KINGDOM OF LESOTHO
LESOTHO HIGHLANDS DEVELOPMENT AUTHORITY

INTERIM HYDROLOGY

PROGRESS REPORT NO. 4

FLOW SEQUENCES AT DAM SITES

Lesotho Highlands Water Project

Lesotho Highlands Development Authority
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Our Ref : LHDA/2/2C

3 June, 1987

The Secretariat
Joint Permanent Technical Commission
5th Floor, Lesotho Bank Tower
Private Bag A 156
MASERU

Dear Sirs,

INTERIM HYDROLOGY FOR THE ENGINEERING PROJECT

The LHDA has the responsibility to update from the feasibility study the flow sequences at the various dam sites to be utilized by the Hydropower design consultant.

The necessary studies will be undertaken in steps with a progress report issued at the conclusion of each step. Four such reports will be issued as follows :

* Progress Report No.1. "Rainfall Stations" concerning the update, infilling and extension of the rain gauge data computed in the feasibility study.

* Progress Report No.2. "Rating Curves" concerning the update of the gauge flow data computation of rating curves and comparison with the feasibility study rating curves.

* Progress Report No.3. "Processed 1983-86 Flows" concerning the update of digitising of the chart recorders, computation of the daily flows, flow infilling of the missing data by watchmen records.

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* Progress Report No.4. "Flow Sequences at Dam Sites" computation of the infilled data by regression of the catchment rainfall, extension of the flow sequences by the Pitman Model and transposition of the flow sequences from different stations to dam sites.

Progress Reports:

- o No.1 entitled "Rainfall Stations"
- o No.2 entitled "Rating Surve"
- o No.3 entitled "Processed 1983-85 Flows", have been sent to with letter reference LHDA/2/2C dated 2 April, 1987, LHDA/2/2C dated 24 April, 1987 and LHDA/2/2C dated 6 May, 1987.

Please find enclosed Progress Report No.4, which is the last of the Interim Hydrology, entitled "Flow Sequences".

Yours faithfully,

M.E. Sole
CHIEF EXECUTIVE

Encl:

AKNOWLEDGEMENTS

This fourth report completes the Interim Hydrology study in which the hydrological data base for the Lesotho Highlands Water Project has been updated to 1986. This has been the first study undertaken by the Lesotho Highlands Development Authority.

Thanks are due to Mr. M. Sole, Chief Executive and Eric Cole for promoting the study, for organising finance for the study and for setting up the necessary technical assistance for Hydraulics Research, Wallingford, UK. The study would not have been possible without Mr. Cole's encouragement and guidance.

We have appreciated the help of WEMMIN throughout the study in providing data and personnel. In particular we would like to thank Mrs Nteso, Mrs Khoboko and Mr. Zozi for their hard work when flow records were being digitised on 24 hr/day basis, as well as Miss Matooane for her help processing the rainfall data.

We are indebted to Hydraulics Research Ltd for assembling an appropriate team to provide technical assistance. The team was led by Dr. Rodney White, Head of the river Engineering Department and Andy Tagg was provided as Senior Hydrologist resident in Maseru. Frank Farquharson and Dr. Chris Green, both of the Institute of Hydrology, Wallingford, UK were responsible for the provision of software and for advice and help with hydrological modelling.

The reports issued during the study have been reviewed by Bruinnette Kruger Stoffberg (B.K.S) and we are grateful for their help and for their useful constructive comments.

Dr. Gerard Chetboun

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1. INTRODUCTION

This fourth and final progress report of the Interim Hydrology studies of the LHDA describes the work that has been undertaken to derive long term monthly flow sequences at the dam sites. As described in earlier progress reports, the water level data for the period October 1983 to September 1986 has been converted to mean daily flows and hence monthly flows. This extension of flow records has been supplemented by a parallel updating of the monthly rainfalls, as described in Progress Report No. 1.

The aims of the study were to utilise these extended data series to review the flow series presented for the four dam sites considered in the feasibility studies by the Lahmeyer Macdonald Consortium (LMC).

The methods employed broadly follow those adopted by LMC in their earlier studies and the Pitman model has been used to provide extended flow series from the long term rainfall series 1930 to 1985. The methods of analysis are briefly described in the following section and the main bulk of this report comprises a series of Annexes of the relevant data.

For the period prior to October 1983, the monthly data presented by LMC in their phase 2B Feasibility Studies report have generally been accepted without change. The exceptions are at station G17, Marakabei, where the river level charts have been redigitised by for the DWA in Pretoria, taking full

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account of all information from watchmen's records. These revised stages have been processed into daily flows using the HYDATA software. In addition, the primary stage data for station DIM09, Oranjedraai, have also been added to HYDATA and converted to daily flows using the modified rating prepared for the DWA in Pretoria by Sigma-Beta ccnsultants.

2. METHOD OF ANALYSIS

2.1 Infilling of Missing Flow Data

The time base adopted for the analyses is one month, which is commonly accepted as being approriate for reservoir studies. For each station, the daily flow data presented in Progress Report No.3 were thus converted to monthly flow volumes in million cubic metres (MCM).

If any month had less than 5 days of missing data, the missing flows were infilled or estimated within the HYDATA software by linear regression using just flows at the station itself. Where any month had more than 5 days of missing daily data, the monthly flow record was infilled by regression against neighbouring stations. Whichever nearby station had the highest overall correlation of monthly flows with the station with missing data, was used to infill the record. However, in some cases, not all missing months could be estimated from just one station as frequently the infilling station was itself incomplete. In such cases, remaining gaps were infilled by regression against the station having the next best correlation.

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2.2 Extension of Flow Sequences to Common Period, 1967-86

In order to compare runoff at various stations, it was necessary to adopt a common base period. In their earlier studies, LMC adopted the period 1967 to 1983. This period has been extended in the present studies to cover period 1967 to 1986.

Linear regression was used to extend short records back to 1967 as necessary using similar methods to those used for infilling missing months as described in Section 2.1 above.

The station chosen for extension was selected on the basis of the inter-station correlation. However, as far as possible, stations were chosen where at least the bulk of the early data were observed rather than being themselves infilled by regression.

2.3 Mass Balance

The earlier LMC studies adopted a mass balance of flows in order to check the internal consistency of the data set above Oranjedraai gauging station. A similar mass balance has been computed for the longer common base period, 1967 to 1985.

Results are presented in Annex 12 and commented on in Section 3.

2.4 Monthly Catchment Rainfall

For catchments upstream of gauging stations, the monthly rainfalls were computed using the same methodology used by LMC using their original computer programs.

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A correlation of monthly flows at gauging stations against monthly rainfall was undertaken to select suitably representative rain gauges for each catchment. The LMC approach was followed, rain gauges having a low correlation with the recorded runoff could be excluded from the analysis, even if they fell within the catchment. Conversely, highly correlated rain gauges outside the catchment were often included in the analysis.

The pattern of long term rainfall in the Lesotho highlands in largely governed by topographic factors, particularly elevation and exposure to the main rain-bearing air masses. The spread of rain gauges however, is believed to provide an inadequate picture of the mean annual precipitation (MAP) and the variability over each catchment. Consequently, for each catchment, the MAP was derived from an isohyetal map prepared by LMC. These LMC MAP estimates have not been changed in the present study as far as estimation of rainfall over the most upstream catchments in each basin is concerned. However, in order to obtain an internally consistent rainfall data set, the catchment rainfall over incremental areas was derived by computation and not by planimetering the isohyetal map as LMC did.

Thus the mean annual precipitation (MAP) over any incremental area is given by :

$$MAP\ inc = (MAP\ T \cdot AT - \sum_{i=1}^{i>N} MAPi.Ai\ ) / A\ inc$$

Where MAP T = Mean annual precipitation over the total catchment

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AT = Area of total catchment (upstream catchments plus incremental area)

MAP i = Mean annual precipitation over subcatchment

Ai = Area of subcatchment

A inc = Area of the incremental area

and N = Number of upstream sub-catchments

For any particular month, t, the precipitation over the incremental area, expressed for input to the Pitman model as a percentage of the MAP over the incremental area, is given by:

$$\left(P_{inc}\right)_t = \left(PT_t \cdot AT - \sum_{i=1}^{i=N} \left(P_i\right)_t A_i \right) / A_{inc}$$

Where $\left(P_{inc}\right)_t$ = Precipitation over the total catchment for month t

$\left(P_i\right)_t$ = Precipitation over the Sub-catchment i for month t.

2.5 Calibration of the Pitman model

The Pitman model is a deterministic catchment model developed by W.V Pitman for modelling of monthly flows from rainfall on catchments in Southern Africa. This model was used, with some modifications, during the feasibility studies by LMC. Figure 2.1 illustrates the original Pitman model structure. The model is governed by the values of a number of parameters.

Input to the model comprises monthly catchment rainfall, expressed as a percentage of the long term catchment MAP, plus monthly evaporation. The rainfall

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is routed through a series of stores representing interception, soil moisture and groundwater, using empirical mathematical relationships developed by Pitman to simulate the physical processes involved. The contribution of each store to the overall catchment rainfall-runoff process can be varied by adjusting the relevant parameter values.

The model can thus be adjusted or optimised so that the generated runoff over some calibration period is in close agreement with the observed flows. This calibration process is undertaken on a trial and error basis as described in the LMC report. The general method used to fit the parameters may be summarised as;

(i) Vary FT and/or ST until the modelled mean annual runoff (MAR) equals the observed MAR.

(ii) Vary ZMIN and ZMAX such that the MAR is unchanged but so that the fit of the seasonal distribution and reservoir storages are improved.

(iii) Repeat steps (i) and (ii) until a best fit is obtained

(iv) Improve the seasonal distribution if possible by changing TL and/or by introducing a groundwater storage. Where LMC had used a ground water store in their previous studies, such storages were generally left in the present model fitting exercise.

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In general, an adequate fit could be obtained fairly and quickly for all catchments and the broad pattern of best-fit parameters shown in Table 2.1 shows that there is an overall regional consistency to the runoff as one would expect. However, as LMC found in their earlier studies, runoff coefficients and parameters in general over catchments G06, Mokhotlong, and G36, Tlokoeng, were unexpectedly high. Thus the rainfall factors utilised by LMC were retained for the present studies so as to maintain the general regional pattern of Pitman parameters. Trials of the Pitman model with RFACT set to unity were nevertheless undertaken, and whilst the model could be fitted to the observed flows perfectly well, the Pitman parameters were very atypical of those on adjacent catchments. There is no reason to believe that the runoff regime of these two catchments is in any way different from the regional pattern. Thus the LMC approach of applying a correction factor to the rainfall and maintaining a regionally consistent set of parameters in the Pitman model was followed.

However, in their studies, LMC had applied a similar rainfall correction factor to the Senqunyane catchment at stations G17 and G32. Perhaps partly because the revised flows at station G17, Marakabei, are somewhat lower than in the LMC 2B studies, this rainfall factor was no longer thought to be necessary. A perfectly good fit to the observed data was achieved at both stations with a rainfall factor of unity and the derived parameter values agree well with those at adjacent stations, as shown in Table 2.1.

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For catchments having gauged sub-catchments upstream, such as Paray, Koma-Koma and Whitehill, the Pitman model was fitted in two ways. The first was to fit the parameters of the model to the total catchment and to ignore all knowledge of the upstream stations. Thus the rainfall over the total catchment was used as input to the model and parameters optimised to obtain agreement between the observed and generated monthly flows.

The second method of fitting these catchments was to fit the Pitman model to the incremental area between the gauging station in question and the upstream gauged areas. Thus, a rainfall file was derived for this incremental area only not for whole catchment. This approach broadly follows that used by LMC, but the incremental catchment rainfalls were derived computationally, as described in Section 2.4, rather than tha MAP being measured from the ishyetal map. A modification to the LMC version of the model was made by Mr. W. Pitman and provided to the LHDA. This modification allowed the flows on the incremental area to be generated using the Pitman model, upstream flows to be added to this, and the resulting total flow to be compared with the total catchment rainfall at the gauging station. This model has been called the Macro-model in this report to show that the whole catchment is being fitted. LMC were only able to fit the flows on these incremental areas to the incremental flows without knowledge of the upstream flows. Consequently, the addition of several upstream flows and the fitted incremental area would often produce a seasonal flow distribution less good than that which can now be obtained from the macro-model. Results for both fitting methods are presented in the Annexes.

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Further explanation of how these alternative fitting methods were applied to estimation of flows at the dam sites is given in Section 2.7. Results of the Pitman fitting for each station are given as Table 3 in the Annexes.

2.6 Generation of Long Term Flow Sequences, 1930-1986

Using the best fit parameters for each gauging station, a long term series of flows for the period October 1930 to September 1967 was produced using the Pitman model. Flows in recent years are either observed or infilled by regression as shown in Table 1 for the period Oct 1967-Sep 1976, of each Annex, and infilled flows from the Pitman model were only used where no other estimate was available. These long term flow sequences are presented as Table 4 in each Annex. The mass balances to Orangedraai are given in Table 2.2. Long term mean flows at the gauging stations are given in Table 2.3 together with LMC 2B Hydrology data.

2.7 Estimation of Flows at the Dam Sites

Immediately upstream of each dam site there is an incremental ungauged catchment. Further upstream there are one or more gauged catchments. The calculation of monthly flow sequences at the dams cosided both the gauged and the ungauged catchments.

The ungauged catchment immediately upstream of each dam forms part of a larger sub-catchment the characteristic of which had been studied at the calibration stage of

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the Pitman model. Is was assumed that the Pitman parameters applicable to the sub-catchments were also applicable to the smaller ungauged catchments upstream of each dam.

The estimation of monthly flow sequences for each dam were thus derived by using Pitman Generated extended flow sequences for both ungauged incremental catchments and the gauged catchments further upstream. The macro version of the Pitman model was used for this.

Monthly flow sequences for Katse, Mohale, Mashai, Tsoelike, Malatsi and Ntoahae are given in Annex 17. Table 2.4 gives a summary of MAR data derived by LHDA and comparative figures from LMC Stage 2A and 2B hydrology.

3. RECOMMENDATIONS

3.1 In using the Pitman model to derive long term flow sequencies for the Mohale Dam site six rain gauges, none of which were within the catchment of the dam. The rain gauges chosen were disposed around the perimeter of the catchment and only those with long continuous records. There are no rain gauges within the catchment.

Recommendation:

Two rainfall stations should be established within the catchment so that cross correlations with existing gauges can be established. This information will help to refine historic records.

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3.2 The Lesotho river gauging station at Marakabei has had many problems historically and yet it provides the key information in terms of establishing the MAR at Mohale Dam Site.

Recommendation:

a) Efforts should be made to improve the rating of this station by further (and more accurate) gaugings and by cross correlations with the crump weir now established at the site.

b) The establishment of a permanent cableway at the Lesotho gauge is required if the ratings are to be improved.

c) A further evalation of the way in which patching of the records is done should be carried out with a view to improving the flow record.

d) LHDA should review the recent digitising of the historic Marakabei charts.

3.3 The Lesotho gauge at Paray, when fully operational has been shown to be in good agreement with the recently constructed crump weir. However, there are periods of the record when the inlet pipe has been blocked and the mass balance figures indicate occassional negative incremental values.

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Recommendation:

The patching of the recod should be checked with a view to minimising the number of occassions when negative incremental flows occur.

3.4 The long term sequences for the Mashai Dam site where derived using the gauged catchments to G08 (Paray), G36 (Tlokoeng) and G6 (Mokhotlong) and the incremental ungauged catchment downstream of these stations. This method was preferred to the use of the loss reliable gauge G05 (Koma-Koma). The incremental ungauged catchment used in the analysis was comparatively large.

Recommendation:

A compound crump weir shold be built just downstream of the proposed Mashai Dam site to provide more accurate data before and after constructions of the dam.

3.5 Gauged flows at Whitehill are known to be unreliable and were not used in the computation of flows to the Tsoelike Dam site.

Recommendation:

Data from the newly constructed weir near Rapase should be used to provide cross correlations with the existing Rapase/Whitehill station. This may help to improve historic records if the development of the shoal on the right bank at the existing Whitehill weir can be established and if

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the influence for this shoal on the calibration of the existing weir can also be established. We are concerned here with a historic rating which will have changed considerably over the years.

3.6 If this becomes necessary to consider the construction of a dam at Malatsi then the current hydrological data is very scant. The only gauges of use are at G17 (Marakabei) and G32 (Nkaus). The former is not of high accuracy and the later was closed in 1983 following a period when the data was not reliable.

Recommendation :

At least one hydrometric station should be built within the catchment of the Malatsi dam site.

3.7 The revised rating curve for the Orangedraai gauging wier produces flow seqences which significantly improve the water balances to Orangedraai. Indicated long term mean flow is now some 14 percent higher than earlier recommendations. There are, however, certain negative incremental flows but not in the more significant middle flow range.

Recommendation:

a) High flow negative incremental flows should be studied with a view to improving (i) the Seaka patching procedure (taking into account the excellent correlation between Seaka annd Orangedraai) and (ii) and the high flow rating of Orangedraai.

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b) Low flow negative incremental flows should be studied to establish the cause. It is possible that it will not be possible to eliminate all negative values because of the relatively high tolerance on low flow measurements at all gauging stations.

TABLE 2.1 BEST FIT PARAMETERS FOR THE PITMAN MODEL

Parameter in Pitman Model	G45 Pelaneng	G41 Bokong	G42 Seshotes	G08 Paray (TOTAL: LMC MODEL)	G081 ParaY (INCREMENTAL_MACRO-MODEL)	G06 Mokhotlong	G36 Tlokoeng	G05 Koma-Koma (TOTAL:LMC -MODEL)	G051 Koma-Koma (INCREMENTAL:MACRO MODEL)	G07 Tsoelike	G04 Whitehill (TOTAL:LMC MODEL)	G041 Whitehill (INCREMENTAL:MACRO-MODEL)	G17 Marakabei	G32 Nkaus (TOTAL: LMC MODEL)	G321 Nkaus (INCREMENTAL: MACRO MODEL)
ST	28	50	53	55	53	80	62	60	58	45	65	184	38	60	55
A1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
ZMIN	45	20	50	61	60	70	60	58	54	50	58	150	60	61	57
ZMAX	450	500	500	450	500	450	500	450	450	450	500	1200	450	500	450
R	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
POW	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
SL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FT	12	4	10	25	19	3	3	4	10	4	4	0	16	8	15
GW	0	0	0	0	0	0	5	5	5	0	5	5	5	0	0
POWG	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
SGL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SG	50	50	0	0	0	0	100	120	120	0	120	50	100	120	120
PG	5	20	0	0	0	0	5	2	2	0	2	2	10	10	10
TL	.25	.5	.5	.25	.25	.75	.5	.5	.25	.25	.25	.5	.25	.25	.25
GL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RFACT	1.0	1.0	1.0	1.0	1.0	0.92	0.91	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Note:- RFACT = Rainfall factor (see LMC report)

Table 2.2 WATER BALANCES TO ORANJEDRAAI
Units are tenths of million cubic metres

ANNUAL TOTALS

	BOK	PEL	SES	PAR	INC PAR	TLO	NOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAS	ORA	INC ORA
1967	693.	2623.	555.	4560.	689.	688.	1059.	7088.	781.	2223.	3823.	1600.	572.	6329.	-1331.	17796.	7644.	2881.	17909.	-2768.
1968	540.	1960.	380.	3320.	440.	536.	876.	5687.	955.	1225.	2845.	1620.	308.	4625.	-1370.	14987.	7517.	2505.	19646.	2134.
1969	513.	1837.	371.	3091.	370.	454.	1230.	5885.	916.	1155.	2639.	1484.	541.	5891.	-535.	15384.	6856.	2562.	12768.	-8180.
1970	1009.	4023.	920.	7163.	1211.	1241.	1828.	11538.	1386.	2418.	5310.	2892.	870.	12512.	184.	26718.	8896.	4072.	30178.	-612.
1971	1037.	3634.	918.	6446.	857.	1605.	3423.	15115.	3441.	3976.	7752.	3778.	1471.	18790.	2204.	33891.	7349.	5055.	43095.	6149.
1972	691.	2262.	524.	4547.	1070.	712.	1441.	7685.	985.	2069.	3254.	1185.	748.	8549.	116.	14668.	2865.	2588.	18983.	827.
1973	1118.	3405.	886.	7027.	1618.	1816.	4561.	17925.	4521.	3090.	6797.	3707.	2489.	23536.	3122.	45302.	14969.	8425.	56206.	2479.
1974	1419.	6252.	1385.	12115.	3059.	2699.	5769.	22282.	1699.	4202.	8321.	4119.	1611.	24627.	734.	40835.	7887.	5549.	50500.	4116.
1975	2144.	9127.	2760.	16850.	2819.	5074.	8505.	40822.	10393.	7396.	17156.	9760.	4140.	49508.	4546.	92257.	25593.	12199.	102308.	-2148.
1976	1428.	6740.	1824.	12436.	2444.	2567.	4624.	25378.	5751.	4754.	11774.	7020.	1614.	26820.	-172.	57358.	18964.	8280.	66112.	274.
1977	1715.	5639.	1532.	11443.	2557.	1743.	3547.	18648.	1915.	5232.	9794.	4562.	1858.	20310.	-196.	44195.	14091.	7677.	48142.	-3730.
1978	1321.	4638.	1319.	9122.	1844.	1280.	2534.	15433.	2477.	3134.	6727.	3593.	1520.	16032.	-921.	33048.	10289.	3763.	35051.	-1760.
1979	867.	3435.	1041.	6585.	1242.	1080.	1863.	11503.	1975.	2144.	3816.	1672.	1226.	12431.	-298.	22459.	6212.	2611.	24748.	-322.
1980	1588.	5577.	1069.	9924.	1690.	1474.	3022.	16851.	2431.	4617.	9095.	4478.	875.	16820.	-906.	38062.	12147.	7419.	42035.	-3446.
1981	862.	2437.	530.	4734.	905.	507.	959.	6715.	515.	2435.	4919.	2464.	606.	6961.	-360.	21116.	9236.	3694.	25642.	832.
1982	536.	2662.	606.	4446.	642.	465.	1058.	6149.	180.	1908.	4164.	2256.	234.	6087.	-296.	13626.	3375.	2832.	19175.	2717.
1983	584.	4026.	747.	6349.	992.	1755.	2334.	10428.	-10.	1548.	4591.	3043.	1530.	11822.	-136.	22931.	6516.	2653.	26490.	906.
1984	554.	2409.	321.	3342.	56.	1051.	2889.	8916.	1634.	1416.	3464.	2048.	1109.	8128.	-1897.	18630.	7038.	2003.	22273.	1640.
1985	745.	3981.	781.	8016.	509.	1769.	2775.	14706.	2146.	1676.	6156.	4480.	2595.	22332.	5031.	33512.	5024.	3858.	37272.	-98.

MONTHLY AVERAGES

	BOK	PEL	SES	PAR	INC PAR	TLO	NOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAS	ORA	INC ORA
OCT	84	429	100	783	169	118	192	1220	127	277	586	310	57	1239	-37	2689	843	402	2935	-156
NOV	141	657	145	1081	138	143	267	1740	249	441	911	470	126	1908	42	3496	676	424	4073	153
DEC	129	574	127	1017	186	159	295	1810	339	276	732	457	180	2034	44	4010	1243	525	4062	-473
JAN	150	557	147	1057	204	284	561	2194	292	450	951	500	271	2689	223	4575	935	645	4521	-699
FEB	131	520	127	951	173	287	712	2556	606	416	880	464	307	3026	163	5376	1448	746	7035	915
MAR	109	499	124	887	154	285	476	2048	401	356	771	415	225	2432	159	4588	1385	707	5386	92
APR	100	360	72	632	99	107	170	1010	101	271	542	271	107	1170	54	2649	956	493	3383	142
MAY	43	136	29	249	61	35	52	393	37	134	282	148	31	368	-56	1192	542	230	1650	228
JUN	27	70	15	140	29	12	25	238	42	75	153	78	15	187	-66	806	466	147	966	13
JUL	13	36	6	68	12	7	14	114	25	44	95	51	9	92	-31	471	284	104	578	3
AUG	38	113	28	218	40	25	25	294	25	118	218	100	13	257	-49	823	347	159	965	-36
SEP	54	189	51	346	52	50	79	526	81	123	320	196	23	497	-53	1255	498	188	1367	-76
YEAR	1019.	4140.	972.	7448.	1317.	1511.	2869.	14143.	2316.	2981.	6442.	3461.	1364.	15901.	392.	31946.	9604.	4770.	36823.	107.
AREA	403.	1157.	652.	3240.	1028.	852.	1660.	7950.	2198.	1087.	3480.	2393.	797.	11000.	2253.	19875.	5395.	3011.	24671.	2077.
MM	253.	358.	149.	230.	128.	177.	173.	178.	105.	274.	185.	145.	171.	145.	17.	161.	178.	158.	149.	5.

Table 2.3 LONG TERM MEAN FLOWS AT GAUGING STATIONS

Station	Name	Area	MAP	LMC $\overline{Q}$ MCM	LHDA $\overline{Q}$ MCM
G45	PELANENG	1157	1013	446.6	464.1
G42	SESHOTES	652	759	107.3	101.8
G41	BOKONG	403	930	120.2	108.1
G36	TLOKOENG	852	924	161.9	153.8
G32	NKAUS	3480	878	787.5	754.2
G17	MARAKABEI	1087	944	405.9	365.8
G08	PARAY	3240	877	836.8	862.7
G07	TSOELIKE	797	791	158.1	149.5
G06	MOKHOTLONG	1660	980	284.8	264.7
G05	KOMA-KOMA	7950	857	1553.0	1561.1
G04	WHITEHILL	11000	824	-	-
G03	SEAKA	19875	796	-	-

TABLE 2.2 MEAN ANNUAL RUNOFF SUMMARY

	AREA	RAIN MAP	RUNOFF		LHDA		RUNOFF		LHC	
							STAGE 2A		STAGE 2B	
	Km2	mm/yr	MCM/yr	m3/s	mm/yr	%	m3/s	%	m3/s	%
KATSE DAM SITE	1860	957	622.6	19.74	335	35.0	20.49	36.3	20.80	36.8
Ungauged catchment upstream of Katse	300	778								
MOHALE DAM SITE	938	944	325.2	10.31	347	36.7	10.44	37.2	11.64	41.5
Ungauged catchment upstream of Mohale	149	944								
MASHAI DAM SITE	7977	857	1565.3	49.64	196	22.9	58.95	27.2	49.75	22.9
Ungauged catchment upstream of Mashai	2225	763								
Catchment from Katse to Mashai	6117	826	942.7	29.89	154	19.6	18.7	24	28.95	18.1
TSOELIKE DAM SITE	10375	830	1971.5	62.52	190	22.9	65.89	24.1	59.96	22.0
Ungauged catchment upstream of Tsoelike	1628	719								
Catchment from Mashai to Tsoelike	2398	740	406.2	12.88	169	22.9	6.94	12.3	10.21	18.1
TOTALS	-	-	2296.7	72.83	-	-	76.33	-	71.60	-
MALATSI DAM	3566	878	773	24.52	217	24.7	25.37	25.6	25.34	25.5
Ungauged catchment from Malatsi	86	848								
Catchment from Malatsi to Mohale	2628	848	448	14.20	170	20.1	14.93	21.1	13.70	19.4
NTOAHAE DAM	11344	830	2133	67.64	188	22.7	70.4	23.6	63.00	21.1
Ungauged catchment upstream to Ntoahae	2597	725								
Catchment from Ntoahae to Tsoelike	969	725	162	5.12	167	23.1	4.51	20.2	3.04	13.6
TOTAL			2906	92.16			95.77		88.34	

ANNEX 1

G03 - SENQU AT SEAKA

TABLE 1

803 : SENGU AT SEAKA : MONTHLY RECORD INFILLED BY REGRESSION

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,2X,12(I5,A),F9.1)

1967	3670	4030*	4030*	11930	7680	14400	13250	23140	7560	5770	4450	5510	1779.6
1968	6460	9080	34330	5830	5210	19990	26290	13790	16360	5410	3610	3510	1498.7
1969	26190	16540	27450	23420	26810	4830	3970	3490	3250	3250	3290	11370	1538.6
1970	51950	23800	31800	40120	35010	20970	31100	12310	4970	4610	5290	5250	2671.8
1971	6240	11090	21210	69050	83130	98990	17240	13790	6640	4210	3730	3590	3389.1
1972	750	1730	807	269	3274	1656	2265	429	162	100M	1926	1292	1466.8
1973	1547	1288	2197	10365	14917	5653	3601	1347	1630M	551	1311	895	4530.2
1974	258	7751M	4655	4049	10037	8780	1527	771	397	832	264	1514	4083.5
1975	3915	8141	9745M	19796M	15508	19778E	6712M	3493M	2558	937	445	1229	9225.7
1976	15543	11544	1187	2545	9446	12260	2350	1102	411	294	150	726	5755.8
1977	4907	3087	1233	10560	4311	2415	12152	1824	451	282	192	2781	4419.5
1978	2710	1314	8887	1864	2433	2767	420	431	393	1468	6041	4312	3304.8
1979	5331	2221	4420	2670	3361	2731	772	271	162	116	104	300	2245.9
1980	1911	1515	3567	7040	6962	4923	1734	1700	2700	423	1886	3701	3806.2
1981	815	1374	4602	1363	1772	2167	5803	1942	478	379	249	173	2111.6
1982	1626	6221M	757	374	686	603	631	806	656	419	581	266	1362.6
1983	1059	1792C	6484	5907C	13630	18050	14060	1124	322	4310	168	1070	2293.1
1984	343	1280	582	1270	8340	4600	1390	317	228	156	82	42	1863.0
1985	905	7080e	11560	3810	3920	1110	764	434	881	232	196	2620	3351.2
AVE.	2689	3496	4010	4575	5374	4588	2669	1192	806	471	823	1255	3194.6
SDV.	3546	3099	3151	4833	4588	4933	2859	826	765	324	1380	1230	
NOBS	19	19	19	19	19	19	19	19	19	19	19	19	

G03 SEAKA - MONTHLY CATCHMENT RAINFALL IN TERMS OF M.A.P. TABLE 2

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,1X,12(I4,A),I8)

1930	89	71	117	201	124	140	121	5	2	71	1	1	943
1931	90	132	116	133	176	109	22	28	7	3	1	45	862
1932	50	132	130	86	121	113	49	18	15	16	5	12	747
1933	33	212	237	257	137	142	65	37	4	43	43	12	1222
1934	118	203	193	120	120	156	81	60	14	3	47	21	1136
1935	74	89	120	134	130	140	33	73	4	10	0	15	822
1936	124	278	138	264	212	136	26	17	3	10	2	11	1221
1937	64	72	147	198	182	49	117	25	50	28	64	36	1032
1938	138	101	197	214	215	90	46	66	5	36	50	52	1210
1939	132	158	118	125	132	139	95	98	16	11	15	127	1166
1940	40	133	187	183	171	82	94	11	3	26	7	57	994
1941	132	24	63	196	159	158	76	27	5	4	58	45	947
1942	109	166	214	168	77	119	143	106	8	57	72	25	1264
1943	195	214	205	130	176	111	19	41	44	5	0	101	1241
1944	88	101	52	112	143	192	31	48	2	1	1	3	774
1945	42	67	102	166	110	133	57	57	3	4	1	24	766
1946	134	116	110	112	134	91	63	20	21	14	5	83	903
1947	111	116	176	166	130	225	63	31	0	5	3	9	1035
1948	80	57	75	159	105	108	53	33	6	9	5	41	731
1949	81	140	165	146	140	210	110	52	9	50	105	32	1240
1950	59	77	178	141	130	104	64	23	19	4	29	42	870
1951	156	27	79	160	167	88	48	19	20	54	42	57	917
1952	56	119	135	115	193	79	96	24	5	0	31	39	892
1953	116	112	134	134	135	134	55	75	15	3	1	29	943
1954	52	104	122	260	203	99	76	40	20	11	4	8	999
1955	83	140	171	106	213	163	58	53	4	7	2	31	1031
1956	102	152	288	186	129	133	63	18	25	33	68	201	1398
1957	202	130	135	235	94	106	104	74	4	1	0	48	1133
1958	65	166	175	115	121	87	114	133	5	65	4	4	1054
1959	118	144	201	134	157	148	91	35	12	11	52	62	1165
1960	109	150	162	156	74	166	99	70	46	13	26	37	1108
1961	18	208	159	130	212	119	78	15	1	1	16	19	976
1962	51	168	107	248	100	193	96	24	29	46	8	10	1080
1963	102	183	139	158	89	188	69	15	50	1	18	51	1063
1964	196	70	138	135	67	58	97	7	63	24	45	23	923
1965	59	117	68	276	128	48	39	30	12	0	22	12	811
1966	60	113	157	310	141	142	125	59	22	9	17	13	1168
1967	89	113	107	69	62	129	64	64	6	16	17	27	763
1968	60	73	136	81	107	175	87	63	7	6	29	23	847
1969	143	60	140	114	82	50	24	17	22	14	52	89	807
1970	100	73	136	186	131	121	84	52	4	28	16	9	940
1971	67	77	125	194	194	166	41	38	14	4	15	34	969
1972	88	126	50	92	164	104	68	15	2	14	89	52	864
1973	38	123	142	250	215	141	58	30	29	8	43	16	1093
1974	53	232	146	194	166	149	60	13	19	22	12	136	1202
1975	69	196	189	273	196	269	89	47	31	2	5	105	1471
1976	186	109	106	190	127	157	60	22	7	0	4	84	1052
1977	155	71	150	214	114	158	115	4	7	4	35	85	1112
1978	85	75	224	71	148	71	34	50	5	72	86	43	964
1979	116	107	140	129	133	76	32	12	4	1	11	106	867
1980	28	138	105	223	177	95	66	31	31	2	87	16	999
1981	47	112	128	119	79	103	130	8	25	24	3	34	812
1982	147	97	56	112	60	87	50	36	20	47	5	25	742
1983	95	162	147	141	75	114	43	50	12	7	59	13	918
1984	99	90	83	130	193	60	36	5	16	1	1	12	726
1985	181	124	202	139	104	86	59	1	48	2	65	44	1055
AVE.	96	124	141	164	139	125	70	38	16	17	27	43	100.0
SDEV	45	51	48	57	43	45	30	27	15	20	28	39	

VALUES IN TENTHS OF A PERCENT OF ANNUAL AVERAGE RAINFALL

ANNEX 2

GOVT SENSE AT WHITEHALL

62 : BENQU AT WHITEHILLS : MONTHLY RECORDS INFILLED BY REGRESSION

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,2X,12(I5,A),F9.1)

TABLE 1

1967	39	1530	1340	420	239	620	627	1040	182	117	55	120	632.9
1968	122	144	1150	205	908	9390	1350	288	225	34	38	40	462.5
1969	1160	768	1210	924	1290	176	57	13	6	2	33	252	589.1
1970	2790	1290	1290	2010	2050	906	1390	486	117	83	54	46	1251.2
1971	90	374	1090	3980	4720	6750	949	525	174	63	36	39	1879.0
1972	304	1230	458	126	2080	1160	1210	161	51	22	969	778	854.9
1973	1270	713	1400	6190	72720	3030	2090	442	483	189	2940	163	2353.6
1974	66	4050	2550	3100	8030	4850	7260	190	60	96	26	883	2462.7
1975	2480	5180	5380	9320	8760	127600	33480	985	583	203	96	4130	4950.8
1976	6550	5980	570	14190	54430	5360	1010	278	93	58	23	36	2682.0
1977	2050	13120	4280	6290	2300	1250	4610	453	162	87	00	13680	2031.0
1978	1450	725	49670	9800	1040	12930	700	1470	1210	449	2520	2270	1603.2
1979	2210	1200	2850	1920	22920	13450	2260	190	37	15	6	311	1243.1
1980	919	774	1490	4530	3360	1720	842	564	589	173	549	1310	1682.0
1981	245	741	2050	423	329	823	1660	509	84	33	19	45	696.1
1982	714	34070	270	1670	405	394	242	253	99	27	55	54	608.7
1983	523	663	2887	4702	599	844	758	399	39	34E	85	289	1182.2
1984	147	550	357	752	4514	1385	286	30	91	12	3	1	812.8
1985	414	5621	6918	3624	2684	605	788	211	358	51	31	1027	2233.2
AVE.	1239	1908	2034	2689	3026	2432	1170	368	187	92	257	497	1590.1
SDV.	1560	1906	1864	2595	2722	3098	1148	287	182	105	599	621	
NOBS	19	19	19	19	19	19	19	19	19	19	19	19	

304 RAPACE \ WHITEHILL - MONTHLY CATCHMENT RAINFALL IN TERMS OF M.A.P.
HYDROLOGICAL YEARS STARTING OCTOBER

TABLE 2

(I4,1X,12(I4,A),I8)

1930	92	67	121	221	132	139	105	4	3	72	1	1	958
1931	72	114	118	129	187	110	26	30	8	2	1	34	831
1932	50	146	143	67	113	116	40	15	11	20	6	11	738
1933	34	214	232	257	144	141	54	38	3	42	41	17	1217
1934	122	198	218	118	128	141	72	42	16	1	37	22	1115
1935	70	83	115	132	135	141	33	80	2	4	0	13	808
1936	112	282	140	245	212	136	23	10	2	5	1	14	1182
1937	69	69	161	210	155	45	112	17	44	31	66	41	1020
1938	130	92	222	222	224	107	38	57	4	27	37	55	1215
1939	107	162	136	134	141	114	80	90	25	6	7	113	1115
1940	52	133	182	216	162	96	83	4	1	21	3	45	998
1941	121	35	61	196	150	131	76	23	3	0	45	45	886
1942	94	162	254	184	65	127	136	81	11	60	74	20	1268
1943	210	211	217	167	177	102	12	31	52	4	1	102	1286
1944	92	101	52	130	168	190	31	32	0	1	2	8	807
1945	46	79	92	176	105	138	49	50	1	4	1	17	758
1946	125	139	103	112	138	113	53	9	35	10	4	68	909
1947	104	132	165	177	147	242	53	31	0	3	2	10	1066
1948	78	57	81	166	113	93	64	19	3	6	7	44	731
1949	78	127	167	158	159	219	73	36	5	41	105	22	1190
1950	55	70	180	125	133	99	58	15	11	2	33	37	818
1951	139	23	79	180	197	102	39	17	17	39	42	47	921
1952	64	117	149	143	189	79	79	21	5	0	26	50	922
1953	113	98	138	144	123	116	48	79	16	1	1	35	912
1954	65	112	124	269	192	102	63	34	20	7	1	10	999
1955	73	138	191	102	224	181	35	49	3	4	3	31	1034
1956	92	166	316	208	134	138	63	14	17	32	59	198	1437
1957	189	113	157	217	100	113	109	56	2	1	0	44	1101
1958	62	170	200	112	117	66	110	158	5	52	8	5	1065
1959	130	145	197	136	161	155	89	33	7	9	39	50	1151
1960	107	153	193	154	88	148	104	60	23	8	19	39	1096
1961	22	196	181	129	191	127	65	18	0	1	25	20	975
1962	61	147	120	255	105	242	82	18	23	43	1	11	1108
1963	118	173	149	213	91	186	70	12	82	1	20	54	1169
1964	211	77	142	146	77	58	78	11	90	26	60	27	1003
1965	69	130	68	260	126	41	36	39	5	0	31	17	822
1966	63	112	188	286	156	160	109	33	31	8	8	12	1166
1967	82	125	143	75	67	123	60	45	3	15	21	35	794
1968	50	82	139	109	115	185	85	65	7	6	20	25	888
1969	143	66	167	118	112	46	25	13	23	8	65	75	861
1970	115	73	107	208	125	115	63	47	5	32	19	9	918
1971	67	80	122	201	190	144	26	31	16	8	14	34	933
1972	83	140	38	92	174	98	54	7	1	10	88	55	840
1973	36	138	140	239	177	161	69	25	29	11	29	18	1072
1974	49	203	158	196	158	137	57	10	5	12	11	121	1117
1975	67	193	211	260	191	300	74	45	18	1	4	82	1446
1976	163	111	124	199	132	154	68	18	6	0	11	71	1057
1977	136	108	155	220	129	134	101	6	7	2	37	77	1112
1978	95	83	229	67	153	86	32	41	4	68	80	37	975
1979	94	117	163	155	123	81	28	10	1	2	6	115	895
1980	33	140	121	238	203	79	71	19	24	3	71	30	1032
1981	46	128	126	128	80	125	86	7	17	17	3	34	797
1982	120	82	52	120	65	86	37	24	8	36	6	21	657
1983	106	159	155	165	95	120	42	46	13	11	48	14	974
1984	91	87	80	145	238	48	27	7	2	1	2	13	741
1985	194	121	201	169	114	79	52	1	50	4	62	44	1091
AVE.	94	125	150	171	143	126	63	33	15	15	25	41	100.0
SDEV	44	49	54	55	42	50	28	28	19	18	27	36	

VALUES IN TENTHS OF A PERCENT OF ANNUAL AVERAGE RAINFALL

TABLE 3A. - PITMAN MODEL FITTED TO TOTAL CATCHMENT

SYNTHESIZED RUNOFF AT GAUGE G04 CATCHMENT AREA= 11000.SQ.KM M.A.P.= 824.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00 %	PI=	1.5 mm/D	%MIN=	50.0 mm/M	ZMAX=	500.0 mm/M	REACT=	1.000
R=	.50	POW=	3.0	SL=	.00 mm	FT=	4.0 mm/M		
GW=	5.0 mm/M	TL=	.50 MTHS	GL=	.00 MTHS	NOFT=	4 PER MTH		
POWG=	2.5	SGL=	.0 mm	SG=	120.0 mm	FG=	2.0 mm/M		

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF OBS	RUNOFF (%MAR) SIM	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	65.0	9.3	7.8	6.6	123.9	104.7	156.0	110.1
NOV	140.0	65.0	11.8	12.0	9.9	190.8	157.3	190.6	122.5
DEC	160.0	65.0	13.8	12.8	11.3	203.4	179.8	186.4	169.0
JAN	150.0	65.0	16.3	16.9	17.7	268.9	282.0	259.5	212.0
FEB	125.0	65.0	13.9	19.0	20.2	302.6	321.8	272.2	271.0
MAR	120.0	65.0	12.1	15.3	16.3	243.2	259.8	309.8	262.9
APR	80.0	65.0	5.6	7.4	8.5	117.0	134.8	114.8	188.6
MAY	70.0	65.0	2.5	2.3	1.5	36.8	23.3	28.7	16.4
JUN	50.0	65.0	1.3	1.2	1.0	18.7	16.1	18.2	4.3
JUL	48.0	65.0	1.3	.6	1.1	9.2	18.1	10.5	15.2
AUG	56.0	65.0	3.1	1.6	2.4	25.7	38.6	59.9	47.6
SEP	96.0	65.0	4.8	3.1	3.5	49.7	55.4	62.1	51.1
YEAR	1203.0					1590.1	1591.6	1080.9	996.1
MEAN AND ST.DEVN. OF LOGS						3.117	3.131	.278	.260

MAXIMUM OBSERVED = 1276.0 MAXIMUM SIMULATED = 1116.0

INITIAL SOIL STORAGE =	23.7	
FINAL SOIL STORAGE =	39.2 mm	
TOTAL RAIN =	14996.8 mm	
TOTAL INTERCEPTION LOSS =	1430.1 mm	9.5 % rain
TOTAL SURFACE RUNOFF =	1444.1 mm	9.6 % rain
TOTAL EVAP FROM SOIL =	10815.7 mm	72.1 % rain
TOTAL INTERFLOW =	1019.7 mm	6.8 % rain
INITIAL G.WATER STORAGE =	106.5 mm	
FINAL G.WATER STORAGE =	94.0 mm	
TOTAL G.WATER RUNOFF =	285.6 mm	1.9 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	88.8	6	APR 1985	SEP 1985
	OBS	131.6	7	MAR 1970	SEP 1970
40.	SIM	438.7	31	APR 1981	OCT 1983
	OBS	385.0	28	JUN 1968	SEP 1970
60.	SIM	1260.2	31	APR 1981	OCT 1983
	OBS	1230.0	33	JAN 1968	SEP 1970
80.	SIM	2318.8	46	APR 1981	JAN 1985
	OBS	2318.1	62	OCT 1967	NOV 1971
90.	SIM	2928.3	46	APR 1981	JAN 1985
	OBS	2990.9	63	OCT 1967	DEC 1971

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	30211.0	30240.9	.1
MEAN ANNUAL RUNOFF	1590.1	1591.6	.1
AVERAGE MONTHLY RUNOFF	132.5	132.6	.1
VARIANCE OF MONTHLY VALUES	38341.7	33382.7	-12.9
RANGE OF RESIDUAL MASS CURVE	7052.1	6222.4	-11.8
MEAN OF RESIDUAL MASS CURVE	-121.3	59.3	-148.8
INDEX OF SEASONAL VARIABILITY	34.4	33.9	-1.3
MEAN DEFICIT FLOW PERIOD(MONTHS)	7.7	6.7	-13.2
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	17	31	82.4

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.849
STUDENTS T VALUE	24.122
REGR[illegible]N COEFFICIENT	.792

TABLE 3A CONTD

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.849
STUDENTS T VALUE	24.122
REGRESSION COEFFICIENT	.792
BASE CONSTANT OF REGRESSION EQUATION	27.706
REGRESSION SUM OF SQUARES	5482082.000
RESIDUAL SUM OF SQUARES	2129179.000
TOTAL SUM OF SQUARES	7611260.000
STANDARD ERROR OF ESTIMATE	97.063
MAXIMUM EQIVALENT CONSTANT ERROR (%)	59.253
RELATIVE ABSOLUTE ERROR(%)	46.297
COEFFICIENT OF DETERMINATION	.720
STANDARD COEFFICIENT OF EFFICIENCY	.713
RESIDUAL MASS CURVE COEFFICIENT	.957
SPECIAL COEFFICIENT OF EFFICIENCY	.607
COEFFICIENT OF PERSISTENCE	1.528
RELATIVE MEAN PERSISTENCE (%)	1.182
DURBIN-WATSON D-STATISTIC	1.950

SIGN TEST

NUMBER OF NEGATIVE RUNS	45
NUMBER OF POSITIVE RUNS	45
EXPECTED NUMBER OF RUNS	111.8
NUMBER OF NEGATIVE RESIDUALS	95
NUMBER OF POSITIVE RESIDUALS	133
STANDARDISED NORMAL VARIATE Z	2.981

RESIDUAL MASS CURVES

	OBSERVED											SIMULATED										
1967	-129.	-108.	-107.	-197.	-306.	-376.	-446.	-475.	-589.	-710.	-837.	-957.	-103.	-130.	-147.	-200.	-314.	-377.	-436.	-547.	-661.	-779.	-897.	-1014.
1968	-1077.	-1196.	-1213.	-1325.	-1449.	-1487.	-1485.	-1588.	-1698.	-1827.	-1956.	-2085.	-1131.	-1242.	-1310.	-1376.	-1467.	-1261.	-1056.	-1142.	-1245.	-1363.	-1481.	-1600.
1969	-2101.	-2157.	-2168.	-2209.	-2212.	-2327.	-2454.	-2585.	-2717.	-2849.	-2978.	-3086.	-1543.	-1485.	-1468.	-1440.	-1530.	-1632.	-1750.	-1870.	-1989.	-2108.	-2180.	-2226.
1970	-2939.	-2943.	-2946.	-2878.	-2803.	-2847.	-2841.	-2924.	-3045.	-3170.	-3297.	-3425.	-2222.	-2241.	-2347.	-2162.	-1934.	-1956.	-2026.	-2136.	-2251.	-2367.	-2483.	-2602.
1971	-3548.	-3643.	-3667.	-3401.	-3062.	-2519.	-2557.	-2637.	-2752.	-2878.	-3007.	-3136.	-2716.	-2825.	-2923.	-2752.	-2302.	-1974.	-1942.	-2081.	-2179.	-2299.	-2418.	-2538.
1972	-3238.	-3247.	-3334.	-3454.	-3378.	-3393.	-3406.	-3523.	-3650.	-3780.	-3816.	-3871.	-2643.	-2640.	-2652.	-2768.	-2672.	-2586.	-2669.	-2787.	-2907.	-3028.	-3024.	-3013.
1973	-3876.	-3937.	-3930.	-3443.	-2849.	-2678.	-2602.	-2690.	-2774.	-2888.	-2991.	-3107.	-3126.	-3159.	-3138.	-2775.	-2219.	-1876.	-1772.	-1884.	-2002.	-2121.	-2238.	-2356.
1974	-3233.	-2961.	-2638.	-2661.	-1990.	-1638.	-1678.	-1811.	-1938.	-2060.	-2190.	-2233.	-2475.	-2257.	-1925.	-1674.	-1368.	-1194.	-1187.	-1303.	-1422.	-1541.	-1660.	-1630.
1975	-2119.	-1734.	-1328.	-529.	215.	1358.	1561.	1527.	1453.	1340.	1217.	1126.	-1593.	-1398.	-898.	-190.	522.	1506.	2186.	2081.	1967.	1849.	1731.	1649.
1976	1649.	2114.	2039.	2048.	2460.	2863.	2832.	2727.	2604.	2477.	2347.	2218.	1852.	2039.	1960.	2128.	2352.	2496.	2573.	2482.	2345.	2227.	2110.	2012.
1977	2291.	2289.	2200.	2696.	2794.	2786.	3115.	3027.	2911.	2787.	2655.	2659.	2085.	2150.	2146.	2484.	2786.	2845.	2906.	2855.	2738.	2621.	2508.	2424.
1978	2672.	2612.	2976.	2941.	2913.	2910.	2784.	2666.	2546.	2458.	2578.	2672.	2362.	2279.	2538.	2792.	2803.	2821.	2711.	2593.	2479.	2426.	2478.	2466.
1979	2761.	2748.	2901.	2960.	3057.	3059.	2949.	2818.	2690.	2539.	2427.	2325.	2373.	2315.	2364.	2479.	2508.	2441.	2330.	2212.	2094.	1976.	1857.	1859.
1980	2285.	2230.	2246.	2567.	2770.	2810.	2761.	2685.	2612.	2496.	2419.	2417.	1862.	1836.	1828.	2150.	2816.	3063.	2958.	2849.	2730.	2611.	2558.	2504.
1981	2309.	2251.	2323.	2233.	2134.	2083.	2117.	2035.	1911.	1782.	1651.	1523.	2386.	2324.	2275.	2189.	2092.	2042.	2006.	1905.	1787.	1667.	1548.	1429.
1982	1462.	1670.	1565.	1449.	1357.	1264.	1156.	1048.	926.	796.	669.	542.	1402.	1380.	1266.	1160.	1055.	944.	831.	711.	591.	475.	360.	239.
1983	462.	396.	532.	889.	817.	769.	712.	619.	491.	362.	238.	134.	156.	258.	425.	546.	571.	512.	446.	330.	213.	93.	-12.	-118.
1984	16.	-61.	-158.	-215.	104.	110.	6.	-124.	-247.	-379.	-511.	-643.	-218.	-310.	-420.	-480.	-45.	332.	212.	92.	-29.	-150.	-272.	-393.
1985	-734.	-305.	295.	485.	620.	548.	495.	383.	287.	159.	30.	0.	-143.	159.	336.	456.	707.	610.	496.	378.	268.	158.	78.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	42.5	85.1	127.6	170.1	212.7	255.2	297.7	340.3	382.8
OBSERVED %TIME	100.0	55.3	39.9	29.8	21.9	18.4	15.4	13.6	11.8	11.0
SIMULATED %TIME	100.0	51.3	38.2	32.9	24.6	20.2	17.5	17.1	12.3	10.1
ERROR	.0	-3.9	-1.8	3.1	2.6	1.8	2.2	3.5	.4	-.9

MONTHLY DISCHARGE	425.3	467.9	510.4	552.9	595.5	638.0	680.5	723.1	765.6	808.1
OBSERVED %TIME	10.1	8.8	7.0	5.3	4.8	3.5	2.6	2.2	1.8	1.3
SIMULATED %TIME	8.8	5.7	3.9	3.9	3.1	2.6	2.6	2.2	2.2	1.8
ERROR	-1.3	-3.1	-3.1	-1.3	-1.8	-.9	.0	.0	.4	.4

MONTHLY DISCHARGE	850.7	893.2	935.7	978.3	1020.8	1063.3	1105.9	1148.4	1190.9	1233.5
OBSERVED %TIME	1.3	.9	.4	.4	.4	.4	.4	.4	.4	.4
SIMULATED %TIME	.4	.4	.4	.4	.4	.4	.4	.0	.0	.0
ERROR	-.9	-.4	.0	.0	.0	.0	.0	-.4	-.4	-.4

OBSERVED MAXIMUM MONTHLY VALUE	1276.000
SIMULATED MAXIMUM MONTHLY VALUE	1115.962

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.5923	.7073
2	.2889	.3186
3	.1373	.0995
4	-.0348	-.1042
5	-.1722	-.2215
6	-.2336	-.2344
7	-.1523	-.1721
8	-.0093	-.0942
9	.0750	.0307
10	.2255	.1867
	.3948	.3121

TABLE 38 :- PITMAN MODEL FITTED TO INCREMENTAL CATCHMENT

SYNTHESIZED RUNOFF AT GAUGE G04 (INC) CATCHMENT AREA= 2253.SQ.KM M.A.P.= 719.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00 %	PI=	1.5 mm/D	ZMIN=	150.0 mm/M	ZMAX=	1200.0 mm/M	RFACT=	1.000		
R=	.50	POW=	3.0	SL=	.00 mm	FT=	.0 mm/M				
GW=	5.0 mm/M	TL=	.25 MTHS	GL=	.00 MTHS	NOFT=	4 PER MTH				
POWG=	2.5	SGL=	.0 mm	SG=	50.0 mm	FG=	2.0 mm/M				

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF (%MAR) OBS	RUNOFF (%MAR) SIM	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	184.0	8.4	7.8	8.1	123.9	129.5	156.0	158.7
NOV	140.0	184.0	10.2	12.0	11.2	190.8	178.3	190.6	173.9
DEC	160.0	184.0	13.9	12.8	12.5	203.4	198.6	186.4	162.0
JAN	150.0	184.0	16.7	16.8	16.2	268.0	257.8	250.5	210.0
FEB	125.0	184.0	14.4	19.0	19.3	302.6	307.6	272.2	246.0
MAR	120.0	184.0	11.3	15.3	15.6	243.2	248.7	309.8	302.6
APR	80.0	184.0	5.3	7.4	7.2	117.0	115.0	114.8	117.1
MAY	70.0	184.0	2.9	2.3	2.3	36.8	36.6	28.7	24.5
JUN	50.0	184.0	2.1	1.2	1.5	18.7	23.6	18.2	24.9
JUL	48.0	184.0	1.8	.6	.7	9.2	11.0	10.5	12.5
AUG	56.0	184.0	3.4	1.6	1.9	25.7	30.1	59.9	65.3
SEP	96.0	184.0	4.3	3.1	3.4	49.7	53.9	62.1	64.0
YEAR	1203.0					1590.1	1590.7	1080.9	994.1
MEAN AND ST.DEVN. OF LOGS						3.117	3.117	.278	.302

MAXIMUM OBSERVED = 1276.0 MAXIMUM SIMULATED = 1279.2

INITIAL SOIL STORAGE =	82.7	
FINAL SOIL STORAGE =	136.5 mm	
TOTAL RAIN =	12807.5 mm	
TOTAL INTERCEPTION LOSS =	1237.5 mm	9.7 % rain
TOTAL SURFACE RUNOFF =	80.4 mm	.6 % rain
TOTAL EVAP FROM SOIL =	10778.8 mm	84.2 % rain
TOTAL INTERFLOW =	657.4 mm	5.1 % rain
INITIAL G.WATER STORAGE =	32.7 mm	
FINAL G.WATER STORAGE =	8.0 mm	
TOTAL G.WATER RUNOFF =	24.7 mm	.2 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	186.9	8	FEB 1986	SEP 1986
	OBS	131.6	7	MAR 1970	SEP 1970
40.	SIM	531.2	18	APR 1985	SEP 1986
	OBS	385.0	28	JUN 1968	SEP 1970
60.	SIM	1010.4	19	MAR 1985	SEP 1986
	OBS	1230.0	33	JAN 1968	SEP 1970
80.	SIM	1988.2	65	MAY 1981	SEP 1986
	OBS	2318.1	62	OCT 1967	NOV 1971
90.	SIM	2985.8	78	APR 1980	SEP 1986
	OBS	2990.9	63	OCT 1967	DEC 1971

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	30211.0	30222.9	.0
MEAN ANNUAL RUNOFF	1590.1	1590.7	.0
AVERAGE MONTHLY RUNOFF	132.5	132.6	.0
VARIANCE OF MONTHLY VALUES	38341.7	34020.2	-11.3
RANGE OF RESIDUAL MASS CURVE	7052.1	6793.7	-3.7
MEAN OF RESIDUAL MASS CURVE	-121.3	1094.7	-1002.1
INDEX OF SEASONAL VARIABILITY	34.4	33.2	-3.4
MEAN DEFICIT FLOW PERIOD(MONTHS)	7.7	6.9	-10.5
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	17	20	17.6

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.478
STUDENTS T VALUE	8.191
REGRESSION COEFFICIENT	.451

TABLE 3B CONTD

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.479
STUDENTS T VALUE	8.191
REGRESSION COEFFICIENT	.451
BASE CONSTANT OF REGRESSION EQUATION	72.839
REGRESSION SUM OF SQUARES	1775617.000
RESIDUAL SUM OF SQUARES	5980986.000
TOTAL SUM OF SQUARES	7756603.000
STANDARD ERROR OF ESTIMATE	162.679
MAXIMUM EQIVALENT CONSTANT ERROR (%)	109.848
RELATIVE ABSOLUTE ERROR(%)	88.463
COEFFICIENT OF DETERMINATION	.229
STANDARD COEFFICIENT OF EFFICIENCY	.014
RESIDUAL MASS CURVE COEFFICIENT	.578
SPECIAL COEFFICIENT OF EFFICIENCY	-.350
COEFFICIENT OF PERSISTENCE	3.026
RELATIVE MEAN PERSISTENCE (%)	3.428
DURBIN-WATSON D-STATISTIC	1.395

SIGN TEST

NUMBER OF NEGATIVE RUNS	36
NUMBER OF POSITIVE RUNS	36
EXPECTED NUMBER OF RUNS	114.1
NUMBER OF NEGATIVE RESIDUALS	104
NUMBER OF POSITIVE RESIDUALS	124
STANDARDISED NORMAL VARIATE Z	5.635

RESIDUAL MASS CURVES

	OBSERVED											SIMULATED										
1967	-129.	-108.	-107.	-197.	-306.	-376.	-446.	-473.	-589.	-710.	-837.	-937.	-114.	-213.	-150.	-256.	-376.	-418.	-426.	-504.	-568.	-688.	-816.	-946.
1968	-1077.	-1196.	-1213.	-1325.	-1449.	-1487.	-1485.	-1588.	-1698.	-1827.	-1956.	-2083.	-956.	-1017.	-1018.	-1040.	-1039.	-983.	-1034.	-1157.	-1287.	-1418.	-1549.	-1639.
1969	-2101.	-2157.	-2168.	-2209.	-2212.	-2327.	-2454.	-2585.	-2717.	-2849.	-2978.	-3086.	-1506.	-1527.	-1514.	-1449.	-1401.	-1439.	-1427.	-1508.	-1630.	-1753.	-1867.	-1985.
1970	-2939.	-2943.	-2946.	-2878.	-2805.	-2847.	-2841.	-2924.	-3045.	-3170.	-3297.	-3425.	-2098.	-2185.	-2210.	-1986.	-1677.	-1290.	-1346.	-1424.	-1537.	-1663.	-1792.	-1921.
1971	-3548.	-3643.	-3667.	-3401.	-3062.	-2519.	-2557.	-2637.	-2752.	-2878.	-3007.	-3136.	-2021.	-2026.	-2120.	-2239.	-2104.	-2100.	-2123.	-2238.	-2365.	-2493.	-2521.	-2573.
1972	-3238.	-3247.	-3334.	-3454.	-3378.	-3395.	-3406.	-3523.	-3650.	-3780.	-3816.	-3871.	-2569.	-2621.	-2603.	-2238.	-1720.	-1622.	-1632.	-1716.	-1797.	-1910.	-2019.	-2129.
1973	-3876.	-3937.	-3930.	-3443.	-2849.	-2678.	-2602.	-2690.	-2774.	-2888.	-2991.	-3107.	-2252.	-1989.	-1909.	-1652.	-1053.	-777.	-836.	-937.	-1053.	-1171.	-1297.	-1336.
1974	-3233.	-2961.	-2838.	-2661.	-1990.	-1638.	-1698.	-1811.	-1938.	-2060.	-2190.	-2235.	-1266.	-918.	-621.	13.	669.	1815.	1984.	1947.	1895.	1781.	1631.	1539.
1975	-2119.	-1734.	-1328.	-529.	215.	1358.	1561.	1527.	1453.	1340.	1217.	1126.	2117.	2608.	2633.	2737.	3185.	3747.	3768.	3662.	3538.	3412.	3283.	3163.
1976	1649.	2114.	2039.	2048.	2460.	2863.	2832.	2727.	2604.	2477.	2347.	2218.	3265.	3254.	3170.	3630.	3692.	3695.	4061.	3989.	3870.	3747.	3621.	3616.
1977	2291.	2289.	2200.	2696.	2794.	2786.	3115.	3027.	2911.	2787.	2655.	2659.	3631.	3599.	3959.	3928.	3906.	3916.	3797.	3687.	3574.	3499.	3845.	3759.
1978	2672.	2612.	2976.	2941.	2913.	2910.	2784.	2666.	2546.	2438.	2578.	2672.	3847.	3843.	4015.	4052.	4168.	4172.	4066.	3943.	3817.	3691.	3562.	3480.
1979	2761.	2748.	2901.	2960.	3057.	3059.	2949.	2819.	2690.	2559.	2427.	2325.	3433.	3408.	3433.	3822.	3979.	4023.	3986.	3914.	3849.	3726.	3649.	3654.
1980	2285.	2230.	2246.	2567.	2770.	2810.	2761.	2685.	2612.	2496.	2419.	2417.	3345.	3496.	3577.	3572.	3669.	3663.	3714.	3640.	3517.	3391.	3264.	3136.
1981	2309.	2251.	2323.	2733.	2134.	2083.	2117.	2035.	1911.	1782.	1651.	1523.	3085.	3263.	3161.	3055.	2964.	2877.	2772.	2669.	2549.	2422.	2299.	2175.
1982	1462.	1670.	1563.	1449.	1357.	1264.	1156.	1048.	926.	796.	669.	542.	2110.	2054.	2215.	2507.	2461.	2400.	2339.	2242.	2119.	1993.	1867.	1772.
1983	462.	396.	352.	889.	817.	769.	712.	619.	491.	362.	239.	134.	1863.	1800.	1512.	1473.	1893.	1912.	1807.	1683.	1557.	1430.	1304.	1174.
1984	16.	-61.	-158.	-215.	104.	110.	6.	-124.	-247.	-379.	-511.	-643.	1073.	1342.	1807.	1848.	2018.	1963.	1882.	1768.	1678.	1553.	1446.	1408.
1985	-734.	-305.	255.	485.	620.	548.	493.	383.	287.	159.	30.	0.	1329.	1209.	1094.	1035.	925.	793.	660.	528.	396.	264.	132.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	42.5	85.1	127.6	170.1	212.7	255.2	297.7	340.3	382.8
OBSERVED %TIME	100.0	55.3	39.9	29.8	21.9	18.4	15.4	13.6	11.8	11.0
SIMULATED %TIME	100.0	58.3	42.5	31.1	23.2	19.3	15.4	13.2	11.4	11.0
ERROR	.0	3.1	2.6	1.3	1.3	.9	.0	-.4	-.4	.0
MONTHLY DISCHARGE	425.3	467.9	510.4	552.9	595.5	638.0	680.5	723.1	765.6	808.1
OBSERVED %TIME	10.1	8.8	7.0	5.3	4.8	3.5	2.6	2.2	1.8	1.3
SIMULATED %TIME	8.8	7.9	6.1	5.3	3.9	3.1	2.6	1.8	1.3	.4
ERROR	-1.3	-.9	-.9	.0	-.9	-.4	.0	-.4	-.4	-.9
MONTHLY DISCHARGE	850.7	893.2	935.7	978.3	1020.8	1063.3	1105.9	1148.4	1190.9	1233.5
OBSERVED %TIME	1.3	.9	.4	.4	.4	.4	.4	.4	.4	.4
SIMULATED %TIME	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4
ERROR	-.9	-.4	.0	.0	.0	.0	.0	.0	.0	.0

OBSERVED MAXIMUM MONTHLY VALUE	1276.000
SIMULATED MAXIMUM MONTHLY VALUE	1279.172

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.5923	.5544
2	.2889	.2675
3	.1373	.1324
4	-.0348	-.0258
5	-.1722	-.1679
6	-.2336	-.2377
7	-.1523	-.1452
8	-.0093	-.0054
9	.0750	.0844
10	.2255	.2281
11	.3948	.4008

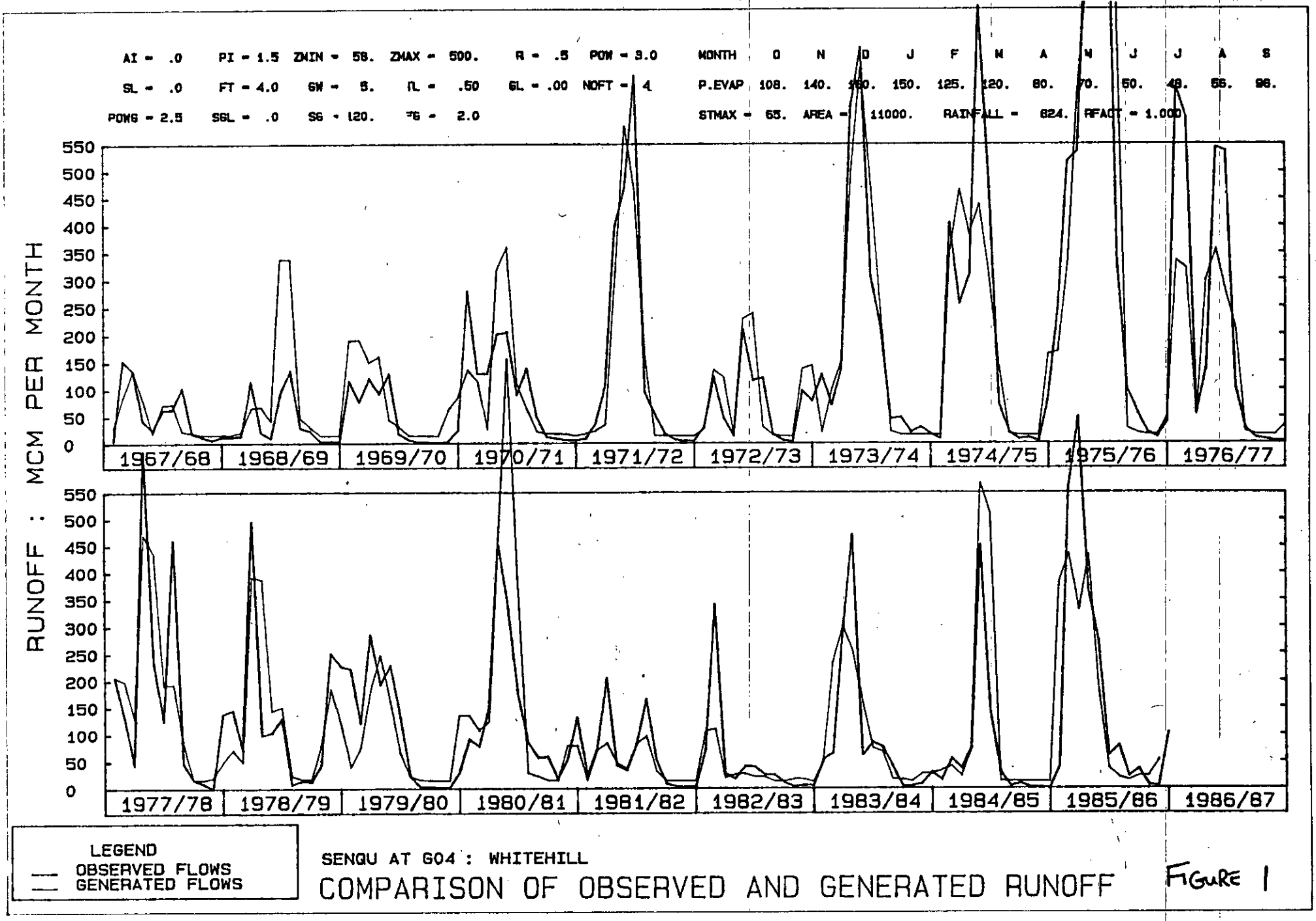
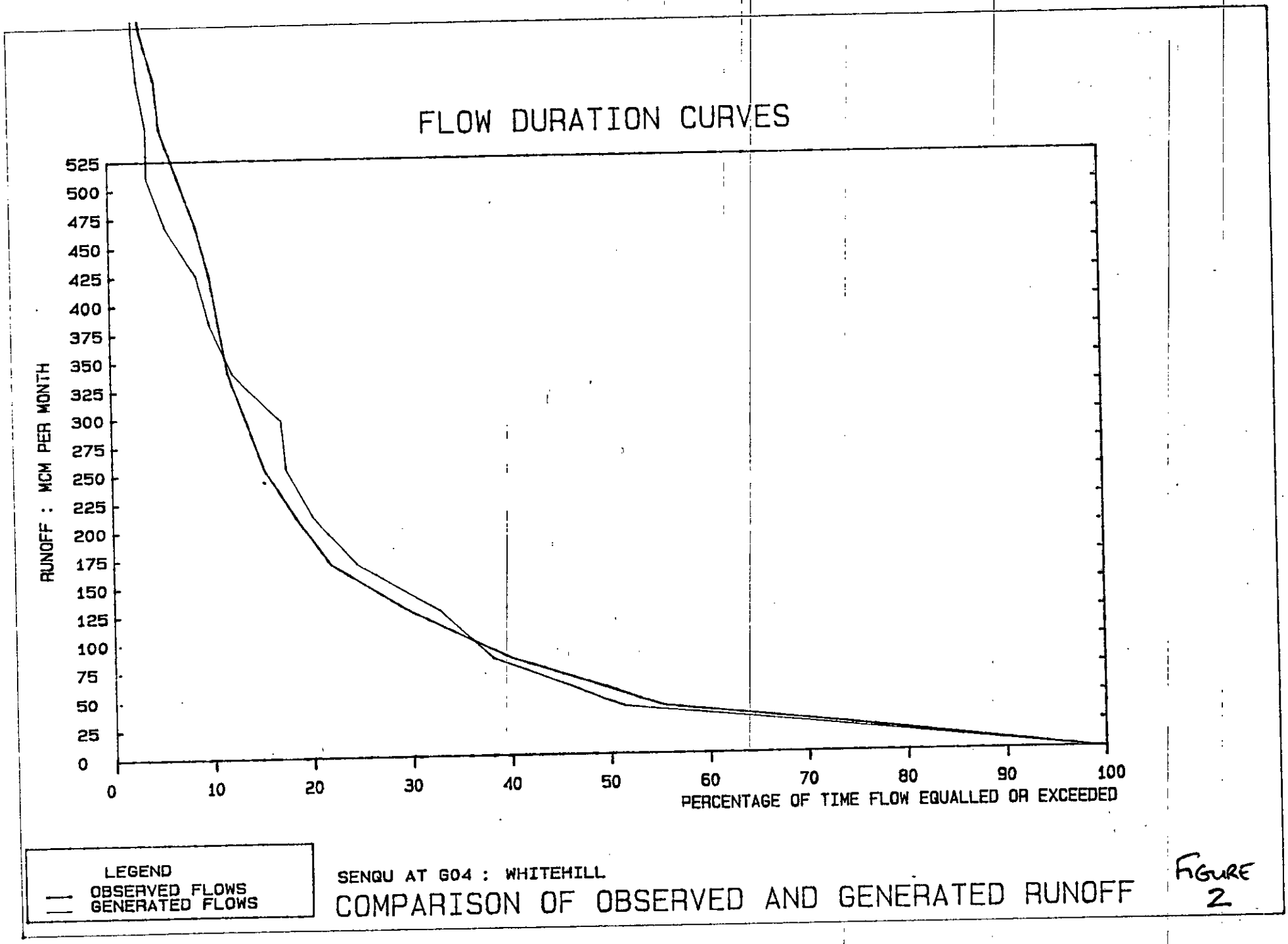

AI = .0 PI = 1.5 ZMIN = 58. ZMAX = 500. R = .5 POW = 3.0
SL = .0 FT = 4.0 GW = 5. RL = .50 GL = .00 NOFT = 4
POWS = 2.5 SGL = .0 SG = 120. PG = 2.0
MONTH O N D J F M A M J J A S
P.EVAP 108. 140. 150. 150. 125. 120. 80. 70. 50. 40. 55. 96.
STMAX = 65. AREA = 11000. RAINFALL = 824. RFACT = 1.000
RUNOFF : MCM PER MONTH
550
500
450
400
350
300
250
200
150
100
50
0
1967/68
1968/69
1969/70
1970/71
1971/72
1972/73
1973/74
1974/75
1975/76
1976/77
1977/78
1978/79
1979/80
1980/81
1981/82
1982/83
1983/84
1984/85
1985/86
1986/87
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
SENQU AT G04 : WHITEHILL
COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 1

ANNEX 3

GCS - SENGUN AT KOMA-KOMA



SENQU AT G04 : WHITEHILL

COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 2

TABLE 1

705 KOMA-KOMA (TOTAL) - OBSERVED AND MODIFIED PITMAN MOD INFILLED BY REGRESSION
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

1967	348	18618	18618	4468	234	569	512	1005	228	139	73	126	708.8
1968	173	3048	15638	1428	1118	848	1162	539	6678	1218	31	26	568.7
1969	1157	676	1220	1019	1188	928	49	25	13	13	158	418	588.5
1970	2442	1038	1437M	1852	1597	897M	1402	465	99	81M	115	113	1153.8
1971	162	404	909	3295	3997M	4788M	711M	539	182	61	37	30	1511.5
1972	288	1190M	340M	91M	1716M	1063	887	158	54	28	1064M	806	768.5
1973	1342	753	1358	4398	5850M	1886	948	361M	438M	186M	202	203M	1792.5
1974	88	3802M	1899	3552M	6809	3853	692	312	160M	149	53	913	2228.2
1975	1996	4609	3718	6676M	7123	11601	2798	905M	781M	179	68	368	4082.2
1976	6619	5990	547	1327M	4796M	4606	904	255	92	68	49M	125	2537.8
1977	2289	1072	386	5377	1775M	1188M	4528	528M	135	88	71	1211	1864.8
1978	1394M	626M	4329	933	788M	1121M	122	216	191	566M	2734M	2413	1543.3
1979	2184	1212M	2524	1188	2233M	1193M	237	92	67	48	36	489M	1150.3
1980	795M	1053M	1480M	5109	2558	1675	946	597	667	97	562	1312	1685.1
1981	221	786	2023	377	235	555	1714	567	91	64	40	42	671.5
1982	816	2981	307	253	399	444	276	293	125	66	98M	91M	614.9
1983	642	734	2650M	3643C	531e	751	552	358	82	66	59	360	1042.8
1984	228	657	437	827	4840	13558	275	82	65	63	49	38	891.6
1985	302	3310	5410	1190	1790	431	480	173	394	86	222	9188	1470.6
AVE.	1220	1740	1810	2194	2556	2048	1010	393	238	114	294	526	1414.5
SDV.	1539	1613	1411	2044	2304	2691	1070	266	235	119	642	617	
NOBS	19	19	19	19	19	19	19	19	19	19	19	19	

G05 KOMA KOMA - MONTHLY CATCHMENT RAINFALL IN TERMS OF M.A.P. TABLE 2

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,1X,12(I4,A),I8)

1930	91	73	129	224	126	133	101	4	1	52	1	1	936
1931	70	114	120	135	186	118	26	31	5	1	1	33	840
1932	52	154	132	74	134	122	41	17	12	20	4	14	776
1933	42	203	241	262	156	141	62	38	4	47	46	13	1255
1934	104	219	209	124	126	150	74	44	12	1	29	24	1116
1935	74	83	121	133	130	150	26	67	2	4	0	13	803
1936	121	282	141	276	215	137	29	5	1	4	1	10	1222
1937	85	75	151	218	168	46	118	20	47	33	73	40	1074
1938	138	87	215	211	234	111	50	60	5	32	42	52	1237
1939	113	173	137	144	140	122	82	99	28	8	3	109	1158
1940	45	145	194	200	163	87	90	6	1	21	4	53	1009
1941	130	33	63	196	154	153	75	25	5	0	49	42	925
1942	97	169	202	184	72	131	134	83	10	69	68	24	1243
1943	229	188	198	155	190	102	13	35	47	6	1	106	1270
1944	99	103	59	115	166	207	34	36	1	0	1	5	826
1945	45	58	95	167	115	139	48	46	1	4	0	16	734
1946	145	141	102	122	136	122	57	9	21	11	5	71	942
1947	109	134	171	176	125	247	62	24	0	4	3	13	1068
1948	77	64	76	178	111	102	58	19	4	6	7	49	751
1949	81	129	169	161	143	223	75	41	4	42	95	25	1188
1950	61	72	176	129	137	90	58	21	10	2	32	31	819
1951	144	29	101	172	184	110	39	14	9	41	41	43	927
1952	62	124	154	132	190	77	92	19	6	0	30	36	922
1953	110	109	142	155	129	110	37	66	14	1	1	29	903
1954	67	122	128	248	195	97	62	37	18	8	1	10	993
1955	76	138	180	108	211	158	32	46	1	5	4	31	990
1956	102	169	314	200	129	138	64	19	23	34	61	197	1450
1957	196	115	139	230	100	111	100	48	3	0	0	56	1098
1958	64	159	161	112	109	75	98	157	7	51	5	6	1004
1959	133	146	189	132	168	141	88	27	4	9	43	62	1142
1960	99	147	173	179	80	142	101	62	22	11	17	50	1083
1961	25	191	157	145	189	117	75	17	0	1	21	21	959
1962	51	142	114	248	104	184	75	18	27	35	1	11	1010
1963	101	167	136	221	83	186	66	10	52	1	20	56	1099
1964	198	89	145	147	68	59	76	10	71	21	46	29	959
1965	56	124	80	264	121	40	30	32	7	0	27	19	800
1966	67	113	181	302	162	152	101	37	15	7	12	15	1164
1967	82	115	127	74	81	123	53	50	4	10	22	22	763
1968	52	91	139	105	96	159	76	70	8	6	13	24	839
1969	139	71	192	114	98	60	28	13	19	12	54	79	879
1970	112	77	129	203	127	115	68	51	4	25	19	11	941
1971	72	81	120	194	180	157	31	36	6	6	16	40	939
1972	87	151	45	108	173	108	64	9	1	12	93	59	910
1973	43	139	149	245	192	158	71	17	31	12	27	19	1103
1974	47	232	153	222	179	145	51	10	5	16	11	143	1214
1975	73	207	186	262	191	293	76	44	19	1	5	81	1438
1976	164	134	118	201	126	164	62	15	3	0	7	74	1068
1977	146	80	150	235	124	130	100	4	5	2	36	79	1091
1978	105	79	224	77	147	86	31	45	4	63	86	47	994
1979	103	128	150	149	129	92	30	10	1	1	7	124	924
1980	37	142	122	229	178	83	72	14	24	2	67	21	991
1981	41	132	130	118	73	116	97	8	13	15	3	32	778
1982	134	83	55	125	70	84	36	22	9	38	7	18	681
1983	109	158	160	158	104	133	41	36	11	7	49	12	978
1984	95	87	84	140	225	43	23	5	2	1	2	14	721
1985	176	131	196	146	110	83	66	2	41	1	60	37	1049
AVE.	96	127	147	173	142	126	63	32	13	15	25	42	100.0
SDEV	44	50	49	56	42	48	27	27	15	18	27	37	

VALUES IN TENTHS OF A PERCENT OF ANNUAL AVERAGE RAINFALL

SYNTHESIZED RUNOFF AT GAUGE G05 CATCHMENT AREA= 7950.SQ.KM. M.A.P.= 857.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00	%	PI=	1.5	mm/D	ZMIN=	58.0	mm/M	ZMAX=	450.0	mm/M
R=	.50		POW=	3.0		SL=	.00	mm	FT=	4.0	mm/M
GW=	5.0	mm/M	TL=	.25	MTHS	GL=	.00	MTHS	NOFT=	4	PER MTH
POWG=	2.5		SGL=	.0	mm	SG=	120.0	mm	FG=	2.0	mm/M

RFACT= 1.000

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF OBS	(%MAR) SIM	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	60.0	9.6	8.6	8.7	122.0	122.8	153.9	121.9
NOV	140.0	60.0	12.2	12.3	11.7	174.0	165.4	161.3	146.1
DEC	160.0	60.0	13.8	12.8	12.2	181.0	172.3	141.1	142.2
JAN	150.0	60.0	16.3	15.5	19.2	219.4	271.9	204.4	222.1
FEB	125.0	60.0	13.7	18.1	17.7	255.6	249.8	230.4	213.4
MAR	120.0	60.0	12.3	14.5	15.0	204.8	212.5	269.1	230.7
APR	80.0	60.0	5.7	7.1	5.2	101.0	73.8	107.0	75.1
MAY	70.0	60.0	2.4	2.8	1.3	39.3	18.5	26.6	11.8
JUN	50.0	60.0	1.1	1.7	.8	23.8	11.9	23.5	3.0
JUL	48.0	60.0	1.2	.8	1.1	11.4	15.0	11.9	17.8
AUG	56.0	60.0	3.1	2.1	3.0	29.4	41.8	64.2	61.6
SEP	96.0	60.0	4.9	3.7	4.2	52.6	58.8	61.7	81.3
YEAR	1203.0					1414.5	1414.5	867.4	819.1
MEAN AND ST.DEVN. OF LOGS						3.085	3.087	.240	.245

MAXIMUM OBSERVED = 1160.1 MAXIMUM SIMULATED = 1028.0

INITIAL SOIL STORAGE =	23.2		
FINAL SOIL STORAGE =	33.7	mm	
TOTAL RAIN =	15684.0	mm	
TOTAL INTERCEPTION LOSS =	1469.2	mm	9.4 % rain
TOTAL SURFACE RUNOFF =	2064.6	mm	13.2 % rain
TOTAL EVAP FROM SOIL =	10836.6	mm	69.1 % rain
TOTAL INTERFLOW =	1023.4	mm	6.5 % rain
INITIAL G.WATER STORAGE =	106.3	mm	
FINAL G.WATER STORAGE =	94.6	mm	
TOTAL G.WATER RUNOFF =	292.6	mm	1.9 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	89.4	6	APR 1985	SEP 1985
	OBS	120.7	6	MAR 1970	AUG 1970
40.	SIM	305.1	10	DEC 1982	SEP 1983
	OBS	267.5	7	MAR 1970	SEP 1970
60.	SIM	906.5	30	APR 1981	SEP 1983
	OBS	843.5	33	JAN 1968	SEP 1970
80.	SIM	1704.2	46	APR 1981	JAN 1985
	OBS	1734.7	48	JAN 1968	DEC 1971
90.	SIM	2283.2	54	APR 1981	SEP 1985
	OBS	2398.5	71	JAN 1968	NOV 1973

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	26875.4	26875.3	.0
MEAN ANNUAL RUNOFF	1414.5	1414.5	.0
AVERAGE MONTHLY RUNOFF	117.9	117.9	.0
VARIANCE OF MONTHLY VALUES	27238.4	25634.6	-5.9
RANGE OF RESIDUAL MASS CURVE	5934.2	5739.8	-3.3
MEAN OF RESIDUAL MASS CURVE	31.9	198.5	522.6
INDEX OF SEASONAL VARIABILITY	31.8	34.5	8.4
MEAN DEFICIT FLOW PERIOD(MONTHS)	6.7	7.0	5.2
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	12	18	50.0

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.868
STUDENTS T VALUE	26.219
REGRESSION COEFFICIENT	.842
BASE CONSTANT OF REGRESSION EQUATION	18.672

TABLE 3A CONTD

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.868
STUDENTS T VALUE	26.219
REGRESSION COEFFICIENT	.842
BASE CONSTANT OF REGRESSION EQUATION	18.672
REGRESSION SUM OF SQUARES	4398586.000
RESIDUAL SUM OF SQUARES	1446110.000
TOTAL SUM OF SQUARES	5844696.000
STANDARD ERROR OF ESTIMATE	79.992
MAXIMUM EQIVALENT CONSTANT ERROR (%)	54.213
RELATIVE ABSOLUTE ERROR(%)	43.563
COEFFICIENT OF DETERMINATION	.753
STANDARD COEFFICIENT OF EFFICIENCY	.742
RESIDUAL MASS CURVE COEFFICIENT	.956
SPECIAL COEFFICIENT OF EFFICIENCY	.655
COEFFICIENT OF PERSISTENCE	1.459
RELATIVE MEAN PERSISTENCE (%)	1.141
DURBIN-WATSON D-STATISTIC	1.917

SIGN TEST

NUMBER OF NEGATIVE RUNS	47
NUMBER OF POSITIVE RUNS	47
EXPECTED NUMBER OF RUNS	114.4
NUMBER OF NEGATIVE RESIDUALS	106
NUMBER OF POSITIVE RESIDUALS	122
STANDARDISED NORMAL VARIATE Z	2.727

RESIDUAL MASS CURVES

	OBSERVED											SIMULATED										
1967	-114.	-46.	22.	-81.	-146.	-207.	-273.	-291.	-386.	-490.	-600.	-706.	-85.	-129.	-175.	-265.	-365.	-374.	-443.	-843.	-847.	-754.	-861.	-968.
1968	-806.	-894.	-855.	-959.	-1066.	-1099.	-1101.	-1164.	-1216.	-1321.	-1436.	-1551.	-1073.	-1164.	-1184.	-1252.	-1343.	-1190.	-1196.	-1265.	-1361.	-1468.	-1576.	-1684.
1969	-1554.	-1604.	-1600.	-1616.	-1615.	-1724.	-1837.	-1952.	-2068.	-2185.	-2301.	-2377.	-1577.	-1609.	-1419.	-1410.	-1497.	-1598.	-1705.	-1813.	-1922.	-2030.	-2100.	-2153.
1970	-2251.	-2265.	-2239.	-2172.	-2130.	-2158.	-2136.	-2207.	-2318.	-2425.	-2532.	-2638.	-2129.	-2190.	-2251.	-1985.	-1881.	-1883.	-1935.	-2050.	-2155.	-2261.	-2368.	-2476.
1971	-2740.	-2817.	-2844.	-2833.	-2351.	-1990.	-2037.	-2101.	-2200.	-2312.	-2426.	-2541.	-2572.	-2667.	-2746.	-2530.	-2211.	-1953.	-1977.	-2083.	-2190.	-2298.	-2406.	-2512.
1972	-2630.	-2629.	-2713.	-2822.	-2768.	-2780.	-2809.	-2911.	-3023.	-3138.	-3150.	-3187.	-2592.	-2689.	-2530.	-2624.	-2448.	-2412.	-2496.	-2601.	-2710.	-2818.	-2730.	-2757.
1973	-3171.	-3213.	-3195.	-2874.	-2406.	-2336.	-2359.	-2441.	-2515.	-2614.	-2712.	-2809.	-2840.	-2830.	-2770.	-2287.	-1823.	-1538.	-1546.	-1649.	-1754.	-1861.	-1968.	-2075.
1974	-2918.	-2656.	-2584.	-2347.	-1784.	-1516.	-1563.	-1651.	-1753.	-1856.	-1969.	-1995.	-2182.	-1733.	-1516.	-1132.	-772.	-570.	-607.	-713.	-821.	-928.	-1036.	-835.
1975	-1914.	-1571.	-1317.	-767.	-173.	870.	1032.	1004.	984.	864.	753.	672.	-827.	-489.	-148.	448.	937.	1847.	2054.	1958.	1853.	1746.	1639.	1588.
1976	1216.	1697.	1634.	1849.	2011.	2354.	2324.	2234.	2125.	2014.	1901.	1796.	1854.	1999.	1961.	2212.	2311.	2520.	2516.	2413.	2306.	2199.	2092.	2025.
1977	1907.	1896.	1817.	2236.	2296.	2297.	2632.	2567.	2462.	2353.	2243.	2246.	2200.	2191.	2209.	2647.	2791.	2848.	2880.	2805.	2698.	2592.	2492.	2438.
1978	2267.	2212.	2527.	2503.	2463.	2458.	2332.	2256.	2157.	2096.	2291.	2375.	2440.	2372.	2703.	2744.	2798.	2756.	2653.	2551.	2446.	2618.	2501.	2455.
1979	2475.	2479.	2613.	2614.	2719.	2721.	2627.	2518.	2407.	2294.	2179.	2110.	2425.	2451.	2505.	2564.	2596.	2541.	2440.	2334.	2227.	2120.	2013.	2120.
1980	2072.	2060.	2090.	2483.	2621.	2470.	2647.	2589.	2538.	2429.	2368.	2381.	2084.	2125.	2094.	2471.	2838.	2847.	2757.	2654.	2548.	2440.	2414.	2334.
1981	2285.	2246.	2330.	2250.	2156.	2094.	2147.	2086.	1977.	1866.	1752.	1638.	2227.	2226.	2207.	2138.	2040.	2001.	1998.	1915.	1807.	1699.	1591.	1484.
1982	1602.	1782.	1695.	1602.	1524.	1451.	1361.	1272.	1167.	1055.	947.	838.	1571.	1538.	1434.	1353.	1256.	1160.	1056.	947.	838.	740.	635.	526.
1983	785.	740.	887.	1134.	1069.	1026.	964.	882.	772.	661.	549.	467.	499.	452.	780.	895.	859.	901.	842.	735.	627.	518.	436.	336.
1984	372.	320.	245.	210.	576.	594.	504.	394.	283.	171.	58.	-56.	267.	185.	85.	58.	512.	582.	474.	365.	256.	146.	37.	-73.
1985	-144.	69.	492.	494.	533.	480.	410.	310.	231.	122.	26.	0.	195.	332.	578.	687.	640.	551.	455.	349.	248.	141.	89.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	38.7	77.3	116.0	154.7	193.3	232.0	270.7	309.4	348.0
OBSERVED %TIME	100.0	58.3	42.5	30.7	22.4	17.1	14.9	12.7	11.4	10.5
SIMULATED %TIME	100.0	51.8	40.8	30.7	25.0	21.1	16.7	14.0	12.7	10.1
ERROR	.0	-6.6	-1.8	.0	2.6	3.9	1.8	1.3	1.3	-.4
MONTHLY DISCHARGE	386.7	425.4	464.0	502.7	541.4	580.0	618.7	657.4	696.1	734.7
OBSERVED %TIME	8.3	7.9	5.7	4.4	3.1	3.1	2.2	2.2	.9	.4
SIMULATED %TIME	7.5	7.0	5.3	3.5	3.5	2.2	.9	.9	.9	.4
ERROR	-.9	-.9	-.4	-.9	.4	-.9	-1.3	-1.3	.0	.0
MONTHLY DISCHARGE	773.4	812.1	850.7	889.4	928.1	966.7	1005.4	1044.1	1082.8	1121.4
OBSERVED %TIME	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4
SIMULATED %TIME	.4	.4	.4	.4	.4	.4	.4	.0	.0	.0
ERROR	.0	.0	.0	.0	.0	.0	.0	-.4	-.4	-.4

OBSERVED MAXIMUM MONTHLY VALUE	1160.100
SIMULATED MAXIMUM MONTHLY VALUE	1028.043

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.5284	.5735
2	.2296	.3274
3	.1254	.0859
4	-.0109	-.0866
5	-.1570	-.2195
6	-.2163	-.2277
7	-.1232	-.1805
8	.0214	-.0787
9	.0727	.0650
10	.1958	.2658
11	.3815	.3609

TABLE 3B - PITMAN MODEL FITTED TO INCREMENTAL CATCHMENT

SYNTHESIZED RUNOFF AT GAUGE G05INC CATCHMENT AREA= 2198.SQ.KM M.A.P.= 733.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00 %	PI=	1.5 mm/D	ZMIN=	54.0 mm/M	ZMAX=	450.0 mm/M	RFACT=	1.000
R=	.50	POW=	3.0		SL= .00 mm		FT= 10.0 mm/M		
GW=	5.0 mm/M	TL=	.25 MTHS		GL= .00 MTHS		NOFT= 4 PER MTH		
POWG=	2.5	SGL=	.0 mm		SG= 120.0 mm		FG= 2.0 mm/M		

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF OBS	RUNOFF (%MAR) SIM	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	58.0	9.0	8.6	9.2	122.0	130.5	153.9	121.1
NOV	140.0	58.0	11.6	12.3	11.7	174.0	165.6	161.3	145.5
DEC	160.0	58.0	13.3	12.8	11.5	181.0	162.2	141.1	104.0
JAN	150.0	58.0	17.4	15.5	17.4	219.4	246.5	204.4	198.6
FEB	125.0	58.0	13.9	18.1	17.4	255.6	246.4	230.4	201.9
MAR	120.0	58.0	12.2	14.5	14.4	204.8	204.1	269.1	224.6
APR	80.0	58.0	5.3	7.1	7.2	101.0	101.9	107.0	97.9
MAY	70.0	58.0	1.8	2.8	2.3	39.3	32.7	26.6	19.6
JUN	50.0	58.0	.9	1.7	1.4	23.8	19.6	23.5	17.6
JUL	48.0	58.0	1.2	.8	.8	11.4	11.9	11.9	10.5
AUG	56.0	58.0	3.1	2.1	2.5	29.4	35.7	64.2	60.4
SEP	96.0	58.0	4.8	3.7	4.0	52.6	57.1	61.7	57.6
YEAR	1203.0					1414.5	1414.3	867.4	806.0
MEAN AND ST.DEVN. OF LOGS						3.085	3.082	.240	.258

MAXIMUM OBSERVED = 1160.1 MAXIMUM SIMULATED = 846.0

INITIAL SOIL STORAGE =	17.9	
FINAL SOIL STORAGE =	33.0 mm	
TOTAL RAIN =	13179.3 mm	
TOTAL INTERCEPTION LOSS =	1312.3 mm	10.0 % rain
TOTAL SURFACE RUNOFF =	1318.9 mm	10.0 % rain
TOTAL EVAP FROM SOIL =	9432.0 mm	71.6 % rain
TOTAL INTERFLOW =	681.9 mm	5.2 % rain
INITIAL G.WATER STORAGE =	109.5 mm	
FINAL G.WATER STORAGE =	113.1 mm	
TOTAL G.WATER RUNOFF =	417.0 mm	3.2 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	119.5	8	FEB 1986	SEP 1986
	OBS	120.7	6	MAR 1970	AUG 1970
40.	SIM	309.1	8	FEB 1986	SEP 1986
	OBS	267.5	7	MAR 1970	SEP 1970
60.	SIM	717.1	18	APR 1985	SEP 1986
	OBS	843.5	33	JAN 1968	SEP 1970
80.	SIM	1508.0	77	MAY 1980	SEP 1986
	OBS	1734.7	48	JAN 1968	DEC 1971
90.	SIM	2426.9	78	APR 1980	SEP 1986
	OBS	2398.5	71	JAN 1968	NOV 1973

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	26875.4	26870.8	.0
MEAN ANNUAL RUNOFF	1414.5	1414.3	.0
AVERAGE MONTHLY RUNOFF	117.9	117.9	.0
VARIANCE OF MONTHLY VALUES	27238.4	22347.5	-18.0
RANGE OF RESIDUAL MASS CURVE	5934.2	5801.8	-2.2
MEAN OF RESIDUAL MASS CURVE	31.9	743.0	2230.9
INDEX OF SEASONAL VARIABILITY	31.8	31.7	-.3
MEAN DEFICIT FLOW PERIOD(MONTHS)	6.7	7.3	10.2
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	12	21	75.0

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.541
STUDENTS T VALUE	9.674
REGRESSION COEFFICIENT	.490
BASE CONSTANT OF REGRESSION EQUATION	60.077

TABLE 3B CONTD

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.541
STUDENTS T VALUE	9.674
REGRESSION COEFFICIENT	.490
BASE CONSTANT OF REGRESSION EQUATION	60.077
REGRESSION SUM OF SQUARES	1492081.000
RESIDUAL SUM OF SQUARES	3603158.000
TOTAL SUM OF SQUARES	5095239.000
STANDARD ERROR OF ESTIMATE	126.266
MAXIMUM EQIVALENT CONSTANT ERROR (%)	97.837
RELATIVE ABSOLUTE ERROR(%)	80.088
COEFFICIENT OF DETERMINATION	.293
STANDARD COEFFICIENT OF EFFICIENCY	.160
RESIDUAL MASS CURVE COEFFICIENT	.725
SPECIAL COEFFICIENT OF EFFICIENCY	-.125
COEFFICIENT OF PERSISTENCE	2.961
RELATIVE MEAN PERSISTENCE (%)	3.381
DURBIN-WATSON D-STATISTIC	1.570

SIGN TEST

NUMBER OF NEGATIVE RUNS	35
NUMBER OF POSITIVE RUNS	35
EXPECTED NUMBER OF RUNS	114.9
NUMBER OF NEGATIVE RESIDUALS	110
NUMBER OF POSITIVE RESIDUALS	118
STANDARDISED NORMAL VARIATE Z	5.962

RESIDUAL MASS CURVES

OBSERVED

1967	-114.	-46.	22.	-51.	-146.	-207.	-273.	-291.	-386.	-490.	-600.	-706.
1968	-806.	-894.	-853.	-959.	-1066.	-1099.	-1101.	-1184.	-1216.	-1321.	-1436.	-1551.
1969	-1534.	-1604.	-1600.	-1616.	-1615.	-1724.	-1837.	-1952.	-2068.	-2185.	-2301.	-2377.
1970	-2251.	-2265.	-2239.	-2172.	-2130.	-2158.	-2136.	-2207.	-2315.	-2425.	-2532.	-2638.
1971	-2740.	-2817.	-2844.	-2833.	-2351.	-1990.	-2037.	-2101.	-2200.	-2312.	-2426.	-2541.
1972	-2630.	-2629.	-2713.	-2822.	-2768.	-2780.	-2809.	-2911.	-3023.	-3138.	-3150.	-3187.
1973	-3171.	-3213.	-3195.	-2874.	-2406.	-2336.	-2359.	-2441.	-2515.	-2614.	-2712.	-2809.
1974	-2918.	-2656.	-2584.	-2347.	-1784.	-1316.	-1565.	-1651.	-1753.	-1856.	-1969.	-1993.
1975	-1914.	-1571.	-1317.	-767.	-173.	870.	1032.	1004.	964.	864.	753.	672.
1976	1216.	1697.	1634.	1649.	2011.	2354.	2328.	2234.	2125.	2014.	1901.	1798.
1977	1907.	1896.	1817.	2236.	2296.	2297.	2632.	2567.	2462.	2353.	2243.	2248.
1978	2267.	2212.	2527.	2503.	2463.	2458.	2352.	2258.	2157.	2096.	2251.	2375.
1979	2479.	2479.	2613.	2614.	2719.	2721.	2627.	2518.	2407.	2294.	2179.	2110.
1980	2072.	2060.	2090.	2483.	2621.	2670.	2647.	2589.	2538.	2429.	2368.	2381.
1981	2285.	2246.	2330.	2250.	2156.	2094.	2147.	2086.	1977.	1866.	1752.	1638.
1982	1602.	1782.	1695.	1602.	1524.	1451.	1361.	1272.	1167.	1055.	947.	838.
1983	785.	740.	887.	1134.	1049.	1026.	964.	882.	772.	661.	549.	467.
1984	372.	320.	243.	210.	576.	594.	504.	394.	283.	171.	58.	-56.
1985	-144.	69.	492.	494.	555.	480.	410.	310.	231.	122.	26.	0.

SIMULATED

1967	-92.	-174.	-156.	-237.	-361.	-413.	-422.	-487.	-540.	-665.	-775.	-896.
1968	-922.	-979.	-991.	-1030.	-1044.	-1108.	-1205.	-1315.	-1427.	-1541.	-1649.	-1710.
1969	-1577.	-1588.	-1347.	-1474.	-1439.	-1472.	-1451.	-1526.	-1633.	-1742.	-1832.	-1927.
1970	-1988.	-2056.	-2092.	-1851.	-1660.	-1380.	-1447.	-1514.	-1618.	-1729.	-1841.	-1954.
1971	-2041.	-2053.	-2118.	-2183.	-2042.	-2024.	-2038.	-2159.	-2270.	-2384.	-2408.	-2446.
1972	-2447.	-2437.	-2416.	-2183.	-1877.	-1850.	-1850.	-1936.	-2021.	-2123.	-2173.	-2253.
1973	-2361.	-2080.	-1971.	-1642.	-970.	-596.	-620.	-711.	-819.	-926.	-1033.	-1051.
1974	-1000.	-668.	-307.	-94.	309.	1037.	1173.	1129.	1070.	971.	865.	823.
1975	1212.	1618.	1625.	1878.	2230.	2753.	2797.	2705.	2597.	2488.	2376.	2283.
1976	2444.	2432.	2357.	2843.	2916.	2923.	3214.	3141.	3036.	2927.	2818.	2815.
1977	2841.	2800.	3020.	3068.	3111.	3132.	3040.	2947.	2851.	2782.	2928.	3038.
1978	3131.	3136.	3290.	3278.	3334.	3344.	3245.	3136.	3024.	2931.	2853.	2790.
1979	2763.	2751.	2761.	3192.	3305.	3349.	3322.	3250.	3191.	3083.	3019.	3031.
1980	2943.	2921.	2995.	2926.	2902.	2863.	2924.	2853.	2746.	2637.	2533.	2425.
1981	2389.	2391.	2509.	2420.	2336.	2306.	2242.	2172.	2068.	1957.	1849.	1740.
1982	1692.	1668.	1833.	2163.	2096.	2041.	1965.	1893.	1784.	1673.	1561.	1477.
1983	1389.	1376.	1331.	1332.	1604.	1614.	1522.	1411.	1297.	1184.	1071.	957.
1984	1038.	1123.	1372.	1386.	1563.	1563.	1500.	1399.	1316.	1205.	1116.	1082.
1985	1059.	1000.	931.	874.	776.	668.	556.	441.	329.	215.	110.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	38.7	77.3	116.0	154.7	193.3	232.0	270.7	309.4	348.0
OBSERVED %TIME	100.0	58.3	42.5	30.7	22.4	17.1	14.9	12.7	11.4	10.5
SIMULATED %TIME	100.0	62.3	44.7	31.6	22.8	18.4	15.4	13.6	11.0	10.1
ERROR	.0	3.9	2.2	.9	.4	1.3	.4	.9	-.4	-.4
MONTHLY DISCHARGE	386.7	425.4	464.0	502.7	541.4	580.0	618.7	657.4	696.1	734.7
OBSERVED %TIME	8.3	7.9	5.7	4.4	3.1	3.1	2.2	2.2	.9	.4
SIMULATED %TIME	8.3	6.1	4.8	3.9	2.2	1.8	1.3	.9	.9	.9
ERROR	.0	-1.8	-.9	-.4	-.9	-1.3	-.9	-1.3	.0	.4
MONTHLY DISCHARGE	773.4	812.1	850.7	889.4	928.1	966.7	1005.4	1044.1	1082.8	1121.4
OBSERVED %TIME	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4
SIMULATED %TIME	.9	.4	.0	.0	.0	.0	.0	.0	.0	.0
ERROR	.4	.0	-.4	-.4	-.4	-.4	-.4	-.4	-.4	-.4

OBSERVED MAXIMUM MONTHLY VALUE	1160.100
SIMULATED MAXIMUM MONTHLY VALUE	845.960

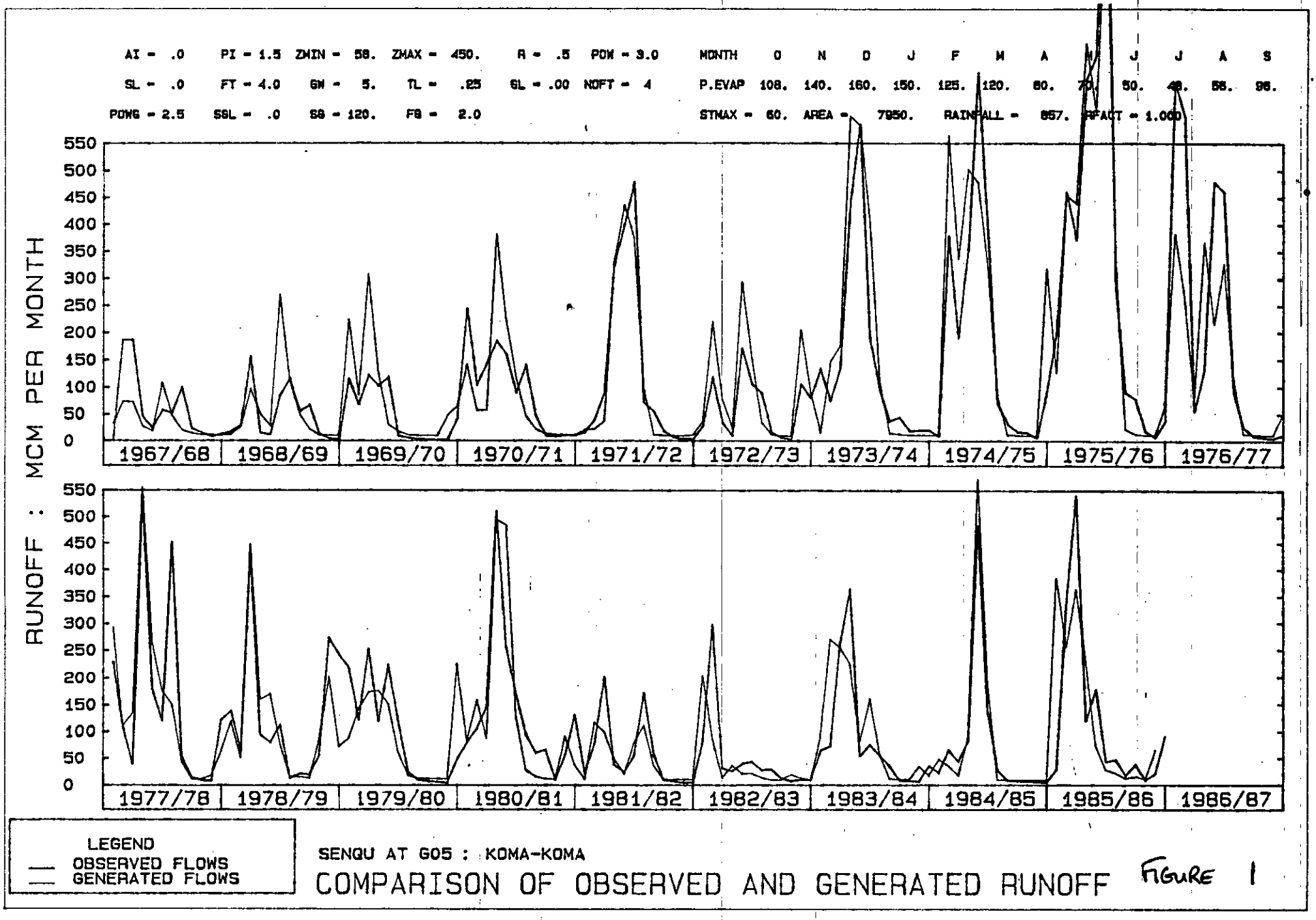
COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.5284	.5382
2	.2296	.2944
3	.1254	.1432
4	-.0109	-.0413
5	-.1570	-.1968
6	-.2163	-.2451
7	-.1232	-.1679
8	.0214	-.0266
9	.0727	.0710
10	.1958	.2633

TABLE 4 (TOTAL CATCHMENT)

SYNTHESISED/ORIGINAL RUNOFF AT GAUGE 605 USING MODIFIED PITMAN MODEL FOR
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

1930	568P	289P	583P	4805P	2527P	1909P	1596P	451P	123P	519P	252P	116P	1373.8
1931	220P	626P	477P	872P	3808P	2163P	415P	121P	114P	109P	106P	112P	914.3
1932	128P	2137P	1375P	320P	1152P	1485P	455P	105P	101P	103P	98P	95P	755.4
1933	99P	4277P	6722P	8175P	4386P	2672P	785P	146P	109P	372P	398P	170P	2831.1
1934	742P	5336P	5558P	1705P	1078P	2626P	1005P	205P	125P	108P	132P	113P	1873.3
1935	241P	253P	347P	793P	1328P	2677P	851P	383P	198P	103P	100P	97P	737.1
1936	1380P	8463P	3711P	7349P	7387P	3464P	676P	108P	105P	102P	99P	96P	3294.0
1937	347P	243P	1357P	4782P	4209P	1000P	1582P	595P	239P	209P	1180P	480P	1622.3
1938	2344P	980P	4124P	5417P	7250P	2691P	349P	297P	171P	164P	270P	247P	2430.4
1939	1310P	3521P	1899P	1403P	1888P	1630P	698P	1696P	633P	125P	118P	1576P	1649.7
1940	613P	1756P	3728P	4617P	3732P	1079P	512P	237P	120P	122P	115P	209P	1684.0
1941	2021P	738P	116P	3157P	3176P	3171P	1065P	167P	111P	108P	370P	226P	1442.6
1942	605P	3103P	4490P	3984P	1052P	1388P	3007P	1796P	403P	1134P	1302P	401P	2266.5
1943	6486P	5890P	4604P	2698P	4277P	1650P	229P	137P	265P	167P	118P	1428P	2794.9
1944	1212P	517P	182P	305P	2687P	5841P	1750P	132P	120P	112P	108P	105P	1307.1
1945	112P	119P	190P	2024P	1194P	1997P	701P	162P	119P	99P	96P	94P	690.7
1946	2450P	2496P	758P	383P	1425P	1549P	489P	115P	100P	97P	94P	428P	1038.4
1947	1240P	1752P	2662P	3171P	1725P	7109P	2415P	130P	105P	102P	99P	97P	2060.7
1948	260P	177P	128P	2412P	1124P	461P	237P	112P	94P	92P	90P	156P	534.3
1949	317P	1241P	2492P	2494P	2231P	6239P	2133P	185P	111P	272P	2217P	789P	2072.1
1950	156P	169P	2372P	1347P	1566P	698P	205P	118P	100P	98P	139P	114P	708.2
1951	2522P	904P	211P	2252P	4191P	1813P	299P	99P	96P	251P	275P	174P	1308.7
1952	167P	952P	1792P	1163P	3942P	1394P	503P	228P	101P	98P	127P	119P	1058.6
1953	1058P	786P	1168P	1880P	1574P	999P	296P	365P	190P	101P	98P	99P	861.4
1954	183P	891P	807P	5883P	6010P	1671P	245P	143P	108P	100P	98P	95P	1623.4
1955	249P	1563P	3086P	1077P	4695P	4249P	981P	156P	118P	98P	95P	99P	1646.6
1956	695P	3129P	9606P	6501P	2285P	2141P	751P	132P	107P	174P	724P	6217P	3246.2
1957	7140P	2398P	1149P	5206P	1883P	732P	1226P	492P	140P	115P	111P	234P	2082.6
1958	220P	2432P	2590P	848P	406P	259P	866P	4678P	1555P	484P	236P	110P	1468.4
1959	1894P	2531P	3638P	1689P	2961P	2849P	1049P	227P	119P	115P	269P	357P	1769.8
1960	811P	2184P	2953P	3351P	1005P	1892P	1683P	650P	192P	121P	118P	191P	1515.1
1961	139P	3695P	2869P	1708P	4080P	2175P	564P	173P	117P	114P	115P	110P	1585.9
1962	127P	1622P	816P	5806P	2180P	3906P	1515P	165P	119P	192P	134P	105P	1668.7
1963	589P	3010P	1762P	4757P	1643P	3877P	1449P	141P	320P	178P	109P	230P	1806.5
1964	5206P	1939P	1204P	1605P	514P	133P	281P	162P	792P	339P	312P	176P	1266.3
1965	140P	930P	409P	6358P	2902P	345P	104P	108P	101P	96P	113P	99P	1170.5
1966	179P	565P	2794P	9082P	5278P	3259P	1864P	450P	110P	103P	100P	98P	2388.2
1967	348	1861#	1861#	446#	234	569	512	1005	228	139	73	126	708.8
1968	173	304#	1563#	142#	111#	848	1162	539	667#	121#	31	26	568.7
1969	1157	676	1220	1019	1188	92#	49	25	13	13	15#	418	588.5
1970	2442	1038	1437W	1852	1597	897W	1402	465	99	81W	115	113	1153.8
1971	162	404	909	3295	3997W	4788W	711W	539	182	61	37	30	1511.5
1972	288	1190W	340W	91W	1716W	1063	887	158	54	28	1064W	806	768.5
1973	1342	753	1358	4398	5850W	1886	948	361W	438W	186W	202	203W	1792.5
1974	88	3802W	1899	3552W	6809	3853	692	312	160W	149	53	913	2228.2
1975	1996	4609	3718	6676W	7123	11601	2798	905W	781#	179	68	368	4082.2
1976	6619	5990	547	1327W	4796W	4606	904	255	92	68	49W	125	2537.8
1977	2289	1072	386	5377	1775W	1188W	4528	528W	135	88	71	1211	1864.8
1978	1394W	626W	4329	933	788W	1121W	122	216	191	566W	2734W	2413	1543.3
1979	2184	1212W	2524	1188	2233W	1193W	237	92	67	48	36	489W	1150.3
1980	795W	1053W	1480W	5109	2558	1675	946	597	667	97	562	1312	1685.1
1981	221	786	2023	377	235	555	1714	567	91	64	40	42	671.5
1982	816	2981	307	253	399	444	276	293	125	66	98W	91W	614.9
1983	642	734	2650W	3643C	531e	751,	552	358	82	66	59	360	1042.8
1984	228	657	437	827	4840	1355#	275	82	65	63	49	38	891.6
1985	302	3310	5410	1190	1790	431	480	173	394	86	222	918#	1470.6
AVE.	1203	1905	2127	2912	2738	2216	965	415	221	164	288	458	1561.1
SDV.	1636	1736	1873	2303	1961	2027	831	674	257	173	504	909	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	


AI = .0 PI = 1.5 ZMIN = 58. ZMAX = 450. R = .5 POW = 3.0
SL = .0 FT = 4.0 GW = 5. TL = .25 GL = .00 NOFT = 4
PONG = 2.5 SSL = .0 SS = 120. FS = 2.0
MONTH O N D J F M A M J J A S
P.EVAP 108. 140. 160. 150. 125. 120. 80. 70. 50. 40. 55. 95.
STMAX = 60. AREA = 7950. RAINFALL = 857. RFACT = 1.000
RUNOFF : MCM PER MONTH
550
500
450
400
350
300
250
200
150
100
50
0
1967/68
1968/69
1969/70
1970/71
1971/72
1972/73
1973/74
1974/75
1975/76
1976/77
1977/78
1978/79
1979/80
1980/81
1981/82
1982/83
1983/84
1984/85
1985/86
1986/87
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
SENQU AT G05 : KOMA-KOMA
COMPARISON OF OBSERVED AND GENERATED RUNOFF
FIGURE 1

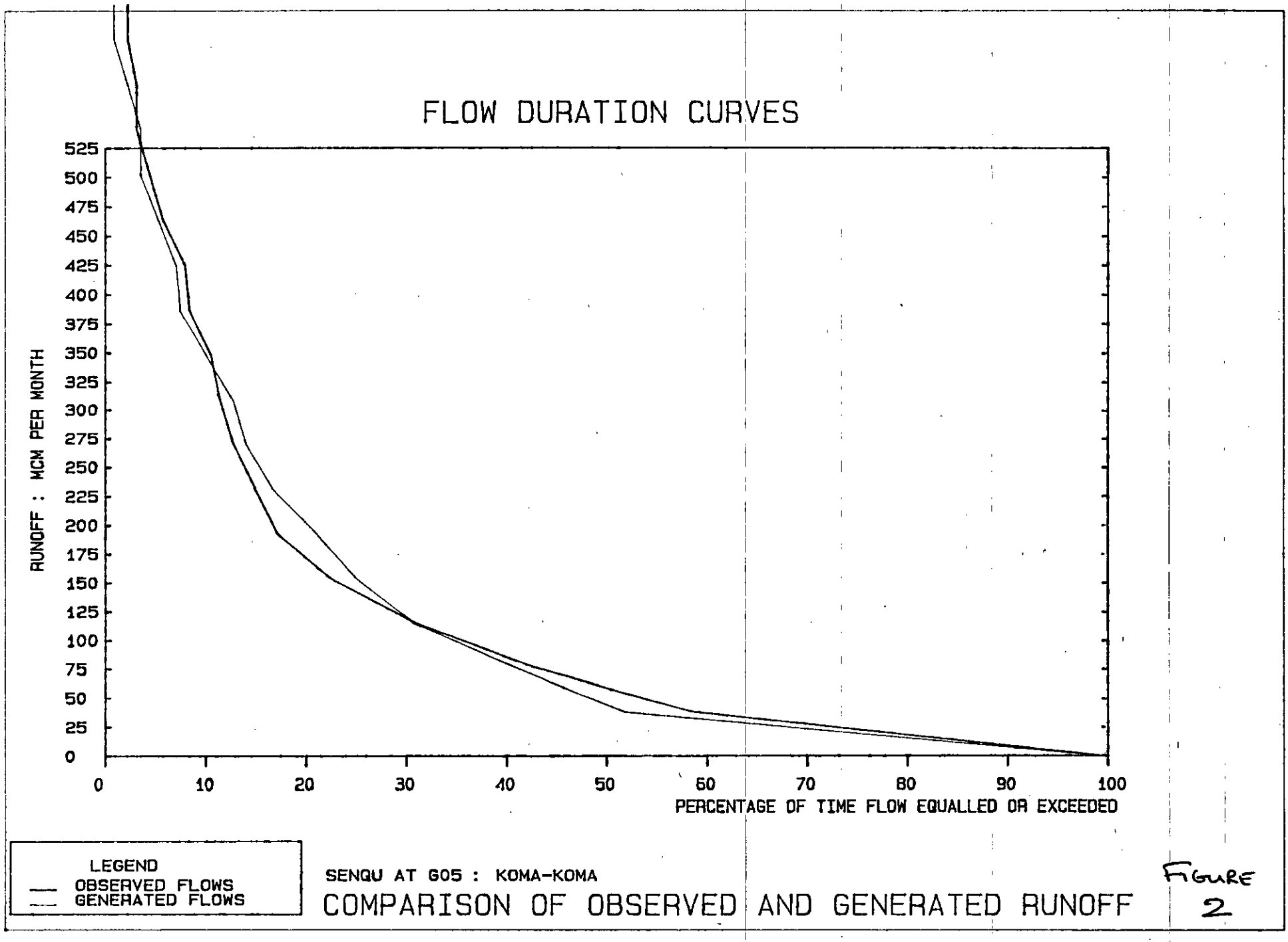

FLOW DURATION CURVES
RUNOFF : MCM PER MONTH
525
500
475
450
425
400
375
350
325
300
275
250
225
200
175
150
125
100
75
50
25
0
0
10
20
30
40
50
60
70
80
90
100
PERCENTAGE OF TIME FLOW EQUALLED OR EXCEEDED
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
SENQU AT G05 : KOMA-KOMA
COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 2

ANNEX 4

TABLE 1

06 MOKHOTLONG - OBSERVED AND MODIFIED PITMAN MODELLED F INFILLED BY REGRESSION
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

967	1	3590	3590	51	69	92	72	32	220	20	00	00	105.9
1968	0	720	3030	410	360	129	162	50	36	380	00	9	87.6
1969	123	62	2450	2000	2380	51	20	7	3	3	450	233	123.0
970	523	148	78	187	449	98	166	61	29	21	31	37M	182.8
1971	88	112	246	1025	8700	10490	1300	920	110	00	00	00	362.3
1972	30	251	129	41	240	219	233	45	10	2M	95	138	144.1
973	395	206	205	1436	1335	618	265	47	35	16	2M	1M	456.1
1974	0	384	247	1227	2527	949	181	48	24	19	7	156	576.9
1975	266	448	624	1522	1755	2926	610M	192	100	32	13	17	850.5
976	926	970	173	478	1067	650M	219	61	24	17	13	26	462.4
1977	253	197	78	1391M	535M	285	567	92	24	17	12	96	354.7
1978	170	112	758	166	224	577	36	68	36	31	166	210	235.4
979	132	139	311	309	434	342	71	25	14	11	9	66M	186.3
1980	474M	45M	264	852	808	183	44	35	28	17	23	249	302.2
1981	56	48	213	94	34	237	188	50	16	10M	7M	6M	95.9
982	50	6420	27	80	117	65	28	14	9	9	8	9	105.8
1983	102	86	537	897	196	246	154	30	20	16	18	32	233.4
1984	26	25	34	385	2150	215	38	16	00	00	00	00	288.9
985	380	772	779	271	441	108	55	32	28M	6	33	212	277.5
AVE.	192	267	295	561	712	476	170	52	25	14	25	79	286.9
IDV.	239	269	226	532	741	662	166	41	21	11	41	91	
NOBS	19	19	19	19	19	19	19	19	19	19	19	19	

G06 MOKHOTLONG - MONTHLY CATCHMENT RAINFALL IN TERMS OF M.A.P. TABLE 2

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,1X,12(I4,A),I8)

1930	101	86	130	242	132	137	87	1	1	46	1	2	966
1931	60	106	137	143	191	119	41	31	6	1	1	31	867
1932	45	167	126	67	131	124	48	18	12	15	3	13	769
1933	42	168	176	218	169	132	76	52	2	38	46	9	1128
1934	72	210	192	105	153	149	63	39	9	0	33	29	1054
1935	81	93	112	108	130	171	36	60	1	4	1	22	819
1936	121	262	141	220	224	113	38	1	2	4	1	12	1139
1937	68	74	140	211	143	38	116	12	45	41	61	39	988
1938	139	91	194	209	265	102	37	52	3	35	39	47	1213
1939	86	167	161	140	140	102	67	94	63	11	5	97	1133
1940	51	125	178	193	193	78	82	4	0	17	11	51	983
1941	117	38	69	163	143	125	80	17	4	0	41	46	843
1942	76	192	167	184	72	95	133	56	6	80	86	22	1169
1943	222	162	187	138	198	78	23	25	47	11	1	111	1203
1944	104	90	71	119	177	232	56	36	1	0	1	7	894
1945	41	58	83	179	119	147	49	27	0	2	0	5	710
1946	127	137	88	103	144	149	70	5	17	8	12	80	940
1947	89	150	147	174	137	206	68	16	0	8	7	19	1021
1948	64	87	80	167	117	93	68	14	5	5	10	66	776
1949	74	136	147	142	184	279	67	30	4	18	77	34	1192
1950	65	93	170	117	164	81	52	12	7	1	40	42	844
1951	103	32	86	183	170	110	78	4	4	30	43	50	893
1952	54	101	147	142	177	96	60	15	4	0	28	44	868
1953	89	100	137	131	134	119	43	63	15	0	5	33	869
1954	67	124	144	232	235	91	65	27	11	8	2	9	1015
1955	63	128	145	132	234	145	37	37	0	2	7	32	962
1956	75	169	238	189	124	138	71	19	20	36	56	170	1305
1957	195	114	159	278	85	129	99	26	0	1	0	65	1151
1958	68	145	142	121	122	99	83	117	7	45	6	13	968
1959	130	141	161	157	186	156	74	15	2	11	37	62	1132
1960	80	135	178	149	76	149	84	41	10	14	9	57	982
1961	31	161	173	186	202	121	72	14	0	1	19	19	999
1962	44	163	164	241	112	148	52	12	25	34	0	10	1005
1963	104	180	105	226	58	170	53	9	43	1	23	76	1048
1964	207	102	145	145	54	60	74	14	71	27	49	38	986
1965	58	110	68	289	120	21	31	30	8	0	29	28	792
1966	70	130	175	214	184	187	141	22	24	11	9	14	1181
1967	65	101	108	100	88	128	47	32	6	7	28	26	736
1968	46	111	178	86	143	188	82	53	10	11	10	38	956
1969	119	70	223	111	130	87	40	8	12	3	61	86	950
1970	99	100	63	210	130	170	89	47	6	41	36	13	1004
1971	94	73	101	207	198	181	38	46	6	3	13	34	994
1972	87	139	60	111	185	120	65	6	0	12	83	85	953
1973	52	148	143	278	209	183	83	9	38	20	10	17	1190
1974	48	265	208	235	218	167	57	3	1	9	6	160	1377
1975	66	188	207	265	216	292	89	45	11	0	3	72	1454
1976	138	103	128	198	135	157	73	12	2	0	8	72	1026
1977	114	78	146	245	137	137	105	0	5	0	35	54	1056
1978	136	63	266	87	169	112	37	53	3	53	66	45	1090
1979	98	160	171	142	133	106	36	10	0	0	14	113	983
1980	33	121	156	230	211	42	67	13	18	1	86	28	1006
1981	39	191	135	105	90	114	118	7	6	13	3	38	859
1982	117	65	46	146	70	85	39	19	5	71	8	22	693
1983	129	149	185	153	141	167	45	33	11	7	57	14	1091
1984	71	73	73	156	226	28	28	4	3	0	3	14	679
1985	184	125	181	187	133	80	78	0	33	0	60	31	1092
AVE.	90	126	144	172	153	129	66	26	12	15	25	44	100.0
SDEV	43	49	47	55	49	53	26	23	16	19	26	36	

VALUES IN TENTHS OF A PERCENT OF ANNUAL AVERAGE RAINFALL

TABLE 3

SYNTHESIZED RUNOFF AT GAUGE G06 CATCHMENT AREA= 1660.SQ.KM M.A.P.= 908.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00	%	PI=	1.5	mm/D	ZMIN=	70.0	mm/M	ZMAX=	450.0	mm/M	RFACT=	.920
R=	.50		POW=	3.0		SL=	.00	mm	FT=	3.0	mm/M		
GW=	.0	mm/M	TL=	.50	MTHS	GL=	.00	MTHS	NOFT=	4	PER MTH		
POWG=	2.5		SGL=	.0	mm	SG=	.0	mm	FG=	.0	mm/M		

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF OBS (%MAR)	RUNOFF SIM (%MAR)	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	80.0	8.4	6.7	5.3	19.2	15.1	23.9	15.3
NOV	140.0	80.0	11.2	9.3	8.9	26.7	25.4	26.9	22.6
DEC	160.0	80.0	13.5	10.3	12.8	29.5	36.6	22.6	36.4
JAN	150.0	80.0	15.7	19.5	17.7	56.1	50.7	53.2	37.6
FEB	125.0	80.0	14.3	24.8	20.1	71.2	57.6	74.1	49.0
MAR	120.0	80.0	12.3	16.6	18.1	47.6	51.9	66.2	44.5
APR	80.0	80.0	5.9	5.9	9.7	17.0	27.6	16.6	29.5
MAY	70.0	80.0	1.9	1.8	1.3	5.2	3.8	4.1	4.8
JUN	50.0	80.0	.9	.9	.3	2.5	.9	2.1	.6
JUL	48.0	80.0	1.2	.5	.6	1.4	1.6	1.1	3.3
AUG	56.0	80.0	2.9	.9	1.9	2.5	5.4	4.1	7.2
SEP	96.0	80.0	4.7	2.7	3.4	7.9	9.6	9.1	13.1
YEAR	1203.0					286.9	286.1	195.2	181.7
MEAN AND ST.DEVN. OF LOGS						2.370	2.374	.284	.292

MAXIMUM OBSERVED = 292.6 MAXIMUM SIMULATED = 179.1

INITIAL SOIL STORAGE =	31.2	
FINAL SOIL STORAGE =	43.7	mm
TOTAL RAIN =	16029.7	mm
TOTAL INTERCEPTION LOSS =	1477.8	mm 9.2 % rain
TOTAL SURFACE RUNOFF =	2153.2	mm 13.4 % rain
TOTAL EVAP FROM SOIL =	11265.1	mm 70.3 % rain
TOTAL INTERFLOW =	1122.1	mm 7.0 % rain
INITIAL G.WATER STORAGE =	.0	mm
FINAL G.WATER STORAGE =	.0	mm
TOTAL G.WATER RUNOFF =	.0	mm .0 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	27.2	6	APR 1985	SEP 1985
	OBS	24.3	7	APR 1985	OCT 1985
40.	SIM	84.7	26	OCT 1967	NOV 1968
	OBS	84.8	32	JAN 1968	AUG 1970
60.	SIM	164.5	21	JAN 1982	SEP 1983
	OBS	237.8	32	JAN 1968	AUG 1970
80.	SIM	300.9	63	OCT 1967	DEC 1971
	OBS	451.7	47	JAN 1968	NOV 1971
90.	SIM	424.8	54	APR 1981	SEP 1985
	OBS	564.0	47	JAN 1968	NOV 1971

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	5451.7	5436.6	-.3
MEAN ANNUAL RUNOFF	286.9	286.1	-.3
AVERAGE MONTHLY RUNOFF	23.9	23.8	-.3
VARIANCE OF MONTHLY VALUES	1674.5	1116.6	-33.3
RANGE OF RESIDUAL MASS CURVE	1361.4	1171.2	-14.0
MEAN OF RESIDUAL MASS CURVE	.1	54.1	45692.8
INDEX OF SEASONAL VARIABILITY	38.9	37.3	-4.0
MEAN DEFICIT FLOW PERIOD(MONTHS)	6.9	7.7	11.3
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	13	18	38.5

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.790
STUDENTS T VALUE	19.361
REGRESSION COEFFICIENT	.645
BASE CONSTANT OF REGRESSION EQUATION	8.423

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.790
STUDENTS T VALUE	19.361
REGRESSION COEFFICIENT	.645
BASE CONSTANT OF REGRESSION EQUATION	8.423
REGRESSION SUM OF SQUARES	158830.000
RESIDUAL SUM OF SQUARES	95760.820
TOTAL SUM OF SQUARES	254590.900
STANDARD ERROR OF ESTIMATE	20.584
MAXIMUM EQIVALENT CONSTANT ERROR (%)	74.622
RELATIVE ABSOLUTE ERROR(%)	56.705
COEFFICIENT OF DETERMINATION	.624
STANDARD COEFFICIENT OF EFFICIENCY	.623
RESIDUAL MASS CURVE COEFFICIENT	.935
SPECIAL COEFFICIENT OF EFFICIENCY	.464
COEFFICIENT OF PERSISTENCE	1.634
RELATIVE MEAN PERSISTENCE (%)	8.700
DURBIN-WATSON D-STATISTIC	1.833

SIGN TEST

NUMBER OF NEGATIVE RUNS	48
NUMBER OF POSITIVE RUNS	48
EXPECTED NUMBER OF RUNS	114.7
NUMBER OF NEGATIVE RESIDUALS	120
NUMBER OF POSITIVE RESIDUALS	108
STANDARDISED NORMAL VARIATE Z	2.487

RESIDUAL MASS CURVES

	OBSERVED												SIMULATED											
1967	-24.	-12.	0.	-19.	-36.	-50.	-67.	-88.	-109.	-133.	-157.	-181.	-23.	-42.	-60.	-81.	-102.	-114.	-127.	-150.	-173.	-197.	-220.	-243.
1968	-205.	-222.	-215.	-235.	-255.	-266.	-274.	-293.	-313.	-333.	-357.	-380.	-266.	-285.	-276.	-271.	-281.	-242.	-213.	-231.	-253.	-276.	-299.	-322.
1969	-392.	-410.	-409.	-413.	-413.	-432.	-454.	-477.	-501.	-524.	-544.	-544.	-333.	-344.	-314.	-283.	-298.	-314.	-335.	-358.	-382.	-405.	-422.	-429.
1970	-516.	-525.	-541.	-546.	-525.	-539.	-547.	-565.	-586.	-607.	-628.	-648.	-437.	-450.	-470.	-452.	-424.	-400.	-380.	-398.	-420.	-442.	-462.	-484.
1971	-664.	-676.	-676.	-597.	-534.	-453.	-464.	-479.	-501.	-525.	-549.	-573.	-502.	-520.	-541.	-521.	-452.	-379.	-356.	-378.	-401.	-424.	-448.	-471.
1972	-594.	-593.	-604.	-624.	-623.	-625.	-625.	-645.	-668.	-691.	-706.	-716.	-491.	-495.	-503.	-524.	-508.	-484.	-496.	-518.	-542.	-565.	-570.	-565.
1973	-700.	-704.	-707.	-587.	-478.	-440.	-437.	-456.	-477.	-499.	-523.	-547.	-579.	-583.	-578.	-502.	-378.	-296.	-268.	-288.	-311.	-333.	-356.	-380.
1974	-571.	-556.	-555.	-457.	-228.	-157.	-163.	-182.	-203.	-225.	-248.	-257.	-403.	-337.	-224.	-136.	-33.	44.	59.	36.	13.	-11.	-35.	-8.
1975	-254.	-233.	-195.	-66.	85.	354.	391.	386.	372.	352.	329.	307.	20.	42.	109.	215.	336.	491.	588.	571.	548.	525.	502.	482.
1976	376.	449.	442.	466.	549.	590.	588.	570.	548.	526.	504.	482.	490.	496.	481.	501.	530.	549.	558.	537.	514.	490.	466.	447.
1977	484.	479.	463.	579.	608.	613.	646.	631.	609.	587.	564.	550.	440.	430.	417.	471.	530.	539.	546.	534.	511.	488.	465.	446.
1978	543.	530.	582.	575.	573.	607.	587.	570.	550.	529.	521.	519.	446.	448.	503.	559.	564.	573.	555.	534.	512.	498.	486.	473.
1979	508.	498.	505.	512.	531.	562.	525.	504.	481.	458.	435.	418.	457.	469.	499.	508.	503.	495.	476.	453.	429.	406.	382.	380.
1980	441.	422.	424.	486.	563.	537.	518.	497.	476.	454.	432.	433.	378.	362.	361.	413.	507.	543.	521.	498.	475.	452.	449.	447.
1981	415.	396.	393.	379.	358.	358.	353.	334.	312.	289.	265.	242.	424.	443.	468.	452.	431.	414.	415.	411.	388.	364.	341.	318.
1982	223.	264.	242.	226.	214.	197.	176.	153.	130.	107.	84.	61.	305.	293.	270.	253.	236.	214.	193.	169.	146.	136.	127.	104.
1983	47.	32.	62.	128.	123.	124.	115.	95.	73.	50.	28.	7.	97.	113.	146.	169.	175.	203.	217.	194.	171.	147.	130.	112.
1984	-14.	-35.	-56.	-41.	150.	147.	127.	105.	81.	57.	33.	9.	90.	69.	47.	35.	90.	134.	111.	87.	63.	40.	16.	-8.
1985	-11.	43.	97.	100.	120.	107.	88.	68.	47.	23.	3.	0.	17.	53.	69.	109.	130.	119.	100.	79.	56.	33.	16.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	9.8	19.5	29.3	39.0	48.8	58.5	68.3	78.0	87.8
OBSERVED %TIME	100.0	45.6	33.3	20.6	17.1	14.0	11.8	9.6	8.3	7.0
SIMULATED %TIME	100.0	47.8	36.0	29.4	24.1	17.1	11.8	9.6	8.8	7.0
ERROR	.0	2.2	2.6	8.8	7.0	3.1	.0	.0	.4	.0

MONTHLY DISCHARGE	97.5	107.3	117.0	126.8	136.5	146.3	156.1	165.8	175.6	185.3
OBSERVED %TIME	5.3	3.9	3.9	3.5	3.1	2.2	1.8	1.8	1.3	1.3
SIMULATED %TIME	5.3	3.9	3.5	2.2	1.8	.9	.4	.4	.4	.0
ERROR	.0	.0	-.4	-1.3	-1.3	-1.3	-1.3	-1.3	-.9	-1.3

MONTHLY DISCHARGE	195.1	204.8	214.6	224.3	234.1	243.8	253.6	263.3	273.1	282.8
OBSERVED %TIME	1.3	1.3	1.3	.9	.9	.9	.4	.4	.4	.4
SIMULATED %TIME	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
ERROR	-1.3	-1.3	-1.3	-.9	-.9	-.9	-.4	-.4	-.4	-.4

OBSERVED MAXIMUM MONTHLY VALUE	292.600
SIMULATED MAXIMUM MONTHLY VALUE	179.052

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

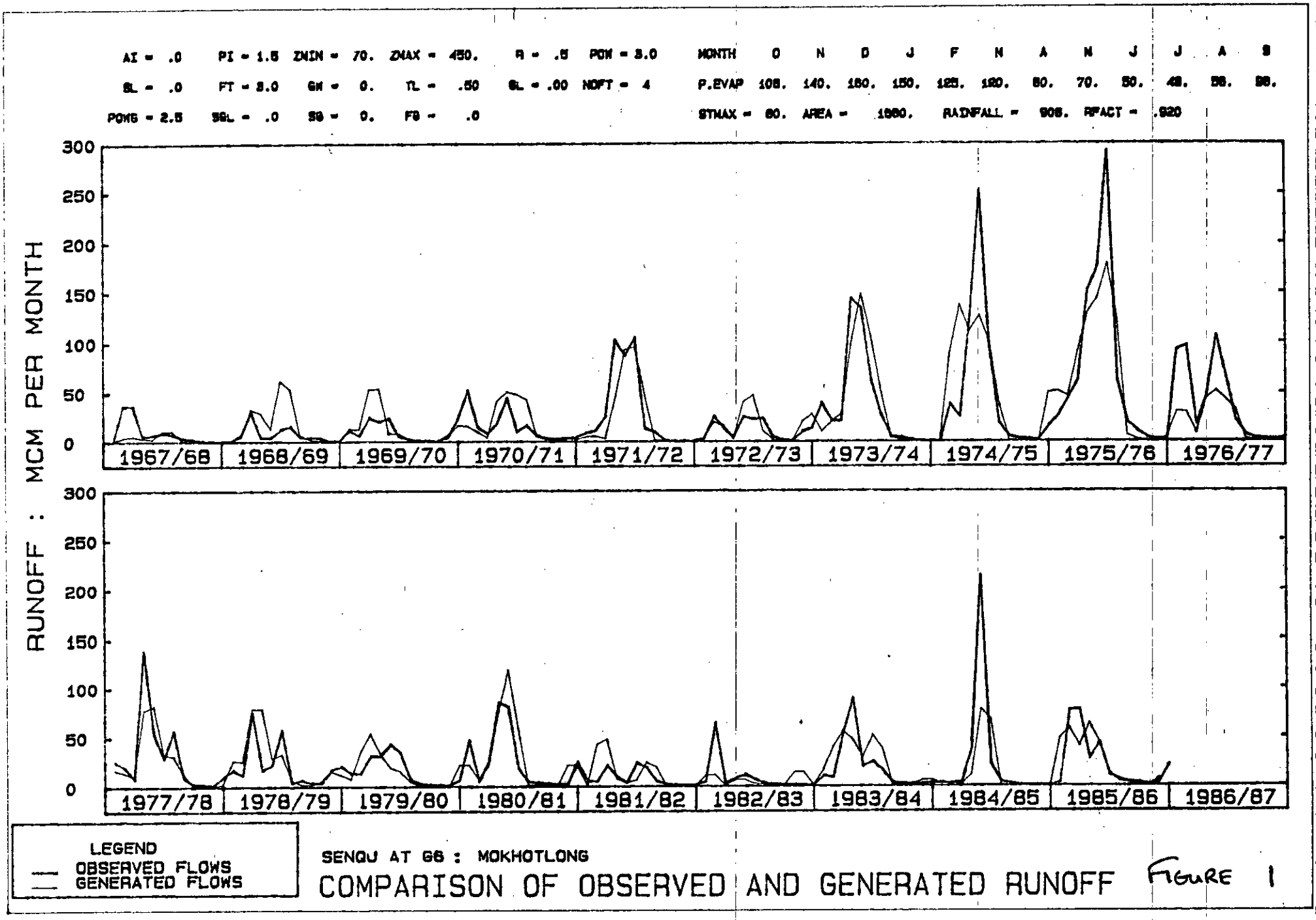
LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.5244	.7275
2	.2028	.3379
3	.0528	.0895
4	-.0907	-.1258
5	-.1830	-.2425
6	-.2142	-.2693
7	-.1433	-.2377
8	-.0486	-.1283
9	.0387	.0754
10	.1797	.2940
11	.3762	.4467
12	.4535	.4861

TABLE 4

SYNTHESISED/ORIGINAL RUNOFF AT GAUGE G06 USING MODIFIED PITMAN MODEL FOR HYDROLOGICAL YEARS STARTING OCTOBER

(I4,2X,12(I5,A),F9.1)

1930	129P	84P	67P	716P	780P	298P	229P	46P	5P	32P	35P	5P	242.6
1931	9P	47P	98P	144P	540P	544P	96P	9P	6P	4P	3P	4P	150.4
1932	6P	287P	326P	47P	67P	169P	112P	10P	5P	5P	5P	4P	104.3
1933	4P	285P	560P	802P	849P	486P	187P	43P	21P	20P	47P	35P	333.9
1934	21P	589P	948P	393P	215P	457P	274P	21P	10P	5P	10P	12P	295.5
1935	32P	53P	51P	45P	83P	452P	393P	29P	28P	5P	3P	3P	117.7
1936	128P	1064P	1031P	627P	1203P	731P	67P	7P	2P	2P	2P	2P	486.6
1937	14P	22P	64P	533P	648P	173P	118P	119P	21P	41P	106P	92P	195.1
1938	272P	287P	393P	839P	1397P	966P	44P	19P	17P	15P	30P	30P	430.9
1939	49P	363P	518P	264P	219P	185P	55P	144P	192P	72P	12P	138P	221.1
1940	143P	75P	352P	657P	842P	485P	46P	35P	4P	3P	4P	15P	266.1
1941	137P	129P	7P	149P	312P	285P	151P	36P	6P	3P	18P	28P	126.1
1942	33P	494P	698P	544P	324P	34P	290P	288P	29P	202P	418P	228P	358.2
1943	775P	1087P	661P	406P	561P	511P	17P	5P	21P	24P	7P	207P	428.2
1944	293P	113P	29P	32P	371P	1127P	794P	17P	8P	4P	2P	2P	279.2
1945	3P	5P	10P	252P	292P	284P	245P	11P	5P	3P	2P	2P	111.4
1946	150P	312P	174P	25P	155P	399P	279P	23P	5P	4P	4P	69P	159.9
1947	110P	274P	346P	372P	389P	747P	632P	22P	5P	3P	3P	3P	290.6
1948	12P	29P	25P	186P	223P	70P	43P	20P	5P	3P	3P	34P	65.3
1949	54P	159P	252P	196P	492P	1491P	1099P	23P	8P	5P	162P	168P	410.9
1950	20P	37P	249P	252P	298P	287P	23P	9P	4P	3P	17P	24P	122.3
1951	79P	75P	11P	276P	596P	379P	80P	32P	5P	8P	30P	38P	160.9
1952	23P	41P	138P	186P	448P	397P	42P	14P	5P	3P	6P	13P	131.6
1953	49P	75P	93P	102P	152P	195P	92P	35P	34P	7P	4P	5P	84.3
1954	16P	78P	163P	707P	1348P	765P	40P	18P	7P	5P	4P	3P	315.4
1955	10P	86P	181P	149P	762P	961P	249P	10P	7P	4P	3P	4P	242.6
1956	23P	343P	978P	1009P	408P	243P	209P	25P	7P	17P	74P	662P	399.8
1957	1266P	713P	227P	1080P	916P	122P	177P	74P	9P	4P	2P	31P	462.1
1958	45P	198P	272P	121P	81P	84P	68P	314P	286P	38P	36P	7P	155.0
1959	163P	348P	377P	351P	585P	729P	329P	28P	6P	3P	14P	40P	297.3
1960	57P	167P	424P	406P	128P	222P	251P	47P	13P	7P	5P	21P	174.8
1961	22P	244P	500P	588P	856P	628P	124P	25P	5P	3P	3P	4P	300.2
1962	5P	260P	465P	874P	703P	276P	247P	11P	6P	15P	15P	5P	288.2
1963	72P	479P	430P	573P	556P	329P	333P	12P	16P	17P	7P	60P	288.4
1964	773P	755P	140P	198P	101P	8P	24P	23P	90P	97P	49P	47P	230.5
1965	18P	56P	52P	915P	959P	51P	4P	4P	4P	3P	7P	9P	208.2
1966	19P	113P	366P	768P	917P	915P	851P	359P	11P	7P	6P	4P	433.6
1967	1	359#	359#	51	69	92	72	32	22#	2#	0#	0#	105.9
1968	0	72#	303#	41#	36#	129	162	50	36	38#	0#	9	87.6
1969	123	62	245#	200#	238#	51	20	7	3	3	45#	233	123.0
1970	523	148	78	187	449	98	166	61	29	21	31	37W	182.8
1971	88	112	246	1025	870#	1049#	130#	92#	11#	0#	0#	0#	362.3
1972	30	251	129	41	248	219	233	45	10	2W	95	138	144.1
1973	395	206	205	1436	1335	618	265	47	35	16	2W	1W	456.1
1974	0	384	247	1227	2527	949	181	48	24	19	7	156	576.9
1975	266	448	624	1522	1755	2926	610W	192	100	32	13	17	850.5
1976	926	970	173	478	1067	650W	219	61	24	17	13	26	462.4
1977	253	197	78	1391W	535W	285	567	92	24	17	12	96	354.7
1978	170	112	758	166	224	577	36	68	36	31	166	210	255.4
1979	132	139	311	309	434	342	71	25	14	11	9	66W	186.3
1980	474W	45W	264	852	808	183	44	35	28	17	23	249	302.2
1981	56	48	213	94	34	237	188	50	16	10W	7W	6W	95.9
1982	50	642#	27	80	117	65	28	14	9	9	8	9	105.8
1983	102	86	537	897	196	246	154	30	20	16	18	32	233.4
1984	26	25	34	385	2150	215	38	16	0#	0#	0#	0#	288.9
1985	38#	772	779	271	441	108	55	32	28e	6	33	212	277.5
AVE.	155	266	309	472	595	456	206	53	25	17	29	63	264.7
SDV.	253	270	259	397	521	468	224	73	46	31	64	109	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	


AI = .0 PI = 1.5 ZNIN = 70. ZMAX = 450. R = .5 PDW = 3.0
SL = .0 FT = 3.0 GW = 0. TL = .50 GL = .00 NOFT = 4
POWG = 2.5 SSL = .0 SS = 0. FS = .0
MONTH O N D J F M A M J J A S
P.EVAP 108. 140. 150. 150. 125. 120. 80. 70. 50. 48. 58. 88.
STMAX = 80. AREA = 1560. RAINFALL = 906. RFACT = .920
RUNOFF : MCM PER MONTH
300
250
200
150
100
50
0
1967/68
1968/69
1969/70
1970/71
1971/72
1972/73
1973/74
1974/75
1975/76
1976/77
1977/78
1978/79
1979/80
1980/81
1981/82
1982/83
1983/84
1984/85
1985/86
1986/87
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
SENQU AT G6 : MOKHOTLONG
COMPARISON OF OBSERVED AND GENERATED RUNOFF
FIGURE 1

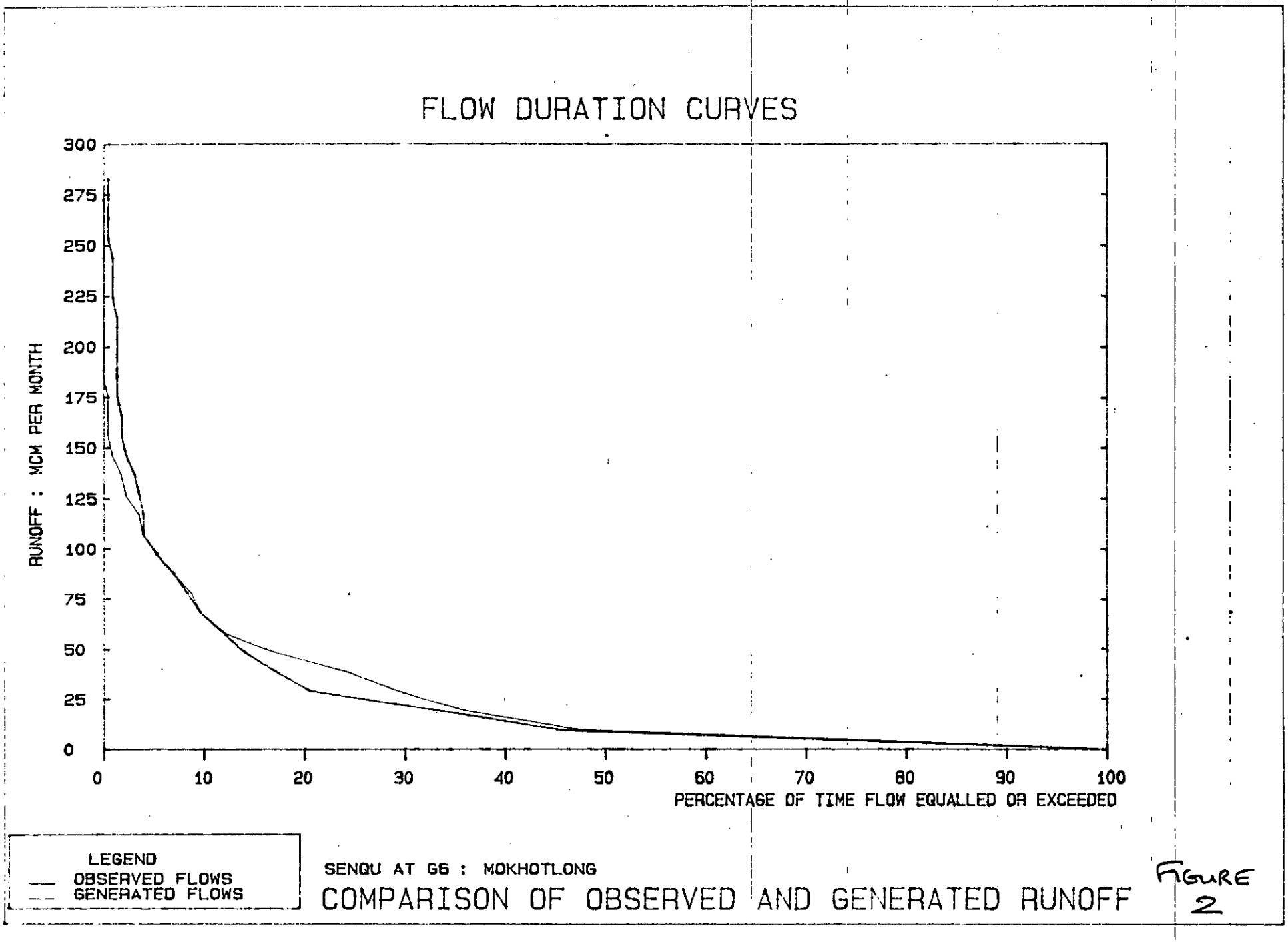

FLOW DURATION CURVES
RUNOFF : MCM PER MONTH
300
275
250
225
200
175
150
125
100
75
50
25
0
0
10
20
30
40
50
60
70
80
90
100
PERCENTAGE OF TIME FLOW EQUALLED OR EXCEEDED
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
SENQU AT G6 : MOKHOTLONG
COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 2

ANNEX 5

(GEN) - TI SIDE LIKE AT TEESLIKE BRIDGE

807 TSOELIKE - OBSERVED AND MODIFIED PITMAN MODELLED FLO INFILLED BY REGRESSION

TABLE 1

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,2X,12(I5,A),F9.1)

1967	10	156	122	75	29	56	82	17	6	4	3	12	57.2
1968	4	13	89	14	10	57	78	19	12	6	4	2	30.8
1969	69e	45e	116e	76	137	22	29e	24e	3	4	4	12	54.1
1970	199M	88	24	122	201	55	48	59	19	21	22	12	87.0
1971	31	50	176	261M	421	417	55	29	12	6	4	9	147.1
1972	42	84	50	30	203	59	225	20	8	4	15	8	74.8
1973	28	53	144	600	656	426	290	120	83	29M	33M	27	248.9
1974	10	152	245	337	522	229	42	15	8	7	4	40	161.1
1975	38	219	581	998	760	1197	221	69	22	12	8	15	414.0
1976	307	244	31	112	413	434	40	11	7	6	4	5M	161.4
1977	45	148	113M	550	178	171	474	87	14	10	7	61	185.8
1978	89	44	474	86	327	300	29	18	9	20	59	65	152.0
1979	22	84	170	407M	256M	189M	35M	10	6	5	4	38	122.6
1980	68	36	86	111	347	100	18M	22M	13	4	9	61	87.5
1981	25	53	127	56	30	137	131	22	10	7	3	5	60.6
1982	5	132M	9	24M	20	14	14	8	3	3	2	0	23.4
1983	36	44	286	619	137	172	166	12	11	13	11	23	153.0
1984	13	47	23	116	706	148	18	7	5	4	21e	1	110.9
1985	36e	699e	562e	552	484	91	30	24	32	6e	34e	45	259.5
AVE.	57	126	180	271	307	225	107	31	15	9	13	23	136.4
SDV.	75	153	176	277	237	271	121	30	18	7	15	22	
NOBS	19	19	19	19	19	19	19	19	19	19	19	19	

G07 TSOELIKE - MONTHLY CATCHMENT RAINFALL IN TERMS OF M.A.P. TABLE 2

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,1X,12(I4,A),I8)

1930	95	53	121	236	143	150	96	1	2	61	1	1	960
1931	62	102	130	135	198	109	24	25	8	3	3	29	828
1932	52	193	153	102	126	124	40	7	6	22	8	9	842
1933	37	223	234	260	173	143	75	28	0	42	33	17	1265
1934	99	195	209	142	143	148	74	38	26	2	36	18	1130
1935	76	59	110	170	157	139	33	81	0	7	0	23	855
1936	95	281	140	222	238	153	24	3	0	3	2	14	1175
1937	61	67	157	224	152	62	99	8	35	41	54	30	990
1938	106	89	216	204	224	137	15	47	2	23	23	60	1146
1939	84	159	167	144	176	122	55	134	26	3	3	109	1182
1940	59	126	200	243	168	126	59	2	1	19	3	27	1033
1941	104	33	86	232	182	127	59	14	0	0	37	38	912
1942	89	180	260	169	60	149	147	62	10	57	86	23	1292
1943	219	203	226	189	213	139	11	29	46	2	5	105	1387
1944	87	93	65	172	186	187	35	32	0	1	6	9	873
1945	61	42	104	205	116	135	43	48	0	6	1	10	771
1946	87	156	116	143	137	97	36	1	45	7	3	61	889
1947	100	145	174	218	153	241	43	33	0	3	2	8	1120
1948	68	56	88	174	126	94	62	14	1	5	12	48	748
1949	60	127	181	193	164	220	52	32	3	31	105	16	1184
1950	38	76	200	121	138	110	56	7	9	3	39	30	827
1951	114	22	73	209	187	89	22	14	10	44	38	52	874
1952	54	136	145	179	178	65	68	14	7	0	33	59	938
1953	94	109	131	190	137	96	53	101	21	1	1	28	962
1954	100	110	142	280	160	95	55	26	30	5	0	18	1021
1955	61	128	173	121	232	200	21	27	1	4	5	23	996
1956	76	157	322	233	143	164	75	10	13	25	60	136	1414
1957	137	92	123	234	124	121	97	44	1	1	1	40	1015
1958	50	181	196	106	139	60	85	257	2	41	5	8	1130
1959	108	142	156	141	167	107	84	34	3	10	28	45	1025
1960	77	169	167	124	95	136	97	40	14	5	16	39	979
1961	21	167	172	141	171	88	54	16	0	2	24	14	870
1962	61	123	122	226	96	284	57	12	25	34	0	10	1050
1963	108	191	156	246	97	179	63	5	80	4	13	38	1180
1964	173	77	151	148	93	58	61	8	112	23	55	29	988
1965	55	168	58	257	136	43	43	33	3	0	34	26	856
1966	50	90	219	280	111	157	87	26	16	16	9	8	1069
1967	75	101	132	82	79	119	45	16	2	10	16	33	710
1968	36	71	116	94	103	143	70	57	4	4	11	20	729
1969	133	68	150	96	123	42	17	9	16	2	67	70	793
1970	141	73	86	227	136	73	42	28	6	27	16	13	868
1971	81	96	165	226	172	152	26	33	5	12	20	46	1034
1972	103	152	47	125	203	109	67	4	1	11	99	44	965
1973	31	138	156	254	248	173	67	19	22	16	34	13	1171
1974	32	165	142	201	129	129	55	11	4	12	7	127	1014
1975	58	192	215	313	170	355	61	41	9	1	3	71	1489
1976	154	70	130	226	147	147	72	6	3	0	13	61	1029
1977	115	128	157	234	159	126	94	3	3	2	39	88	1148
1978	80	85	217	70	181	102	39	24	2	70	79	30	979
1979	61	119	154	212	116	102	23	12	0	5	2	107	913
1980	47	121	133	159	186	68	72	15	16	1	62	31	911
1981	42	116	109	141	82	159	85	6	10	11	6	31	798
1982	120	65	48	172	69	96	36	12	3	33	9	16	679
1983	107	154	201	155	109	129	48	41	17	17	45	12	1035
1984	102	96	70	180	273	38	17	4	0	2	3	17	802
1985	192	119	207	225	104	118	53	0	42	0	59	43	1162
AVE.	85	122	151	186	150	129	56	30	13	14	25	38	100.0
SDEV	40	52	55	56	46	56	26	40	20	17	27	31	

VALUES IN TENTHS OF A PERCENT OF ANNUAL AVERAGE RAINFALL

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.857
STUDENTS T VALUE	25.045
REGRESSION COEFFICIENT	.819
BASE CONSTANT OF REGRESSION EQUATION	2.040
REGRESSION SUM OF SQUARES	50520.710
RESIDUAL SUM OF SQUARES	18203.160
TOTAL SUM OF SQUARES	68723.880
STANDARD ERROR OF ESTIMATE	8.975
MAXIMUM EQIVALENT CONSTANT ERROR (%)	60.997
RELATIVE ABSOLUTE ERROR(%)	46.891
COEFFICIENT OF DETERMINATION	.735
STANDARD COEFFICIENT OF EFFICIENCY	.726
RESIDUAL MASS CURVE COEFFICIENT	.908
SPECIAL COEFFICIENT OF EFFICIENCY	.594
COEFFICIENT OF PERSISTENCE	1.648
RELATIVE MEAN PERSISTENCE (%)	15.314
DURBIN-WATSON D-STATISTIC	1.935
SIGN TEST	
NUMBER OF NEGATIVE RUNS	44
NUMBER OF POSITIVE RUNS	44
EXPECTED NUMBER OF RUNS	110.8
NUMBER OF NEGATIVE RESIDUALS	136
NUMBER OF POSITIVE RESIDUALS	92
STANDARDISED NORMAL VARIATE Z	3.138

RESIDUAL MASS CURVES

OBSERVED

1967	-10.	-6.	-5.	-9.	-18.	-23.	-27.	-36.	-47.	-58.	-69.	-79.
1968	-90.	-109.	-103.	-113.	-123.	-129.	-132.	-142.	-152.	-163.	-174.	-185.
1969	-189.	-196.	-196.	-200.	-197.	-207.	-215.	-224.	-235.	-246.	-257.	-267.
1970	-259.	-261.	-270.	-269.	-261.	-266.	-273.	-278.	-288.	-297.	-306.	-317.
1971	-325.	-331.	-325.	-310.	-279.	-249.	-253.	-263.	-274.	-284.	-295.	-306.
1972	-313.	-316.	-322.	-331.	-322.	-327.	-316.	-325.	-336.	-347.	-357.	-367.
1973	-376.	-382.	-379.	-330.	-276.	-245.	-227.	-227.	-230.	-238.	-246.	-255.
1974	-265.	-261.	-248.	-226.	-185.	-174.	-181.	-191.	-201.	-212.	-223.	-230.
1975	-238.	-227.	-181.	-92.	-27.	81.	92.	87.	78.	68.	57.	47.
1976	67.	80.	71.	71.	101.	133.	126.	116.	105.	94.	83.	72.
1977	65.	69.	69.	112.	119.	125.	161.	158.	148.	138.	127.	122.
1978	119.	112.	148.	146.	167.	186.	177.	168.	157.	148.	142.	137.
1979	128.	125.	131.	160.	174.	182.	174.	164.	153.	142.	131.	124.
1980	119.	111.	108.	108.	131.	130.	121.	111.	101.	90.	80.	75.
1981	66.	60.	61.	53.	47.	49.	51.	42.	31.	21.	10.	-1.
1982	-12.	-10.	-21.	-30.	-39.	-49.	-59.	-70.	-81.	-92.	-103.	-114.
1983	-122.	-129.	-112.	-61.	-59.	-53.	-48.	-58.	-68.	-78.	-87.	-98.
1984	-108.	-114.	-123.	-123.	-64.	-68.	-70.	-81.	-92.	-103.	-112.	-123.
1985	-131.	-72.	-27.	16.	53.	51.	43.	34.	26.	15.	7.	0.

SIMULATED

1967	-9.	-17.	-21.	-30.	-40.	-43.	-51.	-62.	-73.	-84.	-95.	-106.
1968	-117.	-127.	-136.	-145.	-154.	-146.	-150.	-158.	-169.	-180.	-191.	-202.
1969	-195.	-199.	-198.	-205.	-208.	-217.	-228.	-239.	-250.	-261.	-265.	-272.
1970	-259.	-261.	-272.	-239.	-223.	-229.	-240.	-251.	-262.	-273.	-284.	-295.
1971	-303.	-311.	-304.	-266.	-235.	-215.	-218.	-229.	-240.	-251.	-262.	-273.
1972	-276.	-265.	-270.	-277.	-247.	-238.	-246.	-257.	-268.	-279.	-270.	-274.
1973	-284.	-283.	-275.	-227.	-159.	-119.	-118.	-129.	-140.	-151.	-161.	-172.
1974	-183.	-170.	-165.	-140.	-130.	-125.	-131.	-142.	-153.	-165.	-176.	-164.
1975	-167.	-144.	-106.	-25.	18.	125.	151.	141.	130.	119.	108.	100.
1976	119.	118.	112.	146.	166.	180.	178.	167.	156.	145.	134.	124.
1977	126.	130.	136.	176.	203.	210.	211.	202.	191.	180.	170.	166.
1978	160.	152.	179.	180.	200.	203.	193.	182.	171.	169.	175.	169.
1979	159.	154.	159.	189.	196.	190.	180.	169.	158.	147.	136.	138.
1980	132.	128.	126.	132.	160.	161.	151.	141.	130.	119.	113.	105.
1981	94.	88.	81.	79.	72.	86.	86.	75.	64.	53.	42.	31.
1982	34.	28.	17.	25.	21.	13.	2.	-9.	-20.	-30.	-41.	-52.
1983	-53.	-44.	-18.	-5.	-8.	-6.	-12.	-23.	-34.	-45.	-54.	-64.
1984	-68.	-75.	-85.	-73.	-5.	7.	-4.	-15.	-26.	-38.	-49.	-60.
1985	-28.	-17.	8.	51.	56.	54.	47.	36.	26.	15.	9.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	4.0	8.0	12.0	16.0	20.0	23.9	27.9	31.9	35.9
OBSERVED %TIME	100.0	48.2	34.2	26.8	20.6	17.1	14.5	12.7	11.0	9.6
SIMULATED %TIME	100.0	49.6	36.8	29.8	25.0	18.9	14.9	12.7	11.0	10.5
ERROR	.0	1.3	2.6	3.1	4.4	1.8	.4	.0	.0	.9

MONTHLY DISCHARGE	39.9	43.9	47.9	51.9	55.9	59.9	63.8	67.8	71.8	75.8
OBSERVED %TIME	9.6	7.0	6.1	5.7	4.4	3.5	2.6	2.2	1.3	1.3
SIMULATED %TIME	7.5	5.3	4.8	3.1	2.2	2.2	1.8	1.8	1.8	1.8
ERROR	-2.2	-1.8	-1.3	-2.6	-2.2	-1.3	-.9	-.4	.4	.4

MONTHLY DISCHARGE	79.8	83.8	87.8	91.8	95.8	99.7	103.7	107.7	111.7	115.7
OBSERVED %TIME	.9	.9	.9	.9	.9	.9	.4	.4	.4	.4
SIMULATED %TIME	.9	.9	.9	.9	.4	.4	.4	.4	.4	.4
ERROR	.0	.0	.0	.0	-.4	-.4	.0	.0	.0	.0

OBSERVED MAXIMUM MONTHLY VALUE	119.700
SIMULATED MAXIMUM MONTHLY VALUE	118.159

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.5957	.5721
2	.3358	.2963
3	.1028	.0689
4	-.1274	-.1203
5	-.2264	-.2251
6	-.2608	-.2295
7	-.2125	-.2146
8	-.1096	-.1490
9	.0304	-.0298
10	.1969	.1851
11	.3472	.3382
12	.3441	.3912

SYNTHESIZED RUNOFF AT GAUGE 607 CATCHMENT AREA= 797.SQ.KM M.A.P.= 791.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00 %	PI=	1.5 mm/D	ZMIN=	50.0 mm/M	ZMAX=	450.0 mm/M	RFACT=	1.000
R=	.50	POW=	3.0	SL=	.00 mm	FT=	4.0 mm/M		
GW=	.0 mm/M	TL=	.25 MTHS	GL=	.00 MTHS	NOFT=	4 PER MTH		
POWG=	2.5	SGL=	.0 mm	SG=	.0 mm	FG=	.0 mm/M		

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF (%MAR) OBS	RUNOFF (%MAR) SIM	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	45.0	9.0	4.2	7.5	5.7	10.2	7.5	11.7
NOV	140.0	45.0	11.2	9.2	8.5	12.6	11.5	15.3	9.2
DEC	160.0	45.0	13.9	13.2	11.5	18.0	15.7	17.6	14.6
JAN	150.0	45.0	17.9	19.9	23.1	27.1	31.4	27.7	24.4
FEB	125.0	45.0	14.7	22.5	21.3	30.7	29.0	23.7	23.6
MAR	120.0	45.0	12.5	16.5	16.4	22.5	22.4	27.1	26.0
APR	80.0	45.0	5.2	7.8	4.8	10.7	6.5	12.1	8.5
MAY	70.0	45.0	1.8	2.3	.6	3.1	.8	3.0	.7
JUN	50.0	45.0	.9	1.1	.2	1.5	.3	1.8	.3
JUL	48.0	45.0	1.2	.7	.6	.9	.8	.7	2.2
AUG	56.0	45.0	3.1	1.0	2.5	1.3	3.4	1.5	5.9
SEP	96.0	45.0	4.6	1.7	3.1	2.3	4.2	2.2	5.8
YEAR	1203.0					136.4	136.2	94.7	84.1
MEAN AND ST.DEVN. OF LOGS						2.035	2.059	.317	.273

MAXIMUM OBSERVED = 119.7 MAXIMUM SIMULATED = 118.2

INITIAL SOIL STORAGE =	14.6	
FINAL SOIL STORAGE =	24.5 mm	
TOTAL RAIN =	14419.1 mm	
TOTAL INTERCEPTION LOSS =	1384.6 mm	9.6 % rain
TOTAL SURFACE RUNOFF =	1827.3 mm	12.7 % rain
TOTAL EVAP FROM SOIL =	9778.9 mm	67.8 % rain
TOTAL INTERFLOW =	1419.6 mm	9.8 % rain
INITIAL G.WATER STORAGE =	.0 mm	
FINAL G.WATER STORAGE =	.0 mm	
TOTAL G.WATER RUNOFF =	.0 mm	.0 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	13.1	7	MAY 1968	NOV 1968
	OBS	13.0	10	DEC 1982	SEP 1983
40.	SIM	39.0	36	OCT 1967	SEP 1969
	OBS	50.3	19	MAY 1982	NOV 1983
60.	SIM	108.7	48	OCT 1967	SEP 1970
	OBS	113.5	32	APR 1981	NOV 1983
80.	SIM	198.6	62	OCT 1967	NOV 1971
	OBS	219.0	47	JAN 1968	NOV 1971
90.	SIM	255.5	62	OCT 1967	NOV 1971
	OBS	297.9	86	OCT 1967	NOV 1973

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	2591.7	2587.5	-.2
MEAN ANNUAL RUNOFF	136.4	136.2	-.2
AVERAGE MONTHLY RUNOFF	11.4	11.3	-.2
VARIANCE OF MONTHLY VALUES	330.4	301.4	-8.8
RANGE OF RESIDUAL MASS CURVE	567.6	521.9	-8.0
MEAN OF RESIDUAL MASS CURVE	-72.9	-37.0	-49.3
INDEX OF SEASONAL VARIABILITY	39.7	39.1	-1.3
MEAN DEFICIT FLOW PERIOD(MONTHS)	7.7	6.0	-22.2
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	23	17	-26.1

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.857
STUDENTS T VALUE	25.045
REGRESSION COEFFICIENT	.819
BASE CONSTANT OF REGRESSION EQUATION	2.040

SYNTHESISED/ORIGINAL RUNOFF AT GAUGE 607 USING MODIFIED PITMAN MODEL FOR

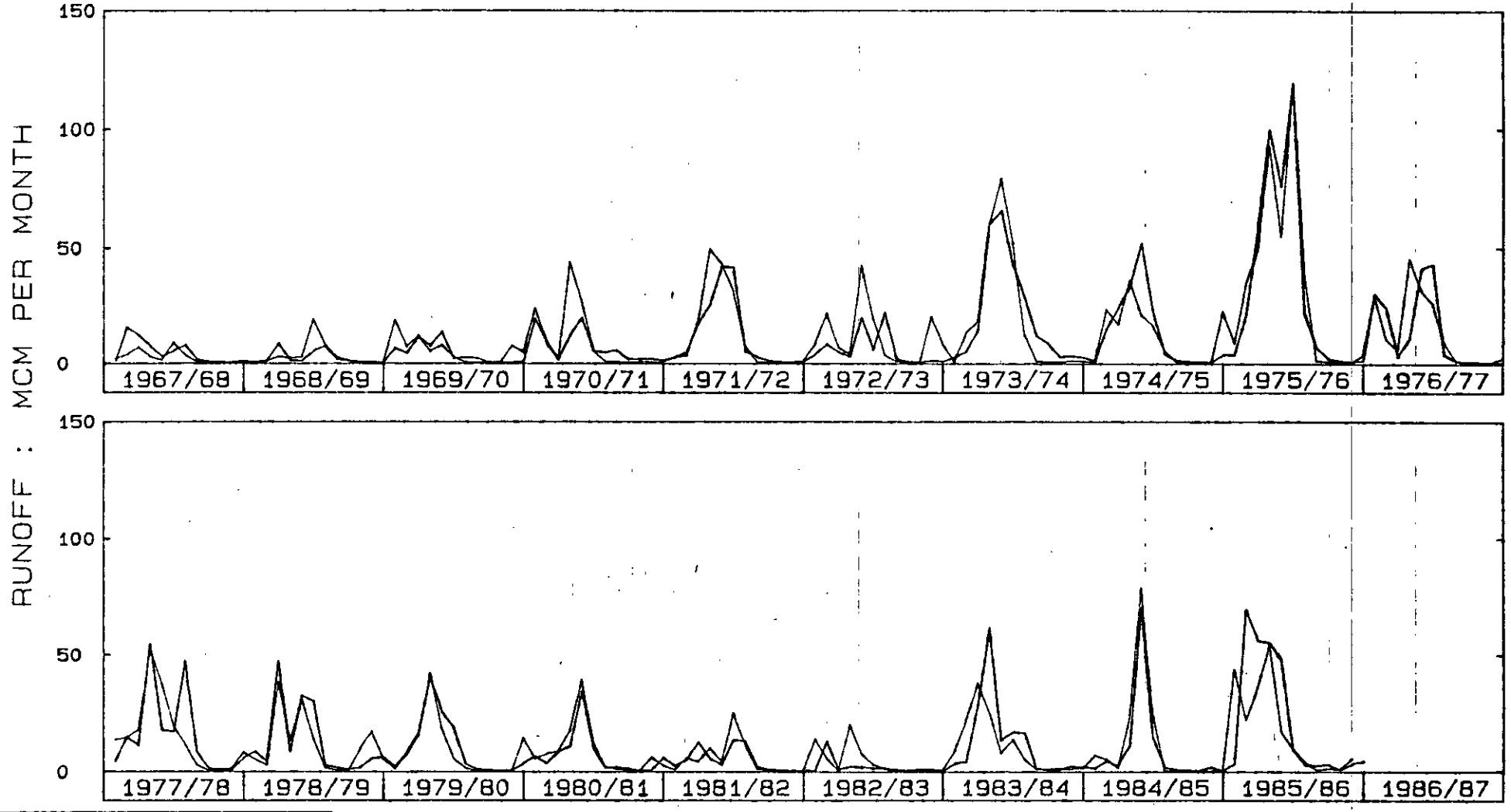
TABLE 4

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,2X,12(I5,A),F9.1)

1930	66P	20P	27P	484P	314P	266P	154P	30P	1P	64P	25P	2P	145.3
1931	10P	35P	65P	90P	413P	189P	22P	3P	2P	2P	2P	3P	83.6
1932	7P	348P	247P	59P	92P	140P	41P	2P	1P	4P	4P	2P	94.7
1933	3P	470P	611P	731P	482P	282P	83P	11P	3P	20P	18P	7P	272.1
1934	59P	381P	469P	212P	185P	257P	89P	13P	7P	4P	12P	7P	169.5
1935	21P	12P	24P	207P	276P	239P	59P	65P	24P	2P	2P	2P	93.3
1936	46P	744P	331P	446P	701P	417P	78P	1P	1P	1P	1P	2P	276.9
1937	10P	11P	144P	473P	333P	70P	88P	31P	8P	23P	49P	20P	126.0
1938	88P	49P	382P	469P	617P	331P	56P	10P	5P	5P	6P	24P	204.2
1939	37P	220P	254P	164P	331P	203P	43P	297P	105P	4P	2P	150P	181.0
1940	60P	95P	340P	610P	436P	208P	50P	5P	1P	3P	3P	3P	181.4
1941	78P	27P	9P	457P	477P	232P	51P	5P	2P	1P	12P	11P	136.2
1942	33P	308P	662P	387P	70P	201P	364P	126P	12P	54P	187P	61P	246.5
1943	555P	584P	553P	423P	549P	323P	58P	3P	18P	9P	2P	134P	321.1
1944	74P	33P	11P	203P	407P	486P	127P	5P	3P	1P	2P	2P	135.4
1945	10P	5P	18P	351P	172P	172P	55P	12P	5P	2P	2P	1P	80.5
1946	32P	208P	94P	108P	163P	71P	12P	2P	15P	8P	3P	22P	73.8
1947	77P	189P	259P	469P	329P	669P	206P	6P	3P	2P	1P	1P	221.1
1948	14P	9P	11P	215P	161P	55P	20P	6P	2P	1P	2P	11P	50.7
1949	14P	98P	263P	375P	339P	594P	179P	6P	3P	9P	245P	85P	221.0
1950	4P	12P	310P	131P	142P	106P	29P	4P	2P	2P	14P	9P	76.5
1951	117P	40P	5P	358P	464P	136P	8P	2P	2P	24P	24P	21P	120.1
1952	13P	129P	144P	274P	387P	109P	17P	7P	2P	1P	9P	24P	111.6
1953	57P	57P	70P	303P	226P	70P	16P	153P	55P	4P	2P	3P	101.6
1954	64P	64P	106P	692P	446P	101P	16P	6P	6P	4P	2P	2P	150.9
1955	10P	101P	232P	95P	542P	608P	145P	3P	2P	2P	2P	2P	174.4
1956	21P	207P	891P	744P	312P	326P	113P	9P	2P	6P	58P	305P	299.4
1957	314P	95P	41P	478P	240P	128P	119P	39P	5P	2P	1P	6P	146.8
1958	8P	297P	393P	116P	141P	50P	33P	849P	284P	20P	10P	2P	220.3
1959	87P	183P	193P	139P	281P	136P	48P	16P	3P	2P	7P	12P	110.7
1960	25P	258P	267P	100P	31P	159P	138P	37P	5P	3P	3P	7P	103.3
1961	4P	243P	277P	158P	307P	112P	14P	4P	2P	1P	4P	3P	112.9
1962	10P	84P	58P	444P	163P	788P	270P	5P	4P	13P	7P	2P	184.8
1963	88P	374P	258P	408	124	163	201	93	95	190	134	67	219.5
1964	149	189	23	128	71	6	9	4	7	66	46P	20P	71.8
1965	9P	107	51	199	333	16	7	12	5	2	1	2	74.4
1966	3	16	127	79	656	451	344	42	60	35	41	31	188.5
1967	10	156	122	75	29	56	82	17	6	4	3	12	57.2
1968	4	13	89	14	10	57	78	19	12	6	4	2	30.8
1969	69e	45e	116e	76	137	22	29e	24e	3	4	4	12	54.1
1970	199M	88	24	122	201	55	48	59	19	21	22	12	87.0
1971	31	50	176	261M	421	417	55	29	12	6	4	9	147.1
1972	42	84	50	30	203	59	225	20	8	4	15	8	74.8
1973	28	53	144	600	656	426	290	120	83	29M	33M	27	248.9
1974	10	152	245	337	522	229	42	15	8	7	4	40	161.1
1975	38	219	581	998	760	1197	221	69	22	12	8	15	414.0
1976	307	244	31	112	413	434	40	11	7	6	4	5M	161.4
1977	45	148	113M	550	178	171	474	87	14	10	7	61	185.8
1978	89	44	474	86	327	300	29	18	9	20	59	65	152.0
1979	22	84	170	407M	256M	189M	35M	10	6	5	4	38	122.6
1980	68	36	86	111	347	100	18M	22M	13	4	9	61	87.5
1981	25	53	127	56	30	137	131	22	10	7	3	5	60.6
1982	5	132M	9	24M	20	14	14	8	3	3	2	0	23.4
1983	36	44	286	619	137	172	166	12	11	13	11	23	153.0
1984	13	47	23	116	706	148	18	7	5	4	21e	1	110.9
1985	36e	699e	562e	552	484	91	30	24	32	6e	34e	45	259.5
AVE.	60	155	208	302	313	235	96	45	19	14	21	27	149.5
SDV.	93	167	199	224	195	219	101	120	43	28	44	49	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

AI = .0	PI = 1.5	ZMIN = 50.	ZMAX = 450.	R = .5	POW = 3.0	MONTH	O	N	D	J	F	M	A	M	J	J	A	S
SL = .0	FT = 4.0	GW = 0.	TL = .25	GL = .00	NOFT = 4	P.EVAP	108.	140.	160.	150.	125.	120.	80.	70.	50.	48.	56.	96.
POWG = 2.5	SGL = .0	SS = 0.	FS = .0			STMAX = 45.	AREA = 797.	RAINFALL = 791.	RFACT = 1.000														



LEGEND
OBSERVED FLOWS
GENERATED FLOWS

TSOELIKE AT G07 : TSOELIKE

COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 1

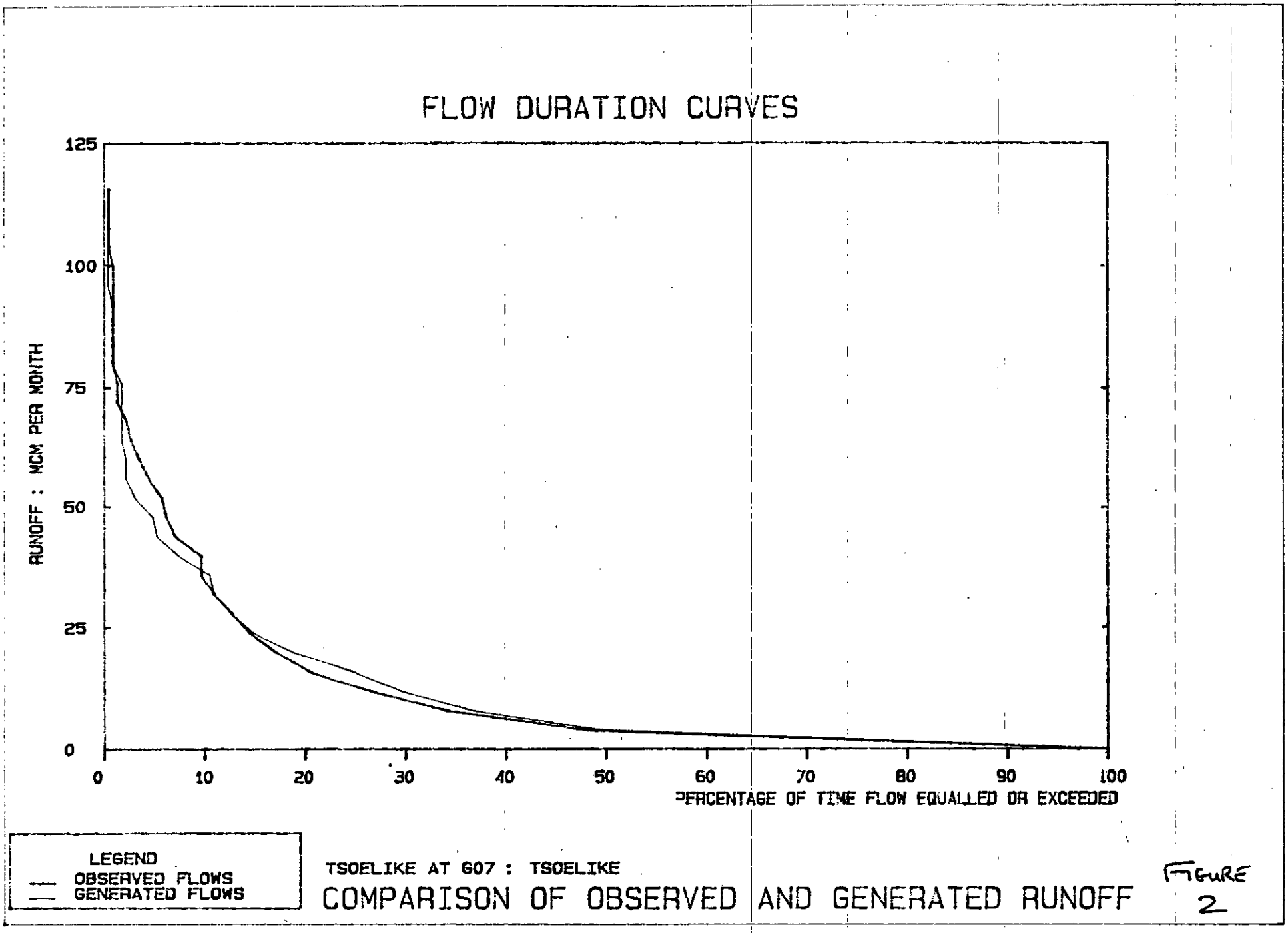

FLOW DURATION CURVES
125
100
75
50
25
0
RUNOFF : MCM PER MONTH
0
10
20
30
40
50
60
70
80
90
100
PERCENTAGE OF TIME FLOW EQUALLED OR EXCEEDED
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
TSOELIKE AT G07 : TSOELIKE
COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 2

ANNEX 6

G08 - MALIBAMATSO AT PARAY

TABLE 1

808 PARAY (TOTAL) - OBSERVED AND MODIFIED PITMAN MODELLE INFILLED BY REGRESSION
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

1967	22	971	971	236	87	382	390	1105	134	105	55	102	456.0
1968	173	162	816	78	62	375	757	403	351	67	41	35	332.0
1969	551	449	598	438	648	52	24	25	10	11	12	273	309.1
1970	1233	637	1071	1402	775	594	1017	298	59	47	23	7	716.3
1971	22	176	387	1376C	1282	2348	303	377	101	33	21	20	644.6
1972	201	676	64	288	1377C	475	398	72	29	13	724	490	454.7
1973	459	365	863W	1491C	1978	337	639	212	254	109	153	165	702.7
1974	50W	3038	1564W	1418	2454W	2230W	319	150	48	75	26	743	1211.5
1975	1199	33908	1565	21398	22648	3533C	13538	441	410	115	68	373	1685.0
1976	3376	3065	200	768	1756	2553	408W	118W	43W	31	19	99	1243.6
1977	1640	543	241	3258	718	634	3064	257	66	44	41	937	1144.3
1978	856	362	2137	449	371	374	49	110	137	417	2228	1635	912.2
1979	1695	858	1787	502	986	323	57	22	14	8	7	326	658.5
1980	358	879	730	3265	823	1122	807	361	513	56	460	550	992.4
1981	102	743	1509	163	144	200	1350	339	62	44W	34	44	473.4
1982	678	2119	194	66	141	264	3068	4228	105	38	68	45	444.6
1983	339	694	17038	25628	83	176	187	283	35	25	11	251	634.9
1984	169	539	260	156	1310	708	155	23	9	11	1	1	334.2
1985	17508	869	2660	294	801	177	417	91	283	37	156	481	801.6
AVE.	783	1081	1017	1057	951	887	632	269	140	68	218	346	744.8
SDV.	863	1017	746	1073	755	1002	712	249	149	91	519	411	
NOBS	19	19	19	19	19	19	19	19	19	19	19	19	

G08 PARAY - MONTHLY CATCHMENT RAINFALL IN TERMS OF M.A.P.
HYDROLOGICAL YEARS STARTING OCTOBER

TABLE 2

(I4,1X,12(I4,A),I8)

1930	77	75	127	212	113	122	115	8	2	49	0	0	900
1931	78	123	102	126	179	128	17	30	2	0	0	31	816
1932	49	139	124	53	134	125	40	23	14	17	2	15	735
1933	40	211	268	290	136	153	40	29	7	55	53	9	1291
1934	121	230	217	128	99	149	83	49	9	1	23	25	1134
1935	72	91	123	111	108	137	18	75	2	2	0	4	743
1936	130	285	146	321	201	135	23	9	1	6	1	7	1265
1937	108	78	140	210	187	37	130	26	53	21	85	45	1120
1938	139	88	225	214	215	95	76	67	7	34	53	50	1263
1939	136	183	125	139	123	128	98	77	15	4	1	100	1129
1940	37	166	191	177	154	76	105	8	2	22	2	65	1005
1941	147	34	41	191	136	182	76	35	5	0	62	39	948
1942	119	162	206	189	79	143	152	102	11	71	50	28	1312
1943	232	205	200	150	175	94	8	47	52	6	0	104	1273
1944	104	121	47	95	149	209	23	36	1	0	0	1	786
1945	40	52	89	156	113	135	52	52	1	3	0	21	714
1946	189	135	89	117	132	127	67	13	15	18	4	72	978
1947	117	130	174	150	105	283	72	25	0	5	3	12	1076
1948	91	57	61	182	96	109	51	27	6	10	3	39	732
1949	93	123	177	158	119	194	96	57	6	55	97	23	1198
1950	76	73	150	140	125	91	69	35	13	1	27	34	834
1951	181	27	120	150	188	126	29	19	9	46	40	38	973
1952	68	133	153	94	206	76	129	24	5	0	23	23	934
1953	128	109	151	153	121	112	27	46	16	1	0	34	898
1954	45	126	108	244	200	97	62	47	13	9	0	7	958
1955	92	154	208	90	189	138	32	63	2	9	1	34	1012
1956	129	178	353	187	126	126	56	19	31	38	59	225	1527
1957	232	127	129	207	86	96	105	60	4	0	0	64	1110
1958	68	154	158	107	90	70	114	142	11	59	1	3	977
1959	147	145	214	114	159	151	94	28	6	11	53	68	1190
1960	119	146	175	233	74	148	112	87	35	13	19	51	1212
1961	20	228	143	127	190	130	87	16	0	0	18	26	985
1962	49	140	91	265	104	149	98	25	28	36	3	12	1000
1963	95	150	143	216	90	208	77	13	42	0	28	50	1112
1964	210	88	135	153	61	68	94	6	46	25	36	31	953
1965	56	121	89	261	116	46	25	28	10	0	18	15	785
1966	72	109	166	356	186	137	91	55	15	6	17	21	1231
1967	88	132	136	64	75	130	62	80	4	12	22	12	817
1968	64	88	128	126	80	149	76	88	7	6	15	18	845
1969	145	76	192	124	69	57	28	17	22	21	39	76	866
1970	101	69	178	194	115	116	72	61	3	20	12	11	952
1971	66	84	103	183	170	151	29	31	8	3	15	36	879
1972	81	142	37	97	165	108	57	11	1	11	93	46	849
1973	44	129	138	211	152	131	59	22	31	5	32	24	978
1974	57	258	135	219	176	147	48	12	8	23	16	142	1241
1975	84	223	169	221	186	270	79	40	30	0	8	92	1402
1976	180	184	104	196	113	195	47	22	4	0	3	81	1129
1977	176	60	154	224	90	132	101	6	8	4	34	84	1073
1978	95	71	224	72	126	70	23	53	6	62	98	57	957
1979	130	124	145	117	143	68	28	10	2	1	6	135	909
1980	31	161	105	265	159	105	74	15	34	1	64	16	1030
1981	40	116	127	109	67	89	104	10	18	22	3	25	730
1982	147	96	50	84	72	76	33	29	11	29	3	19	649
1983	103	166	141	160	86	123	34	43	7	4	50	13	930
1984	105	82	94	102	203	52	22	3	2	1	2	10	678
1985	159	128	206	101	107	72	72	1	45	1	61	32	985
AVE.	104	130	145	167	132	125	66	37	13	15	24	42	100.0
SDEV	51	55	57	66	43	49	34	28	14	19	28	41	

VALUES IN TENTHS OF A PERCENT OF ANNUAL AVERAGE RAINFALL

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00	%	PI=	1.5	mm/D	ZMIN=	61.0	mm/M	ZMAX=	450.0	mm/M	RFACT= 1.000
R=	.60		POW=	3.0		SL=	.00	mm	FT=	25.0	mm/M	
GW=	.0	mm/M	TL=	.25	MTHS	GL=	.00	MTHS	NOFT=	4	PER MTH	
POWG=	2.5		SGL=	.0	mm	SG=	.0	mm	FG=	.0	mm/M	

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF OBS (%MAR)	RUNOFF SIM (%MAR)	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	55.0	10.0	10.5	10.3	78.3	77.0	86.3	64.7
NOV	140.0	55.0	12.6	14.5	13.8	108.1	102.9	101.7	82.3
DEC	160.0	55.0	13.5	13.7	12.8	101.7	95.4	74.6	60.5
JAN	150.0	55.0	15.1	14.2	16.1	105.7	119.8	107.3	91.0
FEB	125.0	55.0	12.4	12.8	13.8	95.1	102.4	75.5	78.5
MAR	120.0	55.0	11.8	11.9	13.2	88.7	97.9	100.2	91.6
APR	80.0	55.0	5.5	8.5	5.9	63.2	43.9	71.2	35.1
MAY	70.0	55.0	2.9	3.6	2.6	26.9	19.2	24.9	17.8
JUN	50.0	55.0	1.3	1.9	1.4	14.0	10.5	14.9	7.2
JUL	48.0	55.0	1.2	.9	1.3	6.8	9.5	9.1	10.4
AUG	56.0	55.0	3.0	2.9	3.5	21.8	25.8	51.9	36.7
SEP	96.0	55.0	4.9	4.6	5.4	34.6	40.0	41.1	43.6
YEAR	1203.0					744.8	744.4	372.3	349.2
MEAN AND ST.DEVN. OF LOGS						2.823	2.831	.213	.193

MAXIMUM OBSERVED = 353.3 MAXIMUM SIMULATED = 404.9

INITIAL SOIL STORAGE =	22.5	
FINAL SOIL STORAGE =	26.7 mm	
TOTAL RAIN =	15697.4 mm	
TOTAL INTERCEPTION LOSS =	1460.6 mm	9.3 % rain
TOTAL SURFACE RUNOFF =	2141.1 mm	13.6 % rain
TOTAL EVAP FROM SOIL =	9867.9 mm	62.9 % rain
TOTAL INTERFLOW =	2224.7 mm	14.2 % rain
INITIAL G.WATER STORAGE =	.0 mm	
FINAL G.WATER STORAGE =	.0 mm	
TOTAL G.WATER RUNOFF =	.0 mm	.0 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	55.7	6	APR 1985	SEP 1985
	OBS	61.1	6	MAR 1970	AUG 1970
40.	SIM	134.6	10	DEC 1982	SEP 1983
	OBS	135.6	6	MAR 1970	AUG 1970
60.	SIM	330.8	29	MAY 1981	SEP 1983
	OBS	362.0	28	JUN 1968	SEP 1970
80.	SIM	618.4	54	APR 1981	SEP 1985
	OBS	737.9	33	JAN 1968	SEP 1970
90.	SIM	1153.5	54	APR 1981	SEP 1985
	OBS	1167.5	71	JAN 1968	NOV 1973

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	14151.6	14143.2	-.1
MEAN ANNUAL RUNOFF	744.8	744.4	-.1
AVERAGE MONTHLY RUNOFF	62.1	62.0	-.1
VARIANCE OF MONTHLY VALUES	6200.6	4901.6	-21.0
RANGE OF RESIDUAL MASS CURVE	2807.2	2587.3	-7.8
MEAN OF RESIDUAL MASS CURVE	-91.3	189.3	-307.3
INDEX OF SEASONAL VARIABILITY	27.7	30.0	8.3
MEAN DEFICIT FLOW PERIOD(MONTHS)	5.9	6.4	7.5
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	12	12	.0

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.858
STUDENTS T VALUE	25.077
REGRESSION COEFFICIENT	.763
BASE CONSTANT OF REGRESSION EQUATION	14.700

TABLE 3A (CONTD)

SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.858
STUDENTS T VALUE	25.077
REGRESSION COEFFICIENT	.763
BASE CONSTANT OF REGRESSION EQUATION	14.700
REGRESSION SUM OF SQUARES	822104.300
RESIDUAL SUM OF SQUARES	295455.300
TOTAL SUM OF SQUARES	1117560.000
STANDARD ERROR OF ESTIMATE	36.157
MAXIMUM EQIVALENT CONSTANT ERROR (%)	51.419
RELATIVE ABSOLUTE ERROR(%)	41.389
COEFFICIENT OF DETERMINATION	.736
STANDARD COEFFICIENT OF EFFICIENCY	.735
RESIDUAL MASS CURVE COEFFICIENT	.824
SPECIAL COEFFICIENT OF EFFICIENCY	.658
COEFFICIENT OF PERSISTENCE	1.341
RELATIVE MEAN PERSISTENCE (%)	1.796
DURBIN-WATSON D-STATISTIC	2.097

SIGN TEST

NUMBER OF NEGATIVE RUNS	53
NUMBER OF POSITIVE RUNS	53
EXPECTED NUMBER OF RUNS	110.4
NUMBER OF NEGATIVE RESIDUALS	91
NUMBER OF POSITIVE RESIDUALS	137
STANDARDISED NORMAL VARIATE Z	.603

RESIDUAL MASS CURVES

	OBSERVED											SIMULATED										
1967	-60.	-25.	10.	-28.	-82.	-106.	-129.	-80.	-129.	-180.	-237.	-289.	-27.	-5.	11.	-28.	-77.	-62.	-81.	-89.	-128.	-182.	-235.	-290.
1968	-334.	-379.	-360.	-414.	-470.	-493.	-481.	-503.	-530.	-585.	-643.	-702.	-335.	-368.	-382.	-394.	-430.	-378.	-377.	-368.	-401.	-457.	-512.	-567.
1969	-709.	-726.	-728.	-746.	-744.	-800.	-860.	-920.	-981.	-1042.	-1103.	-1137.	-504.	-507.	-415.	-392.	-433.	-483.	-539.	-596.	-651.	-702.	-742.	-752.
1970	-1076.	-1074.	-1029.	-951.	-936.	-939.	-899.	-931.	-987.	-1045.	-1105.	-1164.	-747.	-776.	-712.	-579.	-551.	-547.	-567.	-593.	-640.	-693.	-747.	-803.
1971	-1226.	-1270.	-1294.	-1218.	-1152.	-979.	-1011.	-1035.	-1087.	-1146.	-1206.	-1266.	-848.	-883.	-915.	-838.	-718.	-617.	-633.	-686.	-742.	-799.	-855.	-906.
1972	-1308.	-1303.	-1358.	-1417.	-1342.	-1356.	-1379.	-1434.	-1493.	-1553.	-1543.	-1556.	-936.	-899.	-928.	-973.	-907.	-885.	-918.	-970.	-1029.	-1086.	-1043.	-1051.
1973	-1572.	-1598.	-1574.	-1486.	-1391.	-1379.	-1377.	-1418.	-1455.	-1506.	-1553.	-1598.	-1097.	-1092.	-1077.	-932.	-828.	-774.	-793.	-843.	-893.	-946.	-994.	-1044.
1974	-1653.	-1616.	-1519.	-1240.	-1056.	-893.	-926.	-973.	-1030.	-1084.	-1146.	-1132.	-1091.	-841.	-748.	-589.	-434.	-336.	-349.	-403.	-461.	-514.	-566.	-473.
1975	-1074.	-797.	-702.	-551.	-386.	-95.	-22.	-40.	-61.	-111.	-167.	-191.	-449.	-255.	-127.	85.	231.	574.	660.	622.	576.	523.	467.	468.
1976	84.	328.	286.	301.	415.	608.	587.	536.	479.	420.	359.	307.	629.	803.	823.	927.	954.	1104.	1120.	1067.	1011.	952.	893.	877.
1977	409.	401.	363.	627.	637.	638.	883.	846.	791.	733.	675.	707.	1023.	1038.	1058.	1233.	1263.	1208.	1314.	1279.	1221.	1163.	1115.	1111.
1978	730.	704.	656.	839.	814.	789.	732.	681.	633.	612.	773.	874.	1114.	1083.	1231.	1246.	1239.	1210.	1157.	1113.	1062.	1051.	1127.	1134.
1979	982.	1005.	1122.	1110.	1147.	1117.	1060.	1001.	940.	879.	817.	788.	1184.	1217.	1242.	1232.	1263.	1248.	1193.	1139.	1078.	1017.	958.	1032.
1980	762.	787.	798.	1063.	1083.	1133.	1132.	1126.	1119.	1059.	1042.	1033.	1023.	1083.	1085.	1321.	1474.	1491.	1467.	1419.	1370.	1317.	1304.	1267.
1981	984.	994.	1085.	1039.	991.	949.	1022.	994.	938.	880.	822.	764.	1214.	1197.	1189.	1164.	1119.	1083.	1093.	1059.	1004.	952.	898.	843.
1982	770.	720.	877.	821.	773.	738.	706.	686.	633.	577.	521.	464.	911.	924.	877.	826.	778.	735.	684.	630.	575.	525.	473.	417.
1983	436.	443.	531.	745.	692.	647.	604.	570.	511.	452.	391.	334.	404.	493.	537.	987.	573.	580.	547.	499.	446.	389.	336.	310.
1984	309.	301.	264.	218.	287.	298.	249.	189.	128.	67.	5.	-57.	301.	277.	240.	204.	345.	357.	301.	242.	182.	122.	63.	4.
1985	56.	81.	285.	252.	270.	226.	206.	153.	119.	60.	14.	0.	91.	146.	280.	296.	270.	233.	198.	147.	102.	52.	35.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	11.8	23.6	35.3	47.1	58.9	70.7	82.4	94.2	106.0
OBSERVED %TIME	100.0	68.0	57.5	48.2	37.3	33.3	29.4	23.7	21.1	19.3
SIMULATED %TIME	100.0	71.9	60.1	49.1	43.4	36.4	31.6	25.9	21.5	19.7
ERROR	.0	3.9	2.6	.9	6.1	3.1	2.2	2.2	.4	.4

MONTHLY DISCHARGE	117.8	129.5	141.3	153.1	164.9	176.7	188.4	200.2	212.0	223.8
OBSERVED %TIME	18.0	16.7	14.0	12.7	11.0	9.2	8.8	8.3	7.9	6.1
SIMULATED %TIME	17.1	15.4	13.6	12.3	9.6	9.2	8.8	7.5	5.3	3.5
ERROR	-.9	-1.3	-.4	-.4	-1.3	.0	.0	-.9	-2.6	-2.6

MONTHLY DISCHARGE	235.5	247.3	259.1	270.9	282.6	294.4	306.2	318.0	329.7	341.5
OBSERVED %TIME	5.3	4.8	3.9	3.5	3.5	3.5	3.1	2.2	1.3	.4
SIMULATED %TIME	3.5	1.8	1.3	1.3	1.3	1.3	.9	.4	.4	.4
ERROR	-1.8	-3.1	-2.6	-2.2	-2.2	-2.2	-2.2	-1.8	-.9	.0

OBSERVED MAXIMUM MONTHLY VALUE	353.300
SIMULATED MAXIMUM MONTHLY VALUE	404.939

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.3756	.5329
2	.1828	.3147
3	.1096	.0872
4	-.0063	-.0711
5	-.1597	-.2342
6	-.1984	-.2563
7	-.1510	-.1881
8	-.0064	-.0793
9	-.0042	.0579
10	.1374	.2647
11	.3626	.3677
12	.3514	.4861

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

TABLE 3A CONTD

CORRELATION COEFFICIENT	.858
STUDENTS T VALUE	25.077
REGRESSION COEFFICIENT	.763
BASE CONSTANT OF REGRESSION EQUATION	14.700
REGRESSION SUM OF SQUARES	822104.300
RESIDUAL SUM OF SQUARES	295455.300
TOTAL SUM OF SQUARES	1117560.000
STANDARD ERROR OF ESTIMATE	36.157
MAXIMUM EQIVALENT CONSTANT ERROR (%)	51.419
RELATIVE ABSOLUTE ERROR(%)	41.389
COEFFICIENT OF DETERMINATION	.736
STANDARD COEFFICIENT OF EFFICIENCY	.735
RESIDUAL MASS CURVE COEFFICIENT	.824
SPECIAL COEFFICIENT OF EFFICIENCY	.658
COEFFICIENT OF PERSISTENCE	1.341
RELATIVE MEAN PERSISTENCE (%)	1.796
DURBIN-WATSON D-STATISTIC	2.097

SIGN TEST

NUMBER OF NEGATIVE RUNS	53
NUMBER OF POSITIVE RUNS	53
EXPECTED NUMBER OF RUNS	110.4
NUMBER OF NEGATIVE RESIDUALS	91
NUMBER OF POSITIVE RESIDUALS	137
STANDARDISED NORMAL VARIATE Z	.603

RESIDUAL MASS CURVES

	OBSERVED												SIMULATED											
1967	-60.	-25.	10.	-28.	-82.	-106.	-129.	-80.	-129.	-180.	-237.	-289.	-27.	-5.	11.	-28.	-77.	-62.	-81.	-89.	-128.	-182.	-235.	-290.
1968	-334.	-379.	-380.	-414.	-470.	-495.	-481.	-503.	-530.	-585.	-643.	-702.	-335.	-368.	-382.	-394.	-430.	-378.	-377.	-368.	-401.	-457.	-512.	-567.
1969	-709.	-726.	-728.	-746.	-744.	-800.	-860.	-920.	-981.	-1042.	-1103.	-1137.	-504.	-507.	-415.	-392.	-433.	-483.	-539.	-596.	-651.	-702.	-742.	-752.
1970	-1076.	-1074.	-1029.	-951.	-936.	-939.	-899.	-931.	-987.	-1045.	-1105.	-1166.	-747.	-776.	-712.	-579.	-531.	-547.	-567.	-593.	-640.	-693.	-747.	-803.
1971	-1226.	-1270.	-1294.	-1218.	-1152.	-979.	-1011.	-1035.	-1087.	-1146.	-1206.	-1266.	-848.	-883.	-915.	-838.	-718.	-617.	-633.	-686.	-742.	-799.	-855.	-906.
1972	-1308.	-1303.	-1358.	-1417.	-1342.	-1336.	-1379.	-1434.	-1493.	-1553.	-1543.	-1556.	-934.	-899.	-928.	-973.	-907.	-883.	-918.	-970.	-1029.	-1086.	-1043.	-1051.
1973	-1572.	-1598.	-1574.	-1486.	-1351.	-1379.	-1377.	-1418.	-1455.	-1506.	-1553.	-1598.	-1097.	-1092.	-1077.	-932.	-828.	-774.	-793.	-843.	-893.	-946.	-994.	-1044.
1974	-1655.	-1414.	-1319.	-1240.	-1056.	-895.	-926.	-973.	-1030.	-1084.	-1144.	-1132.	-1091.	-841.	-768.	-589.	-434.	-336.	-349.	-403.	-461.	-514.	-566.	-473.
1975	-1074.	-797.	-702.	-551.	-388.	-95.	-22.	-40.	-61.	-111.	-167.	-191.	-449.	-255.	-127.	55.	231.	574.	660.	622.	576.	523.	467.	468.
1976	84.	328.	286.	301.	415.	608.	587.	536.	479.	420.	359.	307.	629.	805.	925.	927.	954.	1104.	1120.	1067.	1011.	952.	893.	877.
1977	409.	401.	363.	427.	637.	638.	883.	846.	791.	733.	675.	707.	1023.	1038.	1058.	1235.	1265.	1288.	1314.	1278.	1221.	1163.	1115.	1111.
1978	730.	704.	856.	839.	814.	789.	732.	681.	633.	612.	773.	874.	1114.	1083.	1231.	1246.	1239.	1210.	1157.	1113.	1062.	1051.	1127.	1134.
1979	982.	1005.	1122.	1110.	1147.	1117.	1060.	1001.	940.	879.	817.	788.	1184.	1217.	1242.	1232.	1243.	1246.	1193.	1135.	1076.	1017.	958.	1032.
1980	762.	787.	798.	1063.	1083.	1133.	1152.	1126.	1115.	1059.	1042.	1035.	1023.	1083.	1085.	1321.	1474.	1491.	1467.	1419.	1370.	1317.	1304.	1267.
1981	984.	996.	1085.	1039.	991.	949.	1022.	994.	938.	880.	822.	764.	1214.	1197.	1189.	1164.	1119.	1083.	1093.	1059.	1006.	952.	898.	843.
1982	770.	920.	877.	821.	773.	738.	706.	686.	635.	577.	521.	464.	911.	924.	877.	826.	778.	735.	684.	630.	575.	523.	473.	417.
1983	436.	443.	551.	745.	692.	647.	604.	570.	511.	452.	391.	334.	404.	493.	537.	587.	573.	580.	547.	499.	446.	389.	336.	310.
1984	309.	301.	264.	218.	287.	296.	249.	189.	128.	67.	5.	-57.	301.	277.	240.	204.	345.	357.	301.	242.	182.	122.	63.	4.
1985	56.	81.	285.	252.	270.	226.	206.	153.	119.	60.	14.	0.	91.	146.	280.	296.	270.	233.	198.	147.	102.	52.	35.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	11.8	23.6	35.3	47.1	58.9	70.7	82.4	94.2	106.0
OBSERVED %TIME	100.0	68.0	57.5	48.2	37.3	33.3	29.4	23.7	21.1	19.3
SIMULATED %TIME	100.0	71.9	60.1	49.1	43.4	36.4	31.6	25.9	21.5	19.7
ERROR	.0	3.9	2.6	.9	6.1	3.1	2.2	2.2	.4	.4
MONTHLY DISCHARGE	117.8	129.5	141.3	153.1	164.9	176.7	188.4	200.2	212.0	223.8
OBSERVED %TIME	18.0	16.7	14.0	12.7	11.0	9.2	8.8	8.3	7.9	6.1
SIMULATED %TIME	17.1	15.4	13.6	12.3	9.6	9.2	8.8	7.5	5.3	3.5
ERROR	-.9	-1.3	-.4	-.4	-1.3	.0	.0	-.9	-2.6	-2.6
MONTHLY DISCHARGE	235.5	247.3	259.1	270.9	282.6	294.4	306.2	318.0	329.7	341.5
OBSERVED %TIME	5.3	4.8	3.9	3.5	3.5	3.5	3.1	2.2	1.3	.4
SIMULATED %TIME	3.5	1.8	1.3	1.3	1.3	1.3	.9	.4	.4	.4
ERROR	-1.8	-3.1	-2.6	-2.2	-2.2	-2.2	-2.2	-1.8	-.9	.0

OBSERVED MAXIMUM MONTHLY VALUE	353.300
SIMULATED MAXIMUM MONTHLY VALUE	404.939

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.3756	.5329
2	.1828	.3147
3	.1096	.0872
4	-.0063	-.0711
5	-.1597	-.2342
6	-.1984	-.2563
7	-.1510	-.1881
8	-.0064	-.0793
9	-.0042	.0579
10	.1374	.2647
11	.3626	.3677
12	.3514	.4861

TABLE 3B – PITMAN MODEL FITTED TO INCREMENTAL CATCHMENT

SYNTHESIZED RUNOFF AT GAUGE G08(DNE) CATCHMENT AREA= 1028.SQ.KM M.A.P.= 777.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00 %	PI=	1.5 mm/D	ZMIN=	50.0 mm/M	ZMAX= 500.0 mm/M	RFACT= 1.000
R=	.50	POW=	3.0	SL=	.00 mm	FT= 19.0 mm/M	
GW=	.0 mm/M	TL=	.75 MTHS	GL=	.00 MTHS	NOFT= 4 PER MTH	
POWG=	2.5	SGL=	.0 mm	SG=	.0 mm	FG= .0 mm/M	

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF (%MAR) OBS	RUNOFF (%MAR) SIM	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	53.0	8.6	10.5	9.4	78.3	69.9	86.3	67.4
NOV	140.0	53.0	11.2	14.5	13.9	108.1	103.9	101.7	89.7
DEC	160.0	53.0	12.7	13.7	12.7	101.7	94.7	74.6	67.5
JAN	150.0	53.0	16.4	14.2	14.7	105.7	109.6	107.3	88.5
FEB	125.0	53.0	13.4	12.8	14.6	95.1	108.9	75.5	75.1
MAR	120.0	53.0	12.1	11.9	13.1	88.7	97.8	100.2	93.0
APR	80.0	53.0	4.8	8.5	9.0	63.2	67.0	71.2	64.9
MAY	70.0	53.0	2.4	3.6	2.8	26.9	20.8	24.9	11.2
JUN	50.0	53.0	1.0	1.9	1.6	14.0	11.8	14.9	11.1
JUL	48.0	53.0	1.1	.9	.8	6.8	5.9	9.1	6.7
AUG	56.0	53.0	3.0	2.9	2.7	21.8	20.2	51.9	39.6
SEP	96.0	53.0	4.5	4.6	4.6	34.6	34.3	41.1	36.1
YEAR	1203.0					744.8	744.8	372.3	372.4
MEAN AND ST.DEVN. OF LOGS						2.823	2.812	.213	.257

MAXIMUM OBSERVED = 353.3 MAXIMUM SIMULATED = 331.0

INITIAL SOIL STORAGE =	16.8	
FINAL SOIL STORAGE =	22.8 mm	
TOTAL RAIN =	13463.1 mm	
TOTAL INTERCEPTION LOSS =	1315.9 mm	9.8 % rain
TOTAL SURFACE RUNOFF =	1316.8 mm	9.8 % rain
TOTAL EVAP FROM SOIL =	9053.2 mm	67.2 % rain
TOTAL INTERFLOW =	1772.3 mm	13.2 % rain
INITIAL G.WATER STORAGE =	.0 mm	
FINAL G.WATER STORAGE =	.0 mm	
TOTAL G.WATER RUNOFF =	.0 mm	.0 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	65.7	9	JAN 1986	SEP 1986
	OBS	61.1	6	MAR 1970	AUG 1970
40.	SIM	220.9	17	MAY 1985	SEP 1986
	OBS	135.6	6	MAR 1970	AUG 1970
60.	SIM	431.9	17	MAY 1985	SEP 1986
	OBS	362.0	28	JUN 1968	SEP 1970
80.	SIM	732.4	65	MAY 1981	SEP 1986
	OBS	737.9	33	JAN 1968	SEP 1970
90.	SIM	1135.8	65	MAY 1981	SEP 1986
	OBS	1167.5	71	JAN 1968	NOV 1973

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	14151.6	14151.2	.0
MEAN ANNUAL RUNOFF	744.8	744.8	.0
AVERAGE MONTHLY RUNOFF	62.1	62.1	.0
VARIANCE OF MONTHLY VALUES	6200.6	5228.2	-15.7
RANGE OF RESIDUAL MASS CURVE	2807.2	2653.3	-5.5
MEAN OF RESIDUAL MASS CURVE	-91.3	389.0	-526.0
INDEX OF SEASONAL VARIABILITY	27.7	29.2	5.4
MEAN DEFICIT FLOW PERIOD(MONTHS)	5.9	7.0	19.0
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	12	19	58.3

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.454
STUDENTS T VALUE	7.649
REGRESSION COEFFICIENT	.416

TABLE 3B CONTD

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.454
STUDENTS T VALUE	7.649
REGRESSION COEFFICIENT	.416
BASE CONSTANT OF REGRESSION EQUATION	36.220
REGRESSION SUM OF SQUARES	245159.400
RESIDUAL SUM OF SQUARES	946880.800
TOTAL SUM OF SQUARES	1192040.000
STANDARD ERROR OF ESTIMATE	64.728
MAXIMUM EQIVALENT CONSTANT ERROR (%)	100.332
RELATIVE ABSOLUTE ERROR(%)	80.007
COEFFICIENT OF DETERMINATION	.206
STANDARD COEFFICIENT OF EFFICIENCY	-.010
RESIDUAL MASS CURVE COEFFICIENT	.504
SPECIAL COEFFICIENT OF EFFICIENCY	-.301
COEFFICIENT OF PERSISTENCE	2.438
RELATIVE MEAN PERSISTENCE (%)	5.556
DURBIN-WATSON D-STATISTIC	1.825

SIGN TEST

NUMBER OF NEGATIVE RUNS	38
NUMBER OF POSITIVE RUNS	38
EXPECTED NUMBER OF RUNS	115.0
NUMBER OF NEGATIVE RESIDUALS	113
NUMBER OF POSITIVE RESIDUALS	115
STANDARDISED NORMAL VARIATE Z	5.176

RESIDUAL MASS CURVES

	OBSERVED											SIMULATED										
1967	-60.	-23.	10.	-28.	-82.	-106.	-129.	-80.	-129.	-180.	-237.	-289.	-43.	-80.	-68.	-120.	-174.	-197.	-186.	-210.	-238.	-292.	-349.	-405.
1968	-334.	-379.	-360.	-414.	-470.	-495.	-481.	-503.	-530.	-585.	-643.	-702.	-420.	-442.	-447.	-434.	-401.	-428.	-460.	-508.	-561.	-617.	-674.	-711.
1969	-709.	-726.	-728.	-746.	-744.	-800.	-860.	-920.	-981.	-1042.	-1103.	-1137.	-663.	-660.	-591.	-490.	-474.	-482.	-460.	-498.	-554.	-610.	-665.	-717.
1970	-1076.	-1076.	-1029.	-931.	-936.	-939.	-899.	-931.	-987.	-1045.	-1105.	-1166.	-765.	-807.	-812.	-699.	-614.	-468.	-498.	-527.	-579.	-637.	-696.	-754.
1971	-1226.	-1270.	-1294.	-1218.	-1152.	-979.	-1011.	-1035.	-1087.	-1146.	-1206.	-1266.	-798.	-803.	-858.	-877.	-774.	-751.	-754.	-803.	-861.	-922.	-933.	-953.
1972	-1308.	-1303.	-1358.	-1417.	-1342.	-1356.	-1379.	-1434.	-1493.	-1553.	-1543.	-1556.	-975.	-994.	-968.	-897.	-797.	-804.	-811.	-855.	-902.	-959.	-998.	-1030.
1973	-1572.	-1598.	-1574.	-1486.	-1351.	-1379.	-1377.	-1418.	-1455.	-1506.	-1553.	-1598.	-1083.	-870.	-817.	-717.	-540.	-412.	-435.	-480.	-537.	-592.	-650.	-653.
1974	-1653.	-1414.	-1319.	-1240.	-1056.	-895.	-926.	-973.	-1030.	-1084.	-1144.	-1132.	-626.	-377.	-290.	-119.	76.	345.	423.	403.	369.	314.	237.	243.
1975	-1074.	-797.	-702.	-531.	-386.	-93.	-22.	-40.	-61.	-111.	-167.	-191.	455.	666.	662.	722.	863.	1100.	1148.	1112.	1058.	999.	938.	888.
1976	84.	328.	286.	301.	415.	608.	587.	536.	479.	420.	359.	307.	981.	982.	954.	1192.	1181.	1219.	1435.	1398.	1340.	1281.	1221.	1239.
1977	409.	401.	363.	627.	637.	638.	883.	846.	791.	733.	675.	707.	1273.	1260.	1372.	1372.	1364.	1346.	1298.	1251.	1201.	1171.	1284.	1374.
1978	730.	704.	856.	939.	814.	789.	732.	681.	633.	612.	773.	874.	1458.	1468.	1555.	1530.	1561.	1539.	1486.	1428.	1370.	1314.	1271.	1262.
1979	982.	1005.	1122.	1110.	1147.	1117.	1060.	1001.	940.	879.	817.	788.	1232.	1255.	1247.	1465.	1491.	1546.	1570.	1537.	1513.	1457.	1430.	1415.
1980	762.	787.	798.	1063.	1083.	1133.	1152.	1126.	1115.	1059.	1042.	1035.	1371.	1384.	1463.	1463.	1484.	1474.	1539.	1504.	1448.	1390.	1334.	1280.
1981	984.	996.	1085.	1039.	991.	949.	1022.	994.	938.	880.	822.	764.	1278.	1396.	1356.	1308.	1269.	1243.	1210.	1179.	1127.	1071.	1016.	960.
1982	770.	920.	877.	821.	773.	738.	706.	686.	635.	577.	521.	464.	954.	1003.	1086.	1209.	1153.	1110.	1062.	1021.	961.	903.	845.	806.
1983	436.	443.	551.	745.	692.	647.	604.	570.	511.	452.	391.	354.	762.	777.	764.	729.	807.	827.	794.	739.	679.	619.	558.	498.
1984	309.	301.	264.	218.	287.	296.	249.	189.	128.	67.	5.	-57.	544.	603.	816.	779.	851.	857.	854.	801.	761.	701.	658.	630.
1985	56.	81.	285.	252.	270.	226.	206.	153.	119.	60.	14.	0.	587.	555.	513.	463.	405.	345.	286.	225.	165.	105.	52.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	11.8	23.6	35.3	47.1	58.9	70.7	82.4	94.2	106.0
OBSERVED %TIME	100.0	68.0	57.5	48.2	37.3	33.3	29.4	23.7	21.1	19.3
SIMULATED %TIME	100.0	71.5	59.6	48.2	41.2	34.2	30.3	25.9	21.9	20.6
ERROR	.0	3.5	2.2	.0	3.9	.9	.9	2.2	.9	1.3
MONTHLY DISCHARGE	117.8	129.5	141.3	153.1	164.9	176.7	188.4	200.2	212.0	223.8
OBSERVED %TIME	18.0	16.7	14.0	12.7	11.0	9.2	8.8	8.3	7.9	6.1
SIMULATED %TIME	18.0	16.7	14.9	11.4	9.6	7.9	7.0	6.6	5.7	5.7
ERROR	.0	.0	.9	-1.3	-1.3	-1.3	-1.8	-1.8	-2.2	-.4
MONTHLY DISCHARGE	235.5	247.3	259.1	270.9	282.6	294.4	306.2	318.0	329.7	341.5
OBSERVED %TIME	5.3	4.8	3.9	3.5	3.5	3.5	3.1	2.2	1.3	.4
SIMULATED %TIME	5.3	4.8	4.4	3.9	1.3	1.3	.9	.4	.4	.0
ERROR	.0	.0	.4	.4	-2.2	-2.2	-2.2	-1.8	-.9	-.4

OBSERVED MAXIMUM MONTHLY VALUE	353.300
SIMULATED MAXIMUM MONTHLY VALUE	330.971

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.3756	.4806
2	.1828	.2889
3	.1096	.1245
4	-.0063	-.0405
5	-.1597	-.2028
6	-.1984	-.2437
7	-.1510	-.2028
8	-.0064	-.0529
9	-.0042	.0399
10	.1374	.1939
11	.3626	.4069

TABLE 4 (TOTAL)

SYNTHESISED/ORIGINAL RUNOFF AT GAUGE 608 USING MODIFIED PITMAN MODEL FOR HYDROLOGICAL YEARS STARTING OCTOBER

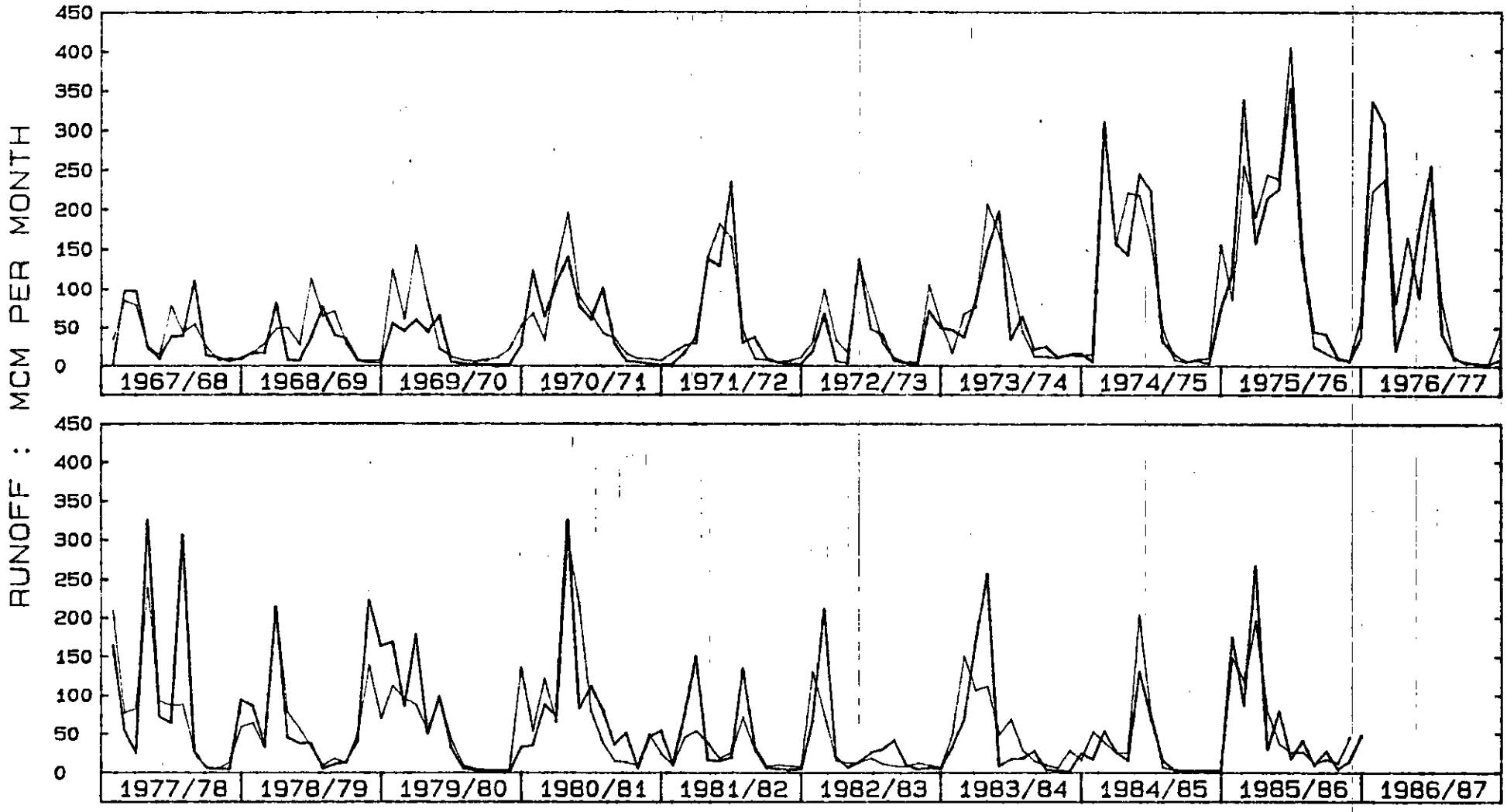
(I4,2X,12(I5,A),F9.1)

1930	332P	288P	345P	1276P	1449P	812P	959P	688P	186P	189P	214P	90P	682.8
1931	145P	447P	507P	410P	1089P	1434P	711P	196P	88P	48P	32P	48P	515.5
1932	92P	496P	714P	352P	432P	795P	575P	191P	94P	80P	74P	56P	395.1
1933	61P	1182P	2938P	3974P	3026P	1655P	1019P	289P	117P	238P	444P	332P	1527.5
1934	515P	1863P	2767P	1815P	709P	857P	930P	457P	225P	97P	74P	89P	1039.8
1935	163P	276P	367P	380P	365P	704P	639P	345P	297P	110P	51P	33P	373.0
1936	501P	2502P	2793P	3057P	3822P	2322P	963P	234P	70P	39P	36P	33P	1637.2
1937	299P	442P	491P	1389P	2173P	1371P	864P	790P	353P	277P	606P	707P	976.2
1938	869P	932P	1428P	2433P	2741P	1924P	680P	446P	303P	173P	299P	364P	1259.2
1939	784P	1647P	1418P	780P	732P	819P	854P	714P	445P	166P	73P	418P	885.0
1940	523P	839P	1623P	1753P	1574P	977P	629P	501P	148P	76P	73P	177P	889.3
1941	892P	926P	226P	801P	1303P	1595P	1399P	484P	182P	75P	256P	358P	849.7
1942	572P	1212P	1845P	2070P	1265P	845P	1534P	1650P	877P	577P	654P	381P	1348.2
1943	1708P	3018P	2578P	1785P	1534P	1237P	416P	160P	235P	235P	110P	465P	1348.1
1944	829P	770P	469P	191P	611P	1839P	1618P	398P	142P	61P	34P	25P	698.7
1945	39P	69P	120P	534P	727P	785P	682P	301P	184P	80P	44P	44P	360.9
1946	1140P	1762P	859P	401P	576P	853P	666P	269P	106P	81P	78P	218P	700.9
1947	643P	922P	1175P	1252P	799P	2283P	2565P	693P	198P	71P	44P	40P	1068.5
1948	204P	275P	137P	726P	936P	526P	388P	181P	95P	63P	54P	79P	366.4
1949	271P	569P	1071P	1333P	982P	1500P	1642P	749P	324P	294P	885P	869P	1048.9
1950	358P	278P	522P	798P	762P	586P	366P	239P	137P	78P	79P	115P	431.8
1951	1122P	1296P	448P	647P	1434P	1580P	733P	202P	82P	164P	285P	255P	824.8
1952	228P	533P	914P	690P	1295P	1429P	964P	829P	240P	82P	65P	83P	735.2
1953	540P	796P	762P	979P	880P	690P	423P	182P	142P	88P	52P	62P	559.6
1954	95P	373P	520P	1571P	2710P	1774P	611P	295P	181P	100P	63P	42P	833.5
1955	203P	818P	1702P	1361P	1246P	1644P	863P	342P	233P	100P	58P	67P	863.7
1956	559P	1459P	3558P	3922P	1876P	1059P	666P	240P	129P	182P	386P	2044P	1608.0
1957	3761P	2738P	1127P	1406P	1332P	509P	603P	625P	312P	112P	49P	151P	1272.5
1958	270P	749P	1204P	830P	382P	243P	542P	1447P	1258P	541P	386P	133P	798.5
1959	695P	1309P	1779P	1504P	1052P	1440P	1139P	510P	178P	82P	207P	398P	1029.3
1960	712P	1106P	1372P	2131P	1720P	973P	1191P	1009P	637P	272P	143P	164P	1143.0
1961	151P	1354P	1913P	931P	1318P	1613P	933P	413P	133P	50P	44P	68P	892.1
1962	98P	505P	626P	1749P	2039P	1151P	1116P	573P	217P	188P	170P	89P	852.1
1963	238P	807P	1055P	1598P	1474P	1585P	1652P	511P	213P	154P	112P	167P	956.6
1964	1492P	1800P	763P	840P	632P	227P	317P	304P	181P	198P	206P	194P	715.4
1965	162P	373P	431P	1663P	2056P	676P	188P	84P	70P	54P	55P	64P	587.6
1966	140P	319P	793P	1060	4056P	2239P	1140	383	671	190	147	267	1140.5
1967	22	971	971	236	87	382	390	1105	134	105	55	102	456.0
1968	173	162	816	78	62	375	757	403	351	67	41	35	332.0
1969	551	449	598	438	648	52	24	25	10	11	12	273	309.1
1970	1233	637	1071	1402	775	594	1017	298	59	47	23	7	716.3
1971	22	176	387	1376C	1282	2348	303	377	101	33	21	20	644.6
1972	201	676	64	288	1377C	475	398	72	29	13	724	490	454.7
1973	459	365	865M	1491C	1978	337	639	212	254	109	153	165	702.7
1974	50M	3038	1564M	1418	2454M	2230M	319	150	48	75	26	743	1211.5
1975	1199	3390#	1565	2139#	2264#	3533C	1353#	441	410	115	68	373	1685.0
1976	3376	3065	200	768	1756	2553	408M	118M	43M	31	19	99	1243.6
1977	1640	543	241	3258	718	634	3064	257	66	44	41	937	1144.3
1978	856	362	2137	449	371	374	49	110	137	417	2225	1635	912.2
1979	1695	858	1787	502	986	323	57	22	14	8	7	326	658.5
1980	358	879	730	3265	823	1122	807	361	513	56	460	550	992.4
1981	102	743	1509	163	144	200	1350	339	62	44M	34	44	473.4
1982	678	2119	194	66	141	264	306#	422#	105	38	68	45	444.6
1983	339	694	1703#	2562#	83	176	187	283	35	25	11	251	634.9
1984	169	539	260	156	1310	708	155	23	9	11	1	1	334.2
1985	1750#	869	2660	294	801	177	417	91	283	37	156	481	801.6
AVE.	648	1028	1119	1259	1271	1097	807	411	220	124	193	282	845.8
SDV.	741	821	822	958	875	745	572	326	221	118	338	377	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

AI = .0 PI = 1.5 ZMIN = 61. ZMAX = 450. R = .5 POW = 3.0 MONTH O N D J F M A M J J A S

SL = .0 FT =25.0 GW = 0. TL = .25 GL = .00 NOFT = 4 P.EVAP 108. 140. 160. 150. 125. 120. 80. 70. 50. 48. 56. 96.

POWG = 2.5 SGL = .0 SS = 0. FS = .0 STMAX = 55. AREA = 3240. RAINFALL = 877. RFACT = 1.000



LEGEND
— OBSERVED FLOWS
— GENERATED FLOWS

MALIBAMATSO AT G08 : PARAY

COMPARISON OF OBSERVED AND GENERATED RUNOFF FIGURE 1

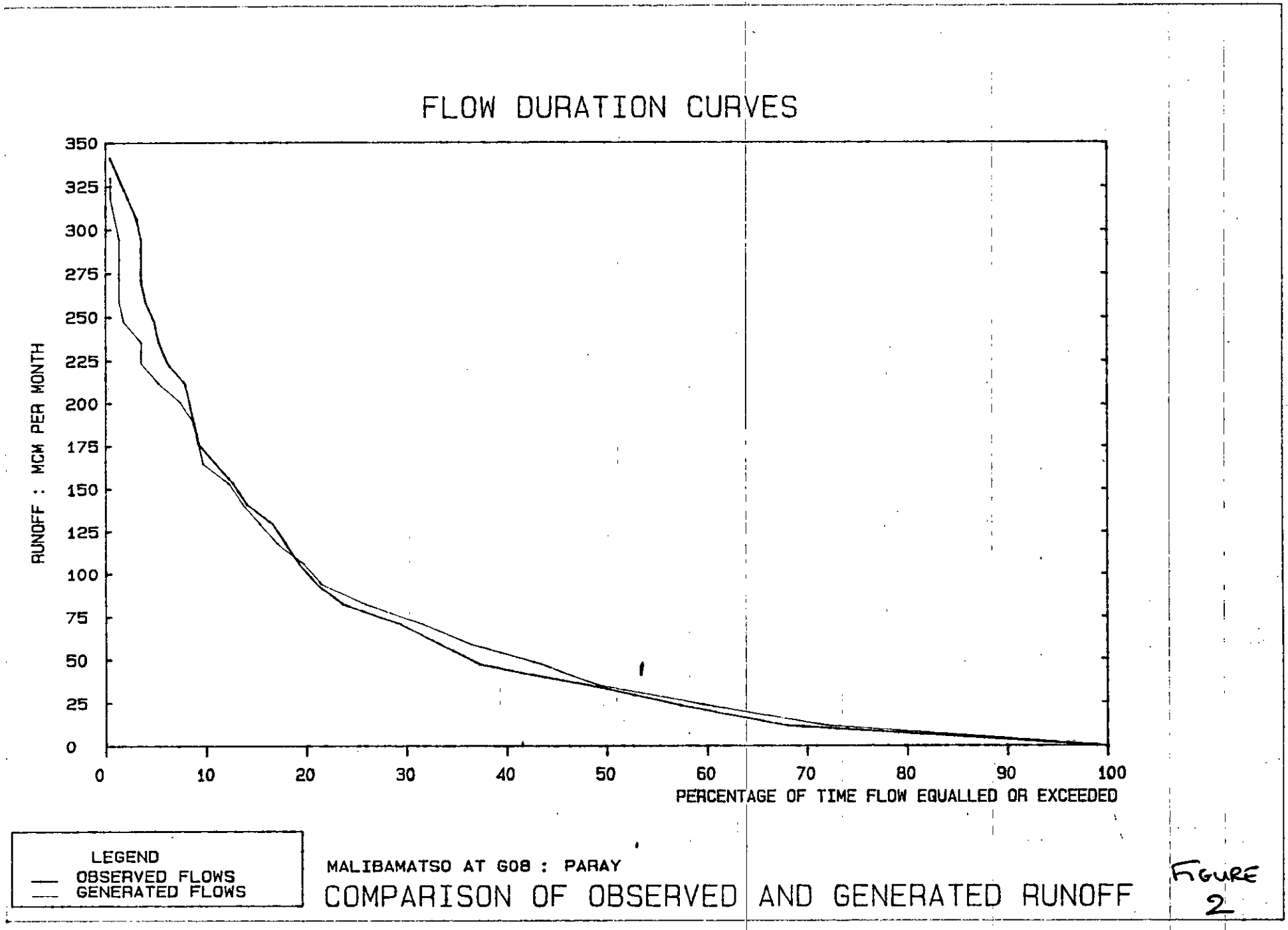

FLOW DURATION CURVES
RUNOFF : MCM PER MONTH
350
325
300
275
250
225
200
175
150
125
100
75
50
25
0
0
10
20
30
40
50
60
70
80
90
100
PERCENTAGE OF TIME FLOW EQUALLED OR EXCEEDED
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
MALIBAMATSO AT G08 : PARAY
COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 2

ANNEX 17

G17 - SENQUNYANE AT MARAKABEI

TABLE 1

617 MARAKABEI - OBSERVED AND MODIFIED PITMAN MODELLED FL INFILLED BY REGRESSION
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

1967	23@	93@	70	43	16	72	216E	545E	100	116	49	35	222.3
1968	91	26	306	12	9	146E	307@	169@	86	23	36	15	122.6
1969	520	162	66	92	158	13	9	9	8	8	8	102	115.5
1970	278	121	525	560	313@	131	257	205	12	1	11	4	241.8
1971	12	30	191	1284	857	852@	134@	345	101	60	60	51	397.7
1972	108	273	20	11	668	158	188	29	16	13	496	89	206.9
1973	68	98	277	865	1003	139	214	71	62	26	139	128	309.0
1974	31	1106	220	543	892	887	135	74	20	70	16	208	420.2
1975	236	1207	511	1186	1351	1400	540	264	338	55	23	285	739.6
1976	1349	774E	42	260	724	1156@	130	65	29	20	17	152	471.8
1977	523E	209	162E	1308@	321@	576E	1611E	80	27	14	20	353	520.4
1978	407	119	809	111	195	51	15	64	40	298	820	205	313.4
1979	815	291	389	122	231	75	53	21	13	9	10	115	214.4
1980	70	369	339	1358	402	554	299	148	313	37	416	312	461.7
1981	50	613	419	94	214	74	778E	105E	32	33	21	22	245.5
1982	454	972	61	51	54	21	42	84	71	39	41	18	190.8
1983	34	516	179	387	23@	43@	76@	209@	9@	5@	3@	104@	158.8
1984	86@	383@	129@	69	256	332	105@	24E	9	5	2	1	140.1
1985	113@	150	524	174	221	57	52	31	146@	13@	65@	160@	170.6
AVE.	277	440	276	449	416	355	272	134	75	44	119	124	298.1
SDV.	344	383	212	497	386	427	376	135	96	68	218	107	
NOBS	19	19	19	19	19	19	19	19	19	19	19	19	

TABLE 2

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,1X,12(I4,A),I8)

1930	92	76	122	180	130	137	161	7	4	80	1	0	990
1931	97	152	85	128	191	123	11	21	9	2	1	37	857
1932	55	125	152	71	117	125	69	22	16	7	2	9	770
1933	29	209	259	333	119	153	85	15	7	47	48	10	1314
1934	135	198	166	153	86	161	84	66	13	2	55	23	1142
1935	88	104	136	119	90	113	34	71	1	5	0	10	771
1936	133	324	146	283	206	143	37	24	4	18	2	24	1344
1937	49	105	166	187	195	34	128	26	43	17	42	28	1020
1938	141	77	169	198	184	66	20	65	3	36	59	48	1066
1939	170	145	89	68	111	126	123	83	6	12	49	133	1115
1940	30	141	196	154	200	77	117	12	1	21	1	55	1005
1941	158	6	62	198	139	166	97	28	1	15	60	35	965
1942	164	181	202	184	58	102	165	112	16	76	80	20	1360
1943	162	276	180	108	185	73	38	48	40	0	0	68	1178
1944	70	102	54	114	101	180	33	64	10	0	0	2	730
1945	40	83	112	158	96	135	52	16	17	2	0	27	738
1946	111	72	145	101	114	46	46	27	16	12	0	82	772
1947	124	75	208	134	82	244	67	43	0	7	1	0	985
1948	53	67	54	192	131	108	37	44	9	11	0	41	747
1949	101	163	212	152	163	198	181	84	11	60	125	33	1483
1950	45	91	202	219	124	122	79	29	26	4	28	28	997
1951	224	31	91	144	171	114	22	28	17	65	40	48	995
1952	46	157	130	118	192	122	102	33	9	0	32	25	966
1953	152	173	179	109	152	139	47	57	22	2	1	29	1062
1954	37	94	113	281	209	93	76	40	10	17	2	6	978
1955	87	138	221	91	238	167	67	69	1	3	0	24	1106
1956	128	91	347	166	106	113	86	7	31	31	63	196	1365
1957	224	141	134	231	84	102	107	85	3	0	0	58	1169
1958	66	155	189	118	119	98	142	101	3	75	0	1	1067
1959	104	140	255	89	178	135	93	42	17	12	41	48	1154
1960	122	168	146	173	84	180	79	64	69	12	30	15	1142
1961	5	279	144	108	215	134	94	18	0	0	7	14	1018
1962	65	227	72	236	121	174	134	39	21	42	14	12	1157
1963	94	179	159	108	89	253	68	15	29	0	15	41	1050
1964	198	60	166	116	44	48	129	1	46	25	50	17	900
1965	78	113	50	303	121	65	51	30	13	0	15	7	846
1966	60	101	131	376	141	123	154	64	20	10	24	10	1214
1967	99	117	108	49	45	124	84	73	5	15	8	17	744
1968	78	63	139	73	123	249	122	102	11	6	30	18	1014
1969	176	44	105	116	63	46	22	14	22	22	35	78	743
1970	71	70	157	173	122	94	72	55	2	30	5	7	858
1971	69	47	117	226	180	199	40	44	19	2	8	47	998
1972	81	99	82	85	202	101	60	7	3	15	94	29	858
1973	29	76	101	247	195	97	35	19	14	5	32	20	870
1974	49	212	129	170	171	168	53	12	18	22	8	103	1115
1975	56	216	142	219	198	229	103	45	47	0	3	124	1382
1976	197	75	81	192	160	193	42	23	5	0	3	101	1072
1977	158	80	136	225	72	181	135	2	13	5	31	70	1108
1978	55	84	181	80	150	58	36	55	12	80	118	23	932
1979	119	97	117	90	86	39	31	10	3	1	8	93	694
1980	10	152	81	211	190	116	70	36	34	0	95	9	1004
1981	41	134	138	79	100	79	161	17	27	25	3	31	835
1982	146	119	52	81	57	70	43	36	20	48	4	22	698
1983	79	184	132	130	59	101	43	92	7	1	55	19	902
1984	92	87	86	117	153	72	49	3	15	2	0	5	681
1985	144	113	182	95	83	77	55	0	78	1	84	40	952
AVE.	98	127	141	158	134	125	78	40	16	18	27	38	100.0
SDEV	54	64	57	71	51	54	43	29	16	23	32	38	

VALUES IN TENTHS OF A PERCENT OF ANNUAL AVERAGE RAINFALL

TABLE 3

SYNTHESIZED RUNOFF AT GAUGE G17 CATCHMENT AREA= 1087.SQ.KM M.A.P.= 944.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00 %	PI=	1.5 mm/D	ZMIN=	60.0 mm/M	ZMAX=	450.0 mm/M	RFACT=	1.000		
R=	.50	POW=	3.0	SL=	.00 mm	FT=	16.0 mm/M				
GW=	5.0 mm/M	TL=	.25 MTHS	GL=	.00 MTHS	NOFT=	4 PER MTH				
POWG=	2.5	SGL=	.0 mm	SG=	100.0 mm	FG=	10.0 mm/M				

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF OBS (%MAR)	RUNOFF SIM (%MAR)	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	38.0	9.2	9.3	9.2	27.7	27.4	34.4	29.6
NOV	140.0	38.0	10.9	14.8	10.6	44.1	31.6	38.3	25.9
DEC	160.0	38.0	11.9	9.2	9.2	27.6	27.6	21.2	19.4
JAN	150.0	38.0	14.0	15.1	14.4	45.0	42.9	49.9	36.2
FEB	125.0	38.0	12.7	14.0	16.0	41.6	47.6	38.7	39.1
MAR	120.0	38.0	12.1	11.9	15.7	35.6	46.8	43.1	42.9
APR	80.0	38.0	6.6	9.1	8.6	27.1	25.7	37.6	28.2
MAY	70.0	38.0	3.4	4.5	3.9	13.4	11.5	13.5	13.3
JUN	50.0	38.0	1.9	2.5	2.0	7.5	5.9	9.7	5.8
JUL	48.0	38.0	1.5	1.5	1.8	4.4	5.2	6.8	6.8
AUG	56.0	38.0	3.3	4.0	4.2	11.8	12.6	21.9	18.7
SEP	96.0	38.0	4.5	4.1	4.6	12.3	13.8	10.7	12.8
YEAR	1203.0					298.1	298.6	165.6	132.5
MEAN AND ST.DEVN. OF LOGS						2.416	2.435	.229	.192

MAXIMUM OBSERVED = 161.1 MAXIMUM SIMULATED = 131.1

INITIAL SOIL STORAGE =	12.8		
FINAL SOIL STORAGE =	19.3	mm	
TOTAL RAIN =	16482.2	mm	
TOTAL INTERCEPTION LOSS =	1487.1	mm	9.0 % rain
TOTAL SURFACE RUNOFF =	2714.8	mm	16.5 % rain
TOTAL EVAP FROM SOIL =	9776.2	mm	59.3 % rain
TOTAL INTERFLOW =	1935.5	mm	11.7 % rain
INITIAL G.WATER STORAGE =	64.8	mm	
FINAL G.WATER STORAGE =	57.8	mm	
TOTAL G.WATER RUNOFF =	570.2	mm	3.5 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	13.2	6	MAR 1980	AUG 1980
	OBS	24.3	6	MAR 1970	AUG 1970
40.	SIM	48.1	10	DEC 1982	SEP 1983
	OBS	57.7	11	DEC 1982	OCT 1983
60.	SIM	102.7	11	DEC 1982	OCT 1983
	OBS	173.7	45	DEC 1982	AUG 1986
80.	SIM	239.1	40	JUN 1982	SEP 1985
	OBS	401.9	46	DEC 1982	SEP 1986
90.	SIM	367.5	89	MAY 1978	SEP 1985
	OBS	516.2	46	DEC 1982	SEP 1986

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	5663.6	5674.3	.2
MEAN ANNUAL RUNOFF	298.1	298.6	.2
AVERAGE MONTHLY RUNOFF	24.8	24.9	.2
VARIANCE OF MONTHLY VALUES	1087.7	859.9	-20.9
RANGE OF RESIDUAL MASS CURVE	1181.9	912.2	-22.8
MEAN OF RESIDUAL MASS CURVE	81.0	134.5	66.1
INDEX OF SEASONAL VARIABILITY	25.1	25.3	.7
MEAN DEFICIT FLOW PERIOD(MONTHS)	5.8	5.9	.6
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	11	12	9.1

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.827
STUDENT T VALUE	22.140
REGRESSION COEFFICIENT	.736
BASE OF REGRESSION EQUATION	6.616

MAXIMUM DEFICIT FLOW PERIOD(MONTHS) 11 12 9.1

TABLE 3 CONTD

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.927
STUDENTS T VALUE	22.140
REGRESSION COEFFICIENT	.736
BASE CONSTANT OF REGRESSION EQUATION	6.616
REGRESSION SUM OF SQUARES	134185.200
RESIDUAL SUM OF SQUARES	61867.200
TOTAL SUM OF SQUARES	196052.400
STANDARD ERROR OF ESTIMATE	16.545
MAXIMUM EQIVALENT CONSTANT ERROR (%)	58.200
RELATIVE ABSOLUTE ERROR(%)	46.285
COEFFICIENT OF DETERMINATION	.684
STANDARD COEFFICIENT OF EFFICIENCY	.681
RESIDUAL MASS CURVE COEFFICIENT	.817
SPECIAL COEFFICIENT OF EFFICIENCY	.610
COEFFICIENT OF PERSISTENCE	2.273
RELATIVE MEAN PERSISTENCE (%)	7.373
DURBIN-WATSON D-STATISTIC	1.758
SIGN TEST	
NUMBER OF NEGATIVE RUNS	44
NUMBER OF POSITIVE RUNS	44
EXPECTED NUMBER OF RUNS	111.8
NUMBER OF NEGATIVE RESIDUALS	95
NUMBER OF POSITIVE RESIDUALS	133
STANDARDISED NORMAL VARIATE Z	3.255

RESIDUAL MASS CURVES

	OBSERVED												SIMULATED											
1967	-23.	46.	29.	8.	-13.	-33.	-36.	-6.	-21.	-35.	-54.	-76.	-3.	3.	-3.	-22.	-44.	-37.	-35.	-38.	-55.	-77.	-99.	-121.
1968	-92.	-114.	-108.	-132.	-156.	-166.	-160.	-168.	-184.	-207.	-228.	-251.	-136.	-155.	-152.	-165.	-163.	-61.	-1.	27.	16.	-6.	-27.	-48.
1969	-224.	-233.	-251.	-267.	-276.	-299.	-323.	-347.	-371.	-395.	-419.	-434.	1.	3.	-13.	-20.	-37.	-59.	-81.	-104.	-126.	-149.	-169.	-176.
1970	-431.	-444.	-416.	-385.	-378.	-390.	-389.	-394.	-417.	-442.	-466.	-490.	-188.	-207.	-191.	-151.	-132.	-136.	-149.	-164.	-185.	-205.	-227.	-249.
1971	-514.	-536.	-541.	-438.	-377.	-317.	-328.	-319.	-334.	-352.	-371.	-391.	-267.	-288.	-298.	-230.	-159.	-78.	-72.	-93.	-114.	-136.	-158.	-179.
1972	-405.	-403.	-425.	-449.	-407.	-416.	-422.	-444.	-467.	-491.	-466.	-482.	-191.	-200.	-217.	-236.	-178.	-159.	-174.	-195.	-217.	-240.	-225.	-234.
1973	-500.	-515.	-512.	-451.	-375.	-386.	-390.	-407.	-426.	-448.	-459.	-471.	-256.	-275.	-292.	-212.	-125.	-110.	-128.	-150.	-172.	-193.	-216.	-238.
1974	-493.	-407.	-410.	-381.	-316.	-252.	-264.	-281.	-304.	-322.	-345.	-349.	-259.	-198.	-172.	-140.	-88.	-31.	-31.	-53.	-75.	-97.	-120.	-112.
1975	-350.	-254.	-228.	-134.	-24.	91.	120.	122.	131.	111.	89.	92.	-122.	-57.	-23.	45.	127.	233.	274.	263.	247.	227.	205.	228.
1976	203.	253.	234.	236.	283.	378.	366.	347.	325.	303.	279.	270.	308.	318.	299.	341.	391.	463.	468.	446.	424.	401.	379.	385.
1977	297.	293.	285.	393.	401.	433.	570.	553.	531.	507.	484.	495.	432.	434.	436.	507.	515.	561.	614.	610.	588.	565.	544.	531.
1978	511.	498.	554.	540.	535.	515.	492.	473.	452.	457.	515.	510.	514.	497.	530.	527.	549.	542.	520.	503.	482.	489.	533.	530.
1979	567.	571.	583.	573.	571.	553.	534.	511.	488.	464.	440.	427.	540.	538.	532.	517.	500.	479.	457.	435.	413.	390.	367.	368.
1980	409.	421.	430.	541.	556.	587.	592.	582.	588.	567.	584.	590.	353.	371.	364.	419.	492.	518.	509.	489.	468.	446.	462.	452.
1981	570.	607.	624.	608.	605.	587.	640.	626.	604.	583.	560.	538.	430.	437.	449.	437.	425.	411.	460.	461.	440.	419.	396.	374.
1982	558.	630.	612.	592.	573.	550.	529.	513.	495.	474.	453.	430.	403.	418.	403.	382.	361.	341.	320.	298.	276.	262.	243.	221.
1983	409.	436.	429.	442.	419.	397.	379.	376.	352.	327.	302.	287.	206.	251.	271.	276.	262.	254.	237.	242.	228.	206.	194.	175.
1984	270.	286.	274.	256.	257.	265.	251.	228.	204.	180.	155.	130.	168.	155.	137.	129.	158.	154.	134.	112.	89.	67.	44.	22.
1985	116.	106.	134.	127.	124.	105.	85.	63.	53.	29.	10.	0.	47.	59.	96.	93.	77.	60.	40.	19.	19.	4.	11.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	5.4	10.7	16.1	21.5	26.9	32.2	37.6	43.0	48.3
OBSERVED %TIME	100.0	67.1	50.0	39.9	33.8	29.4	24.1	21.1	18.0	17.5
SIMULATED %TIME	100.0	66.2	50.4	42.1	36.8	32.0	25.9	22.8	20.6	18.0
ERROR	.0	-.9	.4	2.2	3.1	2.6	1.8	1.8	2.6	.4

MONTHLY DISCHARGE	53.7	59.1	64.4	69.8	75.2	80.6	85.9	91.3	96.7	102.0
OBSERVED %TIME	14.5	11.8	11.4	11.0	10.5	9.6	7.5	6.1	5.7	4.8
SIMULATED %TIME	15.4	14.0	13.6	11.4	9.2	7.9	6.6	5.7	3.9	3.1
ERROR	.9	2.2	2.2	.4	-1.3	-1.8	-.9	-.4	-1.8	-1.8

MONTHLY DISCHARGE	107.4	112.8	118.1	123.5	128.9	134.3	139.6	145.0	150.4	155.7
OBSERVED %TIME	4.8	4.4	4.4	3.1	2.6	2.2	.9	.4	.4	.4
SIMULATED %TIME	1.3	.9	.9	.9	.4	.0	.0	.0	.0	.0
ERROR	-3.5	-3.5	-3.5	-2.2	-2.2	-2.2	-.9	-.4	-.4	-.4

OBSERVED MAXIMUM MONTHLY VALUE	161.100
SIMULATED MAXIMUM MONTHLY VALUE	131.110

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.3544	.5274
2	.1974	.1750
3	.0991	-.0256
4	-.0038	-.1392
5	-.0837	-.1703
6	-.1068	-.1452
7	-.0980	-.1510
8	.0050	-.1253
9	.0101	-.0559

TABLE 4

SYNTHESISED/ORIGINAL RUNOFF AT GAUGE B17 USING MODIFIED PITMAN MODEL FOR HYDROLOGICAL YEARS STARTING OCTOBER

(I4,2X,12(I5,A),F9.1)

1930	278P	155P	229P	655P	543P	537P	880P	280P	41P	322P	133P	35P	408.8
1931	204P	514P	200P	239P	818P	563P	128P	28P	27P	25P	23P	29P	279.8
1932	42P	270P	439P	143P	231P	396P	175P	43P	26P	25P	24P	22P	183.6
1933	21P	833P	1358P	1974P	783P	595P	343P	77P	25P	95P	125P	52P	628.1
1934	452P	913P	705P	538P	190P	588P	357P	180P	64P	29P	130P	63P	420.9
1935	152P	199P	302P	251P	125P	264P	102P	152P	70P	27P	25P	23P	169.2
1936	433P	1769P	862P	1378P	1275P	732P	171P	28P	26P	25P	25P	23P	674.7
1937	32P	159P	495P	762P	974P	276P	464P	173P	60P	39P	74P	45P	353.3
1938	502P	224P	489P	849P	928P	274P	36P	112P	56P	55P	171P	105P	380.1
1939	723P	638P	191P	47P	198P	395P	570P	392P	104P	30P	103P	577P	396.8
1940	205P	373P	776P	615P	939P	330P	414P	154P	29P	28P	27P	68P	395.8
1941	638P	226P	26P	690P	614P	733P	455P	106P	27P	25P	160P	78P	377.8
1942	666P	868P	912P	830P	224P	177P	810P	697P	172P	294P	409P	130P	618.9
1943	651P	1522P	988P	296P	741P	289P	43P	58P	68P	41P	30P	100P	482.7
1944	101P	163P	69P	143P	176P	746P	256P	109P	56P	27P	25P	23P	189.4
1945	23P	71P	140P	456P	241P	422P	162P	30P	25P	24P	22P	22P	163.8
1946	292P	140P	320P	170P	228P	88P	31P	27P	25P	24P	23P	177P	154.5
1947	434P	177P	748P	508P	139P	1159P	445P	60P	34P	26P	25P	23P	377.8
1948	34P	45P	29P	646P	545P	317P	88P	42P	31P	24P	23P	34P	185.8
1949	234P	594P	933P	634P	676P	1011P	1146P	537P	105P	177P	693P	242P	698.2
1950	39P	95P	723P	1070P	559P	400P	239P	71P	34P	32P	38P	33P	333.3
1951	1083P	381P	64P	347P	714P	452P	105P	28P	27P	209P	133P	74P	361.7
1952	46P	488P	385P	237P	804P	558P	393P	125P	32P	29P	42P	33P	317.2
1953	577P	783P	736P	293P	512P	579P	170P	84P	48P	30P	28P	27P	386.7
1954	27P	101P	156P	1298P	1291P	413P	157P	73P	33P	28P	27P	25P	362.9
1955	138P	392P	938P	326P	1081P	971P	269P	160P	68P	27P	25P	24P	441.9
1956	404P	215P	1706P	1039P	320P	294P	259P	80P	34P	47P	194P	1029P	562.1
1957	1410P	741P	368P	1000P	367P	194P	383P	361P	109P	30P	28P	77P	506.8
1958	83P	486P	760P	364P	295P	230P	641P	563P	145P	279P	114P	28P	398.8
1959	244P	443P	1178P	402P	667P	610P	358P	115P	36P	29P	70P	73P	422.5
1960	385P	682P	506P	629P	233P	721P	372P	160P	249P	96P	45P	37P	411.5
1961	31P	1317P	745P	211P	945P	692P	364P	101P	29P	26P	24P	23P	450.8
1962	56P	977P	348P	955P	571P	744P	755P	211P	33P	81P	47P	29P	480.7
1963	185P	692P	614P	243P	103P	1229P	471P	45P	34P	30P	27P	39P	371.2
1964	907P	330P	457P	299P	71P	28P	497P	183P	64P	47P	113P	57P	305.3
1965	97P	233P	89P	1410P	728P	124P	45P	34P	29P	27P	25P	24P	286.5
1966	47P	144P	260P	1972P	1042P	446P	779P	339P	61P	30P	32P	29P	518.1
1967	23#	93#	70	43	16	72	216E	545E	100	116	49	35	222.3
1968	91	26	306	12	9	146E	307#	168#	86	23	36	15	122.5
1969	520	162	66	92	158	13	9	9	8	8	8	102	115.5
1970	278	121	525	560	313#	131	257	205	12	1	11	4	241.8
1971	12	30	191	1284	857	853#	130#	345	101	60	60	51	397.4
1972	108	273	20	11	668	158	188	29	16	13	496	89	206.9
1973	68	98	277	865	1003	139	214	71	62	26	139	128	309.0
1974	31	1106	220	543	892	887	135	74	20	70	16	208	420.2
1975	236	1207	511	1186	1351	1400	540	264	338	55	23	285	739.6
1976	1349	774E	42	260	724	1192#	130	65	29	20	17	152	475.4
1977	523E	209	162E	1332#	325#	576E	1611E	80	27	14	20	353	523.2
1978	407	119	809	111	195	51	15	64	40	298	820	205	313.4
1979	815	291	389	122	231	75	53	21	13	9	10	115	214.4
1980	70	369	339	1358	402	554	299	148	313	37	416	312	461.7
1981	50	613	419	94	214	74	778E	105E	32	33	21	22	245.5
1982	454	972	61	51	54	21	42	84	71	39	41	18	190.8
1983	34	516	179	387	148	328	698	2188	08	08	08	998	154.8
1984	828	4058	1268	69	256	332	1058	24E	9	5	2	1	141.6
1985	1068	150	524	174	221	57	52	31	1458	58	598	1528	167.6
AVE.	306	477	455	580	514	453	330	153	64	58	99	105	359.4
SDV.	332	401	365	493	365	346	306	153	68	77	163	163	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

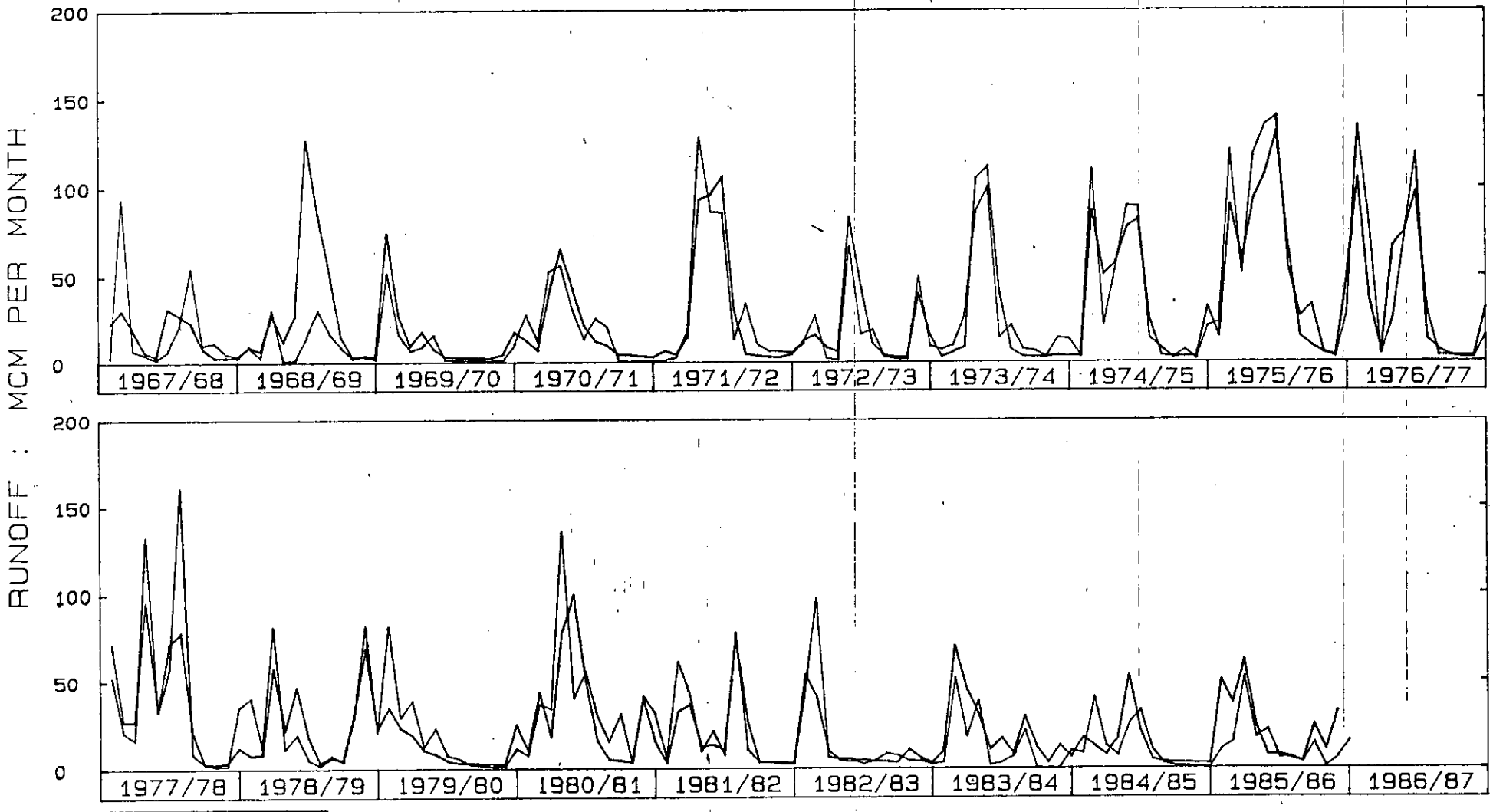
AI = .0 PI = 1.5 ZMIN = 60. ZMAX = 450. R = .5 POW = 3.0

SL = .0 FT =16.0 GW = 5. TL = .25 GL = .00 NOFT = 4

POWG = 2.5 SGL = .0 SG = 100. FG = 10.0

MONTH	O	N	D	J	F	M	A	M	J	J	A	S
P.EVAP	108.	140.	160.	150.	125.	120.	80.	70.	50.	48.	56.	96.

STMAX = 38. AREA = 1087. RAINFALL = 944. RFACT = 1.000



LEGEND
— OBSERVED FLOWS
— GENERATED FLOWS

SENQUNYANE AT G17 : MARAKABEI (REVISED RAINFALL)

COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 1

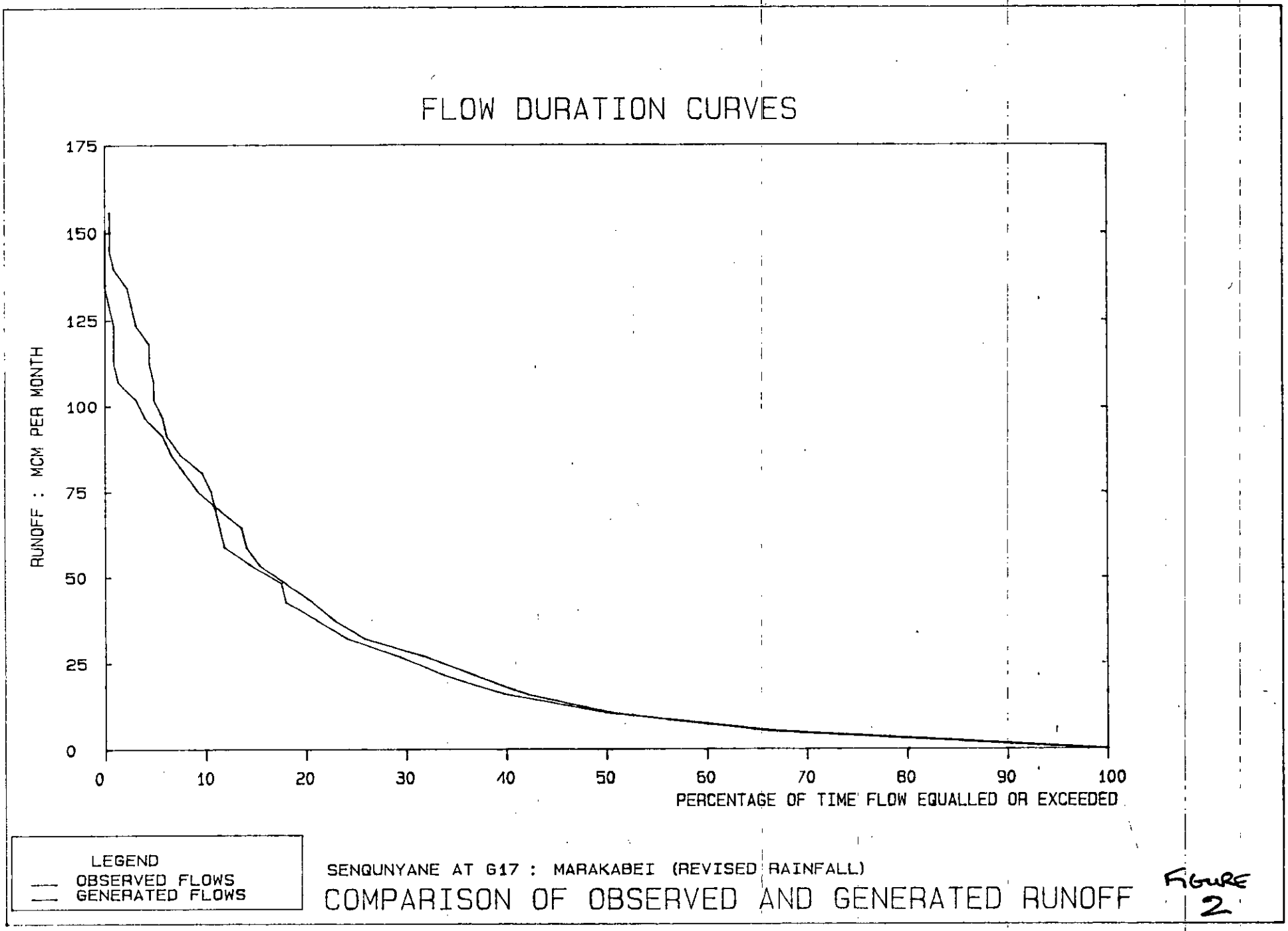

FLOW DURATION CURVES
RUNOFF : MCM PER MONTH
175
150
125
100
75
50
25
0
0
10
20
30
40
50
60
70
80
90
100
PERCENTAGE OF TIME FLOW EQUALLED OR EXCEEDED
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
SENQUNYANE AT G17 : MARAKABEI (REVISED RAINFALL)
COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 2

ANNEX 8

G32 - SENGUNYANE AT NKAUS

TABLE 1

632 NKAUS (TOTAL) - OBSERVED AND MODIFIED PITMAN MODELLE INFILLED BY REGRESSION
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

1967	55	1185	577	158	73	248	252	882	104	162	47	80	382.3
1968	158	48	739	53	32	396	694	404	185	45	68	23	284.5
1969	1050	332	94	287	411	59	41	45	36	35	36	213	263.9
1970	710	323	1370	944	567	310F	565L	3980	52W	40S	232	8:	531.0
1971	211	37N	242K	1986A	1600.	2645F	291L	6160	168W	91	27	28	775.2
1972	225	284	74	39	948	242	244	683	258	791	819.	2076	325.4
1973	127	159	422	1649	2832	2991	412.	1610	159	83	298	196	679.7
1974	74	2029	691	878	1774	1697	284	164	65	125	52	488	832.1
1975	514	2206	1469	2824	2328	2689	1228	800	925	220	107	1846	1715.6
1976	3554	2761	275	488	1419	2586	330	110	23	29	15	184	1177.4
1977	1016	700	237	2844	407	334	3029	246	100	71	36	774	979.4
1978	966	234	1870	311	384	176	18	119	47	448	1740	414	672.7
1979	1140	550	794	322	405	126	82	35	41	35	35	251	381.6
1980	243	722	651	3019	707	1086	676	316	481	76	627	491	909.5
1981	124	1016	1049	181	294	197	1490	286	83	79	57	63	491.9
1982	752	2122	248	115	132	177	135	166	93	69	93	62	416.4
1983	205	966	754	1045	97	287	176	482	144	116W	57E	2621	459.1
1984	49#	355#	110#	209#	1557#	919#	246#	19#	0#	0#	0#	0#	346.4
1985	160#	1286#	2250#	710#	750#	175#	111#	43#	172#	0#	12#	487#	615.6
AVE.	586	911	732	951	880	771	542	282	153	95	218	320	644.2
SDV.	818	822	621	1016	814	923	718	258	215	101	429	425	
NOBS	19	19	19	19	19	19	19	19	19	19	19	19	

SYNTHESIZED RUNOFF AT GAUGE G32 CATCHMENT AREA= 3480.SQ.KM M.A.P.= 878.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00 %	PI=	1.5 mm/D	ZMIN=	62.0 mm/M	ZMAX=	400.0 mm/M	RFACT=	.900
R=	.50	POW=	3.0	SL=	.00 mm	FT=	22.0 mm/M		
GW=	.0 mm/M	TL=	.25 MTHS	GL=	.00 MTHS	NOFT=	4 PER MTH		
POWG=	2.5	SGL=	.0 mm	SG=	.0 mm	FG=	.0 mm/M		

STATISTICS FROM 1967 TO 1985
NOT INCLUDING MONTHS FLAGGED WITH "S"

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF OBS	(%MAR) SIM	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	50.0	8.3	9.4	10.1	59.6	63.6	81.2	68.9
NOV	140.0	50.0	9.6	13.9	10.5	88.0	66.5	81.7	53.5
DEC	160.0	50.0	10.8	11.3	8.4	71.2	53.4	55.3	38.9
JAN	150.0	50.0	12.3	14.6	12.8	92.6	81.1	102.8	75.8
FEB	125.0	50.0	11.4	13.2	14.5	83.4	91.7	79.9	87.0
MAR	120.0	50.0	11.0	11.9	15.8	75.5	100.0	92.4	97.2
APR	80.0	50.0	5.9	8.6	8.6	54.3	54.7	71.7	57.9
MAY	70.0	50.0	3.2	4.5	4.0	28.4	25.3	25.6	25.8
JUN	50.0	50.0	1.7	2.5	2.2	15.7	14.0	21.6	12.6
JUL	48.0	50.0	1.3	1.6	2.1	10.0	13.3	10.1	18.9
AUG	56.0	50.0	3.0	3.6	5.1	22.5	32.4	42.7	45.0
SEP	96.0	50.0	4.2	5.0	5.9	31.5	37.5	42.4	35.5
YEAR	1203.0					632.2	632.7	370.7	298.7
MEAN AND ST.DEVN. OF LOGS						2.741	2.756	.229	.205

MAXIMUM OBSERVED = 355.4 MAXIMUM SIMULATED = 286.7

INITIAL SOIL STORAGE =	17.2	
FINAL SOIL STORAGE =	25.0 mm	
TOTAL RAIN =	13796.1 mm	
TOTAL INTERCEPTION LOSS =	1339.9 mm	9.7 % rain
TOTAL SURFACE RUNOFF =	1874.2 mm	13.6 % rain
TOTAL EVAP FROM SOIL =	8990.4 mm	65.2 % rain
TOTAL INTERFLOW =	1585.0 mm	11.5 % rain
INITIAL G.WATER STORAGE =	.0 mm	
FINAL G.WATER STORAGE =	.0 mm	
TOTAL G.WATER RUNOFF =	.0 mm	.0 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	35.4	5	APR 1980	AUG 1980
	OBS	48.6	5	MAY 1985	SEP 1985
40.	SIM	102.9	8	JAN 1980	AUG 1980
	OBS	108.3	6	APR 1985	SEP 1985
60.	SIM	248.0	34	DEC 1982	SEP 1985
	OBS	297.4	28	JUN 1968	SEP 1970
80.	SIM	606.2	34	DEC 1982	SEP 1985
	OBS	713.1	48	JAN 1968	DEC 1971
90.	SIM	908.7	89	MAY 1978	SEP 1985
	OBS	965.9	48	JAN 1968	DEC 1971

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	12015.9	12034.7	.2
MEAN ANNUAL RUNOFF	632.4	633.4	.2
AVERAGE MONTHLY RUNOFF	52.7	52.8	.2
VARIANCE OF MONTHLY VALUES	4911.5	3909.9	-20.4
RANGE OF RESIDUAL MASS CURVE	2458.3	2041.9	-16.9
MEAN OF RESIDUAL MASS CURVE	63.1	327.6	419.4
INDEX OF SEASONAL VARIABILITY	24.6	22.3	-9.3
MEAN DEFICIT FLOW PERIOD(MONTHS)	5.9	5.7	-2.8
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	12	12	.0

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.816
STUDENTS T VALUE	21.188
REGRESSION COEFFICIENT	.728
BASE CONSTANT OF REGRESSION EQUATION	14.434

TABLE - 3A Cont'd

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.816
STUDENTS T VALUE	21.188
REGRESSION COEFFICIENT	.728
BASE CONSTANT OF REGRESSION EQUATION	14.434
REGRESSION SUM OF SQUARES	592957.600
RESIDUAL SUM OF SQUARES	298506.800
TOTAL SUM OF SQUARES	891464.400
STANDARD ERROR OF ESTIMATE	36.343
MAXIMUM EQIVALENT CONSTANT ERROR (%)	60.178
RELATIVE ABSOLUTE ERROR(%)	45.664
COEFFICIENT OF DETERMINATION	.665
STANDARD COEFFICIENT OF EFFICIENCY	.659
RESIDUAL MASS CURVE COEFFICIENT	.742
SPECIAL COEFFICIENT OF EFFICIENCY	.591
COEFFICIENT OF PERSISTENCE	2.318
RELATIVE MEAN PERSISTENCE (%)	3.438
DURBIN-WATSON D-STATISTIC	1.789

SIGN TEST

NUMBER OF NEGATIVE RUNS	48
NUMBER OF POSITIVE RUNS	49
EXPECTED NUMBER OF RUNS	114.4
NUMBER OF NEGATIVE RESIDUALS	106
NUMBER OF POSITIVE RESIDUALS	122
STANDARDISED NORMAL VARIATE Z	2.326

RESIDUAL MASS CURVES

	OBSERVED												SIMULATED											
1967	-47.	19.	24.	-13.	-59.	-87.	-114.	-79.	-121.	-157.	-209.	-250.	-7.	-2.	-20.	-63.	-113.	-105.	-110.	-93.	-121.	-165.	-210.	-257.
1968	-287.	-335.	-314.	-361.	-411.	-424.	-407.	-419.	-434.	-502.	-548.	-598.	-285.	-320.	-322.	-354.	-364.	-136.	-13.	28.	4.	-42.	-83.	-126.
1969	-546.	-565.	-609.	-633.	-644.	-691.	-740.	-788.	-837.	-886.	-935.	-967.	-10.	-2.	-36.	-99.	-97.	-144.	-193.	-243.	-289.	-333.	-369.	-360.
1970	-948.	-969.	-884.	-843.	-839.	-860.	-857.	-869.	-917.	-966.	-1016.	-1068.	-375.	-409.	-391.	-338.	-325.	-333.	-353.	-376.	-415.	-459.	-498.	-546.
1971	-1119.	-1168.	-1196.	-1050.	-943.	-731.	-755.	-746.	-782.	-825.	-875.	-925.	-582.	-622.	-639.	-517.	-377.	-167.	-140.	-179.	-221.	-267.	-315.	-353.
1972	-955.	-980.	-1025.	-1074.	-1032.	-1060.	-1088.	-1134.	-1185.	-1229.	-1200.	-1232.	-381.	-408.	-446.	-485.	-363.	-328.	-356.	-400.	-449.	-497.	-453.	-464.
1973	-1272.	-1309.	-1319.	-1207.	-977.	-1000.	-1011.	-1048.	-1085.	-1129.	-1152.	-1185.	-509.	-544.	-571.	-386.	-170.	-132.	-171.	-218.	-265.	-313.	-349.	-389.
1974	-1230.	-1080.	-1064.	-1029.	-904.	-787.	-811.	-847.	-894.	-934.	-981.	-985.	-433.	-298.	-258.	-245.	-183.	-53.	-46.	-91.	-138.	-182.	-228.	-191.
1975	-987.	-819.	-724.	-495.	-315.	-98.	-28.	-1.	39.	8.	-34.	98.	-196.	-56.	12.	155.	360.	594.	662.	638.	607.	566.	518.	604.
1976	401.	624.	599.	592.	684.	890.	870.	829.	778.	728.	677.	643.	808.	838.	795.	863.	943.	1070.	1075.	1030.	982.	933.	883.	902.
1977	692.	709.	680.	912.	900.	881.	1131.	1103.	1060.	1014.	965.	990.	1007.	1013.	1000.	1147.	1168.	1283.	1403.	1394.	1346.	1297.	1255.	1240.
1978	1034.	1005.	1139.	1117.	1103.	1068.	1017.	976.	928.	920.	1042.	1030.	1210.	1175.	1248.	1242.	1249.	1221.	1176.	1139.	1097.	1128.	1220.	1218.
1979	1092.	1094.	1121.	1100.	1088.	1048.	1003.	954.	905.	856.	807.	779.	1228.	1222.	1202.	1168.	1134.	1092.	1044.	995.	945.	895.	846.	844.
1980	751.	770.	783.	1032.	1030.	1106.	1121.	1100.	1095.	1050.	1060.	1056.	811.	853.	843.	942.	1081.	1141.	1125.	1086.	1049.	1006.	1080.	1076.
1981	1016.	1065.	1117.	1083.	1059.	1026.	1123.	1099.	1054.	1009.	962.	916.	1031.	1033.	1035.	1007.	980.	948.	1043.	1045.	1003.	962.	917.	871.
1982	939.	1098.	1070.	1029.	989.	954.	915.	879.	836.	790.	746.	700.	953.	984.	949.	904.	857.	816.	774.	734.	693.	671.	634.	588.
1983	668.	712.	734.	786.	743.	719.	684.	680.	641.	600.	553.	527.	559.	633.	658.	643.	603.	570.	529.	530.	502.	454.	436.	401.
1984	489.	486.	456.	417.	469.	463.	424.	375.	323.	270.	218.	165.	382.	361.	328.	301.	317.	299.	260.	213.	164.	116.	66.	16.
1985	138.	139.	260.	238.	244.	205.	176.	130.	102.	52.	12.	0.	68.	87.	164.	166.	129.	93.	54.	6.	7.	-21.	11.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	11.8	23.7	35.5	47.4	59.2	71.1	82.9	94.8	106.6
OBSERVED %TIME	100.0	68.9	52.2	38.2	32.9	27.2	22.8	19.3	17.1	13.6
SIMULATED %TIME	100.0	71.5	52.6	41.7	35.5	28.9	24.6	21.5	18.0	16.2
ERROR	.0	2.6	.4	3.5	2.6	1.8	1.8	2.2	.9	2.6
MONTHLY DISCHARGE	118.5	130.3	142.2	154.0	165.9	177.7	189.5	201.4	213.2	225.1
OBSERVED %TIME	12.7	11.8	11.0	10.1	9.2	7.5	6.6	6.1	5.3	4.8
SIMULATED %TIME	15.4	12.3	11.0	9.6	9.2	6.6	5.3	3.1	3.1	3.1
ERROR	2.6	.4	.0	-.4	.0	-.9	-1.3	-3.1	-2.2	-1.8
MONTHLY DISCHARGE	236.9	248.8	260.6	272.5	284.3	296.2	308.0	319.9	331.7	343.6
OBSERVED %TIME	4.4	4.4	3.9	3.1	1.8	1.3	.4	.4	.4	.4
SIMULATED %TIME	3.1	2.6	1.8	.9	.4	.0	.0	.0	.0	.0
ERROR	-1.3	-1.8	-2.2	-2.2	-1.3	-1.3	-.4	-.4	-.4	-.4

OBSERVED MAXIMUM MONTHLY VALUE	355.400
SIMULATED MAXIMUM MONTHLY VALUE	286.651

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.3848	.5066
2	.1996	.1416
3	.0993	-.0246
4	.0239	-.1131
5	-.0323	-.1196
6	-.0594	-.0675
7	-.0751	-.0737
8	.0377	-.0801
9	.0556	-.0511
10	.1775	.0899
11	.2503	.2433
12	.2540	.3067

SYNTHESIZED RUNOFF AT GAUGE G32INC CATCHMENT AREA= 2393.SQ.KM M.A.P.= 848.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00 %	PI=	1.5 mm/D	ZMIN=	62.0 mm/M	ZMAX=	450.0 mm/M	RFACT=	.900
R=	.50	POW=	3.0	SL=	.00 mm	FT=	19.0 mm/M		
GW=	.0 mm/M	TL=	.25 MTHS	GL=	.00 MTHS	NOFT=	4 PER MTH		
POWG=	2.5	SGL=	.0 mm	SG=	.0 mm	FG=	.0 mm/M		

STATISTICS FROM 1967 TO 1985
NOT INCLUDING MONTHS FLAGGED WITH "S"

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF OBS (%MAR)	RUNOFF SIM (%MAR)	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	60.0	8.3	9.4	9.9	59.6	62.8	81.2	56.2
NOV	140.0	60.0	9.5	13.9	11.8	88.0	74.7	81.7	57.9
DEC	160.0	60.0	10.8	11.3	8.7	71.2	54.9	55.3	26.7
JAN	150.0	60.0	12.2	14.6	13.9	92.6	87.8	102.8	63.7
FEB	125.0	60.0	11.3	13.2	14.4	83.4	91.2	79.9	82.2
MAR	120.0	60.0	11.0	11.9	14.6	75.5	92.4	92.4	83.7
APR	80.0	60.0	5.9	8.6	9.0	54.3	56.7	71.7	47.8
MAY	70.0	60.0	3.2	4.5	3.8	28.4	24.3	25.6	16.0
JUN	50.0	60.0	1.7	2.5	2.3	15.7	14.5	21.6	9.6
JUL	48.0	60.0	1.3	1.6	1.7	10.0	10.9	10.1	11.2
AUG	56.0	60.0	3.1	3.6	4.7	22.5	29.4	42.7	29.4
SEP	96.0	60.0	4.3	5.0	5.2	31.5	33.1	42.4	26.7
YEAR	1203.0					632.2	632.2	370.7	297.1
MEAN AND ST.DEVN. OF LOGS						2.741	2.758	.229	.197

MAXIMUM OBSERVED = 355.4 MAXIMUM SIMULATED = 287.3

INITIAL SOIL STORAGE =	21.6	
FINAL SOIL STORAGE =	31.4 mm	
TOTAL RAIN =	13325.5 mm	
TOTAL INTERCEPTION LOSS =	1310.6 mm	9.8 % rain
TOTAL SURFACE RUNOFF =	1345.6 mm	10.1 % rain
TOTAL EVAP FROM SOIL =	9216.0 mm	69.2 % rain
TOTAL INTERFLOW =	1444.9 mm	10.8 % rain
INITIAL G.WATER STORAGE =	.0 mm	
FINAL G.WATER STORAGE =	.0 mm	
TOTAL G.WATER RUNOFF =	.0 mm	.0 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	18.9	3	JUN 1977	AUG 1977
	OBS	48.6	5	MAY 1985	SEP 1985
40.	SIM	69.7	9	FEB 1983	OCT 1983
	OBS	108.3	6	APR 1985	SEP 1985
60.	SIM	336.3	42	FEB 1983	JUL 1986
	OBS	297.4	28	JUN 1968	SEP 1970
80.	SIM	888.1	58	DEC 1981	SEP 1986
	OBS	713.1	48	JAN 1968	DEC 1971
90.	SIM	1194.9	65	MAY 1981	SEP 1986
	OBS	965.9	48	JAN 1968	DEC 1971

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	12015.9	12025.6	.1
MEAN ANNUAL RUNOFF	632.4	632.9	.1
AVERAGE MONTHLY RUNOFF	52.7	52.7	.1
VARIANCE OF MONTHLY VALUES	4911.5	3136.7	-36.1
RANGE OF RESIDUAL MASS CURVE	2458.3	2233.3	-9.2
MEAN OF RESIDUAL MASS CURVE	63.1	476.8	656.0
INDEX OF SEASONAL VARIABILITY	24.6	23.9	-2.9
MEAN DEFICIT FLOW PERIOD(MONTHS)	5.9	5.8	-2.1
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	12	12	.0

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.698
STUDENTS T VALUE	14.635
REGRESSION COEFFICIENT	.557
BASE CONSTANT OF REGRESSION EQUATION	23.366

TABLE 3B CONTD

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.698
STUDENTS T VALUE	14.635
REGRESSION COEFFICIENT	.557
BASE CONSTANT OF REGRESSION EQUATION	23.366
REGRESSION SUM OF SQUARES	347979.500
RESIDUAL SUM OF SQUARES	367193.800
TOTAL SUM OF SQUARES	715173.300
STANDARD ERROR OF ESTIMATE	40.308
MAXIMUM EQIVALENT CONSTANT ERROR (%)	74.610
RELATIVE ABSOLUTE ERROR(%)	60.300
COEFFICIENT OF DETERMINATION	.487
STANDARD COEFFICIENT OF EFFICIENCY	.476
RESIDUAL MASS CURVE COEFFICIENT	.621
SPECIAL COEFFICIENT OF EFFICIENCY	.371
COEFFICIENT OF PERSISTENCE	2.102
RELATIVE MEAN PERSISTENCE (%)	3.978
DURBIN-WATSON D-STATISTIC	1.919

SIGN TEST

NUMBER OF NEGATIVE RUNS	51
NUMBER OF POSITIVE RUNS	51
EXPECTED NUMBER OF RUNS	112.8
NUMBER OF NEGATIVE RESIDUALS	98
NUMBER OF POSITIVE RESIDUALS	130
STANDARDISED NORMAL VARIATE Z	1.456

RESIDUAL MASS CURVES

	OBSERVED												SIMULATED											
1967	-47.	19.	24.	-13.	-59.	-87.	-114.	-79.	-121.	-157.	-205.	-230.	-20.	-37.	-41.	-87.	-138.	-147.	-145.	-138.	-165.	-209.	-254.	-302.
1968	-287.	-333.	-314.	-361.	-411.	-424.	-407.	-419.	-454.	-502.	-548.	-598.	-289.	-316.	-338.	-372.	-388.	-274.	-227.	-234.	-271.	-319.	-365.	-402.
1969	-546.	-565.	-609.	-633.	-644.	-691.	-740.	-788.	-837.	-886.	-935.	-967.	-332.	-337.	-329.	-311.	-325.	-361.	-387.	-419.	-466.	-514.	-556.	-574.
1970	-948.	-969.	-884.	-843.	-839.	-860.	-857.	-869.	-917.	-966.	-1016.	-1068.	-603.	-643.	-643.	-518.	-453.	-395.	-416.	-417.	-452.	-491.	-531.	-576.
1971	-1119.	-1168.	-1196.	-1050.	-943.	-731.	-755.	-746.	-782.	-825.	-875.	-925.	-609.	-627.	-658.	-619.	-497.	-368.	-351.	-394.	-439.	-487.	-487.	-524.
1972	-955.	-980.	-1025.	-1074.	-1032.	-1060.	-1088.	-1134.	-1185.	-1229.	-1200.	-1232.	-539.	-591.	-611.	-570.	-424.	-416.	-433.	-473.	-517.	-565.	-554.	-571.
1973	-1272.	-1309.	-1319.	-1207.	-977.	-1000.	-1011.	-1048.	-1085.	-1129.	-1152.	-1185.	-616.	-549.	-565.	-422.	-216.	-127.	-158.	-200.	-248.	-291.	-331.	-356.
1974	-1230.	-1080.	-1064.	-1029.	-904.	-787.	-811.	-847.	-894.	-934.	-981.	-985.	-381.	-210.	-163.	-74.	58.	252.	292.	270.	254.	211.	164.	191.
1975	-987.	-819.	-724.	-495.	-315.	-98.	-28.	-1.	39.	8.	-34.	98.	301.	433.	450.	536.	717.	932.	978.	947.	908.	863.	813.	863.
1976	401.	624.	599.	595.	684.	890.	870.	829.	778.	728.	677.	643.	1017.	1034.	1002.	1143.	1190.	1287.	1426.	1387.	1339.	1290.	1241.	1260.
1977	692.	709.	680.	912.	900.	881.	1131.	1103.	1060.	1014.	965.	990.	1333.	1324.	1370.	1441.	1450.	1504.	1556.	1536.	1491.	1469.	1504.	1492.
1978	1034.	1005.	1139.	1117.	1103.	1068.	1017.	976.	928.	920.	1042.	1030.	1532.	1517.	1575.	1561.	1552.	1516.	1471.	1429.	1384.	1378.	1397.	1381.
1979	1092.	1094.	1121.	1100.	1088.	1048.	1003.	954.	905.	856.	807.	779.	1368.	1375.	1371.	1462.	1460.	1469.	1448.	1411.	1391.	1343.	1333.	1335.
1980	751.	770.	783.	1032.	1050.	1106.	1121.	1100.	1095.	1050.	1060.	1056.	1297.	1356.	1368.	1404.	1476.	1496.	1541.	1506.	1466.	1422.	1452.	1433.
1981	1016.	1065.	1117.	1083.	1059.	1026.	1123.	1099.	1054.	1009.	962.	916.	1431.	1503.	1481.	1446.	1412.	1372.	1403.	1389.	1350.	1307.	1263.	1215.
1982	938.	1098.	1070.	1029.	989.	954.	915.	879.	836.	790.	746.	700.	1246.	1293.	1268.	1257.	1208.	1164.	1123.	1100.	1054.	1019.	976.	936.
1983	668.	712.	734.	786.	743.	719.	684.	680.	641.	600.	553.	527.	902.	951.	948.	918.	896.	884.	847.	822.	782.	733.	698.	656.
1984	489.	486.	456.	417.	449.	463.	424.	375.	323.	270.	218.	165.	629.	608.	618.	595.	588.	555.	516.	470.	433.	383.	337.	301.
1985	138.	139.	260.	238.	244.	205.	176.	130.	102.	52.	12.	0.	302.	286.	306.	284.	239.	195.	149.	99.	73.	33.	29.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	11.8	23.7	35.5	47.4	59.2	71.1	82.9	94.8	106.6
OBSERVED %TIME	100.0	68.9	52.2	38.2	32.9	27.2	22.8	19.3	17.1	13.6
SIMULATED %TIME	100.0	78.1	59.2	46.1	36.8	31.1	25.0	21.9	18.4	14.0
ERROR	.0	9.2	7.0	7.9	3.9	3.9	2.2	2.6	1.3	.4
MONTHLY DISCHARGE	118.5	130.3	142.2	154.0	165.9	177.7	189.5	201.4	213.2	225.1
OBSERVED %TIME	12.7	11.8	11.0	10.1	9.2	7.5	6.6	6.1	5.3	4.8
SIMULATED %TIME	12.3	9.6	8.8	7.5	7.0	5.7	4.4	2.6	2.2	1.8
ERROR	-.4	-2.2	-2.2	-2.6	-2.2	-1.8	-2.2	-3.5	-3.1	-3.1
MONTHLY DISCHARGE	236.9	248.8	260.6	272.5	284.3	296.2	308.0	319.9	331.7	343.6
OBSERVED %TIME	4.4	4.4	3.9	3.1	1.8	1.3	.4	.4	.4	.4
SIMULATED %TIME	1.3	.9	.4	.4	.4	.0	.0	.0	.0	.0
ERROR	-3.1	-3.5	-3.5	-2.6	-1.3	-1.3	-.4	-.4	-.4	-.4

OBSERVED MAXIMUM MONTHLY VALUE	355.400
SIMULATED MAXIMUM MONTHLY VALUE	287.255

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.3848	.5083
2	.1996	.2082
3	.0993	.0654
4	.0239	-.0612
5	-.0323	-.1152
6	-.0594	-.0734
7	-.0751	-.0675
8	.0377	-.0473
9	.0556	.0544
10	.1775	.2154
	.2503	.4457

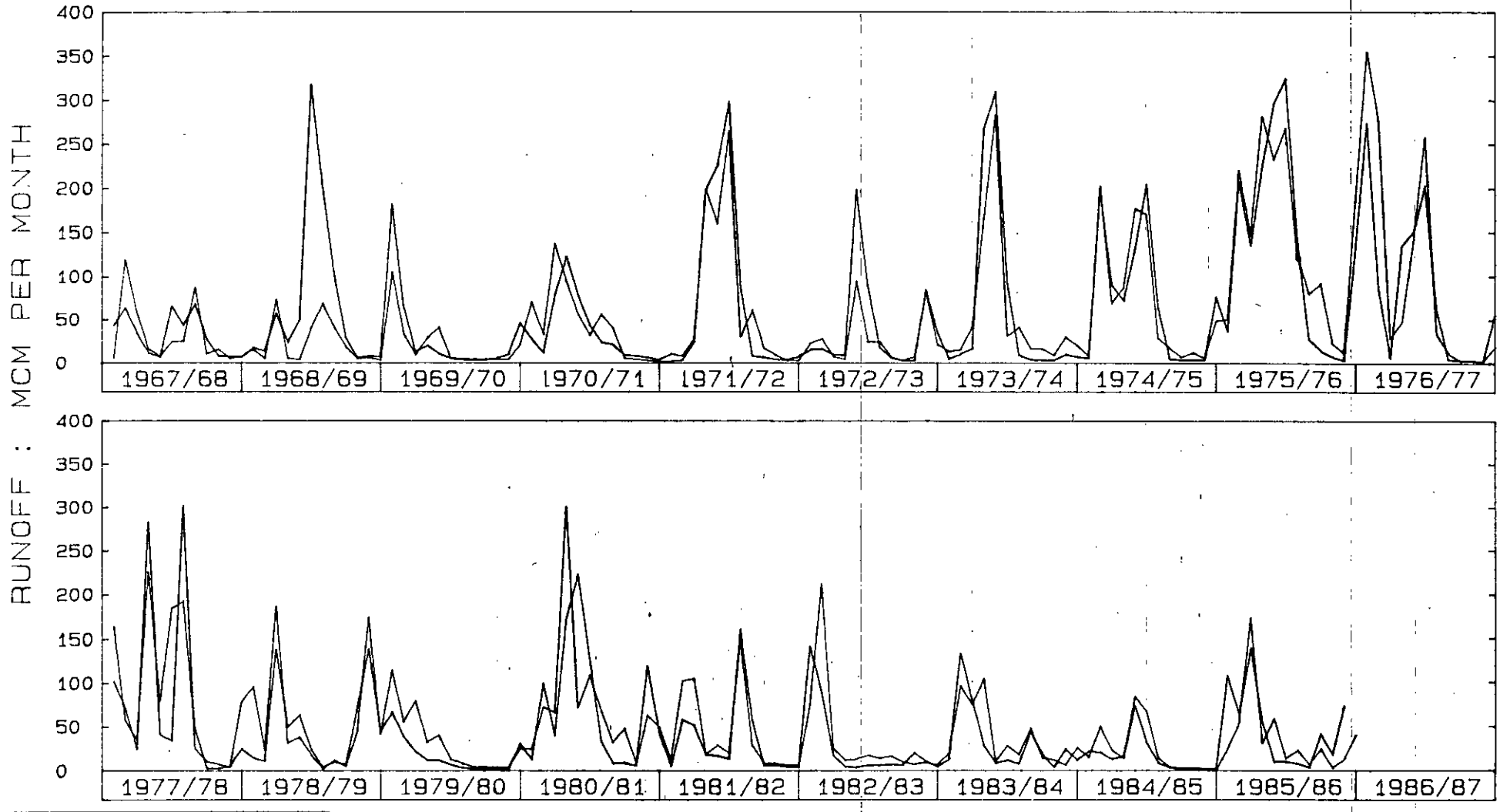
AI = .0 PI = 1.5 ZMIN = 61. ZMAX = 500. R = .5 POW = 3.0

SL = .0 FT = 8.0 GW = 0. IL = .25 GL = .00 NOFT = 4

POWG = 2.5 SGL = .0 SG = 120. FG = 10.0

MONTH	O	N	D	J	F	M	A	M	J	J	A	S
P.EVAP	108.	140.	160.	150.	125.	120.	80.	70.	50.	48.	56.	96.

STMAX = 60. AREA = 3480. RAINFALL = 678. RFACT = 1.000



LEGEND
OBSERVED FLOWS
GENERATED FLOWS

SENQUNYANE AT G32 : NKAUS (REVISED RFACT)

COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 1

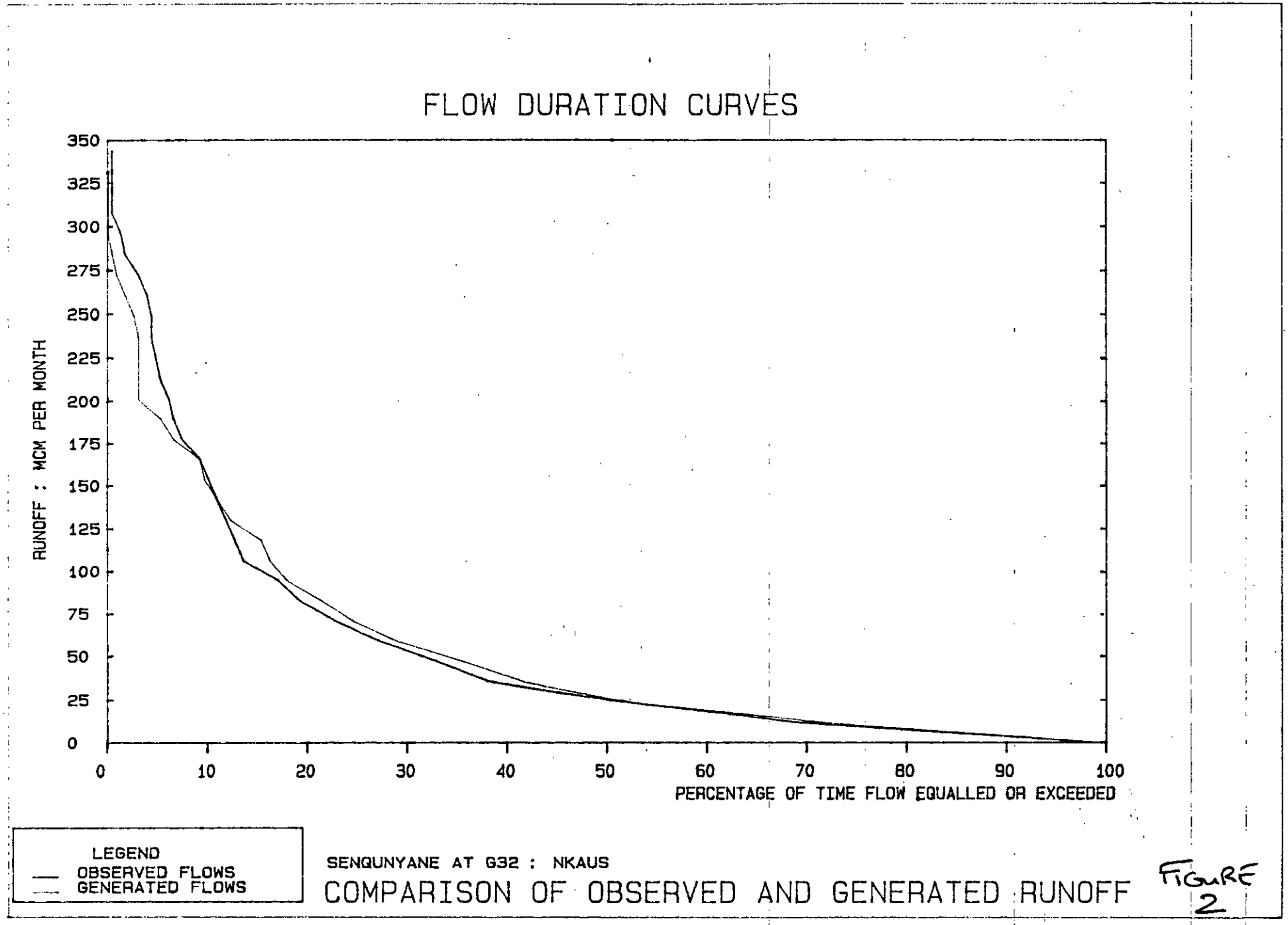

FLOW DURATION CURVES
RUNOFF : MCM PER MONTH
350
325
300
275
250
225
200
175
150
125
100
75
50
25
0
0
10
20
30
40
50
60
70
80
90
100
PERCENTAGE OF TIME FLOW EQUALLED OR EXCEEDED
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
SENQUNYANE AT G32 : NKAUS
COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 2

ANNEX 9

G36 - KUBELA AT TLOKOENG

TABLE 1

636 TLOKOENG - OBSERVED AND MODIFIED PITMAN MODELLED FLO INFILLED BY REGRESSION
HYDROLOGICAL YEARS STARTING OCTOBER
(14,2X,12(I5,A),F9.1)

1967	168	1938	1938	408	168	548	488	1038	158	58	08	38	68.8
1968	98	328	1628	158	128	868	1238	518	338	138	08	08	53.6
1969	1228	678	1298	1068	1288	408	08	08	08	08	17	47	65.4
1970	227	97	1548	2028	193E	112	185	43	11	8W	6	3	124.1
1971	14	41	134	424	430	480	49	16	7	4W	3W	3	160.5
1972	30	104	19	3	103	130	73	17	6	9	91	127	71.2
1973	189	47	94	525C	424W	269	202	27W	15W	10	8W	6W	181.6
1974	4W	319W	86W	410W	1250W	4338	688	21W	8W	8W	5	87	269.9
1975	200	348	389W	817W	8108	1838W	509W	75	33	15	11	9W	507.4
1976	637	455	43	209	619	441	111	26	8	4	2	12	256.7
1977	231	80	24	609	175	137	325	54	15	8	6	79	174.3
1978	142	50W	324	129	70	95	14	15	11	17	198	215	128.0
1979	121	110	282	125	156	224	22	8	4W	3W	2W	23	108.0
1980	41	52	132	464	355	117	33	31	29	6	20	194	147.4
1981	28	15	89	23	20	72	1868	48	9	6	4	7	50.7
1982	58	334	11	10	14	10	6	4	4	3	7	4	46.5
1983	55	54	563	647	84e	162	46	110	5	4	3	22	175.5
1984	12	24	20	414	338	227	9	1e	08	6e	08	0	105.1
1985	98e	287	170	230	261	459	32	13	13	3	87	116	176.9
AVE.	118	143	159	284	287	285	107	35	12	7	25	50	151.1
SDV.	148	136	143	249	320	410	130	32	10	4	50	68	
NOBS	19	19	19	19	19	19	19	19	19	19	19	19	

infilled

G36 TLOKENG - MONTHLY CATCHMENT RAINFALL IN TERMS OF M.A.P. TABLE 2

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,1X,12(I4,A),I8)

1930	97	75	135	238	124	118	97	4	1	53	0	1	943
1931	74	105	130	140	188	119	25	37	5	1	0	28	852
1932	52	162	128	65	147	126	33	19	13	15	2	12	774
1933	42	180	191	216	172	142	52	46	2	54	56	6	1159
1934	95	218	217	111	123	152	74	44	11	0	25	28	1098
1935	70	90	117	116	133	151	17	78	2	3	0	9	786
1936	123	271	160	221	225	122	24	4	1	4	0	6	1161
1937	83	72	139	216	176	44	109	15	54	34	81	43	1066
1938	115	84	206	203	230	95	48	64	5	40	42	50	1181
1939	103	177	153	165	136	131	87	98	44	4	2	106	1206
1940	84	143	186	204	164	83	90	5	1	24	6	61	1020
1941	133	35	57	175	149	175	72	29	7	0	55	42	929
1942	87	168	193	192	83	132	122	106	16	99	55	23	1276
1943	243	164	204	130	202	102	6	37	59	4	0	116	1267
1944	113	106	49	108	174	212	28	39	1	0	0	2	832
1945	42	45	90	177	129	144	44	45	1	5	0	8	730
1946	162	134	79	99	148	151	58	7	16	11	6	84	955
1947	97	134	138	180	115	272	60	19	0	3	4	16	1038
1948	75	76	60	180	102	112	65	18	6	6	5	53	758
1949	93	144	175	176	141	206	57	34	5	26	86	20	1163
1950	71	77	145	107	148	81	54	22	9	2	33	34	783
1951	108	24	95	164	207	97	21	9	8	43	41	42	859
1952	52	119	146	121	233	66	67	13	3	0	23	30	873
1953	99	81	134	121	125	99	34	54	20	1	1	37	806
1954	56	109	123	238	214	98	56	38	9	5	1	5	952
1955	70	135	149	135	214	165	19	60	2	4	5	31	989
1956	105	198	278	191	136	120	57	22	26	47	58	230	1468
1957	211	119	152	227	93	104	97	41	3	0	0	69	1116
1958	66	163	131	105	98	72	91	145	8	54	3	5	941
1959	154	148	171	159	161	129	81	16	4	13	55	64	1155
1960	112	128	193	175	61	150	101	77	17	13	10	59	1096
1961	28	177	167	184	194	116	78	12	0	0	17	33	1006
1962	57	139	144	277	111	138	79	16	33	37	1	14	1046
1963	99	138	159	208	92	194	57	12	58	0	32	57	1106
1964	198	72	137	171	64	81	83	7	56	29	38	33	969
1965	53	125	94	239	137	39	23	29	8	0	22	23	792
1966	56	106	170	244	188	151	86	47	21	8	19	15	1111
1967	79	113	154	85	92	131	60	58	3	10	28	10	823
1968	57	90	120	92	80	154	76	68	5	5	12	18	777
1969	126	69	185	144	78	63	27	18	17	14	54	74	869
1970	123	72	118	199	128	142	75	65	4	21	20	10	977
1971	81	95	112	212	205	151	21	25	5	4	16	27	954
1972	76	145	54	126	181	95	55	6	1	10	93	58	900
1973	48	144	166	264	213	126	73	16	32	5	25	21	1133
1974	55	241	151	219	225	160	47	8	4	20	12	173	1315
1975	92	216	189	250	197	263	73	41	20	0	8	64	1413
1976	169	183	137	197	123	159	62	18	2	0	3	96	1149
1977	148	52	163	279	96	142	96	4	2	2	29	72	1085
1978	111	75	267	69	154	83	34	47	3	69	87	62	1061
1979	96	133	155	125	152	89	24	10	2	2	5	140	933
1980	40	132	128	258	165	58	76	9	25	2	66	28	987
1981	39	113	134	126	67	106	98	8	10	20	4	23	748
1982	151	81	56	121	77	96	27	27	9	31	7	18	701
1983	121	138	176	179	109	131	37	47	10	6	57	10	1021
1984	102	88	87	136	261	41	29	5	2	1	3	14	769
1985	188	129	231	149	128	81	81	1	40	1	57	38	1124
AVE.	97	124	146	172	148	124	59	33	13	15	24	44	100.0
SDEV	46	51	49	55	50	48	28	29	16	21	27	43	

VALUES IN TENTHS OF A PERCENT OF ANNUAL AVERAGE RAINFALL

TABLE 5

SYNTHESIZED RUNOFF AT GAUGE G36 CATCHMENT AREA= 852.SQ.KM M.A.P.= 924.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00 %	PI=	1.5 mm/D	ZMIN=	60.0 mm/M	ZMAX=	500.0 mm/M	RFACT=	.909
R=	.50	POW=	3.0	SL=	.00 mm	FT=	3.0 mm/M		
GW=	5.0 mm/M	TL=	.50 MTHS	GL=	.00 MTHS	NOFT=	4 PER MTH		
POWG=	2.5	SGL=	.0 mm	SG=	100.0 mm	FG=	5.0 mm/M		

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF OBS	(%MAR) SIM	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	62.0	9.1	7.8	7.4	11.8	11.2	14.8	10.8
NOV	140.0	62.0	11.0	9.4	10.7	14.3	16.2	13.6	14.0
DEC	160.0	62.0	13.3	10.5	12.5	15.9	18.9	14.3	16.7
JAN	150.0	62.0	15.5	18.8	18.0	28.4	27.3	24.9	19.9
FEB	125.0	62.0	13.1	19.0	20.4	28.7	30.9	32.0	25.8
MAR	120.0	62.0	10.9	18.8	15.5	28.5	23.4	41.0	21.3
APR	80.0	62.0	5.1	7.1	7.1	10.7	10.7	13.0	12.3
MAY	70.0	62.0	2.3	2.3	1.3	3.5	2.0	3.2	1.5
JUN	50.0	62.0	.9	.8	.8	1.2	1.1	1.0	.5
JUL	48.0	62.0	1.1	.5	.8	.7	1.2	.4	1.3
AUG	56.0	62.0	2.8	1.6	2.0	2.5	3.0	5.0	4.5
SEP	96.0	62.0	4.6	3.3	3.8	5.0	5.8	6.8	8.0
YEAR	1203.0					151.1	151.5	108.3	90.2
MEAN AND ST.DEVN. OF LOGS						2.093	2.105	.277	.274

MAXIMUM OBSERVED = 185.8 MAXIMUM SIMULATED = 80.2

INITIAL SOIL STORAGE =	24.6	
FINAL SOIL STORAGE =	35.4 mm	
TOTAL RAIN =	15739.2 mm	
TOTAL INTERCEPTION LOSS =	1462.1 mm	9.3 % rain
TOTAL SURFACE RUNOFF =	1820.5 mm	11.6 % rain
TOTAL EVAP FROM SOIL =	10907.7 mm	69.3 % rain
TOTAL INTERFLOW =	1319.3 mm	8.4 % rain
INITIAL G.WATER STORAGE =	69.5 mm	
FINAL G.WATER STORAGE =	49.7 mm	
TOTAL G.WATER RUNOFF =	239.9 mm	1.5 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	12.3	10	DEC 1982	SEP 1983
	OBS	17.9	10	DEC 1982	SEP 1983
40.	SIM	48.9	30	APR 1981	SEP 1983
	OBS	43.1	10	DEC 1982	SEP 1983
60.	SIM	124.4	30	APR 1981	SEP 1983
	OBS	102.4	32	APR 1981	NOV 1983
80.	SIM	215.4	46	APR 1981	JAN 1985
	OBS	196.4	47	JAN 1968	NOV 1971
90.	SIM	273.3	46	APR 1981	JAN 1985
	OBS	280.1	68	JAN 1968	AUG 1973

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	2871.6	2879.4	.3
MEAN ANNUAL RUNOFF	151.1	151.5	.3
AVERAGE MONTHLY RUNOFF	12.6	12.6	.3
VARIANCE OF MONTHLY VALUES	437.8	288.5	-34.1
RANGE OF RESIDUAL MASS CURVE	685.8	644.6	-6.0
MEAN OF RESIDUAL MASS CURVE	-10.5	3.0	-128.3
INDEX OF SEASONAL VARIABILITY	34.9	35.3	1.1
MEAN DEFICIT FLOW PERIOD(MONTHS)	6.7	6.6	-.7
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	12	18	50.0

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.780
STUDENTS T VALUE	18.741
REGRESSION COEFFICIENT	.633
BASE CONSTANT OF REGRESSION EQUATION	4.654

TABLE 3 CONTD

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.780
STUDENTS T VALUE	18.741
REGRESSION COEFFICIENT	.633
BASE CONSTANT OF REGRESSION EQUATION	4.654
REGRESSION SUM OF SQUARES	40026.400
RESIDUAL SUM OF SQUARES	25754.570
TOTAL SUM OF SQUARES	65780.960
STANDARD ERROR OF ESTIMATE	10.675
MAXIMUM EQIVALENT CONSTANT ERROR (%)	74.749
RELATIVE ABSOLUTE ERROR(%)	53.570
COEFFICIENT OF DETERMINATION	.608
STANDARD COEFFICIENT OF EFFICIENCY	.607
RESIDUAL MASS CURVE COEFFICIENT	.964
SPECIAL COEFFICIENT OF EFFICIENCY	.479
COEFFICIENT OF PERSISTENCE	1.558
RELATIVE MEAN PERSISTENCE (%)	16.238
DURBIN-WATSON D-STATISTIC	1.774

SIGN TEST

NUMBER OF NEGATIVE RUNS	46
NUMBER OF POSITIVE RUNS	46
EXPECTED NUMBER OF RUNS	107.1
NUMBER OF NEGATIVE RESIDUALS	84
NUMBER OF POSITIVE RESIDUALS	144
STANDARDISED NORMAL VARIATE Z	2.155

RESIDUAL MASS CURVES

	OBSERVED												SIMULATED											
1967	-11.	-4.	2.	-6.	-17.	-24.	-32.	-34.	-45.	-57.	-70.	-82.	-10.	-18.	-18.	-20.	-30.	-32.	-35.	-46.	-56.	-67.	-79.	-90.
1968	-96.	-103.	-100.	-111.	-122.	-126.	-127.	-134.	-143.	-155.	-167.	-180.	-101.	-112.	-121.	-131.	-142.	-139.	-135.	-145.	-155.	-166.	-178.	-190.
1969	-180.	-186.	-186.	-188.	-188.	-196.	-209.	-222.	-234.	-247.	-258.	-266.	-192.	-194.	-189.	-177.	-182.	-193.	-205.	-217.	-228.	-240.	-250.	-259.
1970	-256.	-258.	-256.	-248.	-241.	-243.	-237.	-245.	-257.	-268.	-280.	-293.	-259.	-260.	-270.	-258.	-242.	-235.	-234.	-244.	-254.	-266.	-278.	-289.
1971	-304.	-312.	-312.	-282.	-251.	-216.	-224.	-235.	-246.	-259.	-271.	-283.	-300.	-310.	-320.	-304.	-259.	-226.	-222.	-234.	-246.	-258.	-269.	-281.
1972	-293.	-295.	-306.	-318.	-320.	-320.	-325.	-336.	-348.	-360.	-363.	-363.	-292.	-293.	-294.	-304.	-293.	-283.	-293.	-305.	-317.	-329.	-329.	-328.
1973	-357.	-365.	-368.	-328.	-298.	-284.	-276.	-286.	-297.	-309.	-321.	-333.	-339.	-341.	-331.	-287.	-223.	-194.	-197.	-208.	-220.	-231.	-243.	-255.
1974	-345.	-326.	-330.	-301.	-189.	-158.	-164.	-174.	-186.	-198.	-210.	-214.	-266.	-238.	-202.	-177.	-123.	-80.	-74.	-85.	-97.	-109.	-121.	-102.
1975	-207.	-184.	-158.	-89.	-21.	153.	191.	186.	177.	165.	154.	142.	-82.	-58.	-18.	28.	83.	150.	191.	180.	169.	157.	146.	135.
1976	193.	226.	218.	226.	276.	307.	306.	296.	284.	272.	259.	248.	149.	185.	200.	215.	230.	240.	247.	235.	224.	212.	200.	193.
1977	258.	254.	244.	292.	297.	298.	318.	311.	299.	288.	276.	271.	205.	212.	211.	257.	294.	295.	300.	293.	281.	269.	258.	248.
1978	273.	265.	285.	285.	280.	276.	265.	254.	243.	232.	239.	248.	245.	241.	272.	303.	303.	303.	292.	281.	269.	263.	269.	269.
1979	247.	248.	261.	261.	264.	274.	264.	252.	240.	227.	215.	205.	262.	261.	266.	265.	268.	269.	258.	247.	235.	223.	212.	218.
1980	196.	189.	189.	223.	246.	245.	236.	226.	217.	205.	194.	201.	225.	220.	217.	249.	295.	301.	290.	279.	267.	255.	248.	240.
1981	191.	180.	176.	166.	156.	150.	156.	148.	137.	125.	112.	101.	228.	218.	212.	205.	195.	185.	180.	173.	162.	150.	138.	126.
1982	94.	115.	103.	91.	80.	69.	57.	44.	32.	20.	8.	-4.	131.	137.	126.	115.	105.	94.	83.	71.	59.	48.	36.	24.
1983	-11.	-18.	25.	77.	73.	77.	69.	67.	55.	43.	31.	20.	20.	25.	38.	58.	63.	61.	58.	46.	35.	23.	13.	4.
1984	9.	-1.	-12.	17.	38.	48.	37.	24.	11.	-1.	-13.	-26.	-5.	-13.	-24.	-32.	7.	43.	32.	20.	8.	-4.	-16.	-28.
1985	-29.	-12.	-8.	2.	16.	49.	40.	28.	17.	5.	1.	0.	-11.	12.	39.	67.	69.	63.	53.	42.	30.	19.	9.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	6.2	12.4	18.6	24.8	31.0	37.2	43.4	49.5	55.7
OBSERVED %TIME	100.0	43.9	29.8	22.4	14.9	13.2	10.1	7.0	4.8	3.9
SIMULATED %TIME	100.0	44.3	33.8	22.8	17.1	13.2	11.4	9.2	6.1	3.9
ERROR	.0	.4	3.9	.4	2.2	.0	1.3	2.2	1.3	.0

MONTHLY DISCHARGE	61.9	68.1	74.3	80.5	86.7	92.9	99.1	105.3	111.5	117.7
OBSERVED %TIME	2.6	1.8	1.8	1.8	.9	.9	.9	.9	.9	.9
SIMULATED %TIME	1.8	.9	.9	.0	.0	.0	.0	.0	.0	.0
ERROR	-.9	-.9	-.9	-1.8	-.9	-.9	-.9	-.9	-.9	-.9

MONTHLY DISCHARGE	123.9	130.1	136.3	142.4	148.6	154.8	161.0	167.2	173.4	179.6
OBSERVED %TIME	.9	.4	.4	.4	.4	.4	.4	.4	.4	.4
SIMULATED %TIME	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
ERROR	-.9	-.4	-.4	-.4	-.4	-.4	-.4	-.4	-.4	-.4

OBSERVED MAXIMUM MONTHLY VALUE	185.800
SIMULATED MAXIMUM MONTHLY VALUE	80.175

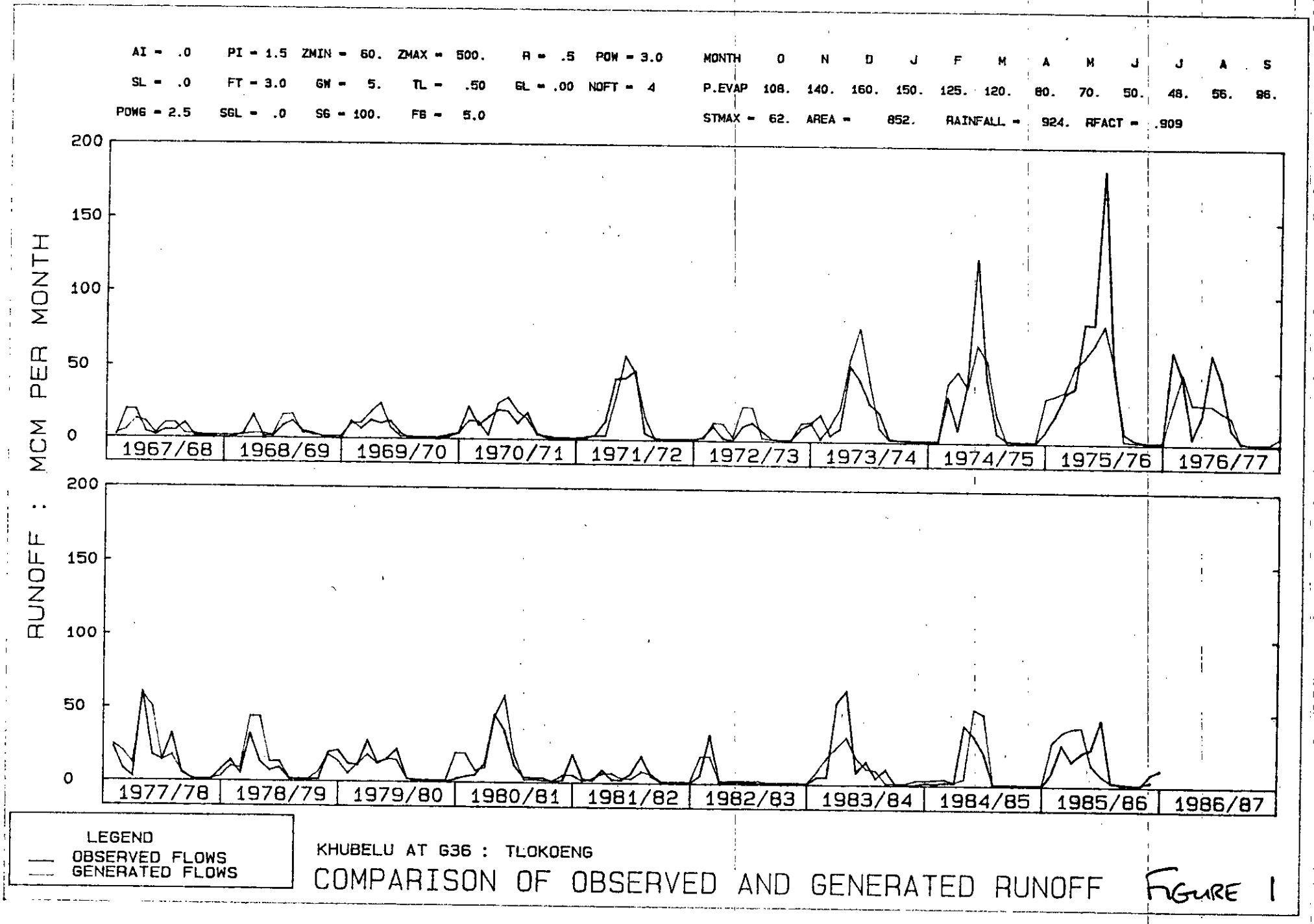
COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.5233	.6937
2	.2229	.2983
3	.0963	.0958
4	-.0382	-.1024
5	-.1495	-.2299
6	-.1813	-.2545
7	-.0735	-.1930
8	-.0180	-.0775
9	.0071	.1024
10	.1412	.3007
11	.3332	.4542
12	.4073	.5042

TABLE 4

SYNTHESISED/ORIGINAL RUNOFF AT GAUGE 636 USING MODIFIED PITMAN MODEL FOR
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

1930	74P	54P	66P	411P	423P	125P	124P	71P	21P	41P	40P	17P	146.7
1931	23P	37P	59P	95P	311P	316P	71P	15P	14P	13P	12P	11P	97.7
1932	12P	164P	187P	35P	107P	181P	86P	10P	10P	9P	9P	9P	81.9
1933	9P	212P	406P	484P	480P	322P	134P	14P	12P	33P	55P	32P	219.3
1934	29P	364P	622P	294P	58P	202P	169P	20P	12P	10P	10P	10P	180.0
1935	14P	21P	28P	30P	86P	226P	158P	35P	35P	9P	8P	8P	65.8
1936	89P	598P	626P	414P	671P	442P	76P	9P	9P	9P	8P	8P	295.9
1937	19P	21P	54P	331P	489P	211P	73P	74P	21P	24P	100P	98P	151.5
1938	87P	91P	249P	485P	628P	398P	21P	22P	21P	16P	24P	20P	206.2
1939	57P	258P	300P	217P	210P	179P	115P	121P	111P	16P	11P	89P	168.4
1940	90P	107P	283P	431P	418P	181P	34P	28P	10P	11P	10P	18P	162.1
1941	151P	142P	9P	143P	261P	353P	243P	16P	10P	9P	30P	31P	139.8
1942	24P	197P	383P	415P	219P	96P	219P	262P	137P	158P	178P	30P	231.8
1943	488P	656P	413P	274P	329P	314P	25P	12P	29P	28P	10P	118P	269.6
1944	197P	100P	22P	17P	203P	543P	357P	11P	11P	9P	9P	9P	148.8
1945	8P	8P	11P	159P	216P	196P	136P	11P	10P	8P	8P	7P	77.8
1946	208P	291P	92P	13P	118P	263P	160P	10P	8P	7P	7P	40P	121.7
1947	75P	124P	136P	220P	197P	573P	552P	12P	9P	8P	8P	8P	192.2
1948	15P	18P	11P	157P	166P	50P	45P	12P	7P	7P	7P	12P	50.7
1949	28P	134P	267P	310P	256P	429P	337P	11P	9P	9P	104P	103P	199.7
1950	14P	17P	72P	75P	123P	122P	15P	10P	8P	8P	10P	10P	48.4
1951	59P	59P	11P	122P	424P	325P	19P	8P	7P	17P	23P	15P	108.9
1952	10P	42P	108P	86P	406P	396P	14P	13P	8P	7P	7P	7P	110.4
1953	33P	37P	46P	53P	66P	67P	20P	13P	13P	7P	7P	8P	37.0
1954	9P	20P	31P	368P	687P	351P	21P	11P	9P	7P	7P	7P	152.8
1955	12P	90P	160P	122P	374P	531P	204P	17P	17P	8P	7P	7P	154.9
1956	48P	319P	750P	685P	295P	147P	69P	11P	9P	22P	48P	539P	294.2
1957	910P	450P	137P	407P	330P	31P	73P	59P	12P	10P	9P	24P	245.2
1958	28P	174P	201P	46P	22P	19P	30P	277P	259P	33P	33P	9P	113.1
1959	184P	308P	270P	251P	267P	247P	105P	21P	10P	10P	30P	41P	174.4
1960	95P	149P	274P	360P	162P	140P	201P	107P	45P	10P	10P	18P	157.1
1961	17P	201P	328P	314P	453P	324P	69P	20P	10P	10P	9P	9P	176.4
1962	11P	97P	158P	545P	496P	130P	127P	20P	11P	16P	14P	9P	163.4
1963	32P	126P	205P	366P	269P	292P	289P	12P	26P	26P	11P	18P	167.2
1964	356P	352P	52P	187P	148P	15P	26P	21P	23P	25P	15P	14P	123.4
1965	10P	58P	61P	358P	439P	94P	9P	9P	8P	8P	8P	8P	107.0
1966	9P	24P	158P	511P	625P	407P	174P	26P	12P	9P	8P	8P	197.1
1967	16#	193#	193#	40#	16#	54#	48#	105#	15#	5#	0#	3#	68.8
1968	9#	32#	162#	15#	12#	86#	123#	51#	33#	13#	0#	0#	53.6
1969	122#	67#	129#	106#	126#	40#	0#	0#	0#	0#	17	47	65.4
1970	227	97	154#	202#	193E	112	185	43	11	8W	6	3	124.1
1971	14	41	134	424	430	480	49	16	7	4W	3W	3	160.5
1972	30	104	19	3	103	130	73	17	6	9	91	127	71.2
1973	189	47	94	525C	424W	269	202	27W	15W	10	8W	6W	181.6
1974	4W	319W	86W	410W	1250W	433#	68#	21W	8W	8W	5	87	269.9
1975	200	348	389W	817W	810#	1858W	509W	75	33	15	11	9W	507.4
1976	637	455	43	209	619	441	111	26	8	4	2	12	256.7
1977	231	80	24	609	175	137	325	54	15	8	6	79	174.3
1978	142	50W	324	129	70	95	14	15	11	17	198	215	128.0
1979	121	110	282	125	156	224	22	8	4W	3W	2W	23	108.0
1980	41	52	132	464	355	117	33	31	29	6	20	194	147.4
1981	28	15	89	23	20	72	186#	48	9	6	4	7	50.7
1982	58	334	11	10	14	10	6	4	4	3	7	4	46.5
1983	55	54	563	647	84e	162	46	110	5	4	3	22	175.5
1984	12	24	20	414	338	227	9	1e	0#	6e	0#	0	105.1
1985	98e	287	170	230	261	459	32	13	13	3	87	116	176.9
AVE.	103	158	183	271	302	261	119	37	22	14	25	43	153.8
SDV.	163	151	172	200	234	265	121	54	39	21	40	82	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	


AI = .0 PI = 1.5 ZMIN = 60. ZMAX = 500. R = .5 POW = 3.0
SL = .0 FT = 3.0 GW = 5. TL = .50 GL = .00 NOFT = 4
POWG = 2.5 SGL = .0 SG = 100. FB = 5.0
MONTH O N D J F M A M J J A S
P.EVAP 108. 140. 160. 150. 125. 120. 80. 70. 50. 48. 56. 96.
STMAX = 62. AREA = 852. RAINFALL = 924. RFACT = .909
RUNOFF : MCM PER MONTH
200
150
100
50
0
1967/68
1968/69
1969/70
1970/71
1971/72
1972/73
1973/74
1974/75
1975/76
1976/77
1977/78
1978/79
1979/80
1980/81
1981/82
1982/83
1983/84
1984/85
1985/86
1986/87
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
KHUBELU AT G36 : TLOKOENG
COMPARISON OF OBSERVED AND GENERATED RUNOFF
FIGURE 1

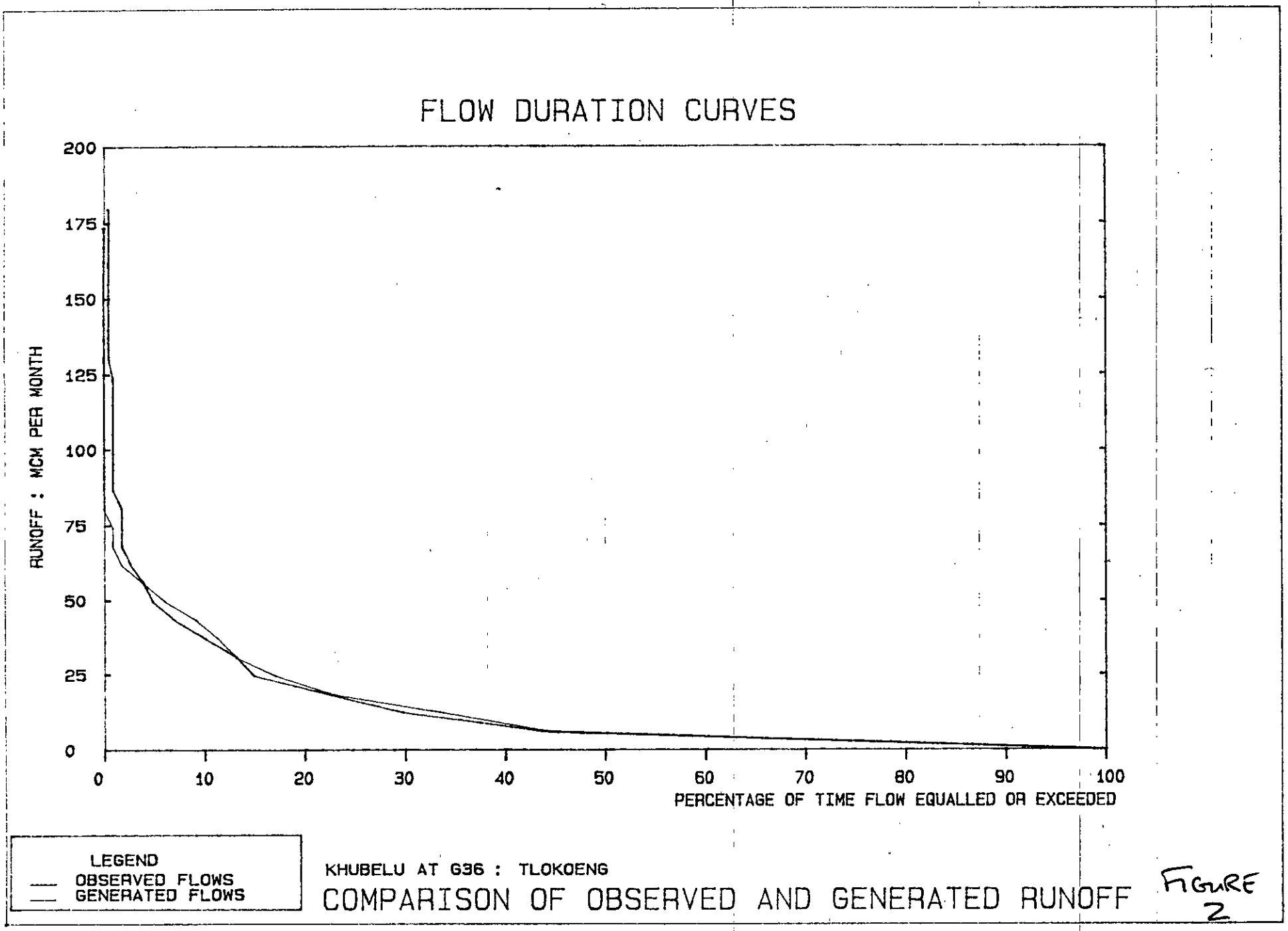

FLOW DURATION CURVES
RUNOFF : MCM PER MONTH
200
175
150
125
100
75
50
25
0
0
10
20
30
40
50
60
70
80
90
100
PERCENTAGE OF TIME FLOW EQUALLED OR EXCEEDED
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
KHUBELU AT G36 : TLOKOENG
COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 2

ANNEX 1C

GHI - BUKONG AT BUKONG

TABLE 1

841 BOKOMO - OBSERVED AND MODIFIED PITMAN MODELLED FLOWS INFILLED BY REGRESSION
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

1967	140	1308	1308	408	228	588	598	1468	288	248	188	248	69.3
1968	328	318	1118	218	198	578	1048	608	548	198	168	168	54.0
1969	798	668	848	658	908	188	148	148	128	138	138	458	51.3
1970	1628	898	1428	1828	1068	848	1358	488	188	178	148	128	100.9
1971	4	15	48	265	280	270	48	78	18	5	3	3	103.7
1972	33	103	8	3	228	57	75	10	3	1	112	58	69.1
1973	40	62	177W	284	285C	31W	64W	33	44	11	45	42	111.8
1974	9W	335	123	247	242	255	48	30	7	15	4	104	141.9
1975	116	377	168	278	351	301	215	88	97	21	13	119	214.4
1976	289	279	25	144	162	403	49	26	8	5	3	35	142.8
1977	216	67	103	434C	113	898	468	26	8	6	5	180	171.5
1978	113	62	357W	60W	45	24	6	36	28	83	325	182	132.1
1979	240	123	233	53	144	58	10	4	1	0	0	1	86.7
1980	26W	131	124W	561W	149	163	106	41	88	8	98	93	158.8
1981	17	159	210C	22	35	29	327C	41	5	6	3	8	86.2
1982	116	241	32	2	9	26	23	26	18	11	18	14	53.6
1983	23	159	96	127	8	12	27	85	4	3	3	37	58.4
1984	33	153e	48	17	107	126	43	18	9	2	0	0	55.6
1985	38	89	236	40	99	19	74	15	55	6	24	50	74.5
AVE.	84	141	129	150	131	109	100	43	27	13	38	54	101.9
SDV.	86	101	87	158	103	115	118	35	28	18	76	57	
NOBS	19	19	19	19	19	19	19	19	19	19	19	19	

G41 BOKONG - MONTHLY CATCHMENT RAINFALL IN TENTHS OF M.A.P

TABLE 2

HYDROLOGICAL YEARS STARTING OCTOBER
(I4,1X,12(I4,A),I8)

1930	80	75	127	201	123	135	143	4	2	66	0	0	956
1931	83	142	95	125	179	125	26	33	4	1	0	34	847
1932	42	145	142	45	127	112	54	14	10	21	1	14	727
1933	29	255	252	306	106	137	87	42	6	58	36	15	1329
1934	120	245	185	159	88	139	62	60	6	2	34	23	1123
1935	69	93	138	114	71	115	28	74	3	5	0	5	715
1936	135	355	166	247	226	133	33	9	1	10	1	18	1334
1937	52	89	153	203	200	31	103	28	47	22	50	36	1014
1938	132	64	191	258	175	56	30	70	6	37	42	46	1107
1939	137	161	96	98	138	102	109	77	6	8	2	124	1058
1940	26	129	178	172	160	62	99	3	1	25	4	79	938
1941	168	6	47	215	140	174	86	35	1	0	67	45	984
1942	131	200	209	183	79	114	122	147	29	109	100	28	1451
1943	230	278	229	100	190	78	20	32	50	0	0	84	1291
1944	94	109	26	94	155	169	50	43	0	1	0	3	744
1945	46	62	83	165	82	126	46	46	2	1	0	22	681
1946	132	104	119	93	93	75	87	5	24	10	3	74	819
1947	116	99	205	122	126	209	66	18	0	12	1	3	977
1948	64	68	38	218	95	73	43	32	3	6	1	46	687
1949	119	172	244	163	111	206	129	58	4	53	128	30	1417
1950	54	94	195	141	116	86	65	31	17	1	27	27	854
1951	195	44	90	124	179	62	15	14	9	61	45	47	885
1952	42	155	125	93	179	80	63	21	6	0	25	26	815
1953	145	141	158	110	143	109	44	57	17	1	0	32	957
1954	32	81	104	268	204	94	70	43	11	7	0	3	917
1955	79	131	194	104	208	127	45	79	1	3	1	33	1005
1956	133	191	392	203	139	120	94	19	35	45	60	235	1666
1957	255	156	127	135	102	96	113	94	2	0	0	71	1151
1958	67	159	182	109	103	78	118	152	8	69	1	2	1048
1959	132	167	265	112	193	176	106	36	7	4	40	75	1313
1960	122	204	189	172	112	148	111	85	42	6	20	43	1254
1961	13	255	147	133	198	146	94	20	0	0	14	20	1040
1962	58	202	83	250	123	145	109	29	26	39	5	14	1083
1963	100	170	149	111	83	210	54	14	38	0	25	59	1013
1964	194	55	135	157	61	40	104	2	51	29	32	27	887
1965	80	128	71	234	103	67	42	39	11	0	20	18	813
1966	50	108	128	350	190	120	113	58	30	11	12	19	1189
1967	91	150	151	64	42	131	85	90	6	16	12	15	853
1968	72	59	142	64	92	156	88	108	8	10	12	16	827
1969	183	50	117	116	50	53	33	16	26	16	32	78	770
1970	81	76	136	183	113	119	82	59	1	32	5	9	896
1971	73	72	76	165	171	164	24	44	13	2	13	69	886
1972	84	156	37	98	170	108	50	4	1	11	103	43	865
1973	36	124	111	176	160	99	65	28	31	7	39	35	911
1974	54	236	150	208	162	170	51	16	13	29	14	156	1259
1975	77	240	165	192	211	280	97	43	45	0	5	130	1485
1976	206	155	82	201	121	197	27	28	7	0	1	72	1097
1977	219	61	162	215	85	139	123	9	15	6	40	92	1166
1978	99	110	290	81	84	56	24	48	6	93	65	57	1013
1979	162	143	155	82	123	40	36	4	1	0	5	136	887
1980	23	179	89	231	144	114	81	21	38	0	69	14	1003
1981	38	132	135	85	84	76	83	16	24	23	1	22	719
1982	140	125	52	68	83	53	36	25	14	21	3	18	638
1983	89	170	109	157	92	102	51	63	8	1	59	15	916
1984	102	107	97	112	152	50	27	7	3	1	3	12	673
1985	145	136	195	132	113	68	62	1	67	2	77	41	1039
AVE.	102	139	145	156	131	115	70	40	15	18	24	45	100.0
SDEV	57	67	67	65	46	51	34	34	16	25	30	44	

VALUES IN TENTHS OF A PERCENT OF ANNUAL AVERAGE RAINFALL

TABLE 5

SYNTHESIZED RUNOFF AT GAUGE G41 CATCHMENT AREA= 403.SQ.KM M.A.P.= 930.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00 %	PI=	1.5 mm/D	ZMIN=	20.0 mm/M	ZMAX=	500.0 mm/M	RFACT=	1.000
R=	.50	POW=	3.0	SL=	.00 mm	FT=	4.0 mm/M		
GW=	.0 mm/M	TL=	.50 MTHS	GL=	.00 MTHS	NOFT=	4 PER MTH		
POWG=	2.5	SGL=	.0 mm	SG=	50.0 mm	FG=	20.0 mm/M		

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF OBS	(%MAR) SIM	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	50.0	10.9	8.3	9.3	8.4	9.5	8.6	8.1
NOV	140.0	50.0	13.2	13.8	14.2	14.1	14.6	10.1	10.8
DEC	160.0	50.0	14.5	12.7	15.1	12.9	15.4	8.7	11.6
JAN	150.0	50.0	15.5	14.7	16.5	15.0	16.9	15.8	10.8
FEB	125.0	50.0	12.4	12.9	15.4	13.1	15.8	10.3	11.8
MAR	120.0	50.0	11.7	10.7	12.6	10.9	12.9	11.5	10.5
APR	80.0	50.0	5.7	9.8	7.6	10.0	7.8	11.8	7.4
MAY	70.0	50.0	3.0	4.3	2.2	4.3	2.3	3.5	2.7
JUN	50.0	50.0	1.3	2.6	1.0	2.7	1.0	2.8	1.6
JUL	48.0	50.0	1.3	1.3	.5	1.3	.5	1.8	.7
AUG	56.0	50.0	2.9	3.7	1.6	3.8	1.7	7.6	2.8
SEP	96.0	50.0	5.2	5.3	4.0	5.4	4.1	5.7	5.3
YEAR	1203.0					101.9	102.3	46.9	53.9
MEAN AND ST.DEVN. OF LOGS						1.967	1.955	.193	.225

MAXIMUM OBSERVED = 56.1 MAXIMUM SIMULATED = 44.7

INITIAL SOIL STORAGE =	23.5	
FINAL SOIL STORAGE =	27.8 mm	
TOTAL RAIN =	17225.5 mm	
TOTAL INTERCEPTION LOSS =	1535.0 mm	8.9 % rain
TOTAL SURFACE RUNOFF =	3051.4 mm	17.7 % rain
TOTAL EVAP FROM SOIL =	10873.3 mm	63.1 % rain
TOTAL INTERFLOW =	1762.3 mm	10.2 % rain
INITIAL G.WATER STORAGE =	12.1 mm	
FINAL G.WATER STORAGE =	1.8 mm	
TOTAL G.WATER RUNOFF =	10.3 mm	.1 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	9.5	6	APR 1985	SEP 1985
	OBS	8.6	6	APR 1980	SEP 1980
40.	SIM	24.2	10	DEC 1982	SEP 1983
	OBS	19.6	7	APR 1980	OCT 1980
60.	SIM	64.0	30	APR 1981	SEP 1983
	OBS	42.7	35	DEC 1982	OCT 1985
80.	SIM	133.1	54	APR 1981	SEP 1985
	OBS	111.7	53	MAY 1982	SEP 1986
90.	SIM	179.0	54	APR 1981	SEP 1985
	OBS	156.8	53	MAY 1982	SEP 1986

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	1936.6	1943.8	.4
MEAN ANNUAL RUNOFF	101.9	102.3	.4
AVERAGE MONTHLY RUNOFF	8.5	8.5	.4
VARIANCE OF MONTHLY VALUES	100.0	99.7	-.3
RANGE OF RESIDUAL MASS CURVE	371.8	413.0	11.1
MEAN OF RESIDUAL MASS CURVE	14.5	11.6	-19.9
INDEX OF SEASONAL VARIABILITY	24.6	33.1	34.7
MEAN DEFICIT FLOW PERIOD(MONTHS)	5.5	6.8	22.5
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	11	13	18.2

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.706
STUDENTS T VALUE	15.004
REGRESSION COEFFICIENT	.705
BA[illegible]TANT OF REGRESSION EQUATION	2.535

TABLE 5

SYNTHESIZED RUNOFF AT GAUGE G41 CATCHMENT AREA= 403.SQ.KM M.A.P.= 930.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00 %	PI=	1.5 mm/D	ZMIN=	20.0 mm/M	ZMAX=	500.0 mm/M	RFACT=	1.000	
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GW=	.0 mm/M	TL=	.50 MTHS	GL=	.00 MTHS	NOFT=	4 PER MTH			
POWG=	2.5	SGL=	.0 mm	SG=	50.0 mm	FG=	20.0 mm/M			

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF (%MAR) OBS	SIM	MEAN RUNOFF (MCM) OBS	SIM	ST.DEVIATION (MCM) OBS	SIM
OCT	108.0	50.0	10.9	8.3	9.3	8.4	9.5	8.6	8.1
NOV	140.0	50.0	13.2	13.8	14.2	14.1	14.6	10.1	10.8
DEC	160.0	50.0	14.5	12.7	15.1	12.9	15.4	8.7	11.6
JAN	150.0	50.0	15.5	14.7	16.5	15.0	16.9	15.8	10.8
FEB	125.0	50.0	12.4	12.9	15.4	13.1	15.8	10.3	11.8
MAR	120.0	50.0	11.7	10.7	12.6	10.9	12.9	11.5	10.5
APR	80.0	50.0	5.7	9.8	7.6	10.0	7.8	11.8	7.4
MAY	70.0	50.0	3.0	4.3	2.2	4.3	2.3	3.5	2.7
JUN	50.0	50.0	1.3	2.6	1.0	2.7	1.0	2.8	1.6
JUL	48.0	50.0	1.3	1.3	.5	1.3	.5	1.8	.7
AUG	56.0	50.0	2.9	3.7	1.6	3.8	1.7	7.6	2.8
SEP	96.0	50.0	5.2	5.3	4.0	5.4	4.1	5.7	5.3
YEAR	1203.0					101.9	102.3	46.9	53.9
MEAN AND ST.DEVN. OF LOGS						1.967	1.955	.193	.225

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DEMAND AS PERCENT OF OBSERVED MAR

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20.	SIM	9.5	6	APR 1985	SEP 1985
	OBS	8.6	6	APR 1980	SEP 1980
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	OBS	19.6	7	APR 1980	OCT 1980
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80.	SIM	133.1	54	APR 1981	SEP 1985
	OBS	111.7	53	MAY 1982	SEP 1986
90.	SIM	179.0	54	APR 1981	SEP 1985
	OBS	156.8	53	MAY 1982	SEP 1986

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	1936.6	1943.8	.4
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VARIANCE OF MONTHLY VALUES	100.0	99.7	-.3
RANGE OF RESIDUAL MASS CURVE	371.8	413.0	11.1
MEAN OF RESIDUAL MASS CURVE	14.5	11.6	-19.9
INDEX OF SEASONAL VARIABILITY	24.6	33.1	34.7
MEAN DEFICIT FLOW PERIOD(MONTHS)	5.5	6.8	22.5
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	11	13	18.2

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.706
STUDENTS T VALUE	15.004
REGRESSION COEFFICIENT	.705
BA[illegible] CONSTANT OF REGRESSION EQUATION	2.535

TABLE 3 CONTD

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.706
STUDENTS T VALUE	15.004
REGRESSION COEFFICIENT	.705
BASE CONSTANT OF REGRESSION EQUATION	2.535
REGRESSION SUM OF SQUARES	11338.440
RESIDUAL SUM OF SQUARES	11382.890
TOTAL SUM OF SQUARES	22721.320
STANDARD ERROR OF ESTIMATE	7.097
MAXIMUM EQIVALENT CONSTANT ERROR (%)	72.522
RELATIVE ABSOLUTE ERROR(%)	56.696
COEFFICIENT OF DETERMINATION	.499
STANDARD COEFFICIENT OF EFFICIENCY	.414
RESIDUAL MASS CURVE COEFFICIENT	.897
SPECIAL COEFFICIENT OF EFFICIENCY	.254
COEFFICIENT OF PERSISTENCE	1.948
RELATIVE MEAN PERSISTENCE (%)	22.821
DURBIN-WATSON D-STATISTIC	1.872

SIGN TEST

NUMBER OF NEGATIVE RUNS	48
NUMBER OF POSITIVE RUNS	48
EXPECTED NUMBER OF RUNS	111.1
NUMBER OF NEGATIVE RESIDUALS	135
NUMBER OF POSITIVE RESIDUALS	93
STANDARDISED NORMAL VARIATE Z	2.080

RESIDUAL MASS CURVES

	OBSERVED												SIMULATED											
1967	-7.	-3.	2.	-3.	-9.	-12.	-14.	-8.	-14.	-20.	-27.	-33.	-7.	-5.	5.	9.	2.	2.	1.	-2.	-5.	-14.	-22.	-30.
1968	-38.	-43.	-41.	-47.	-54.	-56.	-55.	-57.	-60.	-67.	-74.	-81.	-37.	-43.	-47.	-52.	-59.	-59.	-56.	-56.	-59.	-68.	-76.	-84.
1969	-81.	-83.	-83.	-85.	-85.	-91.	-98.	-106.	-113.	-120.	-127.	-131.	-83.	-81.	-77.	-69.	-72.	-79.	-87.	-95.	-104.	-112.	-119.	-123.
1970	-123.	-123.	-117.	-108.	-106.	-106.	-101.	-104.	-111.	-118.	-125.	-132.	-122.	-122.	-124.	-112.	-102.	-97.	-94.	-97.	-102.	-110.	-118.	-127.
1971	-140.	-147.	-151.	-133.	-113.	-95.	-99.	-99.	-106.	-114.	-122.	-130.	-133.	-136.	-141.	-140.	-129.	-116.	-114.	-122.	-131.	-139.	-148.	-156.
1972	-136.	-134.	-142.	-150.	-135.	-138.	-139.	-147.	-155.	-163.	-161.	-163.	-163.	-162.	-162.	-169.	-166.	-161.	-166.	-173.	-182.	-190.	-191.	-191.
1973	-168.	-170.	-161.	-141.	-121.	-126.	-128.	-134.	-138.	-145.	-149.	-153.	-198.	-199.	-194.	-182.	-167.	-157.	-157.	-164.	-172.	-180.	-188.	-196.
1974	-161.	-136.	-132.	-116.	-100.	-83.	-87.	-92.	-100.	-107.	-113.	-113.	-204.	-178.	-145.	-124.	-96.	-79.	-76.	-84.	-92.	-100.	-108.	-98.
1975	-110.	-81.	-73.	-53.	-27.	-5.	8.	8.	9.	3.	-4.	-1.	-84.	-65.	-40.	-14.	15.	52.	73.	66.	59.	51.	43.	38.
1976	19.	39.	33.	39.	46.	78.	75.	69.	61.	53.	45.	40.	53.	87.	105.	114.	121.	132.	141.	133.	125.	117.	108.	103.
1977	53.	51.	53.	88.	91.	91.	129.	124.	116.	108.	100.	110.	116.	127.	126.	149.	165.	163.	166.	163.	155.	146.	138.	134.
1978	112.	110.	137.	135.	131.	123.	117.	112.	106.	106.	130.	140.	135.	133.	153.	172.	172.	173.	166.	159.	151.	146.	148.	148.
1979	153.	159.	174.	171.	177.	174.	166.	158.	150.	141.	133.	124.	156.	168.	178.	182.	183.	183.	175.	167.	159.	150.	142.	149.
1980	119.	123.	127.	175.	181.	189.	191.	187.	187.	179.	181.	181.	156.	137.	159.	179.	206.	209.	205.	198.	190.	182.	177.	172.
1981	175.	182.	194.	188.	183.	178.	202.	197.	189.	181.	173.	166.	164.	161.	160.	156.	151.	144.	144.	143.	135.	127.	119.	110.
1982	169.	164.	179.	171.	163.	157.	151.	145.	138.	131.	124.	117.	114.	118.	111.	104.	97.	91.	83.	75.	67.	59.	51.	43.
1983	111.	118.	129.	124.	116.	109.	103.	103.	95.	87.	79.	74.	39.	45.	54.	66.	71.	67.	63.	55.	47.	38.	32.	26.
1984	69.	75.	72.	65.	67.	71.	67.	60.	53.	44.	36.	27.	23.	22.	16.	10.	22.	33.	25.	17.	8.	0.	-9.	-17.
1985	23.	23.	38.	34.	33.	29.	27.	20.	17.	10.	3.	0.	-9.	5.	24.	44.	44.	41.	35.	28.	21.	13.	6.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	1.9	3.7	5.6	7.5	9.4	11.2	13.1	15.0	16.8
OBSERVED %TIME	100.0	69.7	54.4	44.7	38.2	32.0	26.3	21.1	18.0	14.9
SIMULATED %TIME	100.0	61.8	53.5	46.9	41.7	34.6	29.5	23.7	21.9	19.3
ERROR	.0	-7.9	-.9	2.2	3.5	2.6	2.2	2.6	3.9	4.4
MONTHLY DISCHARGE	18.7	20.6	22.4	24.3	26.2	28.1	29.9	31.8	33.7	35.5
OBSERVED %TIME	13.2	13.2	11.8	9.2	8.3	6.1	4.8	4.4	3.1	2.6
SIMULATED %TIME	16.7	13.2	11.0	9.2	7.5	6.1	5.3	3.9	3.9	2.2
ERROR	3.5	.0	-.9	.0	-.9	.0	.4	-.4	.9	-.4
MONTHLY DISCHARGE	37.4	39.3	41.1	43.0	44.9	46.8	48.6	50.5	52.4	54.2
OBSERVED %TIME	2.2	1.8	1.3	1.3	.9	.9	.4	.4	.4	.4
SIMULATED %TIME	1.8	1.3	1.3	.4	.0	.0	.0	.0	.0	.0
ERROR	-.4	-.4	.0	-.9	-.9	-.9	-.4	-.4	-.4	-.4

OBSERVED MAXIMUM MONTHLY VALUE	56.100
SIMULATED MAXIMUM MONTHLY VALUE	44.726

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.3437	.7131
2	.2032	.3533
3	.0909	.1412
4	-.0433	-.0983
5	-.1366	-.2759
6	-.1725	-.3353
7	-.1640	-.2478
8	-.0331	-.0884
9	-.0193	.1301
10	.1659	.3479
11	.3243	.5008
	.3046	.5402

TABLE 4

SYNTHESISED/ORIGINAL RUNOFF AT GAUGE 641 USING MODIFIED PITMAN MODEL FOR HYDROLOGICAL YEARS STARTING OCTOBER

(I4,2X,12(I5,A),F9.1)

1930	73P	50P	57P	189P	233P	143P	122P	81P	30P	24P	23P	10P	103.5
1931	14P	45P	64P	75P	145P	169P	93P	35P	15P	6P	3P	3P	66.7
1932	5P	73P	115P	60P	64P	100P	70P	25P	10P	5P	3P	2P	53.2
1933	2P	128P	261P	328P	319P	227P	136P	54P	25P	27P	41P	29P	157.7
1934	49P	216P	363P	272P	135P	134P	126P	63P	27P	10P	5P	4P	140.4
1935	8P	17P	28P	42P	64P	108P	94P	60P	50P	18P	7P	3P	49.9
1936	59P	297P	374P	319P	375P	291P	134P	46P	16P	6P	2P	1P	192.0
1937	14P	22P	46P	161P	240P	155P	102P	85P	40P	26P	61P	75P	102.7
1938	83P	88P	145P	273P	327P	235P	92P	49P	29P	15P	19P	21P	137.6
1939	60P	181P	209P	149P	135P	126P	117P	105P	68P	24P	9P	47P	123.0
1940	62P	89P	177P	237P	228P	133P	82P	61P	21P	9P	6P	13P	111.8
1941	94P	110P	38P	110P	185P	210P	176P	72P	27P	10P	24P	32P	108.8
1942	46P	139P	241P	276P	192P	127P	179P	210P	142P	106P	120P	69P	184.7
1943	239P	405P	349P	247P	204P	173P	70P	25P	28P	28P	11P	61P	184.0
1944	114P	102P	61P	26P	85P	229P	207P	73P	27P	10P	4P	2P	94.0
1945	2P	3P	6P	74P	116P	114P	92P	39P	20P	7P	3P	2P	47.8
1946	116P	207P	126P	53P	63P	120P	109P	45P	16P	8P	5P	17P	88.5
1947	60P	109P	135P	147P	144P	264P	269P	98P	34P	12P	5P	2P	127.9
1948	14P	20P	11P	89P	119P	58P	38P	19P	8P	4P	2P	4P	38.6
1949	33P	79P	142P	168P	143P	230P	230P	98P	39P	40P	105P	101P	140.8
1950	45P	32P	34P	54P	90P	84P	41P	23P	11P	5P	3P	5P	42.7
1951	82P	106P	43P	74P	169P	155P	59P	20P	7P	12P	22P	21P	77.0
1952	17P	47P	81P	65P	134P	155P	112P	91P	32P	11P	5P	5P	75.5
1953	37P	56P	48P	65P	75P	65P	39P	20P	14P	7P	3P	3P	43.2
1954	5P	17P	33P	185P	348P	256P	106P	45P	20P	8P	4P	2P	102.9
1955	12P	63P	121P	106P	167P	223P	123P	56P	34P	12P	5P	4P	92.6
1956	68P	234P	422P	439P	274P	153P	91P	36P	16P	16P	34P	241P	202.4
1957	469P	382P	199P	202P	186P	83P	88P	94P	49P	17P	6P	16P	179.1
1958	29P	87P	143P	107P	79P	65P	79P	193P	182P	84P	50P	18P	111.6
1959	97P	193P	229P	208P	165P	199P	172P	80P	28P	10P	24P	41P	144.6
1960	75P	124P	173P	234P	174P	103P	122P	127P	87P	33P	14P	14P	128.0
1961	14P	132P	226P	184P	215P	219P	138P	66P	23P	8P	4P	3P	123.2
1962	5P	53P	86P	232P	287P	183P	145P	74P	28P	19P	14P	6P	113.2
1963	28P	105P	151P	190P	166P	185P	189P	70P	36P	25P	12P	12P	116.9
1964	180P	237P	96P	108P	105P	44P	51P	47P	24P	20P	15P	12P	93.9
1965	10P	56P	77P	178P	250P	132P	46P	17P	8P	3P	2P	2P	78.1
1966	5P	28P	79P	269P	382P	285P	185P	98P	41P	16P	8P	5P	140.1
1967	14#	130#	130#	40#	22#	58#	59#	146#	28#	24#	18#	24#	69.3
1968	32#	31#	111#	21#	19#	57#	104#	60#	54#	19#	16#	16#	54.0
1969	79#	66#	84#	65#	90#	18#	14#	14#	12#	13#	13#	45#	51.3
1970	162#	89#	142#	182#	106#	84#	135#	48#	18#	17#	14#	12#	100.9
1971	4	15	48	265	280	270	48	78	18	5	3	3	103.7
1972	33	103	8	3	228	57	75	10	3	1	112	58	69.1
1973	40	62	177W	284	285C	31W	64W	33	44	11	45	42	111.8
1974	9W	335	123	247	242	255	48	30	7	15	4	104	141.9
1975	116	377	168	278	351	301	215	88	97	21	13	119	214.4
1976	289	279	25	144	162	403	49	26	8	5	3	35	142.8
1977	216	67	103	434C	113	89#	468	26	8	6	5	180	171.5
1978	113	62	357W	60W	45	24	6	36	28	83	325	182	132.1
1979	240	123	233	53	144	58	10	4	1	0	0	1	86.7
1980	26W	131	124W	561W	149	163	106	41	88	8	98	93	158.8
1981	17	159	210C	22	35	29	327C	41	5	6	3	8	86.2
1982	116	241	32	2	9	26	23	26	18	11	18	14	53.6
1983	23	159	96	127	8	12	27	85	4	3	3	37	58.4
1984	33	153e	48	17	107	126	43	18	9	2	0	0	55.6
1985	38	89	236	40	99	19	74	15	55	6	24	50	74.5
AVE.	70	125	136	161	166	143	111	59	32	17	25	34	108.1
SDV.	86	98	101	120	97	88	81	42	33	20	50	50	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

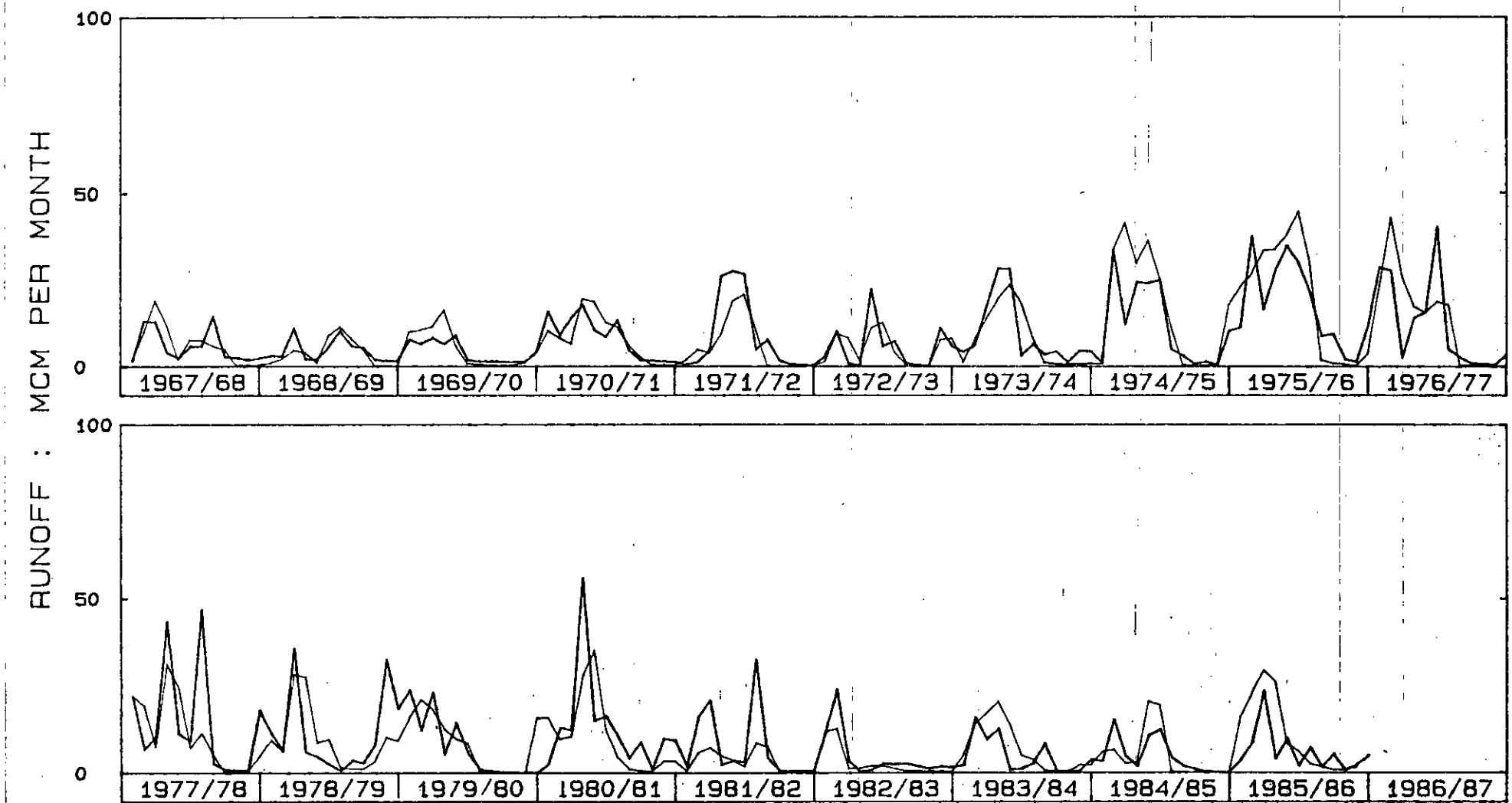
AI = .0 PI = 1.5 ZMIN = 20. ZMAX = 500. R = .5 POW = 3.0

SL = .0 FT = 4.0 GW = 0. RL = .50 GL = .00 NOFT = 4

POWG = 2.5 SGL = .0 SG = 50. ZG = 20.0

MONTH	O	N	D	J	F	M	A	M	J	J	A	S
P.EVAP	108.	140.	150.	150.	125.	120.	80.	70.	50.	48.	66.	96.

STMAX = 50. AREA = 403. RAINFALL = 930. RFACT = 1.000



LEGEND
— OBSERVED FLOWS
— GENERATED FLOWS

BOKONG AT G41 : BOKONG

COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 1

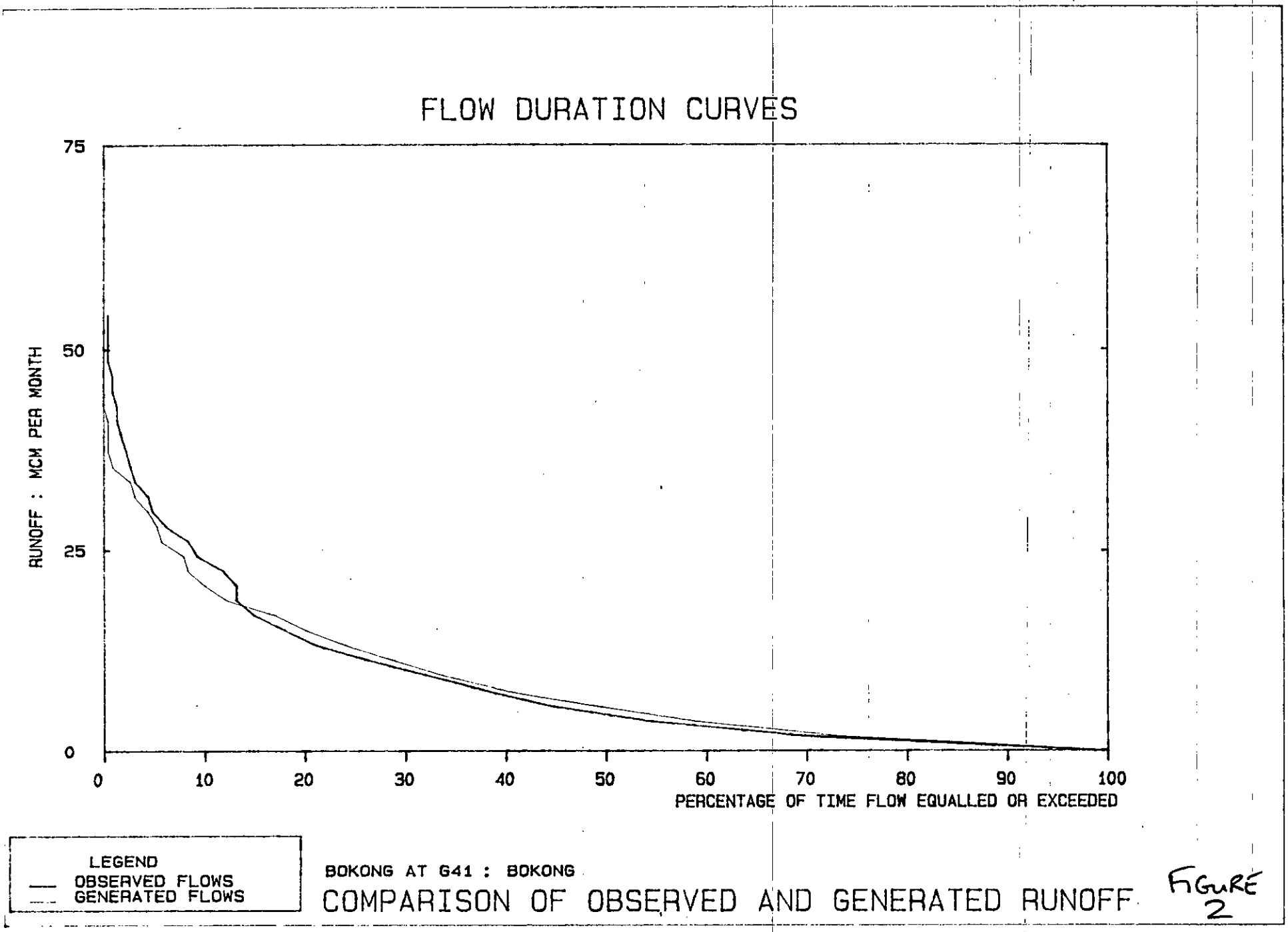

FLOW DURATION CURVES
RUNOFF : MCM PER MONTH
75
50
25
0
0
10
20
30
40
50
60
70
80
90
100
PERCENTAGE OF TIME FLOW EQUALLED OR EXCEEDED
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
BOKONG AT G41 : BOKONG
COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 2

ANNEX II

G42 - MATSOKU AT SESHUTE

842 SESHOTES - OBSERVED AND MODIFIED PITMAN MODELLED FLO INFILLED BY REGRESSION

TABLE 1

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,2X,12(I5,A),F9.1)

1967	0#	129#	129#	26#	5#	46#	47#	148#	11#	7#	0#	7#	55.5
1968	17#	15#	107#	3#	1#	45#	99#	49#	42#	2#	0#	0#	38.0
1969	70#	56#	76#	54#	84#	0#	0#	0#	0#	0#	0#	31#	37.1
1970	166#	82#	143#	190#	101#	76#	127	21N	7	3	3N	1N	92.0
1971	3	12	43C	225	137	417	42C	21	9	3	3	3	91.8
1972	26	90	6	0N	108	81	23	6	3	3	93	85	52.4
1973	69	21	56	186	355	37N	83	13	18	6	18	24	88.6
1974	7	299	77	125	355	339N	41	15	6	7	3	111	138.5
1975	244	579	161	488	343N	609N	224N	53	35	11	6	7N	276.0
1976	421N	496N	24	99N	325N	363N	63N	13	6	4	3	7	182.4
1977	222	66N	12	531	103	34	364	40N	9	6	6	139	153.2
1978	150	52	254	71	44	54	6	8	10	37	332	301	131.9
1979	263N	113N	342N	72	107	64	8	5	3	3	2	59	104.1
1980	60	94	85	367	77	46	69	55	61N	8N	39N	108	106.9
1981	13	63	209	20	10	34	104	54	11	6	3	3	53.0
1982	94	388	15	10	10	33	20	17N	12	3	3	1E	60.6
1983	41	59	316	266N	5	7	7	14	4	2	3	23	74.7
1984	6	34	17	8	181	58	13	2	1	1	0	0	32.1
1985	35#	115#	349	50	60	14	36	10	30	4	18	60#	78.1
AVE.	100	145	127	147	127	124	72	29	15	6	28	51	97.2
SDV.	115	168	115	163	126	172	89	34	16	8	77	75	
NOBS	19	19	19	19	19	19	19	19	19	19	19	19	

G42 SESHOTES - MONTHLY CATCHMENT RAINFALL IN TENTHS OF M.A.P

TABLE 2

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,1X,12(I4,A),I8)

1930	81	79	129	231	116	116	101	9	1	49	0	0	912
1931	77	118	119	137	168	117	24	38	2	0	0	30	830
1932	43	157	122	51	135	117	34	21	12	15	1	14	722
1933	37	210	193	239	149	138	47	52	3	56	52	8	1184
1934	112	239	225	122	112	146	80	47	9	1	20	23	1136
1935	64	90	112	121	119	138	14	86	2	3	0	4	753
1936	131	291	157	232	207	118	21	9	1	4	1	7	1179
1937	87	71	137	208	158	37	116	25	52	25	86	48	1050
1938	122	83	208	211	199	78	68	65	10	35	45	49	1173
1939	117	197	136	147	129	123	98	83	14	4	0	105	1153
1940	44	154	182	195	139	74	98	11	2	26	3	65	993
1941	145	30	42	197	140	172	78	37	6	0	62	40	949
1942	103	178	201	191	86	139	138	116	16	93	63	30	1354
1943	267	193	201	130	176	92	5	35	64	10	0	116	1289
1944	107	114	34	93	159	202	29	39	1	0	0	1	779
1945	40	48	81	169	112	133	47	52	1	3	0	16	702
1946	181	142	78	102	127	142	70	15	17	22	4	76	976
1947	110	136	152	154	131	241	70	15	1	6	4	14	1034
1948	86	58	59	185	79	96	59	30	6	12	2	40	712
1949	101	127	178	146	132	210	79	50	5	65	97	22	1212
1950	79	80	118	127	136	79	68	37	10	1	22	36	793
1951	146	25	98	155	174	82	19	10	6	44	45	43	847
1952	64	124	132	105	186	80	116	22	5	0	23	28	885
1953	107	94	121	131	113	98	32	52	23	1	1	35	808
1954	45	100	115	251	204	95	64	44	13	9	0	6	946
1955	84	134	157	112	199	129	22	71	1	10	2	35	956
1956	135	225	287	196	116	117	61	19	33	42	59	247	1537
1957	231	133	127	207	91	95	110	69	3	0	0	71	1137
1958	77	155	149	112	120	84	113	156	14	60	2	3	1045
1959	161	157	195	138	147	162	86	19	6	14	61	69	1215
1960	118	137	183	192	53	128	107	92	29	18	15	59	1131
1961	20	212	159	154	183	127	84	15	0	0	18	30	1002
1962	50	137	122	271	116	140	89	21	32	39	1	13	1031
1963	100	158	148	191	97	195	65	13	57	0	30	49	1103
1964	227	79	109	166	68	79	95	8	49	30	35	33	978
1965	57	137	108	236	135	50	23	31	8	0	19	19	823
1966	56	111	150	282	178	140	94	53	23	9	23	26	1145
1967	81	142	177	79	94	126	69	84	7	16	24	11	910
1968	67	89	124	85	64	140	85	84	5	10	11	15	779
1969	138	71	176	140	69	57	34	20	20	19	43	77	864
1970	119	73	142	192	122	134	88	70	3	27	14	13	997
1971	87	107	95	158	157	149	20	21	6	4	16	21	841
1972	80	141	45	112	151	106	58	11	1	11	91	44	851
1973	59	135	150	183	159	130	65	23	32	3	35	25	999
1974	59	294	157	237	180	152	48	17	8	29	18	168	1367
1975	106	224	181	239	187	256	74	39	33	0	12	86	1437
1976	192	232	120	195	95	193	42	27	5	0	2	83	1186
1977	187	53	152	251	72	127	97	10	6	2	33	87	1077
1978	105	78	274	64	146	89	24	55	5	61	81	71	1053
1979	157	136	174	112	141	63	27	7	2	0	3	158	980
1980	39	151	106	266	146	105	68	8	34	0	63	17	1003
1981	45	126	112	121	66	89	112	12	16	23	5	25	752
1982	148	91	45	105	83	82	26	36	13	28	2	23	682
1983	108	148	159	181	98	106	34	39	9	4	54	8	948
1984	114	76	111	105	209	44	25	4	4	2	2	15	711
1985	175	132	248	120	125	75	79	1	41	1	51	37	1085
AVE.	105	132	142	165	133	120	64	38	14	17	24	45	100.0
SDEV	53	59	53	57	41	46	33	31	16	21	27	45	

VALUES IN TENTHS OF A PERCENT OF ANNUAL AVERAGE RAINFALL

TABLE 2

SYNTHESIZED RUNOFF AT GAUGE G42 CATCHMENT AREA= 652.8Q.KM M.A.P.= 759.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00 %	PI=	1.5 mm/D	ZMIN=	50.0 mm/M	ZMAX=	500.0 mm/M	RFACT=	1.000
R=	.50	POW=	3.0	SL=	.00 mm	FT=	10.0 mm/M		
GW=	.0 mm/M	TL=	.50 MTHS	GL=	.00 MTHS	NOFT=	4 PER MTH		
POWG=	2.5	SGL=	.0 mm	SG=	.0 mm	FG=	.0 mm/M		

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF (%MAR) OBS	RUNOFF (%MAR) SIM	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	53.0	10.9	10.3	9.8	10.0	9.6	11.5	8.8
NOV	140.0	53.0	13.2	15.0	14.6	14.5	14.2	16.8	12.7
DEC	160.0	53.0	14.5	13.1	14.9	12.7	14.5	11.5	12.9
JAN	150.0	53.0	15.5	15.1	16.2	14.7	15.7	16.3	11.5
FEB	125.0	53.0	12.4	13.1	15.0	12.7	14.6	12.6	12.7
MAR	120.0	53.0	11.7	12.8	11.8	12.4	11.5	17.2	11.5
APR	80.0	53.0	5.7	7.5	7.3	7.2	7.1	8.9	8.2
MAY	70.0	53.0	3.0	2.9	2.0	2.9	2.0	3.4	1.9
JUN	50.0	53.0	1.3	1.5	1.1	1.5	1.1	1.6	1.1
JUL	48.0	53.0	1.3	.6	.8	.6	.8	.8	.7
AUG	56.0	53.0	2.9	2.9	1.9	2.8	1.9	7.7	2.7
SEP	96.0	53.0	5.2	5.3	4.5	5.1	4.4	7.5	5.7
YEAR	1203.0					97.2	97.3	60.0	60.3
MEAN AND ST.DEVN. OF LOGS						1.919	1.917	.249	.253

MAXIMUM OBSERVED = 60.9 MAXIMUM SIMULATED = 49.1

INITIAL SOIL STORAGE =	22.9	
FINAL SOIL STORAGE =	26.8 mm	
TOTAL RAIN =	14058.2 mm	
TOTAL INTERCEPTION LOSS =	1365.3 mm	9.7 % rain
TOTAL SURFACE RUNOFF =	1370.0 mm	9.7 % rain
TOTAL EVAP FROM SOIL =	9855.2 mm	70.1 % rain
TOTAL INTERFLOW =	1465.2 mm	10.4 % rain
INITIAL G.WATER STORAGE =	.0 mm	
FINAL G.WATER STORAGE =	.0 mm	
TOTAL G.WATER RUNOFF =	.0 mm	.0 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	8.0	6	APR 1985	SEP 1985
	OBS	9.7	6	MAR 1970	AUG 1970
40.	SIM	21.4	10	DEC 1982	SEP 1983
	OBS	26.2	20	FEB 1984	SEP 1985
60.	SIM	65.8	31	APR 1981	OCT 1983
	OBS	60.0	21	FEB 1984	OCT 1985
80.	SIM	138.4	54	APR 1981	SEP 1985
	OBS	111.0	72	JAN 1968	DEC 1973
90.	SIM	191.4	81	FEB 1968	OCT 1974
	OBS	169.3	72	JAN 1968	DEC 1973

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	1846.9	1848.2	.1
MEAN ANNUAL RUNOFF	97.2	97.3	.1
AVERAGE MONTHLY RUNOFF	8.1	8.1	.1
VARIANCE OF MONTHLY VALUES	142.8	106.4	-25.5
RANGE OF RESIDUAL MASS CURVE	452.6	462.8	2.3
MEAN OF RESIDUAL MASS CURVE	5.7	-2.2	-139.1
INDEX OF SEASONAL VARIABILITY	29.3	32.3	10.2
MEAN DEFICIT FLOW PERIOD(MONTHS)	6.0	7.6	25.8
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	12	18	50.0

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.737
STUDENTS T VALUE	16.411
REGRESSION COEFFICIENT	.636
BASE CONSTANT OF REGRESSION EQUATION	2.951

TABLE 3 CONTD

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.737
STUDENTS T VALUE	16.411
REGRESSION COEFFICIENT	.636
BASE CONSTANT OF REGRESSION EQUATION	2.951
REGRESSION SUM OF SQUARES	13184.580
RESIDUAL SUM OF SQUARES	11063.330
TOTAL SUM OF SQUARES	24247.910
STANDARD ERROR OF ESTIMATE	6.997
MAXIMUM EQIVALENT CONSTANT ERROR (%)	75.919
RELATIVE ABSOLUTE ERROR(%)	57.012
COEFFICIENT OF DETERMINATION	.544
STANDARD COEFFICIENT OF EFFICIENCY	.528
RESIDUAL MASS CURVE COEFFICIENT	.955
SPECIAL COEFFICIENT OF EFFICIENCY	.422
COEFFICIENT OF PERSISTENCE	1.349
RELATIVE MEAN PERSISTENCE (%)	21.418
DURBIN-WATSON D-STATISTIC	2.025
SIGN TEST	
NUMBER OF NEGATIVE RUNS	53
NUMBER OF POSITIVE RUNS	53
EXPECTED NUMBER OF RUNS	111.1
NUMBER OF NEGATIVE RESIDUALS	93
NUMBER OF POSITIVE RESIDUALS	135
STANDARDISED NORMAL VARIATE Z	.705

RESIDUAL MASS CURVES

	OBSERVED												SIMULATED											
1967	-8.	-3.	1.	-4.	-12.	-15.	-19.	-12.	-19.	-26.	-34.	-42.	-6.	-6.	2.	5.	-2.	-5.	-7.	-11.	-15.	-22.	-29.	-37.
1968	-48.	-55.	-52.	-60.	-68.	-72.	-70.	-73.	-77.	-85.	-93.	-101.	-44.	-50.	-54.	-60.	-67.	-68.	-67.	-70.	-74.	-82.	-89.	-97.
1969	-102.	-105.	-103.	-108.	-107.	-116.	-124.	-132.	-140.	-148.	-156.	-161.	-96.	-94.	-92.	-87.	-92.	-99.	-106.	-114.	-122.	-129.	-135.	-139.
1970	-153.	-152.	-146.	-135.	-133.	-134.	-129.	-135.	-143.	-150.	-158.	-166.	-138.	-139.	-143.	-134.	-127.	-126.	-126.	-130.	-135.	-142.	-150.	-157.
1971	-174.	-181.	-185.	-170.	-165.	-131.	-135.	-141.	-148.	-156.	-164.	-172.	-163.	-167.	-172.	-173.	-166.	-155.	-154.	-161.	-169.	-177.	-185.	-192.
1972	-177.	-176.	-184.	-192.	-189.	-189.	-195.	-202.	-210.	-218.	-217.	-216.	-198.	-199.	-200.	-207.	-206.	-204.	-210.	-217.	-224.	-232.	-232.	-231.
1973	-218.	-224.	-226.	-216.	-188.	-193.	-192.	-199.	-206.	-213.	-219.	-229.	-237.	-240.	-238.	-230.	-217.	-209.	-211.	-218.	-225.	-232.	-239.	-246.
1974	-232.	-211.	-211.	-207.	-179.	-153.	-157.	-164.	-172.	-179.	-187.	-184.	-253.	-222.	-185.	-164.	-134.	-118.	-115.	-123.	-130.	-138.	-145.	-133.
1975	-167.	-118.	-110.	-69.	-43.	10.	24.	22.	17.	10.	2.	-5.	-117.	-97.	-70.	-44.	-13.	28.	55.	49.	42.	35.	27.	23.
1976	29.	71.	65.	67.	91.	119.	117.	111.	103.	95.	88.	80.	40.	80.	100.	107.	114.	125.	136.	129.	121.	113.	106.	101.
1977	94.	93.	86.	131.	133.	128.	137.	153.	145.	139.	130.	136.	116.	130.	127.	150.	168.	165.	165.	160.	152.	144.	137.	132.
1978	143.	140.	158.	157.	153.	150.	143.	135.	128.	124.	149.	171.	131.	128.	150.	173.	171.	171.	164.	157.	151.	146.	148.	149.
1979	189.	192.	218.	218.	220.	219.	211.	204.	196.	188.	180.	178.	158.	170.	177.	180.	179.	177.	170.	162.	154.	146.	138.	147.
1980	176.	177.	177.	206.	206.	202.	201.	198.	196.	189.	185.	188.	157.	157.	158.	180.	209.	210.	205.	198.	191.	184.	179.	174.
1981	181.	179.	192.	186.	179.	174.	176.	173.	166.	159.	151.	143.	167.	163.	159.	155.	148.	142.	141.	139.	132.	124.	117.	110.
1982	145.	175.	169.	162.	155.	150.	144.	137.	130.	123.	115.	107.	113.	118.	111.	104.	98.	92.	85.	77.	70.	63.	55.	48.
1983	103.	101.	124.	143.	135.	128.	120.	113.	106.	98.	90.	84.	43.	47.	53.	62.	66.	62.	56.	49.	41.	34.	28.	22.
1984	77.	72.	66.	58.	48.	66.	59.	51.	43.	35.	27.	19.	19.	16.	10.	5.	18.	31.	23.	15.	7.	-1.	-9.	-16.
1985	15.	18.	45.	42.	40.	33.	28.	21.	16.	8.	2.	0.	-7.	7.	28.	47.	43.	38.	32.	26.	19.	12.	6.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	2.0	4.1	6.1	8.1	10.1	12.2	14.2	16.2	18.3
OBSERVED %TIME	100.0	56.1	46.5	35.1	28.5	23.2	19.3	16.7	14.9	14.0
SIMULATED %TIME	100.0	60.5	46.1	39.5	33.3	25.4	22.4	21.5	18.0	14.9
ERROR	.0	4.4	-.4	4.4	4.8	2.2	3.1	4.8	3.1	.9

MONTHLY DISCHARGE	20.3	22.3	24.4	26.4	28.4	30.5	32.5	34.5	36.5	38.6
OBSERVED %TIME	13.2	12.3	11.4	10.1	9.6	8.8	8.3	6.1	3.9	3.5
SIMULATED %TIME	13.2	10.5	9.6	8.3	7.0	5.3	4.4	3.9	2.6	2.2
ERROR	.0	-1.8	-1.8	-1.8	-2.6	-3.5	-3.9	-2.2	-1.3	-1.3

MONTHLY DISCHARGE	40.6	42.6	44.7	46.7	48.7	50.7	52.8	54.8	56.8	58.9
OBSERVED %TIME	3.1	2.2	2.2	2.2	2.2	1.3	1.3	.9	.9	.4
SIMULATED %TIME	1.3	1.3	1.3	.9	.4	.0	.0	.0	.0	.0
ERROR	-1.8	-.9	-.9	-1.3	-1.8	-1.3	-1.3	-.9	-.9	-.4

OBSERVED MAXIMUM MONTHLY VALUE	60.900
SIMULATED MAXIMUM MONTHLY VALUE	49.080

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

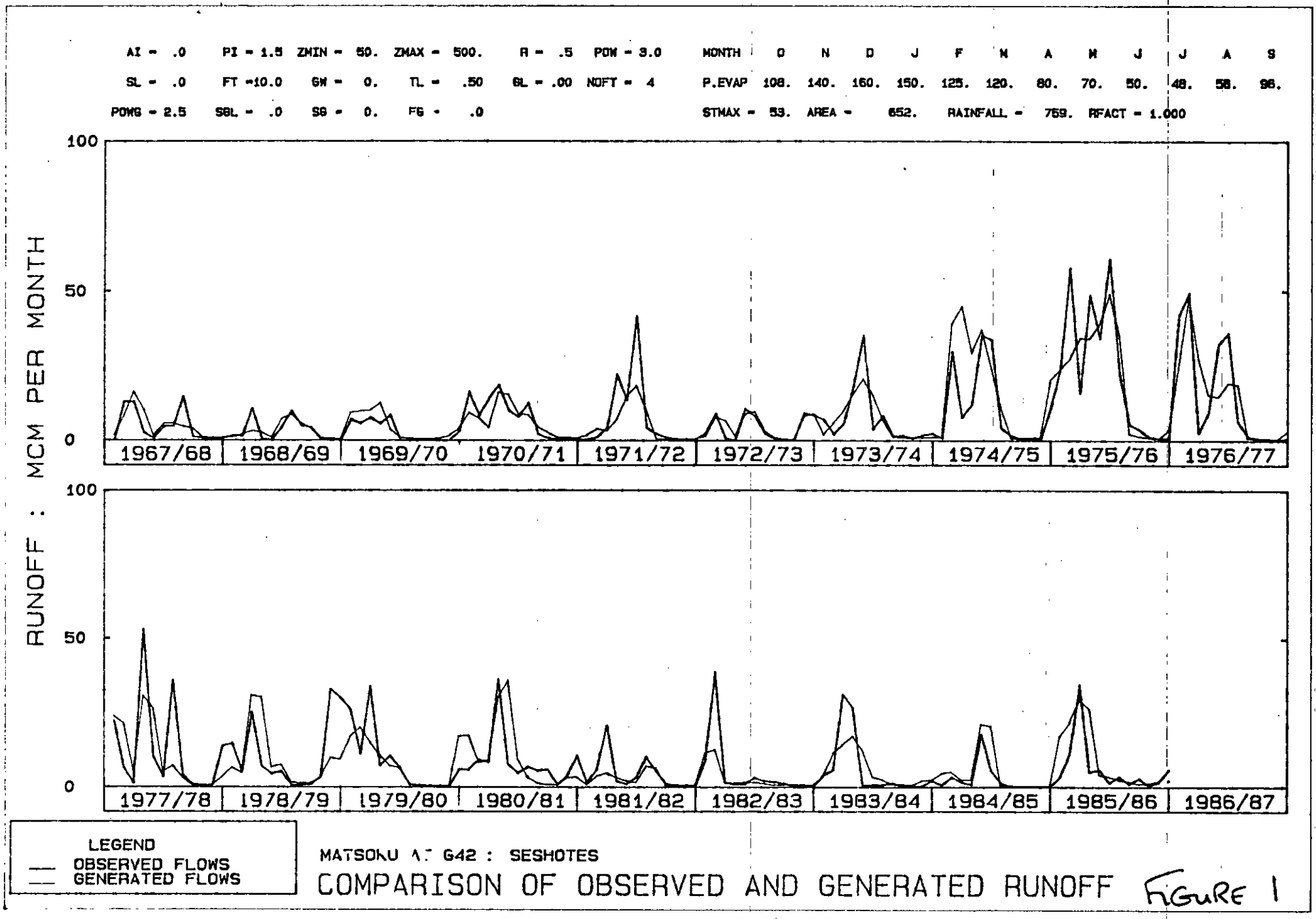
LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.3743	.6941
2	.1825	.3349
3	.1432	.1671
4	.0530	-.0293
5	-.1053	-.1856
6	-.1550	-.2344
7	-.0984	-.1421
8	.0320	-.0166
9	.0353	.1570
10	.1353	.3532
11	.3479	.4754
12	.3601	.4951

TABLE 4

SYNTHESISED/ORIGINAL RUNOFF AT GAUGE 842 USING MODIFIED PITMAN MODEL FOR HYDROLOGICAL YEARS STARTING OCTOBER

(I4,2X,12(I5,A),F9.1)

1930	32P	27P	31P	198P	230P	87P	75P	52P	14P	17P	20P	8P	79.1
1931	12P	32P	41P	45P	123P	144P	58P	17P	9P	5P	3P	4P	49.3
1932	6P	76P	103P	38P	42P	69P	44P	13P	6P	5P	5P	4P	41.1
1933	4P	158P	290P	350P	320P	184P	99P	32P	17P	25P	44P	31P	155.4
1934	42P	257P	426P	258P	81P	99P	102P	41P	18P	8P	6P	6P	134.4
1935	10P	19P	26P	30P	37P	82P	75P	43P	38P	12P	5P	3P	38.0
1936	60P	381P	437P	314P	404P	275P	86P	20P	6P	3P	3P	3P	199.2
1937	15P	23P	31P	161P	242P	127P	76P	68P	30P	24P	69P	81P	94.7
1938	80P	78P	150P	295P	350P	229P	62P	35P	24P	15P	23P	26P	136.7
1939	59P	199P	203P	98P	86P	83P	75P	66P	46P	16P	6P	46P	98.3
1940	58P	84P	172P	233P	203P	93P	47P	34P	11P	7P	7P	16P	96.5
1941	108P	116P	26P	111P	175P	197P	167P	51P	17P	7P	25P	35P	103.5
1942	38P	140P	252P	271P	165P	95P	171P	219P	137P	107P	126P	62P	178.3
1943	323P	507P	355P	205P	163P	149P	43P	12P	25P	30P	13P	67P	189.2
1944	109P	72P	32P	13P	80P	258P	223P	51P	16P	6P	3P	2P	86.5
1945	3P	4P	7P	69P	93P	82P	69P	26P	15P	7P	4P	3P	38.2
1946	149P	232P	106P	33P	40P	98P	93P	31P	11P	8P	7P	23P	83.1
1947	61P	95P	107P	109P	101P	292P	307P	74P	18P	6P	4P	3P	117.7
1948	16P	21P	10P	91P	111P	40P	26P	15P	8P	5P	5P	7P	35.5
1949	28P	62P	126P	141P	98P	238P	244P	71P	25P	37P	122P	114P	130.6
1950	40P	27P	27P	35P	63P	61P	28P	18P	11P	6P	5P	8P	32.9
1951	96P	111P	31P	58P	158P	143P	39P	10P	4P	12P	26P	26P	71.4
1952	20P	38P	51P	36P	135P	155P	93P	77P	21P	7P	5P	7P	64.5
1953	32P	46P	37P	40P	41P	37P	24P	14P	14P	9P	5P	5P	30.4
1954	7P	18P	30P	226P	413P	256P	72P	28P	14P	8P	5P	3P	108.0
1955	14P	57P	101P	80P	170P	222P	91P	36P	26P	10P	5P	6P	81.8
1956	75P	277P	515P	485P	228P	88P	51P	20P	11P	18P	39P	339P	214.6
1957	626P	419P	144P	179P	176P	56P	69P	78P	37P	12P	5P	17P	181.8
1958	31P	91P	129P	75P	44P	36P	65P	224P	211P	72P	44P	14P	103.6
1959	113P	211P	227P	175P	117P	179P	150P	49P	14P	6P	26P	47P	131.4
1960	77P	112P	159P	226P	153P	69P	93P	107P	74P	26P	13P	16P	112.5
1961	16P	167P	248P	148P	193P	198P	96P	37P	11P	4P	4P	6P	112.8
1962	8P	48P	68P	273P	315P	140P	105P	42P	16P	17P	16P	8P	105.6
1963	24P	106P	137P	168P	147P	190P	198P	50P	26P	23P	13P	15P	109.7
1964	246P	294P	78P	88P	83P	27P	32P	29P	18P	20P	20P	17P	95.2
1965	14P	51P	64P	204P	262P	96P	23P	8P	6P	4P	4P	5P	74.1
1966	8P	25P	63P	315P	438P	261P	134P	57P	26P	12P	9P	8P	135.6
1967	0#	129#	129#	26#	5#	46#	47#	148#	11#	7#	0#	7#	55.5
1968	17#	15#	107#	3#	1#	45#	99#	49#	42#	2#	0#	0#	38.0
1969	70#	56#	76#	54#	84#	0#	0#	0#	0#	0#	0#	31#	37.1
1970	166#	82#	143#	190#	101#	76#	127	21W	7	3	3W	1W	92.0
1971	3	12	43C	225	137	417	42C	21	9	3	3	3	91.8
1972	26	90	6	0W	108	81	23	6	3	3	93	85	52.4
1973	69	21	56	186	355	37W	83	13	18	6	18	24	88.6
1974	7	299	77	125	355	339W	41	15	6	7	3	111	138.5
1975	244	579	161	488	343W	609W	224W	53	35	11	6	7W	276.0
1976	421W	496W	24	99W	325W	363W	63W	13	6	4	3	7	182.4
1977	222	66W	12	531	103	34	364	40W	9	6	6	139	153.2
1978	150	52	254	71	44	54	6	8	10	37	332	301	131.9
1979	263W	113W	342W	72	107	64	8	5	3	3	2	59	104.1
1980	60	94	85	367	77	46	69	55	61W	8W	39W	108	106.9
1981	13	63	209	20	10	34	104	54	11	6	3	3	53.0
1982	94	388	15	10	10	33	20	17W	12	3	3	1E	60.6
1983	41	59	316	266W	5	7	7	14	4	2	3	23	74.7
1984	6	34	17	8	181	58	13	2	1	1	0	0	32.1
1985	35#	115#	349	50	60	14	36	10	30	4	18	60#	78.1
AVE.	82	133	133	155	155	134	87	43	23	13	23	37	101.8
SDV.	115	138	124	130	116	117	74	44	33	17	50	64	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	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SL = .0 FT =10.0 GW = 0. TL = .50 GL = .00 NOFT = 4
POWS = 2.5 SBL = .0 SS = 0. FS = .0
MONTH O N D J F M A M J J A S
P.EVAP 108. 140. 160. 150. 125. 120. 80. 70. 50. 48. 58. 96.
STMAX = 53. AREA = 652. RAINFALL = 759. RFACT = 1.000
RUNOFF : MCM PER MONTH
100
50
0
1967/68
1968/69
1969/70
1970/71
1971/72
1972/73
1973/74
1974/75
1975/76
1976/77
1977/78
1978/79
1979/80
1980/81
1981/82
1982/83
1983/84
1984/85
1985/86
1986/87
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
MATSOKU AT G42 : SESHOTES
COMPARISON OF OBSERVED AND GENERATED RUNOFF
FIGURE 1

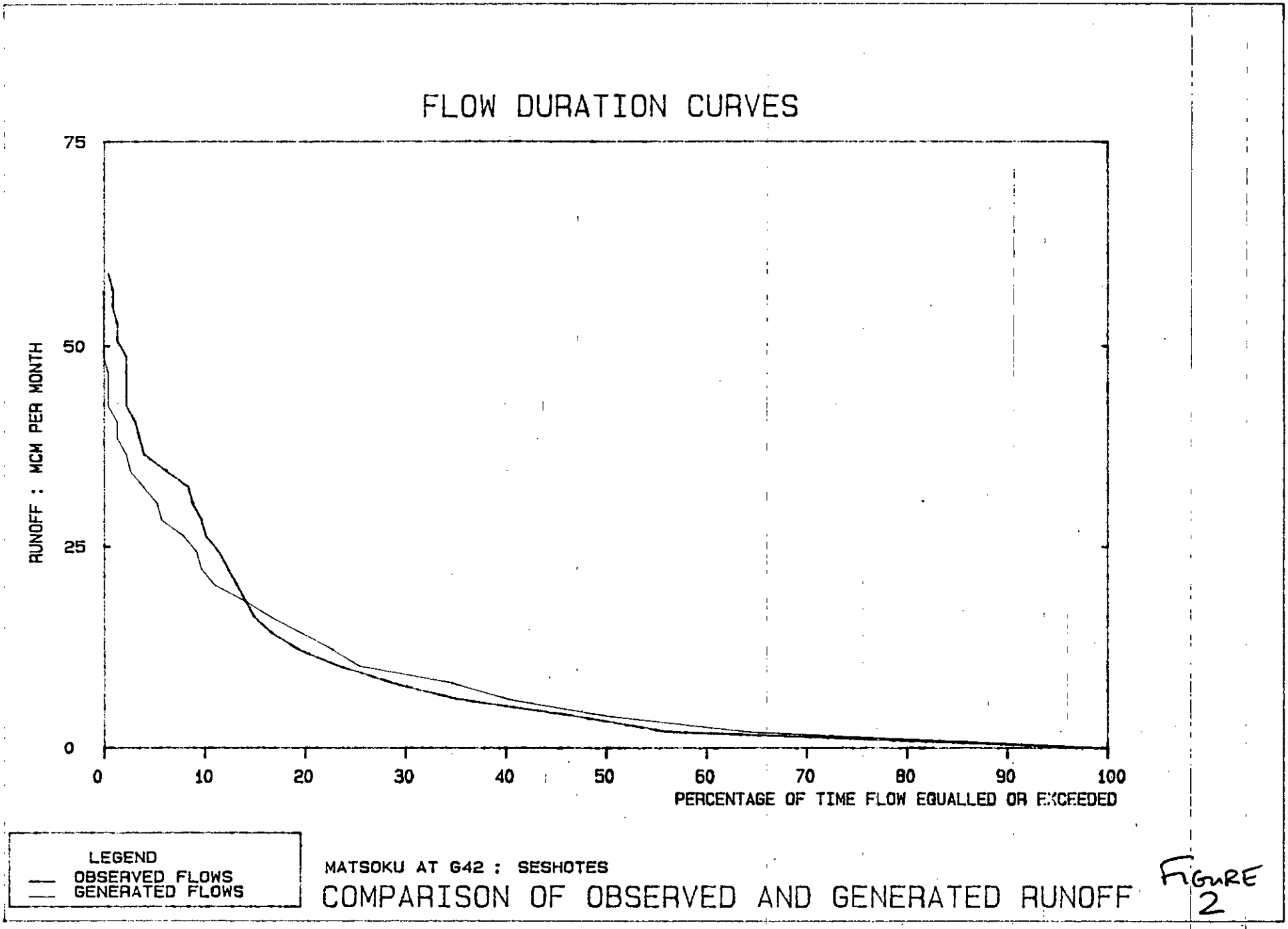

FLOW DURATION CURVES
RUNOFF : MCM PER MONTH
75
50
25
0
0
10
20
30
40
50
60
70
80
90
100
PERCENTAGE OF TIME FLOW EQUALLED OR EXCEEDED
LEGEND
OBSERVED FLOWS
GENERATED FLOWS
MATSOKU AT G42 : SESHOTES
COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 2

ANNEX 12

GIS MALIBAMATSO AT PELANENG

TABLE 1

843 PELANENG - OBSERVED AND MODIFIED PITMAN MODELLED FLO INFILLED BY REGRESSION
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

1967	260	5360	5360	1410	610	2200	2240	6080	870	710	440	690	262.3
1968	1080	1020	4530	570	480	2160	4210	2310	2030	510	370	330	196.0
1969	3100	2560	3360	2500	3630	430	280	280	200	210	210	1610	183.7
1970	6770	3570	5900	7670	4310	3340	5610	1750	460	400	270	180	402.3
1971	260	1090	2220	7530	7030	12750	1770	2170	690	320	260	250	363.4
1972	1230	3780	27	8	657	195	234	41M	14M	5	302	2780	226.2
1973	2610	225	547	831	752	170	281	101	89	36	52	60	340.5
1974	27	2041	809	737E	1097E	919	114	71	26	32	23M	356M	625.2
1975	514	19210	8550	1209M	1280	1945C	762M	213	138	45	32	213	912.7
1976	1848C	1628C	98	431	906	1419	283	55	11	9	7	45	674.0
1977	882	249	117	1383	327	479	1628	94M	27M	18M	22M	413M	563.9
1978	476E	176M	983M	198	198	215	19	49	66	200	1083M	975M	463.8
1979	859M	416	853	201	573	156	48	14	21M	7M	6	281M	343.5
1980	152M	576	290M	17670	470	794	632	179	259M	32	227	199M	557.7
1981	68M	372M	8250	80	53	100	7390	111	25	21	15	28	243.7
1982	3790	11520	100	46	161	247	166	232	62	30	45	42	266.2
1983	326	683	961	1450	44	163	95	101	18	12	10	163	402.6
1984	107	357	165	138	1040	495	68	17	9	7	4	2	240.9
1985	988	953	2140	135	710	104	361	43	134	22	159	232	598.1
AVE.	429	657	574	557	520	499	360	136	70	36	113	189	414.0
SDV.	462	604	497	552	384	532	386	137	70	43	249	227	
NOBS	19	19	19	19	19	19	19	19	19	19	19	19	

G45 PELANENG - MONTHLY CATCHMENT RAINFALL IN TENTHS OF M.A.P.

TABLE 2

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,1X,12(I4,A),I8)

1930	67	80	130	226	109	117	118	7	1	44	0	0	899
1931	77	119	107	128	176	123	16	48	1	0	0	33	828
1932	42	143	121	50	134	116	40	22	14	11	0	17	710
1933	37	233	219	285	132	148	37	29	9	61	58	8	1256
1934	122	257	225	122	99	146	85	51	8	1	16	24	1156
1935	66	92	119	112	105	132	16	64	2	2	0	3	713
1936	125	284	148	247	201	127	23	8	1	4	1	7	1176
1937	97	71	130	205	184	33	122	28	68	16	91	44	1089
1938	122	74	188	212	200	67	72	71	9	35	48	45	1143
1939	132	203	118	137	127	129	106	86	12	3	1	95	1149
1940	36	152	181	167	149	71	106	7	2	24	2	69	966
1941	149	23	41	217	134	185	82	41	8	0	70	34	984
1942	118	166	214	201	81	147	147	111	14	67	42	32	1340
1943	245	205	208	146	173	90	5	37	71	22	0	114	1316
1944	107	129	38	91	149	205	23	37	1	0	0	1	781
1945	38	53	89	156	119	123	54	60	0	4	0	17	713
1946	190	135	82	110	141	139	82	12	14	21	3	76	1005
1947	121	143	167	143	109	255	82	24	0	4	4	15	1067
1948	92	56	61	190	87	100	54	27	9	11	1	32	720
1949	108	126	178	151	125	207	102	68	6	57	89	25	1242
1950	82	77	149	155	126	79	81	53	13	1	21	38	875
1951	178	34	116	160	173	84	27	14	8	44	37	36	911
1952	71	136	143	87	204	97	141	28	5	0	20	22	954
1953	125	107	141	146	117	112	24	48	17	2	0	37	876
1954	46	114	111	250	215	97	69	50	13	9	0	9	983
1955	97	163	179	89	188	129	36	80	1	10	1	38	1011
1956	150	212	295	198	117	121	59	15	37	37	58	246	1545
1957	235	138	114	178	79	89	110	65	5	0	0	73	1086
1958	71	149	156	111	100	74	124	163	14	59	1	2	1024
1959	158	149	208	131	162	163	102	28	5	15	58	69	1248
1960	123	162	191	194	73	125	122	97	41	17	19	54	1218
1961	17	205	135	138	190	132	90	15	0	0	18	27	967
1962	53	136	94	268	111	142	101	30	35	36	3	10	1019
1963	94	156	138	172	93	185	70	13	52	0	34	45	1052
1964	216	82	124	162	56	64	105	6	40	26	29	30	940
1965	57	144	85	246	121	51	29	25	9	0	15	16	798
1966	63	108	152	312	213	129	91	63	13	6	19	29	1198
1967	81	140	143	64	76	130	73	87	5	13	24	12	848
1968	68	93	119	85	78	133	85	96	6	6	12	16	797
1969	150	77	173	127	58	53	34	19	24	27	37	73	852
1970	105	70	181	190	123	118	84	74	3	22	12	12	994
1971	75	100	92	149	161	143	27	27	10	3	16	34	837
1972	84	139	31	104	150	105	62	12	1	11	91	44	834
1973	53	125	137	187	136	137	60	23	29	2	29	21	939
1974	61	292	140	206	168	141	44	16	8	26	19	137	1258
1975	95	222	173	197	192	261	85	35	31	0	11	92	1394
1976	187	224	109	189	93	203	43	23	3	0	3	71	1148
1977	184	49	148	241	78	142	99	8	9	4	33	82	1077
1978	92	66	250	70	117	73	21	56	9	57	117	62	990
1979	149	145	157	105	150	59	25	9	2	0	5	147	953
1980	33	161	101	270	150	135	68	11	34	0	68	16	1047
1981	38	129	128	102	58	80	123	12	14	24	3	29	740
1982	146	90	49	91	82	78	30	34	15	24	1	19	659
1983	110	168	150	177	90	116	34	44	11	3	64	9	976
1984	116	74	117	94	172	48	20	3	2	1	2	13	662
1985	155	125	232	97	127	81	88	0	45	1	51	33	1035
AVE.	106	134	142	161	131	121	69	40	15	16	24	43	100.0
SDEV	53	60	53	61	43	48	37	32	17	19	29	43	

VALUES IN TENTHS OF A PERCENT OF ANNUAL AVERAGE RAINFALL

TABLE 3

SYNTHESIZED RUNOFF AT GAUGE G45 CATCHMENT AREA= 1157.SQ.KM M.A.P.= 1013.MM

USING MODIFIED PITMAN MODEL FORMULATION

AI=	.00 %	PI=	1.5 mm/D	ZMIN=	45.0 mm/M	ZMAX=	450.0 mm/M	RFACT=	1.000	
R=	.50	PON=	3.0	SL=	.00 mm	FT=	12.0 mm/M			
GW=	10.0 mm/M	TL=	.25 MTHS	GL=	.00 MTHS	NOFT=	4 PER MTH			
POWG=	2.5	SGL=	.0 mm	SG=	50.0 mm	FG=	5.0 mm/M			

STATISTICS FROM 1967 TO 1985
ALL DATA INCLUDED

	P.EVAP (mm)	ST (mm)	RAIN (%MAP)	RUNOFF OBS	RUNOFF (%MAR) SIM	MEAN RUNOFF (MCM) OBS	MEAN RUNOFF (MCM) SIM	ST.DEVIATION (MCM) OBS	ST.DEVIATION (MCM) SIM
OCT	108.0	28.0	10.4	10.4	10.0	42.9	41.6	46.2	32.5
NOV	140.0	28.0	13.1	15.9	13.8	65.7	57.3	60.4	45.2
DEC	160.0	28.0	13.8	13.9	14.0	57.4	58.0	49.7	35.2
JAN	150.0	28.0	14.4	13.5	15.3	55.7	63.2	55.2	44.0
FEB	125.0	28.0	11.9	12.6	13.2	52.0	54.7	38.4	36.3
MAR	120.0	28.0	11.8	12.1	13.1	49.9	54.4	53.2	42.3
APR	80.0	28.0	5.8	8.7	7.1	36.0	29.2	38.6	21.5
MAY	70.0	28.0	3.1	3.3	3.4	13.6	13.9	13.7	14.2
JUN	50.0	28.0	1.4	1.7	1.5	7.0	6.4	7.0	4.3
JUL	48.0	28.0	1.2	.9	1.2	3.6	5.0	4.3	4.0
AUG	56.0	28.0	3.1	2.7	3.1	11.3	12.8	24.9	19.0
SEP	96.0	28.0	4.9	4.6	4.3	18.9	18.0	22.7	21.0
YEAR	1203.0					414.0	414.6	196.3	171.5
MEAN AND ST.DEVN. OF LOGS						2.573	2.582	.200	.182

MAXIMUM OBSERVED = 214.0 MAXIMUM SIMULATED = 184.1

INITIAL SOIL STORAGE =	11.8		
FINAL SOIL STORAGE =	12.3	mm	
TOTAL RAIN =	18274.5	mm	
TOTAL INTERCEPTION LOSS =	1583.0	mm	8.7 % rain
TOTAL SURFACE RUNOFF =	3722.3	mm	20.4 % rain
TOTAL EVAP FROM SOIL =	9882.3	mm	54.1 % rain
TOTAL INTERFLOW =	2242.6	mm	12.3 % rain
INITIAL G.WATER STORAGE =	41.6	mm	
FINAL G.WATER STORAGE =	43.6	mm	
TOTAL G.WATER RUNOFF =	843.1	mm	4.6 % rain

CRITICAL PERIOD ANALYSIS
DEMAND AS PERCENT OF OBSERVED MAR

DEMAND %MAR		STORAGE MCM	CRITICAL PERIOD MONTHS	START	END
20.	SIM	23.1	6	APR 1985	SEP 1985
	OBS	30.7	6	APR 1985	SEP 1985
40.	SIM	75.6	10	DEC 1982	SEP 1983
	OBS	72.1	6	APR 1985	SEP 1985
60.	SIM	154.5	16	JUN 1982	SEP 1983
	OBS	172.9	28	JUN 1968	SEP 1970
80.	SIM	359.8	53	MAY 1981	SEP 1985
	OBS	396.1	82	JAN 1968	OCT 1974
90.	SIM	543.4	54	APR 1981	SEP 1985
	OBS	679.0	82	JAN 1968	OCT 1974

COMPARISON OF SIMULATED AND OBSERVED RUNOFF

	OBSERVED RUNOFF	SUMULATED RUNOFF	PERCENT ERROR
TOTAL RUNOFF	7866.7	7876.9	.1
MEAN ANNUAL RUNOFF	414.0	414.6	.1
AVERAGE MONTHLY RUNOFF	34.5	34.5	.1
VARIANCE OF MONTHLY VALUES	1917.4	1325.5	-30.9
RANGE OF RESIDUAL MASS CURVE	1357.3	1319.2	-2.8
MEAN OF RESIDUAL MASS CURVE	-156.4	44.8	-128.7
INDEX OF SEASONAL VARIABILITY	28.5	29.4	3.1
MEAN DEFICIT FLOW PERIOD(MONTHS)	5.9	5.6	-5.0
MAXIMUM DEFICIT FLOW PERIOD(MONTHS)	11	11	.0

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.870
STUDENTS T VALUE	26.549
REGRESSION COEFFICIENT	.724
BASE CONSTANT OF REGRESSION EQUATION	9.585

TABLE 3 CONTD

STATISTICAL MEASURES OF CORRESPONDENCE
SIMULATED RUNOFF IS DEPENDENT VARIABLE

CORRELATION COEFFICIENT	.870
STUDENTS T VALUE	26.549
REGRESSION COEFFICIENT	.724
BASE CONSTANT OF REGRESSION EQUATION	9.585
REGRESSION SUM OF SQUARES	228839.900
RESIDUAL SUM OF SQUARES	73372.260
TOTAL SUM OF SQUARES	302212.200
STANDARD ERROR OF ESTIMATE	18.018
MAXIMUM EQIVALENT CONSTANT ERROR (%)	49.347
RELATIVE ABSOLUTE ERROR(%)	39.432
COEFFICIENT OF DETERMINATION	.757
STANDARD COEFFICIENT OF EFFICIENCY	.756
RESIDUAL MASS CURVE COEFFICIENT	.668
SPECIAL COEFFICIENT OF EFFICIENCY	.679
COEFFICIENT OF PERSISTENCE	1.458
RELATIVE MEAN PERSISTENCE (%)	3.281
DURBIN-WATSON D-STATISTIC	2.033
SIGN TEST	
NUMBER OF NEGATIVE RUNS	51
NUMBER OF POSITIVE RUNS	51
EXPECTED NUMBER OF RUNS	108.6
NUMBER OF NEGATIVE RESIDUALS	87
NUMBER OF POSITIVE RESIDUALS	141
STANDARDISED NORMAL VARIATE Z	.929

RESIDUAL MASS CURVES

	OBSERVED												SIMULATED											
1967	-32.	-13.	6.	-14.	-43.	-55.	-67.	-41.	-47.	-94.	-124.	-152.	-18.	1.	25.	8.	-20.	-5.	-7.	0.	-19.	-49.	-80.	-110.
1968	-175.	-200.	-189.	-218.	-247.	-260.	-253.	-264.	-278.	-308.	-339.	-370.	-137.	-156.	-163.	-184.	-210.	-193.	-182.	-164.	-180.	-211.	-241.	-273.
1969	-373.	-382.	-393.	-393.	-391.	-421.	-453.	-484.	-517.	-549.	-582.	-600.	-237.	-244.	-212.	-192.	-211.	-241.	-271.	-302.	-333.	-363.	-391.	-406.
1970	-567.	-566.	-541.	-499.	-490.	-492.	-470.	-487.	-517.	-547.	-579.	-612.	-401.	-418.	-379.	-308.	-276.	-258.	-251.	-250.	-273.	-302.	-333.	-363.
1971	-644.	-667.	-680.	-639.	-603.	-510.	-527.	-540.	-567.	-599.	-630.	-662.	-384.	-399.	-420.	-403.	-352.	-305.	-316.	-346.	-377.	-408.	-439.	-470.
1972	-685.	-681.	-713.	-747.	-716.	-731.	-742.	-772.	-805.	-839.	-844.	-850.	-487.	-469.	-489.	-503.	-472.	-458.	-475.	-503.	-534.	-565.	-553.	-568.
1973	-859.	-871.	-851.	-802.	-761.	-779.	-785.	-810.	-835.	-866.	-895.	-924.	-597.	-593.	-578.	-521.	-479.	-443.	-453.	-482.	-511.	-541.	-571.	-601.
1974	-956.	-786.	-740.	-700.	-625.	-568.	-591.	-618.	-650.	-682.	-714.	-713.	-629.	-495.	-434.	-362.	-290.	-242.	-253.	-283.	-313.	-343.	-374.	-341.
1975	-696.	-538.	-487.	-401.	-307.	-147.	-106.	-119.	-140.	-170.	-201.	-214.	-327.	-240.	-171.	-97.	-8.	141.	187.	167.	138.	109.	78.	74.
1976	-64.	65.	40.	48.	105.	212.	206.	177.	143.	110.	76.	46.	149.	263.	284.	336.	345.	422.	428.	398.	368.	337.	305.	286.
1977	100.	90.	67.	171.	169.	163.	311.	286.	254.	221.	189.	196.	353.	354.	366.	467.	479.	503.	527.	509.	479.	448.	419.	408.
1978	209.	192.	256.	241.	226.	213.	181.	151.	123.	109.	183.	246.	404.	383.	475.	486.	488.	472.	443.	420.	392.	379.	420.	419.
1979	297.	304.	355.	340.	363.	344.	315.	282.	249.	215.	181.	175.	457.	500.	537.	538.	571.	562.	533.	502.	471.	440.	408.	447.
1980	156.	179.	173.	316.	328.	373.	402.	385.	376.	345.	333.	319.	439.	469.	467.	579.	652.	690.	686.	659.	630.	600.	593.	571.
1981	291.	294.	342.	315.	286.	261.	301.	277.	245.	213.	180.	148.	540.	546.	534.	544.	518.	495.	522.	510.	480.	450.	419.	388.
1982	152.	232.	208.	178.	160.	150.	132.	121.	92.	61.	31.	1.	420.	418.	390.	363.	339.	317.	288.	258.	228.	197.	166.	134.
1983	-1.	32.	94.	204.	174.	156.	131.	107.	74.	41.	7.	-11.	137.	185.	221.	273.	276.	283.	264.	236.	207.	176.	165.	142.
1984	-35.	-34.	-52.	-72.	-3.	12.	-15.	-48.	-82.	-116.	-150.	-184.	150.	134.	123.	105.	151.	147.	117.	86.	54.	22.	-10.	-42.
1985	-120.	-59.	121.	100.	136.	112.	114.	83.	62.	30.	11.	0.	-4.	21.	108.	121.	133.	123.	123.	102.	76.	47.	26.	0.

FLOW DURATION CURVES (PERCENT TIME EXCEEDED)

MONTHLY DISCHARGE	.0	7.1	14.3	21.4	28.5	35.7	42.8	49.9	57.1	64.2
OBSERVED %TIME	100.0	64.9	54.4	44.3	34.6	31.1	26.8	23.7	21.5	19.3
SIMULATED %TIME	100.0	66.7	58.3	48.7	42.1	37.3	32.0	26.3	22.8	20.6
ERROR	.0	1.8	3.9	4.4	7.5	6.1	5.3	2.6	1.3	1.3
MONTHLY DISCHARGE	71.3	78.5	85.6	92.7	99.9	107.0	114.1	121.3	128.4	135.5
OBSERVED %TIME	17.1	14.5	11.8	10.1	7.9	7.5	6.6	5.7	4.8	4.8
SIMULATED %TIME	16.2	12.3	10.1	8.3	7.9	6.1	3.9	3.9	2.2	2.2
ERROR	-.9	-2.2	-1.8	-1.8	.0	-1.3	-2.6	-1.8	-2.6	-2.6
MONTHLY DISCHARGE	142.7	149.8	156.9	164.1	171.2	178.3	185.5	192.6	199.7	206.9
OBSERVED %TIME	3.9	3.5	3.5	2.6	2.6	2.2	1.8	1.3	.9	.4
SIMULATED %TIME	1.8	.9	.9	.9	.4	.4	.0	.0	.0	.0
ERROR	-2.2	-2.6	-2.6	-1.8	-2.2	-1.8	-1.8	-1.3	-.9	-.4

OBSERVED MAXIMUM MONTHLY VALUE	214.000
SIMULATED MAXIMUM MONTHLY VALUE	184.075

COMPARISON OF DEPENDENCE STRUCTURE (AUTO-SERIAL CORRELATION)

LAG IN MONTHS	CORRELOGRAM FOR OBSERVED RUNOFF	CORRELOGRAM FOR SIMULATED RUNOFF
1	.3671	.5355
2	.1980	.3212
3	.0608	.0810
4	-.0286	-.0973
5	-.1882	-.2811
6	-.2226	-.3230
7	-.1831	-.2629
8	-.0571	-.1325
9	-.0213	.0280
10	.1126	.2383
11		

SYNTHESISED/ORIGINAL RUNOFF AT GAUGE 645 USING MODIFIED PITMAN MODEL FOR

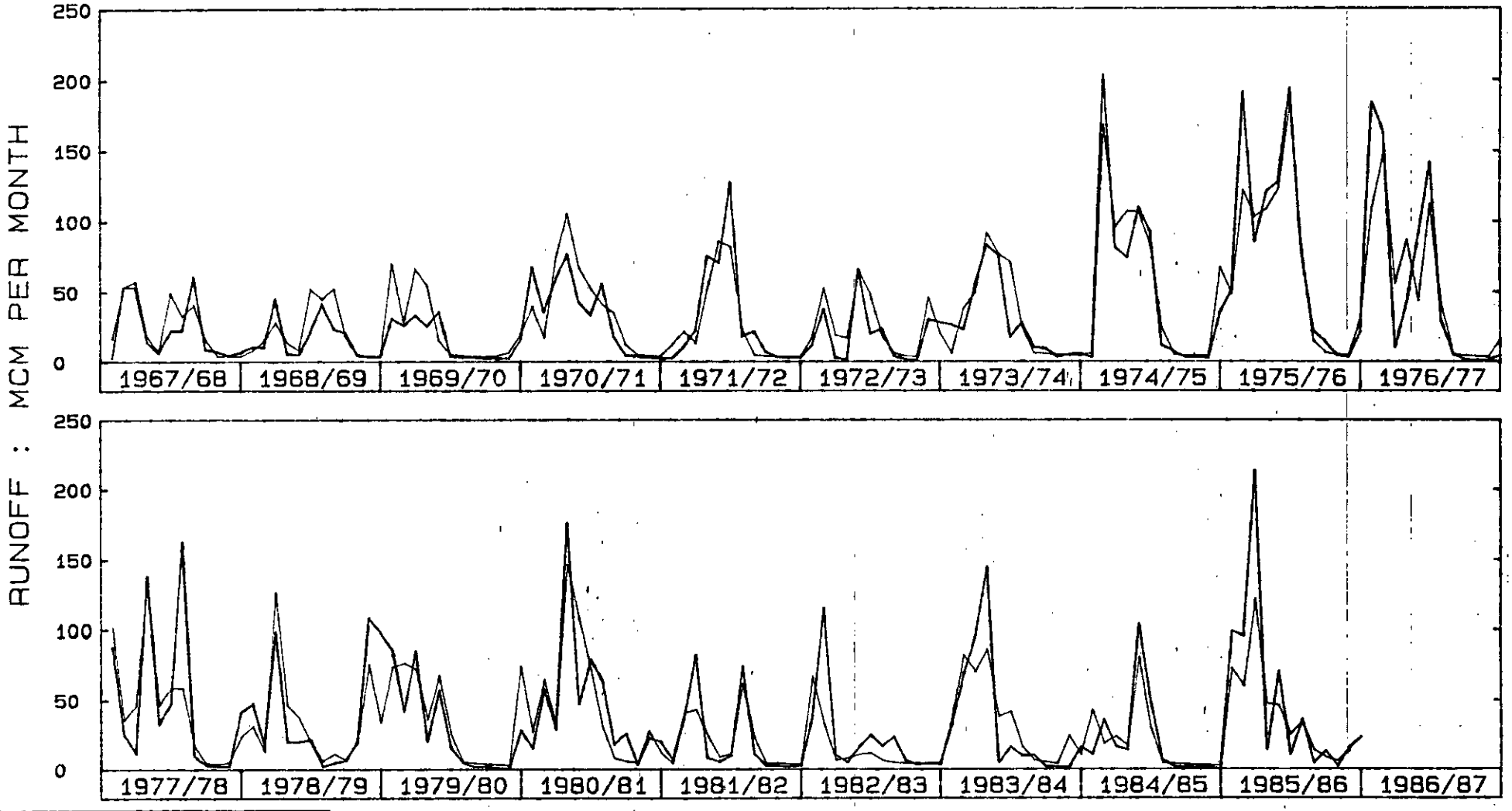
TABLE 4

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,2X,12(I5,A),F9.1)

1930	102P	97P	347P	1205P	663P	484P	683P	221P	43P	110P	63P	34P	405.2
1931	132P	359P	257P	387P	921P	697P	179P	70P	51P	36P	30P	33P	315.2
1932	34P	505P	413P	111P	479P	522P	157P	40P	35P	31P	28P	25P	238.0
1933	26P	1208P	1400P	1878P	979P	774P	244P	46P	39P	241P	276P	98P	720.9
1934	479P	1560P	1527P	651P	321P	683P	496P	181P	67P	44P	39P	36P	608.4
1935	73P	140P	277P	300P	335P	584P	201P	168P	85P	37P	32P	28P	226.0
1936	489P	1765P	989P	1406P	1425P	795P	189P	41P	35P	30P	27P	24P	721.5
1937	266P	134P	328P	1027P	1177P	322P	575P	223P	271P	121P	476P	208P	512.8
1938	497P	213P	788P	1248P	1343P	394P	180P	285P	114P	75P	147P	100P	538.4
1939	582P	1181P	575P	496P	575P	627P	618P	511P	156P	45P	38P	327P	573.1
1940	137P	583P	900P	871P	810P	264P	470P	187P	42P	43P	37P	146P	449.0
1941	734P	258P	34P	1019P	812P	1068P	562P	136P	50P	39P	291P	130P	513.3
1942	452P	838P	1201P	1227P	389P	646P	994P	828P	225P	304P	186P	73P	736.3
1943	1468P	1494P	1274P	796P	958P	449P	98P	52P	301P	136P	44P	485P	755.5
1944	517P	522P	169P	86P	620P	1271P	393P	51P	42P	34P	29P	25P	375.9
1945	26P	30P	54P	553P	536P	538P	187P	148P	77P	37P	32P	28P	224.6
1946	1010P	775P	198P	220P	600P	728P	444P	123P	42P	41P	36P	198P	441.5
1947	527P	663P	774P	655P	446P	1565P	763P	129P	46P	38P	33P	29P	566.8
1948	234P	108P	40P	811P	379P	282P	130P	50P	39P	34P	31P	32P	217.0
1949	362P	488P	807P	738P	582P	1226P	784P	346P	106P	219P	529P	193P	638.0
1950	180P	118P	489P	704P	610P	249P	273P	176P	71P	45P	42P	48P	300.5
1951	932P	338P	222P	648P	977P	394P	80P	41P	35P	107P	93P	58P	392.5
1952	108P	487P	573P	204P	1052P	576P	814P	286P	48P	39P	37P	34P	425.8
1953	497P	391P	477P	606P	509P	460P	151P	72P	53P	39P	33P	39P	332.7
1954	41P	286P	269P	1335P	1542P	602P	214P	119P	62P	43P	38P	32P	458.3
1955	274P	749P	913P	300P	925P	775P	197P	298P	130P	39P	34P	41P	467.5
1956	703P	1280P	1947P	1411P	647P	531P	202P	59P	64P	89P	227P	1614P	877.4
1957	1916P	950P	375P	802P	310P	193P	547P	347P	98P	44P	37P	175P	579.4
1958	150P	586P	704P	390P	300P	154P	620P	1184P	365P	239P	112P	41P	484.5
1959	764P	807P	1108P	671P	823P	979P	676P	182P	48P	41P	201P	214P	651.4
1960	536P	825P	1016P	1119P	341P	463P	736P	644P	219P	65P	50P	72P	608.6
1961	53P	1002P	690P	534P	1059P	808P	495P	147P	44P	37P	33P	33P	493.5
1962	44P	458P	226P	1442P	779P	677P	602P	179P	64P	86P	58P	40P	465.5
1963	257P	692P	585P	802P	388P	971P	454P	88P	149P	81P	63P	69P	459.9
1964	1242P	492P	309P	695P	244P	65P	455P	181P	68P	61P	58P	50P	392.0
1965	60P	533P	234P	1271P	803P	172P	48P	41P	36P	31P	28P	26P	328.3
1966	51P	245P	557P	1914P	1686P	842P	489P	273P	93P	45P	41P	40P	627.6
1967	26#	536#	536#	141#	61#	220#	224#	608#	87#	71#	44#	69#	262.3
1968	108#	102#	453#	57#	48#	216#	421#	231#	203#	51#	37#	33#	196.0
1969	310#	256#	336#	250#	363#	43#	28#	28#	20#	21#	21#	161#	183.7
1970	677#	357#	590#	767#	431#	334#	561#	175#	46#	40#	27#	18#	402.3
1971	26#	109#	222#	753#	703#	1275#	177#	217#	69#	32#	26#	25#	363.4
1972	123#	378#	27	8	657	195	234	41W	14W	5	302	278#	226.2
1973	261#	225	547	831	752	170	281	101	89	36	52	60	340.5
1974	27	2041	809	737E	1097E	919	114	71	26	32	23W	356W	625.2
1975	514	1921#	855#	1209W	1280	1945C	762W	213	138	45	32	213	912.7
1976	1848C	1628C	98	431	906	1419	283	55	11	9	7	45	674.0
1977	882	249	117	1383	327	479	1628	94W	27W	18W	22W	413W	563.9
1978	476E	176W	983W	198	198	215	19	49	66	200	1083W	975W	463.8
1979	859W	416	853	201	573	156	48	14	21W	7W	6	281W	343.5
1980	152W	576	290W	1767#	470	794	632	179	259W	32	227	199W	557.7
1981	68W	372W	825#	80	53	100	739#	111	25	21	15	28	243.7
1982	379#	1152#	100	46	161	247	166	232	62	30	45	42	266.2
1983	326	683	961	1450	44	163	95	101	18	12	10	163	402.6
1984	107	357	165	138	1040	495	68	17	9	7	4	2	240.9
1985	988	953	2140	135	710	104	361	43	134	22	159	232	598.1
AVE.	431	637	606	734	665	577	397	192	86	63	102	151	464.1
SDV.	441	496	464	506	385	409	300	210	78	63	173	255	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

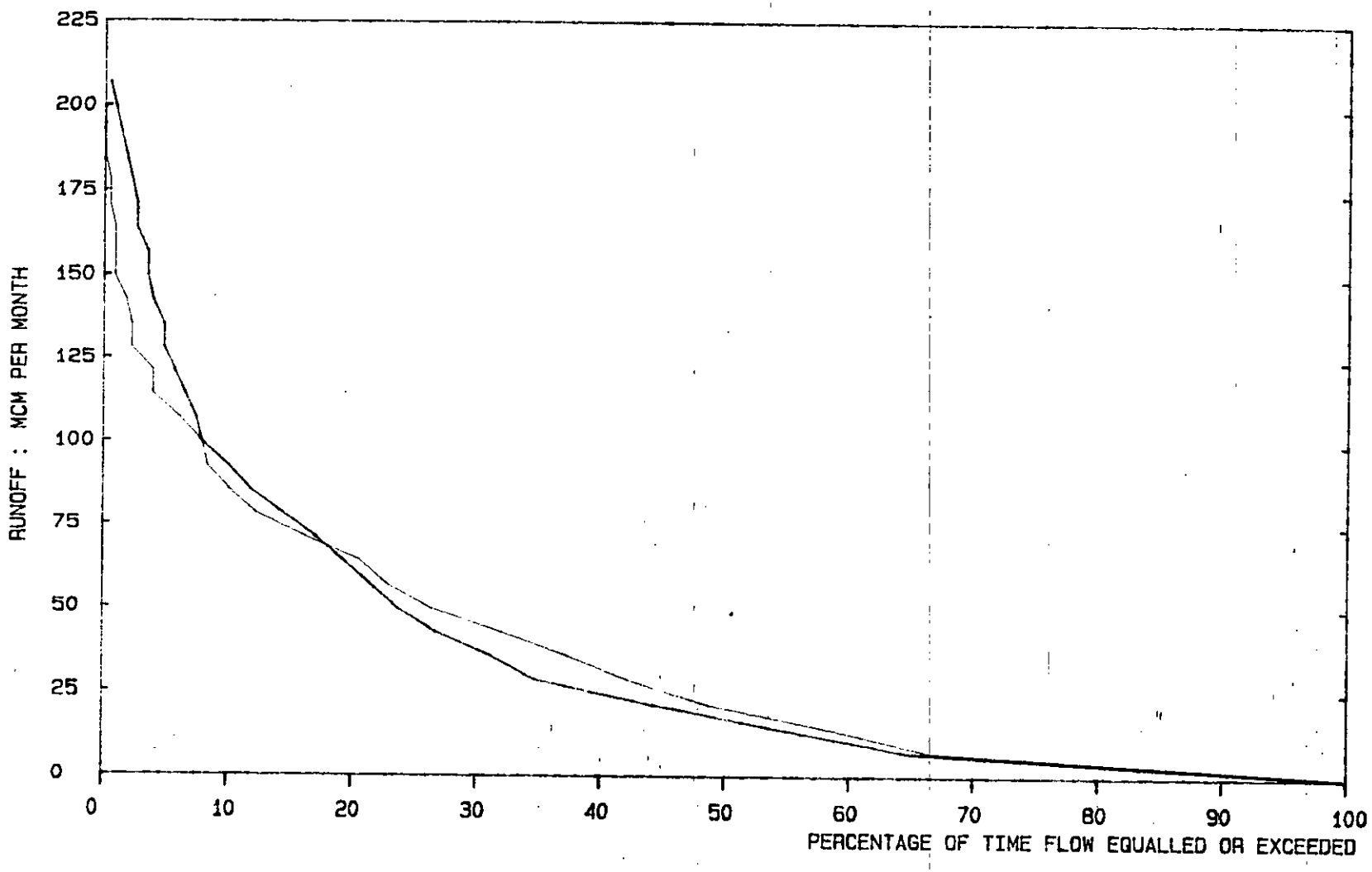
AI = .0	PI = 1.5	ZMIN = 45.	ZMAX = 450.	R = .5	POW = 3.0	MONTH	O	N	D	J	F	M	A	M	J	J	A	S
SL = .0	FT = 12.0	GW = 10.	TL = .25	GL = .00	NOFT = 4	P.EVAP	108.	140.	160.	150.	125.	120.	80.	70.	50.	48.	56.	98.
POWG = 2.5	SGL = .0	SG = 50.	FG = 5.0			STMAX = 28.	AREA = 1157.	RAINFALL = 1013.	RFACT = 1.000														



MALIBAMATSO AT G45 : PELANENG

COMPARISON OF OBSERVED AND GENERATED RUNOFF FIGURE 1

FLOW DURATION CURVES



LEGEND
— OBSERVED FLOWS
— GENERATED FLOWS

MALIBAMATSO AT G45 : PELANENG

COMPARISON OF OBSERVED AND GENERATED RUNOFF

FIGURE 2

ANNEX 13

RESULTS OF THE MASS BALANCE

WATER BALANCES TO ORANJEDRAAI

Units are tenths of million cubic metres
@ : flow infilled by regression
M : flow calculated from matchbeam records
C : flow manually calculated from chart records
E : monthly flow from chart records and estimated water levels

FILENAME	FACTOR	FILE TITLE
T41-6785.BIN	1.000	641 BOKONG - OBSERVED AND MODIFIED PITMAN MODELLED FLOWS INFILLED BY REGRESSION
T45-6785.BIN	1.000	645 PELAKENG - OBSERVED AND MODIFIED PITMAN MODELLED FLO INFILLED BY REGRESSION
T42-6785.BIN	1.000	642 SESHOTES - OBSERVED AND MODIFIED PITMAN MODELLED FLO INFILLED BY REGRESSION
T08-6785.BIN	1.000	608 PARAY (TOTAL) - OBSERVED AND MODIFIED PITMAN MODELLE INFILLED BY REGRESSION
T36-6785.BIN	1.000	636 TLOKOENG - OBSERVED AND MODIFIED PITMAN MODELLED FLO INFILLED BY REGRESSION
T06-6785.BIN	1.000	606 MOKHOTLONG - OBSERVED AND MODIFIED PITMAN MODELLED F INFILLED BY REGRESSION
T05-6785.BIN	1.000	605 KOMA-KOMA (TOTAL) - OBSERVED AND MODIFIED PITMAN MOD INFILLED BY REGRESSION
T17-6785.BIN	1.000	617 MARAKABEI - OBSERVED AND MODIFIED PITMAN MODELLED FL INFILLED BY REGRESSION
T32-6785.BIN	1.000	632 MKAUS (TOTAL) - OBSERVED AND MODIFIED PITMAN MODELLE INFILLED BY REGRESSION
T07-6785.BIN	1.000	607 TSOELIKE - OBSERVED AND MODIFIED PITMAN MODELLED FLO INFILLED BY REGRESSION
T04-6785.BIN	1.000	G2 : SENQU AT WHITEHILLS : MONTHLY RECORDE INFILLED BY REGRESSION
T03-6785.BIN	1.000	G03 : SENQU AT SEAKA : MONTHLY RECORD INFILLED BY REGRESSION
D06-6785.BIN	1.000	D1MD6A : KORNETSPRUIT AT MASHALEEN INFILLED BY REGRESSION
D09-6785.BIN	1.000	ORANJEDRAAI NEW CALIBRATION INFILLED BY REGRESSION

1967	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAS	ORA	INC ORA
OCT	14@	26@	0@	22	-18@	16@	1	34@	-5@	23@	55	32@	10	39	-5@	367@	273@	91@	357	-101@
NOV	130@	536@	129@	971	176@	193@	359@	1861@	338@	93@	1185	247	156	1530	-487@	4030@	1315@	580@	4202	-408@
DEC	130@	536@	129@	971	176@	193@	359@	1861@	338@	70	577	507	122	1340	-643@	4030@	2113@	580@	2087	-2523@
JAN	40@	141@	26@	236	29@	40@	51	446@	119@	43	158	115	75	420	-101@	1193@	613@	201@	91@	-476@
FEB	22@	61@	5@	87	-1@	16@	69	234	62@	16	73	57	29	239	-24	768@	456@	145@	539	-374@
MAR	58@	220@	46@	382	58@	54@	92	569	41@	72	248	176	56	620	-5	1440@	572@	234@	1087	-587@
APR	59@	224@	47@	390	60@	48@	72	512	2@	216E	252	36	82	627	33	1325@	446@	219@	1417	-127@
MAY	146@	608@	148@	1105	203@	105@	32	1005	-237@	545E	882	337	17	1040	18	2314@	392@	351@	3889	1224@
JUN	28@	87@	11@	134	8@	15@	22@	228	57@	100	104	4	6	182	-52	756@	470@	143@	1053	154@
JUL	24@	71@	7@	105	3@	5@	2@	139	27@	116	162	46	4	117	-26	577@	298@	119@	1054	358@
AUG	18@	44@	0@	55	-7@	0@	0@	73	18@	49	47	-2	3	55	-21	445@	343@	102@	473	-74@
SEP	24@	69@	7@	102	2@	3@	0@	126	21@	35	80	45	12	120	-18	551@	351@	116@	833	166@
YEAR	693.	2623.	555.	4560.	689.	688.	1059.	7088.	781.	2223.	3823.	1600.	572.	6329.	-1331.	17796.	7644.	2881.	17909.	-2768.

WATER BALANCES TO ORANJEDRAAI

Units are tenths of million cubic metres
@ : flow infilled by regression
M : flow calculated from watchmans records
C : flow manually calculated from chart records
E : monthly flow from chart records and estimated water levels

1968	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAB	ORA	INC ORA
OCT	32@	108@	17@	173	16@	9@	0	173	-9@	91	158	67	4	122	-55	646@	366@	128@	504	-270@
NOV	31@	102@	15@	162	14@	32@	72@	304@	38@	26	48	22	13	144	-173@	908@	716@	163@	501	-570@
DEC	111@	453@	107@	816	145@	162@	303@	1563@	282@	306	739	433	89	1150	-502@	3433@	1544@	500@	4069	1360
JAN	21@	57@	3@	78	-3@	15@	41@	142@	8@	12	53	41	14	205	49@	583@	325@	120@	619	-84@
FEB	19@	48@	1@	62	-6@	12@	36@	111@	1@	9	32	23	10	90@	-31@	521@	399@	112@	820	167@
MAR	57@	216@	45@	375	57@	86@	129	848	258@	146E	396	250	57	939@	34@	1999@	664@	309@	5034	2726@
APR	104@	421@	99@	757	133@	123@	162	1162	120@	307@	694	387@	78	1350	110	2629@	585@	393@	4656	1634@
MAY	60@	231@	49@	403	63@	51@	50	539	35@	168@	404	236@	19	288	-270	1379@	687@	226@	1413	-192@
JUN	54@	203@	42@	351	52@	33@	36	667@	247@	86	185	99	12	225	-454@	1636@	1226@	261@	998	-899@
JUL	19@	51@	2@	67	-5@	13@	38@	121@	3@	23	45	22	6	34	-93@	541@	462@	114@	415	-240@
AUG	16@	37@	0@	41	-12@	0@	0@	31	-10@	36	68	32	4	38	3	361@	255@	90@	455	4@
SEP	16@	33@	0@	35	-14@	0@	9	26	-18@	15	23	8	2	40	12	351@	288@	89@	162	-278@
YEAR	540.	1960.	380.	3320.	440.	536.	876.	5687.	955.	1225.	2845.	1620.	308.	4625.	-1370.	14987.	7517.	2505.	19646.	2154.

1969	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAB	ORA	INC ORA
OCT	79@	310@	70@	551	92@	122@	123	1157	361@	520	1050	530	69@	1160	-66@	2619@	409@	392@	3390	379@
NOV	66@	256@	56@	449	71@	67@	62	676	98@	162	332	170	45@	768	47@	1654@	554@	263@	1943	26@
DEC	84@	336@	76@	598	102@	129@	245@	1220	248@	66	94	28	116@	1210	-126@	2745@	1441@	409@	1555	-1599@
JAN	65@	250@	54@	438	69@	106@	200@	1019	275@	92	287	195	76	924	-171	2342@	1131@	355@	1715	-982@
FEB	90@	363@	84@	648	111@	126@	238@	1188	176@	158	411	253	137	1290	-35	2681@	980@	400@	2252	-829@
MAR	18@	43@	0@	52	-9@	40@	51	92@	-51@	13	59	46	22	176	62@	483@	248@	107@	443	-147@
APR	14@	28@	0@	24	-18@	0@	20	49	5@	9	41	32	29@	57	-21@	397@	299@	95@	120	-372@
MAY	14@	28@	0@	25	-17@	0@	7	25	-7@	9	45	36	24@	13	-36@	349@	291@	89@	83	-355@
JUN	12@	20@	0@	10	-22@	0@	3	13	0@	8	36	28	3	6	-10	325@	283@	86@	65	-346@
JUL	13@	21@	0@	11	-23@	0@	3	13	-1@	8	35	27	4	2	-15	325@	288@	86@	71	-340@
AUG	13@	21@	0@	12	-22@	17	45@	15@	-59@	8	36	28	4	33	14@	329@	260@	86@	145	-270@
SEP	45@	161@	31@	273	36@	47	233	41@	-135	102	213	111	12	252	-17@	1137@	672@	194@	986	-345@
YEAR	513.	1837.	371.	3091.	370.	654.	1230.	5885.	910.	1155.	2639.	1484.	541.	5891.	-535.	15386.	6856.	2562.	12768.	-5180.

WATER BALANCES TO ORANJEDRAAI

Units are tenths of million cubic metres

\# : flow infilled by regression

M : flow calculated from watchmans records

C : flow manually calculated from chart records

E : monthly flow from chart records and estimated water levels

1970	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAB	ORA	INC ORA
OCT	162#	677#	166#	1233	228#	227	523	2442	459	278	710	432	199M	2790	149	5195#	1695#	736#	3711#	-222##
NOV	89#	357#	82#	637	109#	97	148	1038	156	121	323	202	88	1290	164	2380#	767#	360#	2743	3#
DEC	142#	590#	143#	1071	196#	154#	78	1437M	134#	525	1370	845	24	1290	-171	3180#	520#	467#	4356	709#
JAN	182#	767#	190#	1402	263#	202#	187	1852	61#	560	944	384	122	2010	36	4012#	1058#	578#	3876	-714#
FEB	106#	431#	101#	775	137#	193E	449	1597	180	313#	567	254#	201	2050	252	3501#	884#	509#	4642	632#
MAR	84#	334#	76#	594	100#	112	98	897M	93M	131	310F	179F	55	906	-46	2097#	881#	322#	2244	-175#
APR	135#	561#	127	1017	194#	185	166	1402	34	257	565L	308L	48	1390	-60	3110#	1155#	457#	4288	721#
MAY	48#	175#	21M	298	54#	43	61	465	63	205	3980	1930	59	486	-38	1231#	347#	206#	2603	1166#
JUN	18#	46#	7	59	-12#	11	29	99	0	12	52M	40M	19	117	-1	497#	328#	108#	656	51#
JUL	17#	40#	3	47	-13#	8M	21	81M	5M	1	40S	39S	21	83	-19	461#	338#	104#	427	-138#
AUG	14#	27#	3M	23	-21#	6	31	115	55	11	232	122	22	54	-83	529#	432#	113#	350	-292#
SEP	12#	18#	1M	7	-24#	3	37M	113	66	4	8[illegible]	4[illegible]	12	46	-79	525#	471#	112#	282	-355#
YEAR	1009.	4023.	920.	7163.	1211.	1241.	1828.	11538.	1306.	2418.	5310.	2892.	870.	12512.	104.	26718.	8896.	4072.	30178.	-612.

1971	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAB	ORA	INC ORA
OCT	4	26#	3	22	-11#	14	8#	162	3#	12	21I	9I	31	90	-103	624#	513#	125#	400	-349#
NOV	15	109#	12	176	40#	41	112	404	75	30	37M	7M	50	374	-80	1109#	698#	190#	1104	-195#
DEC	48	222#	43C	387	74#	134	246	909	142	191	242K	51K	176	1090	5	2121#	789#	325#	1735	-711#
JAN	265	753#	225	1376C	133#	424	1025	3295	470	1284	1986A	702A	261M	3980	424	6905#	939#	964#	6445	-1424#
FEB	280	703#	137	1282	162#	430	870#	3997M	1415#	857	1600.	743.	421	4720	302	8313#	1993#	1240	13017	3464#
MAR	270	1275#	417	2348	386#	480	1049#	4788M	911#	853#	2645F	1792#	417	6750	1545	9899#	504#	1363#	13985	2723#
APR	48	177#	42C	303	36#	49	130#	711M	229#	130#	291L	161#	55	949	183	1724#	484#	272#	3303	1307#
MAY	78	217#	21	377	61#	16	92#	539	54#	345	6160	2710	29	525	-43	1379#	238#	226#	2864	1259#
JUN	18	69#	9	101	5#	7	11#	182	63#	101	168M	67M	12	174	-20	664#	322#	131#	1208	413#
JUL	5	32#	3	33	-7#	4M	0#	61	24#	60	91	31	6	63	-4	421#	267#	98#	501	-18#
AUG	3	26#	3	21	-11#	3M	0#	37	13#	60	27	-33	4	36	-5	373#	310#	67	296	-144#
SEP	3	25#	3	20	-11#	3	0#	30	7#	51	2B	-23	9	39	0	359#	292#	54	237	-176#
YEAR	1037.	3634.	918.	6446.	857.	1605.	3623.	15115.	3441.	3974.	7752.	3778.	1471.	18790.	2204.	33891.	7349.	5055.	45095.	6149.

WATER BALANCES TO ORANJEDRAAI

Units are tenths of million cubic metres
0 : flow infilled by regression
W : flow calculated from watchmans records
C : flow manually calculated from chart records
E : monthly flow from chart records and estimated water levels

1972	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAS	ORA	INC ORA
OCT	33	123E	26	201	19E	30	30	28E	27	10E	225	117	42	304	-26	75E	229	17E	1032	96
NOV	103	378E	90	676	105E	10C	251	1190W	159W	273	284	11	84	1230	-44	1730	216	132	1784	-78
DEC	8	27	6	64	23	19	129	340W	128W	20	74	54	50	45E	6E	80C	275	67	78Z	-92
JAN	3	8	0W	28E	17E	3	41	91W	19E	11	39	28	30	126	5	269	104	3	364	92
FEB	22E	65Z	10E	1377C	384C	10C	24E	1716W	-12W	66E	94E	28C	203	2080	161	3274	246	785D	3760	-299
MAR	57	195	61	475	142	130	219	1063	239	15E	242	84	59	1160	3E	1656	254	509	2630	465
APR	75	234	23	39E	66	73	233	88Z	183	18E	244	56	225	1210	9E	2265	811	344E	2637	28E
MAY	10	41W	6	72	15	17	45	15E	24	29	68E	393	20	161	-17	429	200	11E	710	166
JUN	3	14W	3	29	9	6	10	54	9	16	25E	9E	8	51	-11	162	86	49	437	226
JUL	1	5	3	13	4	9	2W	28	4	13	791	661	4	22	-10	100W	-1W	36	232	96
AUG	112	302	93	724	217	91	95	1064W	154W	496	819.	323.	15	969	-110	1926	138	268	2055	-139
SEP	58	278E	85	490	69E	127	138	80E	51	89	2076	1186	8	778	-36	1292	307	102	1660	266
YEAR	691.	2262.	524.	4547.	1070.	712.	1441.	7685.	985.	2069.	3254.	1185.	748.	8549.	116.	14668.	2865.	2588.	18083.	827.

1973	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAS	ORA	INC ORA
OCT	40	261E	69	459	89E	189	395	1342	299	68	127	59	28	1270	-100	1547	150	249E	1459	-337E
NOV	62	225	21	365	57	47	206	75Z	135	98	159	61	53	713	-93	128E	416	74	1427	65
DEC	177W	547	56	865W	85W	94	205	1358	194	277	422	145	144	1400	-102	2197	375	335E	2625	93E
JAN	284	831	186	1491C	190C	525C	1436	4398	946	865	1649	784	600	6190	1192	10365	2526	1300D	9593	-2072
FEB	285C	752	355	1978	586	424W	1335	5850W	2113W	1003	2832	1829	656	7272E	766E	14917	4813E	2750D	24391	6724
MAR	31W	170	37W	337	99	269	618	1886	662	139	2991	1601	426	3030	71E	5653	2324	1980D	8094	461
APR	64W	281	83	639	211	202	265	94E	-15E	214	412.	198.	290	2090	85Z	3601	1099	941	3846	-696
MAY	33	101	13	212	65	27W	47	361W	75W	71	1610	900	120	442	-39	1347	744	223	935	-635
JUN	44	89	18	254	103	15W	35	438W	134W	62	159	97	83	483	-38	1630W	988W	115	743	-1002
JUL	11	36	6	109	56	10	16	186W	51W	26	83	57	29W	189	-26	551	279	79	392	-238
AUG	45	52	18	153	38	8W	2W	202	39	139	298	159	33W	294E	59E	1311	719E	217E	1317	-211E
SEP	42	60	24	165	39	6W	1W	203W	31W	128	196	68	27	163	-67	895	536	162E	1384	327E
YEAR	1118.	3405.	886.	7027.	1618.	1816.	4561.	17925.	4521.	3090.	6797.	3707.	2489.	23536.	3122.	45302.	14969.	8425.	56206.	2479.

WATER BALANCES TO ORANJEDRAAI

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W : flow calculated from watchmans records
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E : monthly flow from chart records and estimated water levels

1974	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAB	ORA	INC ORA
OCT	9W	27	7	30W	7W	4W	0	8B	34	31	74	43	10	66	-32	258	118	778	441	1068
NOV	335	2041	299	3038	363	319W	384	3802W	61W	1106	2029	923	152	4050	96	7751W	1672W	722	9718	1245
DEC	123	809	77	1564W	555W	86W	247	1899	2	220	691	471	245	2550	406	4655	1414	6638	3849	-14698
JAN	247	737E	125	1418	309	410W	1227	3552W	497W	543	878	335	337	3100	-789	4049	71	5838	5732	11008
FEB	242	1097E	355	2454W	760W	1250W	2527	6809	578	892	1774	882	522	8030	699	10037	233	861	12631	1733
MAR	255	919	339W	2230W	717W	433B	949	3853	241B	887	1697	810	229	4850	768	8780	2233	1660	10094	-346
APR	48	114	41	319	116	68B	181	692	124B	135	284	149	42	726B	-8B	1527	517B	246B	2208	435B
MAY	30	71	15	150	34	21W	48	312	93	74	164	90	15	190	-137	771	417	145B	1049	133B
JUN	7	26	6	48	9	8W	24	160W	80W	20	65	45	8	60	-108	397	272	95B	596	104B
JUL	15	32	7	75	21	8W	19	149	47	70	125	55	7	96	-60	832	611	153B	1252	267B
AUG	4	23W	3	26	-4	5	7	53	15	16	52	36	4	26	-31	264	186	77B	565	224B
SEP	104	356W	111	743	172	87	156	913	-73	208	488	280	40	883	-70	1514	143	267	2365	584
YEAR	1419.	6252.	1385.	12115.	3059.	2699.	5769.	22282.	1699.	4202.	8321.	4119.	1611.	24627.	734.	40835.	7887.	5549.	50500.	4116.

1975	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAB	ORA	INC ORA
OCT	116	514	244	1199	325	200	266	1996	331	236	514	278	38	2480	446	3915	921	245	3687	-473
NOV	377	1921B	579	3390B	513B	348	448	4609	423B	1207	2206	999	219	5180	352	8141	755	758	8478	-421
DEC	168	855B	161	1565	381B	389W	624	3718	1140	511	1469	958	581	5380	1081	9745W	2896W	938	10003	-680
JAN	278	1209W	488	2139B	164B	817W	1522	6676W	2198B	1186	2824	163B	998	9320	1646	19796W	7652W	3070D	17518	-5348
FEB	351	1280	343W	2264B	290B	810B	1755	7123	2294B	1351	2328	977	760	8760	877	15508	4420	2470D	20363	2385
MAR	301	1945C	609W	3533C	678C	1858W	2926	11601	3284	1400	2689	1289	1197	12760B	-388	19778E	4329B	1720	22512	1014
APR	215	762W	224W	1353B	152B	509W	610W	2798	326B	540	1228	688	221	3348B	329B	6712W	2136B	1220	8197	265
MAY	88	213	53	441	87	75	192	905W	197W	264	800	536	69	985	11	3493W	1708W	723	4824	608
JUN	97	138	35	410	140	33	100	781B	238B	338	925	587	22	583	-220B	2558	1050	428	3547	561
JUL	21	45	11	115	38	15	32	179	17	55	220	165	12	203	12	937	514	225	1169	7
AUG	13	32	6	68	17	11	13	68	-24	23	107	84	8	96	20	445	242	126	521	-50
SEP	119	213	7W	373	34	9W	17	368	-31	285	1846	1561	15	413B	30B	1229	-1030B	276	1489	-16
YEAR	2144.	9127.	2760.	16850.	2819.	5074.	8505.	40822.	10393.	7396.	17156.	9760.	4140.	49508.	4546.	92257.	25593.	12199.	102308.	-2148.

WATER BALANCES TO ORANJEDRAAI

Units are tenths of million cubic metres
: flow infilled by regression
N : flow calculated from matchbeam records
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E : monthly flow from chart records and estimated water levels

1976	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAB	ORA	INC ORA
OCT	289	1848C	421N	3376	818	637	926	6619	1680	1349	3554	2205	307	6550	-376	15543	5439	25300	19398	1325
NOV	279	1628C	496N	3065	662	455	970	5990	1500	774E	2761	1987	244	5980	-254	11544	2803	1150	11828	-866
DEC	25	98	24	200	53	43	173	547	131	42	275	233	31	570	-8	1187	342	269	1741	285
JAN	144	431	99N	768	94	209	478	1327N	-128N	260	488	228	112	1419#	-20#	2545	6388	3828	3243	3168
FEB	162	906	325N	1756	363	619	1067	4796N	1354N	724	1419	695	413	5443#	234#	9446	25848	13038	10444	-3058
MAR	403	1419	363N	2553	368	441	650N	4606	962	1192#	2586	1394#	434	5360	320	12260	4314	16798	13500	-4398
APR	49	283	63N	408N	13N	111	219	904	166	130	330	200	40	1010	66	2350	1010	3568	2539	-1678
MAY	26	55	13	118N	24N	26	61	255	50	65	110	45	11	278	12	1102	714	137	1238	-1
JUN	8	11	6	43N	18N	8	24	92	17	29	23	-6	7	93	-6	411	295	106	559	42
JUL	5	9	4	31	13	4	17	68	16	20	29	9	6	58	-16	294	207	77	384	13
AUG	3	7	3	19	6	2	13	49N	15N	17	15	-2	4	23	-30	150	112	52	212	10
SEP	35	45	7	99	12	12	26	125	-12	152	184	32	5N	36	-94	726	506	239	1026	61
YEAR	1428.	6740.	1824.	12436.	2444.	2567.	4624.	25378.	5751.	4754.	11774.	7020.	1614.	26820.	-172.	57558.	18964.	8280.	66112.	274.

1977	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAB	ORA	INC ORA
OCT	216	882	222	1640	320	231	253	2289	165	523E	1016	493	45	2050	-284	4907	1841	421	5637	309
NOV	67	249	66N	543	161	80	197	1072	252	209	700	491	148	1312#	92#	3087	10758	351	3582	144
DEC	103	117	12	241	9	24	78	386	43	162E	237	75	113N	428#	-71#	1233	5688	444	1884	207
JAN	434C	1383	531	3258	910	609	1391N	5377	119	1332#	2844	1512#	550	6290	363	10560	1426	1470	10556	-1474
FEB	113	327	103	718	175	175	535N	1775N	347N	325#	407	82#	178	2300	347	4311	1604	609	4724	-196
MAR	89#	479	34	634	328	137	285	1168N	132N	576E	334	-242	171	1250	-109	2415	831	708	2437	-686
APR	468	1628	364	3064	604	325	567	4528	572	1611E	3029	1418	474	4610	-392	12152	4513	2360	13243	-1269
MAY	26	94N	40N	257	97	54	92	528N	125N	80	246	166	87	453	-162	1824	1125	538	2346	-16
JUN	8	27N	9	66	22	15	24	135	30	27	100	73	14	162	13	451	189	159	803	193
JUL	6	18N	6	44	14	8	17	88	19	14	71	57	10	87	-11	282	124	110	498	106
AUG	5	22N	6	41	8	6	12	71	12	20	36	16	7	0#	-78#	192	1568	94	355	69
SEP	180	413N	139	937	205	79	96	1211	99	353	774	421	61	1368#	96#	2781	6398	4138	2077	-11178
YEAR	1715.	5639.	1532.	11443.	2557.	1743.	3547.	18648.	1915.	5232.	9794.	4562.	1858.	20310.	-196.	44195.	14091.	7677.	48142.	-3730.

WATER BALANCES TO ORANJEDRAAI

Units are tenths of million cubic metres
* : flow infilled by regression
W : flow calculated from watchmans records
C : flow manually calculated from chart records
E : monthly flow from chart records and estimated water levels

1978	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAG	ORA	INC ORA
OCT	113	476E	150	856	117	142	170	1394W	226W	407	966	559	89	1450	-33	2718	302	157	2616	-259
NOV	62	176W	52	362	72	50W	112	626W	102W	119	234	115	44	725	55	1314	355	80	1502	108
DEC	357W	983W	254	2137	543	324	758	4329	1110	809	1870	1061	474	4967*	164*	8887	2050*	1310*	10243	46
JAN	60W	198	71	449	120	129	166	933	189	111	311	200	86	980*	-39*	1864	573*	245	1936	-173
FEB	45	198	44	371	84	70	224	788W	123W	195	384	189	327	1040	-75	2433	1009	322	2162	-593
MAR	24	215	54	374	81	95	577	1121W	75W	51	176	125	300	1293*	-128*	2767	1298*	271	2065	-973
APR	6	19	6	49	18	14	36	122	23	15	18	3	29	70*	-81*	420	332*	99	644	125
MAY	36	49	8	110	17	15	68	216	23	64	119	55	18	147*	-87*	431	165*	90	666	145
JUN	28	66	10	137	33	11	36	191	7	40	47	7	9	121*	-79*	393	225*	25	595	177
JUL	83	200	37	417	97	17	31	566W	101W	298	448	150	20	449	-137	1468	571	105	1624	51
AUG	325	1083W	332	2225	485	198	166	2734W	145W	820	1740	920	59	2520	-273	6041	1781	648	6424	-265
SEP	182	975W	301	1635	177	215	210	2413	353	205	414	209	65	2270	-208	4312	1628	411	4574	-149
YEAR	1321.	4638.	1319.	9122.	1844.	1280.	2554.	15433.	2477.	3134.	6727.	3593.	1520.	16032.	-921.	33048.	10289.	3763.	35051.	-1760.

1979	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAG	ORA	INC ORA
OCT	240	859W	263W	1695	333	121	132	2184	236	815	1140	325	22	2210	4	5331	1981	1040	6011	-360
NOV	123	416	113W	858	206	110	139	1212W	105W	291	550	259	84	1200	-96	2221	471	210	2429	-2
DEC	233	853	342W	1787	359	282	311	2524	144	389	794	405	170	2850	156	4420	776	632*	3680	-1372*
JAN	53	201	72	502	176	125	309	1188	252	122	322	200	407W	1920	325	2670	428	151	3341	520
FEB	144	573	107	986	162	156	434	2233W	657W	231	405	174	256W	2292*	-197*	3361	664*	231	4575	983
MAR	58	156	64	323	45	224	342	1193W	304W	75	126	51	189W	1345*	-37*	2731	1260*	156	2632	-255
APR	10	48	8	57	-9	22	71	237	87	53	82	29	35W	226*	-46*	772	464*	62	939	105
MAY	4	14	5	22	-1	8	25	92	37	21	35	14	10	19*	-83*	271	217*	21	291	-1
JUN	1	21W	3	14	-11	4W	14	67	35	13	41	28	6	37	-36	162	84	23	194	9
JUL	0	7W	3	8	-2	3W	11	48	26	9	35	26	5	15	-38	116	66	20	148	12
AUG	0	6	2	7	-1	2W	9	36	18	10	35	25	4	6	-34	104	63	20	137	13
SEP	1	281W	59	326	-15	23	66W	489W	74W	115	251	136	38	311	-216	300	-262	45	371	26
YEAR	867.	3435.	1041.	6585.	1242.	1080.	1863.	11503.	1975.	2144.	3816.	1672.	1226.	12431.	-298.	22459.	6212.	2611.	24748.	-322.

WATER BALANCES TO ORANJEDRAAI

Units are tenths of million cubic metres
: flow infilled by regression
M : flow calculated from matchbeam records
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E : monthly flow from chart records and estimated water levels

1980	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAB	ORA	INC ORA
OCT	26M	152M	60	358	120	41	474M	795M	-78M	70	243	173	68	919	56	1911	749	2978	1626	-582#
NOV	131	576	94	879	78	52	45M	1053M	77M	369	722	353	36	774	-315	1515	19	238	1573	-180
DEC	124M	290M	85	730	231	132	264	1480M	354M	339	651	312	86	1490	-76	3567	1426	482	3890	-159
JAN	561M	1767#	367	3265	570#	464	852	5109	528	1358	3019	1661	111	4530	-690	7040	-509	1150D	3701E	-4489E
FEB	149	470	77	823	127	355	808	2558	572	402	707	305	347	3360	455	6962	2895	1330D	10043E	1751E
MAR	163	794	46	1122	119	117	183	1675	253	554	1086	532	100	1720	-55	4923	2117	1300D	5662	-561
APR	106	632	69	807	0	33	44	946	62	299	676	377	18M	842	-122	1734	216	472	2500	294
MAY	41	179	55	361	86	31	35	597	170	148	316	168	22M	564	-55	1700	820	286	2133	147
JUN	88	259M	61M	513	105	29	28	667	97	313	481	168	13	589	-91	2700	1630	523	3344	121
JUL	8	32	8M	56	8	6	17	97	18	37	76	39	4	173	72	423	174	145	624	56
AUG	98	227	39M	460	96	20	23	562	59	416	627	211	9	549	-22	1886	710	719	2819	214
SEP	93	199M	108	550	150	194	249	1312	319	312	491	179	61	1310	-63	3701	1900	477	4120	-58
YEAR	1588.	5577.	1069.	9924.	1690.	1474.	3022.	16851.	2431.	4617.	9095.	4478.	875.	16820.	-906.	38062.	12147.	7419.	42035.	-3446.

1981	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAB	ORA	INC ORA
OCT	17	68M	13	102	4	28	56	221	35	50	124	74	25	245	-1	815	446	135	1049	99
NOV	159	372M	63	743	149	15	48	786	-20	613	1016	403	53	741	-98	1374	-383	317	2269	578
DEC	210C	825#	209	1509	265#	89	213	2023	212	419	1049	630	127	2050	-100	4602	1503	460	4634	-428
JAN	22	80	20	163	41	23	94	377	97	94	181	87	56	423	-10	1363	759	174	1672	135
FEB	35	53	10	144	46	20	34	235	37	214	294	80	30	329	64	1772	1149	301	2202	129
MAR	29	100	34	200	37	72	237	555	46	74	197	123	137	823	131	2167	1147	217	1953	-431
APR	327C	739#	104	1350	180#	186#	188	1714	-10#	778E	1490	712	131	1660	-185	5803	2653	1350D	7279	126
MAY	41	111	54	339	133	48	50	567	130	105E	286	181	22	509	-80	1942	1147	335	2264	-13
JUN	5	25	11	62	21	9	16	91	4	32	83	51	10	84	-17	478	311	108#	867	283#
JUL	6	21	6	44M	11M	6	10M	64	4	33	79	46	7	33	-38	379	267	157	728	192
AUG	3	15	3	34	13	4	7M	40	-5	21	57	36	3	19	-24	248	172	77	429	104
SEP	8	28	3	44	5	7	6M	42	-15	22	63	41	5	45	-2	173	65	65	296	58
YEAR	862.	2437.	530.	4734.	905.	507.	959.	6715.	515.	2455.	4919.	2464.	606.	6961.	-360.	21116.	9236.	3694.	25642.	832.

WATER BALANCES TO ORANJEDRAAI

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1982	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAS	ORA	INC ORA
OCT	116	379@	94	678	89@	58	50	816	30	454	752	298	5	714	-107	1626	160	391	1825	-192
NOV	241	1152@	388	2119	338@	334	642@	2981	-114@	972	2122	1150	132M	3407@	294@	6221M	692@	1280	10353	2852
DEC	32	100	15	194	47	11	27	307	75	61	248	187	9	270	-46	757	239	247	1037	33
JAN	2	46	10	66	8	10	80	253	97	51	115	64	24M	167@	-110@	374	92@	101	454	-21
FEB	9	161	10	141	-39	14	117	399	127	54	132	78	20	405	-14	686	149	58	777	33
MAR	26	247	33	264	-42	10	65	444	105	21	177	156	14	394	-64	603	32	72	596	-79
APR	23	166	20	306@	97@	6	28	276	-64@	42	135	93	14	242	-48	631	254	97	738	10
MAY	26	232	17M	422@	147@	4	14	293	-147@	84	166	82	8	253	-48	806	387	114	837	-83
JUN	18	62	12	105	13	4	9	125	7	71	93	22	3	99	-29	656	464	104	779	19
JUL	11	30	3	38	-6	3	9	66	16	39	69	30	3	27	-42	419	323	219	777	139
AUG	18	45	3	68	2	7	8	98M	15M	41	93	52	2	55	-45	581	433	106	686	-1
SEP	14	42	1E	45	-12	4	9	91M	33M	18	62	44	0	54	-37	266	150	43	316	7
YEAR	536.	2662.	606.	4446.	642.	465.	1058/	6149.	180.	1908.	4164.	2256.	234.	6087.	-296.	13626.	3375.	2832.	19175.	2717.

1983	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAS	ORA	INC ORA
OCT	23	326	41	339	-51	55	102	642	146	34	205	171	36	523	-135	1059	331	83	942	-180
NOV	159	683	59	694	-207	54	86	734	-100	516	966	450	44	663	-115	1792C	163C	332	2382	258
DEC	96	961	316	1703@	330@	563	537	2650M	-153@	179	754	575	286	2887	-49	6484	2843	567	6040	-1011
JAN	127	1450	266M	2562@	719@	647	897	3643C	-463@	387	1045	658	619	4702	440	5907C	160C	649	8310	1754
FEB	8	44	5	83	26	84@	196	531@	168@	14@	97	83@	137	599	-69	1363@	667@	119	1202	-280@
MAR	12	163	7	176	-6	162	246	751	167	32@	287	255@	172	844	-79	1805@	674@	103	1321	-587@
APR	27	95	7	187	58	46	154	552	165	69@	176	107@	166	758	40	1406@	472@	76	1618	136@
MAY	85	101	14	283	83	110	30	358	-65	218@	482	264@	12	399	29	1124	243	447	2418	847
JUN	4	18	4	35	9	5	20	82	22	0@	144	144@	11	39	-54	322	139	66	478	90
JUL	3	12	2	25	8	4	16	66	21	0@	116M	116@	13	34E	-45E	431@	281@	39	238	-232@
AUG	3	10	3	11	-5	3	18	59	27	0@	57E	57@	11	85	15	168	26	76	358	114
SEP	37	163	23	251	28	22	32	360	55	99@	262I	163@	23	289	-94	1070	519	116	1183	-3
YEAR	584.	4026.	747.	6349.	992.	1755.	2334.	10428.	-10.	1548.	4591.	3043.	1530.	11822.	-136.	22931.	6518.	2653.	26490.	906.

WATER BALANCES TO ORANJEDRAAI

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1984	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAB	ORA	INC ORA
OCT	33	107	6	169	23	12	26	228	21	828	498	-338	13	147	-94	343	147#	123	690	224
NOV	153e	357	34	539	-5	24	25	657	69	4058	3558	-508	47	550	-154	1280	375#	289	1964	395
DEC	48	165	17	260	30	20	34	437	123	1268	1108	-168	23	357	-103	582	115#	246	1405	577
JAN	17	138	8	156	-7	414	385	827	-128	69	2098	1408	116	752	-191	1270	309#	206	1275	-201
FEB	107	1040	181	1310	-18	338	2150	4840	1042	256	15578	13018	706	4514	-1032	8340	2269#	267	9829	1222
MAR	126	495	58	708	29	227	215	13558	2058	332	9198	5878	148	1385	-1188	4600	2296#	407	4443	-564
APR	43	68	13	155	31	9	38	275	73	1058	2468	1418	18	286	-7	1390	858#	228#	1714	968
MAY	18	17	2	23	-14	1e	16	82	42	24E	198	-58	7	30	-59	317	268#	59	301	-75
JUN	9	9	1	9	-10	0#	0#	65	568	9	0#	-98	5	91	21	228	137#	123	370	19
JUL	2	7	1	11	1	6e	0#	63	468	5	0#	-58	4	12	-55	156	144#	35	162	-29
AUG	0	4	0	1	-3	0#	0#	49	488	2	0#	-28	218	3	-678	82	79#	14	76	-20
SEP	0	2	0	1	-1	0	0#	38	378	1	0#	-18	1	1	-38	42	41#	6	44	-4
YEAR	556.	2409.	321.	3342.	56.	1051.	2889.	8916.	1634.	1416.	3464.	2048.	1109.	8128.	-1897.	18630.	7038.	2003.	22273.	1640.

1985	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAB	ORA	INC ORA
OCT	38	988	358	17508	6898	98e	388	302	-15848	1068	1608	548	368	414	768	905	3318	265	994	-176
NOV	89	953	1158	869	-2888	287	772	3310	1382	150	12868	11368	699e	5621	1612	7080e	1738	568	7609	-39
DEC	236	2140	349	2660	-65	170	779	5410	1801	524	22508	17268	562e	6918	946	11560	2392#	1038	11565	-1033
JAN	40	135	50	294	69	230	271	1190	395	174	7108	5368	552	3624	1882	3810	-524#	5518	4630	2698
FEB	99	710	60	801	-68	261	441	1790	287	221	7508	5298	484	2684	410	3920	486#	363	5295	1012
MAR	19	104	14	177	40	459	108	431	-313	57	1758	1188	91	605	83	1110	330#	308	1611	193
APR	74	361	36	417	-54	32	55	480	-24	52	1118	598	30	788	278	764	-135#	73	876	39
MAY	15	43	10	91	23	13	32	173	37	31	438	128	24	211	14	434	180#	44	491	13
JUN	55	134	30	283	64	13	28e	394	70	145#	1728	278	32	358	-68	881	351#	141	1059	37
JUL	6	22	4	37	5	3	6	86	40	58	0#	-58	6e	51	-41	232	181#	47	279	0
AUG	24	159	18	156	-45	87	33	222	-54	598	128	-478	348	31	-225#	196	153#	68#	287	238
SEP	50	232	60#	481	139#	116	212	9188	109#	152#	487#	335#	45	1027	64#	2620	1106#	392#	2576	-436#
YEAR	745.	5981.	781.	8016.	509.	1769.	2775.	14706.	2146.	1676.	6156.	4480.	2595.	22332.	5031.	33512.	5024.	3858.	37272.	-98.

WATER BALANCES TO ORANJEDRAAI
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ANNUAL TOTALS

	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAG	ORA	INC ORA
1967	693.	2623.	555.	4560.	689.	688.	1059.	7088.	781.	2223.	3823.	1600.	572.	6329.	-1331.	17796.	7644.	2881.	17909.	-2768.
1968	540.	1960.	380.	3320.	440.	536.	876.	5687.	955.	1225.	2845.	1620.	308.	4625.	-1370.	14987.	7517.	2505.	19646.	2154.
1969	513.	1837.	371.	3091.	370.	654.	1230.	5885.	910.	1155.	2639.	1484.	541.	5891.	-535.	15386.	6856.	2562.	12768.	-5180.
1970	1009.	4023.	920.	7163.	1211.	1241.	1828.	11538.	1306.	2418.	5310.	2892.	870.	12512.	104.	26718.	8896.	4072.	30178.	-612.
1971	1037.	3634.	918.	6446.	857.	1605.	3623.	15115.	3441.	3974.	7752.	3778.	1471.	18790.	2204.	33891.	7349.	5055.	45095.	6149.
1972	691.	2262.	524.	4547.	1070.	712.	1441.	7685.	985.	2069.	3254.	1185.	748.	8549.	116.	14668.	2865.	2588.	18083.	827.
1973	1118.	3405.	886.	7027.	1618.	1816.	4561.	17925.	4521.	3090.	6797.	3707.	2489.	23536.	3122.	45302.	14969.	8425.	56206.	2479.
1974	1419.	6252.	1385.	12115.	3059.	2699.	5769.	22282.	1699.	4202.	8321.	4119.	1611.	24627.	734.	40835.	7887.	5549.	50500.	4116.
1975	2144.	9127.	2760.	16850.	2819.	5074.	8505.	40822.	10393.	7396.	17156.	9760.	4140.	49508.	4546.	92257.	25593.	12199.	102308.	-2148.
1976	1428.	6740.	1824.	12436.	2444.	2567.	4624.	25378.	5751.	4754.	11774.	7020.	1614.	26820.	-172.	57558.	18964.	8280.	66112.	274.
1977	1715.	5639.	1532.	11443.	2557.	1743.	3547.	18648.	1915.	5232.	9794.	4562.	1858.	20310.	-196.	44195.	14091.	7677.	48142.	-3730.
1978	1321.	4638.	1319.	9122.	1844.	1280.	2554.	15433.	2477.	3134.	6727.	3593.	1520.	16032.	-921.	33048.	10289.	3763.	35051.	-1760.
1979	867.	3435.	1041.	6585.	1242.	1080.	1863.	11503.	1975.	2144.	3816.	1672.	1226.	12431.	-298.	22459.	6212.	2611.	24748.	-322.
1980	1588.	5577.	1069.	9924.	1690.	1474.	3022.	16851.	2431.	4617.	9095.	4478.	875.	16820.	-906.	38062.	12147.	7419.	42035.	-3446.
1981	862.	2437.	530.	4734.	905.	507.	959.	6715.	515.	2455.	4919.	2464.	606.	6961.	-360.	21116.	9236.	3694.	25642.	832.
1982	536.	2662.	606.	4446.	642.	465.	1058.	6149.	180.	1908.	4164.	2256.	234.	6087.	-296.	13626.	3375.	2832.	19175.	2717.
1983	584.	4026.	747.	6349.	992.	1755.	2334.	10428.	-10.	1548.	4591.	3043.	1530.	11822.	-136.	22931.	6518.	2653.	26490.	906.
1984	556.	2409.	321.	3342.	56.	1051.	2889.	8916.	1634.	1416.	3464.	2048.	1109.	8128.	-1897.	18630.	7038.	2003.	22273.	1640.
1985	745.	5981.	781.	8016.	509.	1769.	2775.	14706.	2146.	1676.	6156.	4480.	2595.	22332.	5031.	33512.	5024.	3858.	37272.	-98.

MONTHLY AVERAGES

	BOK	PEL	SES	PAR	INC PAR	TLO	MOK	KOM	INC KOM	MAR	NKA	INC NKA	TSO	WHI	INC WHI	SEA	INC SEA	MAG	ORA	INC ORA
OCT	84	429	100	783	169	118	192	1220	127	277	586	310	57	1239	-37	2689	863	402	2935	-156
NOV	141	657	145	1081	138	143	267	1740	249	441	911	470	126	1908	42	3496	676	424	4073	153
DEC	129	574	127	1017	186	159	295	1810	339	276	732	457	180	2034	44	4010	1243	525	4062	-473
JAN	150	557	147	1057	204	284	561	2194	292	450	951	500	271	2689	223	4575	935	645	4521	-699
FEB	131	520	127	951	173	287	712	2556	606	416	880	464	307	3026	163	5374	1468	746	7035	915
MAR	109	499	124	887	154	285	476	2048	401	356	771	415	225	2432	159	4588	1385	707	5386	92
APR	100	360	72	632	99	107	170	1010	101	271	542	271	107	1170	54	2669	956	493	3303	142
MAY	43	136	29	269	61	35	52	393	37	134	282	148	31	368	-56	1192	542	230	1650	228
JUN	27	70	15	140	29	12	25	238	62	75	153	78	15	187	-66	806	466	147	966	13
JUL	13	36	6	68	12	7	14	114	25	44	95	51	9	92	-31	471	284	104	578	3
AUG	38	113	28	218	40	25	25	294	25	118	218	100	13	257	-49	823	347	159	945	-36
SEP	54	189	51	346	52	50	79	526	51	123	320	196	23	497	-53	1255	438	188	1367	-76
YEAR	1019.	4140.	972.	7448.	1317.	1511.	2869.	14145.	2316.	2981.	6442.	3461.	1364.	15901.	392.	31946.	9604.	4770.	36823.	107.
AREA	403.	1157.	652.	3240.	1028.	852.	1660.	7950.	2198.	1087.	3480.	2393.	797.	11000.	2253.	19875.	5395.	3011.	24671.	2077.
MM	253.	358.	149.	230.	128.	177.	173.	178.	105.	274.	185.	145.	171.	145.	17.	161.	178.	158.	149.	5.

ANNEX 17

FLOW SEQUENCES AT DAMSITES, 1930/31 - 1985/86

(FINAL FLOW SERIES)

KATSE DAM

1930	198	161	409	1442	961	667	855	336	81	142	93	46	539.1
1931	149	415	336	468	1136	965	320	114	64	32	31	32	406.2
1932	37	590	549	188	557	686	275	76	48	37	27	25	309.5
1933	25	1364	1928	2627	1565	1142	464	111	56	269	332	130	1001.3
1934	545	1863	2027	1032	490	871	682	273	94	56	36	38	800.7
1935	85	171	315	364	414	741	347	249	154	49	34	22	294.5
1936	566	2207	1510	2081	2258	1289	400	101	46	33	23	22	1053.6
1937	329	228	406	1291	1590	588	761	387	335	153	574	324	696.6
1938	663	400	1105	1753	1900	852	395	381	154	91	178	157	802.9
1939	712	1469	850	690	748	792	773	639	229	69	35	382	738.8
1940	218	749	1241	1254	1155	471	600	278	71	45	34	157	627.3
1941	866	413	76	1137	1029	1371	827	228	79	44	319	175	656.4
1942	529	1019	1529	1603	635	816	1298	1154	397	417	317	142	985.6
1943	1778	2047	1737	1149	1277	699	192	89	339	159	54	561	1008.1
1944	660	660	246	115	733	1635	734	152	69	44	22	22	509.2
1945	22	34	58	645	676	706	334	192	100	35	33	24	285.9
1946	1230	1131	380	310	714	899	576	171	55	44	34	211	575.5
1947	615	808	973	889	641	2070	1311	279	89	46	33	23	777.7
1948	257	142	60	917	520	388	212	76	36	34	33	36	271.1
1949	400	564	969	954	782	1518	1081	460	143	263	671	344	814.9
1950	242	154	536	787	731	356	339	202	85	43	47	50	357.2
1951	1107	543	306	761	1254	780	302	101	43	122	127	85	553.1
1952	126	548	727	336	1302	848	1003	445	90	46	35	36	554.2
1953	562	499	579	776	664	572	211	100	66	34	33	33	412.9
1954	46	351	366	1608	2028	943	343	165	90	46	34	33	605.3
1955	294	861	1220	572	1168	1108	386	359	167	44	33	44	625.6
1956	775	1534	2648	2202	1038	765	343	95	77	99	272	1960	1180.8
1957	2592	1494	627	1168	659	321	655	453	140	54	33	185	838.1
1958	179	707	916	536	386	216	707	1415	581	333	179	58	621.3
1959	883	1043	1414	958	1029	1213	876	281	69	55	230	270	832.1
1960	636	981	1215	1544	736	682	964	812	318	102	67	89	814.6
1961	68	1252	1071	766	1339	1110	670	222	68	33	33	35	666.7
1962	45	518	322	1788	1189	933	822	273	91	99	69	45	619.4
1963	283	823	775	1200	770	1322	809	212	187	107	75	79	664.2
1964	1520	846	464	851	367	113	515	232	91	93	76	77	524.5
1965	80	589	311	1599	1243	349	91	54	34	33	24	24	443.1
1966	68	294	710	2543	2456	1280	746	392	143	56	44	43	877.5
1967	46	690	684	191	87	299	302	757	113	96	55	85	340.5
1968	136	143	585	183	173	348	600	321	270	68	45	46	291.8
1969	412	353	538	455	494	69	38	33	33	35	40	225	272.5
1970	865	455	808	1091	635	449	711	220	57	54	34	24	540.3
1971	24	114	276	1134	1179	1694	291	302	79	34	24	25	517.6
1972	162	508	57	11	940	334	338	63	15	3	448	372	325.1
1973	321	307	756	1265	1236	321	399	148	129	48	98	108	513.6
1974	28	2444	1012	1082	1506	1297	216	119	26	43	24	496	829.3
1975	678	2392	1143	1634	1818	2480	1181	345	239	68	44	335	1235.7
1976	2188	1969	145	646	1172	1934	419	98	18	4	2	92	868.7
1977	1157	362	257	1898	510	595	2120	134	27	13	26	611	771.0
1978	613	253	1349	267	265	269	22	78	88	295	1456	1209	616.4
1979	1115	548	1096	285	770	251	72	17	24	3	3	306	449.0
1980	202	748	469	2462	823	1061	765	229	340	38	325	297	775.9
1981	79	530	1051	128	99	139	1075	166	27	26	15	24	335.9
1982	531	1459	155	48	164	267	189	256	74	48	60	56	330.7
1983	356	899	1131	1611	62	218	162	195	17	14	14	196	487.5
1984	143	519	212	150	1279	774	138	29	3	1	1	1	325.0
1985	1067	1117	2427	205	813	117	437	55	185	27	195	310	695.5
AVE.	527	809	805	994	932	803	566	270	120	78	129	194	622.6
SDV.	548	607	592	677	534	527	388	260	113	85	230	316	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

MOHALE

1930	240	134	198	566	468	463	760	242	35	278	115	30	352.9
1931	176	444	172	206	706	486	110	24	23	22	20	25	241.4
1932	36	233	379	123	199	342	151	37	22	22	21	19	158.4
1933	18	719	1172	1703	676	513	296	67	22	82	108	45	542.1
1934	390	788	609	464	164	507	308	153	56	25	113	55	363.4
1935	131	172	260	217	108	227	88	131	60	23	22	20	145.9
1936	374	1526	744	1189	1100	632	148	24	23	22	21	20	582.3
1937	27	137	427	658	841	238	401	149	52	34	64	39	306.7
1938	433	194	422	733	801	236	31	96	49	47	147	90	327.9
1939	624	551	165	40	171	341	492	338	89	26	89	498	342.4
1940	177	322	669	530	810	285	357	133	25	24	23	59	341.4
1941	551	195	23	596	530	632	393	92	23	22	138	68	326.3
1942	575	749	787	716	193	153	699	602	149	253	353	112	534.1
1943	561	1313	852	255	639	250	37	50	59	36	26	86	416.4
1944	87	141	59	124	152	643	221	94	48	23	22	20	163.4
1945	20	62	121	393	208	364	140	26	21	21	19	19	141.4
1946	252	121	276	147	197	76	26	23	21	21	20	153	133.3
1947	375	153	646	438	120	1000	384	52	29	23	21	20	326.1
1948	30	39	25	558	470	274	76	37	27	21	20	30	160.7
1949	202	512	805	547	583	872	988	463	91	153	598	209	602.3
1950	34	82	624	924	483	345	207	61	30	28	32	29	287.9
1951	934	329	55	299	616	390	91	24	23	180	115	64	312.0
1952	40	421	332	205	694	481	339	108	28	25	36	28	273.7
1953	498	675	635	253	442	499	147	72	42	26	24	23	333.6
1954	23	87	135	1120	1114	357	135	63	29	24	24	22	313.3
1955	119	338	809	281	933	838	233	138	59	23	22	21	381.4
1956	348	185	1472	897	276	253	223	69	29	40	167	888	484.7
1957	1217	639	318	863	317	167	331	312	94	26	24	67	437.5
1958	72	419	656	314	255	198	553	486	125	241	98	24	344.1
1959	210	382	1016	347	575	527	309	99	31	25	60	63	364.4
1960	332	588	436	543	201	622	321	138	215	83	39	32	355.0
1961	26	1136	643	182	815	597	314	87	25	23	21	20	388.9
1962	49	843	300	824	492	642	652	182	28	69	41	25	414.7
1963	159	597	530	210	89	1060	407	39	29	26	23	34	320.3
1964	782	285	394	258	61	24	429	158	55	40	97	49	263.2
1965	84	201	77	1216	628	107	39	29	25	23	22	21	247.2
1966	40	124	224	1702	899	385	672	292	52	25	27	25	446.7
1967	185	256	153	47	22	268	229	191	66	23	22	21	148.3
1968	79	52	239	100	234	1093	732	451	126	24	33	27	319.0
1969	640	230	80	153	66	26	22	21	20	22	42	150	147.2
1970	107	59	347	561	376	185	103	82	39	35	28	23	194.5
1971	59	35	130	801	830	914	260	40	30	24	22	42	318.7
1972	105	136	71	48	715	380	90	32	22	21	344	131	209.5
1973	23	51	76	904	962	347	60	23	22	21	33	26	254.8
1974	28	746	434	493	665	709	209	28	23	24	23	281	366.3
1975	125	776	507	804	925	1131	562	126	75	41	26	408	550.6
1976	906	306	53	572	646	840	252	27	25	23	21	265	393.6
1977	619	232	234	826	283	618	672	175	23	22	32	104	384.0
1978	64	73	495	189	405	157	27	62	37	273	595	189	256.6
1979	301	198	162	88	68	37	24	23	21	20	19	217	117.8
1980	85	376	155	678	856	436	134	43	36	27	346	132	330.4
1981	24	280	318	105	116	89	641	226	26	30	26	24	190.5
1982	462	346	83	37	29	43	33	30	25	92	47	23	125.0
1983	87	602	387	266	88	147	68	256	102	23	110	53	218.9
1984	149	106	61	147	459	181	41	27	22	21	20	18	125.2
1985	437	316	534	208	60	63	47	26	215	87	277	120	239.0
AVE.	263	375	393	494	461	423	281	126	50	53	87	95	310.1
SDV.	274	324	312	392	313	292	235	132	44	66	129	145	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

HYDROLOGICAL YEARS STARTING OCTOBER
(I4,11,12(15,A),F8.

1930	252	140	207	593	491	486	796	253	37	291	120	32	349.?
1931	185	465	181	216	740	509	116	25	24	23	21	26	253.2
1932	38	244	397	129	209	358	158	39	24	23	22	20	166.1
1933	19	754	1229	1786	709	538	310	70	23	86	113	47	568.4
1934	409	826	638	487	172	532	323	163	58	26	118	57	380.9
1935	138	180	273	227	113	239	92	138	63	24	23	21	153.1
1936	392	1601	780	1247	1154	662	155	25	24	23	23	21	610.5
1937	29	144	448	690	881	250	420	157	54	35	67	41	321.5
1938	454	203	442	768	840	248	33	101	51	50	155	95	343.9
1939	654	577	173	43	179	357	516	355	94	27	93	522	359.1
1940	186	338	702	557	850	299	375	139	26	25	24	62	358.2
1941	577	205	24	624	556	663	412	96	24	23	145	71	341.9
1942	603	785	825	751	203	160	733	631	156	266	370	118	560.0
1943	589	1377	894	268	671	262	39	52	62	37	27	90	436.8
1944	91	147	62	129	159	675	232	99	51	24	23	21	171.4
1945	21	64	127	413	218	382	147	27	23	22	20	20	148.2
1946	264	127	290	154	206	80	28	24	23	22	21	160	139.8
1947	393	160	677	460	126	1049	403	54	31	24	23	21	341.9
1948	31	41	26	585	493	287	80	38	28	22	21	31	168.1
1949	212	537	844	574	612	915	1037	486	95	160	627	219	631.8
1950	35	86	654	968	506	362	216	64	31	29	34	30	301.6
1951	980	345	58	314	646	409	95	25	24	189	120	67	327.3
1952	42	442	348	214	728	505	356	113	29	26	38	30	287.0
1953	522	709	666	265	463	524	154	76	43	27	25	24	349.9
1954	24	91	141	1175	1168	374	142	66	30	25	24	23	328.4
1955	125	355	849	295	978	879	243	145	62	24	23	22	399.9
1956	366	195	1544	940	290	266	234	72	31	43	176	931	508.6
1957	1276	671	333	905	332	176	347	327	99	27	25	70	458.6
1958	75	440	688	329	267	208	580	509	131	252	103	25	360.9
1959	221	401	1066	364	604	552	324	104	33	26	63	66	382.3
1960	348	617	458	569	211	652	337	145	225	87	41	33	372.4
1961	28	1192	674	191	855	626	329	91	26	24	22	21	407.9
1962	51	884	315	864	517	673	683	191	30	73	43	26	435.0
1963	167	626	556	220	93	1112	426	41	31	27	24	35	335.9
1964	821	299	414	271	64	25	450	166	58	43	102	52	276.3
1965	88	211	81	1276	659	112	41	31	26	24	23	22	259.2
1966	43	130	235	1784	943	404	705	307	55	27	29	26	468.8
1967	21	849	63	39	14	65	195	493	90	105	44	32	201.2
1968	82	24	277	11	8	132	278	152	78	21	33	14	110.8
1969	471	147	60	83	143	12	8	8	7	7	7	92	104.5
1970	252	109	475	507	283	119	233	186	11	1	10	4	218.8
1971	11	27	173	1162	775	772	118	312	91	54	54	46	359.6
1972	98	247	18	10	604	143	170	26	14	12	449	81	187.2
1973	62	89	251	783	908	126	194	64	56	24	126	116	279.6
1974	28	1001	199	491	807	803	122	67	18	63	14	188	380.2
1975	214	1092	462	1073	1222	1267	489	239	306	50	21	258	669.2
1976	1221	700	38	235	655	1079	118	59	26	18	15	138	430.2
1977	473	189	147	1205	294	521	1458	72	24	13	18	319	473.4
1978	368	108	732	100	176	46	14	58	36	270	742	186	283.6
1979	737	263	352	110	209	68	48	19	12	8	9	104	194.0
1980	63	334	307	1229	364	501	271	134	283	33	376	282	417.8
1981	45	555	379	85	194	67	704	95	29	30	19	20	222.1
1982	411	880	55	46	49	19	38	76	64	35	37	16	172.7
1983	31	467	162	350	13	29	62	197	0	0	0	90	140.1
1984	74	366	114	62	232	300	95	22	8	5	2	1	128.1
1985	96	136	474	157	200	52	47	28	131	5	53	138	151.7
AVE.	277	432	412	525	465	409	299	138	57	53	89	95	325.2
SDEV	301	363	330	446	331	313	277	139	61	70	147	147	

MONTHLY VALUES IN THOUSANDS, AND ANNUAL VALUES IN MILLIONS OF CUBIC METRES

MOHALE
(Linear)

INDEPENDENT DATA SET	MAR MCM	AREA sq.km	MAP mm
PIT17.BIN	177.0	1087.0	905.0

INDEPENDENT GAUGES

TOTAL MAR = 177.0 MCM
TOTAL AREA = 1087.0 sq.km
AREAL MAP = 905.0 mm/year

DEPENDENT RECORD

AREA = 938.0 sq.km
MAP = 949.0 mm/year
WEIGHT = .9049
MAR = 325.2 MCM/year

SYNTHESISED RUNOFF AT GAUGE MAS USING MODIFIED PITMAN MODEL FORMULATION

HYDROLOGICAL YEARS STARTING OCTOBER

(I4,2I,12(I5,A),F9.1)

1930	570	290	585	4821	2536	1916	1601	453	124	521	253	116	1378.6
1931	221	629	478	875	3821	2170	416	121	115	110	107	112	917.5
1932	129	2144	1380	321	1156	1490	457	106	101	103	98	95	758.0
1933	99	4291	6745	8203	4401	2681	788	147	110	373	399	171	2840.8
1934	744	5354	5577	1711	1082	2635	1008	206	125	108	132	114	1879.6
1935	242	254	348	795	1332	2686	854	385	198	103	100	98	739.5
1936	1385	8492	3723	7374	7412	3476	678	108	105	102	99	97	3305.1
1937	348	244	1361	4798	4224	1003	1587	597	240	209	1184	482	1627.7
1938	2352	984	4138	5436	7274	2700	351	298	172	165	270	248	2438.8
1939	1315	3533	1905	1408	1895	1635	701	1701	635	125	119	1581	1655.3
1940	615	1762	3741	4633	3745	1082	514	238	120	122	116	210	1689.8
1941	2028	740	116	3167	3187	3182	1068	168	112	108	372	226	1447.4
1942	607	3113	4506	3997	1056	1392	3017	1802	405	1138	1307	403	2274.3
1943	6508	5910	4620	2707	4291	1655	230	138	266	168	118	1433	2804.4
1944	1216	518	183	306	2696	5861	1756	133	120	112	109	106	1311.6
1945	113	119	191	2031	1198	2004	703	162	119	99	96	94	692.9
1946	2459	2504	761	384	1430	1554	491	115	100	97	94	429	1041.8
1947	1244	1758	2671	3182	1731	7133	2424	130	105	102	99	97	2067.6
1948	261	178	128	2420	1127	462	238	112	94	92	90	157	535.9
1949	318	1245	2501	2503	2238	6260	2141	186	111	273	2225	791	2079.2
1950	156	170	2380	1352	1571	700	205	119	101	98	139	115	710.6
1951	2530	907	212	2260	4205	1819	300	100	96	252	276	174	1313.1
1952	167	956	1798	1167	3955	1399	504	228	101	98	128	119	1062.0
1953	1062	789	1172	1886	1579	1003	297	366	190	101	99	99	864.3
1954	184	894	810	5903	6030	1677	246	143	108	100	98	96	1628.9
1955	250	1569	3096	1081	4710	4263	984	156	119	98	96	99	1652.1
1956	698	3140	9639	6523	2293	2149	754	132	107	175	727	6238	3257.5
1957	7164	2406	1153	5224	1889	734	1230	493	140	115	112	234	2089.4
1958	221	2440	2599	851	407	260	869	4694	1561	486	237	111	1473.6
1959	1901	2539	3650	1694	2971	2859	1053	228	119	115	270	358	1775.7
1960	814	2191	2963	3362	1009	1898	1688	653	193	121	119	192	1520.3
1961	139	3708	2878	1714	4093	2182	566	174	118	114	115	110	1591.1
1962	128	1628	819	5825	2187	3919	1520	166	119	193	135	105	1674.4
1963	591	3020	1768	4773	1649	3890	1454	141	321	179	109	231	1812.6
1964	5224	1946	1208	1611	516	134	282	162	794	341	313	177	1270.8
1965	140	933	411	6380	2912	346	104	108	101	97	113	99	1174.4
1966	180	567	2804	9113	5296	3270	1870	452	111	103	101	98	2396.5
1967	314	718	704	258	162	1078	448	187	124	95	99	94	428.1
1968	114	259	965	487	267	2698	1117	484	207	95	93	91	687.7
1969	2241	857	3077	1264	303	164	100	91	89	87	473	648	939.4
1970	1420	561	570	3839	2220	1164	455	221	128	113	103	95	1088.9
1971	216	228	384	3341	4378	3753	961	114	103	96	94	117	1378.5
1972	379	2213	770	233	2945	1540	344	122	94	91	2064	907	1170.2
1973	152	1478	1781	6028	5845	4033	1106	146	122	107	118	104	2102.0
1974	109	5666	3372	5043	4791	3209	811	114	103	101	99	3202	2662.0
1975	1265	4571	4399	7370	6086	10314	3255	215	129	112	109	667	3849.2
1976	3858	2632	799	3706	2172	3285	1143	140	115	111	108	502	1857.1
1977	2938	1098	1360	5582	2623	1753	1504	428	115	111	182	642	1833.6
1978	1198	501	4508	1592	1707	773	156	158	124	882	2038	723	1436.0
1979	885	1434	1733	1767	1512	624	177	114	111	107	104	2258	1082.6
1980	824	1593	870	4973	4858	1274	280	154	111	106	922	376	1634.1
1981	106	1180	986	490	207	791	1128	371	102	100	98	102	566.1
1982	2056	856	134	370	212	220	135	93	90	204	126	86	458.2
1983	916	2716	2551	2250	822	1608	586	112	99	92	356	179	1228.7
1984	490	356	180	917	5737	1887	93	90	88	86	84	82	1009.0
1985	3871	2561	3651	2270	716	286	218	121	166	114	654	293	1492.1
AVE.	1208	1881	2104	3099	2726	2249	874	345	180	175	330	480	1565.3
SDV.	1551	1701	1888	2322	1907	1870	716	672	225	188	500	964	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

MASHAI (INC)

1930	714	487	573	3392	3274	1843	1576	838	239	432	367	138	1389.5
1931	210	633	792	825	2802	2642	931	241	130	89	78	92	946.5
1932	150	1466	1637	583	792	1316	834	251	140	129	112	88	749.8
1933	99	2944	5894	7388	5481	2897	1513	403	184	343	584	434	2816.4
1934	735	3918	5510	2915	1386	2137	1592	546	286	143	147	147	1946.2
1935	265	392	548	1224	1309	2063	1371	456	391	152	91	70	833.2
1936	867	6270	5230	5708	7489	4623	1352	273	112	70	69	69	3213.1
1937	358	530	1152	3598	4110	1930	1214	1055	437	420	976	964	1674.4
1938	1773	1551	3031	4938	6483	4293	947	532	379	233	384	488	2503.2
1939	1046	2818	2521	1497	1829	1611	1146	1798	1039	284	133	1246	1696.8
1940	991	1191	3247	4390	3644	1925	810	603	193	122	121	230	1746.7
1941	1357	1269	277	2290	3159	2681	1889	570	232	110	336	448	1461.8
1942	710	2424	4133	3814	1971	1313	2423	2396	1081	996	1699	809	2376.9
1943	4416	6149	4720	3353	3599	2734	586	213	317	313	160	1055	2761.5
1944	1463	1054	551	434	1946	4517	3048	456	193	101	70	59	1389.2
1945	76	111	233	1362	1435	1581	1184	380	237	120	79	78	687.6
1946	1563	2851	1466	793	1106	1603	1136	330	148	122	108	369	1159.5
1947	1110	1578	2458	3051	2086	4885	4160	765	233	111	80	79	2059.6
1948	273	344	224	1366	1698	786	523	253	129	98	87	159	614.0
1949	390	1006	2062	2449	2228	4901	3556	814	361	390	1864	1384	2140.5
1950	422	352	1962	1591	1344	1117	455	284	171	110	138	182	812.8
1951	1655	1575	507	1771	3366	2560	871	270	119	237	402	347	1368.0
1952	306	835	1585	1732	2767	2378	1077	891	283	122	143	165	1228.4
1953	785	1160	1114	1876	1618	1151	600	627	344	124	92	101	959.2
1954	286	646	979	4282	5576	3094	749	359	232	146	102	81	1653.2
1955	272	1145	2599	1842	3571	4574	1680	403	282	141	90	99	1669.8
1956	684	2412	7580	7503	3177	2160	1218	325	163	253	726	4253	3045.4
1957	6695	4120	1633	3975	3215	975	1058	847	369	163	82	241	2337.3
1958	374	1778	2591	1296	715	437	740	3837	2414	673	494	173	1552.2
1959	1184	2402	3079	2384	2516	2756	1745	635	226	133	284	527	1787.1
1960	928	2001	2537	3066	2102	1547	1865	1221	724	323	193	235	1674.2
1961	222	2276	3226	2014	3236	2820	1173	496	183	101	86	102	1393.5
1962	147	1030	1330	4002	3553	3681	2213	645	262	252	235	120	1747.0
1963	515	2378	2144	3647	2688	2742	2493	578	442	277	163	283	1835.0
1964	3454	3236	1341	1443	962	281	394	382	967	554	434	330	1377.8
1965	228	770	670	4268	3999	885	224	128	113	90	118	109	1160.2
1966	199	557	2245	4706	6319	3953	2398	818	733	232	181	299	2264.0
1967	131	1624	1616	377	199	624	561	1269	198	137	86	140	696.2
1968	207	310	1398	197	155	1036	1233	570	457	138	77	66	584.4
1969	1405	795	1318	885	1135	213	77	56	46	45	313	766	705.4
1970	2512	1063	1367	2670	2003	926	1391	431	119	99	88	67	1273.6
1971	154	371	1154	3594	3369	4497	649	515	151	69	58	85	1466.6
1972	425	1797	463	136	2312	1099	795	176	71	50	1478	992	979.4
1973	1072	931	1623	5026	5586	2676	1521	329	334	163	204	206	1967.1
1974	91	4120	2140	4005	6664	3796	634	255	103	121	60	1355	2334.4
1975	1810	5019	3519	6953	6245	11281	3431	770	589	193	122	519	4045.1
1976	5684	4754	518	2342	4011	3931	868	247	103	81	60	179	2277.8
1977	2453	1121	549	6288	2495	1446	4142	467	133	91	122	1325	2063.2
1978	1339	668	3633	883	1112	1258	136	223	212	719	3021	2205	1540.9
1979	1997	1205	2540	1945	1939	1073	226	83	62	50	39	752	1191.1
1980	1007	1182	1272	4852	2824	1741	951	472	593	102	619	1048	1666.3
1981	213	928	1945	456	276	1130	1965	469	112	91	70	85	774.0
1982	1046	3212	268	611	443	403	372	470	138	72	99	77	721.1
1983	604	1381	3300	4417	483	742	456	463	90	70	73	344	1242.3
1984	317	715	380	1561	5443	1645	221	69	38	47	36	35	1050.7
1985	2924	2587	4181	1506	1730	832	553	169	364	73	409	889	1621.7
AVE.	1113	1811	2082	2780	2803	2317	1302	597	329	199	331	485	1614.9
SDV.	1334	1455	1592	1880	1818	1793	960	601	369	183	532	686	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

TSOELIKE

1930	707	341	630	5779	3258	2628	2163	597	144	1438	575	133	1839.3
1931	280	726	583	999	4717	2532	455	141	131	120	119	132	1093.5
1932	140	2510	1978	503	1258	1654	513	117	116	116	106	105	911.6
1933	105	5771	8096	9798	5132	3170	944	170	117	406	417	187	3431.3
1934	1639	6048	6943	2232	1357	2946	1115	231	139	117	279	167	2321.3
1935	279	296	391	1028	1815	3019	936	915	379	117	116	106	939.7
1936	1459	10459	4516	7843	8612	4175	797	118	117	116	106	106	3842.4
1937	365	265	1976	5681	4652	1092	1719	650	249	237	1250	528	1866.4
1938	2518	1112	5396	7238	8697	3203	411	325	189	176	287	305	2985.7
1939	1405	3807	2199	1592	2324	1888	776	2007	747	136	127	2109	1911.7
1940	832	1877	4117	6288	4795	1478	620	251	137	138	127	216	2087.6
1941	2143	779	126	3924	3802	3430	1161	187	125	115	399	266	1645.7
1942	678	3507	7756	5642	1274	1629	3771	2121	449	1199	1789	575	3039.0
1943	7243	8031	6843	4073	5040	2015	295	149	389	212	128	1643	3606.1
1944	1332	585	216	786	3548	6547	1918	148	138	127	117	116	1557.8
1945	137	577	369	2858	1534	2338	825	223	138	106	106	106	931.7
1946	2499	2772	891	500	1777	1697	510	125	311	167	105	472	1182.6
1947	1360	2001	2985	3876	3038	8932	2911	168	124	117	106	106	2572.4
1948	316	196	157	2658	1337	538	305	138	105	104	104	174	613.2
1949	348	1391	2914	2959	3390	7801	2565	202	126	304	3201	1119	2632.0
1950	166	187	3057	1623	1755	981	297	128	116	106	163	155	873.4
1951	2888	1034	225	3053	5876	2318	310	107	133	299	336	238	1681.7
1952	212	1102	1992	1745	4945	1700	535	238	117	106	136	306	1313.4
1953	1444	938	1281	2211	1820	1346	449	942	391	117	107	131	1117.7
1954	265	972	931	8253	7590	2103	323	162	118	117	107	106	2104.7
1955	275	1852	4167	1439	6438	6303	1558	208	141	108	107	108	2290.4
1956	731	3611	11998	8455	3092	2696	928	150	118	190	822	7703	4049.4
1957	8499	2761	2016	6119	2206	941	1862	873	218	131	130	250	2600.6
1958	244	3404	4973	1575	731	375	1497	6134	1987	606	290	131	2194.7
1959	2175	2977	4709	2231	3395	3962	1466	287	139	132	283	382	2213.8
1960	1226	2976	4489	3847	1092	2567	2229	799	221	143	135	212	1993.6
1961	150	4741	4533	2244	5020	3058	775	191	130	130	146	134	2125.2
1962	213	2177	1111	7511	2800	7523	3014	274	131	425	219	120	2551.8
1963	1383	4159	2659	5554	1904	4648	1897	266	1605	774	253	323	2542.5
1964	6799	2610	1279	1825	653	162	347	196	1584	704	917	390	1746.6
1965	380	1297	530	7334	3690	433	128	175	135	111	157	119	1448.9
1966	192	643	3430	9967	6366	4429	2920	674	498	254	162	141	2967.6
1967	90	2462	2700	720	272	714	688	1049	241	163	94	222	941.5
1968	215	330	1754	240	746	2678	2095	675	693	140	92	54	971.2
1969	1719	893	1351	1172	1698	244	79	58	39	31	447	597	832.8
1970	2817	1184	1468	2583	2037	1119	1511	531	119	213	180	138	1390.0
1971	208	472	1112	4203	5566	5533	783	567	256	93	47	46	1888.6
1972	341	1304	411	135	2227	1227	1115	184	64	34	1164	844	905.0
1973	1375	922	1550	5522	6695	2729	1389	519	533	215	252	237	2193.8
1974	112	3990	2496	4014	7343	4126	787	344	175	154	64	964	2456.9
1975	2035	4948	5689	8844	8750	14557	3556	992	820	196	76	488	5095.1
1976	7462	6414	673	1795	5555	5184	1022	294	109	78	59	160	2880.5
1977	2405	1981	1033	6167	2148	1734	5267	671	160	109	103	1319	2309.7
1978	1503	708	5683	1318	1427	1553	163	239	208	863	2935	2505	1910.5
1979	2230	1317	3298	1968	2576	1395	278	117	77	56	46	588	1394.6
1980	887	1236	1644	6537	4885	2306	979	634	689	107	836	1505	2224.5
1981	279	880	2193	660	377	987	1952	598	123	83	58	62	825.2
1982	835	3141	321	289	427	485	302	307	135	78	106	106	653.2
1983	727	1142	3085	4720	825	938	727	477	139	87	98	402	1336.7
1984	257	722	470	1068	6841	1927	300	96	75	75	74	44	1194.9
1985	1670	4466	6574	2767	2686	579	526	205	628	160	394	1055	2171.0
AVE.	1432	2304	2785	3678	3461	2830	1228	524	311	231	378	553	1971.5
SDV.	1889	2106	2478	2742	2345	2557	1038	868	390	274	622	1104	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

SYNTHESISED RUNOFF AT GAUGE MAL USING MODIFIED PITMAN MODEL FORMULATION
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

MALATSI

1930	441	254	348	1030	874	986	1873	594	43	981	397	43	786.4
1931	414	1191	485	378	1705	1084	214	45	50	43	35	109	575.3
1932	139	457	718	281	347	609	361	131	84	65	45	32	326.9
1933	33	1952	2768	4201	1520	1173	658	157	49	196	359	161	1322.7
1934	1071	2064	1374	840	373	1377	773	416	196	74	489	243	929.0
1935	302	436	517	418	283	503	207	364	169	50	37	34	332.0
1936	960	4680	2025	2928	2803	1527	363	68	46	67	59	59	1558.5
1937	82	307	938	1303	2061	619	865	373	218	165	229	158	731.8
1938	1165	556	891	1790	2002	593	57	256	137	187	569	376	857.9
1939	1869	1454	426	116	323	747	1069	818	242	69	220	1646	899.9
1940	588	611	1427	925	1964	763	782	309	47	72	66	182	773.6
1941	1447	489	51	1353	1128	1612	876	219	37	49	551	322	815.4
1942	1678	1978	1841	1480	407	321	1708	1577	440	639	1132	392	1359.3
1943	1182	3931	2258	554	1494	641	109	145	180	97	42	256	1088.9
1944	265	343	141	246	304	1568	557	268	145	50	32	23	394.2
1945	46	189	320	862	451	837	369	80	58	50	37	65	336.4
1946	321	271	512	323	378	158	89	76	78	81	55	530	307.2
1947	957	389	1522	936	299	2739	1094	198	83	43	37	24	832.1
1948	76	108	74	1067	745	495	197	133	86	62	47	90	318.0
1949	441	1212	1718	1014	1194	2277	2599	1192	259	435	1886	716	1494.3
1950	118	221	1484	1990	903	671	419	160	102	71	108	125	637.2
1951	2865	988	131	562	1328	791	182	71	78	469	336	255	803.6
1952	155	1046	672	344	1568	971	624	254	78	42	132	118	600.4
1953	1306	1821	1435	541	956	875	399	631	289	76	39	53	842.1
1954	51	208	328	2856	2891	918	311	196	92	77	61	37	802.6
1955	267	751	1912	701	2475	2154	664	399	163	46	33	56	962.1
1956	916	498	3566	1969	535	503	414	134	109	174	625	2844	1228.7
1957	3751	1767	626	2118	814	349	632	775	266	50	32	161	1134.1
1958	210	1121	1500	668	475	430	1302	996	264	787	327	43	812.3
1959	342	815	2572	940	1273	1209	647	252	109	81	279	251	877.0
1960	862	1419	857	1038	425	1635	783	345	720	310	167	98	865.9
1961	30	3614	1768	410	2133	1392	604	182	43	25	29	39	1026.9
1962	131	2691	991	2040	1050	1595	1636	523	133	285	177	66	1131.8
1963	326	1541	1166	424	229	2746	1072	110	107	74	68	127	799.0
1964	2224	829	690	497	133	52	982	372	157	181	344	171	663.2
1965	226	461	170	3207	1427	230	149	107	75	49	57	44	620.2
1966	130	357	367	4560	2134	745	1644	778	195	91	100	68	1116.9
1967	465	595	356	102	31	620	491	697	270	90	80	63	386.0
1968	251	181	527	212	432	2876	1807	955	298	67	128	96	783.0
1969	1728	631	185	307	149	65	36	34	63	96	179	618	409.1
1970	395	185	733	1079	677	460	330	315	132	132	101	48	458.7
1971	177	129	363	1791	1983	2689	822	139	111	65	54	149	847.2
1972	254	268	150	141	1794	891	260	92	36	46	991	433	535.6
1973	73	184	270	2437	2752	923	147	60	58	49	175	125	725.3
1974	97	1915	953	677	1179	1850	633	82	61	85	74	916	852.2
1975	491	1978	1235	2009	2638	2937	1240	296	225	117	47	1429	1464.2
1976	2626	847	103	1236	1364	1839	589	80	51	37	34	737	954.3
1977	1611	602	410	2045	756	1721	1769	452	46	42	110	390	995.4
1978	231	180	1295	476	608	259	61	180	115	853	1485	498	624.1
1979	668	479	335	187	199	110	51	35	29	27	37	520	267.7
1980	207	972	435	1559	1967	1154	377	143	164	96	1298	497	886.9
1981	87	576	549	248	264	216	1514	564	109	122	77	73	439.9
1982	1375	860	183	77	61	117	112	140	114	314	166	72	359.1
1983	228	1311	796	387	128	204	124	556	248	54	355	185	457.6
1984	345	323	204	264	702	357	145	57	42	43	35	26	254.3
1985	1077	737	1323	561	164	177	136	52	547	250	877	425	632.6
AVE.	714	1000	911	1120	1058	1024	677	333	149	160	278	309	773.2
SDV.	798	968	766	1010	816	788	582	322	129	209	396	473	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

(I4,2X,12(I5,A),F9.1)

1930	759	365	648	6077	3513	2907	2415	667	159	1955	757	147	2036.9
1931	310	772	615	1022	5019	2645	469	154	143	132	131	145	1155.7
1932	152	2534	2198	582	1269	1675	527	127	126	126	115	115	954.6
1933	114	6385	8552	10332	5294	3301	994	182	128	416	426	197	3632.1
1934	2145	6249	7499	2423	1421	2992	1136	244	150	127	362	202	2495.0
1935	290	318	409	1051	1948	3089	957	1197	479	126	126	115	1010.5
1936	1483	11209	4799	7880	8929	4357	832	129	127	126	115	116	4010.2
1937	375	274	2265	5937	4725	1106	1755	668	261	247	1268	545	1942.6
1938	2576	1166	5929	8052	9196	3312	424	340	201	186	296	332	3201.0
1939	1444	3847	2234	1611	2393	1922	803	2023	757	146	137	2340	1965.7
1940	928	1899	4150	6923	5173	1602	655	263	148	148	137	226	2225.2
1941	2175	796	135	4117	3898	3449	1191	204	135	124	410	287	1692.1
1942	706	3570	9306	6405	1366	1658	4015	2246	473	1210	1972	643	3357.0
1943	7370	8961	7850	4646	5176	2043	310	160	460	243	139	1699	3905.7
1944	1363	611	231	957	3827	6683	1947	159	148	137	127	126	1631.6
1945	147	854	470	3148	1638	2444	870	254	155	116	115	115	1032.6
1946	2511	2820	921	512	1894	1749	522	134	431	213	114	491	1231.2
1947	1389	2043	3029	4023	3633	9629	3091	190	138	127	116	115	2752.3
1948	344	211	173	2680	1372	555	338	155	114	113	112	182	634.9
1949	364	1428	3011	3019	3884	8385	2723	215	135	324	3648	1273	2840.9
1950	176	198	3281	1715	1788	1094	343	139	125	115	176	182	933.2
1951	3041	1089	235	3322	6605	2542	322	117	158	316	363	267	1837.7
1952	237	1122	2029	1932	5317	1825	550	249	127	116	145	410	1405.9
1953	1648	1003	1311	2230	1837	1517	538	1200	482	128	117	155	1216.6
1954	281	985	949	9255	8269	2301	367	176	129	128	117	116	2307.3
1955	289	1967	4677	1605	7156	7492	1818	242	159	118	117	118	2575.8
1956	743	3784	12896	9177	3392	2836	969	162	129	202	853	8413	4355.6
1957	9123	2928	2514	6386	2258	995	2178	1083	264	144	142	261	2827.6
1958	258	3812	6159	1947	844	419	1858	6505	2080	669	319	143	2501.3
1959	2298	3136	5238	2482	3487	4553	1696	321	156	145	297	394	2420.3
1960	1462	3301	5250	4083	1129	2881	2479	870	240	156	149	225	2222.5
1961	162	5223	5369	2479	5401	3521	897	203	142	141	167	149	2385.4
1962	262	2461	1260	8267	3074	9215	3749	342	144	559	272	133	2973.8
1963	1814	4623	3045	5795	1990	5016	2049	288	2317	1020	267	342	2856.6
1964	7667	2908	1314	1888	697	181	387	218	2057	891	1254	509	1997.1
1965	524	1456	577	7806	3963	482	145	213	156	123	184	136	1576.5
1966	205	686	3739	10454	6631	4864	3349	784	694	328	175	154	3206.3
1967	120	2731	3129	845	285	776	747	1072	253	183	108	276	1052.5
1968	242	342	1822	294	1119	3742	2610	755	707	152	129	75	1198.9
1969	2022	1002	1364	1228	1929	325	90	69	56	44	707	703	953.9
1970	2929	1228	1479	2947	2185	1225	1553	544	130	280	210	148	1485.8
1971	218	485	1137	4591	6255	5737	796	578	296	113	57	56	2031.9
1972	353	1324	424	144	2416	1296	1124	193	72	42	1220	870	947.8
1973	1383	995	1586	5839	6811	2985	1484	543	546	224	265	247	2290.8
1974	126	4015	2714	4094	7356	4160	820	359	183	163	72	972	2503.4
1975	2043	5031	6522	9549	9268	15608	3882	1011	832	206	85	558	5459.5
1976	7791	6524	734	2012	5766	5276	1070	315	120	88	71	184	2995.1
1977	2456	2440	1357	6315	2272	1963	5431	713	172	121	122	1348	2471.0
1978	1522	736	6214	1501	1622	1632	176	251	219	1031	3027	2525	2045.6
1979	2247	1333	3659	2199	2633	1410	288	128	87	66	55	635	1474.0
1980	908	1328	1694	7327	6073	2625	996	649	701	117	1001	1585	2500.4
1981	303	909	2224	802	446	1169	2019	609	137	96	69	74	885.7
1982	849	3160	333	300	436	505	316	317	144	89	115	115	667.9
1983	761	1364	3177	5000	923	949	737	547	168	97	120	416	1425.9
1984	274	741	482	1150	7615	2188	311	105	84	83	83	52	1316.8
1985	2467	4744	6933	3378	2934	615	535	214	751	207	480	1117	2437.5
AVE.	1538	2454	3058	3960	3710	3061	1333	568	359	269	424	598	2133.1
SDV.	2010	2254	2754	2928	2493	2787	1159	922	476	341	683	1195	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

NTOAHAE

ANNEX 17

FLOW SEQUENCES AT DAM SITES, 1936/37 - 85/86

KATSE

SYNTHESISED/ORIGINAL RUNOFF AT GAUGE KAT USING MODIFIED PITMAN MODEL FOR
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

1930	198P	161P	409P	1442P	961P	667P	855P	336P	81P	142P	93P	46P	539.1
1931	149P	415P	336P	468P	1136P	965P	320P	114P	64P	32P	31P	32P	406.2
1932	37P	590P	549P	188P	557P	686P	275P	76P	48P	37P	27P	25P	309.5
1933	25P	1364P	1928P	2627P	1565P	1142P	464P	111P	56P	269P	332P	130P	1001.3
1934	545P	1863P	2027P	1032P	490P	871P	682P	273P	94P	56P	36P	38P	800.7
1935	85P	171P	315P	364P	414P	741P	347P	249P	154P	49P	34P	22P	294.5
1936	566P	2207P	1510P	2081P	2258P	1289P	400P	101P	46P	33P	23P	22P	1053.6
1937	329P	228P	406P	1291P	1590P	588P	761P	387P	335P	153P	574P	324P	696.6
1938	663P	400P	1105P	1753P	1900P	852P	395P	381P	154P	91P	178P	157P	802.9
1939	712P	1469P	850P	690P	748P	792P	773P	639P	229P	69P	35P	382P	738.8
1940	218P	749P	1241P	1254P	1155P	471P	600P	278P	71P	45P	34P	157P	627.3
1941	866P	413P	76P	1137P	1029P	1371P	827P	228P	79P	44P	319P	175P	656.4
1942	529P	1019P	1529P	1603P	635P	816P	1298P	1154P	397P	417P	317P	142P	985.6
1943	1778P	2047P	1737P	1149P	1277P	699P	192P	89P	339P	159P	54P	561P	1008.1
1944	660P	660P	246P	115P	733P	1635P	734P	152P	69P	44P	22P	22P	509.2
1945	22P	34P	58P	645P	676P	706P	334P	192P	100P	35P	33P	24P	285.9
1946	1230P	1131P	380P	310P	714P	899P	576P	171P	55P	44P	34P	211P	575.5
1947	615P	808P	973P	889P	641P	2070P	1311P	279P	89P	46P	33P	23P	777.7
1948	257P	142P	60P	917P	520P	388P	212P	76P	36P	34P	33P	36P	271.1
1949	400P	564P	969P	954P	782P	1518P	1081P	460P	143P	263P	671P	344P	814.9
1950	242P	154P	536P	787P	731P	356P	339P	202P	85P	43P	47P	50P	357.2
1951	1107P	543P	306P	761P	1254P	780P	302P	101P	43P	122P	127P	85P	553.1
1952	126P	548P	727P	336P	1302P	848P	1003P	445P	90P	46P	35P	36P	554.2
1953	562P	499P	579P	776P	664P	572P	211P	100P	66P	34P	33P	33P	412.9
1954	46P	351P	366P	1608P	2028P	943P	343P	165P	90P	46P	34P	33P	605.3
1955	294P	861P	1220P	572P	1168P	1108P	386P	359P	167P	44P	33P	44P	625.6
1956	775P	1534P	2648P	2202P	1038P	765P	343P	95P	77P	99P	272P	1960P	1180.8
1957	2592P	1494P	627P	1168P	659P	321P	655P	453P	140P	54P	33P	185P	838.1
1958	179P	707P	916P	536P	386P	216P	707P	1415P	581P	333P	179P	58P	621.3
1959	883P	1043P	1414P	958P	1029P	1213P	876P	281P	69P	55P	230P	270P	832.1
1960	636P	981P	1215P	1544P	736P	682P	964P	812P	318P	102P	67P	89P	814.6
1961	68P	1252P	1071P	766P	1339P	1110P	670P	222P	68P	33P	33P	35P	666.7
1962	45P	518P	322P	1788P	1189P	933P	822P	273P	91P	99P	69P	45P	619.4
1963	283P	823P	775P	1200P	770P	1322P	809P	212P	187P	107P	75P	79P	664.2
1964	1520P	846P	464P	851P	367P	113P	515P	232P	91P	93P	76P	77P	524.5
1965	80P	589P	311P	1599P	1243P	349P	91P	54P	34P	33P	24P	24P	443.1
1966	68P	294P	710P	2543P	2456P	1280P	746P	392P	143P	56P	44P	43P	877.5
1967	22	971	971	236	87	382	390	1105	134	105	55	102	456.0
1968	173	162	816	78	62	375	757	403	351	67	41	35	332.0
1969	551	449	598	438	648	52	24	25	10	11	12	273	309.1
1970	1233	637	1071	1402	775	594	1017	298	59	47	23	7	716.3
1971	22	176	387	1376C	1282	2348	303	377	101	33	21	20	644.6
1972	201	676	64	28#	1377C	475	398	72	29	13	724	490	454.7
1973	459	365	865M	1491C	1978	337	639	212	254	109	153	165	702.7
1974	50M	3038	1564M	1418	2454M	2230M	319	150	48	75	26	743	1211.5
1975	1199	3390#	1565	2139#	2264#	3533C	1353#	441	410	115	68	373	1685.0
1976	3376	3065	200	768	1756	2553	408M	118M	43M	31	19	99	1243.6
1977	1640	543	241	3258	718	634	3064	257	66	44	41	937	1144.3
1978	856	362	2137	449	371	374	49	110	137	417	2225	1635	912.2
1979	1695	858	1787	502	986	323	57	22	14	8	7	326	658.5
1980	358	879	730	3265	823	1122	807	361	513	56	460	550	992.4
1981	102	743	1509	163	144	200	1350	339	62	44M	34	44	473.4
1982	678	2119	194	66	141	264	306#	422#	105	38	68	45	444.6
1983	339	694	1703#	2562#	83	176	187	283	35	25	11	251	634.9
1984	169	539	260	156	1310	708	155	23	9	11	1	1	334.2
1985	1750#	869	2660	294	801	177	417	91	283	37	156	481	801.6
AVE.	612	893	897	1089	1004	874	611	298	136	85	151	225	687.4
SDV.	678	745	657	797	602	664	478	274	128	90	325	365	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

MOHALE

SYNTHESISED/ORIGINAL RUNOFF AT GAUGE MOH USING MODIFIED PITMAN MODEL FOR
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

1930	240P	134P	198P	566P	468P	463P	760P	242P	35P	278P	115P	30P	352.9
1931	176P	444P	172P	206P	706P	486P	110P	24P	23P	22P	20P	23P	241.4
1932	36P	233P	379P	123P	199P	342P	151P	37P	22P	22P	21P	19P	158.4
1933	18P	719P	1172P	1703P	676P	513P	296P	67P	22P	82P	108P	45P	542.1
1934	390P	788P	609P	464P	164P	507P	308P	155P	56P	25P	113P	55P	363.4
1935	131P	172P	260P	217P	108P	227P	88P	131P	60P	23P	22P	20P	145.9
1936	374P	1526P	744P	1189P	1100P	632P	148P	24P	23P	22P	21P	20P	582.3
1937	27P	137P	427P	658P	841P	238P	401P	149P	52P	34P	64P	39P	306.7
1938	433P	194P	422P	733P	801P	236P	31P	96P	49P	47P	147P	90P	327.9
1939	624P	551P	165P	40P	171P	341P	492P	338P	89P	26P	89P	498P	342.4
1940	177P	322P	669P	530P	810P	285P	357P	133P	25P	24P	23P	59P	341.4
1941	551P	195P	23P	596P	530P	632P	393P	92P	23P	22P	138P	68P	326.3
1942	575P	749P	787P	716P	193P	153P	699P	602P	149P	253P	353P	112P	534.1
1943	561P	1313P	852P	255P	639P	250P	37P	50P	59P	36P	26P	86P	416.4
1944	87P	141P	59P	124P	152P	643P	221P	94P	48P	23P	22P	20P	163.4
1945	20P	62P	121P	393P	208P	364P	140P	26P	21P	21P	19P	19P	141.4
1946	252P	121P	276P	147P	197P	76P	26P	23P	21P	21P	20P	153P	133.3
1947	375P	153P	646P	438P	120P	1000P	384P	52P	29P	23P	21P	20P	326.1
1948	30P	39P	25P	558P	470P	274P	76P	37P	27P	21P	20P	30P	160.7
1949	202P	512P	805P	547P	583P	872P	988P	463P	91P	153P	598P	209P	602.3
1950	34P	82P	624P	924P	483P	345P	207P	61P	30P	28P	32P	29P	287.9
1951	934P	329P	55P	299P	616P	390P	91P	24P	23P	180P	115P	64P	312.0
1952	40P	421P	332P	205P	694P	481P	339P	108P	28P	25P	36P	28P	273.7
1953	498P	675P	635P	253P	442P	499P	147P	72P	42P	26P	24P	23P	333.6
1954	23P	87P	135P	1120P	1114P	357P	135P	63P	29P	24P	24P	22P	313.3
1955	119P	338P	809P	281P	933P	838P	233P	138P	59P	23P	22P	21P	381.4
1956	348P	185P	1472P	897P	276P	253P	223P	69P	29P	40P	167P	888P	484.7
1957	1217P	639P	318P	863P	317P	167P	331P	312P	94P	26P	24P	67P	437.5
1958	72P	419P	656P	314P	255P	198P	553P	486P	125P	241P	98P	24P	344.1
1959	210P	382P	1016P	347P	575P	527P	309P	99P	31P	25P	60P	63P	364.4
1960	332P	588P	436P	543P	201P	622P	321P	138P	215P	83P	39P	32P	355.0
1961	26P	1136P	643P	182P	815P	597P	314P	87P	25P	23P	21P	20P	388.9
1962	49P	843P	300P	824P	492P	642P	652P	182P	28P	69P	41P	25P	414.7
1963	159P	597P	530P	210P	89P	1060P	407P	39P	29P	26P	23P	34P	320.3
1964	782P	285P	394P	258P	61P	24P	429P	158P	55P	40P	97P	49P	263.2
1965	84P	201P	77P	1216P	628P	107P	39P	29P	25P	23P	22P	21P	247.2
1966	40P	124P	224P	1702P	899P	385P	672P	292P	52P	25P	27P	25P	446.7
1967	23#	938	70	43	16	72	216E	545E	100	116	49	35	222.3
1968	91	26	306	12	9	146E	307#	168#	86	23	36	15	122.5
1969	520	162	66	92	158	13	9	9	8	8	8	102	115.5
1970	278	121	525	560	313#	131	257	205	12	1	11	4	241.8
1971	12	30	191	1284	857	853#	130#	345	101	60	60	51	397.4
1972	108	273	20	11	668	158	188	29	16	13	496	89	206.9
1973	68	98	277	865	1003	139	214	71	62	26	139	128	309.0
1974	31	1106	220	543	892	887	135	74	20	70	16	208	420.2
1975	236	1207	511	1186	1351	1400	540	264	338	55	23	285	739.6
1976	1349	774E	42	260	724	1192#	130	65	29	20	17	152	475.4
1977	523E	209	162E	1332#	325#	576E	1611E	80	27	14	20	353	523.2
1978	407	119	809	111	195	51	15	64	40	298	820	205	313.4
1979	815	291	389	122	231	75	53	21	13	9	10	115	214.4
1980	70	369	339	1358	402	554	299	148	313	37	416	312	461.7
1981	50	613	419	94	214	74	778E	105E	32	33	21	22	245.5
1982	454	972	61	51	54	21	42	84	71	39	41	18	190.8
1983	34	516	179	387	14#	32#	69#	218#	0#	0#	0#	99#	154.8
1984	82#	405#	126#	69	256	332	105#	24E	9	5	2	1	141.6
1985	106#	150	524	174	221	57	52	31	145#	5#	59#	152#	167.6
AVE.	277	432	405	521	463	407	297	138	58	52	91	96	323.9
SDV.	303	362	315	445	331	320	284	137	66	69	155	145	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

MASHAI

SYNTHESISED/ORIGINAL RUNOFF AT BAUBE MASINC USING MODIFIED PITMAN MODEL FOR HYDROLOGICAL YEARS STARTING OCTOBER

(I4,2X,12(I5,A),F9.1)

1930	714P	487P	575P	3392P	3274P	1843P	1576P	858P	239P	432P	367P	138P	1389.5
1931	210P	633P	792P	825P	2802P	2642P	931P	241P	130P	89P	78P	92P	946.5
1932	150P	1466P	1637P	583P	792P	1316P	834P	251P	140P	129P	112P	88P	749.8
1933	99P	2944P	5894P	7388P	5481P	2897P	1513P	403P	184P	343P	584P	434P	2816.4
1934	735P	3918P	5510P	2915P	1386P	2137P	1592P	546P	286P	143P	147P	147P	1946.2
1935	265P	392P	548P	1224P	1309P	2063P	1371P	456P	391P	152P	91P	70P	833.2
1936	867P	6270P	5230P	5708P	7489P	4623P	1352P	273P	112P	70P	69P	68P	3213.1
1937	358P	530P	1152P	3598P	4110P	1930P	1214P	1055P	437P	420P	976P	964P	1674.4
1938	1773P	1551P	3031P	4938P	6483P	4293P	947P	532P	379P	233P	384P	488P	2503.2
1939	1046P	2818P	2521P	1497P	1829P	1611P	1146P	1798P	1039P	284P	133P	1246P	1696.8
1940	991P	1191P	3247P	4390P	3644P	1925P	810P	603P	193P	122P	121P	230P	1746.7
1941	1357P	1269P	277P	2290P	3159P	2681P	1889P	570P	232P	110P	336P	448P	1461.8
1942	710P	2424P	4133P	3814P	1971P	1313P	2423P	2396P	1081P	996P	1699P	809P	2376.9
1943	4416P	6149P	4720P	3353P	3599P	2734P	586P	213P	317P	313P	160P	1055P	2761.5
1944	1463P	1054P	551P	434P	1946P	4517P	3048P	456P	193P	101P	70P	59P	1389.2
1945	76P	111P	233P	1362P	1435P	1581P	1184P	380P	237P	120P	79P	78P	687.6
1946	1563P	2851P	1466P	793P	1106P	1603P	1136P	330P	148P	122P	108P	369P	1159.5
1947	1110P	1578P	2458P	3051P	2086P	4885P	4160P	765P	233P	111P	80P	79P	2059.6
1948	273P	344P	224P	1566P	1698P	786P	523P	253P	129P	98P	87P	159P	614.0
1949	390P	1006P	2062P	2449P	2228P	4901P	3556P	814P	361P	390P	1864P	1384P	2140.5
1950	422P	352P	1962P	1591P	1344P	1117P	455P	284P	171P	110P	138P	182P	812.8
1951	1655P	1575P	507P	1771P	3366P	2560P	871P	270P	119P	237P	402P	347P	1368.0
1952	306P	835P	1585P	1732P	2767P	2378P	1077P	891P	283P	122P	143P	165P	1228.4
1953	785P	1160P	1114P	1876P	1618P	1151P	600P	627P	344P	124P	92P	101P	959.2
1954	286P	646P	979P	4282P	5576P	3094P	749P	359P	232P	146P	102P	81P	1653.2
1955	272P	1145P	2599P	1842P	3571P	4574P	1680P	403P	282P	141P	90P	99P	1669.8
1956	684P	2412P	7580P	7503P	3177P	2160P	1218P	325P	163P	253P	726P	4253P	3045.4
1957	6695P	4120P	1633P	3975P	3215P	975P	1058P	847P	369P	163P	82P	241P	2337.3
1958	374P	1778P	2591P	1296P	715P	437P	740P	3837P	2414P	673P	494P	173P	1552.2
1959	1184P	2402P	3079P	2384P	2516P	2756P	1745P	635P	226P	133P	284P	527P	1787.1
1960	928P	2001P	2537P	3066P	2102P	1547P	1865P	1221P	724P	323P	193P	235P	1674.2
1961	222P	2276P	3226P	2014P	3236P	2820P	1173P	496P	183P	101P	86P	102P	1593.5
1962	147P	1030P	1330P	4002P	3553P	3681P	2213P	645P	262P	252P	235P	120P	1747.0
1963	515P	2378P	2144P	3647P	2688P	2742P	2493P	578P	442P	277P	163P	283P	1835.0
1964	3454P	3236P	1341P	1443P	962P	281P	394P	382P	967P	554P	434P	330P	1377.8
1965	228P	770P	670P	4268P	3999P	885P	224P	128P	113P	90P	118P	109P	1160.2
1966	199P	557P	2245P	4706P	6319P	3953P	2398P	818P	733P	232P	181P	299P	2264.0
1967	34#	1861#	1861#	446#	234	569	512	1005	228	139	73	126	708.8
1968	173	304#	1563#	142#	111#	848	1162	539	667#	121#	31	26	568.7
1969	1157	676	1220	1019	1188	92#	49	25	13	13	15#	41#	588.5
1970	2442	1038	1437M	1852	1597	897M	1402	465	99	81M	115	113	1153.8
1971	162	404	909	3295	3997M	4788M	711M	539	182	61	37	30	1511.5
1972	288	1190M	340M	91M	1716M	1063	887	158	54	28	1064M	806	768.5
1973	1342	753	1358	4398	5850M	1886	948	361M	438M	186M	202	203M	1792.5
1974	88	3802M	1899	3552M	6809	3853	692	312	160M	149	53	913	2228.2
1975	1996	4609	3718	6676M	7123	11601	2798	905M	781#	179	68	368	4082.2
1976	6619	5990	547	1327M	4796M	4606	904	255	92	68	49M	125	2537.8
1977	2289	1072	386	5377	1775M	1188M	4528	528M	135	88	71	1211	1864.8
1978	1394M	626M	4329	933	788M	1121M	122	216	191	566M	2734M	2413	1543.3
1979	2184	1212M	2524	1188	2233M	1193M	237	92	67	48	36	489M	1150.3
1980	795M	1053M	1480M	5109	2558	1675	946	597	667	97	562	1312	1685.1
1981	221	786	2023	377	235	555	1714	567	91	64	40	42	671.5
1982	816	2981	307	253	399	444	276	293	125	66	98M	91M	614.9
1983	642	734	2650M	3643C	531#	751	552	358	82	66	59	360	1042.8
1984	228	657	437	827	4840	1355#	275	82	65	63	49	38	891.6
1985	302	3310	5410	1190	1790	431	480	173	394	86	222	918#	1470.6
AVE.	1073	1799	2103	2655	2806	2291	1285	597	340	194	305	465	1591.2
SDV.	1385	1508	1645	1862	1886	1869	958	598	377	178	495	689	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

TSOGLIKE (PESSIMISTIC ASSUMPTIONS)

SYNTHESISED/ORIGINAL RUNOFF AT GAUBE TSO USING MODIFIED PITMAN MODEL FOR
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

1930	684P	334P	626P	5697P	3176P	2555P	2096P	582P	144P	1371P	552P	132P	1794.9
1931	268P	714P	572P	989P	4637P	2500P	451P	139P	128P	117P	116P	127P	1075.8
1932	136P	2497P	1908P	478P	1255P	1644P	507P	113P	113P	112P	102P	102P	896.7
1933	101P	5664P	8001P	9706P	5103P	3106P	922P	167P	115P	404P	414P	184P	3388.7
1934	1559P	6004P	6864P	2204P	1305P	2917P	1107P	228P	137P	116P	243P	155P	2283.9
1935	276P	286P	382P	1017P	1748P	2984P	927P	847P	357P	116P	115P	105P	916.0
1936	1449P	10376P	4473P	7825P	8537P	4107P	783P	118P	117P	116P	105P	105P	3811.1
1937	364P	263P	1892P	5596P	4624P	1089P	1702P	644P	246P	235P	1243P	521P	1841.9
1938	2483P	1082P	5318P	7141P	8614P	3180P	411P	322P	189P	176P	286P	294P	2949.6
1939	1387P	3800P	2186P	1585P	2267P	1865P	764P	2002P	746P	135P	125P	2040P	1890.2
1940	800P	1868P	4100P	6201P	4714P	1417P	602P	250P	138P	137P	126P	215P	2056.8
1941	2128P	773P	124P	3843P	3758P	3424P	1146P	182P	124P	113P	395P	255P	1626.5
1942	663P	3458P	7661P	5560P	1256P	1616P	3703P	2079P	443P	1199P	1730P	556P	2992.4
1943	7181P	7946P	6754P	3981P	5008P	2008P	295P	150P	360P	203P	129P	1619P	3563.4
1944	1320P	574P	212P	705P	3462P	6484P	1904P	148P	137P	126P	115P	115P	1530.2
1945	134P	500P	341P	2776P	1506P	2273P	801P	209P	133P	105P	104P	104P	898.6
1946	2495P	2749P	877P	496P	1705P	1667P	506P	124P	261P	150P	104P	463P	1159.7
1947	1345P	1988P	2969P	3817P	2950P	8847P	2892P	161P	122P	117P	106P	105P	2541.9
1948	304P	191P	150P	2646P	1319P	532P	289P	132P	103P	103P	102P	172P	604.3
1949	340P	1382P	2864P	2927P	3309P	7716P	2539P	200P	126P	297P	3137P	1099P	2593.6
1950	166P	186P	2983P	1592P	1740P	923P	277P	128P	116P	105P	159P	143P	851.8
1951	2833P	1017P	225P	2956P	5772P	2291P	308P	106P	123P	293P	325P	226P	1647.5
1952	202P	1095P	1974P	1678P	4862P	1671P	533P	238P	117P	106P	135P	240P	1285.1
1953	1378P	924P	1267P	2204P	1813P	1279P	412P	886P	375P	118P	107P	122P	1088.5
1954	262P	969P	923P	8155P	7479P	2033P	304P	161P	118P	117P	106P	106P	2073.3
1955	270P	1794P	4079P	1415P	6340P	6407P	1536P	195P	137P	108P	107P	107P	2249.5
1956	728P	3347P	11902P	8363P	3018P	2634P	913P	151P	119P	189P	810P	7638P	4001.2
1957	8431P	2729P	1941P	6047P	2186P	913P	1795P	819P	209P	133P	132P	250P	2558.5
1958	242P	3349P	4880P	1542P	670P	356P	1411P	6064P	1975P	581P	282P	131P	2148.3
1959	2109P	2911P	4626P	2161P	3327P	3874P	1427P	277P	138P	133P	283P	381P	2164.7
1960	1148P	2898P	4400P	3824P	1077P	2495P	2161P	778P	219P	143P	133P	211P	1948.7
1961	149P	4644P	4430P	2220P	4929P	2970P	756P	191P	130P	128P	138P	131P	2081.6
1962	189P	2110P	1047P	7418P	2762P	7438P	2949P	262P	132P	378P	204P	120P	2500.9
1963	1298P	4076P	2596P	5485P	1870P	4578P	1862P	263P	1533P	751P	254P	319P	2488.5
1964	6724P	2586P	1265P	1782P	629P	157P	330P	190P	1508P	667P	872P	377P	1708.7
1965	321P	1234P	516P	7223P	3602P	416P	125P	159P	130P	110P	146P	114P	1409.6
1966	189P	621P	3371P	9881P	6289P	4347P	2848P	658P	433P	233P	162P	141P	2917.3
1967	39	1530	1340	420	239	620	627	1040	182	117	55	120	632.9
1968	122	144	1150	205	90#	939#	1350	288	225	34	38	40	462.5
1969	1160	768	1210	924	1290	176	57	13	6	2	33	252	589.1
1970	2790	1290	1290	2010	2050	906	1390	486	117	83	54	46	1251.2
1971	90	374	1090	3980	4720	6750	949	525	174	63	36	39	1879.0
1972	304	1230	458	126	2080	1160	1210	161	51	22	969	778	854.9
1973	1270	713	1400	6190	7272#	3030	2090	442	483	189	294#	163	2353.6
1974	66	4050	2550	3100	8030	4850	726#	190	60	96	26	883	2462.7
1975	2480	5180	5380	9320	8760	12760#	3348#	985	583	203	96	413#	4950.8
1976	6550	5980	570	1419#	5443#	5360	1010	278	93	58	23	36	2682.0
1977	2050	1312#	428#	6290	2300	1250	4610	453	162	87	0#	1368#	2031.0
1978	1450	725	4967#	980#	1040	1293#	70#	147#	121#	449	2520	2270	1603.2
1979	2210	1200	2850	1920	2292#	1345#	226#	19#	37	15	6	311	1243.1
1980	919	774	1490	4530	3360	1720	842	564	589	173	549	1310	1682.0
1981	245	741	2050	423	329	823	1660	509	84	33	19	45	696.1
1982	714	3407#	270	167#	405	394	242	253	99	27	55	54	608.7
1983	523	663	2887	4702	599	844	758	399	39	34E	85	289	1182.2
1984	147	550	357	752	4514	1385	286	30	91	12	3	1	812.8
1985	414	5621	6918	3624	2684	605	788	211	358	51	31	1027	2233.2
AVE.	1350	2239	2667	3575	3323	2731	1188	488	273	205	332	512	1888.4
SDV.	1840	2141	2475	2762	2344	2483	995	861	371	259	585	1089	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

TSOELIKE (OPTIMISTIC ASSUMPTIONS)

SYNTHESISED/ORIGINAL RUNOFF AT GAUGE TSO USING MODIFIED PITMAN MODEL FOR
HYDROLOGICAL YEARS STARTING OCTOBER
(I4,2X,12(I5,A),F9.1)

1930	707P	341P	630P	5779P	3258P	2628P	2163P	597P	144P	1438P	575P	133P	1839.3
1931	280P	726P	583P	999P	4717P	2532P	455P	141P	131P	120P	119P	132P	1093.5
1932	140P	2510P	1978P	503P	1258P	1654P	513P	117P	116P	116P	106P	105P	911.6
1933	105P	5771P	8096P	9798P	5132P	3170P	944P	170P	117P	406P	417P	187P	3431.3
1934	1639P	6048P	6943P	2232P	1357P	2946P	1115P	231P	139P	117P	279P	167P	2321.3
1935	279P	296P	391P	1028P	1815P	3019P	936P	915P	379P	117P	116P	106P	939.7
1936	1459P	10459P	4516P	7843P	8612P	4175P	797P	118P	117P	116P	106P	106P	3842.4
1937	365P	265P	1976P	5681P	4652P	1092P	1719P	650P	249P	237P	1250P	528P	1866.4
1938	2518P	1112P	5396P	7238P	8697P	3203P	411P	325P	189P	176P	287P	305P	2985.7
1939	1405P	3807P	2199P	1592P	2324P	1888P	776P	2007P	747P	136P	127P	2109P	1911.7
1940	832P	1877P	4117P	6288P	4795P	1478P	620P	251P	137P	138P	127P	216P	2087.6
1941	2143P	779P	126P	3924P	3802P	3430P	1161P	187P	125P	115P	399P	266P	1645.7
1942	678P	3507P	7756P	5642P	1274P	1629P	3771P	2121P	449P	1199P	1789P	575P	3039.0
1943	7243P	8031P	6843P	4073P	5040P	2015P	295P	149P	389P	212P	128P	1643P	3606.1
1944	1332P	585P	216P	786P	3548P	6547P	1918P	148P	138P	127P	117P	116P	1557.8
1945	137P	577P	369P	2858P	1534P	2338P	825P	223P	138P	106P	106P	106P	931.7
1946	2499P	2772P	891P	500P	1777P	1697P	510P	125P	311P	167P	105P	472P	1182.6
1947	1360P	2001P	2985P	3876P	3038P	8932P	2911P	168P	124P	117P	106P	106P	2572.4
1948	316P	196P	157P	2658P	1337P	538P	305P	138P	105P	104P	104P	174P	613.2
1949	348P	1391P	2914P	2959P	3390P	7801P	2565P	202P	126P	304P	3201P	1119P	2632.0
1950	166P	187P	3057P	1623P	1755P	981P	297P	128P	116P	106P	163P	155P	873.4
1951	2888P	1034P	225P	3053P	5876P	2318P	310P	107P	133P	299P	336P	238P	1681.7
1952	212P	1102P	1992P	1745P	4945P	1700P	535P	238P	117P	106P	136P	306P	1313.4
1953	1444P	938P	1281P	2211P	1820P	1346P	449P	942P	391P	117P	107P	131P	1117.7
1954	265P	972P	931P	8253P	7590P	2103P	323P	162P	118P	117P	107P	106P	2104.7
1955	275P	1852P	4167P	1439P	6438P	6503P	1558P	208P	141P	108P	107P	108P	2290.4
1956	731P	3611P	11998P	8455P	3092P	2696P	928P	150P	118P	190P	822P	7703P	4049.4
1957	8499P	2761P	2016P	6119P	2206P	941P	1862P	873P	218P	131P	130P	250P	2600.6
1958	244P	3404P	4973P	1575P	731P	375P	1497P	6134P	1987P	606P	290P	131P	2194.7
1959	2175P	2977P	4709P	2231P	3395P	3962P	1466P	287P	139P	132P	283P	382P	2213.8
1960	1226P	2976P	4489P	3847P	1092P	2567P	2229P	799P	221P	143P	135P	212P	1993.6
1961	150P	4741P	4533P	2244P	5020P	3058P	775P	191P	130P	130P	146P	134P	2125.2
1962	213P	2177P	1111P	7511P	2800P	7523P	3014P	274P	131P	425P	219P	120P	2551.8
1963	1383P	4159P	2659P	5554P	1904P	4648P	1897P	266P	1605P	774P	253P	323P	2542.5
1964	6799P	2610P	1279P	1825P	653P	162P	347P	196P	1584P	704P	917P	390P	1746.6
1965	380P	1297P	530P	7334P	3690P	433P	128P	175P	133P	111P	157P	119P	1448.9
1966	192P	643P	3430P	9967P	6366P	4429P	2920P	674P	498P	254P	162P	141P	2967.6
1967	39	1530	1340	420	239	620	627	1040	182	117	55	120	632.9
1968	122	144	1150	205	90#	939#	1350	288	225	34	38	40	462.5
1969	1160	768	1210	924	1290	176	57	13	6	2	33	252	589.1
1970	2790	1290	1290	2010	2050	906	1390	486	117	83	54	46	1251.2
1971	90	374	1090	3980	4720	6750	949	525	174	63	36	39	1879.0
1972	304	1230	458	126	2080	1160	1210	161	51	22	969	778	854.9
1973	1270	713	1400	6190	7272#	3030	2090	442	483	189	294#	163	2353.6
1974	66	4050	2550	3100	8030	4850	726#	190	60	96	26	883	2462.7
1975	2480	5180	5380	9320	8760	12760#	3348#	985	583	203	96	413#	4950.8
1976	6550	5980	570	1419#	5443#	5360	1010	278	93	58	23	36	2682.0
1977	2050	1312#	428#	6290	2300	1250	4610	453	162	87	0#	1368#	2031.0
1978	1450	725	4967#	980#	1040	1293#	70#	147#	121#	449	2520	2270	1603.2
1979	2210	1200	2850	1920	2292#	1345#	226#	19#	37	15	6	311	1243.1
1980	919	774	1490	4530	3360	1720	842	564	589	173	549	1310	1682.0
1981	245	741	2050	423	329	823	1660	509	84	33	19	45	696.1
1982	714	3407#	270	167#	405	394	242	253	99	27	55	54	608.7
1983	523	663	2887	4702	599	844	758	399	39	34E	85	289	1182.2
1984	147	550	357	752	4514	1385	286	30	91	12	3	1	812.8
1985	414	5621	6918	3624	2684	605	788	211	358	51	31	1027	2233.2
AVE.	1367	2263	2699	3613	3361	2762	1205	496	280	210	338	519	1911.4
SDV.	1852	2158	2499	2784	2358	2496	1005	872	382	268	594	1098	
NOBS	56	56	56	56	56	56	56	56	56	56	56	56	

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