

WATER RESOURCES PUBLICATION NO. 15

AVERAGE ANNUAL SURFACE WATER RESOURCES OF SABAH AND SARAWAK

1984



JABATAN PENGAIRAN DAN SALIRAN
KEMENTERIAN PERTANIAN MALAYSIA

**AVERAGE ANNUAL
SURFACE WATER RESOURCES OF
SABAH AND SARAWAK**

1984



**Bahagian Parit dan Taliair
Kementerian Pertanian, Malaysia**

AVERAGE ANNUAL SURFACE WATER RESOURCES OF SABAH AND SARAWAK

Contributor: Abdul Razak bin Mohd. Noor

PRICE \$20/=

**Bahagian Parit dan Taliair
Kementerian Pertanian, Malaysia**

**DICETAK OLEH JABATAN PERCETAKAN NEGARA, KUALA LUMPUR
HAJI MOKHTAR SHAMSUDDIN, J.S.D., S.M.T., K.M.N., P.I.S.,
KETUA PENGARAH**

1985

SUMMARY

This study based on the Thornthwaite and Mather Water Balance Model (1955) enables estimation of the surface water resources from ungauged rivers in Sabah and Sarawak to be carried out. A total of 183 rainfall stations, 65 in Sabah and 118 in Sarawak were used in the water balance study. Runoff data so obtained were utilised in mapping the average annual surface water resources for Sabah and Sarawak.

Estimated average annual runoffs obtained from the map compare favourably with the observed average annual runoffs. The accuracy of the map produced is largely within $\pm 20\%$ of the true average annual discharge.

The average annual surface water resources for each division in Sabah and Sarawak was also computed. The average annual surface water resources for Sarawak was estimated to be 2,365 mm, equivalent to 9,333 m³/s and for Sabah the estimate was 1,400 mm, equivalent to 3,280 m³/s.

TABLE OF CONTENTS

	PAGE
SUMMARY	
1. INTRODUCTION	1
1.1 Study Objective	1
2. METHODOLOGY	1
2.1 Water Balance Model	1
2.2 Processing System	1
2.3 Sample Output	3
3. WATER RESOURCES MAPPING	3
3.1 Using Runoff Values Instead of (P-AE) Values	3
3.2 Mapping Average Annual Surface Water Resources	3
3.2.1 Monthly Surface Water Resources	4
3.2.2 Representativeness of Rainfall during the Study Period	4
3.3 Comparison with Observed Water Resources	4
3.3.1 Map Presentation	4
3.3.2 Spatial Variability of Annual Water Resources	4
3.3.3 Method of Computing Average Annual Surface Water Resources from Annual Map	5
4. TIDAL INFLUENCE	5
5. CONCLUSION	5
6. REFERENCES	6
APPENDIX 1—Thornthwaite and Mather Water Balance Model	7
APPENDIX 2—Evaporation Map	9
APPENDIX 3—Sample Output of Water Balance Analysis	11
APPENDIX 4—Rainfall Stations Used in the Study	13
APPENDIX 5—Sarawak Water Balance Summary	15
APPENDIX 6—Sabah Water Balance Summary	23
APPENDIX 7—Comparison of Short Term and Long Term Rainfalls for Selected Locations in Sarawak	28
APPENDIX 8—Comparison of Short Term and Long Term Rainfalls for Selected Locations in Sabah	29
APPENDIX 9—Selected Catchments for Comparison of Observed and Predicted Runoffs	31
APPENDIX 10—Comparison of Predicted and Observed Average Annual Runoffs	33
APPENDIX 11—Average Annual Surface Water Resources Map	35
APPENDIX 12—Average Annual Surface Water Resources by Divisions in Sabah and Sarawak	37
APPENDIX 13—Tidal influence in Sabah and Sarawak	39

1. INTRODUCTION

1.1 Study Objective

When the study was initiated, the objective was intended to be similar to Water Resources Publication (W.R.P.) No. 12 i.e. the preparation of the average annual and monthly surface water resources map. Due to uncertainties in the accuracy of the data used especially the way in which actual evapotranspiration was estimated and also due to a lot of missing data for many months at many rainfall stations, only the preparation of the Average Annual Surface Water Resources Map with histograms showing monthly distributions at a number of selected stations was carried out.

2. METHODOLOGY

2.1 Water Balance Model

The method of analysis is the same as W.R.P. No. 6 and No. 12 which is still based on the Thornthwaite and Mather Water Balance Model (1955), a description of the Model can be found in W.R.P. No. 6 and No. 12 and is attached here as Appendix 1 for easy reference.

2.2 Processing System

A similar processing system used in W.R.P. No. 6 and No. 12 is adopted and the daily rainfall record used is from 1965-1979 i.e. 14½ years of records. The first six months being used for establishing initial soil moisture storage conditions. The main features of the processing system are given as follows:

(i) Rainfall

A total of 183 rainfall stations, 65 in Sabah and 118 in Sarawak, having 3 or more years of records were selected for analysis. Station selection was based on quality and continuity of records.

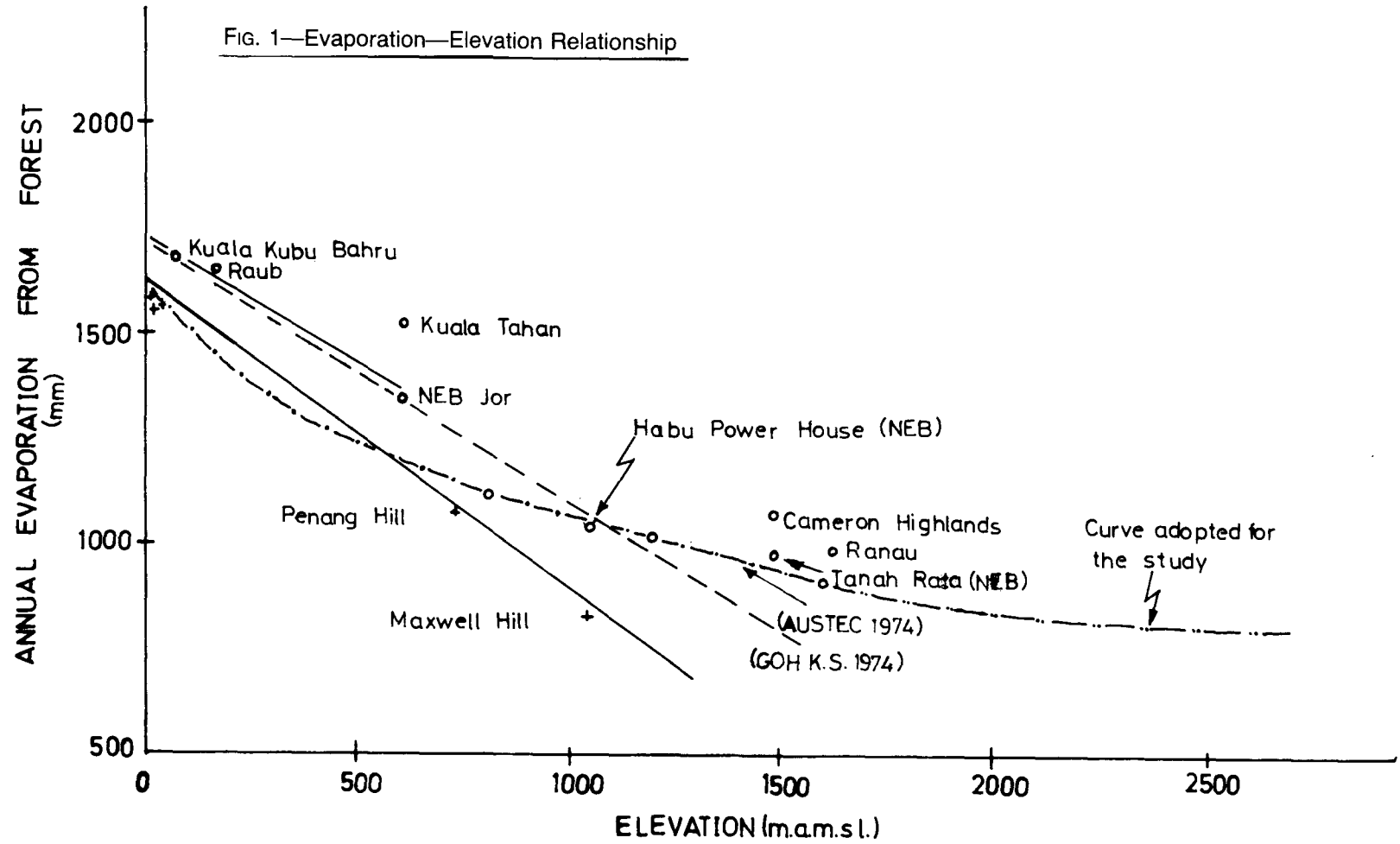
(ii) Potential Evapotranspiration

One of the main parameters required before a water balance study can be carried out is potential evapotranspiration. At the time when the study was initiated, this information was not available and this called for the potential evapotranspiration map for Sabah and Sarawak to be prepared.

The preparation of an accurate potential evapotranspiration map to be used for the water balance study was not easy since the data available were not adequate for mapping purposes due to the fact that there were only 20 pan evaporation stations, 10 each in Sabah and Sarawak with sufficiently good records and the majority of them are located at the major coastal towns. Based on these factors, it was not possible to prepare the potential evapotranspiration map to cover the two states without resorting to other methods. Use was then made of the Evaporation—Elevation relationship as developed by F. Scarf in W.R.P. No. 5 (Evaporation in Peninsular Malaysia) where annual evaporation from forest is correlated with elevation of some hill stations in Peninsular Malaysia. The relationship as reproduced from W.R.P. No. 5 is illustrated in Fig. 1 for reference. The relationship is assumed to be true for Sabah and Sarawak on the assumption that climatic conditions and other factors such as vegetative cover and topography were similar to that of Peninsular Malaysia. The evapotranspiring surface chosen was forest based on the fact that about 70% and 80% of the land areas in Sabah and Sarawak respectively are covered with natural forest and plantation crops such as oil palm and rubber.

Annual potential evapotranspiration at each rainfall stations used in the study for running the water balance model was estimated by linear interpolation of adjacent evaporation isolines obtained from the potential forest evaporation map produced. The forest evaporation map so produced is shown in Appendix 2.

Fig. 1—Evaporation—Elevation Relationship



* from Water Resources Pub. No. 5

(iii) Water Holding Capacity

The water holding capacity used in W.R.P. No. 6 and No. 12 which was fixed at 250 mm is adopted for this study and this means that the soil moisture retention constants of a and b in the soil moisture depletion equation (Please refer to Appendix 1)

$$M.S. = a.e.^b \cdot APPD$$

remained at 249.5 and -0.0040 respectively.

(iv) Recession Constant

The recession constant K is retained at 0.9 recommended by Thornthwaite and Mather for daily modelling. This value was also used in W.R.P. No. 6 and No. 12.

2.3 Sample Output

Sample output of the analyses are shown in Appendix 3.

3. WATER RESOURCES MAPPING

3.1 Using Runoff Values Instead of (P-AE) Values

Over long term and continuous summation, computed (P-AE) values, i.e. Precipitation minus Actual Evapotranspiration do not differ significantly from the computed runoffs. This can be seen in Appendix 3 where the average annual (P-AE) is 2,319 mm and the average annual runoff is 2,317 mm, a difference of only 2 mm. However as a result of soil moisture storage and runoff retention, monthly (P-AE) and runoff values could differ significantly, computed values for the station in Appendix 3 are shown as an example here.

Station No: 1311003

Period: 1965/66-1978/79

	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
Average Runoff (mm)	357	193	133	149	148	89	95	141	203	175	293	341	2,317
Average (P-AE) (mm)	296	151	119	169	124	89	81	203	181	193	320	392	2,319*
% Difference ..	-17	-22	-10	+13	-16	0	-15	+44	-11	+10	+9	+15	-

* Differ a little from annual total as a result of rounding off monthly values to nearest mm.

As can be observed the difference in the monthly values of computed runoff and (P-AE) values can vary between -22% to $+44\%$. Although the difference in the annual values is very small, but to be consistent with W.R.P. No. 6 and No. 12, the runoff values are adopted for use in the mapping process of this publication.

3.2 Mapping Average Annual Surface Water Resources

Using a map with a scale of 1:1,000,000, the location of stations and the corresponding computed runoff values were plotted in; stations having 10-14 years of continuous rainfall records were highlighted. These stations served as the base stations where linear interpolations were carried out to obtain the isohyds of the surface water resources. The spatial distribution of the rainfall stations used in the study is shown in Appendix 4. Stations having less than 10 years of rainfall records due to either bad records in certain years or due to late operation were used to supplement the mapping process provided that the magnitude of the surface water resources were reasonably close with values of adjacent stations. Values which differed significantly were discarded. Where difficulties were encountered in the construction of the isohyds especially in the interior region for which the rainfall station coverage is not adequate, references were then made to the relief map of Sabah and Sarawak and also to the Isohyetal Map of Mean Annual Rainfall 1960-1979 (Sectoral Report SN, Meteorology and Hydrology, National Water Resources Study, March 1982).

3.2.1 *Monthly Surface Water Resources*

Since the monthly map is not prepared, it was felt that the output of the water balance analyses where the monthly runoff values were available should also be presented. This serve to give an indication of the magnitude and the monthly distribution of surface water resources at the rainfall stations analysed. A summary of the water balance output is shown in Appendix 5 for Sarawak and Appendix 6 for Sabah.

3.2.2 *Representativeness of Rainfall used for the Study Period*

A comparative study was carried out to see how representative the 14 years of rainfall data (July 1965-June 1979) are of the long term rainfall average. A total of 16 rainfall stations, 10 in Sabah and 6 in Sarawak, with at least 25 years of continuous rainfall records were selected for this study. The results of the study are shown in Appendix 7 for Sarawak and Appendix 8 for Sabah. Generally it can be seen that all the stations compared were just within $\pm 10\%$ of the long term averages, which is acceptable in view of the accuracy associated with general water resources assessment, the 1965-1979 data therefore can be considered representative of the long term rainfall average.

3.3 **Comparison with Observed Water Resources**

Streamflow records provide the best indication of the surface water resources of a catchment. Accuracy of the isohyds plotted was tested using the observed streamflow records from 12 catchments compiled, varying in areas from 104 km² to 33,800 km² (see Appendix 9).

Isohyetal method was used in estimating the average annual surface water resources from the isohyds plotted for each of the 12 catchments. The computed runoff so obtained was then compared with the observed runoff and the result is shown in Appendix 10.

Of the 12 catchments compared, 10 were within $\pm 20\%$ deviation from the observed average annual runoffs. The estimates for the remaining 2 catchments which are both in Sabah were very much underestimated. The highest being 27% underestimated. Investigations carried out for these 2 catchments failed to reveal conclusively the main factors that cause this. It is felt that the discrepancies may be due to a single or a combination of factors listed below:

- (i) poor spatial distribution of rainfall stations which led to inaccuracies in drawing the isohyds,
- (ii) inadequate coverage of evaporation stations which led to poor estimation of potential evapotranspiration values and
- (iii) poor stage-discharge relations at the gauging stations which could lead to considerable error when computing the observed runoffs.

3.3.1 *Map Presentation*

The average annual surface water resources map for Sabah and Sarawak are presented here as Appendix 11. The map is presented in two scales, one with a scale of 1:1,000,000 which is enclosed at the back of this publication and the other is reduced to A3 size attached directly to this publication.

3.3.2 *Spatial Variability of Water Resources*

Rainfall input is the major component in the water balance calculation and it is of no surprise that the water resources map exhibits a spatial pattern similiar to the mean annual rainfall map (Sectoral Report SN, Meteorology and Hydrology, National Water Resources Study, March 1982). In Sarawak, abundant water resources are to be found in the inner mountain ranges in Mukah and Baram areas corresponding to their high rainfall and low evaporation. Abundant water resources are to be found in areas around Kuching, this is attributed to the heavy rainfall it receives from the North East Monsoon.

Similarly in Sabah, abundant water resources are to be found in the coastal areas, west of the Crocker Range which are exposed directly to the North East Monsoon and also in areas around the Pensiangan district.

Significant dry area is to be found in the Keningau district. This is due to the fact that, this area is being shadowed from the monsoon winds by the high mountain ranges surrounding it.

On the whole, the state of Sarawak has more water resources than Sabah due to the high mean annual rainfall it receives—3,836 mm compared to 3,405 mm in Sabah.

The surface water resources of each division in Sabah and Sarawak is shown in Appendix 12. Isohyetal method was used throughout in the computation.

3.3.3 Method of Computing Average Annual Surface Water Resources from Annual Map.

The estimate of the average annual runoff for a particular area is obtained by integration of the various segments as defined by the runoff isohyds. The equation is as follows:

$$S_t = 1/A_t \cdot (S_1 \cdot A_1 + S_2 \cdot A_2 + S_3 \cdot A_3 + \dots S_n \cdot A_n)$$

Where S_t is the value of the mean annual runoff (in mm) from a total area of A_t , and A_1, A_2, \dots, A_n are the areas into which the runoff isohyds divide. S_1, S_2, \dots, S_n are the mean isohyd values corresponding to each segment (Fig. 2).

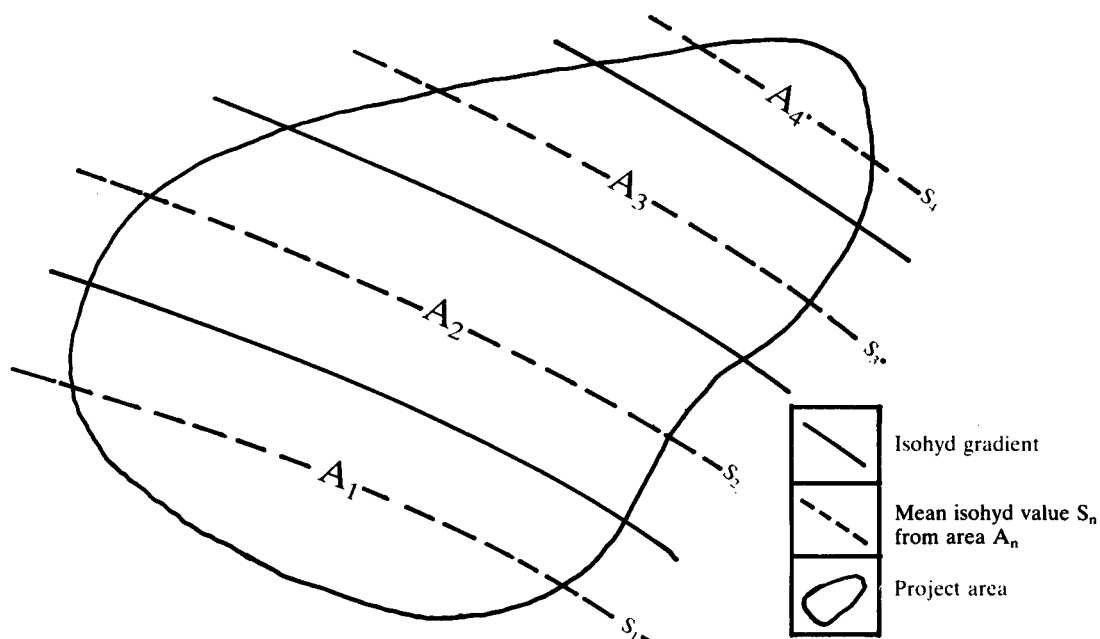


FIG. 2—SAMPLE AREA

4. TIDAL INFLUENCE

Most rivers in Sarawak are affected by salt water intrusion due to tidal influence. Of these, the Rajang river has its longest tidal reach of 200 km from the estuary to Kapit. The extent of salt water intrusion for rivers in Sarawak is shown in Appendix 13. No accurate information on the salt water intrusion is available for rivers on the east-coast of Sabah.

Estimation of the average annual surface water resources, especially for the purpose of irrigation and water supply in these areas, should be carried out with caution. The runoff so computed may not be available from the river throughout the year due to tidal influence particularly during the dry season.

5. CONCLUSION

From the water resources map produced, it is possible to estimate the average annual surface water resources to an accuracy of $\pm 20\%$.

6. REFERENCES

Drainage and Irrigation Department: Hydrological Data, Rainfall Records, Ministry of Agriculture.

Drainage and Irrigation Department: Hydrological Data, Streamflow Records, Ministry of Agriculture.

Drainage and Irrigation Department: Hydrological Data, Evaporation Records, Ministry of Agriculture.

Scarf. F 1976: Evaporation in Peninsular Malaysia, Drainage and Irrigation Department, Ministry of Agriculture, Peninsular Malaysia. Water Resources Publication No. 5. 15p.

Teh, Still, Scarf 1976: Average Annual Surface Water Resources of Peninsular Malaysia, Drainage and Irrigation Department, Ministry of Agriculture, Malaysia, Water Resources Publication No. 6. 11p.

Japan International Cooperation Agency, March 1982: Sectoral Report SN, Meteorology and Hydrology, Government of Malaysia, National Water Resources Study, Phase III.

Thornthwaite, C.W. Mather, J.R. 1957: The Water Balance, Drexel Institute of Technology, Centerton, New Jersey, Publication in Climatology, Vol. VIII, No. 1 pp 1-86.

Thornthwaite, C.W. and Mather, J.R. 1957: Instructions and tables for computing potential evapotranspiration and the water balance. Drexel Institute of Technology, Centerton, New Jersey, Publication in Climatology, Vol. X, No. 3 pp 185-311.

THORNTHWAITE AND MATHER WATER BALANCE MODEL

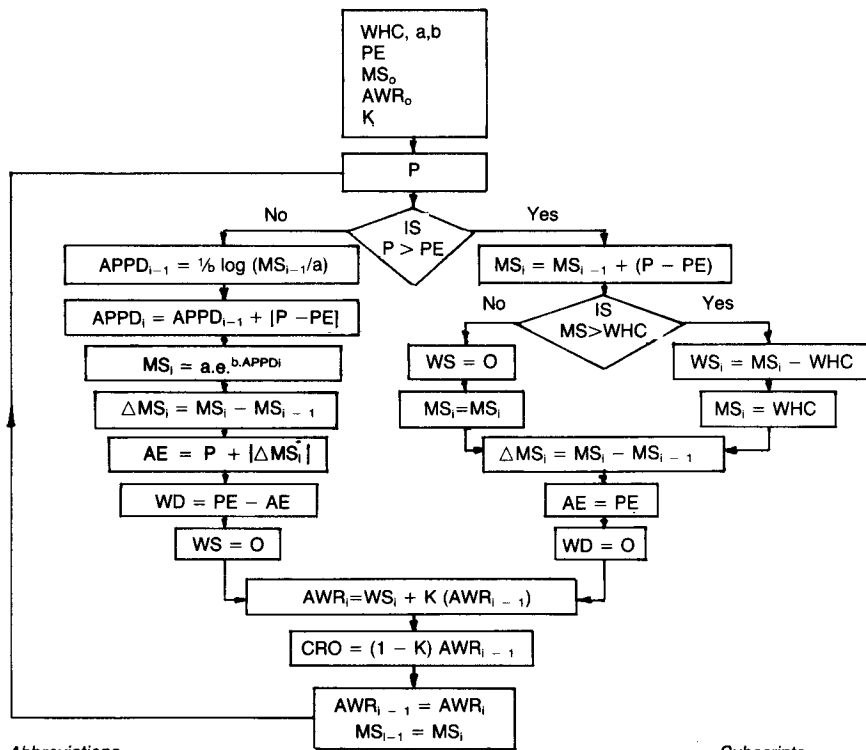
Thornthwaite and Mather (1955) constructed a single storey conceptual model to simulate mathematically the evapotranspiration, soil moisture depletion and thereby rainfall-runoff processes. The model is outlined diagrammatically in Fig. 1.

Daily rainfall (P) in excess of potential evapotranspiration (PE) is added directly to the soil moisture store (MS). If the soil moisture exceeds the water holding capacity of the soil a water surplus (WS) occurs, the actual evapotranspiration (AE) for that day is equivalent to the potential rate, and there is no water deficit.

If rainfall is less than PE, the soil moisture store is adjusted according to a variable function dependent on the soil moisture status at the end of the previous day. Actual evapotranspiration is equated to any precipitation (less than PE) plus the difference in soil moisture between this and the previous day (ΔMS). Water deficit (WD) is the difference between PE and AE.

Following adjustments to the soil moisture store any water surplus is added to previous gravitational water (AWR) available to runoff, which is recessed by a factor K to compute the daily runoff.

FIG. 1—THE THORNTHWAITE AND MATHER WATER BALANCE MODEL

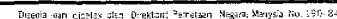


Abbreviations

P	— Precipitation
PE	— Potential evaporation
AE	— Actual evapotranspiration
MS	— Soil Moisture
ΔMS	— Change of soil moisture
AWR	— Available water for runoff
WHC	— Water holding capacity
WD	— Water deficit
WS	— Water surplus
APPD	— Accumulated potential precipitation deficit
CRO	— Computed runoff
K	— Recession Constant
a, b	— Soil moisture retention

Subscripts

°	— Initial value
i	— Indicates today
i-1	— Indicates yesterday



THORNTHWAITES DAILY WATER BALANCE MODEL

STATION NUMBER: 1311003 YEARLY TOTALS (in mm) PERIOD: 1965/66-1978/79
 PE: 1200

<i>Year</i>	<i>Precipitation</i>	<i>Actual Evapo- transpiration</i>	<i>Precipitation Minus Actual Evapo- transpiration</i>	<i>Water Deficit</i>	<i>Runoff</i>
1965/66	3,070	1,138	1,932	57	1,886
1966/67	3,156	1,141	2,015	54	2,146
1967/68	2,135	1,047	1,089	152	1,073
1968/69	3,015	1,152	1,864	43	1,851
1969/70	2,879	1,106	1,773	89	1,785
1970/71	4,032	1,148	2,885	47	2,733
1971/72	4,089	1,165	2,923	32	3,030
1972/73	4,215	1,131	3,083	64	3,128
1973/74	3,947	1,150	2,798	45	2,666
1974/75	3,375	1,167	2,208	28	2,310
1975/76	4,153	1,156	2,997	42	3,010
1976/77	3,381	1,144	2,236	51	2,196
1977/78	3,792	1,156	2,636	39	2,667
1978/79	3,177	1,147	2,030	48	1,963
Mean	3,458	1,139	2,319	57	2,317
Standard Deviation	604	31	583	31	586

THORNTHWAITES DAILY WATER BALANCE MODEL

STATION NUMBER: 1311003

MONTHLY RUNOFF (in mm)

PERIOD: 1965/66-1978/79

PE: 1200

Year	July	August	September	October	November	December	January	February	March	April	May	June
1965/66	34	161	78	97	143	191	308	230	227	110	173	135
1966/67	161	123	126	242	214	211	485	188	217	59	92	27
1967/68	83	121	16	17	204	334	142	6	0	0	63	38
1968/69	67	172	99	129	552	214	205	53	15	145	165	35
1969/70	7	39	76	68	209	296	341	102	7	219	281	140
1970/71	37	226	434	188	223	257	436	388	192	143	46	165
1971/72	207	336	494	197	381	439	269	275	66	182	108	77
1972/73	29	272	343	186	463	458	408	211	267	249	150	91
1973/74	92	89	323	262	325	523	384	133	146	181	69	139
1974/75	120	102	235	222	305	158	292	241	219	185	144	87
1975/76	172	56	259	201	374	572	938	96	5	86	138	113
1976/77	22	44	101	132	189	349	231	417	156	156	285	115
1977/78	163	171	135	422	312	398	350	97	210	182	190	38
1978/79	143	61	124	88	209	328	213	272	132	187	169	38
Mean	95	141	203	175	293	341	357	193	133	149	148	89
Standard Deviation	66	89	147	100	117	128	193	121	96	66	73	47

SARAWAK WATER BALANCE SUMMARY

No.	Station Number	Type	Period of Records Used	No. of years of records	MEAN MONTHLY AND ANNUAL RUNOFF (mm)												
					J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
1.	1003031	A	1965/66-78/79	4	271	136	177	168	159	82	36	72	114	182	198	213	1,807
2.	1005035	A	1965/66-78/79	8	445	336	243	231	182	125	103	129	141	208	250	343	2,741
3.	1006028	A	1965/66-78/79	11	297	221	164	133	134	102	90	112	129	130	190	290	1,991
4.	1006033	A	1965/66-78/79	11	331	249	243	207	153	111	102	105	120	151	185	269	2,229
5.	1006037	A	1965/66-78/79	8	280	211	264	188	155	119	87	92	84	126	200	294	2,101
6.	1006079	A	1971/72-78/79	5	215	217	218	193	205	122	120	83	125	121	154	323	2,096
7.	1008032	M	1965/66-78/79	14	391	340	231	248	203	149	136	155	193	241	317	362	2,966
8.	1015001	A	1965/66-78/79	11	573	432	184	144	112	109	87	131	122	179	260	340	2,684
9.	1018002	A	1965/66-78/79	8	223	170	212	163	165	175	98	99	180	238	263	330	2,319
10.	1102019	A	1965/66-78/79	9	314	310	325	249	208	140	102	90	125	217	292	182	2,557
11.	1105027	A	1965/66-78/79	7	251	263	243	235	196	127	47	95	89	154	218	187	2,339
12.	1105050	A	1965/66-78/79	12	344	289	181	201	173	126	116	118	145	220	248	298	2,461
13.	1111008	M	1965/66-78/79	13	318	247	210	222	156	132	91	116	193	198	296	256	2,434
14.	1113028	M	1969/70-78/79	10	277	238	216	264	180	113	123	170	277	224	279	379	2,740
15.	1114019	M	1965/66-78/79	14	301	186	147	199	162	115	99	130	171	183	273	327	2,293
16.	1201076	M	1965/66-78/79	8	344	399	204	104	73	61	76	76	140	219	285	314	2,301

SARAWAK WATER BALANCE SUMMARY

No.	Station Number	Type	Period of Records Used	No. of years of records	MEAN MONTHLY AND ANNUAL RUNOFF (mm)												
					J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
17.	1204024	M	1965/66-78/79	14	407	356	293	233	186	125	86	117	140	180	253	277	2,653
18.	1205006	A	1965/66-78/79	14	428	364	300	250	156	95	87	68	111	176	260	344	2,639
19.	1212032	M	1971/72-78/79	7	286	173	216	137	171	143	84	90	170	210	318	366	2,351
20.	1214001	A	1965/66-78/79	14	238	154	158	173	179	122	93	117	143	140	231	296	2,047
21.	1217011	M	1965/66-78/79	12	245	177	205	198	229	164	94	128	162	165	241	313	2,321
22.	1219024	A	1967/68-78/79	6	275	221	148	163	157	166	147	111	212	196	217	368	2,381
23.	1302078	M	1971/72-78/79	8	615	520	393	285	229	175	124	154	190	245	288	531	3,748
24.	1303014	A	1965/66-78/79	14	511	439	257	194	175	109	88	126	113	179	263	305	2,759
25.	1305038	M	1965/66-78/79	11	509	410	335	258	216	159	93	110	162	205	313	383	3,176
26.	1307018	M	1965/66-78/79	14	425	360	267	188	136	79	74	60	120	158	244	304	2,415
27.	1311003	M	1965/66-78/79	14	357	193	133	149	148	89	95	141	203	175	293	341	2,317
28.	1313006	A	1965/66-78/79	13	277	170	154	181	153	123	95	104	123	151	233	295	2,058
29.	1316029	M	1969/70-78/79	9	179	163	163	152	131	88	74	94	117	93	160	218	2,082
30.	1401005	A	1965/66-78/79	10	529	474	237	212	180	71	74	96	143	190	262	351	2,818
31.	1402047	M	1965/66-78/79	14	517	436	250	155	117	103	84	100	107	186	271	309	2,635
32.	1403001	A	1965/66-78/79	14	570	462	268	191	136	96	68	87	126	201	267	304	2,775

SARAWAK WATER BALANCE SUMMARY

No.	Station Number	Type	Period of Records Used	No. of years of records	MEAN MONTHLY AND ANNUAL RUNOFF (mm)												
					J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
33.	1404049	A	1965/66-78/79	14	577	511	301	184	151	82	64	85	99	135	194	256	2,639
34.	1415004	M	1965/66-78/79	14	325	189	157	150	174	155	99	115	172	174	260	314	2,286
35.	1499051	M	1967/68-78/79	5	506	489	320	251	187	149	141	128	172	221	267	231	3,060
36.	1502026	M	1965/66-78/79	14	761	609	373	238	177	107	109	154	158	186	285	396	3,554
37.	1503025	A	1965/66-78/79	14	609	473	227	153	110	97	80	119	103	160	246	344	2,722
38.	1506034	M	1965/66-78/79	14	552	487	290	129	76	62	79	67	79	108	217	256	2,400
39.	1509009	A	1965/66-78/79	9	551	389	298	219	118	103	67	75	128	172	295	393	2,808
40.	1516020	M	1965/66-78/79	7	242	212	156	158	104	92	64	76	165	132	170	277	1,850
41.	1602003	M	1965/66-78/79	14	775	618	417	286	170	107	104	165	137	199	292	420	3,693
42.	1603058	M	1967/68-78/79	12	719	623	403	226	86	83	85	118	130	166	256	420	3,313
43.	1612030	M	1970/71-78/79	9	332	226	144	168	132	82	79	87	151	147	229	316	2,093
44.	1615023	M	1966/67-78/79	13	291	194	214	229	173	133	110	140	206	188	254	344	2,474
45.	1616021	M	1966/67-78/79	4	272	175	223	189	262	127	144	85	194	304	298	364	2,640
46.	1698007	A	1965/66-78/79	14	620	616	400	183	91	42	46	54	59	79	124	318	2,630
47.	1704013	A	1965/66-78/79	14	607	524	398	174	112	69	82	97	110	178	259	416	3,025
48.	1713005	A	1965/66-78/79	14	287	170	157	155	143	108	58	107	121	139	182	270	1,899

SARAWAK WATER BALANCE SUMMARY

No.	Station Number	Type	Period of Records Used	No. of years of records	MEAN MONTHLY AND ANNUAL RUNOFF (mm)												
					J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
49.	1722040	M	1965/66-78/79	9	223	201	153	74	111	99	77	112	114	252	218	244	1,879
50.	1726041	A	1965/66-78/79	12	133	108	131	130	120	118	86	126	178	182	181	217	1,791
51.	1811007	M	1965/66-78/79	14	358	192	153	134	130	78	68	118	173	154	259	360	2,176
52.	1811010	M	1965/66-78/79	14	369	207	113	120	150	124	79	122	134	194	300	355	2,266
53.	1816029	M	1965/66-73/74	4	243	254	279	204	132	88	95	102	144	191	202	202	2,138
54.	1834033	M	1965/66-76/77	5	420	295	223	165	223	114	86	166	254	247	288	316	2,799
55.	1836042	M	1965/66-78/79	3	246	164	251	135	98	87	192	78	52	276	313	354	2,247
56.	1897016	A	1965/66-78/79	11	525	530	239	142	30	11	11	33	39	58	144	239	2,003
57.	2016058	M	1973/74-76/77	10	227	175	185	148	105	60	53	87	123	153	167	210	1,693
58.	2019024	M	1965/66-78/79	14	248	194	177	203	165	73	48	99	198	161	252	208	2,023
59.	2021036	M	1965/66-78/79	14	229	159	163	148	124	103	74	107	160	150	204	226	1,847
60.	2025012	A	1965/66-78/79	14	214	126	107	88	69	72	86	102	113	145	185	216	1,522
61.	2029001	A	1965/66-78/79	14	294	222	231	226	195	165	115	163	190	242	261	323	2,626
62.	2112027	M	1965/66-78/79	13	279	168	137	122	149	146	136	132	160	262	259	239	2,199
63.	2115008	M	1965/66-78/79	8	273	138	158	114	84	59	44	124	81	115	129	194	1,514
64.	2116030	M	1965/66-78/79	14	250	168	148	152	126	74	48	110	144	148	110	226	1,703

SARAWAK WATER BALANCE SUMMARY

No.	Station Number	Type	Period of Records Used	No. of years of records	MEAN MONTHLY AND ANNUAL RUNOFF (mm)												
					J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
65.	2218017	M	1965/66-78/79	14	282	205	167	163	124	65	51	93	134	154	134	227	1,801
66.	2231043	A	1965/66-78/79	11	152	121	219	199	115	141	122	113	178	260	316	238	2,270
67.	2318007	A	1965/66-78/79	13	286	182	176	155	110	79	42	71	126	159	148	245	1,780
68.	2320059	M	1971/72-78/79	8	264	190	174	216	161	100	86	108	192	157	230	266	2,144
69.	2325039	M	1973/74-76/77	5	524	373	468	271	169	90	97	114	123	245	342	634	3,447
70.	2333044	M	1967/68-78/79	8	331	246	266	152	175	128	122	225	263	226	300	422	2,856
71.	2338047	A	1965/66-78/79	5	211	213	274	144	215	207	155	169	226	290	298	235	2,639
72.	2418013	M	1965/66-78/79	14	250	200	181	176	109	80	47	60	114	166	156	235	1,772
73.	2514004	M	1965/66-78/79	14	257	172	97	63	49	44	44	38	48	112	144	201	1,268
74.	2520052	M	1966/67-78/79	11	200	176	177	136	105	80	34	111	99	93	140	138	1,489
75.	2524038	M	1970/71-74/75	5	242	411	318	259	190	211	104	176	276	288	310	265	3,050
76.	2615009	M	1965/66-78/79	14	312	207	101	53	35	38	40	29	67	104	122	243	1,352
77.	2625051	M	1966/67-78/79	12	152	108	139	94	64	54	106	117	140	201	243	287	1,687
78.	2718022	M	1965/66-78/79	14	391	363	239	126	57	28	8	7	34	30	73	152	1,509
79.	2737003	A	1965/66-78/79	10	233	235	221	212	154	144	149	133	189	204	228	234	2,333
80.	2828025	A	1965/66-78/79	14	344	224	192	181	162	133	140	154	177	178	220	305	2,411

SARAWAK WATER BALANCE SUMMARY

No.	Station Number	Type	Period of Records Used	No. of years of records	MEAN MONTHLY AND ANNUAL RUNOFF (mm)												
					J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
81.	2920005	A	1965/66-78/79	14	449	369	289	116	38	64	64	80	121	123	141	308	2,163
82.	2920037	M	1965/66-78/79	14	474	376	278	111	36	58	66	92	103	105	143	324	2,165
83.	2925010	M	1965/66-78/79	14	414	301	220	106	77	111	103	130	126	171	195	311	2,264
84.	2931038	M	1965/66-78/79	9	276	204	103	130	74	59	88	130	107	192	260	240	1,861
85.	3048026	M	1966/67-76/77	10	276	217	243	303	242	265	211	250	268	322	400	369	3,470
86.	3050015	M	1965/66-78/79	9	389	262	296	335	385	276	258	275	334	417	376	426	4,032
87.	3130002	A	1965/66-78/79	14	296	204	162	139	118	167	130	137	168	190	284	317	2,309
88.	3132023	M	1965/66-78/79	8	342	264	184	101	101	102	110	100	103	157	273	284	2,172
89.	3137021	A	1965/66-78/79	10	443	380	311	315	232	201	170	241	280	345	422	528	3,864
90.	3152011	A	1965/66-78/79	14	260	200	218	202	226	215	194	181	234	304	329	322	2,886
91.	3234022	A	1965/66-78/79	3	292	399	375	212	110	109	143	148	92	191	376	611	3,058
92.	3342032	M	1965/66-78/79	10	473	359	332	264	399	291	236	115	208	305	350	371	3,705
93.	3347003	M	1965/66-78/79	11	363	236	312	315	311	296	297	256	336	324	339	380	3,768
94.	3444018	M	1965/66-78/79	14	390	327	300	298	260	250	235	204	292	340	362	412	3,669
95.	3451028	M	1965/66-72/73	6	221	171	202	198	273	215	199	135	213	300	258	235	2,621
96.	3541033	A	1965/66-78/79	8	295	240	179	223	252	214	137	243	246	289	319	372	3,010

SARAWAK WATER BALANCE SUMMARY

No.	Station Number	Type	Period of Records Used	No. of years of records	MEAN MONTHLY AND ANNUAL RUNOFF (mm)												
					J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
97.	3737045	M	1968/69-78/79	10	159	92	87	78	52	73	80	55	64	88	133	206	1,168
98.	3744009	A	1965/66-78/79	6	233	287	189	259	262	315	217	129	186	319	369	289	3,055
99.	3754007	A	1965/66-78/79	12	126	86	120	131	185	139	122	75	120	75	120	122	1,508
100.	3837016	M	1965/66-78/79	12	171	117	64	62	47	77	78	57	92	77	112	194	1,150
101.	3842034	A	1967/68-78/79	7	191	135	150	149	108	124	116	62	107	183	289	225	1,842
102.	3847035	M	1965/66-78/79	10	264	199	197	243	222	169	148	175	187	250	330	292	2,673
103.	3940036	M	1965/66-78/79	5	93	99	101	96	65	87	76	57	100	110	102	93	1,079
104.	3945017	M	1965/66-78/79	6	365	174	175	340	232	202	58	41	127	329	252	244	2,779
105.	3950020	M	1965/66-78/79	12	247	237	284	271	239	245	165	194	329	373	317	294	3,141
106.	4038006	M	1965/66-78/79	12	237	104	75	55	51	96	90	82	106	133	174	193	1,396
107.	4039019	M	1971/72-78/79	8	214	60	41	32	72	65	59	56	80	101	171	198	1,148
108.	4143004	A	1965/66-78/79	14	219	120	85	78	81	108	68	74	101	121	165	181	1,401
109.	4239048	M	1969/70-78/79	10	159	77	62	62	58	65	60	63	124	142	299	221	1,390
110.	4255006	A	1965/66-78/79	14	118	103	132	148	142	127	105	92	138	179	194	153	1,630
111.	4339005	A	1965/66-78/79	14	190	80	52	48	54	84	68	66	83	150	207	226	1,309
112.	4349016	M	1965/66-78/79	6	353	334	292	198	258	222	217	166	267	256	352	295	3,208

SARAWAK WATER BALANCE SUMMARY

No.	Station Number	Type	Period of Records Used	No. of years of records	MEAN MONTHLY AND ANNUAL RUNOFF (mm)												
					J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
113.	4440001	A	1965/66-78/79	14	243	98	45	58	57	93	84	85	125	178	244	279	1,589
114.	4449012	A	1965/66-78/79	14	345	195	181	239	229	215	154	173	225	249	306	326	2,835
115.	4548004	A	1965/66-78/79	14	323	188	164	178	205	209	130	132	193	270	338	356	2,686
116.	4649010	M	1965/66-78/79	10	302	178	163	146	127	161	149	136	216	280	260	254	2,371
117.	4852002	M	1965/66-75/76	11	258	109	99	72	137	149	94	129	241	223	271	281	2,063
118.	4854018	M	1966/67-76/77	9	302	243	171	190	227	208	205	227	534	410	375	336	3,296

Note:

M=Manual Station.

A=Automatic Recorder Station.

SABAH WATER BALANCE SUMMARY

No.	Station Number	Type	Period of Records Used	No. of years of records	MEAN MONTHLY AND ANNUAL RUNOFF (mm)												
					J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
1.	4276001	M	1965/66-78/79	14	72	18	38	38	83	86	104	106	89	77	102	75	887
2.	4278001	M	1965/66-78/79	14	45	25	16	7	11	24	91	86	87	65	54	61	570
3.	4278201	A	1969/70-78/79	10	31	21	14	15	11	24	83	87	75	53	46	60	518
4.	4279001	M	1965/66-78/79	14	63	29	18	15	30	35	101	103	83	75	72	87	711
5.	4358001	M	1965/66-78/79	10	91	51	51	89	119	108	54	107	107	81	77	126	1,063
6.	4373001	M	1965/66-68/69	4	115	43	78	74	83	105	87	104	76	54	156	104	1,079
7.	4474001	M	1965/66-78/79	14	75	37	54	48	105	73	68	66	88	85	79	79	858
8.	4480001	M	1965/66-78/79	14	94	79	81	128	173	99	107	68	75	115	168	131	1,317
9.	4480002	M	1965/66-78/79	14	81	71	104	127	157	98	104	61	55	95	156	132	1,260
10.	4485001	M	1965/66-78/79	14	86	87	35	54	103	79	93	75	89	112	116	129	1,058
11.	4562001	M	1965/66-78/79	14	144	92	138	182	235	204	163	167	177	183	216	200	2,100
12.	4584001	M	1965/66-78/79	13	90	69	35	41	153	95	80	58	147	105	81	80	1,034
13.	4681001	M	1965/66-78/79	14	89	64	36	60	129	104	103	73	91	104	91	87	1,031
14.	4959001	A	1969/70-78/79	10	75	60	48	59	66	52	20	31	52	44	51	85	643
15.	5055001	M	1965/66-78/79	14	261	138	76	94	140	131	134	160	181	212	287	228	2,040
16.	5059002	M	1965/66-78/79	14	88	63	36	49	66	51	40	26	53	71	78	88	708

SABAH WATER BALANCE SUMMARY

No.	Station Number	Type	Period of Records Used	No. of years of records	MEAN MONTHLY AND ANNUAL RUNOFF (mm)												
					J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
17.	5074001	A	1974/75-78/79	5	205	71	102	42	66	67	97	100	143	128	196	173	1,391
18.	5083001	M	1966/67-78/79	13	124	116	58	36	45	43	53	30	34	27	53	74	692
19.	5083002	M	1965/66-78/79	14	120	145	96	59	63	39	29	29	63	85	115	111	954
20.	5159001	M	1965/66-78/79	13	82	60	45	41	76	69	80	19	47	52	70	105	688
21.	5163001	A	1969/70-76/77	8	15	38	35	24	29	45	43	34	32	51	71	69	486
22.	5260001	M	1965/66-78/79	14	58	50	22	18	47	50	23	17	20	34	33	41	413
23.	5261001	M	1967/68-78/79	13	36	35	46	41	52	49	35	19	51	42	38	46	446
24.	5274201	A	1967/68-77/78	9	132	135	98	42	36	75	57	73	99	65	100	91	1,021
25.	5357002	M	1965/66-78/79	14	195	124	98	131	260	224	142	117	190	333	312	202	2,328
26.	5357004	M	1965/66-78/79	14	222	153	130	154	267	259	170	126	222	298	214	179	2,323
27.	5361001	M	1965/66-78/79	13	56	30	44	29	54	49	31	15	27	45	25	46	453
28.	5361201	A	1969/70-78/79	10	31	46	37	14	33	27	8	5	18	18	32	51	318
29.	5364001	M	1965/66-78/79	14	75	55	53	35	100	69	66	28	77	83	108	88	839
30.	5372001	A	1969/70-78/79	10	136	113	80	65	86	87	128	145	118	91	146	132	1,326
31.	5457001	M	1965/66-78/79	14	243	161	120	155	273	206	147	152	229	329	322	272	2,610
32.	5457002	M	1965/66-78/79	14	169	95	61	107	210	198	210	147	225	271	292	254	2,239

SABAH WATER BALANCE SUMMARY

No.	Station Number	Type	Period of Records Used	No. of years of records	MEAN MONTHLY AND ANNUAL RUNOFF (mm)												
					J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
33.	5458003	M	1965/66-78/79	14	188	102	72	100	208	228	204	179	265	309	263	258	2,376
34.	5461001	M	1965/66-77/78	10	43	48	52	38	45	33	14	7	36	34	36	35	445
35.	5462001	A	1965/66-78/79	10	69	66	36	27	78	62	28	31	56	56	91	80	679
36.	5462002	M	1965/66-78/79	14	39	48	37	14	45	51	25	14	34	39	29	42	418
37.	5462003	M	1965/66-78/79	12	51	26	27	29	74	66	39	30	43	67	99	63	493
38.	5478001	A	1970/71-75/76	6	163	216	76	41	85	51	139	153	161	181	165	139	1,569
39.	5487001	M	1965/66-78/79	14	302	252	111	24	61	79	77	37	112	128	155	246	1,583
40.	5556001	M	1965/66-78/79	14	131	37	8	1	18	91	101	71	126	145	229	134	1,093
41.	5659002	A	1965/66-78/79	14	160	89	51	41	160	227	181	163	244	306	266	221	2,108
42.	5663001	A	1969/70-77/78	9	27	40	27	14	41	41	33	33	49	65	41	62	475
43.	5759002	M	1965/66-78/79	14	137	70	36	42	171	210	158	144	214	273	245	192	1,894
44.	5760201	A	1969/70-78/79	10	149	102	59	93	166	235	186	154	252	287	291	249	2,221
45.	5763001	M	1965/66-78/79	14	84	52	47	45	110	74	66	53	82	129	107	80	929
46.	5777001	M	1971/72-78/79	8	257	309	176	34	49	72	88	139	121	110	130	232	1,717
47.	5864001	M	1965/66-78/79	14	93	90	76	40	96	111	75	48	81	103	107	95	1,015

SABAH WATER BALANCE SUMMARY

No.	Station Number	Type	Period of Records Used	No. of years of records	MEAN MONTHLY AND ANNUAL RUNOFF (mm)												
					J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
48.	5960001	M	1965/66-78/79	14	83	22	5	1	15	109	113	64	128	185	170	129	1,024
49.	5961001	A	1969/70-77/78	9	143	55	24	13	160	171	126	102	227	220	172	157	1,571
50.	5965001	M	1965/66-78/79	14	110	62	40	27	59	75	95	75	69	118	130	77	937
51.	5966001	A	1969/70-77/78	9	104	112	58	23	58	47	47	67	57	65	79	78	796
52.	5966002	M	1965/66-78/79	14	133	105	75	29	64	78	68	76	90	130	116	92	1,057
53.	5967001	M	1965/66-78/79	14	201	151	79	41	89	99	75	83	77	99	83	109	1,186
54.	5974001	M	1972/73-78/79	7	259	288	139	49	110	102	146	168	99	112	114	215	1,800
55.	5980001	M	1965/66-78/79	14	411	246	126	35	21	47	59	89	119	88	194	304	1,739
56.	5980002	M	1965/66-78/79	14	407	268	129	37	24	76	63	75	116	84	186	353	1,817
57.	6062001	A	1969/70-78/79	8	131	115	64	31	99	108	97	90	176	196	153	151	1,410
58.	6064001	A	1969/70-78/79	10	131	115	94	84	135	181	160	119	158	216	160	147	1,699
59.	6065001	M	1965/66-78/79	14	318	207	174	136	284	276	306	286	337	484	418	302	3,527
60.	6162001	M	1965/66-78/79	12	111	61	34	20	45	96	80	64	106	170	159	106	1,127
61.	6162002	M	1965/66-78/79	13	90	51	23	5	31	85	83	60	100	179	150	88	945
62.	6264001	A	1969/70-78/79	8	185	105	57	31	86	116	78	59	92	155	171	159	1,295

SABAH WATER BALANCE SUMMARY

No.	Station Number	Type	Period of Records Used	No. of years of records	MEAN MONTHLY AND ANNUAL RUNOFF (mm)												
					J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
63.	6365001	A	1969/70-78/79	6	129	73	20	4	121	153	76	33	38	145	151	129	1,073
64.	6567001	M	1965/66-78/79	14	337	330	148	40	52	47	25	38	36	77	108	253	1,491
65.	6868001	A	1969/70-78/79	7	203	59	13	18	16	11	18	7	24	19	69	213	671

Note:

M=Manual station.

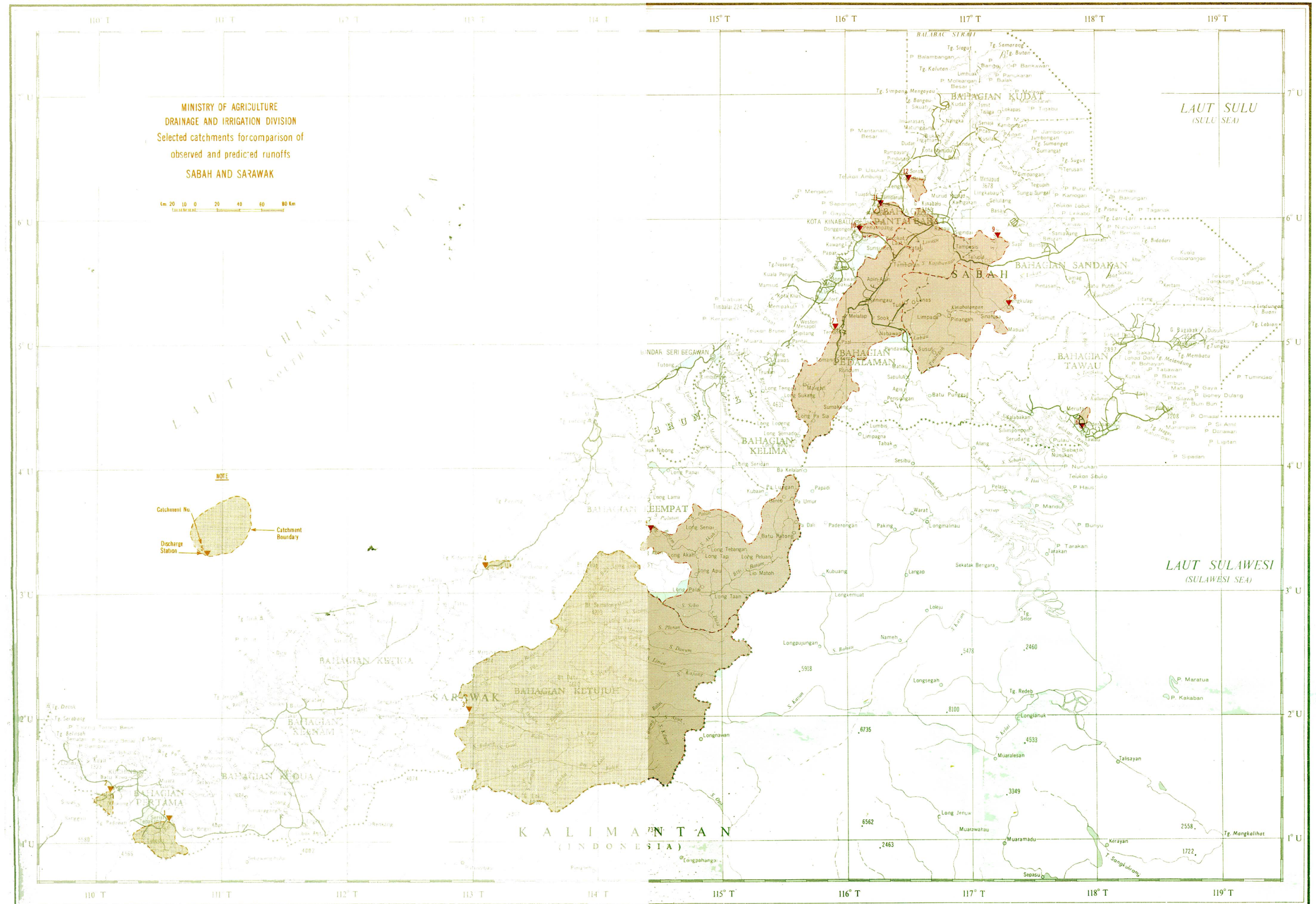
A=Automatic recorder station.

**COMPARISON OF SHORT TERM (1965-1979) AND LONG TERM RAINFALL
FOR SELECTED LOCATIONS IN SARAWAK**

Station No.	Station Name/Location	Total Length of Record (Years)	A	B	B/A	$\frac{B-A}{A} \times 100\%$
			Long Term Mean (mm)	Short Term Mean 1965-79 (mm)		
1214001	Simanggang	31	3,717	3,353	0.90	-9.79
1403001	Kuching	28	4,110	4,119	1.00	0.22
1713005	Saratok	30	3,352	3,297	0.98	-1.64
2029001	Kapit	28	3,665	3,767	1.03	2.78
2920005	Mukah	29	3,531	3,605	1.02	2.09
4339005	Miri	24	2,924	2,817	0.96	-3.65
				Mean	0.98	-1.00

**COMPARISON OF SHORT TERM (1965-1979) AND LONG TERM RAINFALL
FOR SELECTED LOCATIONS IN SABAH**

Station No.	Station Name/Location	Total Length of Record (Years)	A	B	B/A	$\frac{B-A}{A} \times 100\%$
			Long Term Mean (mm)	Short Term Mean 1965-79 (mm)		
4278001	Tawau Air Field ..	54	1,768	1,650	0.93	-6.67
4562001	Pensiangan	41	3,034	3,035	1.00	0.03
4681001	Mostyn	26	2,289	2,192	0.96	-4.24
5055001	Sipitang	43	3,379	3,206	0.95	-5.12
5059002	Sapong	42	1,814	1,688	0.93	-6.94
5361001	Keningau	67	1,673	1,656	0.99	-1.02
5759001	Papar Hospital	48	2,816	2,565	0.91	-8.91
5960001	Kota Kinabalu	48	2,707	2,532	0.93	6.46
5967001	Ranau	26	2,287	2,291	1.00	0.17
5980001	Friendly Rubber Estate (Sandakan)	29	3,129	3,280	1.05	4.83
				Mean	0.96	-3.43



COMPARISON OF PREDICTED AND OBSERVED AVERAGE ANNUAL RUNOFFS

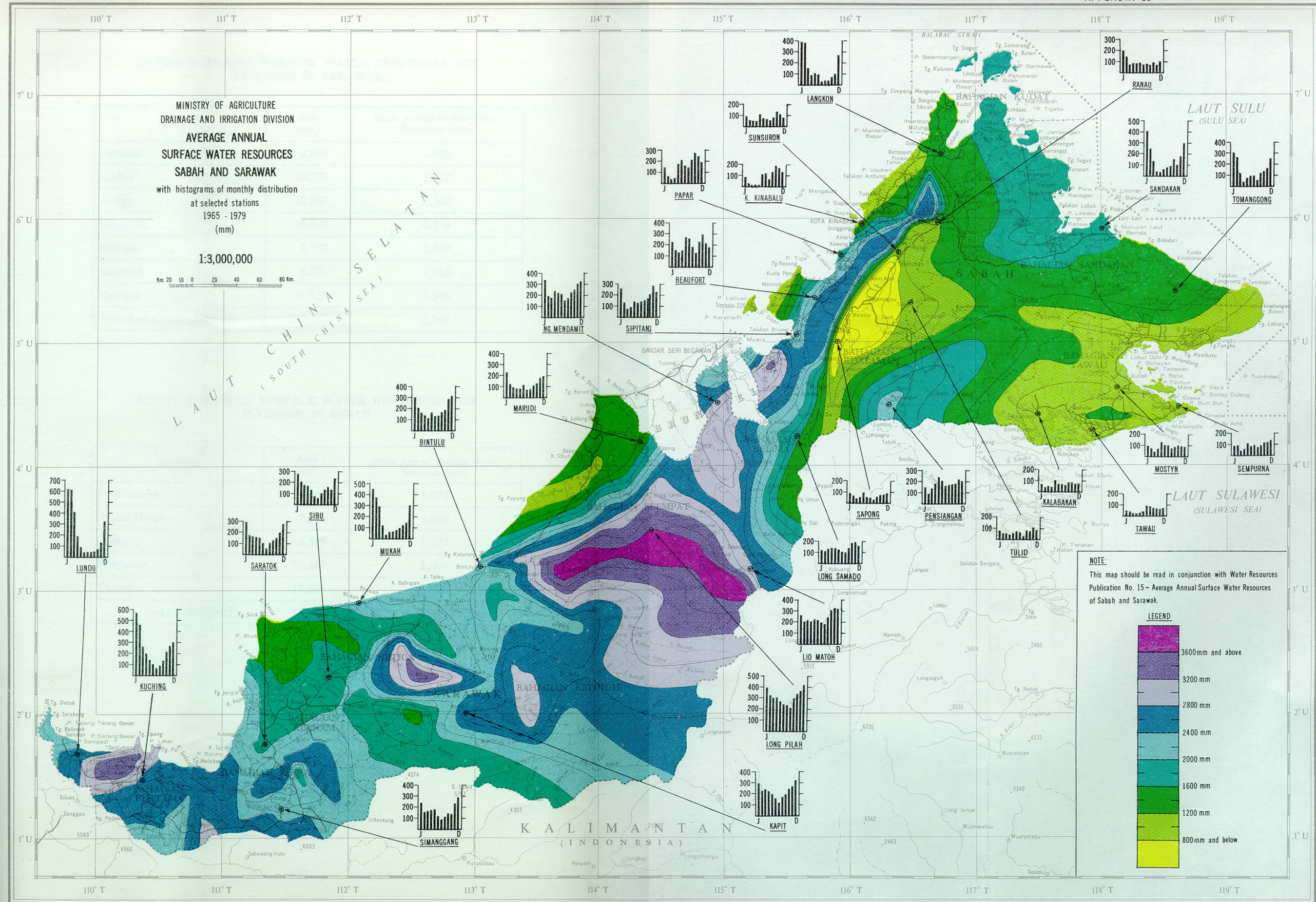
SARAWAK

Catchment No.	Station No.	River	Station	Catchment Area (km ²)	Period of Observed Records	No. of Years of Flow Records (Years)	Observed Mean Annual Runoff (mm)	Predicted Mean Annual Runoff (mm)	% Difference
1.	1105427	Sungai Sadong	Serian	941	65/66-78/79	14	2,017	2,220	+10
2.	1301427	Sungai Sarawak	Buan Bidi	217	70/71-78/79	9	2,518	2,694	+ 7
3.	2029401	Sungai Rajang	Kapit	33,800	67/68-78/79	12	2,631	2,619	0
4.	3131412	Sungai Sibiu	Sibiu	155	67/68-78/79	12	2,300	2,570	+10
5.	3444401	Sungai Baram	Long Pilah	9,300	66/67-78/79	13	2,550	3,022	+18

33

SABAH

6.	4278401	Sungai Jawau	Kuhara	104	68/69-76/77	9	1,245	1,033	-17
7.	5159401	Sungai Padas	Tenom Lama	7,720	68/69-76/77	9	917	1,097	+19
8.	5373401	Sungai Milan	Tangkulap	5,730	65/66-76/77	12	1,211	1,263	+ 4
9.	5872401	Sungai Labuk	Porog	3,240	65/66-76/77	12	1,621	1,368	-15
10.	5961401	Sungai Moyog	Panampang	200	65/66-76/77	12	2,347	1,936	-17
11.	6162403	Sungai Tuaran	Malanggang	564	65/66-76/77	12	2,493	1,877	-24
12.	6364401	Sungai Wariu	Bridge No. 2	243	65/66-76/77	12	2,425	1,770	-27



**AVERAGE ANNUAL SURFACE WATER RESOURCES FOR
DIVISIONS IN SARAWAK**

Bahagian	Area (km ²)	Mean Annual Surface Water Resources (mm)
Pertama	8,899	2,620
Kedua	10,273	1,232
Ketiga	12,887	2,160
Keempat	38,943	2,546
Kelima	7,790	2,480
Keenam	6,721	1,918
Ketujuh	38,935	2,548
SARAWAK (TOTAL) ..	124,448	2,365

**AVERAGE ANNUAL SURFACE WATER RESOURCES FOR
DIVISIONS IN SABAH**

Bahagian	Area (km ²)	Mean Annual Surface Water Resources (mm)
Perdalaman	18,162	1,372
Pantai Barat	7,589	1,630
Kudat	4,599	1,573
Sandakan	29,167	1,494
Tawau	14,365	1,071
SABAH (TOTAL) ..	73,882	1,400



WATER RESOURCES PUBLICATIONS PREVIOUSLY PUBLISHED

	\$
1. Surface Water Resources Map (Provisional) of Peninsular Malaysia 1974	5.00
2. Hydrological Regions of Peninsular Malaysia	6.00
3. Sungai Tekam Experimental Basin Annual Report No. 1 for 1973-1974 (1975) ..	5.00
4. Notes on Some Hydrological Effects of Land Use Changes in Peninsular Malaysia	5.00
5. Evaporation in Peninsular Malaysia (1976)	5.00
6. Average Annual Surface Water Resources of Peninsular Malaysia (1975)	5.00
7. Sungai Lui Representative Basin Report No. 1 for 1971/72 to 1973/74 (1977) ..	5.00
8. Water Resources for Irrigation of Upland Crops in South Kelantan	5.00
9. Sungai Lui Representative Basin Report No. 2 for 1974/75 to 1975/76	5.00
10. Sungai Tekam Experimental Basin Report No. 2 for September, 1974 to March, 1977 (1978)	5.00
11. Comparison of Performance of U.S. Class "A" Evaporation Galvanised Iron Pan and Aluminium Pan	5.00
12. Average Annual and Monthly Surface Water Resources of Peninsular Malaysia, 1982	10.00
13. Sungai Tekam Experimental Basin Calibration Report from July 1977 to June 1980 (1982)	5.00
14. Comparison of Raingauge Performance under Tropical Climate Conditions (1984)	5.00

AVERAGE ANNUAL SURFACE WATER RESOURCES SABAH AND SARAWAK

with histograms of monthly distribution
at selected stations

1965 – 1979
(mm)

1:1,000,000

