US Army Corps
of Engineers
Hydrologic Engineering Center

Generalized Computer Program

REGFQ
Regional Frequency Computation

User's Manual

July 1972
(revised: June 1982)

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CPD-27

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The purpose of this program is to perform frequency computations of annual maximum hydrologic events necessary to a regional frequency study. Frequency statistics are computed for recorded events at each station and for each duration. Missing events are computed so that complete sets of events are obtained for all years at all stations while preserving all inter-correlations. These are arranged in the order of magnitude for each stations and duration and tabulated with median plotting positions. Statistics for each station are then adjusted to the complete period of regional record, and frequency curves are computed in accordance with procedures given in "Statistical Methods in Hydrology" by Leo R. Beard, January 1962, using the logarithmic Pearson Type III function and the expected-probability concept.

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REGIONAL FREQUENCY COMPUTATION

HYDROLOGIC ENGINEERING CENTER
COMPUTER PROGRAM 723-X6-L7350

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REGIONAL FREQUENCY COMPUTATION

HYDROLOGIC ENGINEERING CENTER
723-X6-L7350

1. INTRODUCTION

This program was prepared in the Hydrologic Engineering Center. Up-to-date information and copies of source statement cards for various types of computers can be obtained from the Center upon request by Government and cooperating agencies. While every care is taken to validate this program, it is not feasible to anticipate and test all possible applications. Consequently, the Center is interested in problems that arise in application and will assist in resolving deficiencies in the program to the extent feasible.

2. PURPOSE OF PROGRAM

The purpose of this program is to perform frequency computations of annual maximum hydrologic events necessary to a regional frequency study. Frequency statistics are computed for recorded events at each station and for each duration. Missing events are computed so that complete sets of events are obtained for all years at all stations while preserving all inter-correlations. These are arranged in the order of magnitude for each station and duration and tabulated with median plotting positions. Statistics for each station are then adjusted to the complete period of region record, and frequency curves are computed in accordance with procedures given in "Statistical Methods in Hydrology" by Leo R. Beard, January 1962, using the logarithmic Pearson Type III function and the expected-probability concept. The use of all long-record stations instead of only one for the extension of frequency statistics at short-record stations is considered to constitute some advantage over procedures given in "Statistical Methods". As an alternative use of this program, frequency statistics can be supplied and curves will be computed.

3. DESCRIPTION OF EQUIPMENT

A FORTRAN IV compiler, random number generator (function RNGEN included, see Exhibit 2), and large memory are required. The large amounts of computation make high speed desirable. Accordingly, it is virtually necessary to use a computer of the IBM 7094 class for execution of this program. It is desirable to use one input tape and one output tape unit, in addition to card (tape 7) and printer (tape 6) output and standard (tape 5) input.

4. METHODS OF COMPUTATION

a. Flows for those stations with zeros in the data are first incremented by 1/10 percent of their average for each station and duration in order to preclude infinite negative logarithms. This increment, if added, is later subtracted from reconstituted flows and computed frequency curves. The mean, standard deviation and skew coefficient of the logarithms for each station and duration are then computed. Preliminary to estimating missing flows by correlation, each flow is then converted to a standardized variate using an approximation of the Pearson Type III distribution. This involves the following equations:

$$X_{i,m} = \log (Q_{i,m} + q_i) \tag{1}$$

$$\overline{X}_i = \sum_{m=1}^{N} X_{i,m}/N \tag{2}$$

$$S_i = \sqrt{\sum_{m=1}^{N} (X_{i,m} - \overline{X}_i)^2/(N-1)} \tag{3}$$

$$g_i = N \sum_{m=1}^{N} (X_{i,m} - \overline{X}_i)^3/((N-1)(N-2)S_i^3) \tag{4}$$

$$t_{i,m} = (X_{i,m} - \overline{X}_i)/S_i \tag{5}$$

$$K_{i,m} = 6/g_i \left[((g_i t_{i,m}/2) + 1)^{1/3} - 1\right] + g_i/6 \tag{6}$$

in which:

X = Logarithm of flow event
Q = Recorded flow event
q = Small increment of flow used to prevent infinite logarithms for events with zero flow
$\overline{X}$ = Mean logarithm of flow events
N = Total years of record
S = Unbiased estimate of population standard deviation
g = Unbiased estimate of population skew coefficient
t = Pearson Type III standard deviate
i = Duration number
m = Year number
K = Normal standard deviate

b. After transforming the flows for all stations and durations to normal, the gross (simple) correlation coefficients R between all pairs of stations for each duration and for adjacent durations at each station are computed by use of the following formula:

$$R_i = \left\{ 1 - \left[1 - \left(\sum_{m=1}^{N} (x_{i,m} x_{i-1,m}) \right)^2 / \left(\sum_{m=1}^{N} x_{i,m}^2 \sum_{m=1}^{N} x_{i-1,m}^2 \right) \right] (N-1)/(N-2) \right\}^{\frac{1}{2}} \qquad (7)$$

c. Inasmuch as not all stations and durations necessarily have the same length of record, correlation matrices obtained in b might not be complete or internally consistent. If not, missing values are estimated, and low values are raised to obtain consistency, inasmuch as low values are least reliable and least influential. Each missing value is estimated by examining its relationship to related pairs of values by use of the following formula, using i, j and k subscripts to indicate variables used in the gross correlation:

$$R_{ij} = R_{ki} R_{kj} \pm \sqrt{(1-R_{ki}^2)(1-R_{kj}^2)} \qquad (8)$$

d. Consistency of each correlation matrix to be used for estimating missing flows is assured by first testing all combinations of triads of correlation coefficients used in that matrix. The test for consistency of each complete matrix is made by computing the multiple correlation coefficient. If this value is greater than 1.0, further adjustment is required. Such further adjustment is obtained by introducing a coefficient, successively smaller by .2, on the radical in equation 8 and repeating all triad consistency tests until all matrices are consistent.

e. Missing flows are estimated by correlation with corresponding flows at other stations and the flow at the same station for the adjacent duration (preceding duration, except that the succeeding duration is used when estimating for the first tabulated duration). Since it is not known which stations might have recorded or previously estimated values, the correlation matrix and regression equation might be different for the same station and duration in different years. The regression equation is computed for each missing value in terms of normal standard variates by selecting required coefficients from the complete (and consistent) correlation matrix and solving by the Crout method explained in Exhibit 1. The missing value is computed from this regression equation,

introducing a random component equal to the non-determination of the equation, in order to preserve the proper variance (standard deviation) of the flows. This is done as follows:

$$k_1 = \beta_2 k_2 + \beta_3 k_3 + \quad . \; . \; . \; . \; \beta_n k_n + \sqrt{1-R^2} \quad Z \tag{9}$$

in which:

k = Normal standard deviate
β_2 = Beta coefficient
R^2 = Determination coefficient
Z = Random number normally distributed
n = Number of variables in equation

f. When all flows have been reconstituted, the mean and standard deviation for each station and duration are recomputed. Regression lines of standard deviation and skew coefficient separately versus mean are computed, and "smoothed" values of standard deviation and skew obtained as described in "Statistical Methods". Equivalent record for the recorded and reconstituted flows for each station and duration is estimated by adding the determination coefficient for each year of reconstituted flow to the total years of recorded flows. This equivalent record is used in computing expected probabilities as discussed below. Flows are arranged in descending order of magnitude and median plotting positions are computed as defined in "Statistical Methods". Frequency-curve coordinates for each station and duration are computed from the mean, standard deviation, skew coefficient, flow increment and equivalent record length, using table values of the normal distribution, the transform for the Pearson Type III function shown in Equation 10, and the following approximate transforms for expected probability:

$$P_{.01} = .01 \; (1+1600/N^{1.72}) \tag{10}$$

$$P_{.1} = .1 \; (1+280/N^{1.55}) \tag{11}$$

$$P_1 = 1 + 26/N^{1.16} \tag{12}$$

$$P_5 = 5\ (1 + 6/N^{1.04}) \tag{13}$$

$$P_{10} = 10\ (1 + 3/N^{1.04}) \tag{14}$$

$$P_{30} = 30\ (1 + .46/N^{.925}) \tag{15}$$

in which:

P = Expected probability in percent, symmetrical about 50 percent
N = Equivalent years of record

5. INPUT

Input is summarized in Exhibits 6 and 7. All data are entered consecutively on each card, using 8 columns (digits, including decimal point, if used) per variable and 10 variables per card unless fewer variables are called for, except that the first column on each card is reserved for identification. The first output title card must have an A in column 1. An example of input is given in Exhibit 2. Certain inadequacies of data will abort the job and waste input cards until the next card with A in column 1 is reached. After a job is finished, a card with A in column 1 followed by 3 blank cards causes the computer to stop.

6. OUTPUT

Printed output includes key input information for job identification and all results of computations. An example of printed output is given in Exhibit 3.

7. OPERATING INSTRUCTIONS

Standard FORTRAN IV instructions and random number generator are required. No sense switches are used.

8. DEFINITIONS OF TERMS

Terms used in the program are defined in Exhibit 4.

9. PROPOSED FUTURE DEVELOPMENT

No specific future development of this program is presently planned. It is requested that any user who finds an inadequacy or desirable addition or modification notify the Hydrologic Engineering Center.

EXHIBIT 1

Crout's Method

One of the best methods for solving systems of linear equations on desk calculating machines was developed by P. D. Crout in 1941. This method is based on the elimination method, with the calculations arranged in systematic order so as to facilitate their accomplishment on a desk calculator. In this method the coefficients and constant terms of the equations are written in the form of a "matrix," which is a rectangular array of quantities arranged in rows and columns.

The method is best explained by an example. Suppose that in a multiple correlation analysis it is required to solve the following system of linear equations to obtain the unknown values of b_2, b_3, b_4 and b_5.

$$\Sigma x_2^2 \; b_2 + \Sigma x_2 x_3 \; b_3 + \Sigma x_2 x_4 \; b_4 + \Sigma x_2 x_5 \; b_5 = \Sigma x_1 x_2$$

$$\Sigma x_2 x_3 \; b_2 + \Sigma x_3^2 \; b_3 + \Sigma x_3 x_4 \; b_4 + \Sigma x_3 x_5 \; b_5 = \Sigma x_1 x_3$$

$$\Sigma x_2 x_4 \; b_2 + \Sigma x_3 x_4 \; b_3 + \Sigma x_4^2 \; b_4 + \Sigma x_4 x_5 \; b_5 = \Sigma x_1 x_4$$

$$\Sigma x_2 x_5 \; b_2 + \Sigma x_3 x_5 \; b_3 + \Sigma x_4 x_5 \; b_4 + \Sigma x_5^2 \; b_5 = \Sigma x_1 x_5$$

For simplicity let us replace the coefficients of the b's by the letters p, q, r and s, and the constant terms by the letter t, using subscripts 1, 2, 3 and 4 to denote the respective equations:

$$p_1 \, b_2 + q_1 \, b_3 + r_1 \, b_4 + s_1 \, b_5 = t_1$$

$$p_2 \, b_2 + q_2 \, b_3 + r_2 \, b_4 + s_2 \, b_5 = t_2$$

$$p_3 \, b_2 + q_3 \, b_3 + r_3 \, b_4 + s_3 \, b_5 = t_3$$

$$p_4 \, b_2 + q_4 \, b_3 + r_4 \, b_4 + s_4 \, b_5 = t_4$$

A continuous check on the computations as they progress may be obtained by adding to the matrix of the above system a column of u's, such that $u = p + q + r + s + t$. The matrix and check column are written as follows:

$$\begin{vmatrix} p_1 & q_1 & r_1 & s_1 & t_1 & u_1 \\ p_2 & q_2 & r_2 & s_2 & t_2 & u_2 \\ p_3 & q_3 & r_3 & s_3 & t_3 & u_3 \\ p_4 & q_4 & r_4 & s_4 & t_4 & u_4 \end{vmatrix}$$

The elements p_1, q_2, r_3 and s_4 form the "principal diagonal" of the matrix. Examination of the original equations shows that the coefficients are symmetrical about the principal diagonal, i.e., $q_1 = p_2$, $r_1 = p_3$, $r_2 = q_3$, $s_1 = p_4$, $s_2 = q_4$, and $s_3 = r_4$. This is characteristic of the system of equations to be solved in any multiple correlation analysis. Because of this symmetry, the computations are considerably simplified. While the Crout method may be used to solve any system of linear equations, the computational steps given here are applicable only to those with symmetrical coefficients.

The solution consists of two parts, viz., the computation of a "derived matrix" and the "back solution." Let the derived matrix be denoted as follows:

$$\begin{vmatrix} P_1 & Q_1 & R_1 & S_1 & T_1 & U_1 \\ P_2 & Q_2 & R_2 & S_2 & T_2 & U_2 \\ P_3 & Q_3 & R_3 & S_3 & T_3 & U_3 \\ P_4 & Q_4 & R_4 & S_4 & T_4 & U_4 \end{vmatrix}$$

EXHIBIT 1

The elements of the derived matrix are computed as follows:

$$P_1 = p_1 \qquad P_2 = p_2 \qquad P_3 = p_3 \qquad P_4 = p_4$$

$$Q_1 = \frac{q_1}{p_1} \qquad R_1 = \frac{r_1}{p_1} \qquad S_1 = \frac{s_1}{p_1} \qquad T_1 = \frac{t_1}{p_1} \qquad U_1 = \frac{u_1}{p_1}$$

$$Q_2 = q_2 - P_2Q_1 \qquad Q_3 = q_3 - P_3Q_1 \qquad R_2 = \frac{Q_3}{Q_2}$$

$$Q_4 = q_4 - P_4Q_1 \qquad S_2 = \frac{Q_4}{Q_2} \qquad T_2 = \frac{t_2 - T_1P_2}{Q_2} \qquad U_2 = \frac{u_2 - U_1P_2}{Q_2}$$

$$R_3 = r_3 - Q_3R_2 - P_3R_1 \qquad R_4 = r_4 - Q_4R_2 - P_4R_1 \qquad S_3 = \frac{R_4}{R_3}$$

$$T_3 = \frac{t_3 - T_2Q_3 - T_1P_3}{R_3} \qquad U_3 = \frac{u_3 - U_2Q_3 - U_1P_3}{R_3}$$

$$S_4 = s_4 - R_4S_3 - Q_4S_2 - P_4S_1$$

$$T_4 = \frac{t_4 - T_3R_4 - T_2Q_4 - T_1P_4}{S_4} \qquad U_4 = \frac{u_4 - U_3R_4 - U_2Q_4 - U_1P_4}{S_4}$$

The general pattern of the above computations, which may be applied to a system containing any number of equations, is as follows:

(1) The first column of the derived matrix is copied from the first column of the given matrix.

(2) The remaining elements in the first row of the derived matrix are computed by dividing the corresponding elements in the first row of the given matrix by the first element in that row.

(3) After completing the $n^{\underline{th}}$ row, the remaining elements in the $(n+1)^{\underline{th}}$ column are computed. Such an element (X) equals the corresponding element of the given matrix minus the product of the element immediately to the left of (X) by the element immediately above the principal diagonal in the same column as (X), minus the product of the second element to the left of (X) by the second element above the principal diagonal in the same column as (X), etc. After each element below the principal diagonal is recorded, and while that element is still in the calculator, it is divided by the element of the principal diagonal which is in the same column. The quotient is the element whose location is symmetrical to (X) with respect to the principal diagonal.

EXHIBIT 1

(4) When the elements in the $(n+1)^{\underline{th}}$ column and their symmetrical counterparts have been recorded, the $(n+1)^{\underline{th}}$ row will be complete except for the last two elements, which are next computed. Such an element (X) equals the corresponding element of the given matrix minus the product of the element immediately above (X) by the element immediately to the left of the principal diagonal in the same row as (X), minus the product of the second element above (X) by the second element to the left of the principal diagonal in the same row as (X), etc., all divided by the element of the principal diagonal in the same row as (X).

The check column (U) of the derived matrix serves as a continuous check on the computations in that each element in the column equals one plus the sum of the elements in the same row to the right of the principal diagonal. That is,

$$U_1 = 1 + Q_1 + R_1 + S_1 + T_1$$

$$U_2 = 1 + R_2 + S_2 + T_2$$

$$U_3 = 1 + S_3 + T_3$$

$$U_4 = 1 + T_4$$

This check should be made after completing each row.

The elements of the derived matrix to the right of the principal diagonal form a system of equations which may now be used to compute the unknown values of b_2, b_3, b_4 and b_5 by successive substitution. This is known as the "back solution." The computations are as follows:

$$b_5 = T_4$$

$$b_4 = T_3 - S_3 b_5$$

$$b_3 = T_2 - S_2 b_5 - R_2 b_4$$

$$b_2 = T_1 - S_1 b_5 - R_1 b_4 - Q_1 b_3$$

It is very important that the computations be carried to a sufficient number of digits, both in computing the coefficients and constant terms of the original equations, and in computing the elements of the derived matrix. It is possible for relatively small errors in the coefficients and constant terms of the original equations to result in relatively large errors in the computed solutions of the unknowns. The

greatest source of error in computing the elements of the derived matrix arises from the loss of leading significant digits by subtraction. This must be guarded against and can be done by carrying the computations to more figures than the data. As a general rule, it is recommended that the coefficients and constant terms of the original equations be carried to a sufficient number of decimals to produce at least five significant digits in the smallest quantity, and that the elements of the derived matrix be carried to one more decimal than this, but to not less than six significant digits.

EXHIBIT 1

EXHIBIT 2

RANDOM NUMBER FUNCTION RNGEN

This random number function is for a binary machine and the constants must be computed according to the number of bits in an integer word. The numbers generated are uniformly distributed in the interval 0 to 1.

The function is called from the main program by a statement similar to the following:

A = RNGEN (IX)

Where A is some floating point variable name and IX is some integer variable name. The argument name IX need not be the same in the main program and the function. The argument must be initialized to zero in the main program. The location of the initializing statement is important and depends on the results desired. If it is desired to have different sets of random numbers for each of several different sets of computations (jobs) that are run sequentially on the same program, then the argument must be initialized at the very beginning of the program and never reinitialized. If it is permissible to use the same sequence of random numbers for each job, the argument must be initialized at the beginning of each job. The advantage of this latter option occurs when one of the jobs must be re-run for some minor reason as the same random numbers will be used and the results will be comparable.

Three constants must be computed by the following equations:

Constant one (C1) = $2^{(B+1)/2} + 3$

Constant two (C2) = $2^{B} - 1$

Constant three (C3) = $1./2.^{B}$

Where: B = number of bits in an <u>integer</u> word

The constants for some of the common computers are listed in the following table:

COMPUTER	SIZE OF INTEGER WORD	CONSTANTS C1	C2	C3
GE 200 Series	19	1027	524287	0.190734863E-05
GE 400 Series	23	4099	8388607	0.119209290E-06
IBM 360 Series	31	65539	2147483647	0.465661287E-09
IBM 7040 and 7090 Series	35	262147	34359738367	0.2910383046E-10
UNIVAC 1108	"	"	"	"
CDC 6000 Series	48	16777219	281474976710655	0.3552713678E-14

EXAMPLE INPUT

```
A                          REGIONAL FREQUENCY COMPUTATION
A                                TEST DATA
A                                JULY 1972
B      1     1945        1
C    PEAK
D     0.
G     32     1945    77100
G     32     1946   206000
G     32     1948   185000
G     32     1949   137000
G     32     1950    99000
H
A                                    TEST DATA
A                                  723-X6-L7350
A                          MULTIPLE STATION AND DURATION
B      5     1945
C    PEAK    1-DAY    3-DAY   10-DAY   30-DAY
G     32     1945    77100    71200    62000    51000    30830
G     32     1946   206000   185000   134000    83400    51000
G     32     1947   138000   133000   115000    65300    43670
G     32     1948   185000   167000   132000    85600    44130
G     32     1949   137000   122000    70400    66800    38130
G     32     1950    99000    95900    90000    64200    46100
G     35     1946    48400    32500    24300    12870     7493
G     35     1947    46000    32600    29270    16020     9570
G     35     1948    53400    40300    24870    12980     6890
G     35     1949    18600    14600    10570     8090     5690
G     35     1950    23600    20100    15800     9840     6920
H
A                                    TEST DATA
A                                  723-X6-L7350
A                          SAVE STATIONS FROM PREVIOUS JOB
B      5     1945        1        2
C    PEAK    1-DAY    3-DAY   10-DAY   30-DAY
D    -.2      -.4      -.5      -.6      -.8
E     32       35
G     33     1945     5530     5040     4100     3320     2270
G     33     1946    13300     9560     7700     4840     3150
G     33     1947    10300     9360     8530     4850     3540
G     33     1948    10300     8840     6930     4230     2790
G     33     1949     6470     5400     4300     3120     2330
H
A                                    TEST DATA
A                                  723-X6-L7350
A                              STATISTICS FURNISHED
B      5     1945        1                                          2       -1
C    PEAK    1-DAY    3-DAY   10-DAY   30-DAY
D    -.2      -.4      -.5      -.6      -.8
I     32     PEAK    5.123     .159    -.334       0.      6.0
I     32    1-DAY    5.089     .153    -.366       0.      6.0
I     32    3-DAY    4.984     .133    -.462       0.      6.0
I     32   10-DAY    4.835     .106    -.599       0.      6.0
I     32   30-DAY    4.621     .066    -.795       0.      6.0
I     35     PEAK    4.518     .196    -.278       0.      5.6
I     35    1-DAY    4.408     .177    -.168       0.      6.0
I     35    3-DAY    4.267     .153    -.027       0.      6.0
I     35   10-DAY    4.052     .117     .188       0.      5.8
I     35   30-DAY    3.843     .082     .398       0.      5.9
A
A
A
```

EXAMPLE OUTPUT

```
*****************************
JULY 1972          723-X6-L2350
REGIONAL FREQUENCY COMPUTATION
VERSION DATE - AUGUST 21, 1979
*****************************
```

REGIONAL FREQUENCY COMPUTATION
TEST DATA
JULY 1972

NDUR	IYRA	ISKEW	KEEP	ICONV	IPCHQ	IPCHS	NSTAT	NSMTH	INCAD
1	1945	1	-0	-0	-0	-0	-0	-0	-0

REGIONAL SKEW COEFFICIENTS

PEAK
0.

FREQUENCY STATISTICS OF RECORDED DATA

STA	ITEM	PEAK
32	MEAN	5.120
	STD DEV	.180
	SKEW	-.296
	INCRMT	0.
	YEARS	5.

RECORDED AND RECONSTITUTED DATA

STA	YEAR	PEAK
32	1945	77100.
32	1946	206000.
32	1948	185000.
32	1949	137000.
32	1950	99000.

FREQUENCY ARRAYS

STATION 32

NO	PLOT	PEAK
1	12.94	206000.
2	31.47	185000.
3	50.00	137000.
4	68.53	99000.
5	87.06	77100.

ADOPTED FREQUENCY STATISTICS

STA	ITEM	PEAK
32	MEAN	5.120
	STD DEV	.180
	SKEW	0.
	INCRMT	0.

COMPUTED FREQUENCY CURVES

STATION 32

PLOT	EXP PROB	PEAK
.01	1.01	617437.
.10	2.41	473747.
1.00	5.02	345283.
5.00	10.63	259953.
10.00	15.63	223966.
30.00	33.11	163518.
50.00	50.00	131853.
70.00	66.89	106320.
90.00	84.37	77624.
95.00	89.37	66878.
99.00	94.98	50263.
99.90	97.59	36697.
99.99	98.99	28157.

EXHIBIT 4

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JULY 1972          723-X6-L2350
REGIONAL FREQUENCY COMPUTATION
VERSION DATE - AUGUST 21, 1979
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TEST DATA
723-X6-L2350
MULTIPLE STATION AND DURATION

NDUR	IYRA	ISKEW	KEEP	ICONV	IPCHQ	IPCHS	NSTAT	NSMTH	INCAD
5	1945	-0	-0	-0	-0	-0	-0	-0	-0

FREQUENCY STATISTICS OF RECORDED DATA

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	MEAN	5.123	5.089	4.984	4.835	4.621
	STD DEV	.161	.154	.142	.083	.076
	SKEW	-.388	-.527	-.375	-.266	-1.088
	INCRMT	0.	0.	0.	0.	0.
	YEARS	6.	6.	6.	6.	6.
35	MEAN	4.544	4.420	4.294	4.066	3.858
	STD DEV	.208	.181	.181	.116	.082
	SKEW	-.689	-.721	-.964	-.384	.593
	INCRMT	0.	0.	0.	0.	0.
	YEARS	5.	5.	5.	5.	5.

FREQUENCY STATISTICS AFTER ADJUSTMENT WITH A LONG TERM STATION

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	MEAN	5.123	5.089	4.984	4.835	4.621
	STD DEV	.161	.154	.142	.083	.076
	SKEW	-.334	-.366	-.462	-.599	-.795
	INCRMT	0.	0.	0.	0.	0.
	EQUIV YRS	6.0	6.0	6.0	6.0	6.0
35	MEAN	4.498	4.376	4.242	4.033	3.838
	STD DEV	.227	.202	.208	.133	.091
	SKEW	-.734	-.612	-.478	-.269	-.073
	INCRMT	0.	0.	0.	0.	0.
	EQUIV YRS	5.3	5.3	5.8	5.0	5.0

EXHIBIT 4

CORRELATION COEFFICIENTS OF RECORDED DATA FOR PEAK DURATION

STA	32	35
		WITH SAME DURATION
32	1.000	.616
35	.616	1.000
		WITH ADJACENT DURATION AT ABOVE STATION
32	.995	.494
35	.714	.982

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 1-DAY DURATION

STA	32	35
		WITH SAME DURATION
32	1.000	.604
35	.604	1.000
		WITH ADJACENT DURATION AT ABOVE STATION
32	.995	.714
35	.494	.982

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 3-DAY DURATION

STA	32	35
		WITH SAME DURATION
32	1.000	.867
35	.867	1.000
		WITH ADJACENT DURATION AT ABOVE STATION
32	.848	.949
35	.330	.898

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 10-DAY DURATION

STA	32	35
		WITH SAME DURATION
32	1.000	0.
35	0.	1.000
		WITH ADJACENT DURATION AT ABOVE STATION
32	.827	0.
35	.753	.981

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 30-DAY DURATION

STA	32	35
		WITH SAME DURATION
32	1.000	0.
35	0.	1.000
		WITH ADJACENT DURATION AT ABOVE STATION
32	.690	0.
35	0.	.883

RECORDED AND RECONSTITUTED DATA

STA	YEAR	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	1945	77100.	71200.	62000.	51000.	30830.
32	1946	206000.	185000.	134000.	83400.	51000.
32	1947	138000.	133000.	115000.	65300.	43670.
32	1948	185000.	167000.	132000.	85600.	44130.
32	1949	137000.	122000.	70400.	66800.	38130.
32	1950	99000.	95900.	90000.	64200.	46100.

STA	YEAR	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
35	1945	25357.E	20407.E	20362.E	12398.E	8837.E
35	1946	48400.	32500.	24300.	12870.	7493.
35	1947	46000.	32600.	29270.	16020.	9570.
35	1948	53400.	40300.	24870.	12980.	6890.
35	1949	18600.	14600.	10570.	8090.	5690.
35	1950	23600.	20100.	15800.	9840.	6920.

FREQUENCY STATISTICS OF RECORDED AND RECONSTITUTED DATA

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	MEAN	5.123	5.089	4.984	4.835	4.621
	STD DEV	.161	.154	.142	.083	.076
	SKEW	-.388	-.527	-.375	-.266	-1.088
	EQUIV YRS	6.0	6.0	6.0	6.0	6.0
35	MEAN	4.520	4.401	4.297	4.070	3.873
	STD DEV	.194	.168	.162	.104	.082
	SKEW	-.176	-.240	-1.036	-.573	-.012
	EQUIV YRS	5.4	6.0	5.8	6.0	5.8

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR PEAK DURATION

STA	32	35
	WITH SAME DURATION	
32	1.000	.574
35	.574	1.000
	WITH ADJACENT DURATION AT ABOVE STATION	
32	.995	.475
35	.616	.986

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 1-DAY DURATION

STA	32	35
	WITH SAME DURATION	
32	1.000	.526
35	.526	1.000
	WITH ADJACENT DURATION AT ABOVE STATION	
32	.995	.616
35	.475	.986

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 3-DAY DURATION

STA	32	35
	WITH SAME DURATION	
32	1.000	.558
35	.558	1.000
	WITH ADJACENT DURATION AT ABOVE STATION	
32	.836	.848
35	0.	.875

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 10-DAY DURATION

STA	32	35
	WITH SAME DURATION	
32	1.000	0.
35	0.	1.000
	WITH ADJACENT DURATION AT ABOVE STATION	
32	.820	0.
35	.385	.977

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 30-DAY DURATION

STA	32	35
	WITH SAME DURATION	
32	1.000	0.
35	0.	1.000
	WITH ADJACENT DURATION AT ABOVE STATION	
32	.744	0.
35	0.	.819

FREQUENCY ARRAYS

STATION 32

NO	PLOT	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
1	10.91	206000.	185000.	134000.	85600.	51000.
2	26.55	185000.	167000.	132000.	83400.	46100.
3	42.18	138000.	133000.	115000.	66800.	44130.
4	57.82	137000.	122000.	90000.	65300.	43670.
5	73.45	99000.	95900.	70400.	64200.	38130.
6	89.09	77100.	71200.	62000.	51000.	30830.

STATION 35

NO	PLOT	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
1	10.91	53400.	40300.	29270.	16020.	9570.
2	26.55	48400.	32600.	24870.	12980.	8837.E
3	42.18	46000.	32500.	24300.	12870.	7493.
4	57.82	25357.E	20407.E	20362.E	12398.E	6920.
5	73.45	23600.	20100.	15800.	9840.	6890.
6	89.09	18600.	14600.	10570.	8090.	5690.

ADOPTED FREQUENCY STATISTICS

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	MEAN	5.123	5.089	4.984	4.835	4.621
	STD DEV	.159	.153	.133	.106	.066
	SKEW	-.334	-.366	-.462	-.599	-.795
	INCRMT	0.	0.	0.	0.	0.
35	MEAN	4.520	4.401	4.297	4.070	3.873
	STD DEV	.193	.172	.153	.113	.078
	SKEW	-.462	-.437	-.414	-.365	-.322
	INCRMT	0.	0.	0.	0.	0.

COMPUTED FREQUENCY CURVES

STATION 32

PLOT	EXP PROB	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
.01	.74	404931.	350275.	227309.	127137.	58610.
.10	1.84	347604.	304541.	204648.	119050.	57022.
1.00	4.25	284819.	253204.	177239.	108179.	54512.
5.00	9.65	233536.	210253.	152589.	97369.	51625.
10.00	14.65	209104.	189451.	140041.	91478.	49894.
30.00	32.63	162936.	149501.	114730.	78748.	45770.
50.00	50.00	135585.	125410.	98620.	70013.	42627.
70.00	67.37	111592.	103994.	83702.	61444.	39276.
90.00	85.35	82252.	77412.	64306.	49526.	34128.
95.00	90.35	70568.	66693.	56175.	44236.	31637.
99.00	95.75	51767.	49272.	42524.	34903.	26879.
99.90	98.16	35879.	34363.	30350.	26017.	21825.
99.99	99.26	25794.	24800.	22260.	19751.	17860.

STATION 35

PLOT	EXP PROB	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
.01	.79	115212.	77843.	54915.	25533.	12892.
.10	1.94	98922.	67581.	48195.	23022.	11952.
1.00	4.40	80287.	55798.	40443.	20083.	10832.
5.00	9.84	64601.	45790.	33798.	17503.	9824.
10.00	14.84	57035.	40914.	30530.	16205.	9305.
30.00	32.72	42704.	31545.	24167.	13601.	8235.
50.00	50.00	34283.	25926.	20280.	11944.	7529.
70.00	67.28	27020.	20980.	16797.	10399.	6847.
90.00	85.16	18429.	14956.	12443.	8360.	5903.
95.00	90.16	15146.	12582.	10681.	7488.	5480.
99.00	95.60	10111.	8824.	7816.	5986.	4716.
99.90	98.06	6197.	5753.	5372.	4586.	3950.
99.99	99.21	3951.	3889.	3815.	3604.	3369.

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JULY 1972          723-X6-L2350
REGIONAL FREQUENCY COMPUTATION
VERSION DATE - AUGUST 21, 1979
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TEST DATA
723-X6-L2350
SAVE STATIONS FROM PREVIOUS JOB

NDUR	IYRA	ISKEW	KEEP	ICONV	IPCHQ	IPCHS	NSTAT	NSMTH	INCAD
5	1945	1	2	-0	-0	-0	-0	-0	-0

REGIONAL SKEW COEFFICIENTS

PEAK	1-DAY	3-DAY	10-DAY	30-DAY
-.200	-.400	-.500	-.600	-.800

STATION(S) KEPT FROM LAST RUN, 32, 35,

FREQUENCY STATISTICS OF RECORDED DATA

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
33	MEAN	3.941	3.867	3.781	3.602	3.443
	STD DEV	.158	.137	.148	.090	.083
	SKEW	-.320	-.599	-.412	-.371	.180
	INCRMT	0.	0.	0.	0.	0.
	YEARS	5.	5.	5.	5.	5.

FREQUENCY STATISTICS AFTER ADJUSTMENT WITH A LONG TERM STATION

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	MEAN	5.123	5.089	4.984	4.835	4.621
	STD DEV	.161	.154	.142	.083	.076
	SKEW	-.200	-.400	-.500	-.600	-.800
	INCRMT	0.	0.	0.	0.	0.
	EQUIV YRS	6.0	6.0	6.0	6.0	6.0
35	MEAN	4.520	4.401	4.297	4.070	3.873
	STD DEV	.194	.168	.162	.104	.082
	SKEW	-.200	-.400	-.500	-.600	-.800
	INCRMT	0.	0.	0.	0.	0.
	EQUIV YRS	6.0	6.0	6.0	6.0	6.0
33	MEAN	3.921	3.854	3.776	3.593	3.449
	STD DEV	.155	.131	.135	.088	.080
	SKEW	-.200	-.400	-.500	-.600	-.800
	INCRMT	0.	0.	0.	0.	0.
	EQUIV YRS	5.6	5.7	5.8	5.5	5.4

CORRELATION COEFFICIENTS OF RECORDED DATA FOR PEAK DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	.599	.828
35	.599	1.000	.824
33	.828	.824	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.996	.520	.701
35	.652	.985	.911
33	.873	.730	.955

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 1-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	.579	.768
35	.579	1.000	.845
33	.768	.845	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.996	.652	.873
35	.520	.985	.730
33	.701	.911	.955

EXHIBIT 4

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 3-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	.588	.876
35	.588	1.000	.728
33	.876	.728	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.850	.867	.963
35	0.	.857	.674
33	.623	.781	.974

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 10-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	0.	.297
35	0.	1.000	.708
33	.297	.708	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.828	0.	.385
35	.383	.968	.666
33	.850	.783	.973

CORRELATION COEFFICIENTS OF RECORDED DATA FOR 30-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	0.	.586
35	0.	1.000	.183
33	.586	.183	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.690	0.	.768
35	0.	.805	0.
33	0.	.706	.920

RECORDED AND RECONSTITUTED DATA

STA	YEAR	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
33	1945	5530.	5040.	4100.	3320.	2270.
33	1946	13300.	9560.	7700.	4840.	3150.
33	1947	10300.	9360.	8530.	4850.	3540.
33	1948	10300.	8840.	6930.	4230.	2790.
33	1949	6470.	5400.	4300.	3120.	2330.
33	1950	6669.E	6246.E	6157.E	4151.E	3131.E

FREQUENCY STATISTICS OF RECORDED AND RECONSTITUTED DATA

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
33	MEAN	3.921	3.855	3.782	3.605	3.452
	STD DEV	.149	.126	.132	.081	.077
	SKEW	.173	-.185	-.462	-.513	-.256
	EQUIV YRS	5.9	5.9	5.9	5.9	5.9

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR PEAK DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	.574	.855
35	.574	1.000	.853
33	.855	.853	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.995	.475	.739
35	.616	.986	.907
33	.887	.777	.959

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 1-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	.526	.795
35	.526	1.000	.864
33	.795	.864	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.995	.616	.887
35	.475	.986	.777
33	.739	.907	.959

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 3-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	.558	.904
35	.558	1.000	.647
33	.904	.647	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.836	.848	.964
35	0.	.875	.686
33	.604	.761	.941

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 10-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	0.	.375
35	0.	1.000	.615
33	.375	.615	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.820	0.	.498
35	.385	.977	.561
33	.861	.709	.973

CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTED DATA FOR 30-DAY DURATION

STA	32	35	33
			WITH SAME DURATION
32	1.000	0.	.740
35	0.	1.000	0.
33	.740	0.	1.000
			WITH ADJACENT DURATION AT ABOVE STATION
32	.744	0.	.751
35	0.	.819	0.
33	0.	.385	.923

FREQUENCY ARRAYS

STATION 33

NO	PLOT	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
1	10.91	13300.	9560.	8530.	4850.	3540.
2	26.55	10300.	9360.	7700.	4840.	3150.
3	42.18	10300.	8840.	6930.	4230.	3131.E
4	57.82	6669.E	6246.E	6157.E	4151.E	2790.
5	73.45	6470.	5400.	4300.	3320.	2330.
6	89.09	5530.	5040.	4100.	3120.	2270.

ADOPTED FREQUENCY STATISTICS

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
33	MEAN	3.921	3.855	3.782	3.605	3.452
	STD DEV	.145	.134	.123	.094	.070
	SKEW	-.200	-.400	-.500	-.600	-.800
	INCRMT	0.	0.	0.	0.	0.

COMPUTED FREQUENCY CURVES

STATION 33

PLOT	EXP PROB	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
.01	.76	25133.	17617.	13090.	7011.	4046.
.10	1.88	21266.	15677.	11953.	6611.	3932.
1.00	4.30	17255.	13414.	10535.	6070.	3750.
5.00	9.72	14127.	11445.	9218.	5525.	3541.
10.00	14.72	12677.	10463.	8534.	5226.	3416.
30.00	32.66	9995.	8519.	7122.	4571.	3118.
50.00	50.00	8434.	7306.	6201.	4115.	2892.
70.00	67.34	7074.	6196.	5331.	3662.	2652.
90.00	85.28	5410.	4770.	4173.	3020.	2285.
95.00	90.28	4743.	4177.	3678.	2730.	2108.
99.00	95.70	3654.	3185.	2832.	2209.	1773.
99.90	98.12	2706.	2302.	2059.	1699.	1421.
99.99	99.24	2078.	1713.	1534.	1328.	1148.

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JULY 1972          723-X6-L2350
REGIONAL FREQUENCY COMPUTATION
VERSION DATE - AUGUST 21, 1979
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TEST DATA
723-X6-L2350
STATISTICS FURNISHED

NDUR	IYRA	ISKEW	KEEP	ICONV	IPCHQ	IPCHS	NSTAT	NSMTH	INCAD
5	1945	1	-0	-0	-0	-0	2	-1	-0

ADOPTED FREQUENCY STATISTICS

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	MEAN	5.123	5.089	4.984	4.835	4.621
	STD DEV	.159	.153	.133	.106	.066
	SKEW	-.200	-.400	-.500	-.600	-.800
	INCRMT	0.	0.	0.	0.	0.
35	MEAN	4.518	4.408	4.267	4.052	3.843
	STD DEV	.196	.177	.153	.117	.082
	SKEW	-.200	-.400	-.500	-.600	-.800
	INCRMT	0.	0.	0.	0.	0.

REGIONAL SKEW COEFFICIENTS

PEAK	1-DAY	3-DAY	10-DAY	30-DAY
-.200	-.400	-.500	-.600	-.800

INPUT FREQUENCY STATISTICS

STA	ITEM	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
32	MEAN	5.123	5.089	4.984	4.835	4.621
	STD DEV	.159	.153	.133	.106	.066
	SKEW	-.334	-.366	-.462	-.599	-.795
	INCRMT	0.	0.	0.	0.	0.
	EQUIV YRS	6.0	6.0	6.0	6.0	6.0
35	MEAN	4.518	4.408	4.267	4.052	3.843
	STD DEV	.196	.177	.153	.117	.082
	SKEW	-.278	-.168	-.027	.188	.398
	INCRMT	0.	0.	0.	0.	0.
	EQUIV YRS	5.6	6.0	6.0	5.8	5.9

EXHIBIT 4

COMPUTED FREQUENCY CURVES

STATION 32

PLOT	EXP PROB	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
.01	.74	446115.	342977.	222370.	127450.	58504.
.10	1.84	371280.	300235.	201503.	119328.	56939.
1.00	4.25	295084.	251317.	175691.	108407.	54454.
5.00	9.65	236862.	209670.	152007.	97546.	51588.
10.00	14.65	210287.	189276.	139799.	91627.	49866.
30.00	32.63	161945.	149725.	114888.	78837.	45759.
50.00	50.00	134367.	125648.	98857.	70064.	42623.
70.00	67.37	110754.	104117.	83904.	61459.	39277.
90.00	85.35	82495.	77257.	64335.	49497.	34132.
95.00	90.35	71386.	66397.	56098.	44191.	31641.
99.00	95.75	53600.	48734.	42243.	34833.	26879.
99.90	98.16	38529.	33646.	29892.	25933.	21818.
99.99	99.26	28829.	24015.	21711.	19663.	17848.

STATION 35

PLOT	EXP PROB	PEAK	1-DAY	3-DAY	10-DAY	30-DAY
.01	.77	146877.	83998.	48381.	22408.	10583.
.10	1.91	117125.	72011.	43196.	20837.	10233.
1.00	4.34	88243.	58619.	36894.	18742.	9681.
5.00	9.77	67301.	47535.	31233.	16681.	9052.
10.00	14.77	58118.	42228.	28365.	15567.	8678.
30.00	32.69	42118.	32198.	22633.	13187.	7799.
50.00	50.00	33460.	26287.	19040.	11577.	7141.
70.00	67.31	26367.	21150.	15766.	10018.	6451.
90.00	85.23	18338.	14976.	11616.	7889.	5418.
95.00	90.23	15344.	12569.	9922.	6961.	4931.
99.00	95.66	10777.	8788.	7160.	5353.	4027.
99.90	98.09	7174.	5725.	4809.	3865.	3108.
99.99	99.23	5018.	3876.	3329.	2848.	2421.

EXHIBIT 5

DEFINITIONS 723-X6-L7350

AA(I)	- First half of description for duration I
AB(I)	- Second half
ABS	- Computer library function for absolute value of number
ALOG	- Computer library function for natural logarithm
ANYR(I,K)	- Number of years of data for station K and duration I
ANYRS	- Number of years of data in study
AV(I,K)	- Mean logarithm (or sum of logarithms) for station K and duration I
AVGSK	- Average regional skew coefficient
B(K)	- Regression coefficient for variable (K)
BB	- Regression coefficient
BC	- Regression coefficient
BLANK	- Symbol to identify recorded data
CB	- Regression constant
CC	- Regression constant
CROUT	- Program subroutine to solve simultaneous equations
DQ(I,K)	- Increment added to all flows for duration I at station K to preclude infinite negative logarithms
DTRMC	- Multiple determination coefficient
E	- Symbol to identify reconstituted data
I	- Index for duration
IA	- Indicator in column 1 of first card for each job
ICORL	- Indicator, when positive calls for computation of correlation coefficients
ICSE	- Indicator, case number specifing cause for no independent variables in estimation equation +1 indicates no flows found for correlation +2 indicates all correlations were zero
II	- Index associated with I
INCAD	- Indicator, positive value calls for adjustment of increment to reduce skew coefficient
INDC	- Indicator positive when correlation coefficient has been changed
IPCHQ	- Indicator, when positive calls for punching recorded and reconstituted flows
IPCHS	- Indicator, when positive calls for punching statistics
IPREV	- Order number in regression equation of adjacent duration
IRCRD(J)	- Indicator blank when no record at all stations in year J
IRATO	- Indicator, when positive calls for reading conversion ratios
ISKEW	- Indicator when positive calls for reading skew coefficients

ISTA(K)	- Identification number for station K
ISTAN	- Station number
ISTN	- Array of station sequence by length of record; longest record first
ISTY	- Array of station record lengths used to build ISTN array
ITEMP	- Temporary variable
ITMP	- Temporary variable
ITP	- Temporary variable
IX	- Index associated with I
IXX	- Argument for random number function
IYR	- Year number
IYRA	- Number of earliest year of record
J	- Year index
JA	- Index associated with J
JX	- Index associated with J
K	- Station index
KDUR	- Dimension limit for durations
KEEP	- Number stations to keep from immediately previous job
KEPT(K)	- Station numbers kept from immediately previous job
KRCRD	- Indicator, when positive a complete record exists for all stations
KSTA	- Dimension limit for stations
KX	- Index associated with K
KYRS	- Dimension limit for years
L	- Subordinate station index
LA	- Index associated with L
LTRA	- Letter A for testing IA
LX	- Index associated with L
M	- Sequence index
MM	- Index associated with M
N	- Temporary counter
NCAB(I,K)	- Number of cross products for station K and duration I
NDUR	- Number of durations in study
NINDP	- Number of independent variables in correlation
NLOG(I,K)	- Number of values for station K and duration I
NSMTH	- Indicator, zero or positive value causes smoothing of statistics
NSTA	- Number of stations in study
NSTAT	- Number of stations for which statistics (instead of flows) are supplied
NSTAX	- Twice NSTA
NSTXX	- Number of stations kept from previous job incremented by 1
NVAR	- Total number of variables in correlation
NYDIF	- Indicator, when positive a difference in record length exists between new data and data from previous job
NYRS	- Number of years in study

P(I)	- Exceedence frequency coordinate or ratio to convert flows to average rates
PLTT(J)	- Plotting position for event number J
Q(M,K)	- Flow or logarithm for station K and sequence number M
QM(I)	- Flow for current station and year and for duration I
QR(M,K)	- Indicator whether Q(M,K) is recorded or reconstituted
R(K,K+1)	- Covariance array for multiple regression equation
RA(I,K,L)	- Correlation between stations K and L for duration I
RMAX	- Maximum consistent correlation coefficient
RMIN	- Minimum consistent correlation coefficient
SA	- Sum of mean logarithms for various durations
SAA	- Sum of squares of mean logarithms
SAB	- Sum of cross products of mean logarithm and standard deviation
SAC	- Sum of cross products of mean logarithm and skew coefficient
SB	- Sum of standard deviations for various durations
SC	- Sum of skew coefficients for various durations
SD(I,K)	- Standard deviation (or sum of squares) for station K and duration I
SDA	- Standard deviation of short record station
SDB	- Standard deviation of long record station
SIN	- Computer library function for sine
SKEW(I,K)	- Skew coefficient (or sum of cubes) for station K and duration I
SKW(I)	- Specified skew coefficient for duration I at all stations
SQA(I,K)	- Sum of squares of logarithms in correlation for station K and duration I
SQB(I,K)	- Sum of squares of logarithms at related station in correlation with station K for duration I
SUMA(I,K)	- Sum of logarithms in correlation for station K and duration I
SUMB(I,K)	- Sum of logarithms at related station in correlation with station K for duration I
T	- Large number denoting missing record
TEMP	- Temporary variable
TMP	- Temporary variable
TMPA	- Temporary variable
TMPB	- Temporary variable
TMPP	- Temporary variable
TP	- Temporary variable
X(K)	- Independent variable related to station K
XINCR(I,K)	- Increment for DQ in skew coefficient adjustment routine
XPAB(I,K)	- Sum of cross products of logarithms for station K with related station for duration I
XQ(I)	- Temporary flow array

SOURCE PROGRAM

```
C          723-X6-L7350  REGIONAL FREQUENCY COMPUTATION, HEC, JULY 1972
C      LIBRARY SUBROUTINES USED--ALOG,SIN,ABS
C      PROGRAM SUBROUTINES CROUT,RNGEN--SEE COMMENTS IN RNGEN
C      REFERENCE TO TAPE 7 AT 960+1,1170+8
C      INDEXES I=DURATION  J=YEAR  K=STATION  L=RELATED STA M=SEQUENCE NO
C
       DIMENSION
      1AA(8),AB(8),ANYR(8,10),AV(8,10),B(10),DQ(8,10),
      2IRCRD(100),ISTA(10),ISTN(10),ISTY(10),KEPT(10),NCAB(8,10,20),
      3NLOG(8,10),P(8),PLTT(100),Q(400,10),QM(400),QMIN(8,10),
      4QR(400,10),R(10,11),RA(8,10,20),SD(8,10),SKEW(8,10),SKW(8),
      5SQA(8,10,20),SQB(8,10,20),SUMA(8,10,20),SUMB(8,10,20),X(400),
      6XINCR(8,10),XPAB(8,10,20),XQ(8)
       COMMON DTRMC,NINDP,B
       DATA LTRA/1HA/,BLANK/1H /,E/1HE/
       KSTA=10
       KDUR=8
       KYRS=50
   10  FORMAT(1X,I7,9I8)
   20  FORMAT(1X,F7.0,9F8.0)
   30  FORMAT(A1,A3,9A4,10A4)
   40  FORMAT(1X,A3,9A4,10A4)
   50  FORMAT(1H1)
   60  FORMAT(1X,I7,I8,8F8.0)
   70  FORMAT (2X,A3,A4,F9.3)
   80  FORMAT (1X,2A4,F9.3)
       DO 90 K=1,KSTA
   90  ISTA(K)=-1
       IYRSV=0
C                WASTE CARDS UNTIL AN A IN COL 1, FIRST TITLE CARD
C                                                  ** CARD A-1 **
  100  READ(5,30)IA,(QR(J,1),J=1,20)
       IF (IA.NE.LTRA) GO TO 100
C                                                  ** CARD A-2,3 **
       READ(5,40)((QR(J,K),J=1,20),K=2,3)
C                                                  ** CARD B **
       READ(5,10) NDUR,IYRA,ISKEW,KEEP,ICONV,IPCHQ,IPCHS,NSTAT,NSMTH,
      1INCAD
C                TERMINATE WITH 4 BLANK CARDS, AN A IN COL 1 OF FIRST
       IF(NDUR.LE.0) STOP
       WRITE(6,50)
       WRITE(6,110)
  110  FORMAT(1X,30(1H*)/10H JULY 1972,9X,12H723-X6-L2350/9H REGIONAL,
      $    22H FREQUENCY COMPUTATION/31H VERSION DATE - AUGUST 21, 1979/
      $    1X,30(1H*)///)
       WRITE(6,40)((QR(J,K),J=1,20),K=1,3)
       IF(NDUR.LE.KDUR)GO TO 140
  120  WRITE(6,130) NSTA,NDUR,NYRS
  130  FORMAT(/19H DIMENSION EXCEEDED ,5X,5HNSTA=,I3,5X,5HNDUR=,I2,5X,5HN
      1YRS=,I4)
       GO TO 100
  140  WRITE(6,150) NDUR,IYRA,ISKEW,KEEP,ICONV,IPCHQ,IPCHS,NSTAT,NSMTH,
      1INCAD
  150  FORMAT(/6X,4HNDUR,6X,4HIYRA,5X,5HISKEW,6X,4HKEEP,5X,5HICONV,5X,5HI
      1PCHQ,5X,5HIPCHS,5X,5HNSTAT,5X,5HNSMTH,5X,5HINCAD,/10I10)
C                                                  ** CARD C **
       READ(5,40)(AA(I),AB(I),I=1,NDUR)
       IF(ISKEW.LE.0)GO TO 200
       AVGSK=0.
C                                                  ** CARD D **
       READ(5,20)(SKW(I),I=1,NDUR)
       WRITE(6,160)
  160  FORMAT(/27H REGIONAL SKEW COEFFICIENTS)
       WRITE(6,170) (AA(I),AB(I),I=1,NDUR)
  170  FORMAT(20X,A3,A4,7(3X,2A4))
       WRITE(6,180) (SKW(I),I=1,NDUR)
  180  FORMAT(16X,10F11.3)
       DO 190 I=1,NDUR
  190  AVGSK=AVGSK+SKW(I)
```


EXHIBIT 6

```
      TEMP=NDUR
      AVGSK=AVGSK/TEMP
  200 T=99999999.
      IXX=0
      IYRA=IYRA-1
      NSTA=NSTAT
      IF(NSTAT.GT.10) NSTA=10
      NSTXX=1
      IF(NSTAT.GT.0) GO TO 300
      NSTA=0
      INDC=0
      NYDIF=0
C               INITIATE -1, NO RECORD FOR ALL FLOWS
      ITP=KDUR*KYRS
      DO 210 K=1,KSTA
      DO 210 N=1,ITP
      QR(N,K)=(-1.)
  210 CONTINUE
      IF(KEEP.LE.0) GO TO 300
C               SAVE STATIONS FROM PREVIOUS RUN IF NECESSARY
C                                                   ** CARD E **
      READ(5,10) (KEPT(I),I=1,KEEP)
      WRITE(6,220) (KEPT(I),I=1,KEEP)
  220 FORMAT(/31H  STATION(S) KEPT FROM LAST RUN ,14(1H,I6)/31X6(1H,I6))
      DO 280 K=1,KSTA
      DO 270 L=1,KEEP
      IF(KEPT(L).NE.ISTA(K)) GO TO 270
      INDC=1
      NSTA=NSTA+1
      ISTA(NSTA)=ISTA(K)
      DO 230 I=1,NDUR
      NLOG(I,NSTA)=0
      DQ(I,NSTA)=DQ(I,K)
      XINCR(I,NSTA)=XINCR(I,K)
  230 CONTINUE
      M=0
      ITMP=IYRSV-IYRA
      MM=ITMP*NDUR
      ITP=IYRA-IYRSV+1
      IF(ITP.LE.0) ITP=1
      IF(MM.GE.0) GO TO 240
      M=-MM
      MM=0
  240 DO 260 J=ITP,NYRS
      DO 250 I=1,NDUR
      M=M+1
      MM=MM+1
      IF(IRCRD(J).LE.0) GO TO 250
      TMP=Q(M,K)
      IF(TMP.GE.T) GO TO 250
      QR(MM,NSTA)=TMP
      NLOG(I,NSTA)=NLOG(I,NSTA)+1
  250 CONTINUE
  260 CONTINUE
      GO TO 280
  270 CONTINUE
  280 CONTINUE
      IF(ITMP.NE.0) NYDIF=1
      NYRS=NYRS+ITMP
      NSTXX=NSTA+1
      IF(NSTA.EQ.KEEP) GO TO 300
      ITP=KEEP-NSTA
      WRITE(6,290) ITP
  290 FORMAT(17H NOT ABLE TO FIND,I3,9HSTATIONS )
      KEEP=NSTA
  300 IF(INDC.LT.1) NYRS=0
      IF(ICONV.LE.0) GO TO 320
C                                                   ** CARD F **
      READ (5,20)(P(I),I=1,NDUR)
      WRITE (6,310)
```


EXHIBIT 6

```
  310 FORMAT (/30H RATIOS TO OBTAIN RATE OF FLOW)                        1138
      WRITE(6,170) (AA(I),AB(I),I=1,NDUR)                                1139
      WRITE(6,180)(P(I),I=1,NDUR)                                        1140
      GO TO 340                                                          1141
  320 DO 330 I=1,NDUR                                                    1142
      P(I)= 1.                                                           1143
  330 CONTINUE                                                           1144
C                 SET CONSTANTS                                          1145
  340 IF(NSTAT.GT.0) GO TO 2140                                          1146
      DO 350 K=NSTXX,KSTA                                                1147
      ISTA(K)=-1                                                         1148
  350 CONTINUE                                                           1149
      IYRSV=IYRA                                                         1150
      ITP=KDUR*KYRS/NDUR                                                 1151
      DO 390 K=1,KSTA                                                    1152
      DO 380 I=1,NDUR                                                    1153
      IF(K.LT.NSTXX) GO TO 360                                           1154
      NLOG(I,K)=0                                                        1155
      DQ(I,K)=0.                                                         1156
  360 DO 370 J=1,ITP                                                     1157
      N=NDUR*(J-1)+I                                                     1158
      Q(N,K)=QR(N,K)                                                     1159
  370 CONTINUE                                                           1160
  380 CONTINUE                                                           1161
  390 CONTINUE                                                           1162
C  * * * * * * READ AND PROCESS ONE STATION-YEAR OF DATA * * * * * * * * 1163
C                                                  ** CARD G **          1164
  400 READ(5,60)ISTAN,IYR,(QM(I),I=1,NDUR)                               1165
C                                                  ** CARD H **          1166
C                 BLANK CARD INDICATES END OF FLOW DATA                  1167
      IF(ISTAN.LT.1)GO TO 470                                            1168
      IF(NSTA.LT.1)GO TO 420                                             1169
      DO 410 K=1,NSTA                                                    1170
C                 IDENTIFY STATION SUBSCRIPT                             1171
      IF(ISTAN.EQ.ISTA(K))GO TO 430                                      1172
  410 CONTINUE                                                           1173
  420 NSTA=NSTA+1                                                        1174
C                 ASSIGN SUBSCRIPT TO NEW STATION                        1175
      IF(NSTA.GT.KSTA) GO TO 120                                         1176
      K=NSTA                                                             1177
      ISTA(K)=ISTAN                                                      1178
C                 ASSIGN SUBSCRIPT TO YEAR                               1179
  430 J=IYR-IYRA                                                         1180
      IF(NYRS.LT.J)NYRS=J                                                1181
      IF(J.GT.0)GO TO 450                                                1182
      WRITE(6,440)IYR                                                    1183
  440 FORMAT(/18H UNACCEPTABLE YEAR I5)                                  1184
      GO TO 100                                                          1185
C                 STORE FLOWS IN STATION AND DURATION ARRAY              1186
  450 M=(J-1)*NDUR                                                       1187
      DO 460 I=1,NDUR                                                    1188
      M=M+1                                                              1189
      IF(QM(I).LE.(-1.)) GO TO 460                                       1190
      NLOG(I,K)=NLOG(I,K)+1                                              1191
      DQ(I,K)=DQ(I,K)+QM(I)                                              1192
      Q(M,K)=QM(I)                                                       1193
  460 CONTINUE                                                           1194
      GO TO 400                                                          1195
  470 IF(NYRS*NDUR.GT.KYRS*KDUR) GO TO 120                               1196
C  * * * * * * COMPUTE FREQUENCY STATISTICS  * * * * * * * * * * * * * * 1197
      WRITE(6,480)                                                       1198
  480 FORMAT(/38H FREQUENCY STATISTICS OF RECORDED DATA )                1199
      WRITE(6,490)(AA(I),AB(I),I=1,NDUR)                                 1200
  490 FORMAT(5X,12HSTA     ITEM 3X,A3,A4,7(3X,2A4))                      1201
      DO 500 J=1,NYRS                                                    1202
  500 IRCRD(J)=0                                                         1203
      KRCRD=1                                                            1204
      ICORL=1                                                            1205
      IF(NDUR.EQ.1.AND.NSTA.EQ.1) ICORL=0                                1206
```

```
      INDC=0
      DO 710 K=1,NSTA
      TMPP=T
      XMIN=T
      DO 520 I=1,NDUR
      N=0
      IF(K.LT.NSTXX) GO TO 550
      TEMP=T
      M=I-NDUR
      DO 510 J=1,NYRS
      M=M+NDUR
      TMP=Q(M,K)
      IF(TMP.LE.(-1.)) GO TO 510
      IF(TMP.LT.TEMP) TEMP=TMP
  510 CONTINUE
      QMIN(I,K)=TEMP
      IF(TEMP.LT.TMPP) TMPP=TEMP
      TEMP=NLOG(I,K)
      IF (TEMP.LT.0.1) GO TO 520
      DQ(I,K)=DQ(I,K)*.001/TEMP
      IF(DQ(I,K).LT. .001) DQ(I,K)= .001
      TEMP=(QMIN(I,K)+DQ(I,K))/DQ(I,K)
      IF(TEMP.LT.XMIN) XMIN=TEMP
  520 CONTINUE
      DO 540 I=1,NDUR
      IF(NLOG(I,K).LE.0) GO TO 530
      XINCR(I,K)=XMIN/16.*DQ(I,K)
      IF(XINCR(I,K).LT..01) XINCR(I,K)=.01
  530 IF(TMPP.GT.0..AND.INCAD.LE.0) DQ(I,K)=0.
  540 CONTINUE
  550 DO 560 I=1,NDUR
      ANYR(I,K)=0.
      AV(I,K)=0.
      SD(I,K)=0.
      SKEW(I,K)=0.
  560 CONTINUE
      M=0
      DO 590 J=1,NYRS
      DO 580 I=1,NDUR
      M=M+1
      IF(Q(M,K).LT.(-.1)) GO TO 570
      IRCRD(J)=1
      QR(M,K)=BLANK
      ANYR(I,K)=ANYR(I,K)+1.
C               REPLACE FLOW ARRAY WITH LOG ARRAY
      TEMP=ALOG(Q(M,K)+DQ(I,K))*.4342945
      IF(ICORL.EQ.1) Q(M,K)=TEMP
C               SUM, SQUARES AND CUBES
      AV(I,K)=AV(I,K)+TEMP
      SD(I,K)=SD(I,K)+TEMP*TEMP
      SKEW(I,K)=SKEW(I,K)+TEMP*TEMP*TEMP
      GO TO 580
C               MISSING FLOWS EQUATED TO T
  570 Q(M,K)=T
      QR(M,K)=E
      KRCRD=0
  580 CONTINUE
  590 CONTINUE
      SUM=0.
      DO 620 I=1,NDUR
      TEMP=NLOG(I,K)
      IF (TEMP.LT.0.5) GO TO 620
      TMP=AV(I,K)
      AV(I,K)=TMP/TEMP
      IF (SD(I,K).LE.0.0.OR.TEMP.LT.2.5) GO TO 600
      TMPA=SD(I,K)
      SD(I,K)=(SD(I,K)-AV(I,K)*TMP)/(TEMP-1.)
      IF(SD(I,K).LE.0.) GO TO 600
      SD(I,K)=SD(I,K)**.5
```


EXHIBIT 6

```
      SKEW(I,K)=(TEMP*TEMP*SKEW(I,K)-3.*TEMP*TMP*TMPA+2.*TMP*TMP*TMP)/
     1(TEMP*(TEMP-1.)*(TEMP-2.)*SD(I,K)**3)
      GO TO 610
  600 SD(I,K)=0.
      SKEW(I,K)=0.
  610 SUM=SUM+SKEW(I,K)
  620 CONTINUE
      TEMP=NDUR
      SUM=SUM/TEMP
      N=N+1
      IF(K.LT.NSTXX.AND.NYDIF.EQ.0) GO TO 710
      IF(N.GT.1)GO TO 630
C                PRINT FREQUENCY STATISTICS
      WRITE(6,1070)ISTA(K),(AV(I,K),I=1,NDUR)
      WRITE(6,1080)(SD(I,K),I=1,NDUR)
      WRITE(6,1090)(SKEW(I,K),I=1,NDUR)
      WRITE(6,1100)(DQ(I,K),I=1,NDUR)
      WRITE(6,1110)(ANYR(I,K),I=1,NDUR)
      IF(ISKEW.LE.0.OR.INCAD.LE.0) GO TO 710
  630 IF(N.GE.16) GO TO 710
      IF(SUM.GT.(AVGSK-.1).AND.SUM.LT.(AVGSK+.1)) GO TO 710
      INDC=1
      M=0
      DO 660 J=1,NYRS
      DO 650 I=1,NDUR
      M=M+1
      IF(Q(M,K).GE.T)  GO TO 640
      TEMP=Q(M,K)
      Q(M,K)=10.**TEMP-DQ(I,K)
      GO TO 650
  640 Q(M,K)=-1.
  650 CONTINUE
  660 CONTINUE
      IF(SUM-AVGSK) 670,710,690
  670 DO 680 I=1,NDUR
      IF(NLOG(I,K).LE.0) GO TO 680
      DQ(I,K)=DQ(I,K)*1.5
  680 CONTINUE
      GO TO 550
  690 DO 700 I=1,NDUR
      IF(NLOG(I,K).LE.0) GO TO 700
      DQ(I,K)=DQ(I,K)-XINCR(I,K)
  700 CONTINUE
      GO TO 550
  710 CONTINUE
      IF(NYDIF.GT.0) NSTXX=1
      NSTAX=NSTA+NSTA
      IF (NDUR.EQ.1) NSTAX=NSTA
C               OMIT CORRELATIONS IF ONLY 1 STA AND 1 DURATION
      ITRNS=0
      IF(ICORL.EQ.1) GO TO 730
      M=0
      ANYRS=0.
      DO 720 J=1,NYRS
      M=M+1
      IF (Q(J,1).GE.T) GO TO 720
      ANYRS=ANYRS+1.
      GR(M,1)=BLANK
      IRCRD(M)=1
  720 CONTINUE
      GO TO 1760
C               OMIT CORRELATIONS IF NO MISSING FLOWS
  730 IF(KRCRD.EQ.1) GO TO 1130
C  * * * * * * COMPUTE SUMS OF SQUARES AND CROSS PRODUCTS  * * * * * * *
  740 DO 760 K=1,NSTA
      DO 750 I=1,NDUR
      DO 750 L=1,NSTAX
      RA(I,K,L)=-4.
      SUMA(I,K,L)=0.
      SUMB(I,K,L)=0.
```


EXHIBIT 6

```
      SQA(I,K,L)=0.
      SQB(I,K,L)=0.
      XPAB(I,K,L)=0.
      NCAB(I,K,L)=0
  750 CONTINUE
  760 CONTINUE
      DO 900 K=1,NSTA
      KX=K+1
      IF(KX.GT.NSTAX) GO TO 820
      M=0
      DO 810 J=1,NYRS
      DO 800 I=1,NDUR
      M=M+1
      TEMP=Q(M,K)
      IF(TEMP.GE.T)GO TO 800
      IF(ITRNS.EQ.1) TEMP=ALOG(TEMP+DQ(I,K))*.4342945
      DO 790 L=K,NSTAX
C               SUBSCRIPTS EXCEEDING NSTA RELATE TO ADJACENT DURATION
      IF(L.LE.NSTA)GO TO 770
      LX=L-NSTA
      IF (I.EQ.1) TMP=Q(M+1,LX)
      IF(I.GT.1)TMP=Q(M-1,LX)
      IF(TMP.GE.T)GO TO 790
      IF(ITRNS.EQ.1) TMP=ALOG(TMP+DQ(I,LX))*.4342945
      GO TO 780
  770 TMP=Q(M,L)
      IF(TMP.GE.T)GO TO 790
      IF(ITRNS.EQ.1) TMP=ALOG(TMP+DQ(I,L))*.4342945
C               COUNT AND USE ONLY RECORDED PAIRS
  780 NCAB(I,K,L)=NCAB(I,K,L)+1
      SUMA(I,K,L)=SUMA(I,K,L)+TEMP
      SUMB(I,K,L)=SUMB(I,K,L)+TMP
      SQA (I,K,L)=SQA (I,K,L)+TEMP*TEMP
      SQB (I,K,L)=SQB (I,K,L)+TMP*TMP
      XPAB(I,K,L)=XPAB(I,K,L)+TEMP*TMP
      IF(L.GT.NSTA) GO TO 790
      NCAB(I,L,K)=NCAB(I,K,L)
      SUMA(I,L,K)=SUMB(I,K,L)
      SUMB(I,L,K)=SUMA(I,K,L)
      SQA (I,L,K)=SQB (I,K,L)
      SQB (I,L,K)=SQA (I,K,L)
      XPAB(I,L,K)=XPAB(I,K,L)
  790 CONTINUE
  800 CONTINUE
  810 CONTINUE
C  * * * * * * COMPUTE CORRELATION COEFFICIENTS  * * * * * * * * * * * *
      ITMP=0
  820 DO 890 I=1,NDUR
C               SEARCH FOR DURATION WITH LONGEST RECORD
      ITEMP=NLOG(I,K)
      IF(ITEMP.LE.ITMP) GO TO 830
      ITMP=ITEMP
      IX=I
  830 IF(KX.GT.NSTAX) GO TO 870
      DO 860 L=KX,NSTAX
C               ELIMINATE PAIRS WITH LESS THAN 3 YRS DATA
      IF(NCAB(I,K,L).LE.2) GO TO 840
      TEMP=NCAB(I,K,L)
      SA=SUMA(I,K,L)
      SB=SUMB(I,K,L)
      TMP=(SQA(I,K,L)-SA**2/TEMP)*(SQB(I,K,L)-SB**2/TEMP)
      IF(TMP.LE.0.) GO TO 850
      TMPB=1.
      TMPA=XPAB(I,K,L)-SA*SB/TEMP
      IF(TMPA.LT.0.)TMPB=-TMPB
      TMPA=TMPA*TMPA/TMP
      TMPA=1.-(1.-TMPA)*(TEMP-1.)/(TEMP-2.)
      IF(TMPA.LT.0.)TMPA=0.
      RA(I,K,L)=TMPB*TMPA**.5
```


EXHIBIT 6

```
  840 IF(L.GT.NSTA) GO TO 860
      RA(I,L,K)=RA(I,K,L)
      GO TO 860
  850 RA(I,K,L)=0.
  860 CONTINUE
C                 ELIMINATE NEGATIVE GROSS CORRELATIONS
  870 DO 880 L=1,NSTAX
      TEMP=RA(I,K,L)
      IF (TEMP.LT.0.0.AND.TEMP.GE.(-1.0)) RA(I,K,L)=0.
  880 CONTINUE
      RA(I,K,K)=1.
  890 CONTINUE
  900 CONTINUE
      IF(ITRNS.NE.0) GO TO 1270
C * * * * * *  ADJUSTMENT OF FREQUENCY STATISTICS TO LONG TERM
      DO 980 II=1,NDUR
      I=IX+II-1
      IF(I.GT.NDUR)I=NDUR-II+1
      DO 910 K=1,NSTA
      ISTN(K)=K
      ISTY(K)=NLOG(I,K)
  910 CONTINUE
C                 ARRAY STATIONS - LONGEST RECORD FIRST,ETC
      ITMP=NSTA-1
      IF(ITMP.LE.0) GO TO 985
      DO 930 KX=1,ITMP
      ITP=KX+1
      DO 920 K=ITP,NSTA
      IF(ISTY(KX).GT.ISTY(K)) GO TO 920
      ITEMP=ISTN(KX)
      ISTN(KX)=ISTN(K)
      ISTN(K)=ITEMP
      ITEMP=ISTY(KX)
      ISTY(KX)=ISTY(K)
      ISTY(K)=ITEMP
  920 CONTINUE
  930 CONTINUE
      DO 970 KX=1,NSTA
      K=ISTN(KX)
      TMPB=NLOG(I,K)
      INDC=0
      DO 960 LX=1,KX
      IF(LX.EQ.KX) GO TO 940
      ITP=I
      L=ISTN(LX)
      TMP=NLOG(I,L)
      TMPP=NCAB(I,K,L)
      GO TO 950
  940 IF(NDUR.EQ.1) GO TO 960
      ITP=I-1
      IF(ITP.LE.0)ITP=I+1
      L=K+NSTA
      TMP=NLOG(ITP,K)
      TMPP=NCAB(I,K,L)
  950 TP=RA(I,K,L)
      IF(TP.LT.(-1.)) GO TO 960
      TMPA=TMPP/(1.-(TMP-TMPP)*TP**2/TMP)
      IF(TMPA.LT.TMPB) GO TO 960
      INDC=1
      ANYR(I,K)=TMPA
      TMPB=TMPA
      ITMP=L
      ITEMP=ITP
  960 CONTINUE
      IF(INDC.LE.0) GO TO 970
      L=ITMP
      ITP=ITEMP
      LX=L
      IF(LX.GT.NSTA) LX=LX-NSTA
      TP=RA(I,K,L)
      TEMP=NCAB(I,K,L)
```


EXHIBIT 6

```
      SA=SUMA(I,K,L)
      SB=SUMB(I,K,L)
      SDA=(SQA(I,K,L)-SA**2/TEMP)/(TEMP-1.)
      IF(SDA.LT.0.) SDA=0.
      SDA=SDA**.5
      SDB=(SQB(I,K,L)-SB**2/TEMP)/(TEMP-1.)
      IF(SDB.LT..0005) GO TO 970
      SDB=SDB**.5
      TMPP=SDA/SDB
      AV(I,K)=SA/TEMP+(AV(ITP,LX)-SB/TEMP)*TP*TMPP
      SD(I,K)=SDA+(SD(ITP,LX)-SDB)*TP**2*TMPP
  970 CONTINUE
  980 CONTINUE
  985 IF(ISKEW.GT.0) GO TO 1020
      IF(NSMTH.LE.(-1)) GO TO 1050
C                    SMOOTH SKEW COEFFICIENT
      DO 1040 K=1,NSTA
      SA=0.
      SC=0.
      SAA=0.
      SAC=0.
      ITMP=NDUR
      DO 1000 I=1,NDUR
      IF(NLOG(I,K).LT.3) GO TO 990
      IF(SKEW(I,K).GT.1.) SKEW(I,K)=1.
      IF(SKEW(I,K).LT.(-1.)) SKEW(I,K)=-1.
      IF(NDUR.LT.3) GO TO 1000
      TP=AV(I,K)-ALOG(P(I))
      TEMP=SKEW(I,K)
      SA=SA+TP
      SC=SC+TEMP
      SAA=SAA+TP*TP
      SAC=SAC+TP*TEMP
      GO TO 1000
  990 ITMP=ITMP-1
 1000 CONTINUE
      IF(ITMP.LT.3) GO TO 1050
      TP=ITMP
      SAA=SAA-SA*SA/TP
      SAC=SAC-SA*SC/TP
      BC=SAC/SAA
      IF(BC.GT.1.) BC=1.
      IF(BC.LT.(-1.)) BC=-1.
      CC=(SC-BC*SA)/TP
      DO 1010 I=1,NDUR
      TEMP=AV(I,K)-ALOG(P(I))
      SKEW(I,K)=CC+BC*TEMP
 1010 CONTINUE
 1040 CONTINUE
      GO TO 1050
 1020 DO 1030 I=1,NDUR
      DO 1030 K=1,NSTA
      SKEW(I,K)=SKW(I)
 1030 CONTINUE
 1050 WRITE(6,1060)
 1060 FORMAT(/63H FREQUENCY STATISTICS AFTER ADJUSTMENT WITH A LONG TERM
     1 STATION )
      WRITE(6,490)(AA(I),AB(I),I=1,NDUR)
      DO 1120 K=1,NSTA
      WRITE(6,1070)ISTA(K),(AV(I,K),I=1,NDUR)
 1070 FORMAT(/I8,8H     MEAN 10F11.3)
      WRITE(6,1080)(SD(I,K),I=1,NDUR)
 1080 FORMAT(9X,7HSTD DEV 10F11.3)
      WRITE(6,1090)(SKEW(I,K),I=1,NDUR)
 1090 FORMAT(12X,4HSKEW 10F11.3)
      WRITE(6,1100)(DQ(I,K),I=1,NDUR)
 1100 FORMAT(10X,6HINCRMT F10.2,9F11.2)
      WRITE(6,2000)(ANYR(I,K),I=1,NDUR)
 1110 FORMAT (11X,5HYEARS 10F11.0)
      DO 1120 I=1,NDUR
```


EXHIBIT 6

```
      ANYR(I,K)=NLOG(I,K)
 1120 CONTINUE

C  * * * * * * TRANSFORM TO STANDARDIZED VARIATES  * * * * * * * * * * *
 1130 DO 1180 K=1,NSTA
      M=0
      DO 1170 J=1,NYRS
      DO 1160 I=1,NDUR
      M=M+1
      IF(Q(M,K).GE.T)GO TO 1160
      IF(SD(I,K).LE.0.)GO TO 1150
      Q(M,K)=(Q(M,K)-AV(I,K))/SD(I,K)
C               PEARSON TYPE III TRANSFORM
      TMPP=SKEW(I,K)
      IF(TMPP.EQ.0.) GO TO 1160
      TEMP=.5*TMPP*Q(M,K)+1.
      TMP=1.
      IF(TEMP.GE.0.)GO TO 1140
      TEMP=-TEMP
      TMP=-TMP
 1140 Q(M,K)=6.*(TMP*TEMP**(1./3.)-1.)/TMPP+TMPP/6.
      GO TO 1160
 1150 Q(M,K)=0.
 1160 CONTINUE
 1170 CONTINUE
 1180 CONTINUE
      ITRNS=-1
      GO TO 740
C  * * * * * * ESTIMATE MISSING CORRELATION COEFFICIENTS * * * * * * * *
 1190 IF(NSTA.LE.1) GO TO 1370
      DO 1260 I=1,NDUR
      IX=I-1
      IF(I.EQ.1)IX=I+1
      DO 1250 K=1,NSTA
      KX=K+1
      IF (KX.GT.NSTAX) GO TO 1250
      DO 1240 L=KX,NSTAX
C               L AND K CORRELATION POSSIBLY MISSING
      IF(RA(I,K,L).GE.(-1.))GO TO 1240
      RMAX=1.
      RMIN=-1.
C               LX SEARCHES ALL DIRECTLY RELATED CORRELATIONS
      DO 1230 LX=1,NSTAX
      IF(LX.EQ.K)GO TO 1230
      IF(LX.EQ.L)GO TO 1230
      TEMP=RA(I,K,LX)
      IF(L.LE.NSTA)GO TO 1200
      IF(LX.LE.NSTA)GO TO 1210
C               BOTH L AND LX REPRESENT ADJACENT DURATIONS
      ITMP=L-NSTA
      ITEMP=LX-NSTA
      TMP=RA(IX,ITMP,ITEMP)
      GO TO 1220
C               L REPRESENTS CURRENT DURATION
 1200 TMP=RA(I,L,LX)
      GO TO 1220
C               LX AND NOT L REPRESENTS CURRENT DURATION
 1210 TMP=RA(I,LX,L)
 1220 IF(TMP+TEMP.LT.(-2.))GO TO 1230
      TMPA=((1.-TEMP*TEMP)*(1.-TMP*TMP))**.5
      TMPB=TMP*TEMP+TMPA
      IF(TMPB.LT.RMAX)RMAX=TMPB
      TMPB=TMPB-TMPA-TMPA
      IF(TMPB.GT.RMIN)RMIN=TMPB
 1230 CONTINUE
C               AVERAGE SMALLEST MAX AND LARGEST MIN CONSISTENT VALUE
      RA(I,K,L)=(RMAX+RMIN)*.5
      IF (RA(I,K,L).LT.0.0) RA(I,K,L)=0.
      IF(L.LE.NSTA)RA(I,L,K)=RA(I,K,L)
```


EXHIBIT 6

```
 1240 CONTINUE
 1250 CONTINUE
 1260 CONTINUE
      GO TO 1370
C  * * * * * * PRINT CORRELATION MATRIX  * * * * * * * * * * * * * * * * *
 1270 DO 1360 I = 1,NDUR
      IF(ITRNS.LT.1) WRITE(6,1280)AA(I),AB(I)
 1280 FORMAT(//46H CORRELATION COEFFICIENTS OF RECORDED DATA FOR 2A4,9H
     1DURATION )
      IF(ITRNS.GT.0) WRITE(6,1290)AA(I),AB(I)
 1290 FORMAT(//64H CORRELATION COEFFICIENTS OF RECORDED AND RECONSTITUTE
     1D DATA FOR 2A4,9H DURATION)
      WRITE(6,1300)(ISTA(K),K=1,NSTA)
 1300 FORMAT(/3X,3HSTA 20I6)
      WRITE(6,1310)
 1310 FORMAT(20X,18HWITH SAME DURATION)
      DO 1320 K=1,NSTA
      WRITE(6,1330)ISTA(K),(RA(I,K,L),L=1,NSTA)
 1320 CONTINUE
 1330 FORMAT(1X,I5,20F6.3)
      IF (NDUR.EQ.1) GO TO 1360
      WRITE(6,1340)
 1340 FORMAT(20X,39HWITH ADJACENT DURATION AT ABOVE STATION)
      ITP=NSTA+1
      DO 1350 K=1,NSTA
      WRITE(6,1330)ISTA(K),(RA(I,K,L),L=ITP,NSTAX)
 1350 CONTINUE
 1360 CONTINUE
      IF(KRCRD.EQ.1) GO TO 1760
      IF(ITRNS) 1190,1190,2020
C  * * * * * * RECONSTITUTE MISSING DATA * * * * * * * * * * * * * * * * *
 1370 M=0
      NVAR=NSTA+1
      DO 1750 J=1,NYRS
      IF (IRCRD(J).EQ.1) GO TO 1380
      M=M+NDUR
      GO TO 1750
 1380 DO 1740 I=1,NDUR
      MM=M
      MX=M
      M=M+1
      IF(I.EQ.1)MM=M+1
      DO 1730 K=1,NSTA
      KX=NSTA+K
      IF (Q(M,K).LT.T.OR.NLOG(I,K).LT.3) GO TO 1730
      NINDP=0
      IPREV=0
C              FORM CORRELATION MATRIX FOR EACH MISSING FLOW
      DO 1450 L=1,NSTA
      LA = NINDP
      IF(L.EQ.K)GO TO 1420
      IF(Q(M,L).GE.T)GO TO 1450
      NINDP=NINDP+1
      X(NINDP)=Q(M,L)
      DO 1410 LX = L,NSTA
      IF(LX.EQ.K)GO TO 1390
      IF(Q(M,LX).GE.T)GO TO 1410
      LA=LA+1
      R(NINDP,LA)=RA(I,L,LX)
      GO TO 1400
 1390 IF (NDUR.EQ.1) GO TO 1410
      IF(Q(MM,LX).GE.T)GO TO 1410
      LA=LA+1
      R(NINDP,LA) = RA(I,L,KX)
 1400 R(LA,NINDP) = R(NINDP,LA)
 1410 CONTINUE
      R(NINDP,NVAR)=RA(I,L,K)
      GO TO 1450
 1420 IF (NDUR.EQ.1) GO TO 1450
      IF(Q(MM,K).GE.T)GO TO 1450
```


EXHIBIT 6

```
      NINDP=NINDP+1                                                     1693
      IPREV=NINDP                                                       1694
      X(NINDP)=Q(MM,L)                                                  1695
      DO 1440 LX = L,NSTA                                               1696
      IF(LX.EQ.K)GO TO 1430                                             1697
      IF(Q(M,LX).GE.T)GO TO 1440                                        1698
      LA=LA+1                                                           1699
      R(NINDP,LA) = RA(I,LX,KX)                                         1700
      R(LA,NINDP)=R(NINDP,LA)                                           1701
      GO TO 1440                                                        1702
 1430 LA=LA+1                                                           1703
      R(NINDP,LA)=1.                                                    1704
 1440 CONTINUE                                                          1705
      R(NINDP,NVAR)=RA(I,L,KX)                                          1706
 1450 CONTINUE                                                          1707
C              CASE NUMBER 1 RESULTS WHEN NO FLOWS ARE FOUND FOR CORRELA 1708
      ICSE=1                                                            1709
      IF(NINDP.LE.0) GO TO 1510                                         1710
      ITMP=NINDP+1                                                      1711
      DO 1460 IX=1,NINDP                                                1712
 1460 R(IX,ITMP)=R(IX,NVAR)                                             1713
C     ==========                                                        1714
 1470 CALL CROUT(R)                                                     1715
C     ==========                                                        1716
      ITEMP=NINDP+1                                                     1717
      TEMP=1.                                                           1718
      INDC=0                                                            1719
      DO 1490 L=1,NINDP                                                 1720
      TMP=ABS(R(L,ITEMP))                                               1721
      IF(TMP.GT.TEMP) GO TO 1480                                        1722
      IF(L.EQ.IPREV.AND.TMP.GE..9) GO TO 1480                           1723
      TEMP=TMP                                                          1724
      ITP=L                                                             1725
 1480 IF(R(L,ITEMP).LT.0..AND.B(L).GT.(-1.5).AND.B(L).LT..5) GO TO 1490 1726
      IF(R(L,ITEMP).GT.0..AND.B(L).GT.(-.5).AND.B(L).LT.1.5) GO TO 1490 1727
      INDC=1                                                            1728
 1490 CONTINUE                                                          1729
      IF(INDC.GT.0) GO TO 1500                                          1730
      IF(DTRMC.LE.1..AND.DTRMC.GE.0.) GO TO 1590                        1731
C              IF MATRIX INCONSISTENT, OMIT VARIABLE WITH LEAST CORRELAT 1732
 1500 ITMP=NINDP-1                                                      1733
      IF(ITMP.GT.0) GO TO 1530                                          1734
C              CASE NUMBER 2 RESULTS WHEN ALL CORRELATIONS ARE ZERO      1735
      ICSE=2                                                            1736
C              POSSIBLE BRANCH FROM 870+2                                1737
 1510 IYR=IYRA+J                                                        1738
      WRITE(6,1520) ISTA(K),I,IYR,ICSE                                  1739
 1520 FORMAT(/25H ZERO CORRELATION FOR STA ,I6,10H  DURATION ,I2,6H  YEA 1740
     1R ,I5,6H  CASE ,I2/)                                              1741
      B(1)=0.                                                           1742
      X(1)=0.                                                           1743
      DTRMC=0.                                                          1744
      GO TO 1590                                                        1745
 1530 IF(ITP.GT.ITMP) GO TO 1560                                        1746
      DO 1550 L=ITP,ITMP                                                1747
      DO 1540 LA=1,ITEMP                                                1748
 1540 R(L,LA)=R(L+1,LA)                                                 1749
 1550 X(L)=X(L+1)                                                       1750
 1560 DO 1580 L=1,ITMP                                                  1751
      DO 1570 LA=ITP,NINDP                                              1752
 1570 R(L,LA)=R(L,LA+1)                                                 1753
 1580 CONTINUE                                                          1754
      NINDP=ITMP                                                        1755
      GO TO 1470                                                        1756
C              ADD RANDOM COMPONENT TO PRESERVE VARIANCE                 1757
 1590 TMP=RNGEN(IXX)                                                    1758
      TEMP=RNGEN(IXX)                                                   1759
      TEMP=(-2.*ALOG(TEMP))**.5*SIN(6.2832*TMP)                         1760
C              COMPUTE FLOW                                              1761
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EXHIBIT 6

```
      TEMP=TEMP*(1.-DTRMC)**.5
      DO 1600 L=1,NINDP
      TEMP=TEMP+B(L)*X(L)
 1600 CONTINUE
      Q(M,K)=TEMP
      ANYR(I,K)=ANYR(I,K)+DTRMC
      TP=Q(M,K)
C               ADD NEW VALUE TO SUMS OF SQUARES AND CROSS PRODUCTS
      DO 1670 L=1,NSTAX
C               SUBSCRIPTS EXCEEDING NSTA RELATE TO PRECEDING MONTH
 1610 IF(L.LE.NSTA) GO TO 1620
      LX=L-NSTA
      IF (I.EQ.1) TMP=Q(M+1,LX)
      IF(I.GT.1) TMP=Q(M-1,LX)
      GO TO 1630
 1620 TMP=Q(M,L)
 1630 IF(TMP.GE.T) GO TO 1670
C               COUNT AND USE ONLY RECORDED PAIRS
      NCAB(I,K,L)=NCAB(I,K,L)+1
      SUMA(I,K,L)=SUMA(I,K,L)+TP
      SUMB(I,K,L)=SUMB(I,K,L)+TMP
      SQA (I,K,L)=SQA (I,K,L)+TP*TP
      SQB (I,K,L)=SQB (I,K,L)+TMP*TMP
      XPAB(I,K,L)=XPAB(I,K,L)+TP*TMP
      IF(L.GT.NSTA) GO TO 1640
      NCAB(I,L,K)=NCAB(I,K,L)
      SUMA(I,L,K)=SUMB(I,K,L)
      SUMB(I,L,K)=SUMA(I,K,L)
      SQA (I,L,K)=SQB (I,K,L)
      SQB (I,L,K)=SQA (I,K,L)
      XPAB(I,L,K)=XPAB(I,K,L)
C               RECOMPUTE CORRELATION COEFFICIENTS TO INCLUDE NEW DATA
C               ELIMINATE PAIRS WITH LESS THAN 3 YRS DATA
 1640 IF(NCAB(I,K,L).LE.2) GO TO 1670
      TEMP=NCAB(I,K,L)
      TMP=(SQA(I,K,L)-SUMA(I,K,L)*SUMA(I,K,L)/TEMP)*(SQB(I,K,L)-SUMB
     1(I,K,L)*SUMB(I,K,L)/TEMP)
C               ELIMINATE PAIRS WITH ZERO VARIANCE PRODUCT
      IF(TMP.LE.0.) GO TO 1650
      TMPB=1.
      TMPA=XPAB(I,K,L)-SUMA(I,K,L)*SUMB(I,K,L)/TEMP
C               RETAIN ALGEBRAIC SIGN
      IF(TMPA.LT.0.)TMPB=-TMPB
      TMPA=TMPA*TMPA/TMP
      RA(I,K,L)=TMPB*TMPA**.5
      IF(RA(I,K,L).GE.0.) GO TO 1660
 1650 RA(I,K,L)=0.
 1660 IF(L.GT.NSTA) GO TO 1670
      RA(I,L,K)=RA(I,K,L)
 1670 CONTINUE
      IF(NDUR.EQ.1)GO TO 1730
      DO 1720 L=1,NSTA
      ITP=0
      IX=I+1
      IF(IX.GT.NDUR) GO TO 1680
      TMP=Q(M+1,L)
      GO TO 1700
 1680 IF(I.GT.2) GO TO 1730
 1690 TMP=Q(M-1,L)
      IX=I-1
      ITP=1
 1700 IF(TMP.GE.T) GO TO 1720
      NCAB(IX,L,KX)=NCAB(IX,L,KX)+1
      SUMA(IX,L,KX)=SUMA(IX,L,KX)+TMP
      SUMB(IX,L,KX)=SUMB(IX,L,KX)+TP
      SQA (IX,L,KX)=SQA (IX,L,KX)+TMP**2
      SQB (IX,L,KX)=SQB (IX,L,KX)+TP**2
      XPAB(IX,L,KX)=XPAB(IX,L,KX)+TMP*TP
      IF(NCAB(IX,L,KX).LE.2) GO TO 1720
      TEMP=NCAB(IX,L,KX)
```


EXHIBIT 6

```
      TMP=(SQA(IX,L,KX)-SUMA(IX,L,KX)**2/TEMP)*(SQB(IX,L,KX)-
     1SUMB(IX,L,KX)**2/TEMP)
      IF(TMP.LE.0.) GO TO 1710
      TMPB=1.
      TMPA=XPAB(IX,L,KX)-SUMA(IX,L,KX)*SUMB(IX,L,KX)/TEMP
      IF(TMPA.LT.0.) TMPB=-TMPB
      TMPA=TMPA**2/TMP
      RA(IX,L,KX)=TMPB*TMPA**.5
      IF(RA(IX,L,KX).GE.0.) GO TO 1720
 1710 RA(IX,L,KX)=0.
      IF(I.EQ.2.AND.ITP.LT.1) GO TO 1690
 1720 CONTINUE
 1730 CONTINUE
 1740 CONTINUE
 1750 CONTINUE
 1760 WRITE(6,50)
      WRITE(6,1770)
 1770 FORMAT(33H RECORDED AND RECONSTITUTED DATA )
      DO 1980 K=1,NSTA
      IF(K.GE.NSTXX) WRITE(6,1780)(AA(I),AB(I),I=1,NDUR)
 1780 FORMAT(/2X,10H STA  YEAR 4X,A3,A4,9(3X,2A4))
      M=0
C               CONVERT STANDARD DEVIATES TO FLOWS
      ANYRS=NYRS
      DO 1890 J=1,NYRS
      IF (IRCRD(J).EQ.1) GO TO 1790
      M=M+NDUR
      ANYRS=ANYRS-1.
      GO TO 1890
 1790 DO 1870 I=1,NDUR
      M=M+1
      X(I)=QR(M,K)
      XQ(I)=Q(M,K)
      IF(ICORL.EQ.0)GO TO 1870
      IF (NLOG(I,K).LT.3) GO TO 1860
      TEMP=Q(M,K)
      TMP=SKEW(I,K)
C               USE ADOPTED SKEW FOR RECONSTITUTING
      IF(ISKEW.GT.0) TMP=SKW(I)
      IF(TMP.EQ.0.) GO TO 1820
      TEMP=((TMP*(TEMP-TMP/6.)/6.+1.)**3-1.)*2./TMP
      IF(QR(M,K).NE.E) GO TO 1820
      TMPP=(-2.)/TMP
      IF(TMP) 1800,1820,1810
 1800 IF(TEMP.GT.TMPP) TEMP=TMPP
      GO TO 1820
 1810 IF(TEMP.LT.TMPP) TEMP=TMPP
 1820 TMP=TEMP*SD(I,K)+AV(I,K)
      TEMP=10.**TMP-DQ(I,K)
      IF(TEMP.LT.0.) TEMP=0.
      IF(TEMP.LT.QMIN(I,K)) QMIN(I,K)=TEMP
      Q(M,K)=TEMP
      IF(I.EQ.1) GO TO 1850
      TMP=Q(M-1,K)*P(I)/P(I-1)
      IF(Q(M,K).LT.TMP) GO TO 1850
      IF(QR(M,K).EQ.E) GO TO 1840
      ITP=I-1
      DO 1830 L=1,ITP
      TMP=Q(M-L,K)*P(I)/P(I-L)
      IF(TMP.LT.Q(M,K).AND.QR(M-L,K).EQ.E)Q(M-L,K)=Q(M,K)*P(I-L)/P(I)
      IF(NLOG(I-L,K).GT.2) XQ(I-L)=Q(M-L,K)
 1830 CONTINUE
      GO TO 1850
 1840 Q(M,K)=TMP
 1850 XQ(I)=Q(M,K)
      GO TO 1870
 1860 XQ(I)=-1.
 1870 CONTINUE
      IF(K.LT.NSTXX) GO TO 1890
      IYR=IYRA+J
```


EXHIBIT 6

```
      WRITE(6,1880) ISTA(K),IYR,(XQ(I),X(I),I=1,NDUR)
 1880 FORMAT(2I6,F11.0,A1,F10.0,A1,8(F10.0,A1))
      IF(IPCHQ.GT.0) WRITE(7,60) ISTA(K),IYR,(XQ(I),I=1,NDUR)
 1890 CONTINUE
      IF(K.LT.NSTXX) GO TO 1980
      IF(ICORL.EQ.0.OR.KRCRD.GE.1) GO TO 1980
      INDC=0
 1900 DO 1910 I=1,NDUR
      IF(QMIN(I,K)+DQ(I,K).GT..0001) GO TO 1910
      INDC=1
 1910 CONTINUE
      IF(INDC.LT.1) GO TO 1930
      DO 1920 I=1,NDUR
      DQ(I,K)=DQ(I,K)+XINCR(I,K)
 1920 CONTINUE
      GO TO 1900
C  * * * * * * RECOMPUTE FREQUENCY STATISTICS  * * * * * * * * * * * * * *
 1930 DO 1970 I=1,NDUR
      IF (NLOG(I,K).LT.3) GO TO 1960
      TMP=0.
      TEMP=0.
      TMPA=0.
      M=I
      DO 1950 J=1,NYRS
      IF (IRCRD(J).EQ.0) GO TO 1940
      TP=ALOG(Q(M,K)+DQ(I,K))
      TMP=TMP+TP
      TEMP=TEMP+TP*TP
      TMPA=TMPA+TP*TP*TP
 1940 M = M + NDUR
 1950 CONTINUE
      AV(I,K)=TMP*.4342945/ANYRS
      SD(I,K)=((TEMP-TMP*TMP/ANYRS)/(ANYRS-1.))**.5
      SKEW(I,K)=(ANYRS*ANYRS*TMPA-3.*ANYRS*TMP*TEMP+2.*TMP**3)/
     1  (ANYRS*(ANYRS-1.)*(ANYRS-2.)*SD(I,K)**3)

      SD(I,K)=SD(I,K)*.4342945
      GO TO 1970
 1960 ANYR(I,K)=0.
 1970 CONTINUE
 1980 CONTINUE
      IF(ICORL.EQ.0.OR.KRCRD.GE.1) GO TO 2020
      WRITE(6,50)
      WRITE(6,1990)
 1990 FORMAT(//56H FREQUENCY STATISTICS OF RECORDED AND RECONSTITUTED DA
     1TA )
      WRITE(6,490)(AA(I),AB(I),I=1,NDUR)
      DO 2010 K=NSTXX,NSTA
      WRITE(6,1070)ISTA(K),(AV(I,K),I=1,NDUR)
      WRITE(6,1080)(SD(I,K),I=1,NDUR)
      WRITE(6,1090) (SKEW(I,K),I=1,NDUR)
      WRITE (6,2000) (ANYR(I,K),I=1,NDUR)
 2000 FORMAT (7X,9HEQUIV YRS 10F11.1)
 2010 CONTINUE
C              RECOMPUTE CORRELATION MATRIX
      ITRNS=1
      GO TO 730
C  * * * * * * ARRANGE FLOWS IN ORDER  * * * * * * * * * * * * * * * * * *
 2020 ITMP=ANYRS+.1
C              COMPUTE MEDIAN PLOTTING POSITIONS
      TEMP=1./ANYRS
      PLTT(1)=(1.-.5**TEMP)*100.
      TEMP=(100.-PLTT(1)-PLTT(1))/(ANYRS-1.)
      DO 2030 J=2,ITMP
      PLTT(J)=PLTT(J-1)+TEMP
 2030 CONTINUE
      WRITE(6,2040)
 2040 FORMAT(//17H FREQUENCY ARRAYS)
      DO 2130 K=NSTXX,NSTA
      DO 2080 I=1,NDUR
```

```
      M=I
      QM(I)=Q(M,K)
      IF(QM(I).GE.T) QM(I)=-T
      X(I)=QR(M,K)
      JA=1
      DO 2070 J=2,NYRS
      M=M+NDUR
      IF (IRCRD(J).EQ.0) GO TO 2070
      JA=JA+1
      TEMP=Q(M,K)
      JX=JA*NDUR+I
      DO 2050 L=2,JA
      LX=JX-L*NDUR
      ITP=LX+NDUR
      IF(QM(LX).GE.TEMP)GO TO 2060
      QM(ITP)=QM(LX)
      X(ITP)=X(LX)
 2050 CONTINUE
      QM(I)=TEMP
      X(I)=QR(M,K)
      GO TO 2070
 2060 QM(ITP)=TEMP
      X(ITP)=QR(M,K)
 2070 CONTINUE
 2080 CONTINUE
      WRITE(6,2410)ISTA(K)
 2090 FORMAT(/10H NO  PLOT 3X,A3,A4,9(3X,2A4))
      WRITE(6,2090)(AA(I),AB(I),I=1,NDUR)
      M=0
      DO 2120 J=1,ITMP
      DO 2100 I=1,NDUR
      M=M+1
      X(I)=X(M)
      XQ(I)=QM(M)
      IF(NLOG(I,K).LT.3) XQ(I)=-1.
 2100 CONTINUE
      WRITE(6,2110)J,PLTT(J),(XQ(I),X(I),I=1,NDUR)
 2110 FORMAT(1X,I3,F6.2,F11.0,A1,9(F10.0,A1))
 2120 CONTINUE
 2130 CONTINUE
      GO TO 2190
C  * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C              READ STATISTICS, IF SUPPLIED
 2140 WRITE(6,2150)
 2150 FORMAT(/27H INPUT FREQUENCY STATISTICS )
      WRITE(6,490) (AA(I),AB(I),I=1,NDUR)
      DO 2180 K=1,NSTA
      DO 2170 I=1,NDUR
C                                                  ** CARD I **
      READ(5,2160) ISTA(K),AV(I,K),SD(I,K),SKEW(I,K),DQ(I,K),ANYR(I,K)
 2160 FORMAT(1X,I7,8X,5F8.0)
      NLOG(I,K)=ANYR(I,K)
 2170 CONTINUE
      WRITE(6,1070)ISTA(K),(AV(I,K),I=1,NDUR)
      WRITE(6,1080)(SD(I,K),I=1,NDUR)
      WRITE(6,1090)(SKEW(I,K),I=1,NDUR)
      WRITE(6,1100) (DQ(I,K),I=1,NDUR)
      WRITE(6,2000) (ANYR(I,K),I=1,NDUR)
 2180 CONTINUE
 2190 DO 2250 K=NSTXX,NSTA
C  * * * * * * SMOOTH STATISTICS * * * * * * * * * * * * * * * * * * * * *
      IF (NSMTH.LE.(-1)) GO TO 2230
      IF(NDUR.LT.3)GO TO 2230
C              SUMS, SQUARES AND CROSS PRODUCTS
      SA=0.
      SB=0.
      SC=0.
      SAA=0.
      SAB=0.
      SAC=0.
      ITMP=NDUR
```


EXHIBIT 6

```
      DO 2210 I=1,NDUR
      IF (NLOG(I,K).LT.3) GO TO 2200
      TP=AV(I,K)-ALOG(P(I))
      TMP=SD(I,K)
      IF(SKEW(I,K).GT.1.) SKEW(I,K)=1.
      IF(SKEW(I,K).LT.(-1.)) SKEW(I,K)=(-1.)
      TEMP=SKEW(I,K)
      SA=SA+TP
      SB=SB+TMP
      SC=SC+TEMP
      SAA=SAA+TP*TP
      SAB=SAB+TP*TMP
      SAC=SAC+TP*TEMP
      GO TO 2210
 2200 ITMP=ITMP-1
 2210 CONTINUE
      IF (ITMP.LT.3) GO TO 2230
C              LINEAR REGRESSION, STD DEV AND SKEW VS MEAN
      TP=ITMP
      SAA=SAA-SA*SA/TP
      SAB=SAB-SA*SB/TP
      SAC=SAC-SA*SC/TP
C              LIMIT REGRESSION COEFFICIENT FOR CONSISTENCY
      BB=SAB/SAA
      IF(BB.GT..25)BB=.25
      IF(BB.LT.(-.25))BB=-.25
      BC=SAC/SAA
      IF(BC.GT.1.)BC=1.
      IF(BC.LT.(-1.))BC=-1.
C              REGRESSION CONSTANTS
      SA=SA/TP
      SB=SB/TP
      CB=SB-BB*SA
      SC=SC/TP
      CC=SC-BC*SA
C              COMPUTE SMOOTHED STATISTICS
      DO 2220 I=1,NDUR
      IF (NLOG(I,K).LT.3) GO TO 2220
      TEMP=AV(I,K)-ALOG(P(I))
      SD(I,K)=CB+BB*TEMP
      IF (SD(I,K).LT.0.) SD(I,K)=0.
      SKEW(I,K)=CC+BC*TEMP
 2220 CONTINUE
 2230 IF (ISKEW.LE.0) GO TO 2250
      DO 2240 I=1,NDUR
      SKEW(I,K)=SKW(I)
 2240 CONTINUE
 2250 CONTINUE
      IF (NDUR.LT.3.AND.ISKEW.LE.0) GO TO 2290
      WRITE(6,50)
      WRITE(6,2260)
 2260 FORMAT(//29H ADOPTED FREQUENCY STATISTICS)
      WRITE(6,490)(AA(I),AB(I),I=1,NDUR)
      DO 2280 K=NSTXX,NSTA
      WRITE(6,1070)ISTA(K),(AV(I,K),I=1,NDUR)
      WRITE(6,1080)(SD(I,K),I=1,NDUR)
      WRITE(6,1090)(SKEW(I,K),I=1,NDUR)
      WRITE(6,1100) (DQ(I,K),I=1,NDUR)
      IF(IPCHS.GT.0)WRITE(7,2270)(ISTA(K),AA(I),AB(I),AV(I,K),SD(I,K),SK
     1EW(I,K),DQ(I,K),ANYR(I,K),I=1,NDUR)
 2270 FORMAT(I8,1X,A3,A4,3F8.3,2F8.2/ (I8,2A4,3F8.3,2F8.2 ))
 2280 CONTINUE

C  * * * * * * COMPUTE FREQUENCY CURVES  * * * * * * * * * * * * * * * *
 2290 TMPA=100.
      X(1)=3.73
      X(2)=3.09
      X(3)=2.33
      X(4)=1.64
      X(5)=1.28
```


EXHIBIT 6

```
      X(6)=.52
      WRITE(6,50)
      WRITE(6,2300)
 2300 FORMAT(26H COMPUTED FREQUENCY CURVES)
      DO 2450 K=NSTXX,NSTA
      TMPB=0.
      TMPP=0.
      DO 2400 II=1,NDUR
      I=NDUR-II+1
      IF(NLOG(I,K).LT.3) GO TO 2310
      TMPP=TMPP+1.
      TP=SKEW(I,K)
      TMPB=TMPB+ANYR(I,K)
 2310 DO 2390 J=1,13
      IF (NLOG(I,K).LT.3.AND.NSTAT.LT.1) GO TO 2380
      TEMP=0.
      IF(J-7)2320,2340,2330
 2320 TEMP=X(J)
      GO TO 2340
 2330 TEMP=-X(14-J)
C               PEARSON TYPE III TRANSFORM
 2340 IF(TP.EQ.0.) GO TO 2370
      TEMP=2./TP*((TP/6.*(TEMP-TP/6.)+1.)**3-1.)
      TMP=(-2.)/TP
      IF(TP)         2350,2370,2360
 2350 IF(TEMP.GT.TMP) TEMP=TMP
      GO TO 2370
 2360 IF(TEMP.LT.TMP)   TEMP=TMP
 2370 TMP=AV(I,K)+TEMP*SD(I,K)
      QR(J,I)=10.**TMP-DQ(I,K)
      IF(QR(J,I).LT.0.) QR(J,I)=0.
      IF(II.EQ.1.OR.J.LE.8) GO TO 2390
      TMP=QR(J,I+1)*P(I)/P(I+1)
      IF(QR(J,I).LT.TMP)QR(J,I)=TMP
      GO TO 2390
 2380 QR(J,I)=-1.
 2390 CONTINUE
 2400 CONTINUE
      IF(TMPP.LE.0.) GO TO 2450
      PLTT(1)=.01
      PLTT(2)=.1
      PLTT(3)=1.
      PLTT(4)=5.
      PLTT(5)=10.
      PLTT(6)=30.
      PLTT(7)=50.
      PLTT(8)=TMPA-PLTT(6)
      PLTT(9)=TMPA-PLTT(5)
      PLTT(10)=TMPA-PLTT(4)
      PLTT(11)=TMPA-PLTT(3)
      PLTT(12)=TMPA-PLTT(2)
      PLTT(13)=TMPA-PLTT(1)
C               PLOT VALUES EXCEEDING 13 ARE EXPECTED PROBABILITY
      TMP=TMPB/TMPP
      PLTT(14)=.01*(1.+1600./TMP**1.72)
      PLTT(15)= .1*(1.+280./TMP**1.55)
      PLTT(16)= 1.*(1.+26./TMP**1.16)
      PLTT(17)= 5.*(1.+6./TMP**1.04)
      PLTT(18)=10.*(1.+3./TMP**1.04)
      PLTT(19)=30.*(1.+.46/TMP**.925)
      PLTT(20)=50.
      PLTT(21)=TMPA-PLTT(19)
      PLTT(22)=TMPA-PLTT(18)
      PLTT(23)=TMPA-PLTT(17)
      PLTT(24)=TMPA-PLTT(16)
      PLTT(25)=TMPA-PLTT(15)
      PLTT(26)=TMPA-PLTT(14)
      WRITE(6,2410)ISTA(K)
 2410 FORMAT(/8H STATION I8)
      WRITE(6,2420)(AA(I),AB(I),I=1,NDUR)
```


EXHIBIT 6

```
 2420 FORMAT(4X,16H  PLOT  EXP PROB 4X,A3,A4,9(3X,2A4))
      DO 2440 J=1,13
      WRITE(6,2430) PLTT(J),PLTT(J+13),(QR(J,I),I=1,NDUR)
 2430 FORMAT(2F10.2,9F11.0)
 2440 CONTINUE
 2450 CONTINUE
      NSTAT=NSTAT-NSTA
      NSTA=NSTAT
      IF(NSTAT.GT.10) NSTA=10
      IF(NSTA.GT.0) GO TO 2140
      GO TO 100
      END
      SUBROUTINE CROUT(RX)
      DIMENSION B(10),R(10,11),RX(10,11)
      COMMON DTRMC,NINDP,B
      NVAR=NINDP+1
      DO 20 J=1,NINDP
      DO 10 K=1,NVAR
   10 R(J,K)=RX(J,K)
   20 CONTINUE
      IF(NINDP.GT.1)GO TO 30
      B(1)=R(1,2)/R(1,1)
      DTRMC=B(1)*B(1)
      RETURN
C  * * * * * * DERIVED MATRIX  * * * * * * * * * * * * * * * * * * * * * * *
   30 DO 40 K=2,NVAR
   40 R(1,K)=R(1,K)/R(1,1)
      DO 80 K=2,NINDP
      ITP=K-1
      DO 60 J=K,NINDP
      DO 50 I=1,ITP
      L=K-I
   50 R(J,K)=R(J,K)-R(J,L)*R(L,K)
      IF(J.EQ.K) GO TO 60
      R(K,J)=R(J,K)/R(K,K)
   60 CONTINUE
      DO 70 I=1,ITP
      L=K-I
   70 R(K,NVAR)=R(K,NVAR)-R(L,NVAR)*R(K,L)
   80 R(K,NVAR)=R(K,NVAR)/R(K,K)
C  * * * * * * BACK SOLUTION * * * * * * * * * * * * * * * * * * * * * * *
      B(NINDP)=R(NINDP,NVAR)
      DO 100 I=2,NINDP
      J=NVAR-I
      IX=I-1
      B(J)=R(J,NVAR)
      DO 90 L=1,IX
      K=J+L
   90 B(J)=B(J)-B(K)*R(J,K)
  100 CONTINUE
      DTRMC=0.
      DO 110 J=1,NINDP
  110 DTRMC=DTRMC+B(J)*RX(J,NVAR)
      RETURN
      END
      FUNCTION RNGEN(IX)
C     RANDOM NUMBER SUBROUTINE FOR A BINARY MACHINE
C     GENERATES UNIFORM RANDOM NUMBERS IN THE INTERVAL 0 TO 1
C     GENERAL USAGE IS AS FOLLOWS
C     A=RNGEN(IX)
C     IX SHOULD BE INITIALIZED TO ZERO IN THE PROGRAM
C     IARG CAN BE ANY LARGE, ODD INTEGER
C     CONSTANTS MUST BE COMPUTED BY FOLLOWING EQUATIONS
C     * * * *  ICON1=(2**((B+1)/2))+3  * * * *
C     * * * *  ICON2=(2**B)-1          * * * *
C     * * * *  FCON3=1./(2.**B)        * * * *
C     WHERE B= NUMBER OF BITS IN THE INTEGER WORD
C
      DATA IARG/759821/
      IF(IARG.EQ.IX) GO TO 10
```

```
      IX=IARG
      IY=IX
      ICON1=16777219
   10 IY=IY*ICON1
      ICON2=281474976710655
      IF(IY.LT.0) IY=IY+ICON2+1
      RNGEN=IY
      FCON3=.3552713678E-14
      RNGEN=RNGEN*FCON3
      RETURN
      END
```


EXHIBIT 6

EXHIBIT 7

INPUT DATA

A Three title cards, first must have an A in column 1

B Specification card

1. NDUR - Number of durations, dimensioned for 8.
2. IYRA - Earliest year of record at any station, dimensional for 100 years (NYRS) and NYRS times NDUR (B-1) dimensioned for 400.
3. ISKEW - Indicator, positive value calls for reading skew coefficients for region.
4. KEEP - Number of stations to keep from the immediately preceding job, dimensioned for 10.
5. ICONV - Indicator, positive value calls for reading factors to convert volumes to average flow rates.
6. IPCHQ - Indicator, positive value calls for punching recorded and reconstituted flows on cards.
7. IPCHS - Indicator, positive value calls for punching statistics on cards.
8. NSTAT - Number of stations for which statistics are to be read in, leave blank if statistics are to be computed, no limit on number.
9. NSMTH - Indicator, blank or positive value causes smoothing of statistics.
10. INCAD - Indicator, positive value calls for adjustment of increment to reduce skew coefficient. DO NOT use routinely as frequency curves will be biased.

C Duration description card

1. AAAB - Title of duration such as "PEAK" or "1-DAY," NDUR(B1) items

D Skew coefficients, omit if ISKEW (B3) is not positive

1. SKW - Regional skew coefficient for each successive duration, NDUR(B1) items

E Stations kept, omit if KEEP(B4) is not positive

1. KEPT - Station number (ISTA) of station in preceeding job, KEEP(B4) items. Should be listed in same order as appearing in previous job.

F Conversion factor, omit if ICONV(B5) is not positive

1. P - Factor by which flows for each successive duration are divided to convert to average rate of flow, NDUR(B1) items

G Data cards, omit if NSTAT(B8) is positive

1. ISTA - Station number, limited to five digits
2. IYR - Year number
3. QM - Flow, NDUR(B1) items, -1 indicates missing record. If record for entire year is missing, omit card for that year.

H Card blank after Col 1 to indicate end of flow data, omit if NSTAT(B8) is positive.

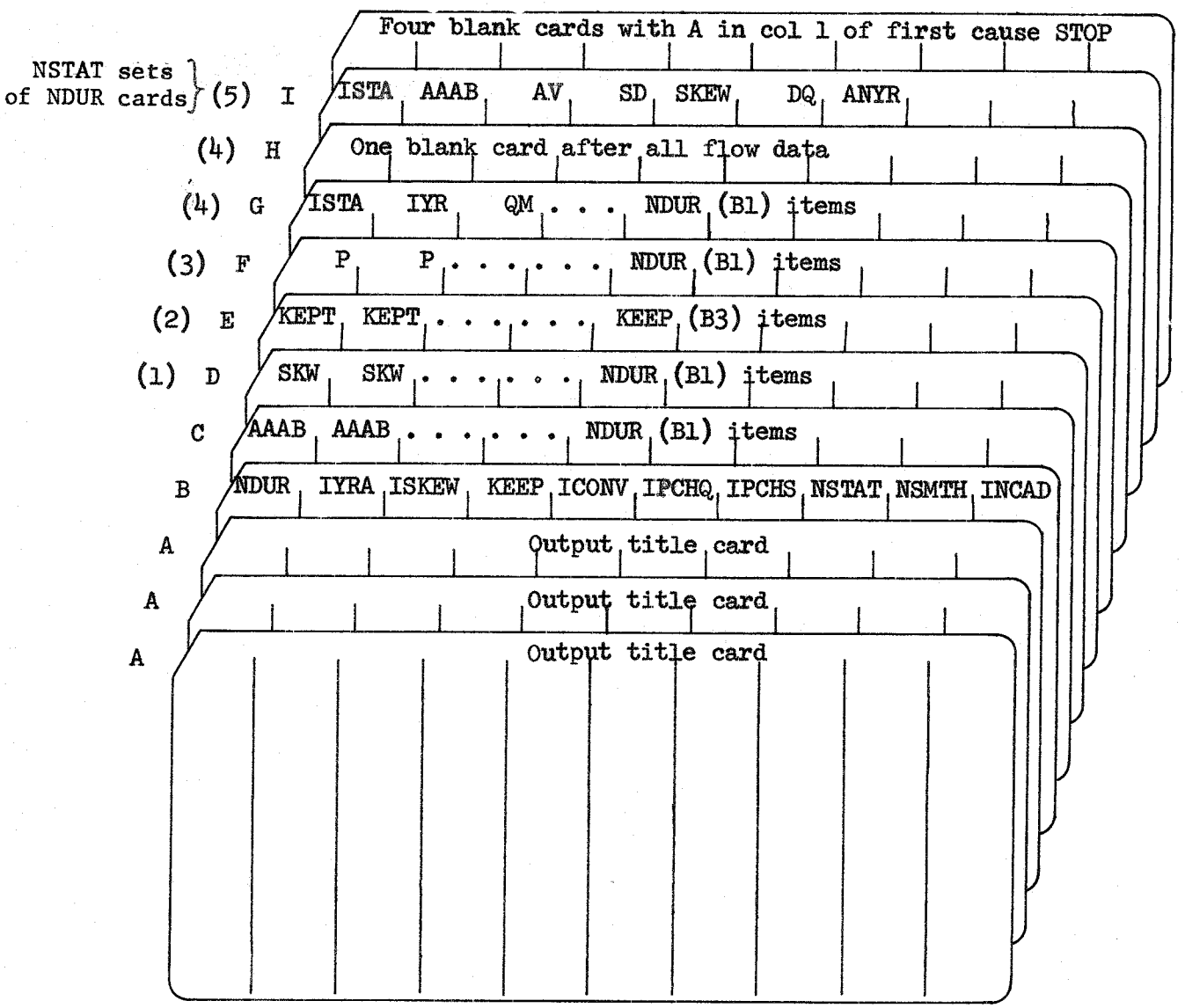
I Input statistics, omit if NSTAT(B8) is not positive. Supply NDUR(B1) cards for each station and data for NSTAT (B8) stations. The order of the durations must be maintained for all stations.

1. ISTA - Station number, limited to five digits.
2. AAAB - Title of duration (see C card.)
3. AV - Mean logarithm for given station and duration
4. SD - Standard deviation of logarithms.
5. SKEW - Skew coefficient of logarithms.
6. DQ - Increment added to flows before statistics were computed.
7. ANYR - Number of years of equivalent record.

Four blank cards with A in Col 1 of the first after the last job will cause a normal stop.

SUMMARY OF REQUIRED CARDS

723-X6-L7350



Notes

(1) Omit if ISKEW (B3) is not positive.
(2) Omit if KEEP (B4) is not positive.
(3) Omit if ICONV (B5) is not positive.
(4) Omit if NSTAT (B8) is positive.
(5) Omit if NSTAT (B8) is not positive.

EXHIBIT 8