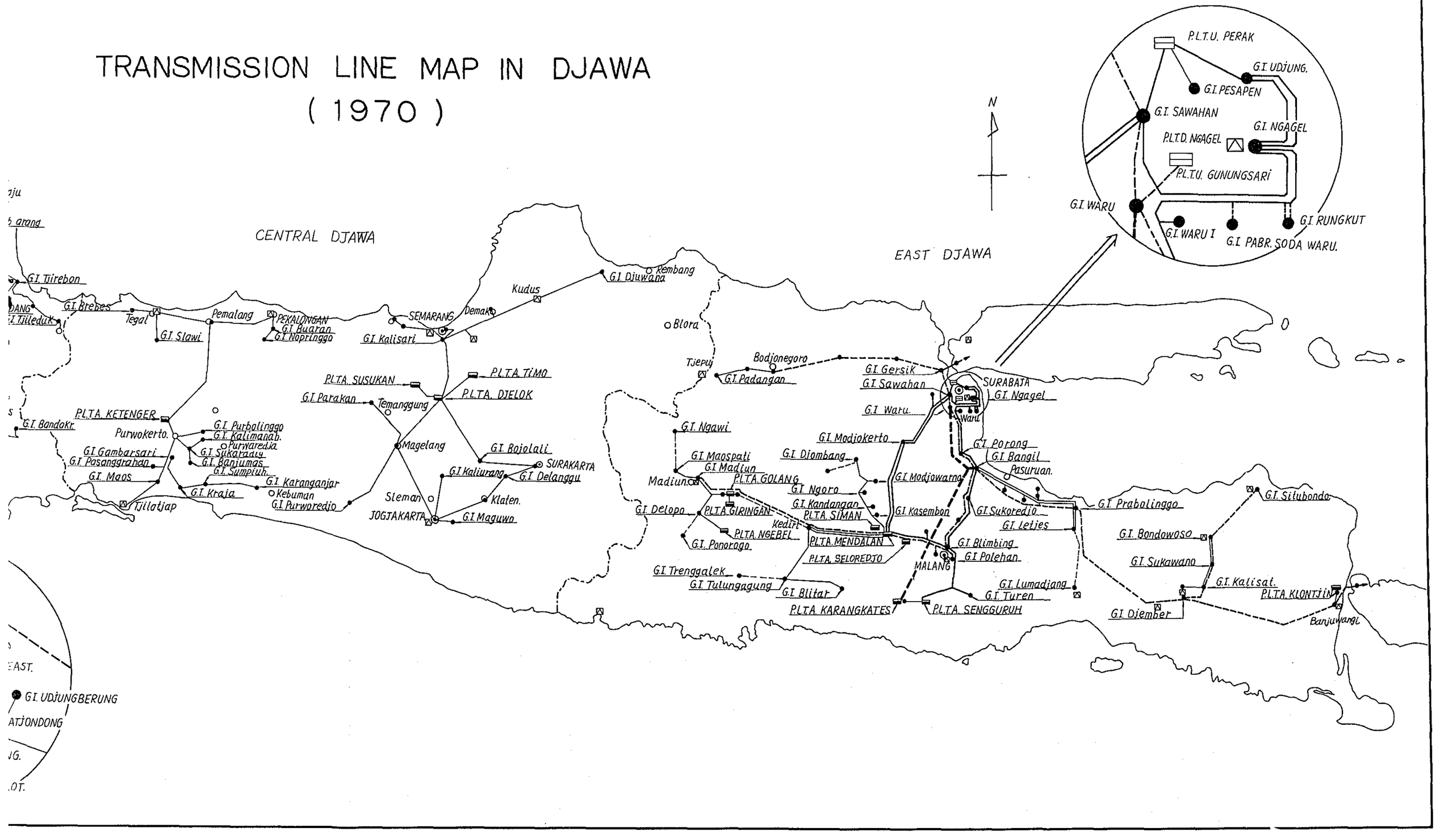


LEGEND :

- STEAM POWER PLANT
- HYDRO POWER PLANT
- DIESEL POWER PLANT
- SUBSTATION
- 150 KV EXISTING TRANSMISSION LINE
- 70 KV —,,— —,,— —,,—
- 30 KV —,,— —,,— —,,— AND UNDER
- 150 KV PROPOSED —,,— —,,— —,,—
- 70 KV —,,— —,,— —,,—
- 30 KV —,,— —,,— —,,— AND UNDER

0 — 50 — 100 Km

TRANSMISSION LINE MAP IN DJAWA
(1970)



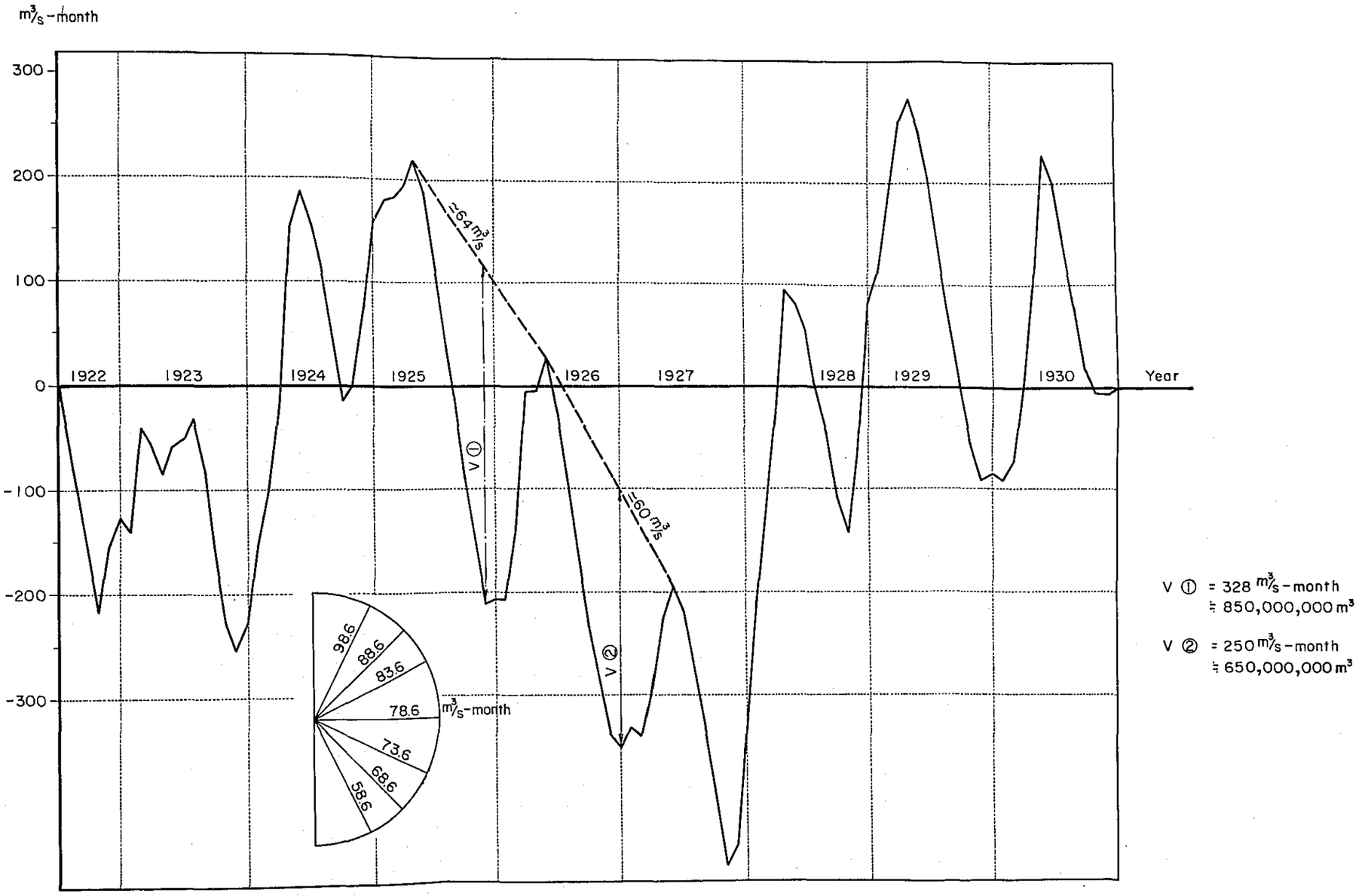
RIVER DEVELOPMENT PLANS IN INDONESIA

Island	Province	Project	Purpose	Remarks
Djawa	West Djawa	Teluk Lada	Irrigation	
		Tji Letul	"	Discharge: $7m^3/s$
		Tji Pamingkis	"	" : $8m^3/s$
		Tji Kunten II	"	" : $8m^3/s$
		Datran Bandjar	"	
		Tji Manuk	Multi-purpose	
		Tji Tanduj	Flood control	
	Central Djawa	Tjatjaban dam	Irrigation	Completed in 1969
		Tadjum	"	
		Sempor dam	"	
		Karang Anjar	"	
		Kali Progo	Debris control	
		Djratunseluna	Multi-purpose	
		Bengawan Solo	"	
	East Djawa	Kali Brantas	"	
Bali	Bali	Bali	Multipurpose	
Lombok	Lombok	Lombok	Irrigation	
Sumatera	Atjeh	Kr. Djreue	Irrigation	
		Kr. Baro	"	
	North Sumatera	Bt. Gadis	"	
		Bt. Paue	"	
	Riau	Bt. Lubu	"	
	Djambi	Bt. Uleh	"	
	South Sumatera	AIR Beliti	"	Discharge: $12m^3/s$
	Lampung	WAY Umpu	"	" : $5m^3/s$
		WAY Pangubuau	"	" : $5m^3/s$
		WAY Djepara	"	" : $7m^3/s$
Kalimantan	South Kalimantan	Riam Kanan	Multi-purpose	
Sulawesi	North Sulawesi	Dumoga	Irrigation	
	Central Sulawesi	Gumbasa	"	
		Laown	"	
	South Sulawesi	Project near Kendari	"	Discharge: $11m^3/s$
		Lake Tempe	"	

Source: Directorate General of Water Resources Development

EXAMPLE OF MASS CURVE

(at R gauging station)



(This curve was drawn by plotting the value of $\sum (Q - \bar{Q})$ in the next sheet)

Calculation method of mass curve at R gauging station

Unit: m^3/s

Year	Month	Monthly Mean Run-off Q	Mean Run-off $\bar{Q}$	Difference $Q-\bar{Q}$	Accumulated Value $\Sigma(Q-\bar{Q})$	Year	Month	Monthly Mean Run-off Q	Mean Run-off $\bar{Q}$	Difference $Q-\bar{Q}$	Accumulated Value $\Sigma(Q-\bar{Q})$	Year	Month	Monthly Mean Run-off Q	Mean Run-off $\bar{Q}$	Difference $Q-\bar{Q}$	Accumulated Value $\Sigma(Q-\bar{Q})$
	1	–	–	–	–		1	97.1	78.6	18.5	178.1		1	202	78.6	123.4	-211.8
	2	–	–	–	–		2	82.3	"	3.8	181.9		2	157	"	78.4	-123.4
	3	–	–	–	–		3	90.1	"	11.5	193.4		3	170	"	91.4	-32.0
	4	–	–	–	–		4	109	"	30.4	223.8		4	206	"	127.4	95.4
	5	–	–	–	–		5	44.5	"	-34.1	189.7		5	64.8	"	-13.8	81.6
1922	6	–	–	–	–	1925	6	14.7	"	-63.9	125.8	1928	6	54.0	"	-24.6	57.0
	7	31.9	78.6	-46.7	-46.7		7	13.0	"	-65.6	60.2		7	22.0	"	-56.6	0.4
	8	26.8	"	-51.8	-98.5		8	7.5	"	-71.1	-10.9		8	31.7	"	-46.9	-46.5
	9	19.5	"	-59.1	-157.6		9	8.5	"	-70.1	-81.0		9	15.5	"	-63.1	-109.6
	10	16.6	"	-62.0	-219.6		10	11.8	"	-66.8	-147.8		10	45.7	"	-32.9	-142.5
	11	145	"	66.4	-153.2		11	13.9	"	-64.7	-212.5		11	156	"	77.4	-65.1
	12	115	"	26.4	-126.8		12	83.7	"	5.1	-207.4		12	220	"	141.4	76.3
	1	64.3	"	-14.3	-141.1		1	78.4	"	-0.2	-207.6		1	117	"	38.4	114.7
	2	178	"	99.4	-41.7		2	148	"	69.4	-138.2		2	147	"	68.4	183.1
	3	64.7	"	-13.9	-55.6		3	210	"	131.4	-6.8		3	155	"	76.4	259.5
	4	48.5	"	-30.1	-85.7		4	80.2	"	1.6	-5.2		4	102	"	23.4	282.9
	5	107	"	28.4	-57.3		5	112	"	33.4	28.2		5	48.1	"	-30.5	252.4
1923	6	84.2	"	5.6	-51.7	1926	6	26.3	"	-52.3	-24.1	1929	6	27.7	"	-50.9	201.5
	7	98.6	"	20.0	-31.7		7	11.7	"	-66.9	-91.0		7	13.9	"	-64.7	136.8
	8	17.2	"	-61.4	-93.1		8	6.4	"	-72.2	-163.2		8	9.5	"	-69.1	67.7
	9	11.4	"	-67.2	-160.3		9	8.3	"	-70.3	-233.5		9	7.0	"	-71.6	-3.9
	10	10.6	"	-68.0	-228.3		10	26.2	"	-52.4	-285.9		10	25.3	"	-53.3	-57.2
	11	50.3	"	-28.3	-256.6		11	26.9	"	-51.7	-337.6		11	44.2	"	-34.4	-91.6
	12	120	"	41.4	-215.2		12	64.9	"	-13.7	-351.3		12	86.0	"	7.4	-84.6
	1	141	"	62.4	-152.8		1	78.6	"	20.0	-331.3		1	71.4	"	-7.2	-91.4
	2	127	"	48.4	-104.4		2	70.7	"	-7.9	-339.2		2	96.9	"	18.3	-73.1
	3	163	"	84.4	-20.0		3	122	"	43.4	-295.8		3	173	"	94.4	21.3
	4	253	"	174.4	154.4		4	148	"	69.4	-226.4		4	165	"	86.4	107.7
	5	113	"	34.4	188.8		5	112	"	33.4	-193.0		5	200	"	121.4	229.1
1924	6	46.6	"	-32.0	156.8	1927	6	51.5	"	-27.1	-220.1	1930	6	44.9	"	-33.7	195.4
	7	37.6	"	-41.0	115.8		7	24.7	"	-53.9	-274.0		7	31.2	"	-47.4	148.0
	8	13.5	"	-65.1	50.7		8	19.9	"	-58.7	-332.7		8	14.8	"	-63.8	84.2
	9	10.7	"	-67.9	-17.2		9	11.2	"	-67.4	-400.1		9	12.4	"	-66.2	18.0
	10	95.6	"	17.0	-0.2		10	14.7	"	-63.9	-464.0		10	53.8	"	-24.8	-6.8
	11	144	"	65.4	65.2		11	97.0	"	18.4	-445.6		11	77.3	"	-1.3	-8.1
	12	173	"	94.4	159.6		12	189	"	110.4	-335.2		12	93.5	"	14.9	6.8

Appendix 5-1

WAITING CONSUMERS IN EAST DJAWA

P.L.N. Exploitasi IX has the waiting big consumers with the capacity more than 200 KVA respectively.

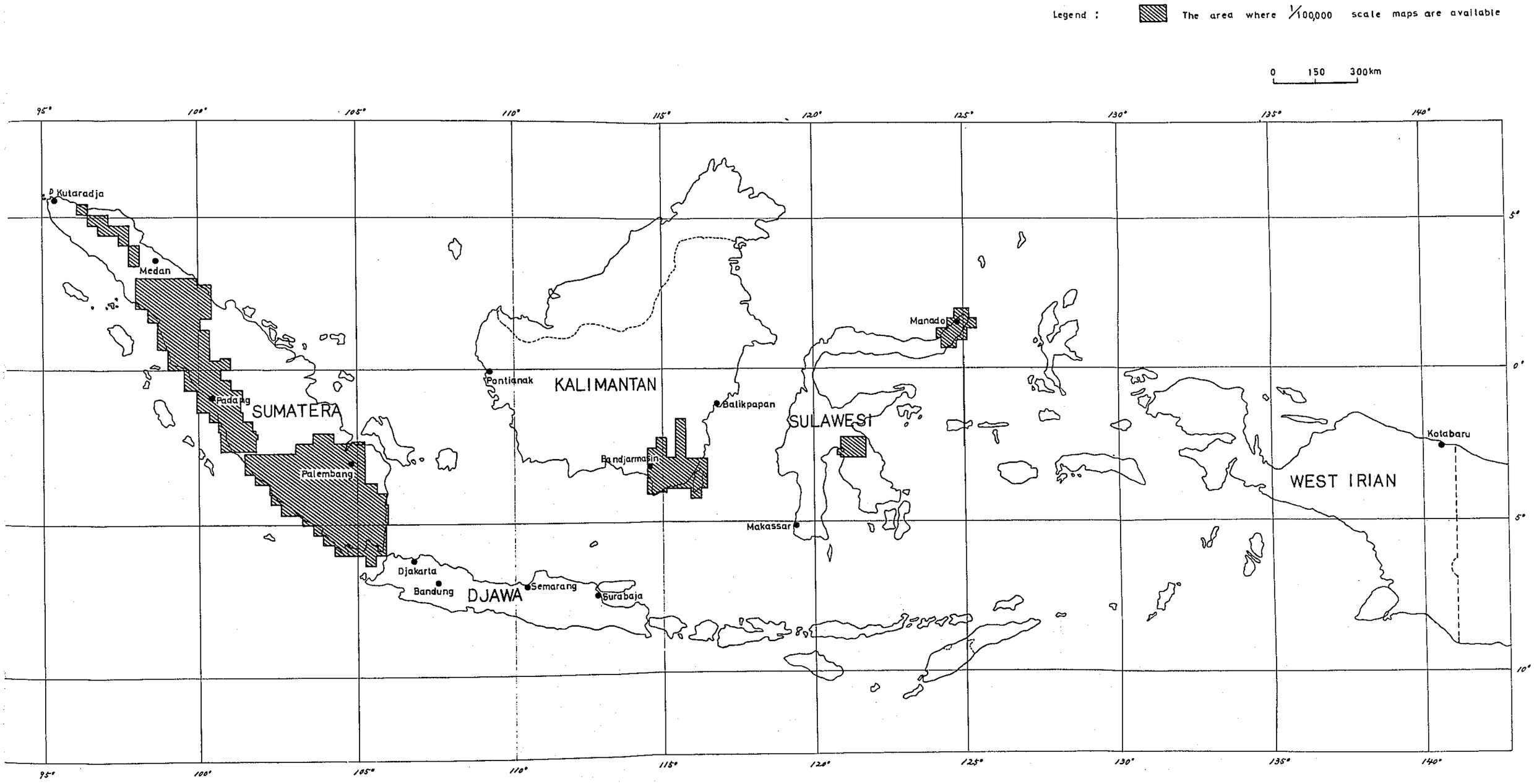
The scheduled capacities of these consumers are shown in the following table.

Unit: KVA

Waiting consumers		1970	1971	1972	1973	Total
Classification	Number					
Manufacturing industry	9	4,200	6,500	35,000	5,000	50,700
Communication service	2	250	1,500	1,000	–	2,750
Others	1	300	–	–	–	300
Total	12	4,750	8,000	36,000	5,000	53,750

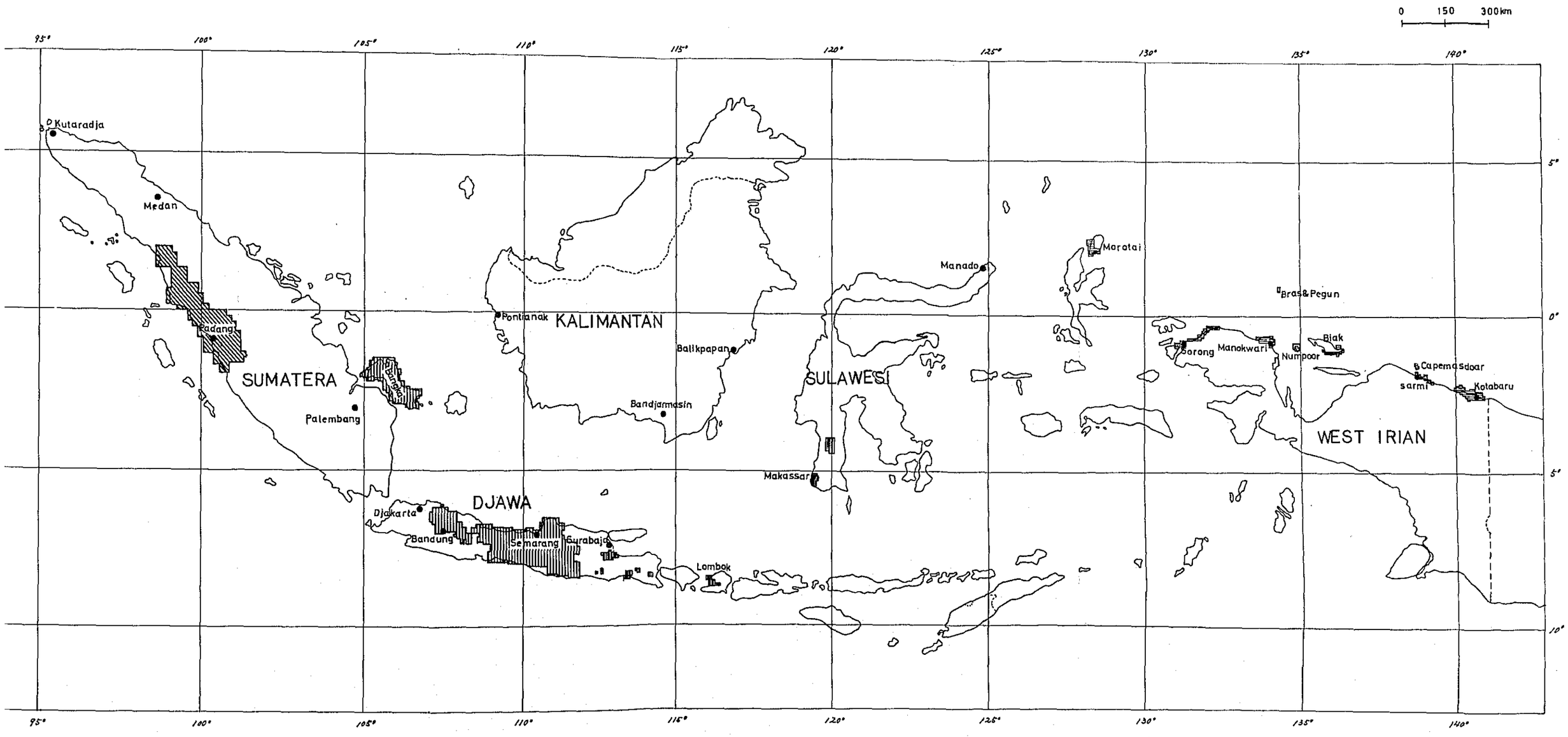
THE AREA WHERE LARGE SCALE MAPS ARE AVAILABLE IN INDONESIA

Appendix 6-1



THE AREA WHERE LARGE SCALE MAPS ARE AVAILABLE IN INDONESIA

Legend :
- The area where 1/40,000 scale maps are available
- The area where 1/25,000 scale maps are available
- The area where 1/20,000 scale maps are available



THE AREA WHERE LARGE SCALE MAPS ARE AVAILABLE IN INDONESIA

Legend: The area where 1/50,000 scale maps are available