THE REPUBLIC OF VENEZUELA

STUDY
ON
COMPREHENSIVE IMPROVEMENT
OF
THE APURE RIVER BASIN

USER'S MANUAL
OF
COMPUTER PROGRAM

FLOOD RUNOFF CALCULATION
STORAGE FUNCTION METHOD

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JAPAN INTERNATIONAL COOPERATION AGENCY

USER'S MANUAL

FLOOD RUNOFF CALCULATION

STORAGE FUNCTION METHOD

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1. Introduction

The flood run-off calculation method using the storage function was proposed by Mr. Toshimitsu Kimura in 1961.

This is a nonlinear analysis method which determines the storage function, delay time, etc. of a river basin based on its area, channel length, mean basin gradient, topographical and geological conditions in order to reproduce the run-off phenomenon caused by rainfall. This method has been widely applied and used in Japan because of the following advantages.

(a) The actual features of flood run-off which is very slowly changing unsteady flow are precisely grasped in this approximate method.

(b) The coefficients used for the equation can be easily obtained from the run-off data in the past.

(c) Non-linearity which is one of the remarkable features of flood run-off in Japan because of the steep topography and heavy rainfall is taken into consideration in this method.

(d) The calculation by this method is very simple, so automatic computer is easily applicable and this method is convenient even for the flood run-off estimation in a river basin with complicated river system.

In this program, consideration is given to enable it to make not only the run-off calculation of a single basin or river course but the synthesis of run-offs in sequence according to the flood trace chart.

2. Basic theoretical equation of the storage function method

2-1 Basic storage function

The equation of motion: $S_\ell = KQ_\ell^P$, where

K, P: Constant of river basin

The equation of continuity: $\frac{1}{3.6} f\, r_{ave} A - Q_\ell = \frac{dS_\ell}{dt}$, where

f: Inflow coefficient

r_{ave}: Mean basin rainfall

A: River basin area
$Q_e(t) = Q(t + T_e)$: Direct basin run-off considering the delay time.
S_e: Apparent basin storage volume
T_e: Delay time

2-2 River course storage function

The equation of motion: $S_\ell = KQ_\ell^P - T_\ell Q_\ell$, where

K, P: Constants of river course
T_e: Delay time of river course

The equation of continuity: $\sum_{j=1}^{n} f_j I_j - Q_\ell = \frac{dS_\ell}{dt}$, where

I_j : Flow rate at the upstream end of inflows
f_j : Inflow coefficient
$Q_\ell(t) = Q(t + T_\ell)$: Flow rate at the downstream end of river course considering the delay time
S_ℓ : Apparent river course storage volume

3. Differentiation of the basic equation of continuity and its solution

3-1 Basin storage function

1) Differential equation:

$$\left(R_{t+1} - \frac{Q_t + Q_{t+1}}{2}\right)\Delta t = S_{t+1} - S_t \quad \ldots\ldots (1), \text{ where}$$

(R, Q: mm/hr, S: mm, Δt: hr)

$$R_{t+1} + \left(\frac{S_t}{\Delta t} - \frac{Q_t}{2}\right) = \frac{S_{t+1}}{\Delta t} + \frac{Q_{t+1}}{2} \quad \ldots\ldots (2)$$

The calculation is possible in succession by giving these equations the initial value.

2) Solution:

In the equation (2), if the left side is known, the right side will be solved as constant. If the equation of motion is taken into account,

$$\frac{KQ_{t+1}^P}{\Delta t} + \frac{Q_{t+1}}{2} = \text{const}$$

In this program, consideration was given to enable the above equation to be solved by the following two methods.

a) Newton-raphson method:

The equation is calculated by the Newton-raphson method until the results come below the allowable error.

b) Interpolation method:

Calculations by the interpolation method are done by giving the function $f(Q) = \frac{KQ^p}{\Delta t} + \frac{Q}{2}$ through linear approximation.

3-2 River course storage function

1) Differential equation:

$$\left(\frac{I_n + I_{n+1}}{2} - \frac{Q_t + Q_{t+1}}{2}\right)\Delta t = S_{t+1} - S_t \quad \text{, where}$$

(I, Q: m^3/sec, S: m^3, Δt sec)

This is changed into:

$$\frac{I_n + I_{n+1}}{2} + \left(\frac{S_t}{\Delta t} - \frac{Q_t}{2}\right) = \frac{S_{t+1}}{\Delta t} + \frac{Q_{t+1}}{2}$$

2) Solution:

The tangent approximation method proposed by Mr. Saburo Mizukoshi is here used. If a finite section is assumed to be linear,

$$Q_{t+1} = \left\{\frac{I_n + I_{n+1}}{2} + \left(\frac{a_2}{\Delta t} - \frac{1}{2}\right)Q_t\right\} \Big/ \left(\frac{a_2}{\Delta t} + \frac{1}{2}\right) \quad \text{where}$$

$$S = a_2 Q + b_2$$

3) Other

In the study to alter any dam plan and main river flow rates, arrangements are made from the conservative viewpoint so that such calculations are possible where no flow rate reduction is considered and only the flow-down time is lagged.

4. Determination of the planned rainfall

4-1 Outline

In this program, the calculations to convert the rainfall distribution data from rain gauging stations (hyetal graph) into the mean probable (planned) rainfall at each river basin shall also be done.

4-2 Probable planned rainfall

The probable planned rainfall shall be decided based on the basic program and by determining the probable year to be controlled and the planned rainfall duration.

This is decided by processing the annual maximum daily rainfall data and input to the computer.

4-3 Conversion of the actual rainfall into the planned rainfall

In this program, the enlargement rate was calculated in an assumption that the probable planned rainfall is decided independently at each area.

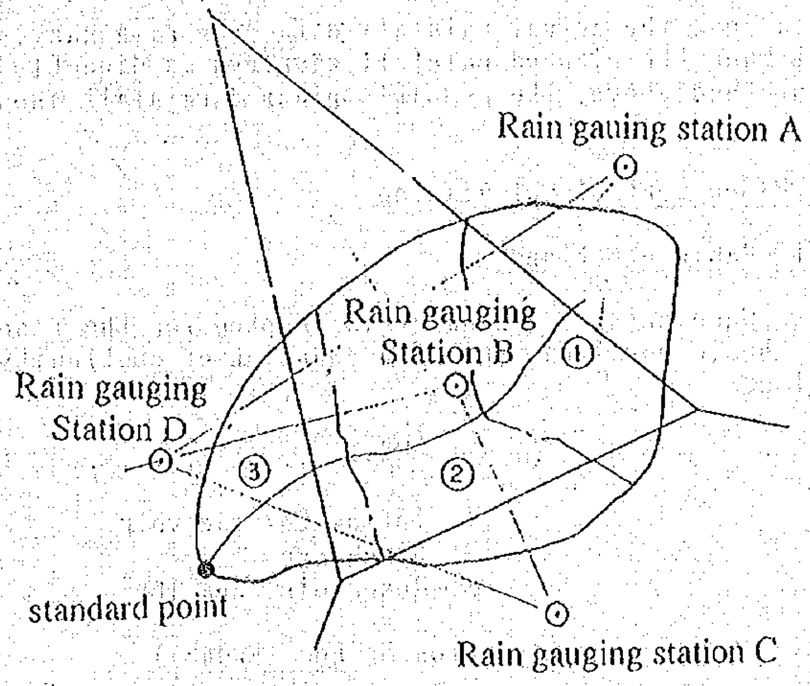
The enlargement rate for each area was calculated in the following manner:

Enlargement rate = Areal probable planned rainfall ÷ Max. rainfall within rain duration × (Σ (hyetal graph from rain gauging stations) × (Thiessen coefficient)

If the actual rainfall duration is longer than the planned one, consideration was given to both cases where enlargement is applied to the whole rainfall duration and to only the planned duration.

4-4 If the enlargement rate is fixes throughout the whole river basin

Often used in the the basin with a relatively wide area (e.g., the first class rivers, etc.), this method determines the planned daily rainfall (2 days) throughout the whole basin area, calculates the enlargement rate based on the actual rainfall by the Thiessen method and determines the planned rainfall waveform for each divided areal river basin.



Work Procedure:

1. The Thiessen coefficient is determined at the 4 rain gauging stations all over the river basin to calculate the mean areal rainfall from the actual rainfall waveform.

2. The enlargement rate from the mean areal rainfall to the planned rainfall is calculated.

3. The Thiessen coefficient for each divided basin area is determined to calculate the mean rainfall waveform, which is multiplied by the enlargement rate.

4. Thus the planned rainfall waveform for each divided basin area is calculated.

4-5 If the rainfall pattern of virtual distribution is input

If the planned rainfall waveform such as those of virtual distribution, etc. is input, no enlargement is usually done.

In this program, it was assumed that the input rainfall data were the actual rainfall data from rain gauging stations. But when the planned rainfall waveform is directly input as mentioned above, the probable planned rainfall should be set at 0.

5. Flood Control Calculation

5-1 Basic equations

When natural discharge is adopted for the flood control, the basic equation, from the equation of continuity, is as shown below.

$$I - O = \frac{dS}{dt} \quad \cdots\cdots\cdots\cdots\cdots\cdots (1)$$, where

I: Inflow to reservoir
O: Discharge
S: Reservoir capacity

5-2 Numerical calculation method (Ekdahl)

The equation (1) is differentiated into the following:

$$\frac{1}{2}(I_t + I_{t+1})\Delta t = (S_{t+1} - S_t) + \frac{1}{2}(O_t + O_{t+1})\Delta t \ \ldots \ (2)$$

This is transformed into the following:

$$\frac{1}{2}(I_t + I_{t+1}) + \left(\frac{S_t}{\Delta t} - \frac{O_t}{2}\right) = \frac{S_{t+1}}{\Delta t} + \frac{O_{t+1}}{2} \quad \cdots\cdots (3)$$

Successive calculations are also possible on the equation (3) if the initial value is given to it.

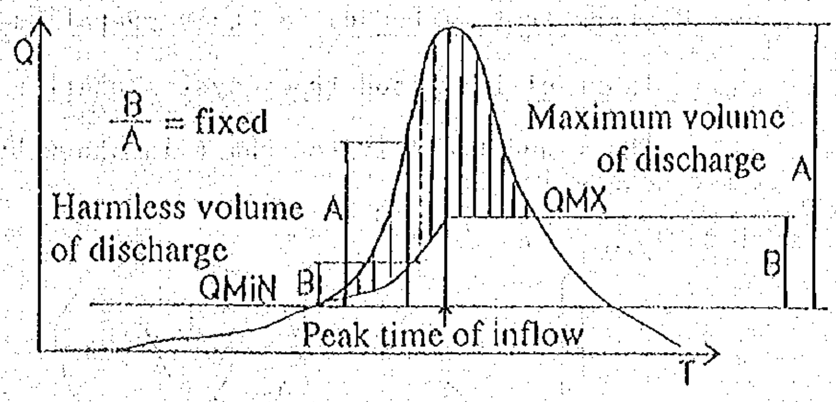
An interpolation method was used in the calculationsl.

5-3 In the case of the constant ratio and discharge control method

The concept of the constant ratio and discharge control method differs between when a dam is planned and when the gate operation rules are made after the completion of dam construction.

① When a dam is planned:

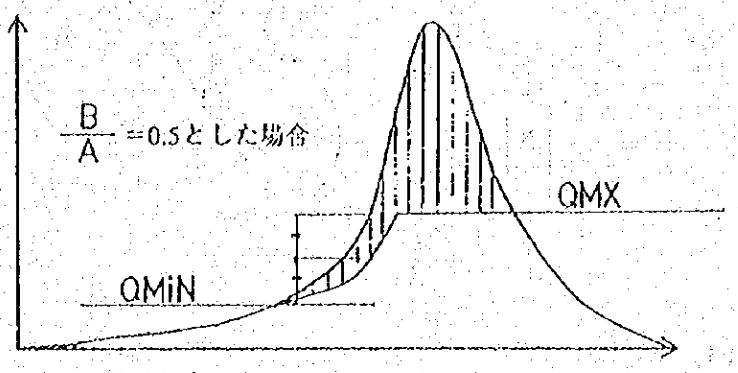
The harmless outflow and the maximum outflow are included in the conditions for the plan, and the fixed-rate volume differs according to the inflow pattern.



The fixed-rate volume is calculated so that the maximum volume of discharge may be reached at the peak time of inflow.

② After the preparation of gate operation rules:

When the gate operation rules are established, the fixed-rate volume is determined from the equation of (Inflow - QMIN) x a fixed rate, and the gate is operated according to the determined fixed volume.



6. Matters to be attended in the preparation of input data

6-1 Input of the flood trace system chart

The flood trace system chart is shown by one of the following schematic charts.

Fig. 1

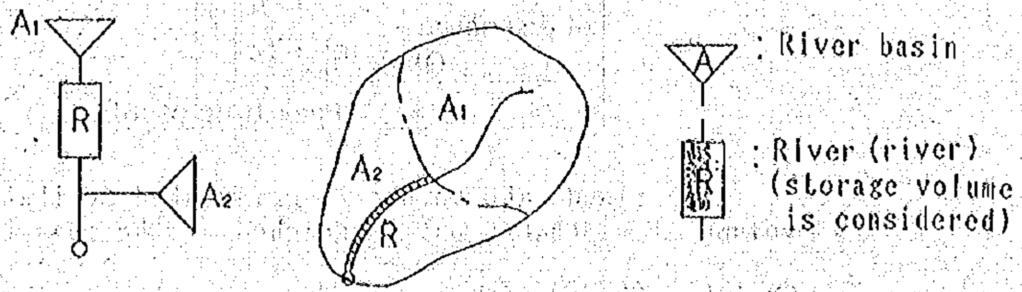


Fig. 2

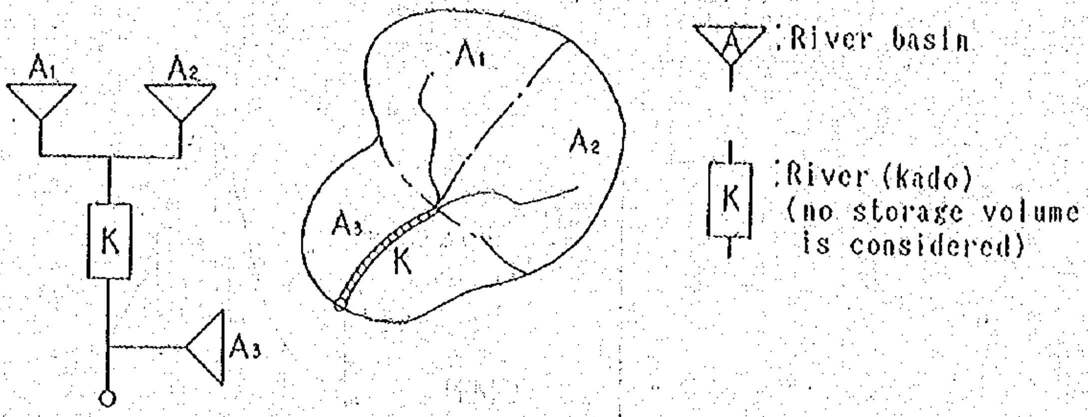
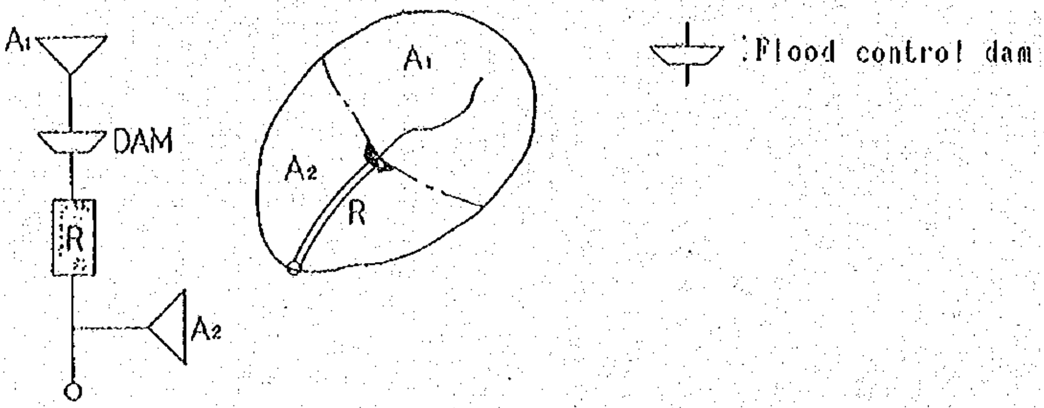


Fig. 3

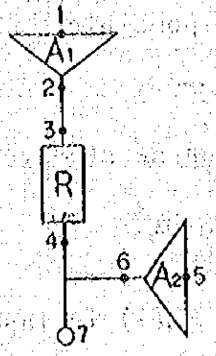


洪水追跡システムのポイント数

1) The point Nos. in the trace system chart

Serial numbers are entered in the flood trace system chart in the manner as shown in, for instance, Figs. 1 through 3.

Fig. 1



Point No.	1	2	3	4	5	6	7
Name	1-R	1-Q	R(in)	R(ou)	2-R	2-Q	KIJUNTEN
Rainfall input point	○				○		○

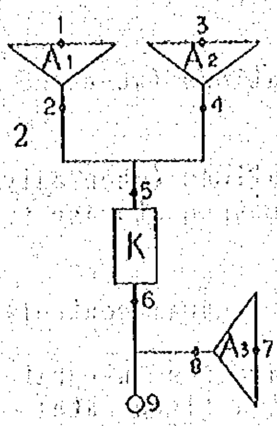
No. of basins NARBA = 2

No. of river courses NRIV = 1

Total No. of points NPOIN = 7

No. of dams IDAM = 0

Fig. 2



Point No.	1	2	3	4	5	6	7	8	9
Name	1-R	1-Q	2-R	2-Q	K(in)	K(ou)	3-R	3-Q	KIJUNTEN
Rainfall input point	○		○				○		

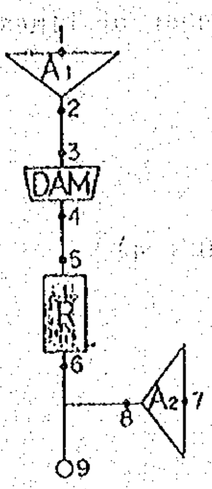
No. of basins NARBA = 3

No. of river courses NRIV = 1

Total No. of points NPOIN = 9

No. of dams IDAM = 0

Fig. 3



Point No.	1	2	3	4	5	6	7	8	9
Name	1-R	1-Q	DAM(IN)	DAM(OU)	R(in)	R(ou)	2-R	2-Q	KIJUNTEN
Rainfall input point	○						○		

No. of basins NARBA = 2

No. of river courses NRIV = 1

Total No. of points NPOIN = 9

No. of dams IDAM = 0

NZ(i)の説明

2) Explanation of (NZ(i), i = 1, NPOIN)

It is a control parameter of run-off trace calculations.

In the run-off calculations, if the run-off is traced with the point numbers, the following division is possible.

(a) Rainfall data are input.
降雨データ
(b) Calculations are made (basin and river course storage calculations and flood control calculations)
流域、河道における貯留計算 及び ダムによる洪水調節計算
(c) The calculated run-off values are cumulated.
計算結果の保存

In the case of (a), the point number of NZ(i) is input as it is.

In the case of (b), one of the following shall be selected as NZ(i).

(91) for the basin storage calculations.
流域貯留

(92) for the river course storage calculations (when the river course storage is considered)
河道貯留計算

(93) for the river course storage calculations (when only the flow-down time is considered with no river course storage taken into account) 河道の遅れ時間考慮

(94) for the flood control calculations (natural control)
洪水調節（自然調節）

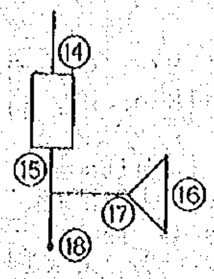
(95) for the run-off calculations by Nakayasu's Integrated Unit Hydrograph (the fixed volume control at a fixed rate)
洪水流出計算（中安の総合単位図）

In the case of (c), NZ(i) shows the number of times of cumulative calculations. ?

If the addition is once, NZ(i) is 81.

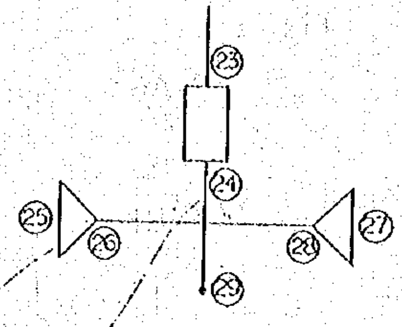
If the addition is twice, NZ(i) is 82.

If the addition is thrice, NZ(i) is (80 + n)



○ In ⑱, the addition is done twice → 82?

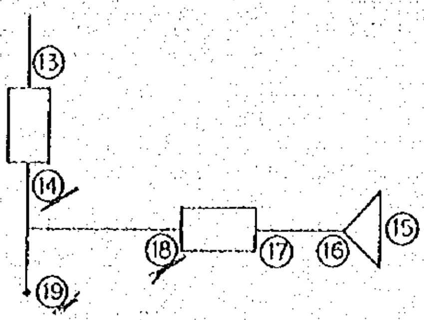
⑱	=	⑰	+	⑮
N		N - 1		N - 3



○ In (29), the addition is done thrice → 83.

㉙	=	㉘	+	㉖	+	㉔
N		N - 1		N - 3		N - 5

○ The following is adopted if the calculations are not done according to the above rules.



The addition frequency in ⑲ is twice, and if NZ(19) = 82, ⑲ = ⑱ + ⑯. This is unreasonable.

不合理

⑲	=	⑱	+	⑯
N		N - 1		N - 3

1002

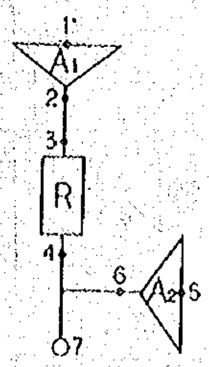
加算回数

In this case, assuming that NZ (19) = 1002 (1000 + No. of addition times), NZZ (19, ①) = 18 or (and) NZZ (19, ②) = 14 is input.

Further if the calculation results are desired to be used, the point number J of the area of which the calculation results are to be used shall be input as it is.
この他、計算済の結果を利用したい場合は、その利用したい地点のPoint番号Jをそのまま入力

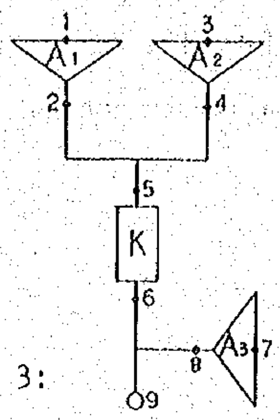
NZ (1) = J is necessary when Figs. 1 and 3 are executed at once. It is explained later.

Fig. 1:



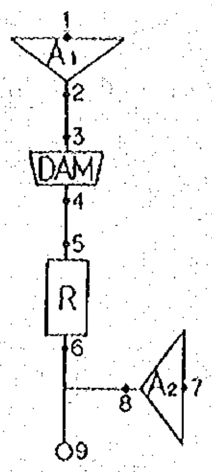
Point No.	1	2	3	4	5	6	7
NZ(i)	①	91	81 (or 2)	91	⑤	91	82

Fig. 2:



Point No.	1	2	3	4	5	6	7	8	9
NZ(i)	①	91	③	91	82	93	⑦	91	82

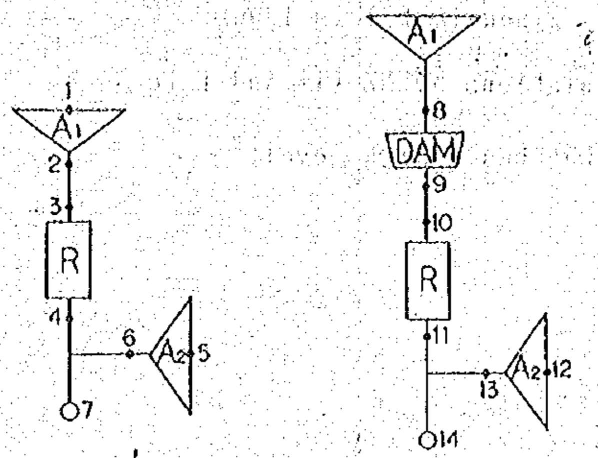
Fig. 3:



Point No.	1	2	3	4	5	6	7	8	9
NZ(i)	①	91	81 (or 2)	94	81 (or 4)	92	⑦	91	82

図-1, -3を同時に行う場合
(ダム計画において、基本高水流量と計画高水流量を
基準地点まで同時追跡.

When Figs. 1 and 3 are executed at once (in a dam plan, the basic and the planned high-level flow rates are traced at the same time up to the standard point)



Number of river basins	NAREA=2
Number of river courses	NRIV=1
Total number of points	NPOIN=14
Number of dams	IDAM=1

Point No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
NZ(i)	①	91	81 (or2)	92	⑤	91	82	2 (or3)	94	81 (or9)	92	5	6	82

3) Explanation of (KRAIN (i), i = 1, NAREA)

In the explanation of the point number NZ (i) to accommodate the river basin rainfall data in floppy disks in advance, the encircled number is read by the number of river basins NAREA.

In Fig. 1, → KRAIN (i) = 1, 5 (NAREA = 2)
In Fig. 2, → KRAIN (i) = 1, 3, 7 (NAREA = 3)
In Fig. 3, → KRAIN (i) = 1, 7 (NAREA = 2)
In Fig. 1 / In Fig. 3 → KRAIN (i) = 1, 5 (NAREA =)

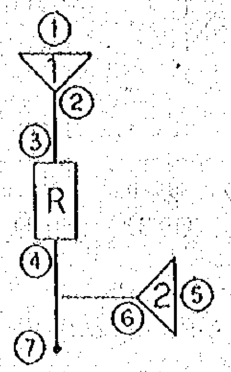
4) (NAME (I), I = 1, NPOIN)

The name corresponding to each point number in the flood trace system chart (explained in 1)) is input.

NZ(i) とファイルによる計算例

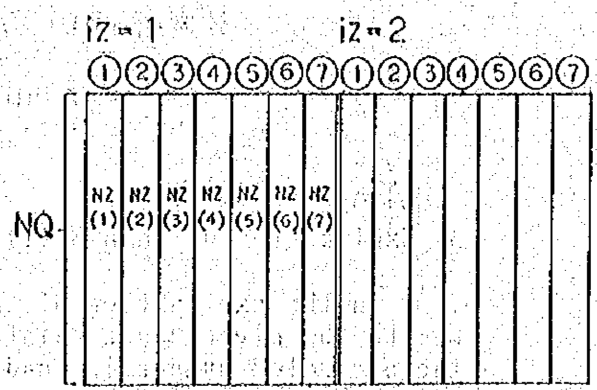
5) Example of the calculations by NZ (I) and file

① Calculations of the basic high level:

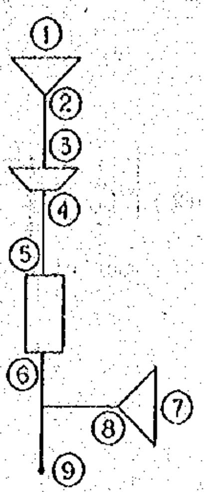


NPOIN=7

Contents of the file (3D')



② Calculations of the planned high level:



NPOIN = 9

NPFL = 7 (NPOIN in the calculations of ① basic high level)

POINT	①	②	③	④	⑤	⑥	⑦	⑧	⑨
NZ(i)	1.	2002	81.	94.	81.	93.	7.	2006.	82

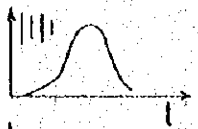
Only the file reading is enough without the need of run-off calculations in ② and ⑧.

6-2 Explanation of the case where the run-off calculation results are plotted:

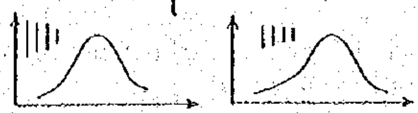
1) Explanation of IPLOT:

IPLOT shows the number of calculation results to be plotted.

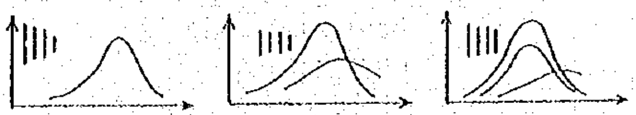
If IPLOT = 1,



If IPLOT = 2,



If IPLOT = 3,



2) (JQ (i), i = 1, 5)

JQ (i) is the parameter to control plotting.

In one plot (IPLOT = 1), 1 rainfall (represented by -) and 4 run-offs (represented by dot ·) can be output.

Examples of Figs. 1, 2 and 3 are shown below.

Fig. 1: The case of IPLOT = 1

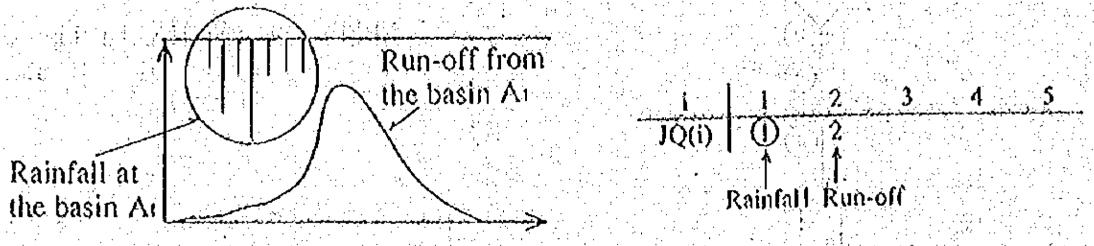


Fig. 1: The case of IPLOT = 2

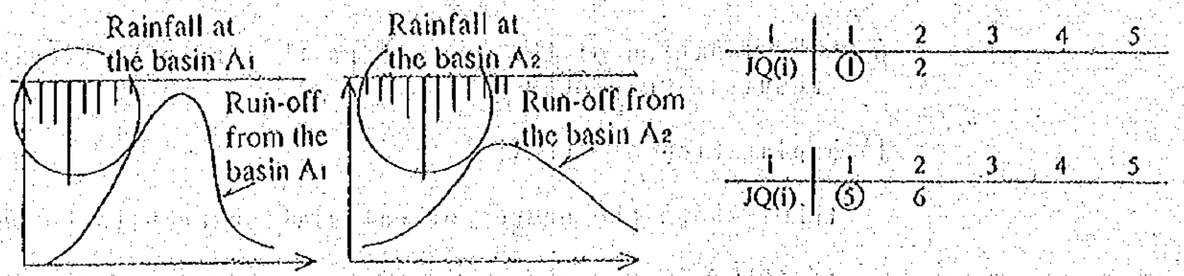


Fig. 2: The case of IPLOT = 1

(To plot the run-off reduction and lag time due to the river course storage)

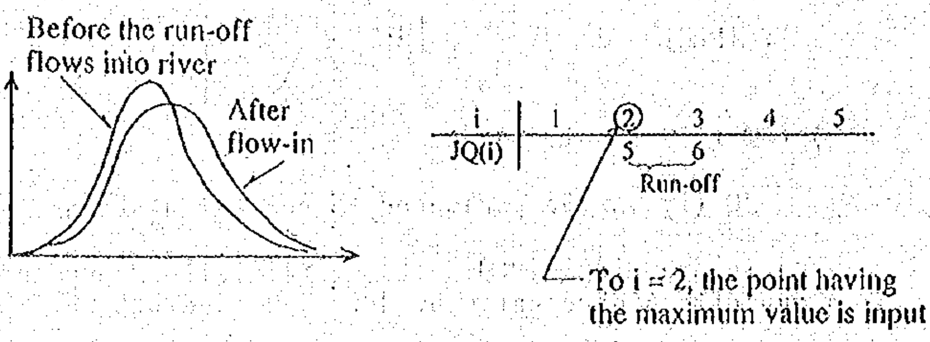
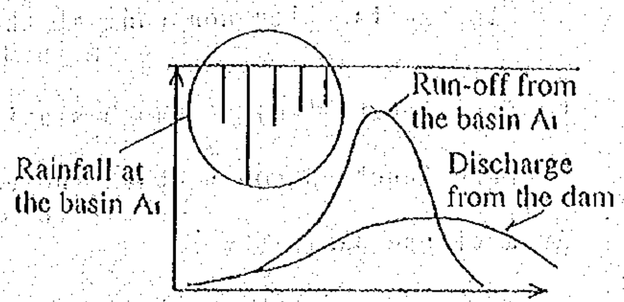


Fig. 3: The case of IPLOT = 1

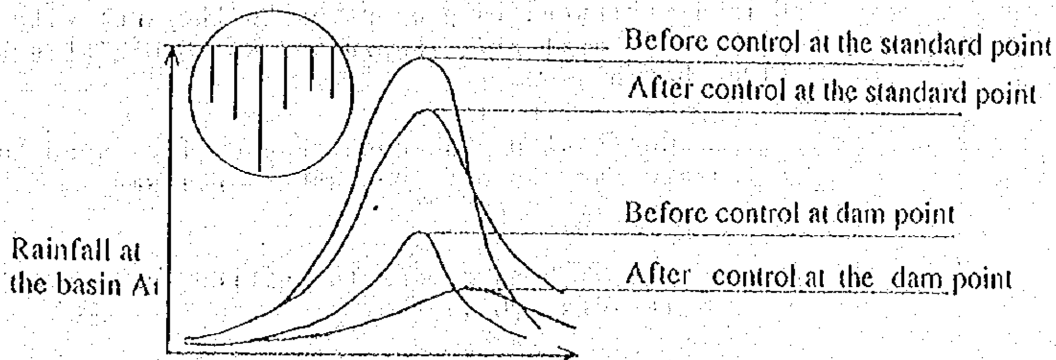
(To plot the dam control effects)



i	1	2	3	4	5
JQ(i)	①	2	4		

The case of Figs. 1 and 3 and IPLOT = 1

(To plot the basic and the planned high-level flow rates at the dam point and the standard point)



i	1	②	3	4	5
JQ(i)	①	7	2	14	9

The order is movable

To I = 2, the standard point having the maximum value and the 7 points before run-off control are input.

入力変数の説明

6-3 Explanation of the input variables

AF (i) .... Flow-in coefficient at the basin i; generally AF(i) = 1.0

FK (i) .... Storage function constant at the basin i: K in $S = KQ^p$

AL (i) .... Channel length (km) at the basin i.

AP (i) .... Storage function constant at the basin i: P in $S = KQ^p$

AREA (i) .... Area of the basin (km^2)

AS (i) .... Mean gradient of the basin i; when E x 1/50, AS (i) = 50

ATL................Lag time at the basin (hr)

BBB .... Width B of usual spillway: (m)

C .... Constant of IZZARDS when the reserve constant is used to determine the constant of basin storage function.

C is distributed in proportion to the area with C = 0.12 at natural river basin and C = 0.012 at urban river basin.

CF .... Constant of the open channel flow used to calculate the run-off from usual spillway.

$$Q_f = C_f \cdot B \cdot H^{3/2} \quad CF = C_f$$

CM (i)............ Title which covers the entire run-off calculations (20A4)

CP .... Constant of the tube channel flow used to calculate the run-off from usual spillway.

$$Q_p = C_p \cdot A \cdot \sqrt{28H} \qquad CP = C_p$$

DAMP .... Reservoir calculation time interval (second)

DT .... Time interval (second) of the run-off calculations with the storage function

DTR .... Unit time of input rainfall distribution (sec) Usually 3600 seconds

EL .... Height from the sea level of usual spillway (EL). Usually full-level in general

F1(i)............. The primary run-off rate at the basin i.

HHH .... Height of usual spillway, H(m)

HS .... Reservoir level ~ capacity curves (EL)

IDAM .... Number of dams for which the flood control calculations are done: IDAM = 0

IQXR .... Output control parameter

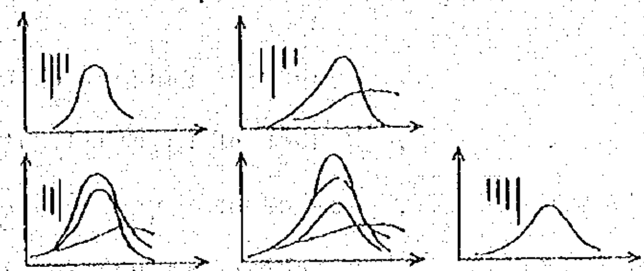
If the results of calculations at all intervals are output: IQXR = 1

If the results are output at every other interval: IQXR = 2

If the results are output at every two intervals: IQWR = 3

(Example): If the calculation results per hour, with the calculation time interval DT = 600 sec. are desired to be output.

IPLOT .... Number of the run-off calculation results to be plotted.



IPLOT = 2

IPLOT = 3

IROUT .... In the trace calculations, if the selected parameter interpolation method is used, IROUT = 0.
If Newton-raphson method is used, IROUT = 1.
(The results are larger when the interpolation method is used.)

JADATA .... Parameter to select the empirical equation to determine the basin storage function.

JRDATA .... Parameter to select the empirical equation to determine the river course storage function.

KOUZUI .... Name of the flood in rainfall data (A80)

KRAIN .... The point No. to accommodate the basin rainfall data into floppy disks in advance

LSA (i) .... If no percolation area is considered at the basin i: LSA (i) = 0
If the percolation area is considered at the basin i: LSA (i) = 1.

N .... Number of the rain gauging stations which use the rainfall data. If the basin rainfall is directly input, N = 1.

NAME (1X, A9)..... Name of the point No.

NAREA .... Number of the river basins to be calculated.

NPOIN .... Total number of points to be calculated

NQ .... Number of run-off calculations.

NR .... Number of rainfall data to be input.

NRIV .... Number of river courses to be calculated.

NSTR .... Number of inputs for inputting the flow rate/river course storage curves in succession when the constant of river course storage function is determined.

NZ .... Control parameter of the run-off trace calculations.

QC (i) .... The base flow rate at the basin i (m^3/sec)

RB (i) .... Mean river width of river course i (m)

RK (i) .... Storage function constant of river course i
when $S = KQ^P$, $RK(i) = K$

RL (i) .... Channel length of the river course i (km)

RN (i) .... Coarseness coefficient of the river course i
RP (i) .... Storage function constant of river course i
when $S = KQ^P$, $RP(i) = P$

RS (i) .... Bed slope of the river course i
when $I = 1/500$, $RS(i) = 500$
RSA (i)........... Saturation rainfall at the basin i (mm)

RTL (i)........... Lag time of the river course i (hr) or the flow-down time (hr) if no river course storage calculation is done.

TITLEA (i)........ Name of the basin i
(3A4)
(example) 1-RYUiK1

TITLEA (i)........ Name of the water course i
(3A4)
(example) 1-KADO

VS .... The reservoir level ~ capacity curve capacity (m^3): the cumulative increase in capacity from the lowest level (capacity = 0) is added to the capacity.

X .... The flow rate (m^3/sec) used to determine the river course storage function from the flow rate ~ river course storage curve by the method of least squares.

Y .... The river course storage rate (m^3) to X.

JQ .... The point designation and control parameter for plotting the run-off calculation results.

IR .... Probable rainfall duration (hr).
For probability treatment of daily rainfall;

Ir = 24

For probability treatment of 2-day rainfall:

Ir = 48

If no such treatment is done: Ir = NR.

IW .... Enlargement control parameter

If IW = 0, enlargement is applied to the whole time.

If IW = 0, enlargement is applied only within the probable rainfall duration period.

RKA(i) .... Probable rainfall at the basin i (mm)

If no probability treatment (enlargement) is done, it should be that RKA (i) = 0.0, IR = NR, IW = 1.

DATA SHEET

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Run-Off Calculations (Operation)

CM(i)	, i = 1 , 20	Title	(20A 4)

A title of 80 letters at maximum is entered.

NPOIN	IG	NPFL	(3I10)

NPOIN: Total number of points

IG: IG = 0 during ordinary output & IG = 1 if no run-off calculation results are output but only the maximum value is output at PRO2.

NPFL: Number of points is usually 0 (see P.19) when other files data are accessed.

IROUT	(I10)

IROUT: When the run-off calculations are done using the storage function:
IROUT = 0 by Linear interpolation method. IROUT = 1 by Newton-Raphson method. The linear interpolation method is faster in calculations and larger in the run-off calculation results.

When Nakayasu's integrated unit hydrograph is used:
IROUT = 0: No loss is considered.
IROUT = -1: $R \leqq 100$ $R_L = R(1-3.6\times10^{-4}\times R^{1.5})$; $R > 100$ $R_L = 64.0$
IROUT = -2: Rainfall 20mm in the previous term is considered.

NAREA	NRIV	JADATA	JRDATA	(4I10)

NAREA: Number of basins
NRIV: Number of rivers (Total number of river courses R and K)
JADATA: Parameter to select the empirical formula for determining the basin constant.
JRDATA: Parameter to select the empirical formula for determining the river course constant.

JADATA = -1: The basin storage constant (K, P) is directly input.
= 0: The empirical formula of Tone River or Nakayasu's integrated unit hydrograph.
= 1: The empirical formula using the reserve constant.

JRDATA = -1: The river course storage constant (K, P) is directly input.
= 0: Empirical formula of Tone River
= 1: The storage function (K, P) is determined from the flow rate/river course storage curve by the method of least squares.

DATA SHEET

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① Skip to ⑬ if the number of basins AREA = 0. 流域の数が0なら ⑬までスキップ

② Repeat by the number of times of NAREA. 流域の数だけ繰り返す

流域名

TITLEA(i)

(A12)

Title of the divided basin area

流域データ

③ When the storage function is used to calculate the run-off from basins 流域データから K,P を計算する時

AERA(i)	AL(i)	AS(i)
Basin area (km^2)	Channel length (km)	Basin gradient

(3F10.0)

Ex. AS(i)=100.0 if the gradient is 1/100.

④ Input only when JADATA = -1. 流域定数を直接入力する場合

AK(i)	AP(i)

(2F10.0)

$S=KQ^P$. Storage function constant. AK(i)=K, AP(i)=P

⑤ Input only when JADATA = 1. 流域定数を計算する場合

C

(F10.0)

Izzards' constant

$K=43.4\times C\times AL(i)^{1/3}\times i^{-\frac{1}{3}}$

$P=1/3$

⑥ If JADATA = 0, calculations are done from $K = 118.84 \times i^{0.3}$ and $P = 0.175 \times i^{-0.235}$.

DATA SHEET

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⑦

RSA(i)	F1(i)	AF(i)	QC(i)	ATL(i)

(5F10.0)

Saturation rainfall(mm) | Primary run-off coefficient f_1 | Inflow coefficient f=1.0 | Base flow rate (m^3/s) | Lag time (hr)

If ATL(i)=0.0 , ATL(i)= 0.047×AL(i) ^0.56

If ATL(i)<0.0 ATL(i)=0.0

If QC(i) ≤ 0.0 QC(i)=0.04×AREA(i)

LSA(i)

(I10)

If no percolation area is considered, i.e., (f_1=1.0), LSA(i) = 0. If it is considered, LSA(i) = 1.

⑧

⑨ If Nakayasu's integrated unit hydrograph is used to calculate the run-off from basins (i.e., JADATA = 0)

AERA(i)	AL(i)	DO(i)

(3F10.0)

Basin area (km^2) | Channel length (km) | Unit time t_0 (hr)

⑩ If LSA(i) = 0 is used, read by ⑩.

AL(i) ≥ 15.0 t_g = 0.4+0.058×AL(i)

AL(i) < 15.0 t_g = 0.21×AL(K)**0.7

t_α = 0.47×(AL(i)×AREA(i))**0.25

t_p = 0.8×DO(i) + t_g

QC(i)

(30X,F10.0)

Base flow rate(m^3/s). QC(i) ≤ 0.0 QC(i)=0.04×AREA(i)

DATA SHEET

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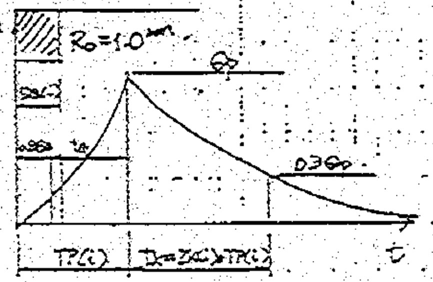
⑪ If LSA(i) = 1 is used, read by ⑫.

TP(i)	ZK(i)	QC(i)	(2F10.0,10X,10.0)
Flood reach time (hr)	Reduction coefficient	Base flow rate (m^3/s)	



⑫ LSA(i) (I10)

See ⑩ and ⑪.

河道データ

⑬ Completion of inputting the basin parameters.

⑭ If the number of river courses is NRIV=0, skip to ⑲.

⑮ Repeat by the number of times of NRIV.

河道名

TITLER(i) (A12)

The title of divided water courses.

⑯ Input only when JRDATA = (-1) 遅滞入力時

RK(i)	RP(i)	RL(i)	RS(i)	RTL(i)	RF(i)	(6F10.0)
K in S=KQP	P in S=KQP	Channel length (km)	Bed slope	Lag time (hr) or flood reach time (hr)	RF(i)=0.0 Operation based on S=KQP RF(i)=1.0 Operation based on S=KQP-TeQ	

DATA SHEET

PROBLEM ________ WRITTEN BY ________ PAGE ____ OF ____

⑰ Input only when JRDATA = 0 ・・ 利根川の経験式を採用

河道長	勾配	幅	粗度	
RL(i)	RS(i)	RB(i)	RN(i)	RF(i)
Channel length (km)	Bed slope	Mean river width (m)	Coarseness coefficient n	RF(i)=0.0 Operation based on S=KQP RF(i)=0.0 〃 〃 S=KQP-TeQ

(5F10.0)

$RK(i)=0.185*RL(i)*RB(i)^{0.4}\times RS(i)^{0.3}*RN(i)^{0.6}*1.67$

RP(i)=0.6

RTL(i)=0.000736*RL(i)*SQRT(RS(i))

⑱ Input only when JRDATA=1

NSTR

(I10)

Number of combinations of flow rate (X) and river course storage (Y) to be input.

河道長	河床勾配	遅れ時間	
RL(i)	RS(i)	RTL(i)	RF(i)
Channel length (Km)	Bed slope	Lag time (hr)	RF(i)=0.0 Operation based on S=KQP RF(i)=1.0 〃 〃 S=KQP-TeQ

(4F10.0)

X(1)	Y(1)
X(2)	Y(2)
X(NSTR)	Y(NSTR)
Flow rate (m^3/sec)	River course storage (m^3)

Number of NSTRs is input.

(2F10.0)

⑲ Completion of inputting river course parameters.

DATA SHEET

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⑳

DT	(F10.0)

Calculation time interval (sec)

㉑ Control parameter of the run-off trace calculations. NZ(i).

NZ(1)	NZ(2)	NZ(3)	NZ(4)	---	---	---	---

---	---	NZ(NPOIN)

(8i10)

If Point i:

- Is a rainfall data. NZ(i) = 1
- Uses the result of point J. NZ(i) = J
- Is added N times. NZ(i) = 80 + n
- Storage function/basin calculations. NZ(i) = 91
- Storage function/river course calculations. NZ(i) = 92
- River course calculations with only flow-down time lagged. NZ(i) = 93
- Reservoir plan (natural control). NZ(i) = 94
- Nakayasu's integrated unit hydrograph. NZ(i) = 95
- The fixed volume control calculations. NZ(i) = 96
- The fixed volume control at a fixed rate calculations. NZ(i) = 97
- A point is designated and added n times. NZ(i) = 1000+n
- Point J in No.31 file is read. NZ(i) = 2000+J
- The result of point n is added or subtracted. NZ(i) = -n

㉒ Skip to (25) if there is no "NZ(i) <0" and "1000< NZ(i) <2000".

In the ascending order of the point numbers, input (23) in case of NZ(i)<0 and (24) in case of 1000<NZ(i) <2000, with the initial value set at NNZ=1.

㉓ If NZ(i)=-n, NZKO = n.

NZZ(NNZ,1)	NZZ(NNZ,2)	---	NZZ(NNZ,NZKO)

(8i10)

If it is desired to add the result of point J, NZZ(NNZ, i)=J
If it is desired to deduct it, NZZ(NNZ, i) = -J

NNZ=NNZ+1

DATA SHEET

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NO

㉔ If 1000<NZ(i) <2000, NZKO = NZ(i) - 1000

NZZ(NNZ,1)	NZZ(NNZ,2)	---	NZZ(NNZ,NZKO)	(8i10)

If it is desired to add the result of point J, NZZ(NNZ, NZKO)= J.

NNZ=NNZ+1

㉕ Skip to (27) If the number of basins is NAREA = 0.

㉖ The POINT No. for putting the rainfall data in floppy disks in advance (input the data corresponding to NAREA).

KRAIN(1)	KRAIN(2)	---	---	KRAIN(NAREA)	(8i10)

㉗ Input the name of each point.

NAME(1)	NAME(2)	--- EX	1 - R	1 - Q	DAM(iN)	K1(iN)	K1(OU)	
---	---	---	NAME(NPOiN)	8(1X,A9)				

DATA SHEET

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(28)

iDAM	iPLOT	iPL	iVL

(4i10)

iDAM: Number of the dams for which either the reservoir calculations (natural control) or the fixed volume control at a fixed rate calculations are done for flood control.
iPLOT: Number of the kinds to be plotted by a line printer.
iPL: Time axis scale in plotting
iVL: Hydrograph volume calculations are done on the point iVL.

On iPL:
- iPL=0 for plotting every result of each DT.
- iPL=1 for the plotting, reduced in scale, of Q(2), Q(4) & Q(6).
- iPL=2 for the plotting, reduced in scale, of Q(3),Q(6) & Q(9).
- iPL=-1 for plotting doubled in scale.
- iPL=-2 for plotting tripled in scale.

(29) If the number of dams is iDAM = 0, skip to (38).

(30)

DAMT

(F10.0)

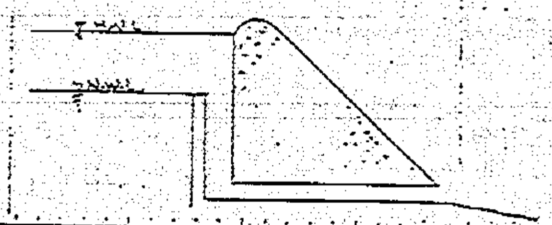
Flood control calculation time interval (sec)

NDJ(1)	NDK(2)	---	--- -	NDJ(iDAM)

(8i10)

NDJ(i) < 0: The fixed rate, fixed volume calculations (H~Q, H~V curves are not input.)
NDJ(i) = 0: Combination of usual and emergency spillways. (Shapes of discharge tubes and overflow width are input.)
NDJ(i) = 1: For inputting the H~Q curves.
NDJ(i) = 2: If the usual spillway is of an orifice shape (of Kadokawa system).

Kadokawa System



DATA SHEET

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(31) Repeat by the number of times represented by IDAM.

(32) Skip to (36) or (37) if NDJ(i) <0.

NV(i)	(I10)

Number of combinations of the reservoir ~capacity curves (EL)
(EL)

HS(i,1)	VS(i,1)
HS(i,2)	VS(i,2)
HS(i,NV)	VS(i,NV)

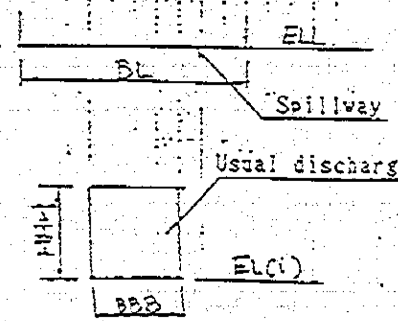
Input all the NV(i)s displayed. (2F10.0)

(33) Input should be done only when NDJ(i) = 0.

(8F10.0)

BBB	HHH	EL(i)	CF	CP	FLL	BL	DH
Usual discharge tube width (m)	Usual discharge tube height (m)	Usual discharge tube bundle height (EL)	Open channel constant. CF = 2.0 if $Q = CBH^{3/2}$ and CF = 0.0.	Channel constant CP = 0.90 if $Q = CA\sqrt{2gH}$ and CP = 0.0	Emergency spillway level (EL)	Emergency spillway width (EL)	H~Q curve calculation DH = 0.20 if DH = 0.0

This column is left blank if no spillway calculation is done.



PROBLEM ______ WRITTEN BY ______ PAGE ______ OF ______

(34) Input only when NDJ(i) = 1.

NO(i)	EL(i)
Number of combinations of the level ~ flow rate curves.	Usual full level (EL)

(i10,F10.0)

HF(i,1)	QF(i,1)
HF(i,2)	QF(i,2)
HF(i,NO)	QF(i,NO)
Water level (EL)	Flow rate (m³/s)

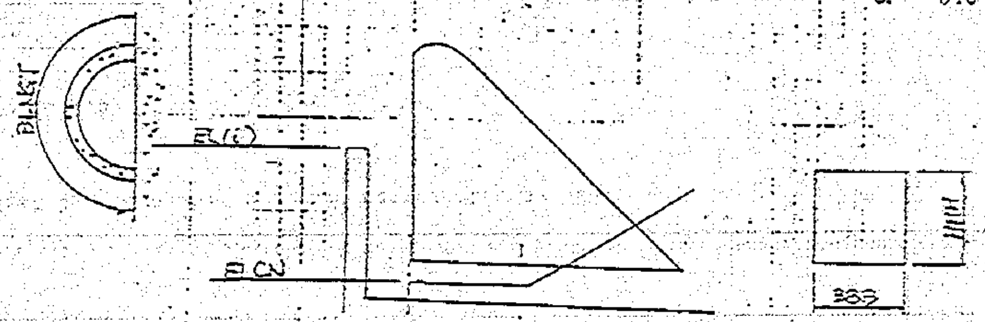
Input all the NO(i)s displayed.

(2F10.0)

(35) Input only when NDJ(i) = 2.

BBB	HHH	EL(i)	CF	CP	ELCN	BLNGT
Spillway width (m)	Usual spillway height (m)	Usual full level (EL)	Open channel constant CF = 2.0 if CF = 0	Tube channel constant. CP = 0.90 if CP = 0.0	Discharge gate central height from sea level (EL)	Overflow bank width (m)

(7F10.0)



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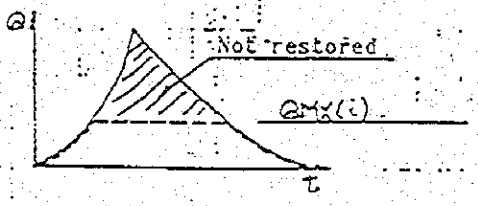
(36) Input only when NDJ(i) < 0 and NZ(J) = 96 (a fixed-volume control calculation) is done.

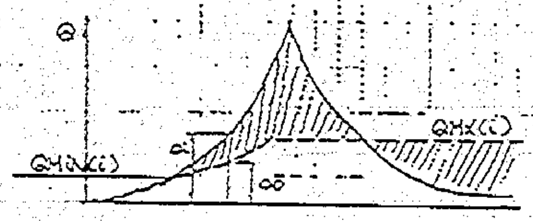
QMX(i)	(F10.0)
The fixed-volume control volume (m^3/s)	



(37) Input only when NDJ(i) < 0 and NZ(J) = 97 (a fixed-volume control calculation) is done.

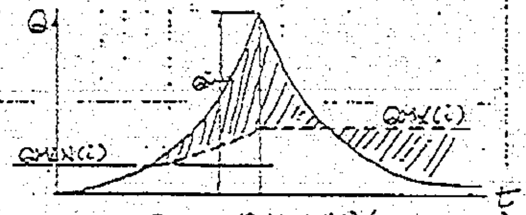
QMX(i)	QMiN(i)	RTCUT(i)	(3F10.0)
The fixed-volume control volume (m^3/s)	Flow rate where the control starts (m^3/s)	Control rate	

(1) When the control rate is input (RTCUT(i) > 0)



QO = QMIN + (QI − QMIN) × RTCUT

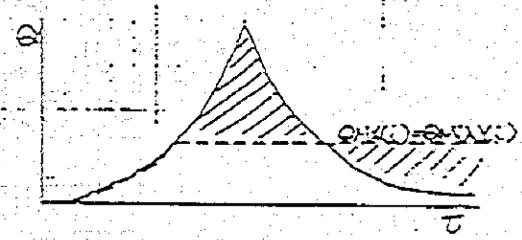
(2) No control rate is input (RTCUT(i) = 0)



RTCUT = (QMX − QMIN)/(QI − QMIN)

The control rate RTCUT is calculated at the time of peak occurrence

(3) When QMX(i) = QMIN(i) and RTCUT(i) = 1.0



The fixed-volume control comes and the control volume is also restored.

DATA SHEET

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(38). Skip to (39) for plotting by a line printer and iPLOT = 0.

JQ(1,1)	JQ(1,2)	JQ(1,3)	JQ(1,4)	JQ(1,5)	JQ(1,6)	(6I10)
JQ(2,1)	JQ(2,2)	JQ(2,3)	JQ(2,4)	JQ(1,5)	JQ(1,6)	

JQ(iPLOT,1)	JQ(iPLOT,2)	JQ(iPLOT,3)	JQ(iPLOT,4)	JQ(iPLOT,5)	JQ(iPLOT,6)
The point No. for plotting the rainfall data (----)	Point No. for plotting the run-off data (•)	Same with the left	Same with the left	Same with the left	Point No. for plotting the actual flow rate data. (*)

CPL(1)	CPL(2)	CPL(3)	CPL(4)	CPL(5)	(5F10.0)
For fixing a 1-figure range.	For 2-figure one	For 3-figure one	For 4-figure one	For 5-figure one	

Note) If the peak run-off volume is, for instance, 1800m³/sec, and it is plotted in a 3000m³/sec range, input CPL(4) = 3000.0.
If the computer determines it, 2000.0m³/sec is adopted. But in this case, "Blank" will do.

DATA SHEET

PROBLEM ______ WRITTEN BY ______ PAGE ______ OF ______

(39) Skip to (40) for the hydrograph volume calculations and iVL = 0.

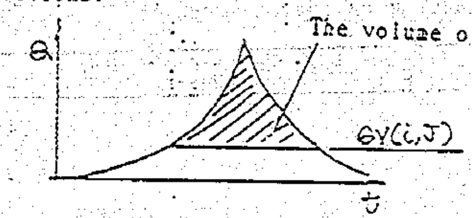
NPV(1)	NQB	QV(1,1)	QV(1,2)	QV(1,NQB)			
NPV(2)	NQB	QV(2,1)	QV(2,2)	---	QV(2,NQB)		
NPV(iVL)	NQB	QV(iVL,1)	QV(iVL,2)	---	---	---	QV(iVL,NQB)

(2I10,6F10.0)

The point number for the hydrograph volume calculations.

1QV or more is calculated, but 1≤NQB≤6

The flow rate for volume calculations. (m^3/s)



DATA SHEET

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(40) Repeat the number of floods up to (53). Number of cases is unlimited.

(41)

KOUZUL	Name of flood	(A80)

EX. SHOWA.50.NEN.8GATSU.18NiCHi

(42) (3i10)

NQ	iQXR	iZ
Number of run-off calculations	Control of output steps. All are output if iQXR = 1.	Flood No. A serial number is given starting from 1.

(43) (2i10,F10.0)

N	NR	DTR
Number of rain gauging stations	Number of rain data.	Unit-time of the rain data (sec). usually DTR = 3600.0

(44) (i10,2F10.0,10i5)

iDAY1	T1	H1	NFL(1)	NFL(2)	NFL(3)	---	---	---	NFL(N)
Date of the initial time	O'clock of the initial time	Minute of the initial time	The point number when inputting the rain data from the 31st file.						

(45) Repeat N times equal to the number of rain gauging stations.

(46)

KAN(i)	(A80)

Name of rain gauging station.

(47) (6F10.0)

RX(1)	RX(2)	RX(3)	RX(4)	---	---
---	---	---	---	---	RX(NR)

The rain data from No. i rain gauging station, generally RX(i) (mm/hr) In this case, DTR = 3600 sec

DATA SHEET

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(48)

iR	iW	MQY	NNK	NQX	DTQX	iBY

(5i10,F10.0,i10)

- iR, iW: The parameters for rainfall enlargement.
- MQY, NNK, NQX, DTQX: The parameters for reading the measured flow rate data.
- iBY: The parameter for rainfall enlargement method.

iR: Probable rainfall duration (hr), usually 24 or 48.

iW: Enlarged over the entire hours if iW = 0, and only within the probable rainfall duration (iR (hr)) if iW = 1.

MQY: Number of the measuring points of measured flow rate data. The number is 0 if no measured data are available.

NNK: The point number for storing the measured flow rate data. (If the number of points in the system chart is NP, NNK = NP + 1. In this case, NPOIN = NP + MQY.)

NQX: Number of measured flow rate data, which should be the same at all measuring points.

DTQX: The unit time of measured flow rate data, which is the same throughout the entire data.

iBY: iBY = 0 if the enlargement rate for each divided basin area is determined by reading the probable rainfall there.
iBY = 1 if the enlargement rate for the entire basin is decided and multiplied by the value for each divided basin area.
iBY = -1 if the enlargement rate is directly input.

(49) Skip to (53) if the number of basins is NAREA = 0.

DATA SHEET

PROBLEM ______ WRITTEN BY ______ PAGE ____ OF ____

(50) Input only when IBY = 0.

Repeat by the number of basins NAREA.

RKA	(F10.0)

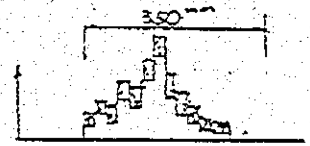
Probable basin rainfall (mm). RKA = 0.0 if no enlargement is done.

M	LZ(1)		LZ(M)	(8I10)

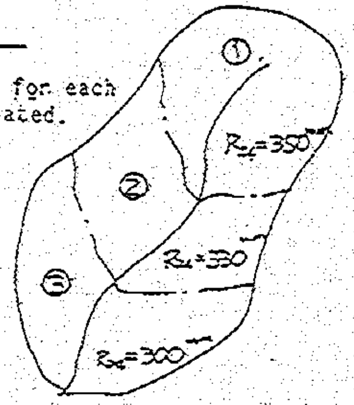
The number of rain gauging stations for calculating the mean basin rainfall. Input rain gauging station nos. in number M.

F(1)		F(M)	(8F10.0)

Thiessen coefficient of the rain gauging station i.

① 

The enlargement rate for each basin area is calculated.



(51) Input only when IBY = 1.

RNAME	(A12)

Title of the point where the enlargement rate is decided (name of the point)

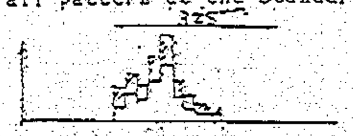
RKA	(F10.0)

Probable rainfall at this point.

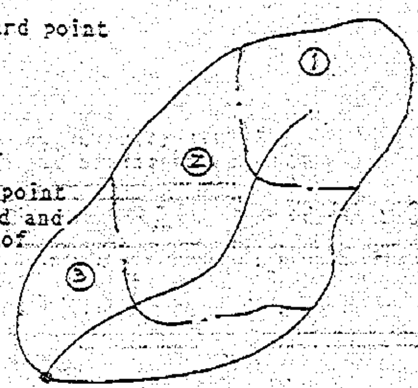
M	LZ(1)	---	LZ(M)	(8I10)

Number of the rain gauging stations for calculating the mean rainfall at this point. Input the rain gauging station nos. in number M

Mean rainfall pattern at the standard point



The enlargement rate at a specific point (e.g., standard point) is calculated and multiplied by the rainfall pattern of each divided basin.



Standard point R_A=325mm

DATA SHEET

PROBLEM ______ WRITTEN BY ______ PAGE ______ OF ______

F(1)	---	F(M)

(8F10.0)

coefficient of rain gauging station i

Repeat by the number of basins NAREA.

M	LZ(1)	---	LZ(M)

(8i10)

Number of rain gauging stations for calculating the mean basin rainfall.

Input the rain gauging stations nos. in number M.

F(1)	---	F(M)

(8F10.0)

Thiessen coefficient of rain gauging station i

(52) Input only when iBY = -1.

RKA	RAT	iMAX
Probable basin rainfall	Enlargement rate	Start time of the rainfall duration iMAX = 1 if measured from the beginning.

(2F10.0,i10)

Repeat by the number of basins NAREA.

M	LZ(1)	---	LZ(M)

(8i10)

Number of rain gauging stations for calculating the mean basin rainfall.

Input the rain gauging station nos. in number M.

DATA SHEET

PROBLEM ______ WRITTEN BY ______ PAGE ______ OF ______

F(1)	- - -	F(M)

(8F10.0)

Thiessen coefficient of rain gauging station i

(53) Completion of the input for one flood. Return to (40) if next flood is calculated.

(54) After the completion of the input for all floods, input (END).

END

7. Computer program for flood analysis

7-1 Brief explanation of the computer program

Outline:A flood analysis of plural basins is made to calculate their run-off hydrograph according to the trace chart,with stress laid on the folld analysis for a dam constructin plan.The run-off calculation is made by the storage function method to calculate the basic and design discharge.In the flood control calculation,either the netural control method or the constant ratio and discharge control is used to determine the dessign flood discharge.

By the above calculations,the distribution for the basic and design discharge,the flood control capacity and the hige water level of dam reservoir are determined.

Input:

*Constants of basin parmeters and basin storage functions.

*Constants of river couse parameters and river course storage functions.

*Calculation time interval and number of calculation units.

*Rainfall time distribution data at rain gauging stations.

*Probable rainfall anda the basic Thinessen's caefficient.

*The dam and usual spillways,if flood control calculations are made.

Output:

*Constants of the basin and river course storage functions.

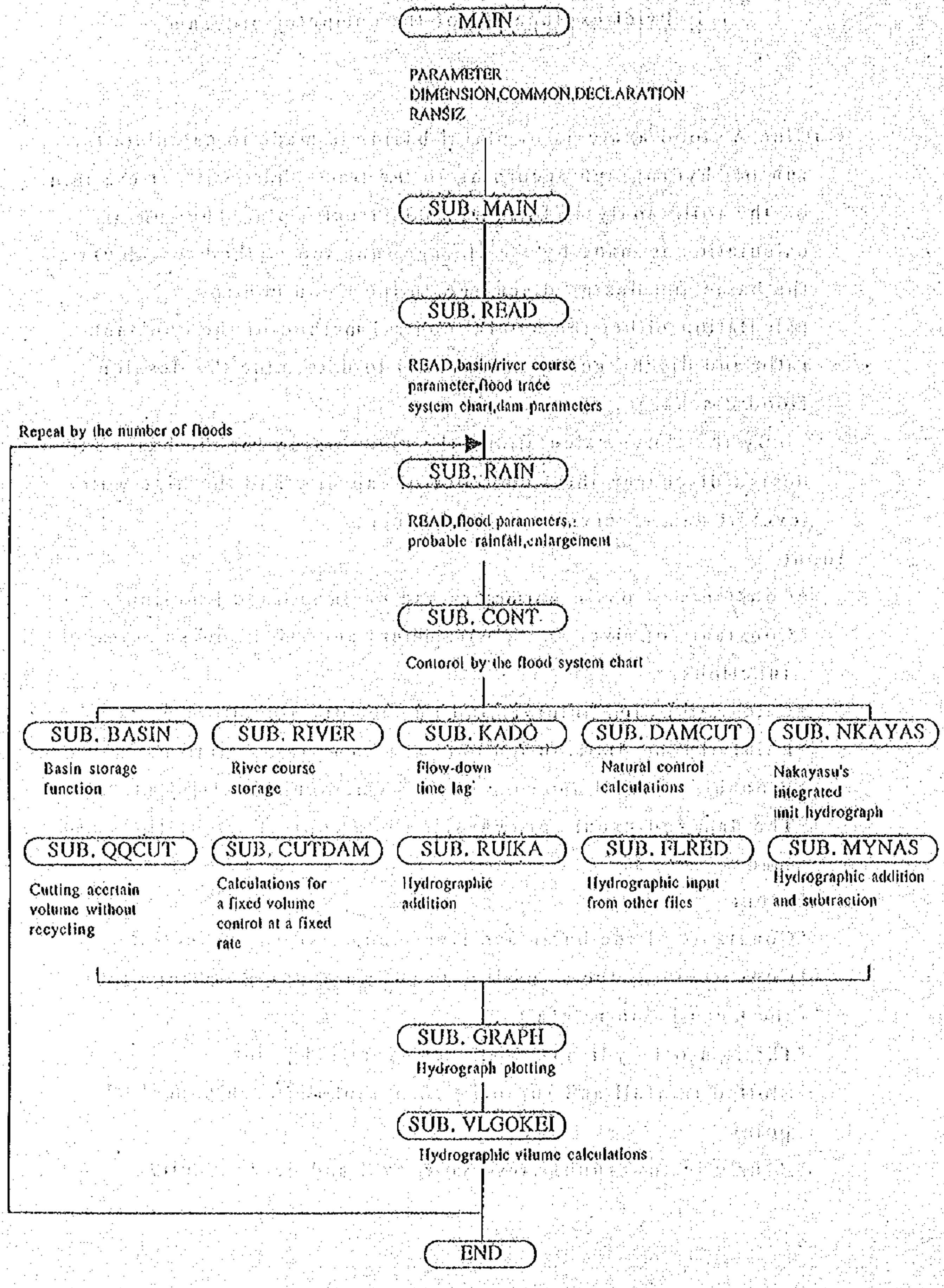
*Conversion of the rainfall data at rain gauging stations into the mean basin rainfall.

*The rum-off hydrograph at each specified point.

*Plotted rainfall and run-off hydrographs at each specefied point.

*Hourly inflow,runoff,reservoir level and dam capacity.

7.2 General Flow Chart of Flood Analysis Program



7-3 Program list

```
C*****************************************************
C
C   FLOOD ANALYSIS BY STORAGE FUNCTION METHOD
C
C*****************************************************
      PARAMETER (IA=25,IB=15,IP=100,IC=900,ID=10,IH=200,IE=800,IK=12)
      PARAMETER  ( IN=12 ,IS=200)
C
      DIMENSION AK(IA),AP(IA),ATL(IA),AF(IA),FI(IA),RSA(IA),QC(IA),
     &     AREA(IA),LSA(IA),TITLEA(IA)  ,AL(IA),AS(IA),XQ(25),
     &     XS(IA,25),KRAIN(IA)
      DIMENSION RK(IB),RP(IB),RTL(IB),RF(IB),TITLER(IB),RL(IB),RS(IB),
     &     RB(IB),RN(IB)
C
      DIMENSION NAME(IP),NZ(IP),IKZ(IP)
C
      DIMENSION QX(IC),QSAL(IC),T(IC),RAVE(IC),HYO(13,IC)
      DIMENSION NV(ID),HS(IP,ID),VS(IP,ID),NO(ID),HF(IH,ID),QF(IH,ID),
     &     BL(ID),QMX(ID),QMIN(ID),RTCUT(ID),NDJ(ID)
C
      DIMENSION HDAM(IE),QI(IE),QO(IE),VV(IE),TI(IE)
C
      DIMENSION RX(IK,IS ),F(IK),LZ(IK),NFL(IK),ARAIN(IK),FT(IK),
     &     KAN(IK)
      DIMENSION NZKO(IN),NZZ(IN,10),AZV(IN,10)
      DIMENSION X(IP),Y(IP),NPNT(IP)
C
      CHARACTER*20 A$,B$
C
      COMMON
     & /BLK02/NAREA,NRIV  /BLK03/DDT,NQ,DT  /BLK04/NPOIN,NNPN,IG,NPFL
     & /BLK05/IDAM,IVL,IEPS,IPNT /BLK06/NQXR,IQXR /BLK07/CM(20)
     & /BLK07C/KOUZUI
     & /BLK08/NNZ  /BLK09/IROUT  /BLK10/CPL(5)  /BLK11/BBB,HHH,CF,CP,
     & QIG,HG,HMIN  /BLK12/DTL,ITL  /BLK13/NKZ,IZ,IRN  /BLK14/NCASE,NQQ
     & /BLK15/T1,ID1,H1  /BLK16/DAMT  /BLK17/QMAX,TP,TK /BLK18/RX1,RX2
     & /BLK20/JQ(10,6),IPLOT,IPL
      COMMON /BLK30/MTOT,MTIN
      CHARACTER KOUZUI*80,NAME*9,KAN*80,TITLEA*12,TITLER*12
      DATA XQ/-100.,0.,0.1,0.2,0.35,0.5,0.75,1.,1.5,2.,3.5,5.,7.5,10.,
     &15.,20.,30.,40.,50.,60.,100.,150.,200.,250.,300./
C
      WRITE(6,4321)
      READ(5,1234) A$
      WRITE(6,4322)
      READ(5,1234) B$
 4321 FORMAT('    INPUT DATA : ')
 1234 FORMAT(A15)
 4322 FORMAT('    OUTPUT DATA : ')
C
C   ***** FILE OPEN *****
C
      OPEN( 4,FILE=A$,STATUS='UNKNOWN')
      OPEN( 3,FILE=B$,STATUS='UNKNOWN')
      OPEN(30,ACCESS='DIRECT',FORM='UNFORMATTED',RECL=900,
     &   STATUS='SCRATCH')
      OPEN(31,ACCESS='DIRECT',FORM='UNFORMATTED',RECL=900,
     &   STATUS='SCRATCH')
      OPEN(32,ACCESS='DIRECT',FORM='UNFORMATTED',RECL=900,
```

```
&     STATUS='SCRATCH')
      CALL MAIN    (AK,AP,ATL,AF,F1,RSA,
     &  QC,AREA,LSA,TITLEA,AL,AS,XQ,XS,KRAIN,RK,RP,RTL,RF,TITLER,RL,RS,
     &  RB,RN,NAME,NZ,IKZ,QX,QSAL,T,RAVE,HYO,NV,HS,VS,NO,HF,QF,BL,QMX,
     &  QMIN,RTCUT,NDJ,HDAM,QI,QO,VV,TI,RX,F,LZ,NFL,ARAIN,FT,KAN,NZKO,
     &  NZZ,AZV,X,Y,NPNT)
      STOP
      END
      SUBROUTINE MAIN(AK,AP,ATL,AF,F1,RSA,
     &  QC,AREA,LSA,TITLEA,AL,AS,XQ,XS,KRAIN,RK,RP,RTL,RF,TITLER,RL,RS,
     &  RB,RN,NAME,NZ,IKZ,QX,QSAL,T,RAVE,HYO,NV,HS,VS,NO,HF,QF,BL,QMX,
     &  QMIN,RTCUT,NDJ,HDAM,QI,QO,VV,TI,RX,F,LZ,NFL,ARAIN,FT,KAN,NZKO,
     &  NZZ,AZV,X,Y,NPNT)
C
      PARAMETER (IA=25,IB=15,IP=100,IC=900,ID=10,IH=200,IE=800,IK=12)
      PARAMETER  ( IN=12 ,IS=200)
C
      DIMENSION AK(*),AP(*),ATL(*),AF(*),F1(*),RSA(*),QC(*),AREA(*),
     &  LSA(*),TITLEA(*),AL(*),AS(*),XQ(*),XS(IA,*),KRAIN(*),RK(*),RP(*)
     &  ,RTL(*),RF(*),TITLER(*),RL(*),RS(*),RB(*),RN(*),NAME(*),NZ(*),
     &  IKZ(*),QX(*),QSAL(*),T(*),RAVE(*),HYO(13,*),NV(*),HS(IP,*),
     &  VS(IP,*),NO(*),HF(IH,*),QF(IH,*),BL(*),QMX(*),QMIN(*),RTCUT(*),
     &  NDJ(*),HDAM(*),QI(*),QO(*),VV(*),TI(*),RX(IK,*),F(*),LZ(*),
     &  NFL(*),ARAIN(*),FT(*),KAN(*),NZKO(*),NZZ(IN,*),AZV(IN,*),X(*),
     &  Y(*),NPNT(*)
      COMMON
     &      /BLK02/NAREA,NRIV
     &      /BLK03/DDT,NQ,DT
     &      /BLK04/NPOIN,NNPN,IG,NPFL
     &      /BLK05/IDAM,IVL,IEPS,IPNT
     &      /BLK06/NQXR,IQXR
     &      /BLK07/CM(20)
     &      /BLK07C/KOUZUI
     &      /BLK08/NNZ
     &      /BLK09/IROUT
     &      /BLK10/CPL(5)
     &      /BLK11/BBB,HHH,CF,CP,QIG,HG,HMIN
     &      /BLK12/DTL,ITL
     &      /BLK13/NKZ,IZ,IRN
     &      /BLK14/NCASE,NQQ
     &      /BLK15/T1,IDAY1,H1
     &      /BLK16/DAMT
     &      /BLK17/QMAX,TP,TK
     &      /BLK18/RRMAX1,RRMAX2
     &  /BLK20/JQ(10,6),IPLOT,IPL
      COMMON /BLK30/MTOT,MTIN
C
      CHARACTER KOUZUI*80
      CHARACTER NAME*9
      CHARACTER KAN*80
      CHARACTER TITLEA*12,TITLER*12
      IRN=0
C     CALL LISTOT
      JA=IA
      JR=IB
      JP=IP
      JC=IC
      JD=ID
      JE=IE
      JK=IK
```

```
      JN=IN
      JH=IH
      JS=IS
      CALL RED (X,Y,AK,AP,ATL,AF,F1,RSA,QC,AREA,LSA,RK,RP,RTL,RF,
     &      XQ,XS,TITLEA,AL,AS,TITLER,RL,RS,RB,RN,AZV,HDAM,QI,QO,VV,
     &      NZ,NZKO,NZZ,KRAIN,NAME,EL,QMX,QMIN,RTCUT,NV,HS,VS,
     &   NO,HF,QF,JP,JA,JR,JD,JN,NDJ,JH,IKZ,NPNT)
   10 CALL RAIN(RAVE,NR,KRAIN,QSAL,TITLEA,HDAM,QI,QO,RX,F,LZ,NFL,ARAIN,
     &    FT,KAN,JC,JK,NDJ,NAME,IKZ,JS,HF,QF,HS,VS,VV,JH,JP     )
      CALL CONT(QX,QSAL,T,RAVE,NZ,NZKO,NZZ,EL,QMX,QMIN,RTCUT,AK,AP,ATL,
     &      AF,F1,RSA,QC,AREA,LSA,RK,RP,RTL,RF,NV,HS,VS,NO,HF,QF,
     &   HDAM,QI,QO,VV,TI,AL,JD,JA,XQ,XS,JN,JP,JE,JH,AS  )
      CALL WRH(AK,AP,ATL,AF,F1,RSA,QC,AREA,RK,RP,RTL,QX,TITLEA,
     &      TITLER,KRAIN,LSA     )
      JKZ=1+2*IDAM+IZ+IDAM*4*(IZ-1)
      WRITE(32,REC=JKZ) KOUZUI,NQ,NQQ,TI,IDAY1,H1
      IF(IG.GE.0) CALL OUTPUT(HYO,NAME,NPNT)
      IF(IPLOT.EQ.0) GO TO 20
      DO 30 I=1,IPLOT
      K=I
   30 CALL GRAPH(IZ,K,T,RAVE,QI,QO,HDAM,VV,NAME,TI)
   20 CONTINUE
      IF(IVL.EQ.0) GO TO 10
      CALL VLGOKE(NAME,AZV,HDAM,JN)
      CALL EPSCAL(NAME,AZV,HDAM,JN,QSAL)
      GO TO 10
      END
      SUBROUTINE RED(X,Y,AK,AP,ATL,AF,F1,RSA,QC,AREA,LSA,RK,RP,
     &      RTL,RF,XQ,XS,TITLEA,AL,AS,TITLER,RL,RS,RB,RN,AZV,
     &      HDAM,QI,QO,VV,NZ,NZKO,NZZ,KRAIN,NAME,EL,QMX,QMIN,
     &  RTCUT,NV,HS,VS,NO,HF,QF,IP,IA,IR,ID,IN,NDJ,IH,IKZ,NPNT)
C
C
      DIMENSION X(*),Y(*),AK(*),AP(*),ATL(*),AF(*),F1(*),RSA(*),
     &      QC(*),AREA(*),LSA(*),RK(*),RP(*),RTL(*),RF(*),XQ(25),
     &      XS(IA,25),TITLEA(*),AL(*),AS(*),TITLER(*),RL(*),RS(*),
     &      RB(*),RN(*),AZV(IN,*),HDAM(*),QI(*),QO(*),VV(*),NZ(*),
     &      NZKO(*),NZZ(IN,*),KRAIN(*),NAME(*),EL(*),QMX(*),QMIN(*),
     &    RTCUT(*),NV(*),HS(IP,*),VS(IP,*),NO(*),HF(IH,*),
     &   QF(IH,*),NDJ(*),NPNT(*)
      DIMENSION CC(20),IKZ(*)
      COMMON
     &      /BLK02/NAREA,NRIV
     &      /BLK03/DDT,NQ,DT
     &      /BLK04/NPOIN,NNPN,IG,NPFL
     &     /BLK05/IDAM,IVL,IEPS,IPNT
     &      /BLK06/NQXR,IQXR
     &      /BLK07/CM(20)
     &      /BLK07C/KOUZUI
     &      /BLK08/NNZ
     &      /BLK09/IROUT
     &    /BLK10/CPL(5)
     &  /BLK20/JQ(10,6),IPLOT,IPL
      COMMON /BLK30/MTOT,MTIN
      COMMON /BLK13/NKZ,IZ,IRN
      CHARACTER NAME*9
      CHARACTER KOUZUI*80
      CHARACTER TITLEA*12,TITLER*12
      CHARACTER YY*30
      READ(4,120) (CM(I),I=1,20)
```

```
      READ(4,100) NPOIN,IG,NPFL,MTOT,MTIN
      IF(MTIN.EQ.0) GO TO 9998
      REWIND 02
      READ(2)  (CC(I),I=1,20),NNPN,DDT,DT,IDAM,DAMT,IRN,
     &      (NDJ(I),I=1,IDAM),(NAME(I),I=1,NNPN),(IKZ(I),I=1,IRN)
      WRITE (32,REC=1)
     &        (CC(I),I=1,20),NNPN,DDT,DT,IDAM,DAMT,IRN,
     &      (NDJ(I),I=1,IDAM),(NAME(I),I=1,NNPN),(IKZ(I),I=1,IRN)
      IF(IDAM.EQ.0) GO TO 7005
      DO 7001 K=1,IDAM
      READ(2)     NN,(HF(I,K),QF(I,K),I=1,NN),MHQ
      JKZ=(K-1)*2+2
      WRITE(32,REC=JKZ)NN,(HF(I,K),QF(I,K),I=1,NN),MHQ
      READ(2)     NS,(HS(I,K),VS(I,K),I=1,NS)
      JKZ=JKZ+1
      WRITE(32,REC=JKZ)NS,(HS(I,K),VS(I,K),I=1,NS)
 7001 CONTINUE
 7005 CONTINUE
      DO 7002 II=1,IRN
      JZ=IKZ(II)
      READ(2)      KOUZUI,NQ,NQQ,T1,IDAY1,H1
      JKZ=1+2*IDAM+JZ+IDAM*4*(JZ-1)
      WRITE(32,REC=JKZ) KOUZUI,NQ,NQQ,T1,IDAY1,H1
      IF(IDAM.EQ.0) GO TO 7006
      DO 7003 JJ=1,IDAM
      READ(2)     (QI(I),I=1,NQQ),QIG
      JKZ=3+2*IDAM+(JZ-1)*5+(JJ-1)*4
      WRITE(32,REC=JKZ)(QI(I),I=1,NQQ),QIG
      READ(2)     (QO(I),I=1,NQQ),QOG
      JKZ=JKZ+1
      WRITE(32,REC=JKZ)(QO(I),I=1,NQQ),QOG
      READ(2)     (HDAM(I),I=1,NQQ),HG,HHK,HMIN
      JKZ=JKZ+1
      WRITE(32,REC=JKZ)(HDAM(I),I=1,NQQ),HG,HHK,HMIN
      READ(2)     (VV(I),I=1,NQQ),VG,VC,VVC
      JKZ=JKZ+1
      WRITE(32,REC=JKZ)(VV(I),I=1,NQQ),VG,VC,VVC
 7003 CONTINUE
 7006 CONTINUE
      JKZ=(JZ-1)*NNPN+1
      DO 7004 IJ=1,NNPN
      READ(2)    (QI(I),I=1,NQ)
      WRITE(30,REC=JKZ) (QI(I),I=1,NQ)
      JKZ=JKZ+1
 7004 CONTINUE
 7002 CONTINUE
 9998 CONTINUE
      I5=IP
      YY='SUB.RED NPOIN POINT SOSU'
      CALL SIZE(1,I5,NPOIN,YY)
      NNPN=NPOIN
      READ(4,100) IROUT
      READ(4,100) NAREA,NRIV,JADATA,JRDATA
      I1=IA
      YY='SUB.RED NAREA RYUIKI SOSU'
      CALL SIZE(0,I1,NAREA,YY)
      I2=IR
      YY='SUB.RED NRIV KADO SU'
      CALL SIZE(0,I2,NRIV,YY)
      IF(NAREA.EQ.0) GO TO 1112
```

```
      DO 1 I=1,NAREA
      READ(4,121) TITLEA(I)
  121 FORMAT(A12)
      READ(4,110) AREA(I),AL(I),AS(I)
      IF(JADATA) 300,400,500
  300 READ(4,110) AK(I),AP(I)
      GO TO 600
  400 AK(I)=118.84*AS(I)**(-0.3)
      AP(I)=0.175*AS(I)**(0.235)
      GO TO 600
  500 READ(4,110) C
      AK(I)=43.4*C*(AL(I)*AS(I))**(1./3.)
      AP(I)=0.333
  600 READ(4,110) RSA(I),F1(I),AF(I),QC(I),ATL(I)
      IF(ATL(I).EQ.0) ATL(I)=0.047*AL(I)-0.56
      IF(ATL(I).LT.0.) ATL(I)=0.
      IF(QC(I).LE.0.0) QC(I)=0.04*AREA(I)
      READ(4,100) LSA(I)
    1 CONTINUE
 1112 CONTINUE
      IF(NRIV.EQ.0) GO TO 1111
      DO 2 I=1,NRIV
      READ(4,121) TITLER(I)
      IF(JRDATA) 3,4,5
    3 READ(4,110) RK(I),RP(I),RL(I),RS(I),RTL(I),RF(I)
      GO TO 9
    4 READ(4,110) RL(I),RS(I),RB(I),RN(I),RF(I)
      RK(I)=0.185*RL(I)*RB(I)**0.4*RS(I)**0.3*RN(I)**0.6*1.67
      RP(I)=0.6
      RTL(I)=0.000736*RL(I)*SQRT(RS(I))
      GO TO 9
    5 READ(4,100) NSTR
      YY='SUB.RED KADO S - Q SETTENSU'
      CALL SIZE(1,15,NSTR,YY)
      READ(4,110) RL(I),RS(I),RTL(I),RF(I)
      DO 6 J=1,NSTR
    6 READ(4,110) X(J),Y(J)
      CALL FIT(RK(I),RP(I),X,Y,NSTR)
      IF(RTL(I).EQ.0.) RTL(I)=0.000736*RL(I)*SQRT(RS(I))
    9 CONTINUE
    2 CONTINUE
 1111 CONTINUE
      READ(4,110) DT
      DDT=DT/3600.
      READ(4,100) (NZ(I),I=1,NPOIN)
      NNZ=0
      DO 5001 I=1,NPOIN
      N1=NZ(I)
      IF(N1.GE.0.AND.N1.LT.999) GO TO 5001
      IF(N1.GT.2000) GO TO 5001
      IF(N1.GT.1000) NK=N1-1000
      IF(N1.LT.0) NK=-N1
      NNZ=NNZ+1
      NZKO(NNZ)=NK
      READ(4,100) (NZZ(NNZ,J),J=1,NK)
 5001 CONTINUE
      IF(NAREA.NE.0) READ(4,100) (KRAIN(I),I=1,NAREA)
      READ(4,700) (NAME(I),I=1,NPOIN)
  700 FORMAT((8(1X,A9)))
      DO 8 I=1,NAREA
```

```
      COEF=AK(I)/DDT
      XS(I,1)=-(405./DDT+50.)
      XS(I,2)=0.
      P=AP(I)
      DO 8 J=3,25
      XX=XQ(J)
      XS(I,J)=COEF*XX**P+XX*0.5
    8 CONTINUE
      READ(4,100) IDAM,IPLOT,IPL,IVL,IEPS,IPNT
      I3=ID
      YY='SUB.RED IDAM DAM SOSU'
      CALL SIZE(0,I3,IDAM,YY)
      I4=IN
      YY='SUB.RED IVL VOLUME KEISANSU'
      CALL SIZE(0,I4,IVL,YY)
      IF(IDAM.EQ.0) GO TO 999
      JH=IH
      CALL INPDAM(NV,HS,VS,NO,HF,QF,EL,QMX,QMIN,RTCUT,NDJ,I3,HDAM,I5,JH)
  999 IF(IPLOT.EQ.0) GO TO 7
      DO 5002 I=1,IPLOT
 5002 READ(4,100) (JQ(I,J),J=1,6)
      READ(4,110) (CPL(I),I=1,5)
    7 CONTINUE
      IF(IVL.EQ.0) GO TO 11
      DO 5055 I=1,IVL
 5055 READ(4,110) (AZV(I,J),J=1,8)
   11 CONTINUE
      IF(IEPS.EQ.0) GO TO 12
      DO 5056 I=1,IEPS
      READ(4,110) (AZV(I+IVL,J),J=1,2)
 5056 CONTINUE
   12 CONTINUE
      IF(IPNT.EQ.0) GO TO 13
      READ(4,100) (NPNT(I),I=1,IPNT)
   13 CONTINUE
      RETURN
  100 FORMAT(8I10)
  110 FORMAT(8F10.0)
  120 FORMAT(20A4)
  220 FORMAT(1H0,20A4/)
  200 FORMAT(1H ,6F20.7)
      END
      SUBROUTINE FIT(A,B,X,Y,N)
      DIMENSION X(*),Y(*)
      DO 3 I=1,N
      X(I)=ALOG10(X(I))
      Y(I)=ALOG10(Y(I))
    3 CONTINUE
      SX2=0.0
      SXY=0.0
      SY2=0.0
      XB=0.0
      YB=0.0
      DO 1 I=1,N
      XB=XB+X(I)
      YB=YB+Y(I)
    1 CONTINUE
      FN=FLOAT(N)
      XB=XB/FN
      YB=YB/FN
```

```
      DO 2 I=1,N
      XX=X(I)-XB
      YY=Y(I)-YB
      SX2=SX2+XX*XX
      SXY=SXY+XX*YY
      SY2=SY2+YY*YY
    2 CONTINUE
      B=SXY/SX2
      A=10.0**(YB-B*XB)
      RETURN
      END
      SUBROUTINE INPDAM(NV,HS,VS,NO,HF,QF,EL,QMX,QMIN,RTCUT,NDJ,ID,HX,
     &    IP,IH)
      DIMENSION NV(*),HS(IP,*),VS(IP,*),NO(*),HF(IH,*),QF(IH,*),EL(*),
     &      QMX(*),QMIN(*),RTCUT(*),NDJ(*)
      COMMON
     &      /BLK05/IDAM,IVL,IEPS,IPNT
     &      /BLK16/DAMT
      CHARACTER YY*30
      READ(4,1001) DAMT
 1001 FORMAT(8F10.0)
      READ(4,1002) (NDJ(I),I=1,IDAM)
 1002 FORMAT(8I10)
      DO 5001 I=1,IDAM
      IF(NDJ(I).LT.0) GO TO 3001
      READ(4,1002) NV(I)
      NVV=NV(I)
      JP=IP
      YY='SUB.INPDAM NV H - V SETTENSU'
      CALL SIZE(1,JP,NVV,YY)
      DO 5002 J=1,NVV
 5002 READ(4,1001) HS(J,I),VS(J,I)
      K=I
      I1=ID
      JH=IH
      IF(NDJ(I).EQ.0) CALL INPUFP(K,NO,HF,QF,EL,HX,I1,JH)
      IF(NDJ(I).EQ.1) CALL INPUHQ(K,NO,HF,QF,EL ,I1,JH)
      IF(NDJ(I).EQ.2) CALL INPKDF(K,NO,HF,QF,EL,I1,JH)
      GO TO 5001
 3001 READ(4,1001) QMX(I),QMIN(I),RTCUT(I)
 5001 CONTINUE
      RETURN
      END
      SUBROUTINE INPUFP(K,NO,HF,QF,EL,HX,ID,IH)
      DIMENSION NO(*),HF(IH,*),QF(IH,*),EL(*),HX(*)
      READ(4,1001) BBB,HHH,EL(K),CF,CP,ELL,BL,DH
      IF(ABS(DH).LT.0.001) DH=0.20
      IF(ELL.LT.EL(K)) ELL=10000.0
      IF(CF.EQ.0.0) CF=2.0
      IF(CP.EQ.0.0) CP=0.90
      NO(K)=195
      AAA=BBB*HHH
      INDT=0
      HCN=EL(K)+0.5*HHH
      H1=EL(K)+1.2*HHH
      H2=EL(K)+1.8*HHH
      Q1=CF*BBB*(H1-EL(K))**(3./2.)
      Q2=CP*AAA*SQRT(19.6*(1.3*HHH))
      HF(1,K)=EL(K)
      DO 5000 I=1,195
```

```
      IF(HF(I,K).LT.H1) GO TO 3001
      IF(HF(I,K).GE.H1.AND.HF(I,K).LT.H2) GO TO 3002
      IF(HF(I,K).GE.H2.AND.HF(I,K).LT.ELL) GO TO 3003
      IF(HF(I,K).GE.ELL) GO TO 3004
 3001 QF(I,K)=CF*BBB*(HF(I,K)-EL(K))**(3./2.)
      GO TO 5001
 3002 QF(I,K)=Q1+(Q2-Q1)*(HF(I,K)-H1)/(H2-H1)
      GO TO 5001
 3003 QF(I,K)=CP*AAA*SQRT(19.6*(HF(I,K)-HCN))
      GO TO 5001
 3004 QF(I,K)=CP*AAA*SQRT(19.6*(HF(I,K)-HCN))
     &        +CF*BL*(HF(I,K)-ELL)**(3./2.)
 5001 HF(I+1,K)=HF(I,K)+DH
      IF(HF(I+1,K).LT.ELL) GO TO 5000
      IF(INDT.EQ.1) GO TO 5000
      HF(I+1,K)=ELL
      INDT=1
 5000 CONTINUE
 1001 FORMAT(8F10.0)
      RETURN
      END
      SUBROUTINE INPUHQ(K,NO,HF,QF,EL,ID,IH)
      DIMENSION NO(*),HF(IH,*),QF(IH,*),EL(*)
      READ(4,1000) NO(K),EL(K)
 1000 FORMAT(I10,F10.0)
      NHQ=NO(K)
      DO 5001 I=1,NHQ
 5001 READ(4,1001) HF(I,K),QF(I,K)
 1001 FORMAT(8F10.0)
      RETURN
      END
      SUBROUTINE INPKDF(K,NO,HF,QF,EL,ID,IH)
      DIMENSION NO(*),HF(IH,*),QF(IH,*),EL(*)
      READ(4,1001) BBB,HHH,EL(K),CF,CP,ELCN,BLNGT
 1001 FORMAT(8F10.0)
      CH=0.2
      IF(CF.EQ.0.0) CF=2.0
      IF(CP.EQ.0.0) CP=0.90
      HFLOW=0.0
      DO 5002 I=1,195
      QA=CF*BLNGT*HFLOW**1.5
      QB=CP*BBB*HHH*SQRT( 19.6*(EL(K)+HFLOW-ELCN))
      IF(QB.LT.QA) GO TO 3001
      HF(I,K)=EL(K)+HFLOW
      QF(I,K)=QA
      HFLOW=HFLOW+0.2
 5002 CONTINUE
 3001 CONTINUE
      IFF=I
      DO 5001 I=IFF,195
      QF(I,K)=CP*BBB*HHH*SQRT(19.6*(EL(K)+HFLOW-ELCN))
      HF(I,K)=HFLOW+EL(K)
      HFLOW=HFLOW+CH
 5001 CONTINUE
      NO(K)=195
      RETURN
      END
      SUBROUTINE RAIN(RAVE,NR,KRAIN,QSAL,TITLEA,HDAM,QI,QO,RX,F,
     &  LZ,NFL,ARAIN,FT,KAN,IC,IK,NDJ,NAME,IKZ,IS,
     &  HF,QF,HS,VS,VV,IH,IP                    )
```

```
      DIMENSION RAVE(*),KRAIN(*),QSAL(*),TITLEA(*) ,HDAM(*),QI(*),
     &     QO(*),RX(IK,*),F(*),LZ(*),NFL(*),ARAIN(*),FT(*),KAN(*)
     &     ,NDJ(*),NAME(*),IKZ(*)
      DIMENSION HF(IH,*),QF(IH,*),HS(IP,*),VS(IP,*),VV(*)
      COMMON
     &     /BLK02/NAREA,NRIV
     &     /BLK03/DDT,NQ,DT
     &     /BLK04/NPOIN,NNPN,IG
     &     /BLK05/IDAM,IVL,IEPS,IPNT
     &     /BLK06/NQXR,IQXR
     &     /BLK07/CM(20)
     &     /BLK07C/KOUZUI
     &     /BLK09/IROUT
     &     /BLK13/NKZ,IZ,IRN
     &     /BLK14/NCASE,NQQ
     &     /BLK15/T1,IDAY1,H1
     &     /BLK16/DAMT
     &     /BLK18/RRMAX1,RRMAX2
      COMMON /BLK30/MTOT,MTIN
      CHARACTER KOUZUI*80,KAN*80
      CHARACTER RNAME*12
      CHARACTER NAME*9
      CHARACTER TITLEA*12
      CHARACTER YY*30
      DO 5005 I=1,IC
 5005 RAVE(I)=0.0
      READ(4,100,END=999) KOUZUI
  100 FORMAT(A80)
      IF(KOUZUI.EQ.'END') GO TO 999
      IRN=IRN+1
      READ(4,200) NQ,IQXR,IZ
      YY='SUB.RAIN NQ KEISAN KOSU'
      CALL SIZE(1,IC,NQ,YY)
      IF(IZ.EQ.0) IZ=1
      IKZ(IRN)=IZ
      IF(IQXR.EQ.0) IQXR=1
      NQXR=NQ/IQXR
      READ(4,201) N,NR,DTR
      I1=IK
      YY='SUB.RAIN N KANSOKUJO SU'
      CALL SIZE(1,I1,N,YY)
      YY='SUB.RAIN NR URYO DATA SU'
      CALL SIZE(1,IS,NR,YY)
      IQX=INT(DTR/DT+0.0001)
  201 FORMAT(2I10,F10.0)
  200 FORMAT(8I10)
      READ(4,600) IDAY1,T1,H1,(NFL(I),I=1,N)
  600 FORMAT(I10,2F10.0,(10I5))
      WRITE(3,2001) (CM(LL),LL=1,20),KOUZUI
 2001 FORMAT(1H1,//1H ,20X,20A4//30X,A80///)
      DO 10 I=1,N
      ARAIN(I)=0.0
      READ(4,300) KAN(I)
  300 FORMAT(A80)
      NO=NFL(I)
      IF(NO.EQ.0) GO TO 800
      READ(31,REC=NO) (RX(I,J),J=1,NR)
      GO TO 1000
  800 READ(4,501) (RX(I,J),J=1,NR)
  501 FORMAT(8F10.0)
```

```
1000 CONTINUE
      DO 30 J=1,NR
   30 ARAIN(I)=ARAIN(I)+RX(I,J)
      WRITE(3,400)KAN(I),(KO,KO=1,24),(RX(I,J),J=1,NR)
  400 FORMAT(1H ,A80//2X,24I5/5X,122(1H-)/(4X,24F5.1/))
      WRITE(3,700) ARAIN(I)
  700 FORMAT(2X,9HSIGMA R =,F7.1//)
   10 CONTINUE
      READ(4,211) IR,IW,MQY,NNK,NQX,DTQX,IBY
  211 FORMAT(5I10,F10.0,I10)
      NNK=(IZ-1)*NNPN+NNK
      IF(NAREA.EQ.0) GO TO 1111
      WRITE(3,2051) IR
 2051 FORMAT(//1H ,19X,I2,1X,'HR.URYO',2X,'TIME OF MAX',3X,'KAKURITSU UR
     &YO',2X,'HIKINOBASHI-RITSU',2X,'MAX RAINFALL',/)
      WRITE(3,2002)
 2002 FORMAT(1H ,77X,'1.HR',4X,'3.HR',4X,'6.HR'/)
      IF(IBY.EQ.0) GO TO 3002
      IF(IBY.LT.0) GO TO 3003
      READ(4,215) RNAME
  215 FORMAT(A12)
      READ(4,500) RKA
      DO 71 K=1,NQ
   71 QSAL(K)=0.0
      READ(4,200) M,(LZ(J),J=1,M)
      READ(4,500) (F(J),J=1,M)
      DO 51 K=1,M
      L1=LZ(K)
      DO 51 J=1,NR
      RAVE(J)=RX(L1,J)*F(K)
   51 QSAL(J)=QSAL(J)+RAVE(J)
      CALL STATIS(RKA,IR,NR,R,IMAX,RAT,IW,0,QSAL,QI)
      CALL TANJIR(RAVE,NR,QSAL,QI,QO)
      RMAX=-1.0
      DO 61 K=1,NR
      IF(QSAL(K).LT.RMAX) GO TO 61
      RMAX=QSAL(K)
   61 CONTINUE
      WRITE(3,2005) RNAME,R,IMAX,RKA,RAT,RMAX,RRMAX1,RRMAX2
 2005 FORMAT(1H0,3X,A12,2X,F10.2,5X,
     &          I5,7X,F10.2,6X,F10.3,4X,3F8.2)
      GO TO 3002
 3003 READ(4,1001) RKA,RAT,IMAX
      IF(IMAX.EQ.0) IMAX=1
 1001 FORMAT(2F10.0,I10)
 3002 DO 40 I=1,NAREA
      IF(IBY.EQ.0) READ(4,500) RKA
      DO 70 K=1,NQ
   70 QSAL(K)=0.
      READ(4,200) M,(LZ(J),J=1,M)
      READ(4,500) (F(J),J=1,M)
      DO 50 K=1,M
      L1=LZ(K)
      DO 50 J=1,NR
      RAVE(J)=RX(L1,J)*F(K)
   50 QSAL(J)=QSAL(J)+RAVE(J)
      CALL STATIS(RKA,IR,NR,R,IMAX,RAT,IW,IBY,QSAL,QI)
      IF(IROUT.LT.0) CALL REFECT(QSAL,NR,IROUT)
      CALL TANJIR(RAVE,NR,QSAL,QI,QO)
      RMAX=-1.0
```

```
     &      /BLK04/NPOIN,NNPN,IG,NPFL
     &      /BLK15/T1,IDAY1,H1
      I1=IA
      I2=ID
      I3=IN
      I4=IP
      I5=IE
      I6=IH
      K1=1
      K2=1
      K3=1
      K4=1
      DO 10 L=1,NPOIN
      LK=L
      NKZ=(IZ-1)*NNPN+L
      IF(NZ(L).LT.0) GO TO 30
      IF(NZ(L).LT.80) GO TO 20
      IF(NZ(L).GT.90) GO TO 30
      N1=NZ(L)-80
      J=L+(IZ-1)*NNPN
      CALL TOTAL(N1,J,QX,QSAL)
      GO TO 10
   20 N2=NZ(L)+(IZ-1)*NNPN
      READ(30,REC=N2)(RAVE(K),K=1,NQ)
      LL=(IZ-1)*NNPN+L
      WRITE(30,REC=LL) (RAVE(K),K=1,NQ)
      DO 40 M=1,NQ
   40 QX(M)=RAVE(M)
      GO TO 10
   30 CONTINUE
      IF(NZ(L).EQ.91)
     &      CALL BASIN(K1,AK,AP,ATL,AF,F1,RSA,QC,AREA,LSA,
     &      RAVE,QX,QSAL,HDAM,XQ,XS,I1)
      IF(NZ(L).EQ.91) K1=K1+1
      IF(NZ(L).EQ.92)
     &      CALL RIVER(K2,RK,RP,RTL,RF,QX,QSAL)
      IF(NZ(L).EQ.93) CALL KADO(K2,RTL,QX,QSAL)
      IF(NZ(L).EQ.92) K2=K2+1
      IF(NZ(L).EQ.93) K2=K2+1
      IF(NZ(L).EQ.94) CALL DAMCUT(K3,NV,HS,VS,NO,HF,QF,
     &    QX,T,HDAM,QI,QO,VV,TI,EL,I2,I4,I5,I6)
      IF(NZ(L).EQ.94) K3=K3+1
      IF(NZ(L).EQ.95) CALL NKAYAS(K1,AK,AP,ATL,AF,F1,RSA,QC,AREA,LSA,
     &    AL,QX,HDAM,QI,QO,VV,TI,RAVE,AS    )
      IF(NZ(L).EQ.95) K1=K1+1
      IF(NZ(L).EQ.96) CALL QQCUT(K3,QMX,QX,QO     )
      IF(NZ(L).EQ.96) K3=K3+1
      IF(NZ(L).EQ.97) CALL CUTDAM(K3,QMX,QMIN,RTCUT,VV,QI,QO,
     &      HDAM,TI,QX)
      IF(NZ(L).EQ.97) K3=K3+1
      IF(NZ(L).GT.999.AND.NZ(L).LT.2000) CALL RUIKA(K4,QX,QSAL,NZKO,NZZ,
     &      I3)
      IF(NZ(L).GT.999.AND.NZ(L).LT.2000) K4=K4+1
      IF(NZ(L).GT.2000) CALL FLRED(LK,NZ,QX,RAVE)
      IF(NZ(L).LT.0) CALL MYNAS(K4,QX,QSAL,NZKO,NZZ,I3)
      IF(NZ(L).LT.0) K4=K4+1
   10 CONTINUE
      RETURN
      END
      SUBROUTINE BASIN(K,AK,AP,ATL,AF,F1,RSA,QC,AREA,LSA,RAVE,QX,QSAL,
```

```
&     HDAM,XQ,XS,IA)
 DIMENSION AK(*),AP(*),ATL(*),AF(*),F1(*),RSA(*),QC(*),
&     AREA(*),LSA(*),RAVE(*),QX(*),QSAL(*),HDAM(*)
&     ,XQ(25),XS(IA,25)
 COMMON
&     /BLK02/NAREA,NRIV
&     /BLK03/DDT,NQ,DT
&     /BLK09/IROUT
&     /BLK12/DTL,ITL
&     /BLK13/NKZ,IZ
 IF(K.GT.NAREA) GO TO 90
 KSA=LSA(K)
 I1=IA
 TTL=(ATL(K)+0.0001)/DDT
 ITL=TTL
 DTL=TTL-FLOAT(ITL)
 IF(LSA(K).EQ.0) GO TO 11
 SR=0.
 ISA=0
 DO 9 I=1,NQ
 SR=SR+RAVE(I)*DDT
 IF(SR.LT.RSA(K)) GO TO 9
 ISA=I
 SSR=SR-RSA(K)
 GO TO 10
9 CONTINUE
 KSA=0
 GO TO 11
10 CONTINUE
 ISA1=ISA-1
 DO 12 I=1,ISA1
12 QSAL(I)=0.
11 CONTINUE
 IF(IROUT.LE.0) CALL ROUTA(QX,1,K,AK,AP,RAVE,XQ,XS,I1)
 IF(IROUT.GT.0) CALL ROUTB(QX,1,K,AK,AP,RAVE,HDAM,AF,LSA )
 IF(KSA.NE.0) GO TO 14
13 DO 15 I=1,NQ
15 QSAL(I)=0.
 GO TO 16
14 RAVE(ISA)=SSR/DDT
 IF(IROUT.LE.0) CALL ROUTA(QSAL,ISA,K,AK,AP,RAVE,XQ,XS,I1)
 IF(IROUT.GT.0) CALL ROUTB(QSAL,ISA,K,AK,AP,RAVE,HDAM,AF,LSA )
16 CONTINUE
 F2=AF(K)-F1(K)
 DO 17 I=1,NQ
17 QX(I)=(F1(K)*QX(I)+F2*QSAL(I))*AREA(K)/3.6+QC(K)
 WRITE(30,REC=NKZ) (QX(I),I=1,NQ)
 RETURN
90 WRITE(3,666)
666 FORMAT(1H1,'*** RYUIKI KEISAN NO KAISUU O CHECK SARETASHI ***')
 STOP
 END
 SUBROUTINE ROUTA(YY,IF,K,AK,AP,RAVE,XQ,XS,IA)
 DIMENSION YY(*),AK(*),AP(*),RAVE(*),XQ(25),XS(IA,25)
 COMMON
&     /BLK12/DTL,ITL
&     /BLK03/DDT,NQ,DT
 S1=RAVE(IF)
 IF1=IF+1
 QL1=0.
```

```
      DMTL=1.-DTL
      ITL1=ITL+IF
      DO 5 I=IF,ITL1
    5 YY(I)=0.
      DO 20 I=IF1,NQ
      J=1
    2 IF(XS(K,J).GT.S1) GO TO 1
      J=J+1
      GO TO 2
    1 X=XQ(J-1)+(S1-XS(K,J-1))/(XS(K,J)-XS(K,J-1))*(XQ(J)-XQ(J-1))
      QL2=X
      MMM=I
      S1=AK(K)*X**AP(K)/DDT-X/2.+RAVE(MMM)
      IPTL=ITL+I
      YY(IPTL)=(QL2-QL1)*DMTL+QL1
      QL1=QL2
      IF(I.EQ.NQ) GO TO 30
   20 CONTINUE
   30 CONTINUE
      RETURN
      END
      SUBROUTINE ROUTB(YY,IF,K,AK,AP,RAVE,HX,AF,LSA  )
      DIMENSION LSA(*)
      DIMENSION YY(*),AK(*),AP(*),RAVE(*),HX(*),AF(*)
      COMMON
     &      /BLK03/DDT,NQ,DT
     &      /BLK12/DTL,ITL
      REAL*8 EPS,COEF1,COEF2,QL1,SL1,C,X,QLP,QLP1,FX,FDX,RAN,DFX,
     *      EEE,DMTL
      EPS=0.00001
      HX(IF)=0.0
      COEF1=AK(K)/DDT
      COEF2=AP(K)*COEF1
      QL1=0.
      SL1=0.
      IF1=IF+1
      IF(LSA(K).EQ.0.OR.LSA(K).EQ.1) GO TO 3001
      WRITE(3,2002)
 2002 FORMAT(1H1,///)
      WRITE(3,2003) K,EPS,AK(K),AP(K),COEF1,COEF2,IF
 2003 FORMAT(1H ,1X,'K=',I3,3X,'EPS=',F11.8,3X,'AK=',F7.3,3X,
     &  'AP=',F7.3,3X,'COEF1=',E12.5,3X,'COEF2=',E12.5,3X,'IF=',I4,//)
      WRITE(3,2007)
 2007 FORMAT(1H ,4X,'I',3X,'KK',4X,'RAVE',5X,'QL1',6X,'SL1',8X,'C',
     &  8X,'X',9X,'QLP',9X,'QLP1',9X,'FDX',10X,'DFX(E)',8X,'FX(R)',
     &    5X,'RAN',///)
 3001 CONTINUE
      DO 40 I=IF1,NQ
      C=0.5*QL1-AF(K)*RAVE(I)-SL1
      KK=0
      X=QL1
    4 CONTINUE
      IF(X.LE.EPS) GO TO 9
      QLP=X**AP(K)
      QLP1=QLP/X
      FX=COEF1*QLP+0.5*X+C
      FDX=COEF2*QLP1+0.5
      RAN=EPS*FDX
      DFX=FX/FDX
      IF(LSA(K).EQ.0.OR.LSA(K).EQ.1) GO TO 3002
```

```
      IF(KK.EQ.0) WRITE(3,2004) I,KK,RAVE(I),QL1,SL1,C,X,QLP,QLP1,
     &          FDX,DFX,FX,RAN
 2004 FORMAT(1H ,I6,I5,F8.3,F9.3,F9.3,F10.3,F10.4,1X,6E12.5)
      IF(KK.NE.0) WRITE(3,2005) KK,X,QLP,QLP1,FDX,DFX,FX,RAN
 2005 FORMAT(1H ,I11,36X,F10.4,1X,6E12.5)
 3002 CONTINUE
      IF(ABS(DFX).LT.EPS.AND.ABS(FX).LT.RAN) GO TO 3
      KK=KK+1
      IF(KK.GT.100) GO TO 1000
      X=X-DFX
      GO TO 4
    9 CONTINUE
      IF(ABS(C).LT.EPS) GO TO 10
      EEE=1.0
      QLP1=0.0
      FDX=0.0
      DFX=0.0
      RAN=EPS
      X=EEE
    8 CONTINUE
      QLP=X**AP(K)
      FX=COEF1*QLP+0.5*X+C
      IF(LSA(K).EQ.0.OR.LSA(K).EQ.1) GO TO 3005
      IF(KK.EQ.0) WRITE(3,2004) I,KK,RAVE(I),QL1,SL1,C,X,QLP,QLP1,
     &          FDX,DFX,FX,RAN
      IF(KK.NE.0) WRITE(3,2005) KK,X,QLP,QLP1,FDX,DFX,FX,RAN
 3005 CONTINUE
      IF(ABS(FX).LT.EPS) GO TO 3
      KK=KK+1
      IF(KK.GT.200) GO TO 1000
      IF(FX.GT.0.0) GO TO 7
      X=X+EEE
      GO TO 8
    7 EEE=0.5*EEE
      X=X-EEE
      GO TO 8
   10 X=0.0
      QLP=0.0
    3 HX(I)=X
      QL1=X
      SL1=COEF1*QLP
      IF(LSA(K).EQ.0.OR.LSA(K).EQ.1) GO TO 3003
      WRITE(3,2006)
 2006 FORMAT(1H )
 3003 CONTINUE
   40 CONTINUE
   30 DMTL=1.-DTL
      ITL1=ITL+IF
      DO 5 I=IF,ITL1
    5 YY(I)=HX(IF)
      DO 6 I=IF1,NQ
      IPTL=ITL+I
      YY(IPTL)=(HX(I)-HX(I-1))*DMTL+HX(I-1)
    6 CONTINUE
      RETURN
 1000 WRITE(3,2001)  K
 2001 FORMAT(1H1,//1H ,20X,' OVER  TIMES  AT  ',I5,' - RYUIKI'//)
      WRITE(3,2000) I,X,FX,DFX,RAN,EPS
 2000 FORMAT(1H ,30X,I10,5X,'HOUR',
     &    /1H ,25X,E15.5,5X,'MM/HR',
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```
     &    /1H ,25X,E15.5,5X,'EPS.Y.DIREC.',
     &    /1H ,25X,E15.5,5X,'EPS.X.DIREC.',
     &    /1H ,25X,E15.5,5X,'ALLOWED Y.EPS.',
     &    /1H ,25X,E15.5,5X,'ALLOWED X.EPS.'///)
      STOP
      END
      SUBROUTINE RIVER(K,RK,RP,RTL,RF,QX,QSAL)
      DIMENSION RK(*),RP(*),RTL(*),RF(*),QX(*),QSAL(*)
      COMMON
     &       /BLK02/NAREA,NRIV
     &       /BLK03/DDT,NQ,DT
     &       /BLK13/NKZ,IZ
      IF(K.GT.NRIV) GO TO 90
      TTL=RTL(K)/DDT
      ITL=TTL
      DTL=TTL-FLOAT(ITL)
      DMTL=1.-DTL
      ITL1=ITL+1
      DO 1 I=1,ITL1
    1 QSAL(I)=QX(1)
      NQ1=NQ
      DO 25 I=2,NQ
      IPTL=I+ITL
      QSAL(IPTL)=(QX(I)-QX(I-1))*DMTL+QX(I-1)
      IF(IPTL.EQ.NQ1) GO TO 9
   25 CONTINUE
    9 CONTINUE
      QX(1)=QSAL(1)
      COEF1=RK(K)/DT
      COEF2=RP(K)*COEF1
      QL1=QSAL(1)
      IF(RF(K).LT.0.0001) SL1=COEF1*QSAL(1)**RP(K)
      IF(RF(K).GT.0.0001)
     &       SL1=COEF1*QSAL(1)**RP(K)-RTL(K)*QSAL(1)*3600.0
      DO 40 I=2,NQ
      QUM=0.5*(QSAL(I)+QSAL(I-1))
      C=0.5*QL1-QUM-SL1
      KK=0
      X=QL1
    4 CONTINUE
      IF(X.LT.0.000001) GO TO 5
      QLP=X**RP(K)
      QLP1=QLP/X
      IF(RF(K).LT.0.0001) FX=COEF1*QLP+0.5*X+C
      IF(RF(K).GT.0.0001) FX=COEF1*QLP+0.5*X+C-RTL(K)*X*3600.0
      IF(RF(K).LT.0.0001) FDX=COEF2*QLP1+0.5
      IF(RF(K).GT.0.0001) FDX=COEF2*QLP1+0.5-RTL(K)*3600.0
      RAN=0.001*FDX
      DFX=FX/FDX
      IF(ABS(DFX).LT.0.001.AND.ABS(FX).LT.ABS(RAN)) GO TO 3
      KK=KK+1
      IF(KK.GT.500) GO TO 1000
      X=X-DFX
      GO TO 4
    3 QX(I)=X
      QL1=X
    6 IF(RF(K).LT.0.0001) SL1=COEF1*QLP
      IF(RF(K).GT.0.0001) SL1=COEF1*QLP-RTL(K)*X*3600.0
      IF(SL1.LT.0.0) SL1=0.00001
      GO TO 40
```

```
    5 QX(I)=QSAL(I)
      IF(QX(I).LT.0.000001) QX(I)=0.000001
      QL1=QX(I)
      X=QL1
      QLP=X**RP(K)
      GO TO 6
   40 CONTINUE
      WRITE(30,REC=NKZ)(QX(I),I=1,NQ)
      RETURN
 1000 WRITE(3,2000) I,X,FX,DFX ,RAN
 2000 FORMAT(1H0,'OVER TIMES AT RIVER',I20,4E15.7)
      GO TO 9999
   90 WRITE(3,666)
  666 FORMAT(1H1,'*** RIVER KEISAN NO KAISUU O CHECK SARETASHI ***')
 9999 STOP
      END
      SUBROUTINE KADO(K,RTL,QX,XX)
      DIMENSION RTL(*),QX(*),XX(*)
      COMMON
     &       /BLK02/NAREA,NRIV
     &       /BLK03/DDT,NQ,DT
     &       /BLK13/NKZ,IZ
      IF(K.GT.NRIV) GO TO 90
      TTL=RTL(K)/DDT
      ITL=TTL
      DTL=TTL-FLOAT(ITL)
      DMTL=1.0-DTL
      ITL1=ITL+1
      DO 2 I=1,NQ
    2 XX(I)=QX(I)
      DO 1 I=1,ITL1
    1 QX(I)=XX(1)
      ITLL=ITL1+1
      DO 5000 I=ITLL,NQ
      J=I-ITL1
      QX(I)=XX(J)+(XX(J+1)-XX(J))*DMTL
 5000 CONTINUE
      WRITE(30,REC=NKZ) (QX(I),I=1,NQ)
      RETURN
   90 WRITE(3,666)
  666 FORMAT(1H1,'*** KADO KEISAN NO KAISUU O CHECK SARETASHI ***')
      STOP
      END
      SUBROUTINE NKAYAS(K,AK,AP,ATL,AF,F1,RSA,QC,AREA,LSA,
     &   AL,QX,HDAM,QI,QO,VV,T,RAVE,AS  )
      DIMENSION AK(*),AP(*),ATL(*),AF(*),F1(*),RSA(*),QC(*),AREA(*),
     &     LSA(*),AL(*),QX(*),HDAM(*),QI(*),QO(*),VV(*),T(*),
     &   RAVE(*),AS(*)
      COMMON
     &   /BLK03/DDD,NQ,DT
     &     /BLK13/NKZ,IZ
     &     /BLK17/QMAX,TP,TK
     &     /BLK15/T1,IDAY1,H1
      DOUBLE PRECISION UNIT
      DO 5001 I=1,NQ
      HDAM(I)=0.0
      QI(I)=0.0
      QO(I)=0.0
 5001 VV(I)=0.0
      DDT=AS(K)
```

```
      IX=IFIX(DDT/DDD+0.001)
      NI=IFIX(FLOAT(NQ)*DDD/DDT)+1
      IF(LSA(K).EQ.0) GO TO 3001
      IF(IZ.GE.2) GO TO 3333
      TP=RSA(K)
      ZK=F1(K)
      TG=TP-0.8*DDT
      TK=ZK*TP
      GO TO 3332
 3333 CONTINUE
      TP=AP(K)
      ZK=RSA(K)
      TG=TP-0.8*DDT
      TK=ZK*TP
      GO TO 3332
 3001 CONTINUE
      TG=0.4+0.058*AL(K)
      IF(AL(K).LT.15.0) TG=0.21*AL(K)**0.7
      TK=0.47*(AREA(K)*AL(K))**0.25
      TP=0.8*DDT+TG
 3332 CONTINUE
      ATL(K)=TG
      AK(K)=TK
      AP(K)=TP
      QMAX=0.2778*AREA(K)*DDT/(0.3*TP+TK)
      F1(K)=QMAX
      RSA(K)=ZK
      ITP=IFIX(TP)
      FTP=FLOAT(ITP)
      Z=TP-FTP
      HDAM(1)=0.0
      QI(1)=0.0
      DO 10 L=1,NI
      TT=FLOAT(L-1)*DDT+Z
      HDAM(L)=TT
      QI(L)=UNIT(TT)
   10 CONTINUE
      IF(IZ.GE.2) GO TO 3005
      IF(K.EQ.1) WRITE(3,2001)
 2001 FORMAT(1H1,///)
      WRITE(3,2002) K
 2002 FORMAT(1H ,////5X,'UNIT HYDRO GRAPH ',5X,I5,//)
      CALL WRIT(HDAM,QI,NQ)
 3005 CONTINUE
      VV(1)=0.0
      QO(1)=QC(K)
      DO 20 IZT=2,NI
      TT=FLOAT(IZT-1)*DDT+Z
      VV(IZT)=TT
      QO(IZT)=0.0
      IA=IFIX(TT/DDT+1.0)
      IZT1=IA
      IF(IA.GT.NI) IZT1=NI
      DO 21 IQ=1,IZT1
      TX=TT-FLOAT(IQ-1)*DDT
      IF(TX.LT.0.0) TX=0.000001
   21 QO(IZT)=QO(IZT)+RAVE(IX*IQ)*UNIT(TX)
      QO(IZT)=QO(IZT)+QC(K)
   20 CONTINUE
      DO 5003 I=1,NQ
```

```
      HDAM(I)=0.0
5003 QI(I)=0.0
      HDAM(1)=0.0
      DO 5004 I=1,NQ
      NN=NQ
      CALL CHANG(HDAM(I),QI(I),NN,VV,QO)
      HDAM(I+1)=HDAM(I)+DDD
5004 CONTINUE
      DO 5002 I=1,NQ
5002 QX(I)=QI(I)
      WRITE(30,REC=NKZ) (QX(I),I=1,NQ)
      RETURN
      END
      DOUBLE PRECISION FUNCTION UNIT(X)
      COMMON
     &      /BLK17/QMAX,TP,TK
      Y=(X-(TP+TK+1.5*TK))/2./TK
      IF(X.LE.TP) UNIT=(X/TP)**2.4*QMAX
      IF(X.GT.TP.AND.X.LE.TP+TK) UNIT=0.3**((X-TP)/TK)*QMAX
      IF(X.GT.TP+TK.AND.X.LE.TP+TK+1.5*TK)
     &UNIT=0.3*0.3**((X-(TP+TK))/1.5/TK)*QMAX
      IF(Y.GT.30.) GO TO 10
      IF(X.GT.TP+TK+1.5*TK)
     &UNIT=0.3*0.3*0.3**((X-(TP+TK+1.5*TK))/2./TK)*QMAX
      RETURN
   10 UNIT=0.
      RETURN
      END
      SUBROUTINE DAMCUT(K,NV,HS,VS,NO,HF,QF,QX,T,HDAM,QI,QO,VV,
     &  TI,EL,ID,IP,IE,IH)
      DIMENSION NV(*),HS(IP,*),VS(IP,*),NO(*),HF(IH,*),QF(IH,*),
     &      QX(*),T(*),
     &      HDAM(*),QI(*),QO(*),VV(*),TI(*),EL(*)
      DIMENSION VQ(200),VF(200)
      COMMON
     &      /BLK03/DDT,NQ,DT
     &      /BLK07/CM(20)
     &      /BLK07C/KOUZUI
     &      /BLK13/NKZ,IZ,IRN
     &      /BLK14/NCASE,NQQ
     &      /BLK05/IDAM,IVL,IEPS,IPNT
     &      /BLK15/T1,IDAY1,H1
     &      /BLK16/DAMT
     &      /BLK04/NPOIN,NNPN,IG
      CHARACTER KOUZUI*80
      IF(K.GT.IDAM) GO TO 90
      I1=ID
      I2=IP
      NCASE=0
      RNQ=(DT/DAMT)*FLOAT(NQ)+1.0
      NQQ=RNQ
      CALL SIZE(1,IE,NQQ)
      TD=DT/60.0
      DTD=DAMT/60.
      T(1)=0.0
      TI(1)=H1
      NN=NO(K)
      NS=NV(K)
      IF(IRN.NE.1) GO TO 3331
      WRITE(3,2031)
```

```
2031 FORMAT(1H1,//1H ,20X,'H - V CURVE'//)
     CALL WRIT(HS(1,K),VS(1,K),NS)
     WRITE(3,2032)
2032 FORMAT(////1H ,20X,'H - Q CURVE'//)
     HMX=HS(NS,K)
     DO 5022 I=1,NN
     IF(HF(I,K).GE.HMX) GO TO 3333
5022 CONTINUE
3333 MHQ=I
     CALL WRIT(HF(1,K),QF(1,K),MHQ)
3331 CONTINUE
     DO 5001 I=1,NQ
5001 T(I+1)=T(I)+TD
     NK=NQ
     DO 5002 I=1,NQQ
     CALL CHANG(TI(I),QI(I),NK,T,QX)
     TI(I+1)=TI(I)+DTD
5002 CONTINUE
     CALL CHANG(QX(1),HIN,NN,QF(1,K),HF(1,K))
     CALL CHANG(HIN,VIN,NS,HS(1,K),VS(1,K))
     DO 5003 I=1,NN
     CALL CHANG(HF(I,K),VF(I),NS,HS(1,K),VS(1,K))
     VQ(I)=VF(I)/DAMT+0.5*QF(I,K)
5003 CONTINUE
     QO(1)=QX(1)
     QO1=QO(1)
     VX=VIN
     HDAM(1)=HIN
     VV(1)=VIN
     DO 5004 I=2,NQQ
     IF(HDAM(I-1).LT.EL(K)) GO TO 3003
3004 UHEN=0.5*(QI(I)+QI(I-1))+VX/DAMT-0.5*QO1
     CALL CHANG(UHEN,VV(I),NN,VQ,VF)
     CALL CHANG(UHEN,QO(I),NN,VQ,QF(1,K))
     IF(VV(I).GT.VIN) GO TO 3002
     VV(I)=VIN
     QO(I)=QI(I)
     QO1=QO(I)
     VX=VIN
     HDAM(I)=HIN
     GO TO 5004
3003 VV(I)=VX+(QI(I-1)+QI(I))*DAMT/2.0
     QO(I)=0.0
     CALL CHANG(VV(I),HDAM(I),NS,VS(1,K),HS(1,K))
     IF(HDAM(I).GT.EL(K)) GO TO 3004
     QO1=0.0
     VX=VV(I)
     GO TO 5004
3002 CALL CHANG (QO(I),HDAM(I),NN,QF(1,K),HF(1,K))
     QO1=QO(I)
     VX=VV(I)
5004 CONTINUE
     IF(IG.GE.0) CALL OUTDAM(HDAM,QI,QO,VV)
     CALL CHOSET(K,HDAM,QI,QO,VV,TI,NV,HS,VS,EL,I1,I2,HG,QIG,QOG,VG,
     &      VC,VVC,HHK,HMIN)
     DO 5010 I=1,NQ
5010 CALL CHANG(T(I),QX(I),NQQ,TI,QO)
     WRITE(30,REC=NKZ) (QX(I),I=1,NQ)
     IF(IG.GT.0) GO TO 99
     JKZ=(K-1)*2+2
```

```
      WRITE(32,REC=JKZ) NN,(HF(I,K),QF(I,K),I=1,NN),MHQ
      JKZ=JKZ+1
      WRITE(32,REC=JKZ) NS,(HS(I,K),VS(I,K),I=1,NS)
      JKZ=3+2*IDAM+(IZ-1)*5+(K-1)*4
      WRITE(32,REC=JKZ) (QI(I),I=1,NQQ),QIG
      JKZ=JKZ+1
      WRITE(32,REC=JKZ) (QO(I),I=1,NQQ),QOG
      JKZ=JKZ+1
      WRITE(32,REC=JKZ) (HDAM(I),I=1,NQQ),HG,HHK,HMIN
      JKZ=JKZ+1
      WRITE(32,REC=JKZ) (VV(I),I=1,NQQ),VG,VC,VVC
   99 RETURN
   90 WRITE(3,666)
  666 FORMAT(1H1,'*** DAM KEISAN NO KAISUU O CHECK SARETASHI ***')
      STOP
      END
      SUBROUTINE CHANG(X,Y,N,XX,YY)
      DIMENSION XX(N),YY(N)
      DO 5000 I=2,N
      IF(X.LE.XX(I)) GO TO 3000
 5000 CONTINUE
 3000 JK=I
      Y=(X-XX(JK-1))*(YY(JK)-YY(JK-1))/(XX(JK)-XX(JK-1))+YY(JK-1)
      RETURN
      END
      SUBROUTINE CHOSET(KY,HX,QI,QO,VX,T,NV,HS,VS,EL,ID,IP,HG,QIG,QOG,
     &    VG,VC,VVC,HHK,HMIN)
      DIMENSION HX(*),QI(*),QO(*),VX(*),T(*),NV(*),HS(IP,*),VS(IP,*),
     &         EL(*)
      COMMON
     &      /BLK14/NCASE,NQQ
      HMIN=10000.0
      HG=-1.0
      QIG=-1.0
      QOG=-1.0
      VG=-1.0
      DO 5001 I=1,NQQ
      IF(HX(I).LT.HMIN) HMIN=HX(I)
      IF(HX(I).GT.HG) HG=HX(I)
      IF(QI(I).GT.QIG) QIG=QI(I)
      IF(QO(I).GT.QOG) QOG=QO(I)
      IF(VX(I).GT.VG) VG=VX(I)
 5001 CONTINUE
      CALL CHANG(EL(KY),VIN,NV(KY),HS(1,KY),VS(1,KY))
      VC=VG-VIN
      VVC=1.2*VC
      VVC=(AINT(VVC/100000.)+1.)*100000.
      WRITE(3,2001) HG,QIG,QOG,VG
 2001 FORMAT(//1H ,25X,'MAXIMAM OF WATER ELEVATION =',F10.3,
     &/1H ,25X,'MAXIMAM OF INFLOW =',F19.3,
     &/1H ,25X,'MAXIMAM OF DISCHARGE =',F16.3,
     &/1H ,25X,'MAXIMAM OF VOLUME =',F19.3//)
      WRITE(3,2002) VC,VVC
 2002 FORMAT(1H ,20X,'KOUZUI CHOSETSU YORYO',
     &/1H ,30X,'1.2  * ',F13.1,'  =  ',F13.1//)
      VVK=VIN+VVC
      CALL CHANG(VVK,HHK,NV(KY),VS(1,KY),HS(1,KY))
      WRITE(3,2003) HHK
 2003 FORMAT(1H ,20X,'KOUZUI JI MANSUI I',
     &/1H ,55X,F13.3//)
```

```
      WRITE(1)  (HDAM(I),I=1,NQQ),HG,HHK,HMIN
      JKZ=JKZ+1
      READ(32,REC=JKZ) (VV(I),I=1,NQQ),VG,VC,VVC
      WRITE(1)  (VV(I),I=1,NQQ),VG,VC,VVC
 6003 CONTINUE
 6006 CONTINUE
      JKZ=(JZ-1)*NNPN+1
      DO 6004 IJ=1,NNPN
      READ(30,REC=JKZ)(QI(I),I=1,NQ)
      WRITE(1)  (QI(I),I=1,NQ)
      JKZ=JKZ+1
 6004 CONTINUE
 6002 CONTINUE
 9999 CONTINUE
      STOP
  500 FORMAT(8F10.0)
      END
      SUBROUTINE STATIS(RKA,IR,NR,RMAX,IMAX,RAT,IW,IBY,QSAL,TT)
      DIMENSION TT(*),QSAL(*)
      IF(IBY.LT.0) GO TO 3004
      NN=NR-IR+1
      DO 5001 I=1,NN
      K=I
      II=I+IR-1
      RR=0.0
      DO 5002 J=K,II
 5002 RR=RR+QSAL(J)
      TT(I)=RR
 5001 CONTINUE
      RMAX=-1.0
      DO 5003 I=1,NN
      IF(TT(I).LT.RMAX) GO TO 5003
      RMAX=TT(I)
      IMAX=I
 5003 CONTINUE
      GO TO 3005
 3004 K=IMAX
      II=K+IR-1
      RMAX=0.0
      DO 5005 I=K,II
 5005 RMAX=RMAX+QSAL(I)
      GO TO 3003
 3005 CONTINUE
      IF(IBY.GT.0) GO TO 3003
      IF(RKA.EQ.0.) RKA=RMAX
      RAT=RKA/RMAX
 3003 JJ=IMAX+IR-1
      IF(IW.EQ.0) GO TO 3001
      K1=IMAX
      K2=JJ
      GO TO 3002
 3001 K1=1
      K2=NR
 3002 DO 5004 I=K1,K2
      QSAL(I)=QSAL(I)*RAT
 5004 CONTINUE
      RETURN
      END
      SUBROUTINE TANJIR(RAVE,NR,QSAL,QI,QO)
      DIMENSION RAVE(*),QSAL(*),QI(*),QO(*)
```

```
      COMMON
     &      /BLK18/RRMAX1,RRMAX2
      DO 5007 I=1,NR
       QI(I)=0.
 5007  QO(I)=0.
      KR1=3
      KR2=6
      NKR1=NR-2
      DO 5006 I=1,NKR1
      II=I+KR1-1
      DO 5006 J=I,II
 5006  QI(I)= QI(I)+QSAL(J)
      NKR2=NR-5
      DO 5009 I=1,NKR2
      II=I+KR2-1
      DO 5009 J=I,II
 5009  QO(I)= QO(I)+QSAL(J)
      RRMAX1=-1.0
      RRMAX2=-1.0
      DO 5010 I=1,NKR1
      IF( QI(I).LT.RRMAX1) GO TO 5010
      RRMAX1= QI(I)
 5010 CONTINUE
      DO 5011 I=1,NKR2
      IF( QO(I).LT.RRMAX2) GO TO 5011
      RRMAX2= QO(I)
 5011 CONTINUE
      RETURN
      END
      SUBROUTINE REFECT(QSAL,NR,IROUT)
      DIMENSION QSAL(*)
      RL1=0.0
      SIGR=0.0
      IF(IROUT.EQ.-1) GO TO 3001
      SIGR=20.0
      RL1=SIGR*(1.0-3.6*0.0001*SIGR**1.5)
 3001 CONTINUE
      DO 5001 I=1,NR
      SIGR=SIGR+QSAL(I)
      RL=SIGR*(1.0-3.6*0.0001*SIGR**1.5)
      IF(SIGR.GE.100) RL=64.0
      RRL=RL-RL1
      QSAL(I)=QSAL(I)-RRL
      RL1=RL
 5001 CONTINUE
      RETURN
      END
      SUBROUTINE CONT(QX,QSAL,T,RAVE,NZ,NZKO,NZZ,EL,QMX,QMIN,RTCUT,
     &      AK,AP,ATL,AF,F1,RSA,QC,AREA,LSA,RK,RP,RTL,RF,
     &      NV,HS,VS,NO,HF,QF,HDAM,QI,QO,VV,TI,AL,ID,IA,XQ,XS,
     &   IN,IP,IE,IH,AS   )
      DIMENSION QX(*),QSAL(*),T(*),RAVE(*),NZ(*),NZKO(*),NZZ(IN,*),
     &      EL(*),QMX(*),QMIN(*),RTCUT(*),AK(*),AP(*),ATL(*),AF(*),
     &      F1(*),RSA(*),QC(*),AREA(*),LSA(*),RK(*),RP(*),RTL(*),
     &   RF(*),NV(*),HS(IP,*),VS(IP,*),NO(*),HF(IH,*),QF(IH,*)
     &      ,HDAM(*),QI(*),QO(*),VV(*),TI(*),AL(*)
     &   ,XQ(25),XS(IA,25),AS(*)
      COMMON
     &      /BLK03/DDT,NQ,DT
     &      /BLK13/NKZ,IZ
```

```
      DO 60 K=1,NR
      IF(QSAL(K ).LT.RMAX) GO TO 77
      RMAX=QSAL(K )
   77 CONTINUE
      IQF=K*IQX
      IQE=IQF-IQX+1
      DO 60 JJ=IQE,IQF
   60 RAVE(JJ)=QSAL(K)
      NKZ=KRAIN(I)+(IZ-1)*NNPN
      WRITE(3,5002) TITLEA(I)       ,R,IMAX,RKA,RAT,RMAX,RRMAX1,RRMAX2
   40 WRITE(30,REC=NKZ) (RAVE(K),K=1,NQ)
 5002 FORMAT(1H0, 3X,A12,2X,F10.2,5X,I5,7X,F10.2,6X,F10.3,4X,3F8.2)
 1111 IF(MQY.EQ.0) GO TO 7
      DO 5004 J=1,MQY
      READ(4,500) (HDAM(I),I=1,NQX)
      QI(1)=0.
      DO 5022 I=2,NQX
 5022 QI(I)=QI(I-1)+DTQX
      TT=0.
      DO 5003 I=1,NQ
      CALL CHANG(TT,QO(I),NQX,QI,HDAM)
      TT=TT+DT
 5003 CONTINUE
      WRITE(30,REC=NNK) (QO(I),I=1,NQ)
      NNK=NNK+1
 5004 CONTINUE
    7 CONTINUE
      RETURN
  999 WRITE(32,REC=1) (CM(I),I=1,20)       ,NNPN,DDT,DT    ,IDAM,
     &      DAMT,IRN,(NDJ(I),I=1,IDAM),(NAME(I),I=1,NNPN)
     &      ,(IKZ(I),I=1,IRN)
      IF(MTOT.EQ.0) GO TO 9999
      REWIND 01
      WRITE(1) (CM(I),I=1,20),NNPN,DDT,DT,IDAM,DAMT,IRN,
     &    (NDJ(I),I=1,IDAM),(NAME(I),I=1,NNPN),(IKZ(I),I=1,IRN)
      IF(IDAM.EQ.0) GO TO 6005
      DO 6001 K=1,IDAM
      JKZ=(K-1)*2+2
      READ(32,REC=JKZ) NN,(HF(I,K),QF(I,K),I=1,NN),MHQ
      WRITE(1)    NN,(HF(I,K),QF(I,K),I=1,NN),MHQ
      JKZ=JKZ+1
      READ(32,REC=JKZ) NS,(HS(I,K),VS(I,K),I=1,NS)
      WRITE(1)    NS,(HS(I,K),VS(I,K),I=1,NS)
 6001 CONTINUE
 6005 CONTINUE
      DO 6002 II=1,IRN
      JZ=IKZ(II)
      JKZ=1+2*IDAM+JZ+IDAM*4*(JZ-1)
      READ(32,REC=JKZ)  KOUZUI,NQ,NQQ,T1,IDAY1,H1
      WRITE(1)     KOUZUI,NQ,NQQ,T1,IDAY1,H1
      IF(IDAM.EQ.0) GO TO 6006
      DO 6003 JJ=1,IDAM
      JKZ=3+2*IDAM+(JZ-1)*5+(JJ-1)*4
      READ(32,REC=JKZ) (QI(I),I=1,NQQ),QIG
      WRITE(1)    (QI(I),I=1,NQQ),QIG
      JKZ=JKZ+1
      READ(32,REC=JKZ) (QO(I),I=1,NQQ),QOG
      WRITE(1)    (QO(I),I=1,NQQ),QOG
      JKZ=JKZ+1
      READ(32,REC=JKZ) (HDAM(I),I=1,NQQ),HG,HHK,HMIN
```

```
 1 RETURN
  END
  SUBROUTINE CUTDAM(K,QMX,QMIN,RTCUT,VV,QI,QO,HDAM,T,QX)
  DIMENSION QMX(*),QMIN(*),RTCUT(*),VV(*),QI(*),QO(*),HDAM(*),
 &     T(*),QX(*)
  COMMON
 &     /BLK03/DDT,NQ,DT
 &     /BLK13/NKZ,IZ
 &     /BLK14/NCASE,NQQ
  DAMT=DT
  NQQ=NQ
  NCASE=1
  IDENT=0
  RATIO=RTCUT(K)
  IF(RATIO.GT.0.000001    ) GO TO 3003
  QQMAX=-1.0
  DO 5001 I=1,NQ
  IF(QX(I).LT.QQMAX) GO TO 5001
  QQMAX=QX(I)
  IMAX=I
5001 CONTINUE
  DO 5002 I=1,NQ
  J=IMAX-I
  IF(QX(J).GT.QMIN(K)) GO TO 5002
  IMIN=J
  GO TO 3001
5002 CONTINUE
3001 IDH=IMAX-IMIN
  RATIO=(QMX(K)-QMIN(K))/(QQMAX-QMIN(K))
3003 DO 5003 I=1,NQ
  HDAM(I)=0.0
5003 VV(I)=0.0
  TV=0.0
  QL1=0.0
  DO 5004 I=1,NQ
  IF(QX(I).LT.QMIN(K).AND. TV    .LT.0.0001) GO TO 3004
  QO(I)=(QX(I)-QMIN(K))*RATIO+QMIN(K)
  QO(I)=(QX(I)-QMIN(K))*RATIO+QMIN(K)+0.001
  IF(QO(I).GT.QMX(K)) GO TO 3005
  IF(QO(I).LT.QMIN(K)) GO TO 3007
  IF(IDENT.EQ.1) GO TO 3006
  QL2=QX(I)-QO(I)
  VV(I)=0.5*DAMT*(QL1+QL2)
  TV=TV+VV(I)
  HDAM(I)=TV
  QL1=QL2
  GO TO 5004
3004 QO(I)=QX(I)
  VV(I)=0.0
  TV=0.0
  QL1=0.0
  HDAM(I)=TV
  GO TO 5004
3005 QO(I)=QMX(K)
  QL2=QX(I)-QO(I)
  VV(I)=0.5*DAMT*(QL1+QL2)
  TV=TV+VV(I)
  HDAM(I)=TV
  QL1=QL2
  IDENT=1
```

```
      GO TO 5004
 3006 QL2=QX(I)-QMX(K)
      VV(I)=0.5*DAMT*(QL1+QL2)
      TV=TV+VV(I)
      HDAM(I)=TV
      QL1=QL2
      IF(HDAM(I).LT.0.0001) GO TO 3004
      QO(I)=QMX(K)
      GO TO 5004
 3007 QL2=QX(I)-QMIN(K)
      VV(I)=0.5*DAMT*(QL1+QL2)
      TV=TV+VV(I)
      HDAM(I)=TV
      QL1=QL2
      IF(HDAM(I).LT.0.0001) GO TO 3004
      IF(HDAM(I).GT.VV(I-1)) GO TO 3008
      QO(I)=QMIN(K)
      GO TO 5004
 3008 QO(I)=QMX(K)
 5004 CONTINUE
      DO 5005 I=1,NQ
      QI(I)=QX(I)
 5005 QX(I)=QO(I)
      CALL OUTDAM(VV,QI,QO,HDAM)
      WRITE(3,2001) QMIN(K),QMX(K),RATIO
 2001 FORMAT(///1H ,20X,'SAITEI HORYU RYO',F10.3,3X,'M*3/SEC',
     &  /1H ,20X,'MUGAI  HORYU RYO',F10.3,3X,'M*3/SEC',
     &  /1H ,20X,'RYUNYU RYO NI TAISURU HORYU RITSU',
     &   1H ,36X,F10.3)
      WRITE(30,REC=NKZ) (QX(I),I=1,NQ)
      RETURN
      END
      SUBROUTINE QQCUT(K,QMX,QX,QO )
      DIMENSION QMX(*),QX(*),QO(*)
      COMMON /BLK03/DDT,NQ,DT
     &    /BLK13/NKZ,IZ
      DO 5001 I=1,NQ
      QO(I)=QX(I)
      IF(QO(I).GE.QMX(K)) QO(I)=QMX(K)
 5001 CONTINUE
      DO 5002 I=1,NQ
 5002 QX(I)=QO(I)
      WRITE(30,REC=NKZ) (QX(I),I=1,NQ)
      RETURN
      END
      SUBROUTINE TOTAL(K,L,QX,QSAL)
      DIMENSION QX(*),QSAL(*)
      COMMON
     &      /BLK03/DDT,NQ,DT
     &      /BLK13/NKZ,IZ
      DO 30 I=1,NQ
   30 QSAL(I)=0
      J=L-3
      DO 20 I1=1,NQ
   20 QSAL(I1)=QSAL(I1)+QX(I1)
      IF(J.LE.0.OR.K.LE.1) GO TO 50
      DO 10 I=2,K
      READ(30,REC=J) (QX(I1),I1=1,NQ)
      DO 60 I1=1,NQ
   60 QSAL(I1)=QSAL(I1)+QX(I1)
```

```
   10 J=J-2
   50 WRITE(30,REC=L)(QSAL(I),I=1,NQ)
      DO 40 I=1,NQ
      QX(I)=QSAL(I)
   40 QSAL(I)=0.
      RETURN
      END
      SUBROUTINE RUIKA(K,QX,QSAL,NZKO,NZZ,IN)
      DIMENSION QX(*),QSAL(*),NZKO(*),NZZ(IN,*)
      COMMON
     &      /BLK03/DDT,NQ,DT
     &      /BLK04/NPOIN,NNPN,IG
     &      /BLK13/NKZ,IZ
      DO 5001 I=1,NQ
      QX(I)=0.0
 5001 QSAL(I)=0.0
      NK=NZKO(K)
      DO 5002 I=1,NK
      NM=NZZ(K,I)+(IZ-1)*NNPN
      READ(30,REC=NM) (QSAL(J),J=1,NQ)
      DO 5002 L=1,NQ
 5002 QX(L)=QX(L)+QSAL(L)
      WRITE(30,REC=NKZ) (QX(I),I=1,NQ)
      RETURN
      END
      SUBROUTINE MYNAS(K,QX,QSAL,NZKO,NZZ,IN)
      DIMENSION QX(*),QSAL(*),NZKO(*),NZZ(IN,*)
      COMMON
     &      /BLK03/DDT,NQ,DT
     &      /BLK04/NPOIN,NNPN,IG
     &      /BLK13/NKZ,IZ
      DO 5001 I=1,NQ
      QX(I)=0.0
 5001 QSAL(I)=0.0
      NK=NZKO(K)
      DO 5002 I=1,NK
      NM=NZZ(K,I)
      CT=1.0
      IF(NM.LT.0) CT=-1.0
      IF(NM.LT.0) NM=NM*(-1)
      N1=NM+(IZ-1)*NNPN
      READ(30,REC=N1) (QSAL(J),J=1,NQ)
      DO 5002 L=1,NQ
      QX(L)=QX(L)+QSAL(L)*CT
      IF(QX(L).LT.0.0) QX(L)=0.0
 5002 CONTINUE
      WRITE(30,REC=NKZ) (QX(I),I=1,NQ)
      RETURN
      END
      SUBROUTINE FLRED(LK,NZ,QX,RAVE)
      DIMENSION NZ(*),QX(*),RAVE(*)
      COMMON
     &      /BLK03/DDT,NQ,DT
     &      /BLK04/NPOIN,NNPN,IG,NPFL
     &      /BLK13/NKZ,IZ
      LKZ=(IZ-1)*NPFL+NZ(LK)-2000
      READ(31,REC=LKZ) (RAVE(I),I=1,NQ)
      DO 5001 I=1,NQ
 5001 QX(I)=RAVE(I)
      WRITE(30,REC=NKZ) (QX(I),I=1,NQ)
```

```
      RETURN
      END
      SUBROUTINE OUTDAM(HDAM,QI,QO,VV)
      DIMENSION HDAM(*),QI(*),QO(*),VV(*)
      COMMON
     &     /BLK14/NCASE,NQQ
     &     /BLK07/CM(20)
     &     /BLK07C/KOUZUI
     &     /BLK15/TM,IDAY,HM
     &     /BLK16/DAMT
      CHARACTER KOUZUI*80
      DDT=DAMT/60.0
      PAGE=0.0
      DA1=IDAY
      T1=TM
      H1=HM
      NCASE=NCASE+1
      DO 5000 I=1,NQQ
      IF((I-1)/50*50+1.NE.I) GO TO 3000
      PAGE=PAGE+1.0
      WRITE(3,2000) NCASE,(CM(J),J=1,20)
      WRITE(3,2003) KOUZUI
 2003 FORMAT(/1H ,10X,A80)
      WRITE(3,2001) PAGE
 3000 WRITE(3,2002) DA1,T1,H1,HDAM(I),QI(I),QO(I),VV(I)
      H1=H1+DDT
      IF(H1.LT.60.0) GO TO 3001
      T1=T1+1.0
      H1=H1-60.0
 3001 IF(T1.LT.24.0) GO TO 5000
      DA1=DA1+1.0
      T1=T1-24.0
 5000 CONTINUE
 2000 FORMAT(1H1,//1H ,I5,15X,20A4/)
 2001 FORMAT(1H ,77X,'PAGE.',F4.0,
     &//1H ,18X,' DAY  TIME',9X,'WATER DEPTH',5X,'INFLOW',
     &5X,'DISCHARGE',7X,'VOLUME',/)
 2002 FORMAT(1H ,18X,3F3.0,5X,F14.3,2X,F10.3,3X,F10.3,2X,F13.1)
      RETURN
      END
      SUBROUTINE WRI1(AK,AP,ATL,AF,F1,RSA,QC,AREA,RK,RP,RTL,QX,TITLEA,
     &     TITLER,KRAIN,LSA    )
      DIMENSION AK(*),AP(*),ATL(*),AF(*),F1(*),RSA(*),QC(*),AREA(*),
     &     RK(*),RP(*),RTL(*),QX(*),TITLEA(*) ,TITLER(*),
     &    KRAIN(*),LSA(*)
      COMMON
     &     /BLK02/NAREA,NRIV
     &     /BLK03/DDT,NQ,DT
     &     /BLK04/NPOIN,NNPN,IG
     &     /BLK07/CM(20)
     &     /BLK07C/KOUZUI
     &     /BLK09/IROUT
     &     /BLK13/NKZ,IZ
      CHARACTER KOUZUI*80
      CHARACTER TITLEA*12,TITLER*12
      IF(NAREA.EQ.0) GO TO 10
      WRITE(3,2001) (CM(I),I=1,20),KOUZUI
 2001 FORMAT(1H1,///1H ,20X,20A4//30X,A80///)
      IF(IROUT.LT.0) GO TO 3007
      WRITE(3,2002)
```

```
 2002 FORMAT(/1H ,20X,'INPUT',5X,'DATA',6X,'LIST'/
     &/1H ,12X,'RYUIKI',9X,'K',10X,'P',8X,'TL',8X,'F1',8X,'A',9X,
     &'QB',7X,'RSA',7X,'RAVE',/)
      GO TO 3008
 3007 WRITE(3,2009)
 2009 FORMAT(/1H ,20X,'INPUT',5X,'DATA',6X,'LIST'/
     &/1H ,12X,'RYUIKI',9X,'TK',9X,'TP',7X,'TG',8X,'QMAX',6X,'A',9X,
     &'QB',17X,'RAVE',/)
 3008 DO 3001 I=1,NAREA
      A=0.0
      N1=KRAIN(I)+(IZ-1)*NNPN
      READ(30,REC=N1) (QX(J),J=1,NQ)
      DO 40 J=1,NQ
   40 A=A+QX(J)
      A=A*DDT
      WRITE(3,2003) TITLEA(I)       ,AK(I),AP(I),ATL(I),F1(I),AREA(I)
     &   ,QC(I),RSA(I),A,LSA(I)
 3001 CONTINUE
 2003 FORMAT(1H ,10X,A12,8F10.3,I5)
   10 CONTINUE
      IF(NRIV.LE.0) GO TO 20
      WRITE(3,2004)
 2004 FORMAT(/////1H ,13X,'KADO',10X,'K',10X,'P',8X,'TL',/)
      DO 3002 I=1,NRIV
      WRITE(3,2005) TITLER(I)       ,RK(I),RP(I),RTL(I)
 3002 CONTINUE
 2005 FORMAT(1H ,10X,A12,3F10.3)
      IF(IROUT.EQ.0) WRITE(3,2007)
      IF(IROUT.EQ.1) WRITE(3,2008)
 2007 FORMAT(//1H ,30X,'KAISEKI SHUHO TOSHITE    ORESEN-HO O MOC
     &HIIRU.'//)
 2008 FORMAT(//1H ,30X,'KAISEKI SHUHO TOSHITE CHUKAN-SABUN-HO O MOC
     &HIIRU.'//)
   20 CONTINUE
      RETURN
      END
      SUBROUTINE OUTPUT(HYO,NAME,NPNT)
      DIMENSION HYO(13,*),NAME(*),NPNT(*)
      COMMON
     &     /BLK03/DDT,NQ,DT
     &     /BLK04/NPOIN,NNPN,IO
     &     /BLK06/NQXR,IQXR
     &     /BLK07/CM(20)
     &     /BLK07C/KOUZUI
     &     /BLK13/NKZ,IZ
     &     /BLK15/T1,IDAY1,H1
     &     /BLK05/IDAM,IVL,IEPS,IPNT
      CHARACTER NAME*9,KOUZUI*80
      MDM=(IQXR*DT/60.)+0.0001
      IF(IPNT.NE.0) GO TO 3001
      IPPP=NPOIN
      DO 5003 I=1,NPOIN
      NPNT(I)=I
 5003 CONTINUE
      GO TO 3002
 3001 CONTINUE
      IPPP=IPNT
 3002 IP=0
      NK0=(IZ-1)*NNPN
      NW0=0
```

```
      NPOIS=(IZ-1)*NNPN+NPOIN
      M=13
      L=1
      NQ1=NQ+1
    1 CONTINUE
      KEI=1
      IDAY=IDAY1
      T=T1
      MH=IFIX(H1)
      DO 20 N=1,13
      IP=IP+1
      NKZ=NK0+NPNT(IP)
      NWZ=NW0+NPNT(IP)
      READ(30,REC=NKZ) (HYO(N,I),I=1,NQ)
      IF(IP.EQ.IPPP) GO TO 2
   20 CONTINUE
      GO TO 3
    2 M=N
    3 CONTINUE
      DO 6 IJ=1,100
      WRITE(3,900) CM,KOUZUI,(NAME(NPNT(I)),I=L,IP)
  900 FORMAT(1H1///30X,20A4/31X,A80//15X,13A9)
      WRITE(3,901)
  901 FORMAT(1H0)
      DO 10 I=1,48
      WRITE(3,100) IDAY,T,MH,(HYO(J,KEI),J=1,M)
  100 FORMAT(1H ,6X,I2,1H.,F3.0,I2,13F9.2)
      MH=MH+MDM
      IF(MH.LT.60) GO TO 5
      MH=MH-60
      T=T+1.
      IF(T.LT.24.) GO TO 5
      T=0.
      IDAY=IDAY+1
    5 CONTINUE
      KEI=KEI+IQXR
      IF(KEI.GT.NQ) GO TO 4
   10 CONTINUE
    6 CONTINUE
      GO TO 1
    4 CONTINUE
      DO 5001 I=1,M
      QMX=-1.0
      DO 5002 J=1,NQ
      IF(HYO(I,J).GT.QMX) QMX=HYO(I,J)
 5002 CONTINUE
      HYO(I,NQ1)=QMX
 5001 CONTINUE
      WRITE(3,2001) (HYO(J,NQ1),J=1,M)
 2001 FORMAT(//1H ,6X,'MAXIMUM',1X,13F9.2)
      L=L+13
      IF(IP.NE.IPPP) GO TO 1
      RETURN
      END
      SUBROUTINE WRIT(ZZ,AA,NX)
      DIMENSION ZZ( *),AA( *)
      II=NX/5
      IF(II*5.NE.NX) II=II+1
      DO 10 I=1,II
      WRITE(3,100) (ZZ(J),AA(J),J=I,NX,II)
```

```
 100 FORMAT(1H ,10X,5(F8.3,1X,E12.6,3X))
  10 CONTINUE
     RETURN
     END
     SUBROUTINE VLGOKE(NAME,AZV,HDAM,IN)
     DIMENSION NAME(*),AZV(IN,*),HDAM(*)
     COMMON
    &      /BLK03/DDT,NQ,DT
    &      /BLK04/NPOIN,NNPN,IG
    &      /BLK05/IDAM,IVL,IEPS,IPNT
    &      /BLK07/CM(20)
    &      /BLK07C/KOUZUI
    &      /BLK13/NKZ,IZ
     CHARACTER NAME*9  ,KOUZUI*80
     WRITE(3,2000) (CM(I),I=1,20)
2000 FORMAT(1H1,20X,20A4 // 30X,'HYDROGRAPH  VOLUME' // 25X,'NAME',3X,
    & 'BASEVOL(M**3/SEC)   VOLUME(M**3)')
     DO 5001 I=1,IVL
     NB=IFIX(AZV(I,1))
     NA=NB+(IZ-1)*NNPN
     NJ=IFIX(AZV(I,2))
     READ(30,REC=NA) (HDAM(J),J=1,NQ)
     DO 5003 JJ=1,NJ
     VT=0.
     KK=2+JJ
     QJ=AZV(I,KK)
     DO 5002 K=2,NQ
     QL1=HDAM(K-1)-QJ
     QL2=HDAM(K)  -QJ
     IF(QL1.LT.0.0) QL1=0.0
     IF(QL2.LT.0.0) QL2=0.0
     VK=(QL1+QL2)/2.0*DT
     VT=VT+VK
5002 CONTINUE
     WRITE(3,2001) NAME(NB),QJ,VT
2001 FORMAT(1H0,25X,A9,F15.3,F16.3)
5003 CONTINUE
5001 CONTINUE
     RETURN
     END
     SUBROUTINE EPSCAL(NAME,AZV,HDAM,IN,QSAL)
     DIMENSION NAME(*),AZV(IN,*),HDAM(*),QSAL(*)
     COMMON /BLK03/DDT,NQ,DT
     COMMON /BLK04/NPOIN,NNPN,IG
     COMMON /NLK05/IDAM,IVL,IEPS,IPNT
     COMMON /BLK07/CM(20)
     COMMON /BLK07C/KOUZUI
     COMMON /BLK13/NKZ,IZ
     CHARACTER NAME*9,KOUZUI*80
     WRITE(3,2000) (CM(I),I=1,20)
2000 FORMAT(/////1H ,20X,20A4,//30X,'HYDRO GRAPH   ERROR  ',
    &  //25X,'  NAME       NAME       ERROR')
     EE=0.0
     DO 5001 I=1,IEPS
     NA=IFIX(AZV(I+IVL,1))
     NB=IFIX(AZV(I+IVL,2))
     NX=(IZ-1)*NNPN+NA
     NY=(IZ-1)*NNPN+NB
     READ(30,REC=NX) (HDAM(J),J=1,NQ)
     READ(30,REC=NY) (QSAL(J),J=1,NQ)
```

```
      QMX=-1.0
      DO 5002 J=1,NQ
      IF(QSAL(J).GT.QMX)  QMX=QSAL(J)
 5002 CONTINUE
      DO 5003 J=1,NQ
      EE=EE+(HDAM(J)-QSAL(J))*(HDAM(J)-QSAL(J))/QMX/QMX
 5003 CONTINUE
      EE=EE/FLOAT(NQ)
      WRITE(3,2001)  NAME(NA),NAME(NB),EE
 2001 FORMAT(1H0,25X,2(A9,2X),E15.6)
 5001 CONTINUE
      RETURN
      END
      SUBROUTINE GRAPH(IZ,K,T,RX,QI,QO,HX,VX,NAME,ZZ    )
      DIMENSION T(*),RX(*),QI(*),QO(*),HX(*),VX(*),NAME(*),ZZ(*)
      DIMENSION KA(6),YP(5),MEMO(6),PPL(11),R(6),P(120)
      COMMON
     &       /BLK07/CM(20)
     &       /BLK07C/KOUZUI
     &    /BLK03/DDT,NII,DT
     &    /BLK04/NPOIN,NNPN,IG,NPFL
     &    /BLK10/CPL(5)
     &    /BLK20/JQ(10,6),IPLOT,IPL
     &       /BLK15/T1,IDAY1,H1
      CHARACTER KOUZUI*80
      CHARACTER NAME*9,MEMO*9
      DATA KA/1005,234,882,1672,1410,663/
      DATA PL1,PL2,PL3,PL4,PL5,PL6/1H ,1H+,1H-,1H.,1HI,1H*/
C     CHARACTER KOUZUI*80
C     CHARACTER NAME*9,MEMO*9
      DATA YP/ 1.,10.,100.,1000.,10000./
      DO 5002 I=1,5
      IF(CPL(I).LT.0.1) GO TO 5002
      YP(I)=CPL(I)
 5002 CONTINUE
      IF(K.EQ.1) WRITE(3,2001) (CM(I),I=1,20),KOUZUI
 2001 FORMAT(1H1///1H ,20X,20A4//,30X,A80//)
      JZZ=0
      DO 5001 I=1,6
      I1=JQ(K,I)
      IF(I1.EQ.0) GO TO 5001
      JZZ=JZZ+1
      MEMO(JZZ)=NAME(I1)
 5001 CONTINUE
      WRITE(3,2002) (MEMO(I),I=1,JZZ)
 2002 FORMAT(/1H ,30X,6(A9,6X)//)
      JQ1=0
      JQ2=0
      JQ3=0
      JQ4=0
      JQ5=0
      JQ6=0
      RCA=1.0
      XMAX=-1.0
      RMAX=-1.0
      DO 10 I=1,NII
      HX(I)=0.
      QI(I)=0.
      QO(I)=0.
      VX(I)=0.
```

```
      RX(I)=0.
      T(I)=0.
   10 CONTINUE
      DO 90 L=1,6
      IF(JQ(K,L).EQ.0) GO TO 90
      GO TO (81,82,83,84,85,86),L
   81 JQ1=JQ(K,L)+(IZ-1)*NNPN
      READ(30,REC=JQ1)(RX(J),J=1,NII)
      GO TO 90
   82 JQ2=JQ(K,L)+(IZ-1)*NNPN
      READ(30,REC=JQ2)(QI(J),J=1,NII)
      GO TO 90
   83 JQ3=JQ(K,L)+(IZ-1)*NNPN
      READ(30,REC=JQ3)(HX(J),J=1,NII)
      GO TO 90
   84 JQ4=JQ(K,L)+(IZ-1)*NNPN
      READ(30,REC=JQ4)(QO(J),J=1,NII)
      GO TO 90
   85 JQ5=JQ(K,L)+(IZ-1)*NNPN
      READ(30,REC=JQ5)(VX(J),J=1,NII)
      GO TO 90
   86 JQ6=JQ(K,L)+(IZ-1)*NNPN
      READ(30,REC=JQ6) (T(J),J=1,NII)
   90 CONTINUE
      DO 60 I=1,NII
      IF(XMAX.LT.QI(I)) XMAX=QI(I)
      IF(XMAX.LT.HX(I)) XMAX=HX(I)
      IF(XMAX.LT.QO(I)) XMAX=QO(I)
      IF(XMAX.LT.VX(I)) XMAX=VX(I)
      IF(XMAX.LT. T(I)) XMAX= T(I)
      IF(RMAX.LT.RX(I)) RMAX=RX(I)
   60 CONTINUE
      IF(RMAX.GT. 40.) RCA=2.0
      PLL=YP(1)
      IF(XMAX.GT. 10.) PLL=YP(2)
      IF(XMAX.GT.100.) PLL=YP(3)
      IF(XMAX.GT.1000.) PLL=YP(4)
      IF(XMAX.GT.10000.) PLL=YP(5)
      PMM=PLL/10.
      I=1
    1 IF(FLOAT(I)*PLL.GE.XMAX) GO TO 2
      I=I+1
      GO TO 1
    2 IPLMAX=I
      IP=IPL+1
      ZZ(1)=0.0
      DO 1000 I=2,NII
 1000 ZZ(I)=ZZ(I-1)+DDT
      ZZ(2)=0.
      ZZ(3)=0.
      NI=NII
      IF(IPL.GE.0) GO TO 5
      NI=NII*(1-IPL)
      DO 1001 I=(2-IPL),NI
 1001 ZZ(I)=ZZ(I-1)+DDT/(1-IPL)
      N=NI
      IP=1
      DO 600 I=1,NII
      DO 610 IO=1,(1-IPL)
      RX(N)=RX(NII-I+1)
```

```
      N=N-1
  610 CONTINUE
      NK=NI-(1-IPL)*(I-1)
      QI(NK)=QI(NII-I+1)
      QO(NK)=QO(NII-I+1)
      HX(NK)=HX(NII-I+1)
      VX(NK)=VX(NII-I+1)
      T(NK)=T(NII-I+1)
      QI(NII-I+1)=0.
      QO(NII-I+1)=0.
      HX(NII-I+1)=0.
      VX(NII-I+1)=0.
      T(NII-I+1)=0.0
  600 CONTINUE
    5 CONTINUE
      DO 20 I=1,10
   20 PPL(I)=FLOAT(IPLMAX)*PMM*FLOAT(I)
      SCA=FLOAT(IPLMAX)*PLL/100.
      WRITE(3,300) (PPL(I),I=1,10)
6     DO 30 I=1,120
   30 P(I)=PL3
      WRITE(3,400) (P(I),I=1,115)
      DO 40 I=IP,NI,IP
      DO 41 J=1,120
      IF(JQ1.EQ.0) GO TO 4
   41 P(J)=PL1
      KR=115-IFIX(RX(I) /RCA )
      IF(KR.LE.0) KR=1
      DO 42 J=KR,120
   42 P(J)=PL3
    4 CONTINUE
      IF(JQ2.GT.0) JX=IFIX(QI(I)/SCA)
      IF(JQ3.GT.0) KX=IFIX(HX(I)/SCA)
      IF(JQ4.GT.0) LX=IFIX(QO(I)/SCA)
      IF(JQ5.GT.0) MX=IFIX(VX(I)/SCA)
      IF(JQ6.GT.0) IX=IFIX(T(I)/SCA)
      IF(JQ2.GT.0) P(JX+1)=PL4
      IF(JQ3.GT.0) P(KX+1)=PL4
      IF(JQ4.GT.0) P(LX+1)=PL4
      IF(JQ5.GT.0)P(MX+1)=PL4
      IF(JQ6.GT.0) P(IX+1)=PL6
      P(115)=PL4
      P(1)=PL5
      IF((I/(IP*5))*(IP*5).EQ.I) GO TO 3
      WRITE(3,400) (P(J),J=1,115)
      GO TO 40
    3 WRITE(3,500) ZZ(I),(P(J),J=1,115)
   40 CONTINUE
      DO 51 I=1,120
   51 P(I)=PL3
      WRITE(3,400) (P(I),I=1,115)
      WRITE(3,300) (PPL(I),I=1,10)
  300 FORMAT(1H0,5X,1H0,10F10.1)
  400 FORMAT(1H ,5X,115A1)
  500 FORMAT(1H ,F5.2,115A1)
   50 RETURN
      END
      SUBROUTINE SIZE(IL,IU,I,YY)
      CHARACTER YY*30
C
```

```
      IF(I.GE.IL.AND.I.LE.IU) RETURN
      WRITE(3,1000) I,IL,IU
 1000 FORMAT(1H0,120(1H*)/1H0,'ARRAY SIZE OVER  I =',I7,'  IL =',I2,
     & '  IU =',I6)
      WRITE(3,2001) YY
 2001 FORMAT(//1H ,30X,A30)
      STOP
      END
```