UM-15

APPLICATION OF TANK MODEL FOR FLOOD ANALYSIS

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CONTENTS

LIST OF FIGURES

ABSTRACT

Tank Models for daily analysis and flood analysis were developed in Japan by Sugawara (1967). The input requirements of the Tank Models for flood analysis and daily analysis are different. The former model requires the floods data at time unit in hours while the later model needs the continuous daily data at least for three to four years for the calibration purpose. The flood analysis model consists of three tanks which are laid vertically in series. First initial set of parameter values of the model is obtained based on the procedure stated in this user's manual for computer programme of the model. The model parameters along with the data related to floods are supplied as input. Evapotranspiration effect has been considered by including a SUBROUTINE in the programme. The programme simulates out flow hydrographs.

Five hydrographs are plotted simultaneously if river channel modification option is considered. These five hydrographs are plots of observed discharge, calculated discharge, sum of outputs from first, second, third and base discharge, and sum of output from second, third tanks and base discharge and sum of output from third tank and base discharge against time. However, only four hydrographs are plotted without considering the river channel modification viz., observed discharge,calculated discharge, sum of outputs from second, third tanks and base discharge and sum of output from third

tank and base discharge. Trial and error procedure has been used to calibrate the parameters so as to get better fit of simulated hydrograph with observed one. These calibration parameters lead to final model structure.

The programme has been implemented on VAX-11/780 system at National Institute of Hydrology, Roorkee. In the appendix of this User's manual the input and output specifications for the programme have been described with an illustrative example. The programme can be run on computers other than VAX-11/780 system having FORTRAN Compiler after making suitable software modifications.

1.0 INTRODUCTION

Tank model for flood analysis is a simple conceptual model developed by Sugawara (1967) in Japan. The model usually consists of three tanks laid vertically in series. Rainfall is the input to the top tank. In all the three tanks water input from top moves both horizontally and vertically. Discharges through bottom outlet of the top tank is the inflow to the second tank. Similarly, discharge through bottom outlet of second tank is the inflow to the third tank. The discharge through bottom outlet of the third tank is stationary showing a little change during the flood period. Therefore, the discharge component from the bottom outlet of third tank is assumed to be constant during a flood. This discharge component is termed as baseflow.

The model is based on the hypothesis that the runoff at any instant from each tank depends on the storage in the tank at that instant and follows an exponential function with river channel modification. More details of Tank Model for flood analysis are given else where(Sugawara et al(1967) and Datta and Seth (1983-85)). Since in Japan evapotranspiration values are not high, basins are relatively small in size and river gradients are stiff, therefore the evapotranspiration values were not considered for flood analysis. However, in this respect the Indian conditions are different from Japan. Therefore, a SUBROUTINE EVAP is incorporated in the computer programme of tank model for flood analysis in order to include the effect of evapotranspiration. The model is highly non linear and as such, it is very difficult to find optimum parameter values using analytical techniques of optimisation. One way of calibration is therefore by using suitable trial and error method or by using numerical technique for optimisation. The computer programme included in this ' User's manual provides for use trial and error method for calibration of the model.

1.1 Purpose and Capabilities

The main purpose of this User's manual is to familiarise the computer programme of tank model for flood analysis to the users, so that it can be run without facing any difficulty. This program is based on the series storage type model which is called ' Tank Model' with river channel modification. The programme developed by Sugwara in FORTRAN-IV language has been partially modified at National Institute of Hydrology Roorkee in order to take the evapotranspiration effects into account. The programme has been implemented and tested on VAX-11/780 computer system.

1.2 Terminology

TU	Time unit in hours for flood analysis
α	Decreasing ratio
A0,A1,A2,A3	The discharge coefficients of bottom outlet and three side outlets of 'TA'type first tank

HA1,HA2,HA3	Height of three side outlets respectively for 'TA' type first tank.
HA	Height of side outlet in 'TX' type first tank
AIM	Turning point value of discharge curve in 'TX' type first tank.
HB,HC	Height of side outlets of second and third tanks respectively.
B0,C0	Infiltration coefficient for second and third tank respectively.
B1,C1	Discharge coefficients for the side outlets of second and third tank respectively.
ACH	Discharge coefficient for the river channel tank.
LAG	Time lag for different rain fall stations.
XAIN,XBIN,XCIN	Initial storage values for each tank..
CP	Coefficient for precipitation for different rainfall stations.
WE	Weight for discharge of different rainfall stations.

1.3 Scope

The tank model programme for flood analysis requires the observed rainfall at each rainguage station and discharge values at a specific time unit, evaporation values and different station Weights for each flood as input. The model parameters are also supplied as input. The programme estimates the following components and stores in a disk file TANK.OUT alongwith various input data:

(1) Line printer output of the hydrographs for each flood where each symbol corresponds as follows:
(in case of RVCH='RC')

*	Observed discharge.
+	Calculated discharge (output of channel tank).
'	Sum of outputs from first, second third tanks and base discharge.
,	Sum of outputs from second, third tanks and base discharge.
-	Sum of output from third tank and base discharge.
I	Scale points.

(2) In case of RVCH is not equal to 'RC' the line printer output for each flood will be as follows:

*	Observed discharge.
+	Calculated discharge.
.	Sum of outputs from second, third tanks and base discharge.
,	Sum of output from third tank and base discharge
(-	does n't use).
I	Scale points

2.0 TANK MODEL FOR FLOOD ANALYSIS

2.1 General Description

Tank model for flood analysis consists of three tanks laid vertically in series as shown in Figure 1. Each tank has one side outlet and one bottom outlet except the top tank which has two additional side outlets. Top tank corresponds to the structure of ground surface and sum of discharges Y1=(YA1+YA2+YA3) represents surface runoff. Discharge through side outlet from second tank (Y2) and third tank (Y3) represent intermediate flow and sub-base flow respectively. Sum total of discharges through side outlets together with constant base flow represent total simulated flood discharge (QE= Y1+Y2+Y3 + constant base flow) from the basin. Discharges through bottom outlets of top tank, second tank and third tank represent infiltration, percolation and deep percolation respectively. Deep percolation from the bottom tank goes deep below the ground and flows out after sufficiently long time, as such it does not effect the flood flow from a particular storm. Rate of flow through any outlet depends on the height of storage above the initial loss head of the outlet and discharge coefficient.

2.2 Data Requirements'

Following data inputs are necessary for running the computer programme;

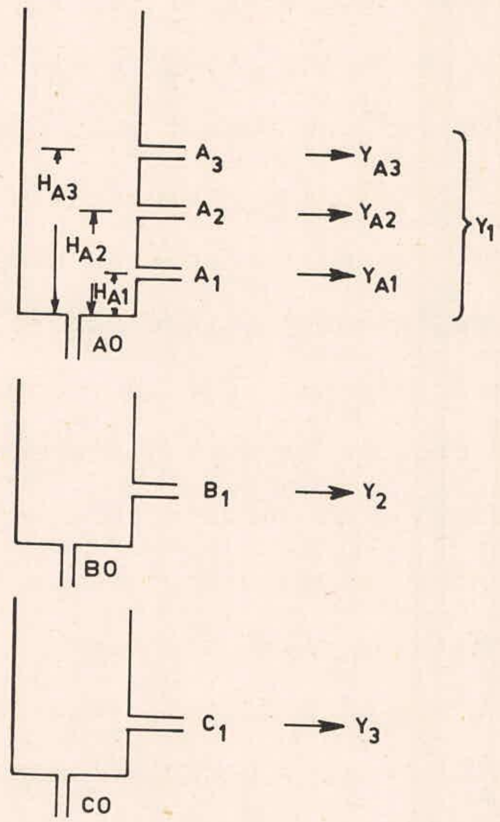


FIGURE 1. STRUCTURE OF TANK MODEL FOR FLOOD ANALYSIS

A. Data for floods- The following input data are required for floods:

(i) Number of floods, number of rainfall stations

(ii) River name, basin name, catchment area in sq.km.

(iii) Time unit in hours

(iv) Rainfall stations name

(v) Hourly rainfall values of number of S.R.R.G. stations located within and near the basin for first flood

(vi) Symbol and number of data for first flood

(vii) Observed discharge data for first flood

(viii) Step (v) to (vii) will be repeated for other floods

(ix) Evaporation values - only a fixed value corresponding to time unit is used. This value can be ascertained from average monthly value of daily evapotranspiration pertaining to that area.

B. Parameter values - Following parameter values are required for first trial run:

(i) Initial storage for each tank

(ii) Coefficient of discharge & initial loss head of Ist tank, 2nd tank and third tank.

(iii) CP,WE and lag for each rainfall station

(iv) CPF and base for each flood

C. Data to be supplied for output requirements-Following inputs are to be supplied for output requirements.

(i) Number of graphs to be plotted, number of scale points, range of plot, minimum and maximum values to be plotted.

(ii) Scale points to be defined.

(iii) Output format to be supplied.

2.3 Analysis

Following proecedure is to be followed for initial analysis and selection of initial parameter values for first trial run to start the calibration process of the Tank Model for flood analysis by human judgement.

(i) Number of flood - It is preferable to have 10 to 15 number of floods selected from large, medium and small ranges

(ii) Time Unit - An appropriate time unit (TU) for flood analysis is approximately proportional to the square root of the catchment area. Conveniently, it is assumed to follow:

$$TU(hours) = 0.05\sqrt{S}$$

where S = catchment area in sq.km.

Time unit is generally selected as 1/6,1/3,1/2,1,2,3,4,6,8 etc. in hours.

(iii) Observed discharge hydrograph - Observed discharges for flood periods of selected time unit are plotted in semi-logarithmic paper and rough estimation of time constant TC of flood runoff is made from recession slope of the flood hydrographs.

(iv) Initial tank model parameters- Decreasing ratio α is calculated as 1/TC. From the value of α the discharge coefficients are selected as :

$A0 = A1=A2=A3 = \alpha/2$

$B0 = B1 = \alpha/10$

$C0 = C1 = \alpha/50$

The value of initial losses are selected from the following ranges

HA1 = 0 ~ 15 (mm), HA2 = 15 ~ 40 (mm)

HA3 = 40 ~ 60 (mm), HB = 5 ~ 15 (mm)

HC = 5 ~ 15 (mm)

(v) Input precipitation- Weighted mean of the basin may be considered as input or directly rainfall of individual stations may be used with the weightage of the respective stations.

(vi) Time lag (LAG) - Time lag may be determined by rough estimation. In the first trial run, value of lag may be provided as zero.

(vii) Initial storage (XAIN,XBIN,XCIN) - For first trial, initial value of storage for each tank may be set to zero.

(viii) Correction factor for precipitation - For initial trial the value of correction factor (CP&WE) are usually considered as 1.0.

(ix) Base discharge (Base) - The value of base discharge for each flood is considered from stationary discharge value before the commencement of flood.

(x) Channel deformation - Output from the tank model goes into river channel where its hydrograph is deformed by storage effect of the channel. If RVCH is set to 'RC' in the programme, channel deformation is considered. The outflow from the channel tank is given by the equation.

QCH = ACH * XCH ** 2

where, QCH is the outflow from the channel tank,
ACH is the discharge coefficient for river channel tank, and
XCH is the storage of the river channel tank,

In earlier trials, this effect is usually disregarded. After selecting the parameters of the tank Model for trial run, the model is run with precipitation data and discharge values are simulated and compared with discharge. The value of parameters are adjusted one by one in successive trial runs and by comparing the hydrographs best suited values of each of the parameters are obtained.

User's of the programme may follow the following procedure while adjusting the parameters of the model during the trial runs.

(i) If the calculated hydrograph is steeper than the observed one, decrease the discharge coefficients of side outlets and bottom outlet of the top tank

(ii) If the calculated hydrograph shows a larger peak than the observed one, increase the discharge coefficient of the bottom outlet and decrease the discharge coefficients of the side outlets of the top tank.

(iii) If the calculated hydrographs show smaller peaks than the observed ones only for larger floods but not for small floods, increase discharge coefficient of first side outlet (A2) of top tank.

(iv) The recession component of the hydrograph may be approximated by adjusting the parameters of second and third tanks.

2.4 Advantages and Limitations

Main advantages of the Tank Model for flood analysis are:-

(i) It is a simple model having reasonable physical correspondence to the zonal structure of ground water.

(ii) It can represent the non linear character of surface runoff.

(iii) It can model several components of runoff with reasonable accuracy.

(iv) Calibration parameters are determined considering more than one flood.

(v) It can also consider the evapotranspiration effect.

(vi) Data requirements are comparatively less.

Users should keep in mind the following limitations while using this programme.

i) Number of raingauge stations(NRG): Less than 6

ii) Number of floods (NFLD): Less than 51

iii) Number of data in a flood(NDATA): Less than 600 time lag

iv) Raingauge station name (PNAME): Less than 21 characters

v) Basin name (ANAME): Less than 21 charcacters

vi) River name (RNAME): Less than 21 characters

vii) Nummmber of scale points in the hydrograph plotting : less than 6

viii) Number of pringing position in the line printer: Less than 132 characters

ix) Number of characters in one line for hydrograph plotting: Less than 121

x) Number of graphs in hydrograph plotting: Less than 6

3.0 RECOMMENDATIONS

The pgoramme TANK.FOR can be used for flood analysis with due consideration for river channel deformations. The programme is developed in Japan by Sugawara and it has been implemented and tested at National Institute of Hydrology, Roorkee on VAX-11/780 computer system, which is a 32 bit machine, after some modification to include evaporation component. The programme occupies the larger part of the computer storage due to the data represented by DIMENSION P (600,5) and QEI (600,3). If the user of this programme wants to decrease the required storage capacity of this programme he should decrease the maximum number of data in a flood and/or the number of rainfall stations at first, if possible. User may modifidy the DIMENSION statements of the programme as per his requirements. The execution time varies depending on the number of rainfall station, the number of floods, and the number of data in a flood. The programme may run on other computer systems having FORTRAN compiler, after making suitable modifications in the programme as per software requirements of particular system.

REFERENCES

1. Datta, Bhaskar and S M Seth (1985),'Application of Tank Model for flood and daily, runoff analysis to some basins in India', International Workshop on Operational Applications of Mathematical Models (Surface Water) in developing countries, IIT Delhi from 26 February to 1 March.

2. Sugawara,M(1967),'The flood forecasting by a series storage type model', International Symposium on Flood and Their Computation, Leningrad, August.

APPENDIX - I

DETAILS OF COMPUTER PROGRAMME FOR TANK MODEL FOR FLOOD ANALYSIS

A. DESCRIPTION OF COMPUTER PROGRAMME

The computer programme TANK.FOR is developed in FORTRAN-IV language and it has been implemented and tested on VAX-11/780 digital computer system. Main programme and eight subroutines form the structure of the programme for flood analysis. The subroutine are called within the main programme or subroutines for different computations.

(I) Main programme

(a) The main steps followed for flood analysis ysing this programme are :

(1) File reference no.5 and 6 are set for input and output.

(2) An intermediate file is created at file reference No.D2(D2=2) for storing various input informations. This file is deleted as soon as the execution is over.

(3) No. of floods (NFLD), number of rainfall stations (NRG), and MRAIN are input. If mean precipitation data is used, MRAIN is set to 1, otherwise MRAIN is set to 0.

(4) "DATAFL" is the subroutine which inputs various data from the file D1(D1=5) and stores these data into the file D2.

(5) If MRAIN=1, number of rainfall(NRG) is set to 1 in this point

(6) Various parameters are input from system input, and printed for checking purposes.

(7) Percent ratios (WE(K)) for the weights for the rainfall stations are obtained

(8) Flood symbol (FLDSYM), number of data (NDATA), comments (CMT), observed discharge (Q) and observed precipitation data (P) for a flood are input from the file D2.

(9) Tank Model calculation is done, and total calculated discharge (QE) and total discharge of each tank (QEI) are obtained.

(10) If RVCH = 'RC' river channel calculation is done

(11) Calculated discharges of every tanks are summed up for plotting of graphs.

(12) Graph and several data are printed.

(13) Step (8) to (12) are repeated for NFLD times.

(b) Descriptions of the variables used in the programme

Various variables/ constants used in the programme are described below:

Variable/Constant	Description
NFLD	Number of floods (total)
NRG	Number of raingauge (General)
MRAIN	Switch for using the option of rainfall. If MRAIN=1, use mean rainfall otherwise if MRAIN=0 use each rainfall

RNAME	Name of River
ANAME	Name of catchment area,
AREA	Catchment area
NF	Number of floods to be considered for analysis
NR	Number of rainfall stations
TU	Unit time (Hours)
PNAME(I,K)	Name of K-th rainfall station
FLDSYM	Flood symbol
NDATA	Number of data
CMT	Comment for first flood
Q(I)	Observed discharge data (m^3/sec) for a flood
P(I,K)	Observed precipitation data(mm) for K-th rainfall station for a flood
LARY	Adjusted dimension for number of data in a flood
FTANK	Top tank option,= 'TA' , three pipes tank, = 'TX' special tank
RVCH	Switch for the use of river channel modification option, if equal to 'RC'
XAIN	Initial storage value for first tank
XBIN	Initial storage value for second tank
XCIN	Initial storage value for third tank
HA1	Height of first side outlet of first tank
HA2	Height of second side outlet of first tank
HA3	Height of third side outlet of first tank
A1,A2,A3	Discharge coefficient of three side outlets of first tank
AO	Infiltration coefficient for first tank

HA	Height of side outlet in 'TX' type first tank
A!M	Turning point value of discharge curve in 'TX' type first tank
HB	Height of the side outlet for second tank
B0	Infiltration coefficient for second tank
B1	Discharge coefficient for the side outlet of the second tank.
HC	Height of the side outlet for third tank
CO	Infiltration coefficient for third tank
C1	Discharge coefficient for the side outlet of third tank
ACH	Discharge coefficient for river channel tank
CP(K)	Coefficient for precipitation of Kth rainfall station
WE(K)	Weight for discharge of K-th rainfall station
LAG(K)	Time lag for K-th rainfall station
CPF(N)	Coefficient for precipitation of N-th flood
BASE(N)	Base discharge for N-th flood
EV	Evaporation value
NPLOT	Number of graphs plotted
NSCAL	Number of scale point
LY	Maximum plotting position
YMIN	Minimum value to be plotted
YMAX	Maximum value to be plotted
SCAL	Plotting value for NI-th scale point
FMT1, FMT2	Format specifications for plotting
QE	Total calculated discharge
QEI	Calculated discharge of each tank.

(II) SUBROUTINES

(a) SUBROUTINE DATAFL(NFLD,MRAIN,NRG,Q,P,LARY,D1,D2)

This is the subroutine which inputs various data from the file D1 (D1=5) and stores these data into the file D2. The variables used at arguments are:

NFLD	No. of floods
MRAIN	=1, use mean rainfall
	=0, use station's rainfall
NRG	Number of rainguages
Q	Observed discharge data (m^3/s)
P	Observed precipitation data(mm)
LARY	Adjusted Dimension for number of data in a flood
D1	Input file reference number
D2	Intermediate output file reference no.

(b) SUBROUTINE EVAP(EV,XA,XB,XC)

This subroutine extracts the evapotranspiration and adjusts the storage values of each tank. The variables used as arguments are:

EV	Evapotranspiration value
XA	Storage of first tank
XB	Storage of second tank
XC	Storage of third tank

(c) SUBROUTINE TANKB(P,X,Y,Y0,H1,B0,B1)

This subroutine is used for the calculation of second and third tanks which has only one side outlet. The variables used as arguments are :

P	Infiltration coefficient for first and second tank
X	Storage of second or third tank

Y Discharge from the side outlet of second tank

Y0 Infiltration for second or third tank

H1 Height of the side outlet for second or third tank

B0 Infiltration coefficient for second or third tank

B1 Discharge coefficient for the side outlets of second or third tank.

(d) SUBROUTINE TANKX(P,XA,Y,Y0,HA,A0,A1,A1M)

This is the subroutine for first tank calculation for 'TX' type. The variables used as arguments are:

P Final value of precipitation

XA Storage of first tank

Y Discharge from the first tank

Y0 Infiltration from first tank

HA Height of side outlet in 'TX' type first tank

A0 Infiltration coefficient for first tank bottom outlet

A1 Discharge coefficient for first 'TX' type tank's side outlet

A1M Turning point value of discharte curve in 'TX' type first tank

(e) SUBROUTINE TANKA(P,X,Y1,Y2,Y3,Y0,H1,H2,H3,A0,A1,A2,A3)

This is the subroutine for the calculation of first tank of 'TA' type which has three side outlets. The variables used as arguments are:

P Final value of precipitation

X Storage of first 'TA' type tank

Y1	Discharge from first side outlet of the top tank
Y2	Discharge from second side outlet of the top tank
Y3	Discharge from third side outlet of the top tank
Y0	Infiltration from the top tank
H1	Height of first side outlet of top tank
H2	Height of second side outlet of top tank
H3	Height of third side outlet of top tank
A0	Infiltration coefficient for top tank
A1	Discharge coefficient for first side outlet of top tank
A2	Discharge coefficient for second side outlet
A3	Discharge coefficient for third side outlet

(f) SUBROUTINE HYGRFL(RNAME,ANAME,FLDNO,FLDSYM,TU,N,NRG,
CMT,P,Q,QA,QB,QC,QD,LARY)

This is subroutine for graph plotting. The variables used das arguments are:

RNAME	Name of river
ANAME	Name of catchment area
AREA	Catchment area
FLDNO	No. of floods
FLDSYM	Flood symbol
TU	Unit time (hours)
NDATA	No. of data points
NRG	No. of rainfall stations
CMT	Comment for first flood
P	Observed precipitation data (mm) for different rainfall stations for different flood

Q Observed discharge data (m^3/s) for a flood

QA Calculated discharge (m^3/s)

QB,QC,QD Calculated discharge (m^3/s) from different tanks i.e. first,second, third etc.

LARY Adjustable dimension for number of data in a flood

(g) SUBROUTINE TNKMDL(P,NRG,NDATA,CPF,BASE,QEI,QE,LARY)

This is the subroutine for tank model calculations for each flood. This subroutine calls the following subroutines.

(i) SUBROUTINE TANKA which perform calculation for a TA type first tank or

(ii) SUBROUTINE TANKX which perform the calculation for TX type first tank

(iii) SUBROUTINE TANKB which performs the calculations for second and third tanks

and

(iv) SUBROUTINE EVAP which perform the adjustment for evapotranspiration.

The variables used as arguments in the SUBROUTINE TANKMDL are:

P Observed precipitation data at different rangauge stations

NRG No. of raingauges

NDATA No. of data points

CPF Coefficient for precipitation of a specific flood

BASE Base discharge for a specific flood

QEI Calculated discharge for each tank

QE Total calculated discharge

LARY   Adjusted Dimension for number of data in a flood

(h) SUBROUTINE TANKCH(QE,NDATA,BASE,QCH,LARY,ACH)

This is the subroutine for calculation of river channel modification. The variables used as arguments are.

QE	Total calculated discharge
NDATA	No. of data points
BASE	Base discharge for a specific flood
QCH	Calculated discharge after channel modification
LARY	Adjusted dimension for number of data in a flood
ACH	Discharge coefficient for river channel tank

B. INPUT SPECIFICATIONS:-

The input lists and their specifications which are to be supplied through an input file TANK.DAT are:

NO.	INPUT LISTS	FORMAT	REMARK
1	NFLD,NRG,MRAIN	10I8	
2	RNAME,ANAME,AREA	5A4,5A4,F10.0	
3	NF,NR,TU	2I8,F8.0	
4	((PNAME(I,K),I=1,5),K=1, NR)	5A4	
5	FLDSYM,NDATA,CMT	4A4,I8,3A4	
6	(Q(I),I=1,NDATA)	10F8.1	
7	((P(I,K),I=1,NDATA),K=1, NRG)	12F6.1	
8	FTANK,RVCH	2(6X,A2)	
9	XAIN,XBIN,XCIN	10F8.4	
10	HA1,HA2,HA3,A0,A1,A2,A3	3F8.0,4F8.4	Skip input list no. 10 if FTANK=TX
11	HA,A0,A1,A1M	10F8.4	Skip input list
12	HB,B0,B1	F8.0,2F8.4	no. 11 if FTANK=TA
13	HC,C0,C1	F8.0,2F8.4	
14	ACH	10F8.4	Skip input list
15	(CP(K),K=1,NRG)	10F8.4	no. 14 if RVCH
16	(WE(K),K=1,NRG)	10F8.4	not equals to RC
17	(LAG(K),K=1,NRG)	10I8	
18	(CPF(N),N=1,NFLD)	10F8.4	
19	(BASE(N),N=1,NFLD)	10F8.4	
20	NPLOT,NSCAL,LY,YMIN,YMAX	3I8,2F8.4	
21	(SCAL(NI),NI=1,NSCAL)	3F8.2	
22	FMT1,FMT2	10A4,10A4	

NOTE:-

(i) Input lists no.1 & no. 8 to 22 are in MAIN PROGRAMME

(ii) Input lists no.2 to 7 are in SUBROUTINE DATAFL

C.OUTPUT SPECIFICATIONS

The output file TANK.OUT consists the values of the followins output lists in the specified format:

NO.	OUTPUT LISTS	FORMAT	REMARK
1	RNAME,ANAME,AREA,TU	1H1,10A4,2X,'(',F10.3,'KM2)',6X,'TU=',F8.3	
2	Title	1H0,8X,'PNAME'	
3	((PNAME(I,K),I=1,5),K=1,NRG)	1H ,8X,5A4	
4	NFLD,NRG,MRAIN,FTANK,RVCH	1H0,10X,'NFLD',7X,'NRG',5X,'MRAIN',5X,'FTANK',6X,'RVCH'/1H ,10X,3I10,7X,A2,8X,A2	
5	XAIN,XBIN,XCIN,ACH	1H0,8X,'XA',8X,'XB',8X,'XC',7X,'ACH'/1H ,3F10.0,F10.2	
6	HA1,HA2,HA3,A0,A1,A2,A3	1H0,7X,'HA1',7X,'HA2',7X,'HA3',8X,'A0',8X,'A1',8X,'A2',8X,'A3'/1H ,3F10.0,4F10.4	The ouput lists of no.6 will be skipped if FTANK =TX
7	HA,A0,A1,A1M	1H0,8X,'HA',8X,'A0',8X,'A1',7X,'A1M'/1H ,F10.0,F10.6,2F10.4	The output lists of no.7 will be skipped if FTANK =TA
8	HB,B0,B1,HC,C0,C1	1H0,8X,'HB',8X,'B0',8X,'B1',8X,'HC',8X,'C0',8X,'C1'/1H ,2(F10.0,2F10.4)	
9	(CP(K),K=1,NRG)	1H0,8X,'CP',5X,10F10.4	
10	(WE(K),K=1,NRG)	1H0,8X,'WE',5X,10F10.4	
11	(LAG(K),K=1,NRG)	1H0,8X,'LAG',10I10	
12	(N,CPF(N),N=1,NFLD)	//,5X,'CPF'/5(I12,F10.2)	
13	(N,BASE(N),N=1,NFLD)	//,5X,'BASE DISCHARGE'/5(I12,F10.4)	
14	NPLOT,NSCAL,LY,YMIN,YMAX,(SCAL(NI),NI=1,NSCAL)	//,6X,'NPLOT',5X,'NSCAL',8X,'LY',6X,'YMIN',6X,'YMAX',14X,'SCAL'/1H ,3I10,2F10.3,12X,5F8.3	
15	FMT1,FMT2	1H0,5X,'FMT1',44X,'FMT2'/2(8X,10A4)	
16	EV	6X,'EV=',F8.4	
17	RNAME,ANAME,FLDNO,FLDSYM,N,TU,CMT	1H1,/,1X,10A4,2X,'FLOOD NO.',I3,2X,4A4,5X,'N=',I4,5X,'TU=',F8.3,3X,3A4/	
18	NO,(P(I,K),K=1,NRG),(PLOT(J),J=1,2)	FMT1	Output list no. 18 will be skipped if Q(I)=-999

19	NO,(P(I,K),K=1,NRG), PLOT(2),(GBUF(L),L= 1,LY)	FMT2	Output list no. 18 will be skip ped if Q(I) not equal to -999 Output list no. 18 and 19 will be written N times

NOTE:-

(i) Output lists from no 1 to 16 are in MAIN PROGRAMME

(ii) Output lists from no 17 t0 19 are in SUBROUTINE HYGRFL

(iii)Two intermediate files at refernce no.2 and 25 are created during the execution.As soon as execution is over those files are automatically deleted

D COMPUTER PROGRAMME

```
C
C
C
C     THIS IS THE TANK MODEL CALCULATION PROGRAM FOR FLOOD FORECASTING.
C
C     THE OBSERVED PRECIPITATION AND DISCHARGE DATA ARE STORED IN THE
C     MAGNETIC TAPE OR DISC.  USUAL SETUP IN THIS TAPE AND DISC IS
C     AS FOLLOWS:
C       * RNAME (RIVER NAME), ANAME (DISCHARGE STATION NAME),
C         AREA (CATCHMENT AREA)
C       * NF (NUMBER OF FLOODS), NR (NUMBER OF RAINGAUGE STATIONS),
C         TU (UNIT TIME)
C       * PNAME (RAINGAUGE STATION NAME FOR EACH STATION)
C       * FLDSYM (FLOOD SYMBOL), NDATA (NUMBER OF DATA IN THE FLOOD)
C         CMT (COMMENT) FOR FIRST FLOOD
C       * Q (OBSERVED DISCHARGE) FOR FIRST FLOOD
C       * P (PRECIPITATION DATA FOR FIRST RAINGAUGE STATION),
C       * P (PRECIPITATION DATA FOR SECOND STATION),
C           .
C           .
C       * P (PRECIPITATION DATA FOR NR-TH STATION), FOR FIRST FLOOD
C       * FLDSYM (FOR SECOND FLOOD),
C           .
C           .
C
C     USUAL DATA SETUP FROM CARD READER (OR SYSTEM INPUT) IS AS FOLLOWS:
C       * NFLD (NUMBER OF FLOODS, (I8)), NRG (NUMBER OF RAINGAUGES
C         (GENERAL) (I8)), MRAIN (0 OR 1, (I8))
C       * FTANK ('TA' OR 'TX', (6X,A2)), RVCH ('RC' OR NOT, (6X,A2))
C       * XAIN, XBIN, XCIN (3F8.0)
C       * HA1, HA2, HA3, A0, A1, A2, A3 (7F8.0) OR
C            HA, A0, A1, A1M (4F8.0)
C                (FIRST TANK PARAMETERS)
C       * HB, B0, B1 (3F8.0)  (SECOND TANK PARAMETERS)
C       * HC, C0, C1 (3F8.0)  (THIRD TANK PARAMETERS)
C       * IF RVCH='RC',  ACH (F8.0)  (RIVER CHANNEL PARAMETER)
C       * CP(K) (F8.0*NRG)
C       * WE(K) (F8.0*NRG)
C       * LAG(K) (I8*NRG)
C       * CPF(N) (F8.0*NFLD)
C       * BASE(N) (F8.0*NFLD)
C       * NPLOT, NSCAL, LY, YMIN, YMAX (3I8,2F8.3) FOR GRAPH PLOTTING
C       * SCAL(NI) (F8.0*NSCAL) FOR GRAPH PLOTTING
C       * FMT1, FMT2 (2*10A4) FOR GRAPH PLOTTING
C
C     LIMITATIONS IN THIS PROGRAM ARE AS FOLLOWS:
C          MAXIMUM NUMBER OF RAINGAUGES (NRG) = 5
C          MAXIMUM NUMBER OF FLOODS (NFLD) = 50
C          MAXIMUM NUMBER OF DATA IN A FLOOD (NDATA) = 600 - TIME LAG
C
```

```
C     (THESE VALUES CAN BE CHANGED BY MODIFING THE SUBSCRIPT VALUES OF
C      THE DIMENSION STATEMENTS IN THE MAIN PROGRAM AND COMMON STATEMENT
C      IN VARIOUS SUBROUTINES.)
C     DATA SET NO. 1 IS A SEQUENTIAL FILE FOR Q,P AND OTHERS
C             (FOR INITIAL)
C     DATA SET NO.2 IS A SEQUENTIAL FILE FOR Q, P AND OTHERS
C             (FOR CALCULATION)
C
      DEFINE FILE 25 (25,2500,U,IV)
      COMMON // RNAME(5), ANAME(5), PNAME(5,8), AREA, TU
      INTEGER D1, D2
      COMMON /PRM/ HA1,HA2, HA3, A0, A1, A2, A3,
     1     HA, A1M, HB, B0, B1, HC, C0,
     1     C1, CP(8), WE(8), LAG(8), XAIN, XBIN, XCIN, FTANK
      COMMON /HYGR/ NPLOT, NSCAL, LY, YMIN, YMAX, SCAL(5),
     1     FMT1(10), FMT2(10)
      COMMON /EE/ EV
      DIMENSION BASE(50), CPF(50), FLDSYM(4), CMT(3)
      DIMENSION Q(600),  P(600,5), QEI(600,3),QE(600)
      DATA LARY /600/
      DATA TA, TX, RC / 'TA', 'TX', 'RC' /
      DATA D1, D2 / 5, 2 /
        OPEN(UNIT=D1,FILE='TANK.DAT',STATUS='OLD')
        OPEN(UNIT=6,FILE='TANK.OUT',STATUS='NEW')
        OPEN(UNIT=D2,STATUS='SCRATCH',FORM='UNFORMATTED')
C
C                 NFLD : NUMBER OF FLOODS
C                 NRG  : NUMBER OF RAINGAUGES (GENERAL)
C                 MRAIN: =1, USE MEAN RAINFALL
C                        =0, USE EACH RAINFALL
      READ (5,10) NFLD, NRG, MRAIN
        TYPE *,NFLD,NRG,MRAIN
C
C                 Q    : DISCHARGE DATA
C                 P    : RAINFALL DATA
C                 LARY : ADJUSTABLE DIMENSION FOR NUMBER OF DATA
C                        IN A FLOOD
C
C                 DATA ARE ARRANGED.
C                 ESPECIALLY IF MRAIN IS NOT ZERO,
C                 MEAN RAINFALL IS CALCULATED.
      CALL DATAFL (NFLD, MRAIN, NRG, Q, P, LARY, D1, D2)
C
C                 IF MRAIN=1, THAT IS, IF MEAN RAINFALL IS CALCULATED,
C                 NUMBER OF RAINFALL (NRG) IS SET TO 1.
      IF (MRAIN .EQ. 1) NRG=1
C
C                 READING VARIOUS PARAMETERS
C                   FTANK: TOP TANK OPTION
C                        = 'TA', THREE PIPES TANK
```

```
C                               = 'TX', SPECIAL TANK
C                         RVCH : = 'RC', USE RIVER CHANNEL MODIFICATION
C                         XAIN ETC.: INITIAL STORAGE VALUE FOR EACH TANK
C                         HA1 ETC.: HIGHT OF EACH PIPE IN EACH TANK
C                         A0 ETC. : INFILTRAION COEFFICIENT FOR EACH TANK
C                         A1 ETC. : DISCHARGE COEFFICIENT FOR EACH TANK
C                         A1M  : TURNING POINT VALUE OF DISCHARGE CURVE
C                                IN 'TX' TYPE FIRST TANK
C                         ACH  : DISCHARGE COEFFICIENT FOR RIVER CHANNEL TANK
C                         CP(K): COEFFICIENT FOR PRECIPITATION OF K-TH
C                                RAINFALL STATION
C                         WE(K)  : WEIGHT FOR DISCHARGE OF K-TH
C                                RAINFALL STATION
C                         LAG(K): TIME LAG FOR K-TH RAINFALL STATION
C                         CPF(N): COEFFICIENT FOR PRECIPITATION
C                                OF N-TH FLOOD
C                         BASE(N): BASE DISCHARGE FOR N-TH FLOOD
      READ (5,14) FTANK, RVCH
        TYPE 14,FTANK,RVCH
      READ (5,11) XAIN, XBIN, XCIN
        TYPE 11 ,XAIN,XBIN,XCIN
      IF (FTANK .EQ. TA) READ (5,17) HA1, HA2, HA3, A0, A1, A2, A3
      IF (FTANK .EQ. TX) READ (5,11) HA, A0, A1, A1M
      READ (5,8) HB, B0, B1
      READ (5,9) HC, C0, C1
        TYPE 9 ,HC,C0,C1
      IF (RVCH .EQ. RC) READ (5,11) ACH
      READ (5,11) (CP(K), K=1,NRG)
      READ (5,11) (WE(K), K=1,NRG)
      READ (5,10) (LAG(K), K=1,NRG)
      READ (5,11) (CPF(N),N=1,NFLD)
      READ (5,11 ) (BASE(N), N=1,NFLD)
        TYPE 11 ,(BASE(N),N=1,NFLD)
      READ(5,6) EV
C
C                      READING PARAMETERS FOR GRAPH PLOTTING
C                         NPLOT : NUMBER OF GRAPHS PLOTTED
C                         NSCAL : NUMBER OF SCALE POINT
C                         LY    : MAXIMUM PLOTTING POSITION
                          YMIN  : MINIMUM VALUE TO BE PLOTTED
C                         YMAX  : MAXMUM VALUE TO BE PLOTTED
C                         SCAL(NI): PLOTTING VALUE FOR NI/TH SCALE POINT
C                         FMT1 ETC. : FORMAT SPECIFICATIONS FOR PLOTTING
      READ (5,12) NPLOT, NSCAL, LY, YMIN, YMAX
        TYPE 12,NPLOT,NSCAL,LY,YMIN,YMAX
      READ (5,16) (SCAL(NI), NI=1,NSCAL)
      READ (5,13) FMT1, FMT2
C
   10 FORMAT (10I8)
   11 FORMAT(10F8.4)
```

```
12      FORMAT(3I8,2F8.4)
   9    FORMAT(F8.0,2F8.4)
   13 FORMAT (10A4,10A4)
   14 FORMAT (2(6X,A2))
   17   FORMAT (3F8.0,4F8.4)
    8   FORMAT (F8.0,2F8.4)
   16   FORMAT (3F8.2)
6       FORMAT(F8.4)
C
C               WRITING VARIOUS PARAMETERS FOR CHECKING
C
C                 RNAME: NAME OF RIVER
C                 ANAME: NAME OF DISCHARGE STATION
C                 AREA : CATCHMENT AREA
C                 TU   : UNIT TIME
      WRITE (6,20) RNAME, ANAME, AREA, TU
      WRITE (6,34)
      DO 15 K = 1, NRG
   15 WRITE (6,35) (PNAME(I,K), I = 1,5)
      WRITE (6,21) NFLD, NRG, MRAIN, FTANK, RVCH
      WRITE (6,22) XAIN, XBIN, XCIN, ACH
      IF (FTANK .EQ. TA) WRITE (6,23) HA1, HA2, HA3, A0, A1, A2, A3
      IF (FTANK .EQ. TX) WRITE (6,24) HA, A0, A1, A1M
      WRITE (6,25) HB, B0, B1, HC, C0, C1
      WRITE (6,26) (CP(K), K=1,NRG)
      WRITE (6,27) (WE(K), K=1,NRG)
      WRITE (6,28) (LAG(K), K=1,NRG)
      WRITE (6,29) (N, CPF(N), N=1,NFLD)
      WRITE (6,30) (N, BASE(N), N=1,NFLD)
      WRITE (6,32) NPLOT, NSCAL, LY, YMIN, YMAX, (SCAL(NI), NI=1,NSCAL)
      WRITE (6,33) FMT1, FMT2
C
   20 FORMAT (1H1,10A4,2X,'(',F10.3,'KM2)',6X,'TU=',F8.3)
   34 FORMAT (1H0,8X,'PNAME')
   35 FORMAT(1H ,8X,5A4)
   21 FORMAT (1H0,10X,6X,'NFLD',7X,'NRG',5X,'MRAIN',
     1     5X,'FTANK',6X,'RVCH'/1H ,10X,3I10,7X,A2,8X,A2)
   22 FORMAT (1H0,8X,'XA',8X,'XB',8X,'XC',7X,'ACH'/
     1     1H ,3F10.0,F10.2)
   23 FORMAT(1H0,7X,'HA1',7X,'HA2',7X,'HA3',8X,'A0',8X,'A1',8X,'A2',8X,
     1     'A3'/1H ,3F10.0,4F10.4)
   24 FORMAT(1H0,8X,'HA',8X,'A0',8X,'A1',7X,'A1M'/
     1     1H ,F10.0,F10.6,2F10.4)
   25 FORMAT (1H0,8X,'HB',8X,'B0',8X,'B1',8X,'HC',8X,'C0',8X,'C1'/
     1     1H ,2(F10.0,2F10.4))
   26 FORMAT (1H0,8X,'CP',5X,10F10.4)
   27 FORMAT (1H0,8X,'WE',5X,10F10.4)
   28 FORMAT (1H0,8X,'LAG',10I10)
   29 FORMAT (//,5X,'CPF'/5(I12,F10.2))
   30 FORMAT (//,5X,'BASE  DISCHARGE'/5(I12,F10.4))
```

```
   32 FORMAT (//6X,'NPLOT',5X,'NSCAL',8X,'LY',6X,'YMIN',6X,'YMAX',
     1      14X,'SCAL'/1H ,3I10,2F10.3,12X,5F8.3)
   33 FORMAT (1H0,5X,'FMT1',44X,'FMT2'/2(8X,10A4))
      WRITE(6,1000) EV
 1000    FORMAT(6X,'EV=',F8.4)
C
C                   NORMALIZING THE WEIGHT FOR DISCHARGE
      SWE=0.
      DO 130 K=1,NRG
  130 SWE=SWE+WE(K)
      DO 140 K=1,NRG
  140 WE(K)=WE(K)/SWE
C
      REWIND 2
C
C                   START OF CALCULATION
      IV=1
      DO 330 NL=1,NFLD
      NF = NL
C
C                     FLDSYM: SYMBOL CHARACTERS FOR A FLOOD
C                     NDATA : NUMBER OF DATA IN A FLOOD
C                     CMT   : COMMENT FOR A FLOOD
C                     Q(J)  : OBSERVED DISCHARGE DATA
C                     P(J,K): OBSERVED PRECIPITATION DATA AT K-TH
C                             RAINGAUGE STATION
      READ (D2) FLDSYM, NDATA, CMT
      READ (D2) (Q(J), J=1,NDATA)
      DO 300 K=1,NRG
  300 READ (D2) (P(J,K), J=1,NDATA)
C                   TANK MODEL CALCULATION
C                     QE : CALCULATED DISCHARGE (TOTAL)
C                     QEI: CALCULATED DISCHARGE FOR EACH TANK
      CALL TNKMDL (P, NRG, NDATA, CPF(NF), BASE(NF), QEI, QE, LARY)
C
C                   RIVER CHANNEL CALCULATION
      IF (RVCH .EQ. RC)
     1     CALL TNKCH (QE, NDATA, BASE(NF), QE, LARY, ACH)
C
C                   SUMMING UP CALCULATED DISCHARGE OF EACH TANK
C                   FOR GRAPH PLOTTING
      DO 310 J=1,NDATA
      QEI(J,3)=QEI(J,3)+BASE(NF)
      QEI(J,2)=QEI(J,2)+QEI(J,3)
      QEI(J,1)=QEI(J,1)+QEI(J,2)
  310 CONTINUE
C
C                   GRAPH PLOTTING
      IF (RVCH .EQ. RC) GO TO 320
C
```

```
      CALL HYGRFL (RNAME, ANAME, NF, FLDSYM, TU, NDATA, NRG, CMT,
     1      P, Q, QEI(1,1), QEI(1,2), QEI(1,3), Q, LARY)
      WRITE (25'IV) FLDSYM,NDATA,(Q(J),J=1,NDATA),(QEI(J,1),J=1,NDATA)
      GO TO 330
C
  320 CALL HYGRFL (RNAME, ANAME, NF, FLDSYM, TU, NDATA, NRG, CMT,
     1      P, Q, QE, QEI(1,1), QEI(1,2), QEI(1,3), LARY)
      WRITE (25'IV) FLDSYM,NDATA,(Q(J),J=1,NDATA),(QE(J),J=1,NDATA)
C
  330 CONTINUE
C
        CLOSE(UNIT=25,DISP='DELETE')
      STOP
      END
C
C
C
C          CALCULATION OF RIVER CHANNEL MODIFICATION
C
      SUBROUTINE TNKCH (QE, NDATA, BASE, QCH, LARY, ACH)
      DIMENSION QCH(LARY), QE(LARY)
C
C                   CALCULATION OF INITIAL STORAGE VALUE
C                   IN RIVER CHANNEL TANK
      XCH=SQRT(BASE/ACH)-BASE
C
C                   CALCULATION OF DISCHARGE VALUES FROM
C                   THE RIVER CHANNEL
      DO 200 J=1,NDATA
      XCH = XCH + QE(J)
      QCH(J) = XCH**2*ACH
      XCH = XCH - QCH(J)
      IF (XCH .GE. 0) GO TO 200
      QCH (J) = QCH(J) + XCH
      XCH = 0.
  200 CONTINUE
C
      RETURN
      END
C
C
C
C          SUBROUTINE FOR DATA ARRANGEMENT
C           (IF MRAIN IS EQUAL TO 1, MEAN PRECIPITATION IS OBTAINED.)
C
      SUBROUTINE DATAFL (NFLD, MRAIN, NRG, Q, P, LARY, D1, D2)
C
C     THIS IS THE SUBROUTINE FOR TRANSFERING VARIOUS DATA FROM  THE FILE
C     D1 TO THE FILE D2. (* SYMBOL CORRESPONDS TO ONE CARD OR RECORD.)
C     ORDER AND FORMAT IN THE FILE D1 ARE AS FOLLOWS:
```

```
C      *RNAME: NAME OF RIVER (5A4)
C       ANAME: NAME OF CATCHMENT BASIN (5A4)
C       AREA : CATCHMENT AREA (F10.0)
C      *NF   : NUMBER OF FLOODS (I8)
C       NR   : NUMBER OF RAINFALL STATIONS (I8)
C       TU   : UNIT TIME (HOUR) (F8.0)
C      *PNAME(K): NAME OF K-TH RAINFALL STATION (5A4)
C            (NR CARDS OR RECORDS)
C      * FLDSYM: FLOOD SYMBOL (4A4)
C       NDATA : NUMBER OF DATA (I8)
C       CMT   : COMMENT (3A4) FOR FIRST FLOOD
C      *Q     : OBSERVED DISCHARGE DATA (M**3/SEC) (12F6.1)
C                  FOR FIRST FLOOD
C      *P     : PRECIPITATION DATA (MM) (12F6.1) AT FIRST STATION
C                    FOR FIRST FLOOD
C      *P     : PRECIPITATION DATA (MM) (12F6.1) AT SECOND STATION
C                  FOR FIRST FLOOD
C            .
C            .
C      *P     : PRECIPITATION DATA (MM) (12F6.1) AT NR-TH STATION
C             FOR FIRST FLOOD
C      *FLDSYM: FLOOD SYMBOL (4A4)
C       NDATA : NUMBER OF DATA (I8)
C       CMT   : COMMENT (3A4) FOR SECOND FLOOD
C            .
C            .
C
C     USER OF THIS PROGRAM MAY USE ANY FILE IN WHICH ORDER AND/OR
C     FORMAT OF DATA ARE DIFFERENT FROM THIS STANDARD SUBROUTINE.
C     HOWEVER IN THIS CASE, HE MUST WRITE NEW SUBROUTINE 'DATAFL'.
C     IN THIS NEW SUBROUTINE, DATA ARE STORED IN THE FILE D2 IN BINARY
C     FORMAT AS FOLLOWING ORDER:
C      *FLDSYM, NDATA, CMT FOR FIRST FLOOD
C      *Q (MM)             FOR FIRST FLOOD
C      *P (MM)             AT FIRST STATION FOR FIRST FLOOD
C      *P (MM)             AT SECOND STATION FOR FIRST FLOOD
C            .
C            .
C      *P (MM)             AT ([-TH STATION FOR FIRST FLOOD
C      *FLDSYM, NDATA, CMT FOR SECOND FLOOD
C      *Q (MM)             FOR SECOND FLOOD
C            .
C            .
C     NOTES: (1) RNAME, ANAME, AREA, PNAME  AND TU MUST BE READ AND
C                STORED IN BLANK COMMON.
C            (2) IF MRAIN IS EQUAL TO 1, P IN THE FILE D2 MUST BE
C                THE MEAN PRECIPITATION.
      COMMON // RNAME(5), ANAME(5), PNAME(5,8), AREA, TU
      INTEGER D1, D2
      DIMENSION Q(LARY), P(LARY,NRG), FLDSYM(4), CMT(3)
```

```
C
      D1 = 5
      REWIND D2
C
C                 READING VARIOUS DATA FROM DATA SET D1
      READ (D1,1) RNAME, ANAME, AREA
        TYPE 1,RNAME,ANAME,AREA
    1 FORMAT (5A4,5A4,F10.0)
      READ (D1,12) NF, NR, TU
        TYPE 12,NF,NR,TU
   12 FORMAT (2I8,F8.0)
      DO 50 K=1,NR
      READ (D1,2) (PNAME(I,K), I=1,5)
        TYPE 2,(PNAME(I,K), I=1,5)
   50 CONTINUE
    2 FORMAT (5A4)
C
C                 IF NUMBER OF RAINGAUGE STATIONS (GENERAL) IS NOT
C                 EQUAL TO NUMBER OF RAINGAUGE STATION IN DATA SET D1,
C                 STOP CALCULATION
      IF (NRG .NE. NR) STOP
C
C                 IF NUMBER OF FLOODS(NFLD) SET BY MAIN PROGRAM IS
C                 GREATER THAN THE NUMBER OF FLOODS(NF) IN THE FILE D1,
C                 STOP CALCULATION
      IF (NFLD .GT. NF) STOP
C
C                 GETTING CONVERSION FACTOR AR FROM M**3/SEC TO MM
      AR = 3.6 * TU/AREA
C
      DO 200 N = 1, NFLD
C
C                 READING DISCHARGE DATA FROM DATA SET D1 AND
C                 WRITING TO DATA SET D2 FOR ONE FLOOD
      READ (D1,3) FLDSYM, NDATA, CMT
        TYPE 3,FLDSYM,NDATA,CMT
    3 FORMAT (4A4,I8,3A4)
      READ (D1,4) (Q(I), I=1,NDATA)
    4 FORMAT(10F8.1)
C   4 FORMAT(12F6.1)
C
      WRITE (D2) FLDSYM, NDATA, CMT
C
C                 CONVERTING Q FROM M**3/SEC TO MM
      DO 60 I=1,NDATA
      Q(I) = Q(I) * AR
      IF (Q(I) .LE. 0.) Q(I) = -999.
   60 CONTINUE
      WRITE (D2) (Q(I), I=1,NDATA)
C
```

```
C                 READING PRECIPITATION DATA FROM DATA SET D1
C                 FOR ONE FLOOD
      DO 100 K=1,NRG
  100 READ (D1,5) (P(I,K), I=1,NDATA)
    5 FORMAT (12F6.1)
C
C                 IF MRAIN IS NOT EQUAL TO ZERO,
C                 MEAN PRECIPITATION IS CALCULATED
      IF (MRAIN .EQ. 0) GO TO 130
C
      DO 120 I = 1, NDATA
      SP = 0.
      SN = 0.
      DO 110 K = 1, NRG
      IF (P(I,K) .LT. 0.) GO TO 110
      SP = SP + P(I,K)
      SN = SN + 1.
  110 CONTINUE
      IF  (SN .NE. 0.)   GO TO 111
      P(I,1) = 0.
      GO TO 120
  111 CONTINUE
C
C                 MEAN PRECIPITATION IS SET INTO P(I,1)
      P(I,1) = SP/SN
  120 CONTINUE
      NR = 1
C
C                 WRITING PRECIPITATION DATA TO DATA SET D2
  130 DO 140 K = 1, NR
      WRITE (D2) (P(I,K),I = 1, NDATA)
  140 CONTINUE
C
  200 CONTINUE
      RETURN
      END
      SUBROUTINE EVAP (EV,XA,XB,XC)
      XA=XA-EV
      IF(XA.GE.0.) RETURN
      XB=XB+XA
      XA=0.
      IF(XB.GE.0.) RETURN
      XC=XC+XB
      XB=0.
      IF(XC.GE.0.) RETURN
      XC=0.
      RETURN
      END

C
```

```
C          CALCULATION OF 2ND AND 3RD TANKS
      SUBROUTINE TANKB (P, X, Y, YO, H1, B0, B1)
C
      X = X + P
      Y = 0.
      IF (X .GT. H1) Y = (X-H1) * B1
      Y0 = X * B0
      X = X - Y0 - Y
C
      RETURN
      END
C
C
C          CALCULATION OF FIRST TANK FOR TYPE 'TX'
C
      SUBROUTINE TANKX (P, XA, Y, YO, HA, A0, A1, A1M)
C
      XA = XA + P
      Y = 0.
C
      IF (XA .LT. HA) GO TO 200
C
      XA1 = XA - HA
      HA1 = A1M/(2.*A1)
C
      IF (XA1 .GE. HA1) GO TO 100
C
      Y = A1 * XA1 * XA1
      GO TO 200
C
  100 Y = A1M * (XA1 - HA1 / 2. )
C
  200 Y0 = XA * A0
      XA = XA - Y - Y0
C
      RETURN
      END
C
C
C          CALCULATION OF FIRST TANK FOR TYPE 'TA'
C
      SUBROUTINE TANKA (P,X,Y1,Y2,Y3,Y0,H1,H2,H3,A0,A1,A2,A3)
C
C                ADDING PRECIPITATION INTO STORAGE
      X = X + P
C
      Y1 = 0.
      Y2 = 0.
      Y3 = 0.
C
```

```
C                 CALCULATION OF DISCHARGE FROM EACH PIPE
      IF (X .LE. H1) GO TO 100
      Y1 = (X-H1) * A1
C
      IF (X .LE. H2) GO TO 100
      Y2 = (X-H2) * A2
C
      IF (X .LE. H3) GO TO 100
      Y3 = (X-H3) * A3
C
  100 Y0 = X * A0
C
C                 GETTING STORAGE AFTER DRAWING DISCHARGES
      X=X-Y0-Y1-Y2-Y3
      RETURN
      END
C
C            SUBROUTINE FOR GRAPH PLOTTING
C
      SUBROUTINE HYGRFL ( RNAME, ANAME, FLDNO, FLDSYM, TU, N, NRG, CMT,
     1     P, Q, QA, QB, QC, QD, LARY)
      COMMON /HYGR/ NPLOT, NSCAL, LY, YMIN, YMAX, SCAL(5),
     1     FMT1(10), FMT2(10)
      INTEGER FLDNO
      DIMENSION P(LARY,NRG), Q(N), QA(N), QB(N), QC(N), QD(N),
     1     RNAME(5), ANAME(5), FLDSYM(4), CMT(3)
      DIMENSION GBUF(120), ISCAL(5), CHAR(5), PLOT(24)
      DATA CHAR / '*', '+', ';', ',', '-' /
     1     BLK, CI / ' ', 'I' /
C
C                 SETTING MAXIMUM AND MINIMUM PRINTING VALUES
C                   IN LOGARITHMIC SCALE
      AMIN = ALOG10 (YMIN)
      AMAX = ALOG10 (YMAX)
C
C                 SETTING VALUE FOR ONE CHARACTER SPACE
      DY = IFIX(FLOAT(LY-1)/(AMAX-AMIN))
C
C                 SETTING POSITIONS OF SCALE POINTS
      DO 100 NI=1,NSCAL
      ISCAL(NI)=(ALOG10(SCAL(NI))-AMIN)*DY+1.
      IF (ISCAL(NI) .LT. 1) ISCAL(NI) = 1
      IF (ISCAL(NI) .GT. LY) ISCAL(NI) = LY
  100 CONTINUE
C
      WRITE (6,20) RNAME, ANAME, FLDNO, FLDSYM, N, TU, CMT
   20 FORMAT (1H1,/,1X,10A4,2X,'FLOOD NO.',I3,2X,4A4,5X,'N=',I4,
     1     5X,'TU=',F8.3,3X,3A4/)
C
      DO 300 I = 1, N
```

```
C
      IF (I .GT. 60 .AND. MOD(I,60) .EQ. 1) WRITE (6,30)
   30 FORMAT (1H1,//)
C
C                 INITIALIZE TO BLANK FOR GBUF
      DO 120 L = 1, LY
  120 GBUF(L) = BLK
C
C                 PREPARATION FOR PRINTING OF SCALE POINTS
      IF (MOD(I,12) .NE. 1) GO TO 140
      DO 130 NI = 1,NSCAL
      IP = ISCAL(NI)
  130 GBUF(IP) = CI
C
C                 PREPARATION FOR PRINTING OF EACH PRAPH
  140 PLOT(1) = Q(I)
      PLOT(2) = QA(I)
      PLOT(3) = QB(I)
      PLOT(4) = QC(I)
      PLOT(5) = QD(I)
C
      NX = NPLOT
  150 PLT = PLOT(NX)
      IF (PLOT(NX) .EQ. -999.) GO TO 180
      IF (PLOT(NX) .LT. 0.) PLOT(NX)=SIGN(PLOT(NX), 1.)
      IF (PLOT(NX) .GT. YMIN) GO TO 160
      IP = 1
      GO TO 170
C
C                 SETTING PRINT POSITION (IP) FOR EACH GRAPH AND
C                 APPROPRIATE CHARACTER IN IP POSITION OF GBUF
  160 IP = (ALOG10(PLOT(NX))-AMIN)*DY+1.
      IF (IP .LE. 0) IP = 1
      IF (IP.GT.LY) IP = LY
  170 GBUF(IP) = CHAR(NX)
  180 NX = NX - 1
      IF (NX .GT. 0) GO TO 150
C
      NO = I - 1
C
C                 PRINTING EACH VALUE
      IF (Q(I) .EQ. -999.) GO TO 200
C
      WRITE (6,FMT1) NO, (P(I,K),K=1,NRG), (PLOT(J),J=1,2),
     1     (GBUF(L),L=1,LY)
      GO TO 300
C
  200 WRITE (6,FMT2) NO, (P(I,K),K=1,NRG), PLOT(2), (GBUF(L),L=1,LY)
C
  300 CONTINUE
```

```
      RETURN
      END
C
C
C        SUBROUTINE FOR TANK MODEL CALCULATION FOR EACH FLOOD
C
      SUBROUTINE TNKMDL (P, NRG, NDATA, CPF, BASE, QEI, QE, LARY)
C
      COMMON /PRM/ HA1,HA2, HA3, A0, A1, A2, A3,
     1     HA, A1M, HB, B0, B1, HC, C0,
     1     C1, CP(8), WE(8), LAG(8), XAIN, XBIN, XCIN, FTANK
      COMMON /EE/ EV
C
      DIMENSION P(LARY, NRG), QEI(LARY,3), QE(LARY),
     1     XA(8), XB(8), XC(8), Y(3)
      DATA TA, TX /'TA', 'TX'/
C
C                CLEARING CALCULATED DISCHARGES FOR EACH TANK
      DO 110 J=1,NDATA
      DO 100 I=1,3
  100 QEI(J,I)=0.
  110 CONTINUE
C
C                INITIALIZING STORAGE VALUES FOR EACH TANK
      DO 120 K=1,NRG
      XA(K)=XAIN
      XB(K)=XBIN
      XC(K)=XCIN
  120 CONTINUE
C
C                START OF CALCULATION FOR EACH DATA
      DO 170 J=1,NDATA
C
C                START OF CALCULATION FOR EACH STATION
      DO 160 K=1,NRG
C
C                CALCULATION OF FINAL VALUE OF PRECIPITATION
      PX=P(J,K)*CP(K)*CPF
      CALL EVAP(EV,XA(K),XB(K),XC(K))
C
C                FIRST TANK CALCULATION
C                  Y1 ETC. : DISCHARGE VALUES FROM EACH SIDE PIPE
C                  YA0 ETC.: INFILTRATION VALUE
      IF (FTANK .EQ. TX) GO TO 130
C
      CALL TANKA (PX, XA(K), Y1, Y2, Y3, YA0, HA1, HA2, HA3,
     1     A0, A1, A2, A3)
      Y(1) = Y1+Y2+Y3
      GO TO 140
C
```

```
  130 CALL TANKX (PX, XA(K), Y(1), YAO, HA, AO, A1, A1M)
C
C                SECOND AND THIRD TANK CALCULATION
  140 CALL TANKB (YAO, XB(K), Y(2), YBO, HB, BO, B1)
      CALL TANKB (YBO, XC(K), Y(3), YCO, HC, CO, C1)
C
C                GETTING TIME LAG POSITION
      JL=LAG(K)+J
C
C                CALCULATION OF WEIGHTED DISCHARGE VALUE OF EACH TANK
      DO150 I=1,3
  150 QEI(JL,I)=QEI(JL,I)+Y(I)*WE(K)
C
  160 CONTINUE
  170 CONTINUE
C
C                CALCULATION OF TOTAL CALCULATED DISCHARGE
      DO 190 J=1,NDATA
      QE(J)=BASE
      DO 180 I=1,3
  180 QE(J)=QE(J)+QEI(J,I)
  190 CONTINUE
C
      RETURN
      END
```

E INPUT

```
     4         3         0
RIVER-NARMADA      JAMTARA SUB-BASIN      16576.
     4         3         6.
    JAMTARA
    MANDLA
    PENDRA-ROAD
FLOOD(1) 1978        87    MEDIUM
   47.5     85.3    103.5     94.2     89.6     89.6     89.6     89.6     85.3     85.3
   85.3     85.3     89.6     85.3     85.3     89.6     89.6     85.3     85.3     76.9
   76.9    161.5    161.8    220.8    316.6    329.5    256.0    163.0    521.9    696.1
  543.2    400.9    273.5    193.8    140.3    112.7    103.6    153.5    479.6    784.0
 1099.1   1024.0    758.4    632.7    490.8    372.8    313.0    273.5    265.9    248.6
  213.6    220.8    272.5    235.2    174.8    257.2    469.5    565.3    796.9    906.4
  784.0    543.2    459.2    364.2    312.4    242.4    329.3    449.4    288.2    207.3
  207.3    288.2    784.0   1634.6   1022.9    744.8    599.5    500.4    565.3    469.5
  373.4    288.2    272.5    272.5    249.6    257.2    304.3
   0.0   0.5   0.0   0.0   6.8   0.0   0.2  10.7   0.0   0.0   0.0   2.5
   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   3.8  22.1   3.3  71.2
   7.3  16.5   0.0   4.5   0.4   0.0   7.4   0.0  15.0   0.0   5.5   0.0
   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.1   0.0   0.0   0.0   0.0
   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.2   0.1   5.8   4.4
   0.5   3.9   1.8   0.0   0.0   0.3  31.2   0.0   6.5   0.0   3.5  19.4
  22.9   3.3   5.5   0.0   0.0   0.0   4.2   0.1   0.0   0.0   4.5   0.5
   0.5   0.8   0.1
   2.9   0.6   0.0   0.0   0.0   0.2   8.9   0.0   0.0   0.0   6.2   1.5
   0.3   0.0   0.0   0.0   0.0   0.0   0.0   0.0   5.0  15.2   0.0   0.0
  20.3   7.5   0.1   0.1   0.0   0.0   0.0   8.0   0.0  18.5   5.8   2.7
   0.0   0.0  50.7   0.0   0.0   0.9   0.0   0.0   0.0   0.0   0.0   0.0
   0.0   0.5   0.0   0.0   0.0  30.6  38.4   0.0   0.0   0.7  10.1   0.0
   0.0   5.5  18.8   0.0   0.0   0.5   0.2   0.0   0.0   3.8   0.2   3.0
  28.5   9.8   0.0   0.0   0.0  10.5  22.5   3.7   0.0   0.0   1.7   1.2
   0.0   0.0   0.0
   0.0   0.0   0.0  15.2   0.0   0.0   0.0   3.1   3.9   1.8   1.5   0.7
   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  19.3   1.5  41.5  32.0
   2.8   1.0   0.2  12.0   0.0   0.0   0.0   8.7   1.3   0.0  45.8   5.2
  11.6   6.9   1.5   0.2   0.0   0.1   0.0   0.0   0.0   0.0   0.0   0.0
   0.0   0.0   0.0   0.0   3.6   0.3  40.4   2.3   0.0   0.5   0.2   0.3
   0.0   0.0   0.0   0.0   0.0   3.7   0.0   0.0   6.8   0.2   8.5   0.0
   1.7   0.0   0.0   0.0   1.0   0.0   0.2   0.0   0.0   0.0   2.5   1.6
   7.3  15.2   1.8
FLOOD(2) 1978        79    MEDIUM
  400.9    391.7    410.5    622.0    719.5    669.9    587.8    500.4    439.4    355.4
  346.5    304.3    288.2    419.9    682.4    682.4    694.5   1162.3   2504.6   3285.0
 3021.6   2527.7   1931.2   1450.4   1162.3    949.5    769.4    645.9    565.3    532.5
  554.0    532.5    490.1    459.2    459.2    459.2    479.6    521.6    511.1    543.2
  610.8    645.9    657.6    587.8    532.5    459.2    400.9    373.3    355.4    320.9
  296.1    272.5    249.6    242.4    242.4    337.9    707.1    732.3    610.8   1022.9
 1432.3   1540.8   1711.4   1750.4   2164.3   1993.2   1522.8   1450.4    963.8    757.9
  610.8    511.1    449.4    391.7    346.5    320.9    288.2    280.1    296.1
   0.0   0.0   0.0   0.0   0.0   0.0   0.6   0.0   0.0   0.0   0.0   0.0
```

0.0	0.0	10.5	28.7	42.0	24.0	9.8	0.1	0.1	0.1	0.9	0.0
0.0	0.9	0.3	0.0	0.7	0.0	0.7	0.0	0.3	1.0	1.0	6.3
17.4	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0
0.0	0.0	2.0	1.8	0.0	0.5	23.2	56.3	5.7	0.0	13.3	0.0
8.4	3.2	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	6.7					
0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	1.1	0.3	0.0	0.0
0.0	1.0	13.2	9.2	10.7	36.4	4.1	1.2	0.0	0.0	0.1	0.6
0.0	0.0	1.4	0.0	2.6	10.9	0.5	0.1	0.0	0.7	1.5	1.6
0.5	2.0	0.4	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.2	0.0
0.7	0.0	1.0	0.0	0.0	0.0	0.1	16.6	0.0	0.0	0.0	0.0
38.6	7.5	14.6	1.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
0.4	0.0	0.0	0.0	0.0	0.0	0.8					
0.0	0.0	0.0	0.2	0.3	0.0	37.5	30.5	15.2	1.8	0.0	0.0
0.0	0.5	0.0	4.0	0.7	1.2	0.4	0.7	0.0	0.0	0.2	0.4
0.3	0.7	0.2	0.0	0.0	5.3	8.6	0.4	0.0	0.0	0.5	7.8
0.9	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	14.2	0.2	0.0
3.1	2.3	0.0	0.0	0.0	0.3	3.2	5.5	2.6	7.8	2.9	0.8
13.2	8.3	3.2	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	30.7
2.8	0.0	0.0	0.0	0.0	7.3	1.7					

FLOOD(3) 1978 54 MEDIUM

280.1	296.1	410.5	543.2	500.4	459.2	500.4	511.1	490.1	449.4
511.1	576.3	837.4	796.9	770.6	892.6	796.9	1227.1	2970.2	2599.4
1931.2	1596.9	1379.8	1211.0	1008.3	837.4	864.8	810.5	744.8	810.5
2056.9	1540.8	978.7	837.4	784.0	784.0	878.4	1130.5	1146.6	1038.3
920.9	837.4	770.7	682.4	610.8	565.3	511.1	447.4	391.7	355.4
329.3	329.3	320.9	329.3						

0.0	6.7	5.8	0.5	0.0	0.0	0.0	0.0	0.0	6.6	0.0	5.9
0.0	3.5	23.5	2.7	1.4	0.0	4.7	1.0	5.9	15.4	0.0	0.0
0.0	41.5	0.6	0.0	0.0	0.0	0.8	0.0	11.6	8.5	0.0	0.0
0.0	0.0	0.6	0.0	0.3	0.0	0.0	0.0	0.0	2.1	0.0	0.0
0.0	0.0	0.0	2.8	0.0	0.0						
0.0	0.8	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26.5	2.1	7.9	0.0	5.0	39.0	0.1	0.1	9.1	0.0	0.0	0.0
0.0	5.5	5.0	0.0	4.7	42.0	0.2	10.3	7.0	0.1	0.0	0.7
0.3	0.5	1.9	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1.3	0.9	0.0	0.0	0.0	0.0						
10.3	1.7	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.2	0.0
2.0	5.2	0.0	22.8	33.9	1.3	0.0	0.0	0.0	2.3	0.0	0.0
0.0	0.4	0.0	0.0	0.0	0.0	0.5	6.2	5.6	5.8	2.2	8.2
7.8	1.6	11.7	0.2	0.5	0.0	0.0	0.0	0.0	0.3	0.0	0.0
0.0	5.0	0.0	0.0	0.1	4.2						

FLOOD(4) 1979 279 MEDIUM

4.1	4.1	4.0	3.7	3.5	3.4	3.4	3.3	3.2	3.5
3.5	3.4	3.3	3.3	3.3	3.7	9.5	10.7	14.8	30.2
77.5	69.0	62.7	53.9	58.6	42.7	79.6	72.2	45.8	47.9
45.3	42.7	42.7	100.0	142.1	140.3	119.3	101.5	90.9	81.0
74.2	71.6	82.4	94.7	111.8	136.7	141.2	135.8	131.4	111.0
97.7	88.8	78.2	70.3	64.6	60.9	54.5	50.6	47.9	45.8
43.2	41.2	38.3	36.5	35.1	34.6	33.3	31.9	29.8	28.9

28.6	27.7	27.3	26.5	26.1	26.9	28.9	30.7	32.4	33.7
44.8	253.5	226.1	183.3	161.1	151.5	135.8	122.7	113.5	161.0
404.6	467.2	450.7	525.5	484.0	478.9	609.7	676.0	720.5	944.3
818.8	638.5	506.2	441.0	384.7	286.4	307.6	274.7	243.8	233.1
214.3	212.5	198.1	193.8	248.6	289.0	278.6	256.0	233.1	209.1
193.8	181.2	175.0	172.9	167.0	160.1	156.2	159.1	154.3	144.0
136.7	131.3	120.1	116.8	134.9	179.1	191.7	185.4	213.6	233.1
227.3	204.7	190.6	188.5	215.8	225.0	246.2	248.6	231.9	208.0
189.5	173.0	155.3	139.4	135.8	134.9	173.0	212.4	200.3	187.5
183.3	188.5	215.8	227.3	243.8	222.7	215.8	170.9	219.2	215.8
246.2	295.6	347.9	332.3	291.6	400.0	409.3	377.2	352.3	436.1
660.1	602.1	566.8	587.1	611.6	587.1	545.0	537.8	559.5	951.5
886.2	724.8	1677.8	2344.8	3749.1	7030.1	11391.3	10553.5	8606.1	6387.7
5139.7	4185.1	3535.6	2957.6	2500.0	2116.0	1783.4	1479.2	1225.0	1043.7
900.0	792.6	708.3	644.3	623.1	609.7	583.4	527.2	484.0	455.6
340.8	326.7	383.2	361.0	340.8	335.1	313.0	302.2	290.3	276.0
268.4	259.7	251.1	243.8	236.6	234.3	229.6	226.1	218.1	210.2
201.4	193.8	186.4	179.1	173.0	166.0	161.1	158.1	151.5	146.7
141.2	138.5	134.0	128.9	125.2	122.7	119.3	115.9	112.7	111.0
107.8	103.8	102.3	100.0	97.7	94.7	93.2	90.9	88.8	87.3
85.9	84.5	82.4	78.9	78.2	77.5	76.2	73.5	72.2	

0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.1	5.4	0.0
0.0	0.0	0.0	0.0	29.2	1.8	0.0	0.0	0.0	0.0	1.9	61.1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0
0.0	3.5	0.0	0.0	0.2	0.0	0.6	0.1	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0
0.0	0.0	0.0	8.4	4.6	5.8	16.9	9.9	0.0	0.0	0.0	0.0
0.0	0.0	0.1	0.0	0.1	3.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.5	0.0
0.2	0.7	0.0	24.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.5	0.0	0.0	0.0
0.0	13.5	0.0	0.0	0.0	8.0	0.7	0.0	0.0	0.0	0.0	0.0
0.0	2.2	0.1	0.0	0.0	0.0	13.9	0.0	0.9	12.6	0.0	0.0
0.0	0.3	0.7	0.0	0.0	0.0	0.0	0.0	9.5	0.0	0.0	0.9
25.5	0.0	20.5	46.5	0.4	0.0	5.5	0.0	1.2	0.1	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0									
0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	18.0	0.0
0.0	0.0	0.0	5.8	0.6	0.5	9.3	0.0	0.0	0.0	0.0	0.0
0.0	0.3	0.9	0.6	2.3	0.0	3.2	0.5	0.0	0.0	0.0	0.1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

0.0	3.1	8.7	0.0	0.0	0.0	8.3	0.0	0.0	0.0	4.2	0.0
0.0	0.0	12.0	0.0	0.0	0.0	1.7	0.0	9.0	0.0	0.0	0.0
0.4	0.0	0.2	22.8	10.8	7.0	7.8	4.0	6.2	1.6	0.0	0.0
0.0	0.0	6.2	0.0	0.0	12.0	22.0	1.7	0.0	1.3	7.2	2.5
0.0	0.0	0.0	0.0	0.0	2.5	1.4	0.0	0.0	2.4	1.4	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	37.0	0.0	8.5	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	25.0	0.0
0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.2	0.0
0.0	0.0	4.7	0.0	0.5	0.0	26.7	1.2	13.7	0.0	8.4	6.3
0.5	0.0	14.2	0.0	0.0	3.3	10.9	2.3	8.7	2.3	0.2	4.6
15.5	17.6	37.9	32.3	1.7	1.5	0.9	2.3	0.3	0.3	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0
0.0	0.2	4.0	1.0	0.0	0.0	0.4	0.0	0.0	0.0	1.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0									

0.0	0.0	0.0	0.0	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	1.8	8.7	0.3	0.0	8.7	22.5	0.7	0.1	1.5	2.5	0.4
0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5	12.2	0.0	0.0	0.7
0.0	0.0	2.2	0.7	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.2
0.0	3.8	0.0	0.0	0.0	0.0	1.2	0.0	0.0	8.3	0.0	0.0
0.1	11.0	6.5	6.1	0.7	0.8	0.0	0.3	2.7	27.9	0.5	0.0
0.4	0.2	0.0	0.5	0.0	0.0	20.3	2.2	0.0	1.0	0.0	0.0
3.0	0.2	2.0	0.0	0.0	0.0	18.1	1.2	0.0	0.0	46.5	13.7
0.0	0.5	0.1	0.0	0.0	0.0	7.5	2.5	0.0	0.0	0.0	0.0
0.0	0.0	11.2	0.1	0.2	4.7	3.4	0.0	0.0	4.5	1.8	0.0
0.0	0.0	0.0	0.0	0.0	0.0	7.8	1.5	0.0	0.0	0.0	0.0
0.0	0.0	5.4	0.1	0.0	0.0	13.2	0.0	0.0	0.0	0.0	1.4
0.0	0.0	0.0	0.0	0.1	0.5	13.3	0.0	6.0	4.5	12.2	18.9
3.2	1.2	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0									

TA

0.	0.	0.				
15.	25.	40.	.0520	.0520	.0520	.0520
15.	0.0052	0.0052				
15.	0.0010	0.0010				
1.0000	1.0000	1.0000				
1.0000	1.0000	1.0000				

```
     0       1       2
1.0000  1.0000  1.0000  1.0000
0.0600  0.5200  0.3600  0.0100
1.0000
     5       3      90  0.0100 10.0000
  0.02    0.20    2.00
(1H ,I4,3F6.1,2F6.2,90A1)               (1H ,I4,3F6.1,6X,F6.2,90A1)
```

F OUTPUT

```
1 RIVER-NARMADA      JAMTARA SUB-BASIN     ( 16576.000KM2)      TU=   6.000
0        PNAME
              JAMTARA
              MANDLA
              PENDRA-ROAD
0                 NFLD        NRG      MRAIN      FTANK      RVCH
                     4          3          0         TA
0        XA         XB         XC        ACH
         0.         0.         0.       0.00
0       HA1        HA2        HA3         A0         A1         A2         A3
        15.        25.        40.     0.0520     0.0520     0.0520     0.0520
0        HB         B0         B1         HC         C0         C1
        15.     0.0052     0.0052        15.     0.0010     0.0010
0        CP          1.0000     1.0000     1.0000
0        WE          1.0000     1.0000     1.0000
0       LAG             0          1          2

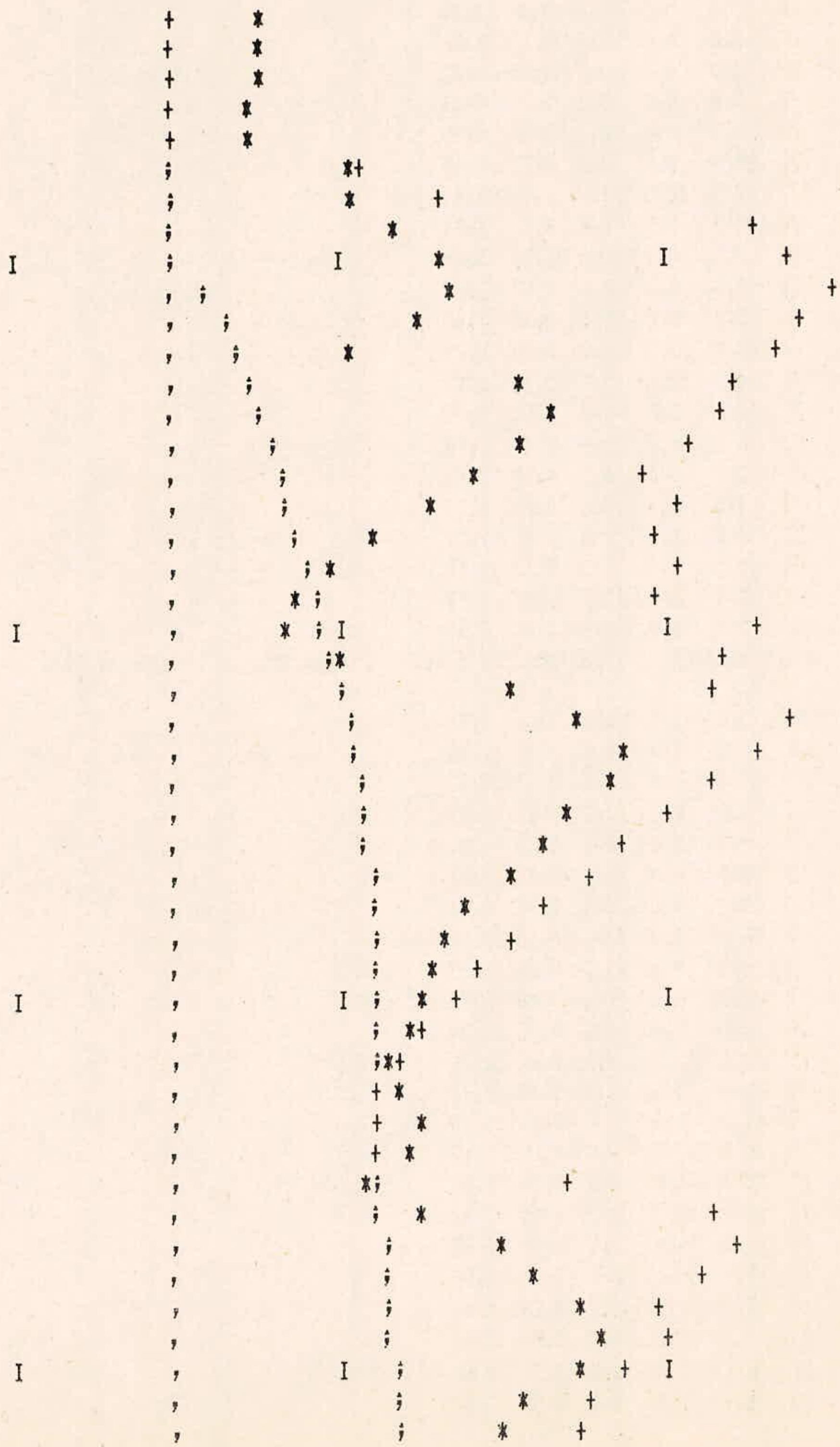

    CPF
          1      1.00             2      1.00             3      1.00             4      1.00


    BASE  DISCHARGE
          1    0.0600             2    0.5200             3    0.3600             4    0.0100


     NPLOT      NSCAL         LY       YMIN       YMAX                SCAL
         5          3         90      0.010     10.000                 0.020    0.200    2.000
0    FMT1                                                        FMT2
       (1H ,I4,3F6.1,2F6.2,90A1)                  (          1H ,I4,3F6.1,6X,F6.2,90A1)
     EV=  1.0000
 RIVER-NARMADA       JAMTARA SUB-BASIN      FLOOD NO. 1   FLOOD(1) 1978        N=  87       TU=    6.000        MEDIUM

    0   0.0   2.9   0.0  0.06  0.06         I             *             I                             I
    1   0.5   0.6   0.0  0.11  0.06                       +       *
    2   0.0   0.0   0.0  0.13  0.06                       +         *
    3   0.0   0.0  15.2  0.12  0.06                       +        *
    4   6.8   0.0   0.0  0.12  0.06                       +       *
    5   0.0   0.2   0.0  0.12  0.06                       ;+      *
    6   0.2   8.9   0.0  0.12  0.06                       +       *
    7  10.7   0.0   3.1  0.12  0.06                       +       *
    8   0.0   0.0   3.9  0.11  0.06                       +       *
    9   0.0   0.0   1.8  0.11  0.06                       +       *
   10   0.0   6.2   1.5  0.11  0.06                       +       *
   11   2.5   1.5   0.7  0.11  0.06                       +       *
   12   0.0   0.3   0.0  0.12  0.06         I             +       *     I                             I
   13   0.0   0.0   0.0  0.11  0.06                       +       *
   14   0.0   0.0   0.0  0.11  0.06                       +       *
   15   0.0   0.0   0.0  0.12  0.06                       +       *
```

16	0.0	0.0	0.0	0.12	0.06
17	0.0	0.0	0.0	0.11	0.06
18	0.0	0.0	0.0	0.11	0.06
19	0.0	0.0	0.0	0.10	0.06
20	3.8	5.0	19.3	0.10	0.06
21	22.1	15.2	1.5	0.21	0.23
22	3.3	0.0	41.5	0.21	0.39
23	71.2	0.0	32.0	0.29	3.64
24	7.3	20.3	2.8	0.41	4.72
25	16.5	7.5	1.0	0.43	6.50
26	0.0	0.1	0.2	0.33	5.29
27	4.5	0.1	12.0	0.21	4.22
28	0.4	0.0	0.0	0.68	3.10
29	0.0	0.0	0.0	0.91	2.81
30	7.4	0.0	0.0	0.71	2.38
31	0.0	8.0	8.7	0.52	1.65
32	15.0	0.0	1.3	0.36	2.08
33	0.0	18.5	0.0	0.25	1.80
34	5.5	5.8	45.8	0.18	2.17
35	0.0	2.7	5.2	0.15	1.81
36	0.0	0.0	11.6	0.14	3.61
37	0.0	0.0	6.9	0.20	2.96
38	0.0	50.7	1.5	0.62	2.77
39	0.0	0.0	0.2	1.02	4.79
40	0.0	0.0	0.0	1.43	3.66
41	0.0	0.9	0.1	1.33	2.69
42	0.0	0.0	0.0	0.99	1.96
43	0.1	0.0	0.0	0.82	1.45
44	0.0	0.0	0.0	0.64	1.12
45	0.0	0.0	0.0	0.49	0.85
46	0.0	0.0	0.0	0.41	0.63
47	0.0	0.0	0.0	0.36	0.51
48	0.0	0.0	0.0	0.35	0.42
49	0.0	0.5	0.0	0.32	0.34
50	0.0	0.0	0.0	0.28	0.29
51	0.0	0.0	0.0	0.29	0.26
52	0.0	0.0	3.6	0.36	0.26
53	0.0	30.6	0.3	0.31	0.25
54	0.0	38.4	40.4	0.23	0.97
55	0.0	0.0	2.3	0.34	2.70
56	0.2	0.0	0.0	0.61	3.25
57	0.1	0.7	0.5	0.74	2.50
58	5.8	10.1	0.2	1.04	1.86
59	4.4	0.0	0.3	1.18	1.92
60	0.5	0.0	0.0	1.02	1.42
61	3.9	5.5	0.0	0.71	1.08
62	1.8	18.8	0.0	0.60	1.04

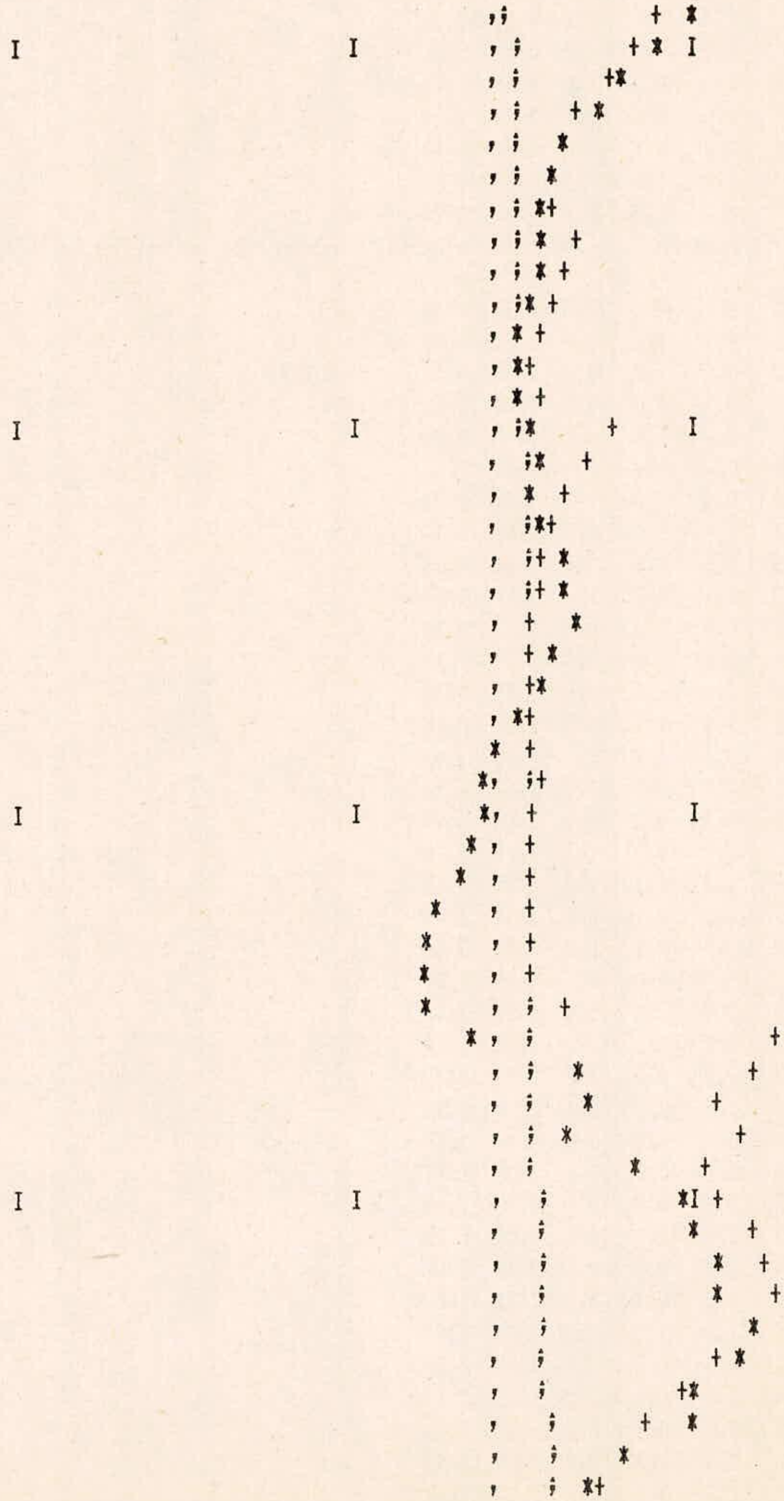


						Plot
63	0.0	0.0	0.0	0.47	1.68	, ; * +
64	0.0	0.0	0.0	0.41	1.25	, ; * +
65	0.3	0.5	3.7	0.32	0.94	, ;* +
66	31.2	0.2	0.0	0.43	1.34	, ; * +
67	0.0	0.0	0.0	0.59	1.08	, ; * +
68	6.5	0.0	6.8	0.38	1.02	, ; * +
69	0.0	3.8	0.2	0.27	0.81	, * ; +
70	3.5	0.2	8.5	0.27	0.88	, * ; +
71	19.4	3.0	0.0	0.38	1.45	, ; * +
72	22.9	28.5	1.7	1.02	2.44	I , I ; * I +
73	3.3	9.8	0.0	2.13	3.06	, ; * +
74	5.5	0.0	0.0	1.33	3.06	, ; * +
75	0.0	0.0	0.0	0.97	2.23	, ; * +
76	0.0	0.0	1.0	0.78	1.63	, ; * +
77	0.0	10.5	0.0	0.65	1.29	, ; * +
78	4.2	22.5	0.2	0.74	1.52	, ; * +
79	0.1	3.7	0.0	0.61	2.28	, ; * +
80	0.0	0.0	0.0	0.49	1.90	, ; * +
81	0.0	0.0	0.0	0.38	1.43	, * +
82	4.5	1.7	2.5	0.36	1.19	, *; +
83	0.5	1.2	1.6	0.36	1.04	, *; +
84	0.5	0.0	7.3	0.33	0.89	I , I * ; + I
85	0.8	0.0	15.2	0.34	0.73	, * ; +
86	0.1	0.0	1.8	0.40	0.59	, * +

RIVER-NARMADA JAMTARA SUB-BASIN FLOOD NO. 2 FLOOD(2) 1978 N= 79 TU= 6.000 MEDIUM

						Plot
0	0.0	0.0	0.0	0.52	0.52	I I * I
1	0.0	0.0	0.0	0.51	0.52	*
2	0.0	0.0	0.0	0.53	0.52	+*
3	0.0	0.0	0.2	0.81	0.52	+ *
4	0.0	0.0	0.3	0.94	0.52	+ *
5	0.0	0.0	0.0	0.87	0.52	+ *
6	0.6	0.0	37.5	0.77	0.52	+ *
7	0.0	8.0	30.5	0.65	0.52	+ *
8	0.0	1.1	15.2	0.57	1.13	;* +
9	0.0	0.3	1.8	0.46	2.42	*; +
10	0.0	0.0	0.0	0.45	2.69	* ; +
11	0.0	0.0	0.0	0.40	2.21	* ; +
12	0.0	0.0	0.0	0.38	1.73	I I * ; + I
13	0.0	1.0	0.5	0.55	1.36	;* +
14	10.5	13.2	0.0	0.89	1.12	; * +
15	28.7	9.2	4.0	0.89	1.59	; * +
16	42.0	10.7	0.7	0.90	3.47	,; * +
17	24.0	36.4	1.2	1.51	4.32	,; * +
18	9.8	4.1	0.4	3.26	5.50	,; * +
19	0.1	1.2	0.7	4.28	4.44	,; *
20	0.1	0.0	0.0	3.94	3.45	,; + *
21	0.1	0.0	0.0	3.29	2.60	,; + *
22	0.9	0.1	0.2	2.52	2.02	,; + *

23	0.0	0.6	0.4	1.89	1.59
24	0.0	0.0	0.3	1.51	1.30
25	0.9	0.0	0.7	1.24	1.09
26	0.3	1.4	0.2	1.00	0.92
27	0.0	0.0	0.0	0.84	0.84
28	0.7	2.6	0.0	0.74	0.77
29	0.0	10.9	5.3	0.69	0.74
30	0.7	0.5	8.6	0.72	0.92
31	0.0	0.1	0.4	0.69	0.79
32	0.3	0.0	0.0	0.64	0.78
33	1.0	0.7	0.0	0.60	0.71
34	1.0	1.5	0.5	0.60	0.67
35	6.3	1.6	7.8	0.60	0.70
36	17.4	0.5	0.9	0.62	1.09
37	0.0	2.0	0.0	0.68	0.97
38	0.0	0.4	0.0	0.67	0.84
39	0.0	0.0	1.7	0.71	0.76
40	0.0	0.2	0.0	0.80	0.72
41	0.0	0.0	0.0	0.84	0.68
42	0.3	0.2	0.0	0.86	0.65
43	0.3	0.0	0.0	0.77	0.64
44	0.0	0.0	0.0	0.69	0.64
45	0.0	0.0	14.2	0.60	0.64
46	0.0	0.2	0.2	0.52	0.64
47	0.0	0.0	0.0	0.49	0.69
48	0.0	0.7	3.1	0.46	0.66
49	0.0	0.0	2.3	0.42	0.64
50	2.0	1.0	0.0	0.39	0.65
51	1.8	0.0	0.0	0.36	0.66
52	0.0	0.0	0.0	0.33	0.64
53	0.5	0.0	0.3	0.32	0.64
54	23.2	0.1	3.2	0.32	0.85
55	56.3	16.6	5.5	0.44	3.39
56	5.7	0.0	2.6	0.92	3.02
57	0.0	0.0	7.8	0.95	2.39
58	13.3	0.0	2.9	0.80	2.62
59	0.0	0.0	0.8	1.33	2.20
60	8.4	38.6	13.2	1.87	2.23
61	3.2	7.5	8.3	2.01	3.00
62	5.8	14.6	3.2	2.23	3.29
63	0.0	1.0	0.9	2.28	3.51
64	0.0	0.0	0.1	2.82	2.88
65	0.0	0.0	0.0	2.60	2.25
66	0.0	0.0	0.0	1.98	1.79
67	0.0	0.0	0.0	1.89	1.44
68	0.0	0.5	0.0	1.26	1.22
69	0.0	0.0	0.0	0.99	1.05



```
 70    0.0   0.0   0.0  0.80  0.92                                                  ,    ;*+
 71    0.0   0.0  30.7  0.67  0.82                                                  ,  * ;+
 72    0.0   0.4   2.8  0.59  0.78        I                             I           ,*   +           I
 73    0.0   0.0   0.0  0.51  1.56                                                  *    ;        +
 74    0.0   0.0   0.0  0.45  1.42                                                * ,    ;       +
 75    0.0   0.0   0.0  0.42  1.24                                                * ,    ;     +
 76    0.0   0.0   0.0  0.38  1.10                                              *   ,    ;    +
 77    0.0   0.0   7.3  0.36  0.97                                              *   ,    ;  +
 78    6.7   0.8   1.7  0.39  0.90                                               *  ,    ; +
RIVER-NARMADA      JAMTARA SUB-BASIN     FLOOD NO. 3  FLOOD(3) 1978      N= 54     TU=  6.000      MEDIUM

  0    0.0   0.0  10.3  0.36  0.36        I                             I       *                    I
  1    6.7   0.8   1.7  0.39  0.36                                              +*
  2    5.8   1.8   0.0  0.53  0.36                                              +    *
  3    0.5   0.0   0.0  0.71  0.36                                              +       *
  4    0.0   0.0   0.0  0.65  0.36                                              +      *
  5    0.0   0.0   0.0  0.60  0.36                                              +     *
  6    0.0   0.0   1.2  0.65  0.36                                              +      *
  7    0.0   0.0   0.0  0.67  0.36                                              +      *
  8    0.0   0.0   0.0  0.64  0.36                                              +      *
  9    6.6   0.0   0.0  0.59  0.36                                              +     *
 10    0.0   0.0   0.2  0.67  0.36                                              +      *
 11    5.9   0.0   0.0  0.75  0.36                                              +        *
 12    0.0  26.5   2.0  1.09  0.36        I                             I       +             *      I
 13    3.5   2.1   5.2  1.04  0.59                                              ;     +      *
 14   23.5   7.9   0.0  1.00  1.04                                              ;            *
 15    2.7   0.0  22.8  1.16  1.16                                              ;             *
 16    1.4   5.0  33.9  1.04  0.94                                              ;           +*
 17    0.0  39.0   1.3  1.60  1.10                                              ;             +   *
 18    4.7   0.1   0.0  3.87  4.18                                              ;                             *+
 19    1.0   0.1   0.0  3.39  3.19                                              ;                          +*
 20    5.9   9.1   0.0  2.52  2.50                                              ;                       *
 21   15.4   0.0   2.3  2.08  2.84                                              ;                     *   +
 22    0.0   0.0   0.0  1.80  2.12                                              ;                   * +
 23    0.0   0.0   0.0  1.58  1.69                                              ;                 *+
 24    0.0   0.0   0.0  1.31  1.28        I                             I      ,;               *    I
 25   41.5   5.5   0.4  1.09  2.85                                             ,;             *           +
 26    0.6   5.0   0.0  1.13  2.37                                             ,;             *        +
 27    0.0   0.0   0.0  1.06  1.96                                             ,;            *       +
 28    0.0   4.7   0.0  0.97  1.44                                              , ;         *    +
 29    0.0  42.0   0.0  1.06  1.28                                              , ;          *  +
 30    0.8   0.2   0.5  2.68  2.97                                              , ;                      *+
 31    0.0  10.3   6.2  2.01  2.29                                              , ;                  * +
 32   11.6   7.0   5.6  1.28  2.67                                              ,  ;            *        +
 33    8.5   0.1   5.8  1.09  2.71                                              ,  ;          *          +
 34    0.0   0.0   2.2  1.02  2.17                                              ,  ;         *        +
 35    0.0   0.7   8.2  1.02  1.73                                              ,  ;         *     +
 36    0.0   0.3   7.8  1.14  1.42        I                             I       ,  ;          *  +   I
 37    0.0   0.5   1.6  1.47  1.33                                              ,  ;            +*
```

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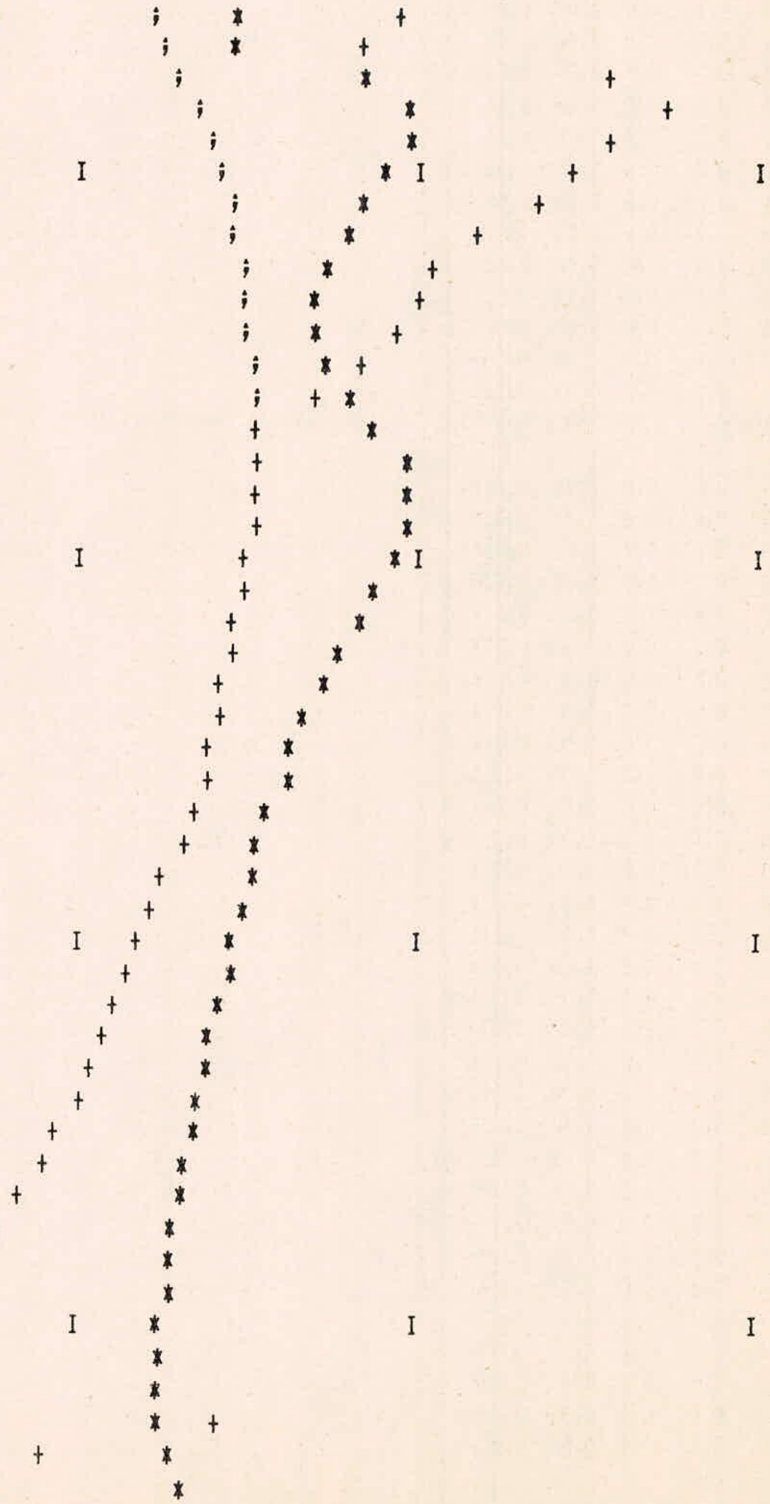
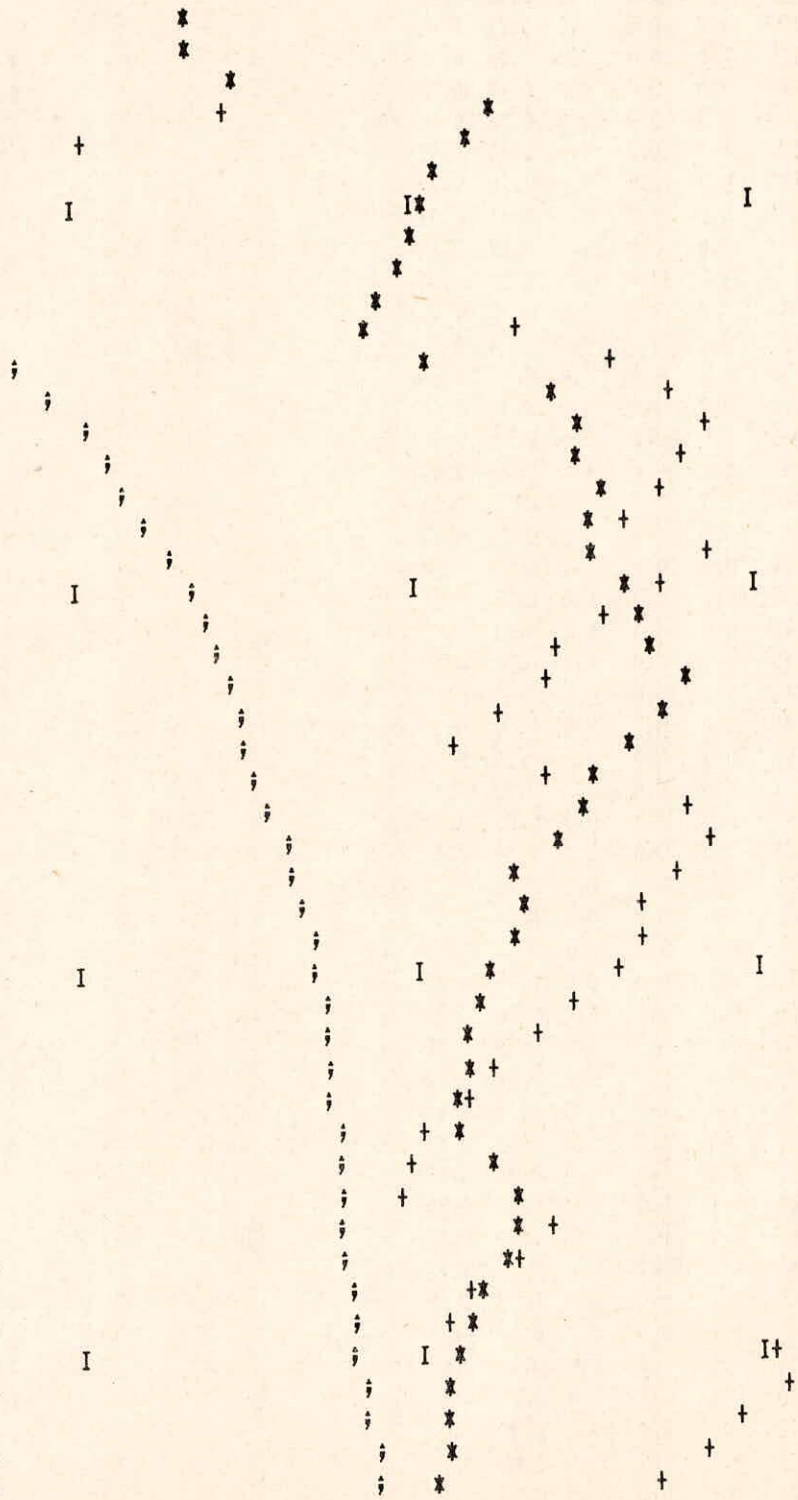
 38   0.6   1.9  11.7  1.49  1.34                                             ,   ;           + *
 39   0.0   0.0   0.2  1.35  1.17                                             ,   ;         + *
 40   0.3   0.2   0.5  1.20  1.33                                             ,   ;          *+
 41   0.0   0.1   0.0  1.09  1.09                                             ,   ;         *
 42   0.0   0.0   0.0  1.00  0.93                                             ,   ;       +*
 43   0.0   0.0   0.0  0.89  0.77                                             ,   ;    + *
 44   0.0   0.0   0.0  0.80  0.66                                             ,   ;  +  *
 45   2.1   0.0   0.3  0.74  0.62                                             ,   ; +  *
 46   0.0   0.0   0.0  0.67  0.58                                             ,   ; +*
 47   0.0   0.0   0.0  0.59  0.55                                             ,   ;+*
 48   0.0   1.3   0.0  0.51  0.52        I                            I       ,   *                I
 49   0.0   0.9   5.0  0.46  0.52                                             ,  *+
 50   0.0   0.0   0.0  0.43  0.52                                             , * +
 51   2.8   0.0   0.0  0.43  0.52                                             , * +
 52   0.0   0.0   0.1  0.42  0.52                                             , * +
 53   0.0   0.0   4.2  0.43  0.52                                             , * +
RIVER-NARMADA      JAMTARA SUB-BASIN     FLOOD NO.  4   FLOOD(4) 1979       N= 279      TU=   6.000         MEDIUM

  0   0.0   0.0   0.0  0.01  0.01*       I                            I                            I
  1   0.0   0.0   0.0  0.01  0.01*
  2   0.0   0.0   0.0  0.01  0.01*
  3   0.0   0.0   0.0  0.00  0.01*
  4   0.0   5.8   7.2  0.00  0.01*
  5   0.0   0.0   0.0  0.00  0.01*
  6   0.0   0.0   0.0  0.00  0.01*
  7   1.5   0.0   0.0  0.00  0.01*
  8   0.0   0.0   0.0  0.00  0.01*
  9   0.1   0.0   0.0  0.00  0.01*
 10   5.4  18.0   0.0  0.00  0.01*
 11   0.0   0.0   0.0  0.00  0.06*                     +
 12   0.0   0.0   0.0  0.00  0.03*       I  +                         I                            I
 13   0.0   0.0   1.8  0.00  0.01*
 14   0.0   0.0   8.7  0.00  0.01*
 15   0.0   5.8   0.3  0.00  0.01*
 16  29.2   0.6   0.0  0.01  0.33; *                                        +
 17   1.8   0.5   8.7  0.01  0.27;   *                                    +
 18   0.0   9.3  22.5  0.02  0.17;       *                          +
 19   0.0   0.0   0.7  0.04  0.21;                *                    +
 20   0.0   0.0   0.1  0.10  0.65;                            *                      +
 21   0.0   0.0   1.5  0.09  0.45;                          *                   +
 22   1.9   0.0   2.5  0.08  0.30;                         *               +
 23  61.1   0.0   0.4  0.07  2.77;                       *                                             +
 24   0.0   0.0   0.0  0.08  2.10;       I                *           I                            I+
 25   0.0   0.3   0.0  0.06  1.54,    ;               *                                         +
 26   0.0   0.9   0.0  0.10  1.08,      ;                     *                             +
 27   0.0   0.6   0.0  0.09  0.74,        ;                  *                         +
 28   0.0   2.3   0.0  0.06  0.53,          ;          *                          +
 29   0.0   0.0   0.0  0.06  0.37,            ;         *                     +
 30   0.0   3.2   0.0  0.06  0.25,            ;        *                 +
```

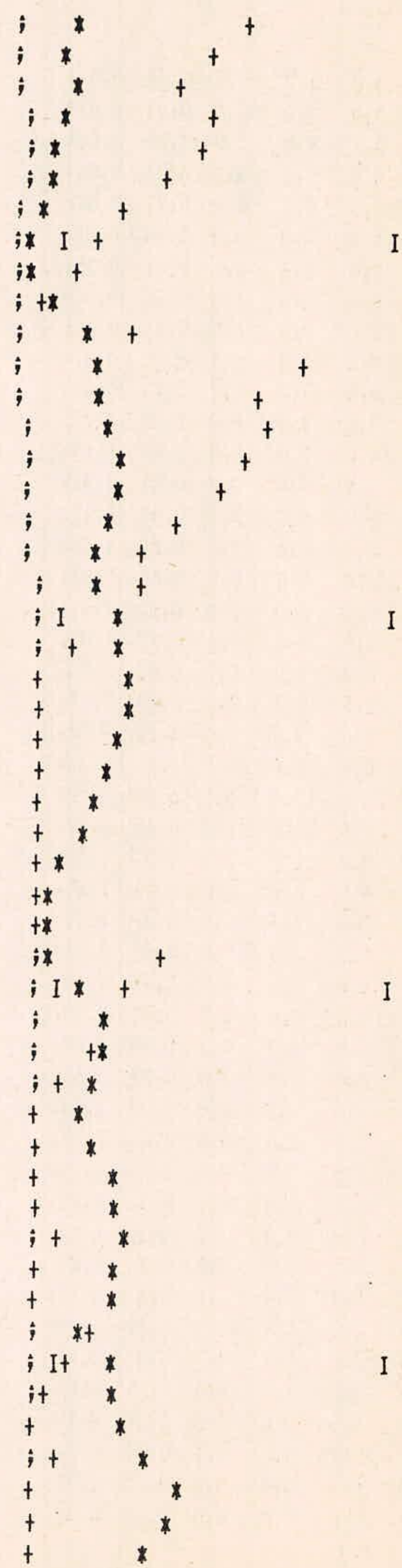
31	0.0	0.5	30.5	0.06	0.17,
32	0.0	0.0	12.2	0.06	0.13,
33	0.0	0.0	0.0	0.13	0.72,
34	0.0	0.0	0.0	0.19	1.04,
35	0.0	0.1	0.7	0.18	0.71,
36	0.0	0.0	0.0	0.16	0.54,
37	0.0	0.0	0.0	0.13	0.42,
38	0.0	0.0	2.2	0.12	0.29,
39	0.0	0.0	0.7	0.11	0.21,
40	0.0	0.0	0.0	0.10	0.20,
41	0.0	0.0	0.1	0.09	0.17,
42	0.0	0.0	0.0	0.11	0.13,
43	0.0	0.0	0.0	0.12	0.10,
44	0.0	0.0	0.0	0.15	0.06,
45	0.0	0.0	0.0	0.18	0.06,
46	0.0	0.0	0.0	0.18	0.06,
47	0.0	0.0	0.0	0.18	0.06,
48	0.0	0.0	0.0	0.17	0.06,
49	0.0	0.0	0.0	0.14	0.06,
50	0.0	0.0	1.4	0.13	0.06,
51	0.0	0.0	0.0	0.12	0.05,
52	0.0	0.0	0.0	0.10	0.05,
53	0.3	0.0	0.0	0.09	0.05,
54	0.1	0.0	0.0	0.08	0.05,
55	0.0	0.0	0.0	0.08	0.05,
56	0.0	0.0	0.0	0.07	0.04,
57	0.0	0.0	0.0	0.07	0.04,
58	0.0	0.0	0.0	0.06	0.04,
59	0.0	0.0	0.0	0.06	0.03,
60	0.0	0.0	0.0	0.06	0.03,
61	3.5	3.1	0.0	0.05	0.03,
62	0.0	8.7	0.0	0.05	0.03,
63	0.0	0.0	0.0	0.05	0.02,
64	0.2	0.0	0.0	0.05	0.02,
65	0.0	0.0	0.0	0.05	0.02,
66	0.6	8.3	0.0	0.04	0.02,
67	0.1	0.0	0.0	0.04	0.02,
68	0.0	0.0	0.0	0.04	0.01,
69	0.0	0.0	0.0	0.04	0.01,+
70	0.0	4.2	0.1	0.04	0.01+
71	0.0	0.0	1.2	0.04	0.01+
72	0.0	0.0	0.0	0.04	0.01+
73	0.0	0.0	3.8	0.03	0.01+
74	0.0	12.0	0.0	0.03	0.01+
75	0.0	0.0	0.0	0.04	0.05;
76	0.0	0.0	0.0	0.04	0.02;
77	0.0	0.0	0.0	0.04	0.01+



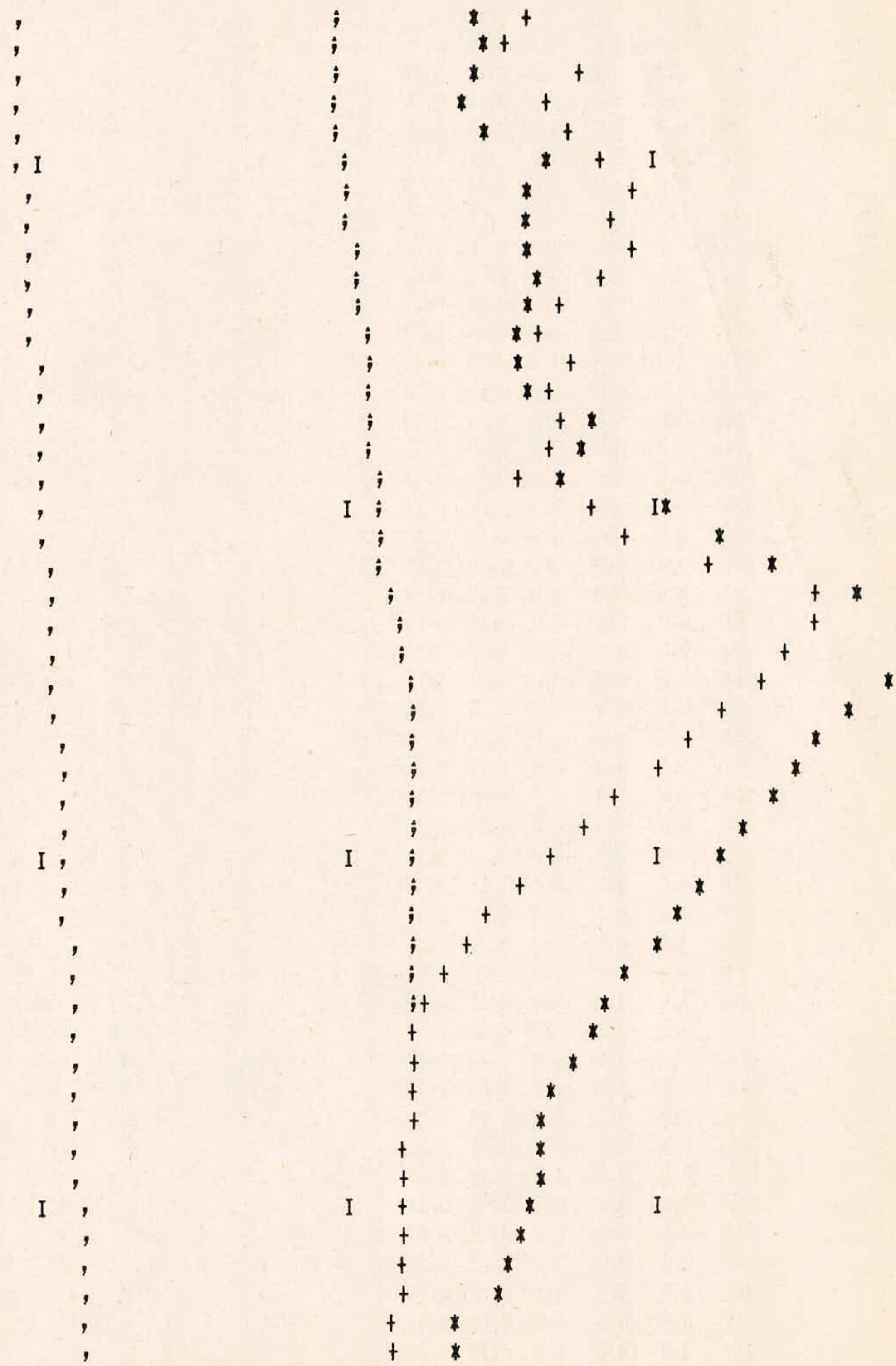
78	0.0	1.7	1.2	0.04	0.01+
79	0.0	0.0	0.0	0.04	0.01+
80	0.7	9.0	0.0	0.06	0.01+
81	0.0	0.0	8.3	0.33	0.06;
82	0.0	0.0	0.0	0.29	0.02;
83	0.0	0.0	0.0	0.24	0.01+
84	0.0	0.4	0.1	0.21	0.01+
85	0.0	0.0	11.0	0.20	0.01+
86	0.0	0.2	6.5	0.18	0.01+
87	8.4	22.8	6.1	0.16	0.01+
88	4.6	10.8	0.7	0.15	0.40;
89	5.8	7.0	0.8	0.21	0.74,
90	16.9	7.8	0.0	0.53	1.15,
91	9.9	4.0	0.3	0.61	1.47,
92	0.0	6.2	2.7	0.59	1.19,
93	0.0	1.6	27.9	0.68	1.08,
94	0.0	0.0	0.5	0.63	0.83,
95	0.0	0.0	0.0	0.62	1.41,
96	0.0	0.0	0.4	0.79	1.02,
97	0.0	0.0	0.2	0.88	0.70,
98	0.1	6.2	0.0	0.94	0.49,
99	0.0	0.0	0.5	1.23	0.46,
100	0.1	0.0	0.0	1.07	0.33,
101	3.0	12.0	0.0	0.83	0.25,
102	0.0	22.0	20.3	0.66	0.47,
103	0.0	1.7	2.2	0.57	1.23,
104	0.0	0.0	0.0	0.50	1.45,
105	0.0	1.3	1.0	0.37	1.12,
106	0.0	7.2	0.0	0.40	0.87,
107	0.0	2.5	0.0	0.36	0.89,
108	0.0	0.0	3.0	0.32	0.75,
109	0.0	0.0	0.2	0.30	0.56,
110	0.0	0.0	2.0	0.28	0.45,
111	0.0	0.0	0.0	0.28	0.33,
112	0.0	0.0	0.0	0.26	0.28,
113	0.0	2.5	0.0	0.25	0.20,
114	0.0	1.4	18.1	0.32	0.18,
115	0.0	0.0	1.2	0.38	0.17,
116	0.0	0.0	0.0	0.36	0.45,
117	0.0	2.4	0.0	0.33	0.36,
118	0.0	1.4	46.5	0.30	0.27,
119	0.0	0.0	13.7	0.27	0.23,
120	0.0	0.0	0.0	0.25	2.13,
121	0.0	0.0	0.5	0.24	2.31,
122	0.0	0.0	0.1	0.23	1.74,
123	0.0	0.0	0.0	0.23	1.31,
124	0.0	0.0	0.0	0.22	0.95,



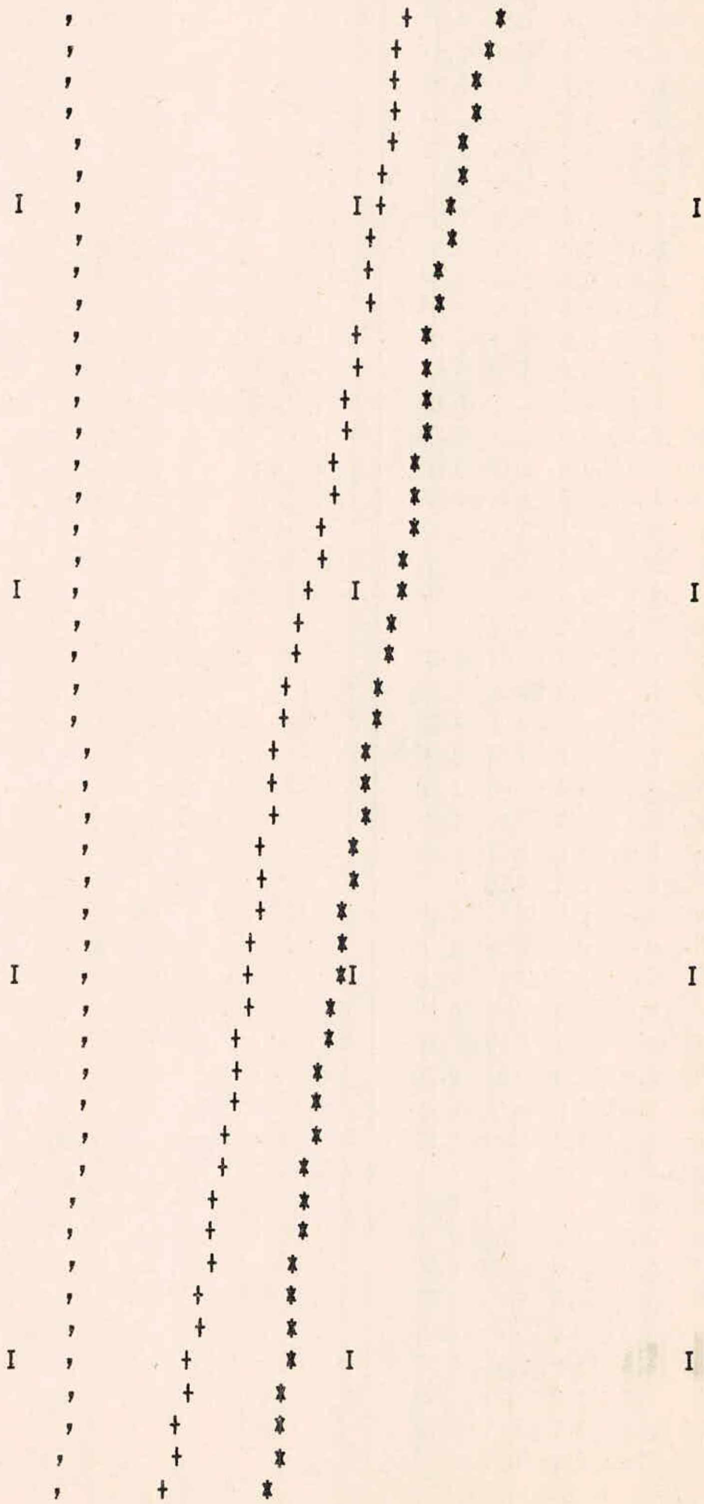
125	0.0	0.0	0.0	0.21	0.72,	
126	0.0	0.0	7.5	0.20	0.56,	
127	0.0	0.0	2.5	0.21	0.43,	
128	0.0	0.0	0.0	0.20	0.57,	
129	2.0	0.0	0.0	0.19	0.52,	
130	0.5	0.0	0.0	0.18	0.40,	
131	0.0	0.0	0.0	0.17	0.30,	
132	0.2	0.0	0.0	0.16	0.25,	I
133	0.7	0.0	0.0	0.15	0.21,	
134	0.0	0.0	11.2	0.18	0.17,	
135	24.5	37.0	0.1	0.23	0.31,	
136	0.0	0.0	0.2	0.25	1.01,	
137	0.0	8.5	4.7	0.24	0.76,	
138	0.0	0.0	3.4	0.28	0.84,	
139	0.0	0.0	0.0	0.30	0.69,	
140	0.0	0.0	0.0	0.30	0.57,	
141	0.0	0.0	4.5	0.27	0.42,	
142	0.0	0.0	1.8	0.25	0.33 ,	
143	0.0	0.0	0.0	0.25	0.33 ,	
144	0.0	0.0	0.0	0.28	0.29 ,	I
145	0.0	0.0	0.0	0.29	0.21 ,	
146	0.0	0.0	0.0	0.32	0.17 ,	
147	0.0	0.0	0.0	0.32	0.17 ,	
148	0.0	0.0	0.0	0.30	0.17 ,	
149	0.0	0.0	0.0	0.27	0.17 ,	
150	0.0	0.0	7.8	0.25	0.17 ,	
151	0.8	0.8	1.5	0.23	0.17 ,	
152	0.5	0.0	0.0	0.20	0.17 ,	
153	0.0	0.0	0.0	0.18	0.17 ,	
154	0.0	25.0	0.0	0.18	0.17 ,	
155	0.0	0.0	0.0	0.18	0.40 ,	
156	0.0	0.0	0.0	0.23	0.32 ,	I
157	13.5	0.5	0.0	0.28	0.27 ,	
158	0.0	0.0	5.4	0.26	0.24 ,	
159	0.0	0.0	0.1	0.24	0.20 ,	
160	0.0	0.0	0.0	0.24	0.17 ,	
161	8.0	0.0	0.0	0.25	0.17 ,	
162	0.7	0.0	13.2	0.28	0.17 ,	
163	0.0	0.0	0.0	0.30	0.17 ,	
164	0.0	0.0	0.0	0.32	0.20 ,	
165	0.0	0.0	0.0	0.29	0.17 ,	
166	0.0	15.2	0.0	0.28	0.17 ,	
167	0.0	0.0	1.4	0.22	0.25 ,	
168	0.0	0.0	0.0	0.29	0.21 ,	I
169	2.2	0.0	0.0	0.28	0.18 ,	
170	0.1	4.7	0.0	0.32	0.17 ,	
171	0.0	0.0	0.0	0.39	0.20 ,	
172	0.0	0.5	0.1	0.45	0.17 ,	
173	0.0	0.0	0.5	0.43	0.17 ,	
174	13.9	26.7	13.3	0.38	0.17 ,	



175	0.0	1.2	0.0	0.52	0.75
176	0.9	13.7	6.0	0.53	0.63
177	12.6	0.0	4.5	0.49	1.15
178	0.0	8.4	12.2	0.46	0.90
179	0.0	6.3	18.9	0.57	1.04
180	0.0	0.5	3.2	0.86	1.31
181	0.3	0.0	1.2	0.78	1.72
182	0.7	14.2	1.6	0.74	1.41
183	0.0	0.0	0.0	0.77	1.63
184	0.0	0.0	0.0	0.80	1.29
185	0.0	3.3	0.0	0.77	0.99
186	0.0	10.9	0.0	0.71	0.84
187	0.0	2.3	0.0	0.70	1.01
188	9.5	8.7	0.0	0.73	0.88
189	0.0	2.3	0.0	1.24	0.99
190	0.0	0.2	0.0	1.15	0.85
191	0.9	4.6	0.0	0.94	0.68
192	25.5	15.5	0.0	2.19	1.18
193	0.0	17.6	0.0	3.06	1.52
194	20.5	37.9	0.0	4.89	2.82
195	46.5	32.3	0.0	9.16	6.44
196	0.4	1.7	0.0	14.84	6.62
197	0.0	1.5	0.0	13.75	5.16
198	5.5	0.9	0.0	11.21	4.27
199	0.0	2.3	0.0	8.32	3.25
200	1.2	0.3	0.0	6.70	2.58
201	0.1	0.3	0.0	5.45	1.94
202	0.0	0.0	0.0	4.61	1.46
203	0.0	0.0	0.0	3.85	1.13
204	0.0	0.0	0.0	3.26	0.87
205	0.0	0.0	0.0	2.76	0.69
206	0.0	0.0	0.0	2.32	0.56
207	0.0	0.0	0.0	1.93	0.47
208	0.0	0.0	0.0	1.60	0.39
209	0.0	0.0	0.0	1.36	0.35
210	0.0	1.6	0.0	1.17	0.31
211	0.0	0.0	0.0	1.03	0.31
212	0.0	0.0	0.0	0.92	0.31
213	0.0	0.0	0.0	0.84	0.31
214	0.0	0.0	0.0	0.81	0.30
215	0.0	0.0	0.0	0.79	0.30
216	0.0	0.0	0.0	0.76	0.29
217	0.0	0.2	0.0	0.69	0.29
218	0.0	4.0	0.0	0.63	0.29
219	0.0	1.0	0.0	0.59	0.28
220	0.0	0.0	0.0	0.44	0.28
221	0.0	0.0	0.0	0.43	0.27



222	0.0	0.4	0.0	0.50	0.26
223	0.0	0.0	0.0	0.47	0.26
224	0.0	0.0	0.0	0.44	0.25
225	0.0	0.0	0.0	0.44	0.25
226	0.0	1.0	0.0	0.41	0.24
227	0.0	0.0	0.0	0.39	0.23
228	0.0	0.0	0.0	0.38	0.23
229	0.0	0.0	0.0	0.36	0.22
230	0.0	0.0	0.0	0.35	0.21
231	0.0	0.0	0.0	0.34	0.21
232	0.0	0.0	0.0	0.33	0.20
233	0.0	0.0	0.0	0.32	0.19
234	0.0	0.0	0.0	0.31	0.18
235	0.0	0.0	0.0	0.31	0.18
236	0.0	0.0	0.0	0.30	0.17
237	0.0	0.0	0.0	0.29	0.16
238	0.0	0.0	0.0	0.28	0.16
239	0.0	0.0	0.0	0.27	0.15
240	0.0	0.0	0.0	0.26	0.14
241	0.0	0.0	0.0	0.25	0.14
242	0.0	0.0	0.0	0.24	0.13
243	0.0	0.0	0.0	0.23	0.12
244	0.0	0.0	0.0	0.23	0.12
245	0.0	0.0	0.0	0.22	0.11
246	0.0	0.0	0.0	0.21	0.11
247	0.0	0.0	0.0	0.21	0.11
248	0.0	0.0	0.0	0.20	0.11
249	0.0	0.0	0.0	0.19	0.10
250	0.0	0.0	0.0	0.18	0.10
251	0.0	0.0	0.0	0.18	0.10
252	0.0	0.0	0.0	0.17	0.10
253	0.0	0.0	0.0	0.17	0.09
254	0.0	0.0	0.0	0.16	0.09
255	0.0	0.0	0.0	0.16	0.09
256	0.0	0.0	0.0	0.16	0.09
257	0.0	0.0	0.0	0.15	0.08
258	0.0	0.0	0.0	0.15	0.08
259	0.0	0.0	0.0	0.14	0.08
260	0.0	0.0	0.0	0.14	0.08
261	0.0	0.0	0.0	0.14	0.07
262	0.0	0.0	0.0	0.13	0.07
263	0.0	0.0	0.0	0.13	0.07
264	0.0	0.0	0.0	0.13	0.07
265	0.0	0.0	0.0	0.12	0.06
266	0.0	0.0	0.0	0.12	0.06
267	0.0	0.0	0.0	0.12	0.06
268	0.0	0.0	0.0	0.12	0.05



```
269   0.0   0.0   0.0   0.11   0.05            ,         +           *
270   0.0   0.0   0.0   0.11   0.05            ,         +           *
271   0.0   0.0   0.0   0.11   0.05            ,        +            *
272   0.0   0.0   0.0   0.11   0.05            ,       +            *
273   0.0   0.0   0.0   0.10   0.04            ,       +            *
274   0.0   0.0   0.0   0.10   0.04            ,      +             *
275   0.0   0.0   0.0   0.10   0.04            ,     +              *
276   0.0   0.0   0.0   0.10   0.04         I  ,     +             *         I                          I
277   0.0   0.0   0.0   0.10   0.03            ,    +              *
278   0.0   0.0   0.0   0.09   0.03            ,  +                *
```