UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

DIGITAL-COMPUTER PROGRAMS FOR ANALYSIS OF GROUND-WATER FLOW

By M. S. Bedinger, J. E. Reed,
and J. D. Griffin

Prepared by the U.S. Geological Survey in cooperation with the

Arkansas Geological Commission

Open-File Report
Little Rock, Arkansas
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INTRODUCTION

The purpose of this report is to describe for hydrologic application three digital computer programs—GROUND-WATER FLOW, RIVER-INDUCED FLUCTUATIONS, and EVAPOTRANSPIRATION. The programs apply digital-computer solutions to previously described mathematical and hydrologic techniques. Before using the programs, the reader should be familiar with the background references given under the description of each program.

The GROUND-WATER FLOW program computes the head response in an aquifer to various boundary conditions. The EVAPOTRANSPIRATION program computes the steady-state relation between evapotranspiration and depth to water as a function of thickness and layering of fine-grained material overlying the aquifer. The output from EVAPOTRANSPIRATION is applicable in some problems as boundary criteria in the GROUND-WATER FLOW program. The relation between the EVAPOTRANSPIRATION program and the GROUND-WATER FLOW program is shown in figure 1.

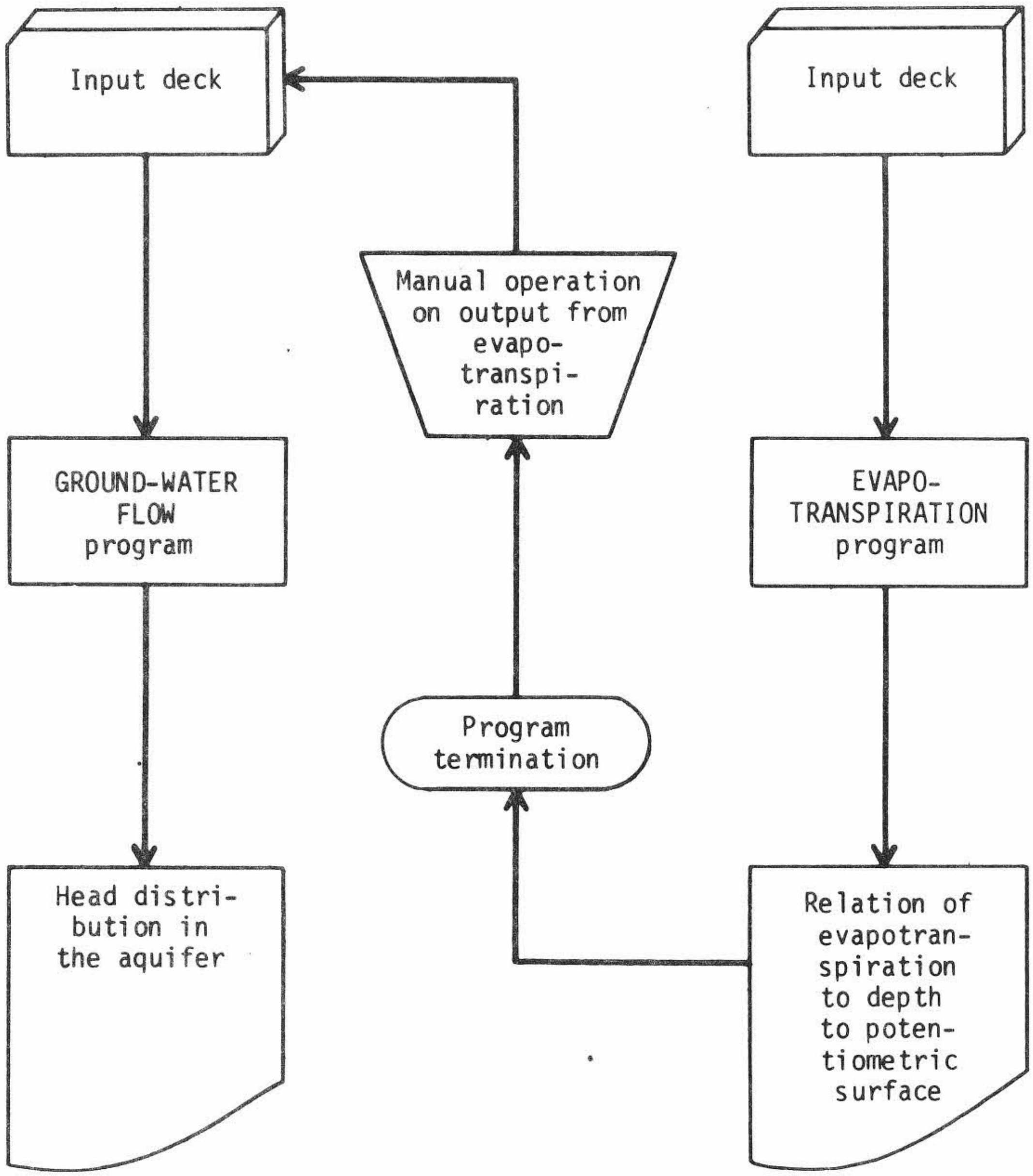

Figure 1.—Flow chart showing relation between EVAPOTRANSPIRATION program and GROUND-WATER FLOW program.

The RIVER-INDUCED FLUCTUATIONS program accepts as input the unit change in stream stage computed by GROUND-WATER FLOW. Using the unit response of the aquifer and a hydrograph of the stream, RIVER-INDUCED FLUCTUATIONS computes the head fluctuations in the aquifer induced by the changes in river stage (fig. 2).

Each program is compatible for use with the dimensional units of feet and days. Any set of consistent units could be used with GROUND-WATER FLOW and EVAPOTRANSPIRATION; however, program output is written to accommodate feet and days. RIVER-INDUCED FLUCTUATIONS is written for use with units of feet and days only.

PROGRAMS

GROUND-WATER FLOW

General Features

The GROUND-WATER FLOW program provides for reading input data on the properties of the aquifer and boundary conditions at intersection points (nodes) in a rectangular matrix. The program computes head response in the aquifer to the specified changes in boundary conditions. A program listing is given in table 4.

The program permits modeling (1) irregular aquifer configurations; (2) nonhomogeneous transmissivity and storage coefficient of the aquifer; (3) areal variations in thickness and hydraulic

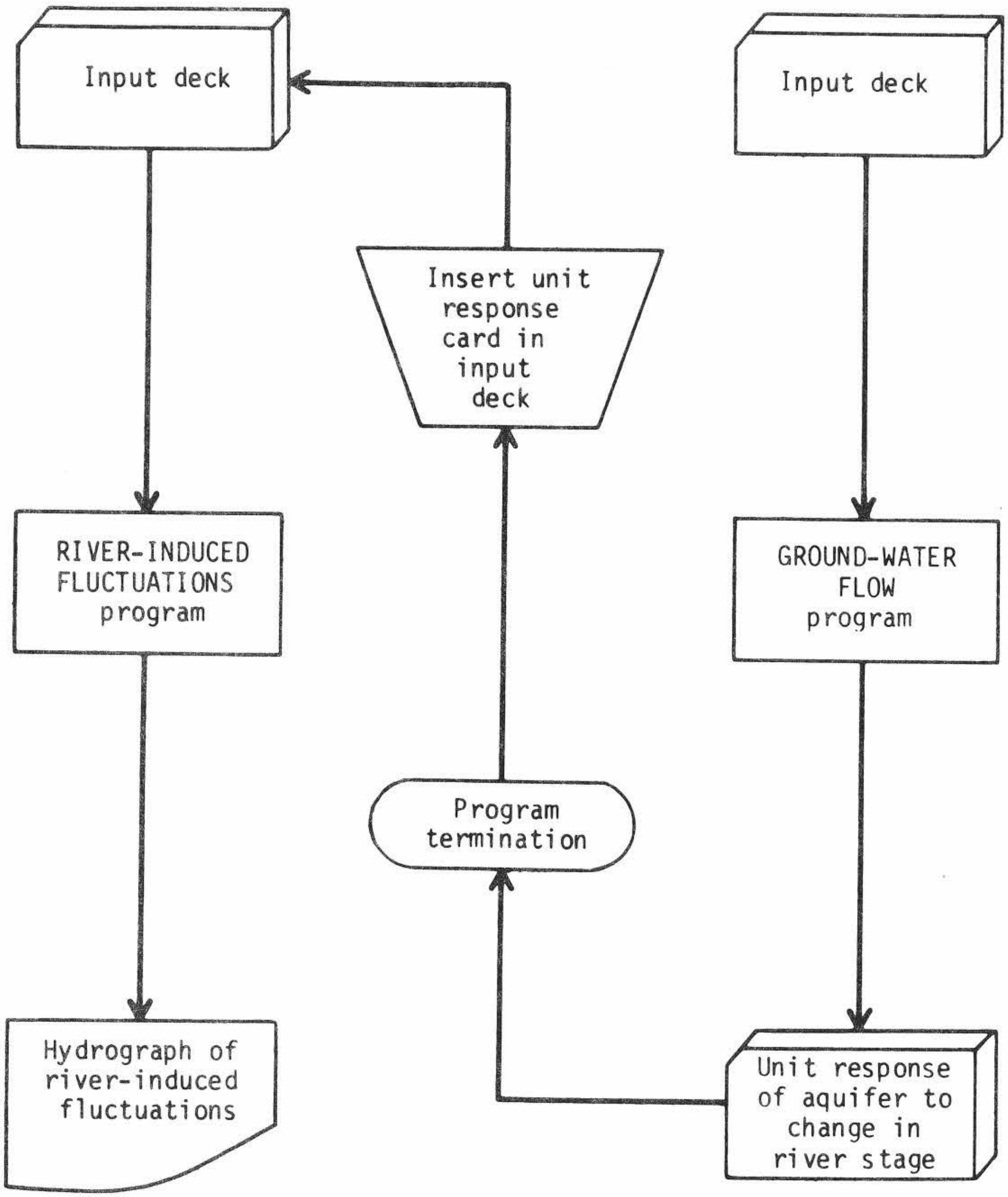

Figure 2.—Flow chart showing relation between RIVER-INDUCED FLUCTUATIONS program and GROUND-WATER FLOW program.

conductivity of confining beds, streambeds, and lakebeds; and (4) various boundary conditions, including bed leakage, accretion, evapotranspiration, discharging or recharging wells, and changes in stream and lake stage.

Accretion to or from the aquifer is modeled as either dependent upon or independent of the head in the aquifer. Change in accretion, as a function of the head in the aquifer, can be used to simulate an increase or decrease in evapotranspiration with change in depth to potentiometric surface. Leakage across confining beds to the aquifer is modeled as a function of the head difference across the confining bed. The effects of streams or lakes having partial hydraulic connection with aquifers are simulated by modeling the variations in permeability and thickness of streambed or lakebed material. Variations in stage of streams or lakes and variations in pumping rates of wells tapping the aquifer are modeled as step changes in head and recharge-discharge rates of wells, respectively.

The finite-difference matrix is a rectangular array of nodes superposed on a plan view of the aquifer. Data on properties of the aquifer and boundaries are specified for each node, the location of which is designated by the intersection of a row and a column in the network. According to the convention adopted for this report, rows are numbered from the top to the bottom; columns are numbered from left to right. The matrix size for

GROUND-WATER FLOW is specified by the user. The matrix is limited to 80 columns by format statements of the program; the number of rows is not limited.

The nodes spacing is designated separately in the x- and y-directions. Node spacing can be increased (or decreased) parallel to each coordinate axis to enlarge (or reduce) the model of the aquifer, depending on the detail desired along each side. Experience has shown that the grid spacing must not be increased more than 1.5 times without incurring noticeable truncation error.

A numerical method, the ADIP (alternating-direction implicit procedure) method, is used in the GROUND-WATER FLOW program for solving the finite-difference approximations of the differential equation for ground-water flow. This method is described in detail by Peaceman and Rachford (1955). Application of the method to the solution of ground-water flow problems has been used also by Pinder and Bredehoeft (1968) and Pinder (1970).

As the name implies, ADIP uses an alternating-direction procedure in solving the finite-difference equations of ground-water flow. The GROUND-WATER FLOW program computes the head change at all nodes in the aquifer at successive specified increments of time. At each time step the equations are solved in the matrix by alternately cycling through the matrix by row and then cycling through the matrix by column. For example, when cycling through the matrix by rows, an equation is set up for each point, incorporating three unknown heads in the direction of the rows and three known heads in the direction of the columns. When cycling through the matrix by columns, the known and unknown heads are interchanged from the previous cycle.

The mass-balance residual affords a measure of the accuracy of the solution of the finite-difference equations. Errors are introduced by (1) representing the continuous time and space fields by discrete elements and (2) inaccuracies in the method of solving the finite-difference equations. The program user can reduce the errors due to discretization of time and space by his selection of computation times, node spacing, transmissivity, and storage coefficient.

The initial time increment should be small; subsequent time increments should become progressively larger. The following computation times have been used with satisfactory results.

.00130	.00200	.00500	.00760	.01080	.01490	.02010	.02650	.03470	.04500
.05800	.07400	.09500	.12100	.15300	.19400	.24600	.31000	.39200	.49500
.62500	.78500	.99500	1.2500	1.5700	1.9800	2.2500	3.1400	4.0000	5.0000
6.2900	7.8900	10.000	12.600	15.800	20.000	25.000	31.500	40.000	50.000
63.000	79.000	100.00	126.00	158.00	200.00	250.00	315.00	400.00	500.00
630.00	790.00	1000.0	1260.0	1580.0	2000.0	2500.0	3150.0	4000.0	5000.0
6300.0	7900.0	10000.	12600.	15800.	20000.	25000.	31500.	40000.	50000.

These times are cumulative times relative to time zero for a given boundary set. The time increments, Δt, for each step are computed within the program from the computation times. Generally, discretization error can be reduced by reducing the magnitude of head change per time increment. This can be effected by reducing the magnitude of the time increments or the node spacing. A similar effect could be achieved by reducing the magnitude of the transmissivity or storage coefficient of the aquifer. But, obviously, transmissivity and storage cannot be changed without altering the representation of the aquifer. However, the manner in which nonuniform transmissivity and storage are mapped can introduce computational error in the program. That is, abrupt changes in transmissivity and storage may introduce error. From experience, it is recommended that the change in transmissivity or storage between adjacent points within the aquifer not exceed 10 percent.

Outputs from GROUND-WATER FLOW are tabulations of head at specified points for each computation time, and tabular and map printouts of head at all points in the array at specified times. The printout for each computer run contains information on the transmissivity and storage coefficient of the aquifer, node spacing, and thickness and hydraulic conductivity of confining beds, streambed, and lakebed materials. An alphameric contour is included for each parameter that varies throughout the aquifer. The mass-balance residual—the cumulative difference between net inflow and the change in storage—is printed with each head printout.

In addition, output can be specified as punch cards in the format for use with the RIVER-INDUCED FLUCTUATIONS program, which is described elsewhere in this report. Samples of output from the GROUND-WATER FLOW program are given in figures 3 and 4.

Preparation of Input Data

An outline of the input-data deck is given below. The outline is keyed to table 1, which contains information for coding input data. The components of the input deck are illustrated in figure 5.

1. PARAMETERS

One card—contains values for each of the following parameters that is uniform: Node spacing in x- and y-directions, number of rows and columns in matrix, transmissivity, and storage coefficient. Each parameter that is modeled as nonuniform is coded blank on this card.

2. NODE LEVEL

A group of cards—forms a matrix indicating the status of each node in the matrix. The following codes are used: 1—inside the aquifer at a point where the head is not specified, 2—inside the aquifer at a point where the head is specified (head specification may consist of stage on a stream or lake that is in full

```
NODE LEVEL MAP OF FLOW SYSTEM

EXPLANATION

1 -- INSIDE FLOW SYSTEM WITH HEAD NOT SPECIFIED
2 -- INSIDE FLOW SYSTEM WITH HEAD SPECIFIED
3 -- OUTSIDE FLOW SYSTEM

          333333333333333333333333333333
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          311111111111111111111111111113
          322222222222222222222222222223
          333333333333333333333333333333

TRANSMISSIVITY --       5000.0

COEFFICIENT OF STORAGE --       0.020000

INITIAL ELEVATION OF POTENTIOMETRIC SURFACE --     0.

NUMBER OF ROWS --     20    NUMBER OF COLUMNS --     30

NODE SPACING --       500.0FEET
```

FIGURE 3, SHEET 1 OF 3.—SAMPLE OUTPUT FROM GROUND-WATER FLOW PROGRAM.

```
NUMBER OF BOUNDARY SETS --  1
BOUNDARY SET       DURATION
     1              100.00



BOUNDARY CONDITIONS FOR SET     1


NUMBER OF WITHDRAWAL RATES --  1


WITHDRAWAL RATE, CUBIC FEET PER DAY --      20000.00
  ROW COL    ROW COL    ROW COL    ROW COL
  10  15


NUMBER OF STREAM STAGES --  1
STREAM STAGE --      0.000000
  ROW COL    ROW COL    ROW COL    ROW COL
  19   2     19   3     19   4     19   5
  19   6     19   7     19   8     19   9
  19  10     19  11     19  12     19  13
  19  14     19  15     19  16     19  17
  19  18     19  19     19  20     19  21
  19  22     19  23     19  24     19  25
  19  26     19  27     19  28     19  29
```

FIGURE 3, SHEET 2 OF 3.—SAMPLE OUTPUT FROM GROUND-WATER FLOW PROGRAM.

```
MAP OF HEAD DISTRIBUTION IN AQUIFER

TIME --        1.00

$ -- FULLY PENETRATING STREAM OR LAKE

= -- PARTIALLY PENETRATING STREAM OR LAKE

* -- PUMPING WELL

CUMULATIVE MASS BALANCE RESIDUAL, PERCENT OF TOTAL FLUX -- -0.108E-01

SYMBOL              HEAD,IN FEET

  A           -1.24-      -1.18
  B           -1.18-      -1.11
  C           -1.11-      -1.05
  D           -1.05-      -0.99
  E           -0.99-      -0.93
  F           -0.93-      -0.87
  G           -0.87-      -0.80
  H           -0.80-      -0.74
  I           -0.74-      -0.68
  J           -0.68-      -0.62
  K           -0.62-      -0.56
  L           -0.56-      -0.50
  M           -0.50-      -0.43
  N           -0.43-      -0.37
  O           -0.37-      -0.31
  P           -0.31-      -0.25
  Q           -0.25-      -0.19
  R           -0.19-      -0.12
  S           -0.12-      -0.06
  T           -0.06-       0.00
  U             0.00


123456789012345678901234567890
2UUUUUUUUUUTTTTTTTUUUUUUUUUUU2
3UUUUUUUUUTTTTTTTTTUUUUUUUUUU3
4UUUUUUUUTTTTTTTTTTTUUUUUUUUU4
5UUUUUUUTTTTTTTTTTTTTUUUUUUUU5
6UUUUUUTTTTTTTTTTTTTTTUUUUUUU6
7UUUUUTTTTTTTTTTTTTTTTTUUUUUU7
8UUUUUTTTTTTTTSTTTTTTTTUUUUUU8
9UUUUTTTTTTTTRORTTTTTTTTUUUUU9
0UUUUTTTTTTTSO*OSTTTTTTTUUUUU0
1UUUUTTTTTTTTRORTTTTTTTTUUUUU1
2UUUUUTTTTTTTTSTTTTTTTTUUUUUU2
3UUUUUTTTTTTTTTTTTTTTTTUUUUUU3
4UUUUUUTTTTTTTTTTTTTTTUUUUUUU4
5UUUUUUUTTTTTTTTTTTTTUUUUUUUU5
6UUUUUUUUTTTTTTTTTTTUUUUUUUUU6
7UUUUUUUUUTTTTTTTTTUUUUUUUUUU7
8UUUUUUUUUUTTTTTTTUUUUUUUUUUU8
9$$$$$$$$$$$$$$$$$$$$$$$$$$$$9
123456789012345678901234567890
```

FIGURE 3, SHEET 3 OF 3.—SAMPLE OUTPUT FROM GROUND—WATER FLOW PROGRAM.

NODE LEVEL MAP OF FLOW SYSTEM

EXPLANATION

```
1 -- INSIDE FLOW SYSTEM WITH HEAD NOT SPECIFIED
2 -- INSIDE FLOW SYSTEM WITH HEAD SPECIFIED
3 -- OUTSIDE FLOW SYSTEM

     333333333333333333333333333333
     333331111112222211111111333333
     333111112221111111111111113333
     331111121111111111111111111133
     311111211111111111111111111133
     311112111111111111111111111133
     311121111111111111111111111133
     311121111111111111111111111133
     311112111111111111111111111133
     331111211111111111111111111133
     331111121111111111111111111133
     333111211111111111111111111133
     333111211111111111111111111133
     331111211111111111111111111333
     311112111111111111111111111333
     311121111111111111111111113333
     312211111111111111111111113333
     321111111111111111111111133333
     321111111111111111111111333333
     333333333333333333333333333333
```

FIGURE 4, SHEET 1 OF 7.—SAMPLE OUTPUT FROM GROUND-WATER FLOW PROGRAM.

```
123456789012345678901234567890
2****BBBBBBCCCCCDDDDDDDD*****2
3**BBBBBBBBBCCCCDDDDDDDDDD***3
4*BBBBBBBBBBCCCCDDDDDDDDDDDD*4
5BBBBAAABBBBBCCCCDDDDDDDDDDD*5
6BBAAAAABBBBBBCCCCDDDDDDDDDD*6
7AAAAAAABBBBBBBCCCDDDDDDDDDD*7
8AAAAAAAABBBBBBBBCCDDDDDDDDD*8
9AAAAAAAAABBBBBBBBCDDDDDDDDD*9
0*AAAAAAAABEEEBBBBCDDDDDDDDD*0
1*AAAAAAAAEAAAEBBBCDDDDDDDDD*1
2**AAAAAAAAAAAAEBBCDDDDDDDDD*2
3**AAAAAAAAAAAEBBCCDDDDDDDDD*3
4*AAAAAAAAAEEEBBBCCDDDDDDDD**4
5AAAAAAAAABBBBBBCCCDDDDDDDD**5
6AAAAAAAABBBBCCCCCCCDDDDDD***6
7AAAAAAABBBBCCCCCCCCDDDDDD***7
8AAAAAABBBBCCCCCCCCCDDDDD****8
9AAAAABBBBCCCCCCCCDDDDDD*****9
023456789012345678901234567890
```

TRANSMISSIVITY MAP OF AQUIFER
EXPLANATION

SYMBOL	TRANSMISSIVITY
4	0.0
5	0.0
6	0.0
7	0.0
8	0.0
9	0.0
0	0.0
*	0.0
A	3500.0
B	3000.0
C	2000.0
D	100.0
E	50.0
1	0.0
2	0.0
3	0.0

FIGURE 4, SHEET 2 OF 7.—SAMPLE OUTPUT FROM GROUND-WATER FLOW PROGRAM.

```
123456789012345678901234567890
2****WWWWWWWWWWWAAAAAAA******2
3**WWWWWWWWWWWWWAAAAAAAAAA***3
4*WWWWWWWWWWWWWWAAAAAAAAAAAA*4
5WWWWWWWWWWWWWWWWAAAAAAAAAAA*5
6WWWWWWWWWWWWWWWWWAAAAAAAAAA*6
7WWWWWWWWWWWWWWWWWAAAAAAAAAA*7
8WWWWWWWWWWWWWWWWWWAAAAAAAAA*8
9WWWWWWWWWWWWWWWWWWAAAAAAAAA*9
0*WWWWWWWWWAAAWWWWWAAAAAAAAA*0
1*WWWWWWWWAWWWAWWWWAAAAAAAAA*1
2*WWWWWWWWWWWWWAWWWAAAAAAAAA*2
3*WWWWWWWWWWWWAWWWWAAAAAAAAA*3
4*WWWWWWWWWAAAWWWWWAAAAAAAA**4
5WWWWWWWWWWWWWWWWWWAAAAAAAA**5
6WWWWWWWWWWWWWWWWWWWAAAAAA***6
7WWWWWWWWWWWWWWWWWWWWAAAAA***7
8WWWWWWWWWWWWWWWWWWWAAAAA****8
9WWWWWWWWWWWWWWWWWAAAAAA*****9
023456789012345678901234567890
```

COEFFICIENT OF STORAGE MAP OF AQUIFER

SYMBOL	COEFFICIENT OF STORAGE
A	0.00200000
W	0.19999990
1	0.00000000
2	0.00000000
3	0.00000000
4	0.00000000
5	0.00000000
6	0.00000000
7	0.00000000
8	0.00000000
9	0.00000000
0	0.00000000
*	0.00000000
	0.00000000

FIGURE 4, SHEET 3 OF 7.—SAMPLE OUTPUT FROM GROUND-WATER FLOW PROGRAM.

```
123456789012345678901234567890
2****                   *****2
3**                       ***3
4*                          *4
5                           *5
6                           *6
7                           *7
8                           *8
9                           *9
0*         GGG              *0
1*        G   G             *1
2**            G            *2
3**           F             *3
4*         FFF             **4
5                          **5
6                          **6
7                         ***7
8                        ****8
9                       *****9
023456789012345678901234567890
```

MAP OF CONDUCTIVITY OF STREAM AND LAKE BED MATERIAL

SYMBOL	HYDRAULIC CONDUCTIVITY
F	0.010000
G	0.001000
H	0.000000
1	0.000000
2	0.000000
3	0.000000
4	0.000000
5	0.000000
6	0.000000
7	0.000000
8	0.000000
9	0.000000
0	0.000000
*	0.000000
*	0.000000
	0.000000

FIGURE 4, SHEET 4 OF 7.—SAMPLE OUTPUT FROM GROUND-WATER FLOW PROGRAM.

```
123456789012345678901234567890
2****                   *****2
3**                       ***3
4*                          *4
5                           *5
6                           *6
7                           *7
8                           *8
9                           *9
0*         IJJ              *0
1*        I   K             *1
2**            L            *2
3**           K             *3
4*         JJK             **4
5                          **5
6                         ***6
7                         ***7
8                        ****8
9                       *****9
023456789012345678901234567890
```

MAP OF THICKNESS OF STREAM AND LAKE BED MATERIAL

SYMBOL	THICKNESS
I	10.
J	15.
K	20.
L	25.
1	0.
2	0.
3	0.
4	0.
5	0.
6	0.
7	0.
8	0.
9	0.
0	0.
*	0.
	0.

FIGURE 4, SHEET 5 OF 7.—SAMPLE OUTPUT FROM GROUND—WATER FLOW PROGRAM.

```
123456789012345678901234567890
2****           NNNNPPPP*****2
3**           MNNNNNPPPPPP***3
4*           MMNNNNNPPPPPPPP*4
5            MMMNNNNNPPPPPPP*5
6           MMMMMNNNNPPPPPPP*6
7           MMMMMNNNNPPPPPPP*7
8          MMMMMMMNNNPPPPPPP*8
9         MMMMMMMMNNNPPPPPPP*9
0*        M   MMMMNNNPPPPPPP*0
1*       M     MMMNNNPPPPPPP*1
2**             MMNNNPPPPPPP*2
3**            MMMNNNPPPPPPP*3
4*        M   MMMMNNNPPPPPP**4
5         MMMMMMMMNNNPPPPPP**5
6         MMMMMMMMNNNNPPPP***6
7        MMMMMMMMMNNNNNPPP***7
8       MMMMMMMMMMNNNNNPP****8
9      MMMMMMMMMMMMNNNNN*****9
023456789012345678901234567890
```

MAP OF VERTICAL CONDUCTIVITY OF AQUITARD

SYMBOL	HYDRAULIC CONDUCTIVITY
M	0.010000
N	0.001000
P	0.001000
1	0.000000
2	0.000000
3	0.000000
4	0.000000
5	0.000000
6	0.000000
7	0.000000
8	0.000000
9	0.000000
0	0.000000
*	0.000000
	0.000000

FIGURE 4, SHEET 6 OF 7.--SAMPLE OUTPUT FROM GROUND-WATER FLOW PROGRAM.

```
123456789012345678901234567890
2****           RSTTTTTT*****2
3**           RRSTTTTTTTTT***3
4*           RRRSTTTTTTTTTTT*4
5            RRRSTTTTTTTTTTT*5
6           RRRRSTTTTTTTTTTT*6
7           RRSSTTTTTTTTTTTT*7
8          RRRRSSTTTTTTTTTTT*8
9         RRRRRRSSTTTTTTTTTT*9
0*        R   RRSSSSTTTTTTTT*0
1*       R     RRSSSSTTTTTTT*1
2**             RRSSSTTTTTTT*2
3**            RRRSSSTTTTTTT*3
4*        R   RRRSSSSSTTTTT**4
5         RRRRRRSSSSSSTTTTT**5
6         RRRRRSSSSSSTTTTTT**6
7        RRRRRRRSSSSSSSTTT***7
8       RRRRRRRRRSSSSSSST****8
9      RRRRRRRRRRSSSSSS******9
023456789012345678901234567890
```

MAP OF THICKNESS OF AQUITARD

SYMBOL	THICKNESS
R	10.
S	20.
T	30.
1	0.
2	0.
3	0.
4	0.
5	0.
6	0.
7	0.
8	0.
9	0.
0	0.
*	0.
	0.

INITIAL ELEVATION OF POTENTIOMETRIC SURFACE -- 0.

NUMBER OF ROWS -- 20 NUMBER OF COLUMNS -- 30

NODE SPACING -- 1000.0FEET

IN THE AREA TO THE LEFT OF COLUMN 1 AND TO THE RIGHT OF 25 THE NODE SPACING IS 5000.0 FEET

IN THE AREA ABOVE ROW 1 AND BELOW ROW 20 THE NODE SPACING IS 1000.0 FEET

FIGURE 4. SHEET 7 OF 7.—SAMPLE OUTPUT FROM GROUND-WATER FLOW PROGRAM.

Table 1.—*Input data for GROUND-WATER FLOW program*

Outline reference	Number of cards	Columns	Format	Program variable	Input item	Remarks
1. Parameters	1 card	1-10	F10.1	XM	Node spacing (ft) in X-direction.	Code only those parameters that are uniform.
		11-20	F10.1	YM	Node spacing (ft) in Y-direction.	
		24-25	I2	M	Number of rows.	
		28-30	I3	N	Number of columns.	
		31-40	F10.1	TM	Transmissivity (ft^2/day).	
		41-50	F10.1	SM	Storage coefficient (dimensionless).	
2. Node level	M cards	1-N	NI1	IV(M,N)	Node level indicating the condition of each node in the network: IV=1, point in aquifer, head not specified. IV=2, point in aquifer, head specified. IV=3, point outside aquifer.	First and last rows and first and last columns must be coded 3.
3. Nonuniform node spacing	1 card	1-2	I2	IXMIN	Column number.	Omit if X and Y are uniform.
		3-4	I2	IXMAX	Column number.	
		5-14	F10.1	XINF	Node spacing from column 1 to IXMIN and column IXMAX to N.	
		15-24	F10.1	X	Node spacing (ft) from column IXMIN to IXMAX.	
		25-27	I3	IYMIN	Row number.	
		28-30	I3	IYMAX	Row number.	
		31-40	F10.1	YINF	Node spacing (ft) from row 1 to IYMIN and row IYMAX to M.	
		41-50	F10.1	Y	Node spacing (ft) from row IYMIN to IYMAX.	
4. Optional parameters	1 card	1	I1	IPS	Data-level indicators for PS (hydraulic conductivity of streambed material) and SAM (thickness of streambed material), respectively: 1=Parameter uniform. 2=Parameter varies. 3=Parameter not modeled.	
		2	I1	ISAM		
		3	I1	IPZ	Data-level indicators for PZM and AMM, respectively: 1=Parameter uniform. 2=Parameter varies. 3=Parameter not modeled.	
		4	I1	IAM		
		5-12	E8.1	PSM	Hydraulic conductivity (ft/day) of streambed material.	Code value of parameters that are uniform (coded 1 in columns 1 thru 4.
		13-20	E8.1	SAMM	Thickness (ft) of streambed material.	
		21-28	E8.1	PZM	Hydraulic conductivity (ft/day) of aquitard normal to plane of aquifer.	
		29-36	E8.1	AMM	Thickness (ft) of aquitard.	

Table 1.—*Input data for GROUND-WATER FLOW program*--Continued

Outline reference		Number of cards	Columns	Format	Program variable	Input item	Remarks
5. Nonhomogeneous parameters	5.1 through 5.6	1 card	1-2	I2	NS	Number of symbols used.	This sequence of cards is repeated for each parameter modeled as nonhomogeneous. The first card in each sequence specifies the number of symbols used, following are 1-8 cards, as needed, indicating the alphameric representation of the mapped parameter values, following these are M cards (1 card for each row), each containing N alphameric symbols (1 symbol for each column). Sets used are stacked in the following order: 1. Transmissivity (ft^2/day). 2. Storage (dimensionless). 3. Conductivity (ft/day) of streambed. 4. Thickness (ft) of streambed. 5. Conductivity (ft/day) of confining bed. 6. Thickness (ft) of confining bed.
		1 to 8 cards	1	A1	AT(AIT,1)	Alphameric symbol, AT(AIT,1), and corresponding parameter value, AT(AIT,2).	
			2-9	E8.1	AT(AIT,2)		
			10	A1	AT(AIT,1)		
			11-18	E8.1	AT(AIT,2)		
			19	A1	AT(AIT,1)		
			20-27	E8.1	AT(AIT,2)		
			28	A1	AT(AIT,1)		
			29-36	E8.1	AT(AIT,2)		
			37	A1	AT(AIT,1)		
			38-45	E8.1	AT(AIT,2)		
			46	A1	AT(AIT,1)		
			47-54	E8.1	AT(AIT,2)		
			55	A1	AT(AIT,1)		
			56-63	E8.1	AT(AIT,2)		
			64	A1	AT(AIT,1)		
			65-72	E8.1	AT(AIT,2)		
		M cards	1-N	NI1	CARD (KIX), KIX=1,N	CARD is the symbol representing the value of a nonhomogeneous parameter.	
6. OBSERVATION NODES		1 card	1-4	2I2	IF(I),JF(I)	Row and column, respectively, of point for which head will be printed and (or) punched for each computation time.	This card is coded blank if printout or punchout is not required. The punch cards contain the head and time. These cards are input for the RIVER-INDUCED FLUCTUATIONS program.
			5-8	2I2	IF(I),JF(I)		
			9-12	2I2	IF(I),JF(I)		
			13-16	2I2	IF(I),JF(I)		
			17-20	2I2	IF(I),JF(I)		
			21-24	2I2	IF(I),JF(I)		
			25-28	2I2	IF(I),JF(I)		
			29-32	2I2	IF(I),JF(I)		
			33-36	2I2	IF(I),JF(I)		
			37-40	2I2	IF(I),JF(I)		
			41-44	2I2	IF(I),JF(I)		
			45-48	2I2	IF(I),JF(I)		
			49-52	2I2	IF(I),JF(I)		
			53-56	2I2	IF(I),JF(I)		
			57-60	2I2	IF(I),JF(I)		
			61-64	2I2	IF(I),JF(I)		
			65-68	2I2	IF(I),JF(I)		
			69-72	2I2	IF(I),JF(I)		
			73-76	2I2	IF(I),JF(I)		
			77-80	2I2	IF(I),JF(I)		

Table 1.—*Input data for GROUND-WATER FLOW program*—Continued

Outline reference	Number of cards	Columns	Format	Program variable	Input item	Remarks
7. COMPUTATION TIMES	7 cards	1-8	E8.3	TTIME(K)	Times (days) for which head computations are made.	
		9-16	E8.3	TTIME(K)		
		17-24	E8.3	TTIME(K)		
		25-32	E8.3	TTIME(K)		
		33-40	E8.3	TTIME(K)		
		41-48	E8.3	TTIME(K)		
		49-56	E8.3	TTIME(K)		
		57-64	E8.3	TTIME(K)		
		65-72	E8.3	TTIME(K)		
		73-80	E8.3	TTIME(K)		
	1 card	1-8	E8.3	CTIME(KC)	Times (days) for which all head values in the network will be printed.	
		9-16	E8.3	CTIME(KC)		
		17-24	E8.3	CTIME(KC)		
		25-32	E8.3	CTIME(KC)		
		33-40	E8.3	CTIME(KC)		
		41-48	E8.3	CTIME(KC)		
		49-56	E8.3	CTIME(KC)		
		57-64	E8.3	CTIME(KC)		
		65-72	E8.3	CTIME(KC)		
		73-80	E8.3	CTIME(KC)		
8. OUTPUT CODES	1 card	1	I1	IPCO(1)	Code for printout of head at designated nodes for each computation time.	Code as 1 to obtain the indicated output.
		2	I1	IPCO(2)	Code for punching head for RIVER-INDUCED FLUCTUATIONS program.	
		3	I1	IPCO(3)	Code for printout of map in symbolic form of head distribution at each time specified.	Times for tabular or map printout of head is specified in card 8 of COMPUTATION TIMES.
		4	I1	IPCO(4)	Code for table printout of heads for each time specified.	
		5	I1	IPCO(5)	Code for printout of base flow to fully penetrating streams.	
9. BOUNDARY CONDITIONS 9.1	1 card	1-3	I3	NQSET	Number of boundary condition steps, can be from 1 to 12.	
9.2	1 card	1-6	F6.1	QPER(1)	Duration (days) of each boundary step.	
		7-12	F6.1	QPER(2)		
		13-18	F6.1	QPER(3)		
		19-24	F6.1	QPER(4)		
		25-30	F6.1	QPER(5)		
		31-36	F6.1	QPER(6)		
		37-42	F6.1	QPER(7)		
		43-48	F6.1	QPER(8)		
		49-54	F6.1	QPER(9)		
		55-60	F6.1	QPER(10)		
		61-66	F6.1	QPER(11)		
		67-72	F6.1	QPER(12)		

Table 1.—*Input data for GROUND-WATER FLOW program*--Continued

Outline reference			Number of cards	Columns	Format	Program variable	Input item	Remarks	
9. BOUNDARY CONDITIONS—Con.	9.3	9.3.1	1 card	1	I1	IAC	Codes for model treatment of accretion (IAC) and evapotranspiration (IET): 1=Parameter uniform. 2=Parameter varies. 3=Parameter not modeled.		These cards are repeated for each boundary set.
				2	I1	IET			
				3-10	E8.1	ACCON	Accretion (ft/day). Code ACCON positive for recharge; negative for discharge.	Code values of parameters that are uniform throughout the aquifer.	
				11-18	E8.1	ETCON	Evapotranspiration (ft/day/ft). Code ETCON positive. Evapotranspiration must be computed with reference to an initial head elevation of zero.		
		9.3.2	1 card	1-2	I2	NS	Number of symbols used.	This sequence of cards is used for ACCON and ETCON if modeled as nonhomogeneous. The first card in each sequence specifies the mumber of symbols used, following are 1-8 cards, as needed, indicating the alphameric characters representing mapped-parameter values. Following are M cards (one card for each row), each containing N alphameric symbols (one symbol for each column).	
		9.3.3	8 cards	1	A1	AT(AIT,1)	Alphameric symbol, AT(AIT,1), and corresponding parameter value AT(AIT,2).		
				2-9	E8.1	AT(AIT,2)			
				10	A1	AT(AIT,1)			
				11-18	E8.1	AT(AIT,2)			
				19	A1	AT(AIT,1)			
				20-27	E8.1	AT(AIT,2)			
				28	A1	AT(AIT,1)			
				29-36	E8.1	AT(AIT,2)			
				37	A1	AT(AIT,1)			
				38-45	E8.1	AT(AIT,2)			
				46	A1	AT(AIT,1)			
				47-54	E8.1	AT(AIT,2)			
				55	A1	AT(AIT,1)			
				56-63	E8.1	AT(AIT,2)			
				64	A1	AT(AIT,1)			
				65-72	E8.1	AT(AIT,2)			
		9.3.4	M cards	1-N	NI1	CARD (KIX), KIX=1,N	CARD is the symbol representing the value of a nonhomogeneous parameter, i.e., ACCON or ETCON.		
	9.4	9.4.1	1 card	1-3	I3	NQ	Number of withdrawal rates.	Use blank card if no withdrawal.	
		9.4.2	1 card	1-10	E10.3	QU	Withdrawal (ft³/day). Code rate positive for discharge; negative for recharge.	These cards are repeated for each withdrawal rate. Omit if no withdrawal.	
			1 card	1-2	I2	IQUN	Number of withdrawal nodes.		
			Number of cards determined by QUN	1-4	2I2	IJQ(I,1), IJQ(I,2)	Row IJQ(I,1) and column IJQ(I,2) for which withdrawal rate applies.		
				5-8	2I2	IJQ(I,1), IJQ(I,2)			
				9-12	2I2	IJQ(I,1), IJQ(I,2)			
				13-16	2I2	IJQ(I,1), IJQ(I,2)			
				17-20	2I2	IJQ(I,1), IJQ(I,2)			
				21-24	2I2	IJQ(I,1), IJQ(I,2)			
				25-28	2I2	IJQ(I,1), IJQ(I,2)			
				29-32	2I2	IJQ(I,1), IJQ(I,2)			

Table 1.—*Input data for GROUND-WATER FLOW program*--Continued

Outline reference			Number of cards	Columns	Format	Program variable	Input item	Remarks
9. BOUNDARY CONDITIONS--Con.	9.4--Con.	9.4.2 Con.		33-36	2I2	IJQ(I,1), IJQ(I,2)		
				37-40	2I2	IJQ(I,1), IJQ(I,2)		
				41-44	2I2	IJQ(I,1), IJS(I,2)		
				45-48	2I2	IJQ(I,1), IJQ(I,2)		
				49-52	2I2	IJQ(I,1), IJS(I,2)		
				53-56	2I2	IJQ(I,1), IJQ(I,2)		
				57-60	2I2	IJQ(I,1), IJQ(I,2)		
				61-64	2I2	IJQ(I,1), IJQ(I,2)		
				65-68	2I2	IJQ(I,1), IJQ(I,2)		
				69-72	2I2	IJQ(I,1), IJQ(I,2)		
				73-76	2I2	IJQ(I,1), IJQ(I,2)		
				77-80	2I2	IJQ(I,1), IJQ(I,2)		
	9.5	9.5.1	1 card	1-3	I3	NSTGE	Number of river-stage values.	Use blank card if no stage used.
		9.5.2	1 card	1-5	F5.0	XSTAGE	River stage (ft).	
			1 card	1-2	I2	IXSTN	Number of stage nodes.	These cards are repeated for each river stage. Omit if no stage used.
			Number of cards determined by XSTN.	1-4	2I2	IJS(I,1), IJS(I,2)	Row, IJS(I,1), and column, IJS(I,2), for which river stage applies.	
				5-8	2I2	IJS(I,1), IJS(I,2)		
				9-12	2I2	IJS(I,1), IJS(I,2)		
				13-16	2I2	IJS(I,1), IJS(I,2)		
				17-20	2I2	IJS(I,1), IJS(I,2)		
				21-24	2I2	IJS(I,1), IJS(I,2)		
				25-28	2I2	IJS(I,1), IJS(I,2)		
				29-32	2I2	IJS(I,1), IJS(I,2)		
				33-36	2I2	IJS(I,1), IJS(I,2)		
				37-40	2I2	IJS(I,1), IJS(I,2)		
				41-44	2I2	IJS(I,1), IJS(I,2)		
				45-48	2I2	IJS(I,1), IJS(I,2)		
				49-52	2I2	IJS(I,1), IJS(I,2)		
				53-56	2I2	IJS(I,1), IJS(I,2)		
				57-60	2I2	IJS(I,1), IJS(I,2)		
				61-64	2I2	IJS(I,1), IJS(I,2)		
				65-68	2I2	IJS(I,1), IJS(I,2)		
				69-72	2I2	IJS(I,1), IJS(I,2)		
				73-76	2I2	IJS(I,1), IJS(I,2)		
				77-80	2I2	IJS(I,1), IJS(I,2)		

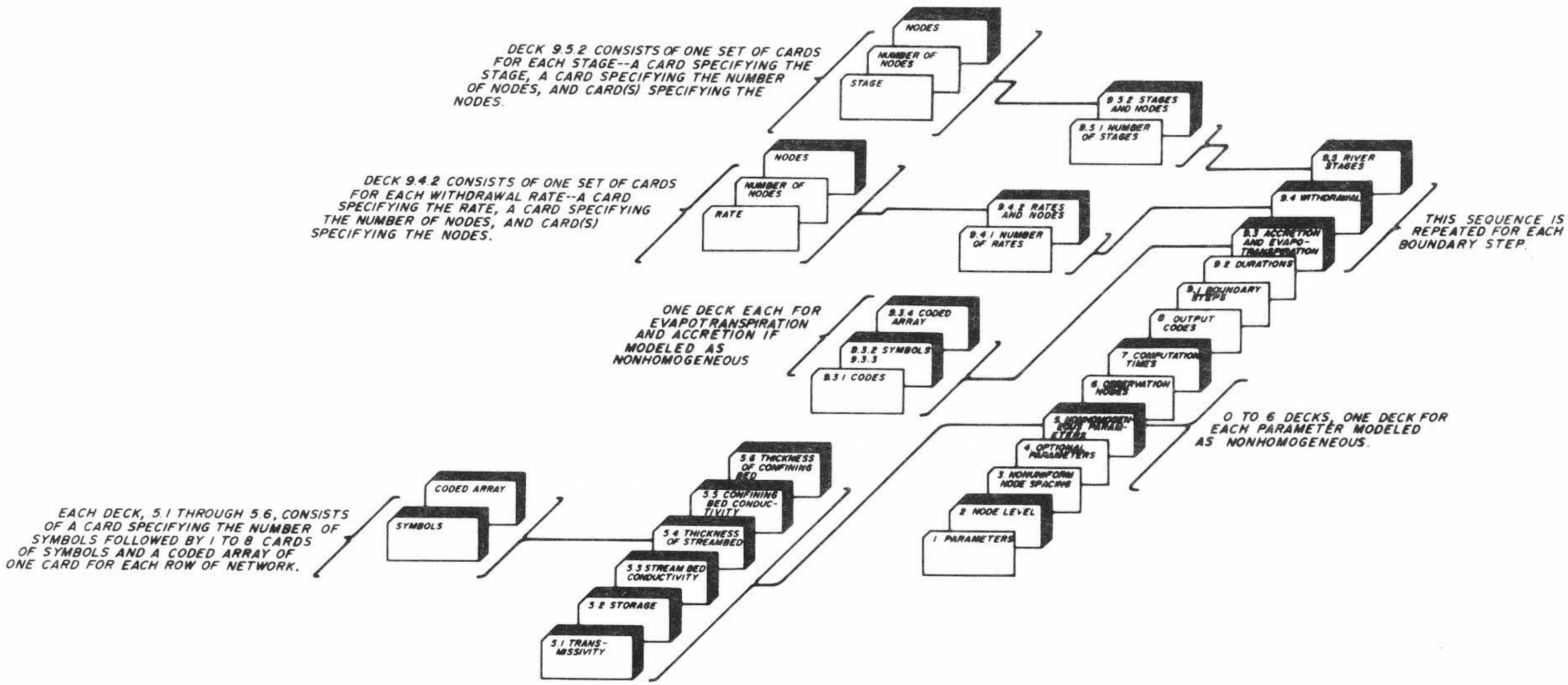

Figure 5.--Input-data deck for GROUND-WATER FLOW program.

connection with the aquifer), and 3—outside the aquifer. Each row in the matrix is coded on one card, using one column for each node in the row. Node level is coded in consecutive columns, beginning in the first column. All nodes on the perimeter of the matrix are coded 3. A printout of the node-level array is included in each problem output (figs. 3 and 4).

3. NONUNIFORM NODE SPACING

One card—card is omitted if the node spacing in both the x- and y-directions is uniform. If the node spacing varies in either the x- or y-direction, this card contains the data on node spacings in the aquifer. The format for coding these values is shown in table 1.

4. OPTIONAL PARAMETERS

One card—contains indices for hydraulic conductivities and thicknesses of the aquitard and the streambed and lakebed materials. The modeling of these parameters is optional. The indices indicate whether or not each parameter is modeled, and if so, whether the parameter is uniform or nonuniform throughout its occurrence. The values of these parameters, if modeled and if uniform throughout the aquifer, are coded on the same card with the indices.

5. NONHOMOGENEOUS PARAMETERS

This part of the deck consists of from zero to six sequences of cards—one sequence of cards for each parameter modeled as nonhomogeneous. The parameters coded here are transmissivity (symbols), storage coefficient, hydraulic conductivity and thickness of streambed and lakebed material, and hydraulic conductivity and thickness of confining beds. The first card in each sequence specifies the number of symbols used, following are one to eight cards containing the set of mapped values of the parameter and a corresponding set of single alphameric symbols by which the values are mapped. As many as 64 alphameric symbols are chosen from the 64 characters available in the IBM 360-65 system. The symbols in each row in the array are coded on a card, using one card for each row in arrays containing as many as 80 nodes. A map of each nonhomogeneous parameter is included in each problem output.

6. OBSERVATION NODES

One card—designates zero to 20 nodes at which head will be printed and (or) punched for each computation time. The punched cards provide input for the RIVER-INDUCED FLUCTUATIONS program. This card can be left blank if such printout is not wanted.

7. COMPUTATION TIMES

Eight cards. Cards one through seven contain computation times. Card eight contains times at which all head values in the aquifer will be printed. The times specified on the eighth card may be the same as, or different from, the computation times specified in the first seven cards.

8. OUTPUT CODES

One card—containing codes specifying program output.

9. BOUNDARY CONDITIONS

This part of the input deck specifies the boundary conditions by a sequence of cards for each of one or more step changes in boundary conditions. Boundary conditions that can be changed as step functions are the rate and distribution of pumping, stage on lakes and streams, change in evapotranspiration with change in head, and accretion to the aquifer. Modeling of each of these boundary conditions is optional.

9.1 One card—indicates the number of step changes in boundary conditions.

9.2 One card—specifies the duration of each boundary step.

9.3 Accretion and evapotranspiration.

9.3.1 One card—specifies by an index whether each parameter is modeled; if the parameter is modeled this card specifies by an index whether the parameters are uniform or nonuniform. If the parameter is uniform, the value of the parameter is coded on this card.

9.3.2 One card—specifies number of symbols used.

9.3.3 Eight cards—specifies each parameter value mapped by a single alphameric character. The first eight cards consist of the mapped values of the parameters and the corresponding alphameric character. Omit if parameters are uniform or are not modeled.

9.3.4 A set of cards—One card for each row containing alphameric symbols representing the parameter values at each node. Omit if parameters are uniform or are not modeled.

9.4 Ground-water withdrawal

9.4.1 One card—containing the number of withdrawal rates in the step.

9.4.2 One set of cards is prepared for each withdrawal rate. If there is no withdrawal, these cards are omitted. The first card of each set specifies the rate; the second card specifies the number of withdrawal nodes; the following cards specify locations for the withdrawal rate. The number of location cards is determined by the number of withdrawal nodes.

9.5 River and lake stages

9.5.1 One card—containing the number of distinct stream and lake stages in the step.

9.5.2 One set of cards is prepared for each stage value. If there are no specified stages, these cards are omitted. The first card specifies the stage; the second contains the number of nodes at which the stage is specified; the following cards specify the locations for the stage. The number of cards is determined by the number of stage nodes.

RIVER-INDUCED FLUCTUATIONS

General Features

The RIVER-INDUCED FLUCTUATIONS program computes the river-induced changes in ground-water head in response to changes in river stage. The method of computation is based on a paper by Bedinger and Reed (1964). The program computes changes in ground-water level from daily river-stage readings. The change in head in the aquifer for each day is computed as the net response of the aquifer to all antecedent changes in river stage. The unit response of the aquifer is the change in head with time at a given point in the aquifer induced by a 1-foot change in stage along the stream boundary. The unit response is entered into the program as described under item 12 of Preparation of Input Data.
The unit response can be computed by the previous program, GROUND-WATER FLOW (fig. 2), or can be compiled from tables of the drain function compiled by Stallman (Ferris, Knowles, Brown, and Stallman, 1962), or from tables of the complementary-error function (U.S. Dept. of Commerce, 1954). GROUND-WATER FLOW provides the unit response of the unique aquifer modeled by GROUND-WATER FLOW. The drain function provides the response of a semi-infinite homogeneous aquifer bounded by a straight stream.

Five time scales are available for the printout, ranging from daily (1 day per line) to monthly (1 month per line). The printout includes the computed ground-water fluctuation, the observed ground-water levels, and the river-stage hydrograph. According to conventional coding procedure, the datum of observed water levels will be land surface; the datum of the river-stage hydrograph will be the zero of the stage. However, these datums can be shifted by any specified amount to accommodate both hydrographs on the same vertical scale. The datum for the computed ground-water hydrograph is indefinite; only relative changes are significant. The program computes changes in ground-water level and adjusts the values so that the average of computed water levels coincides with the average of the observed water levels.

A listing of this program is given in table 5. Samples of output from the RIVER-INDUCED FLUCTUATIONS program are given in figure 6.

Preparation of Input Data

An outline of the input-data deck for RIVER-INDUCED FLUCTUATIONS is given below. The outline is keyed to table 2, which contains information for coding the input data. The input-data deck is shown diagrammatically in figure 7.

WELL R 732 12-12 T=5000. S=.2

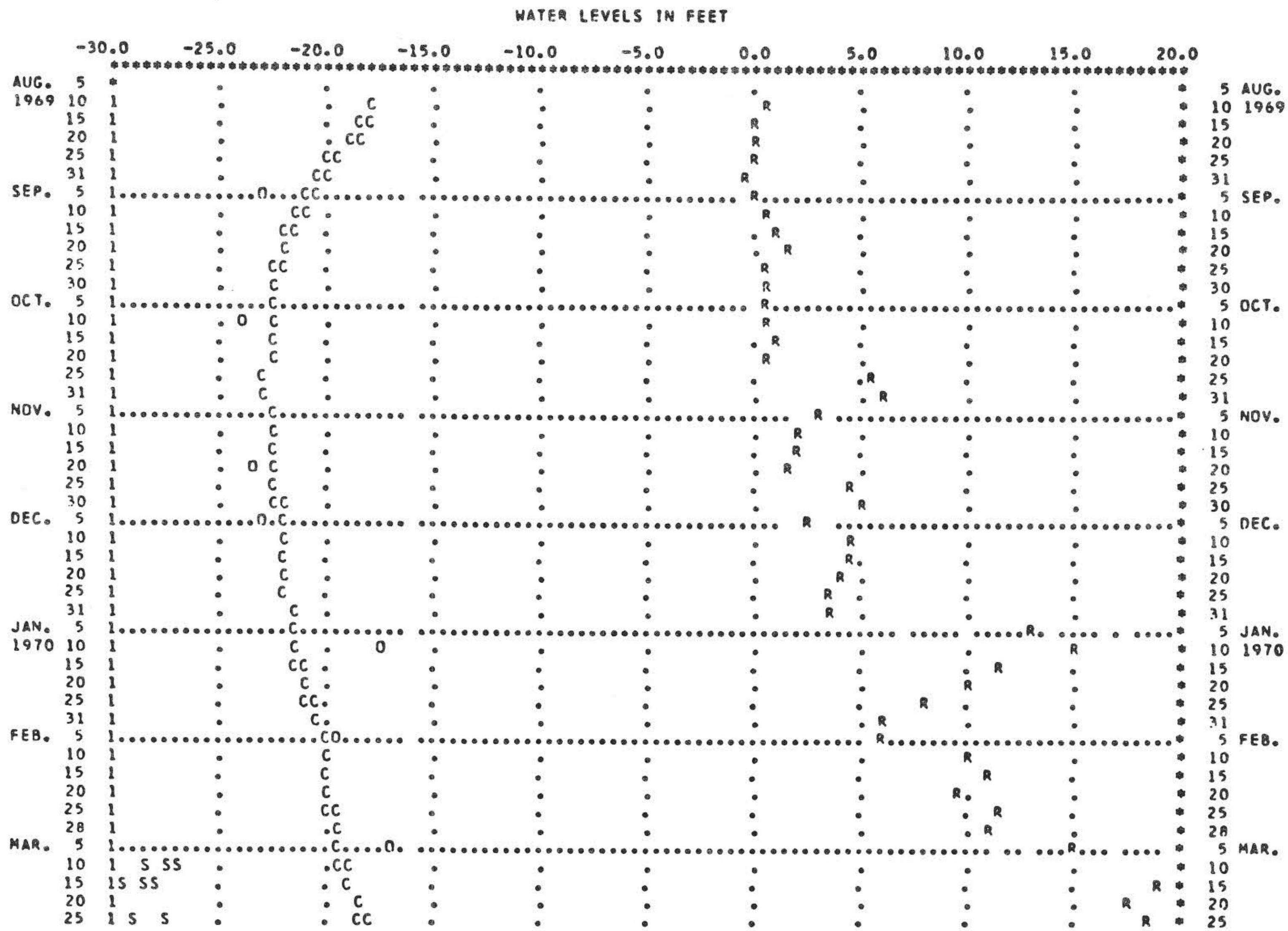

Figure 6, sheet 1 of 3.—Sample output from RIVER-INDUCED FLUCTUATIONS program.

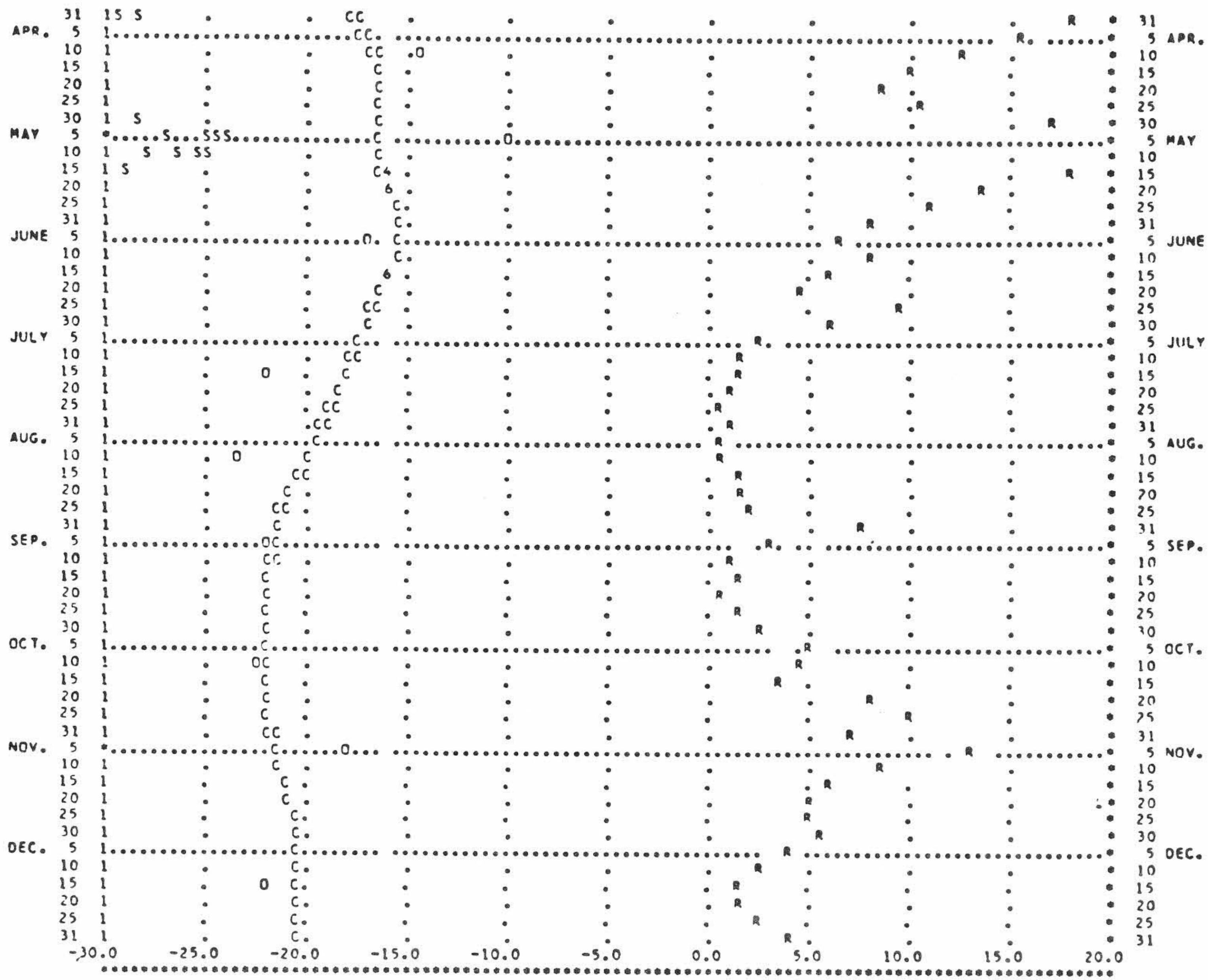

Figure 6, sheet 2 of 3.—Sample output from RIVER-INDUCED FLUCTUATIONS program.

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EXPLANATION OF SYMBOLS

    R = RIVER LEVEL HYDROGRAPH, 0.0 POINT EQUALS      0.0 FEET ABOVE ZERO OF GAGE.
    C = CALCULATED HYDROGRAPH
    O = OBSERVED WATER LEVEL IN WELL, 0.0 POINT EQUALS      0.0 FEET BELOW LAND SURFACE.

         A NUMBER INDICATES THE NUMBER OF SYMBOLS THAT FALL AT A POINT.
         POINTS PLOTTED OFF SCALE ARE INDICATED BY THE NEXT LETTER IN ALPABETIC ORDER.
```

Figure 6, sheet 3 of 3.—Sample output from RIVER-INDUCED FLUCTUATIONS program.

Table 2.—*Input data for RIVER-INDUCED FLUCTUATIONS program*

Outline reference	Number of cards	Columns	Format	Program variable	Input item	Remarks
1. DATES	1 card	1-5 6-10	I5 I5	IMON(1) NYR(1)	Beginning month and year, respectively, of hydrograph.	
		11-15 16-20	I5 I5	IMON(2) NYR(2)	Ending month and year, respectively, of hydrograph.	
2. DATUMS	1 card	1-10	F10.1	RIVDAT	Datum for river hydrograph relative to zero of gage.	
		11-20	F10.1	OBSDAT	Datum for ground-water hydrograph relative to land surface.	
3. NUMBER OF RIVER STAGES	1 card	1-5	I5	ICNT	Number of daily river stages to be read.	
4. RIVER-STAGE DATA	3 cards for each month	1	I1	(1)	Card type. If applicable, punch "6" in column 1 for all cards for compatibility with other WRD programs.	
		2-9	I8	(1)	Station number.	
		10-11	I2	IYR	Last two digits of calendar year.	
		12-13	I2	IMOND	Number of the calendar month.	
		14	I1	(1)	Card number; a number, 1 to 3, indicating for which set of days the entries in columns 15-80 apply.	
		15-20 21-26 27-32 33-38 39-44 45-50 51-56 57-62 63-68 69-74 75-80	F6.2 F6-2 F6-2 F6-2 F6-2 F6-2 F6-2 F6.2 F6.2 F6.2 F6.2	TEMP(J), J=1 to 31	Eleven fields for values of daily stage. For card 1, there are entries for days 1-10 of the month with columns 75-80 not used. For card 2, there are entries for days 11-20 of the month with columns 75-80 not used. For card 3, there are entries for the remainder of the days in the month with blank fields for nonexistent days in the month. Program will not run properly if there are days of no river-stage data.	
5. NUMBER OF COMPUTED HYDRO-GRAPHS	1 card	1-4	I4	NRUNS	Number of hydrographs to be computed.	
6. SCALES	1 card	1-25	5F5.0	HSCAL(I),I=1 to 5	Feet-of-water scale.	This sequence is repeated for multiple hydrographs.
		26-50	5F5.0	VSCAL(I),I=1 to 5	Time scale.	
7. IDENTIFI-CATION	1 card	1-80	20A4	IC1 to IC20	Heading for hydrograph.	
8. NUMBER OF GROUND-WATER LEVELS	1 card	1-5	I5	NICNT	Number of ground-water levels to be read.	
9. GROUND-WATER LEVELS	Group of cards containing ground-water levels, coded by instructions given in Lang and Leonard (1967).					
10. NUMBER OF UNIT-RESPONSE CARDS	1 card	1-2	I2	KLIMIT	Number of unit-response cards to be read.	
11. UNIT RESPONSE	KLIMIT cards	1-10	F10.8	DUHF(I),I=1 to KLIMIT	Head change, DUHF, in aquifer at time, TIM, in response to a unit change in stream stage.	
		11-20	F10.5	TIM(I),I=1 to KLIMIT		

[1] Not read in program. This information may be needed in other programs using stage data in this format.

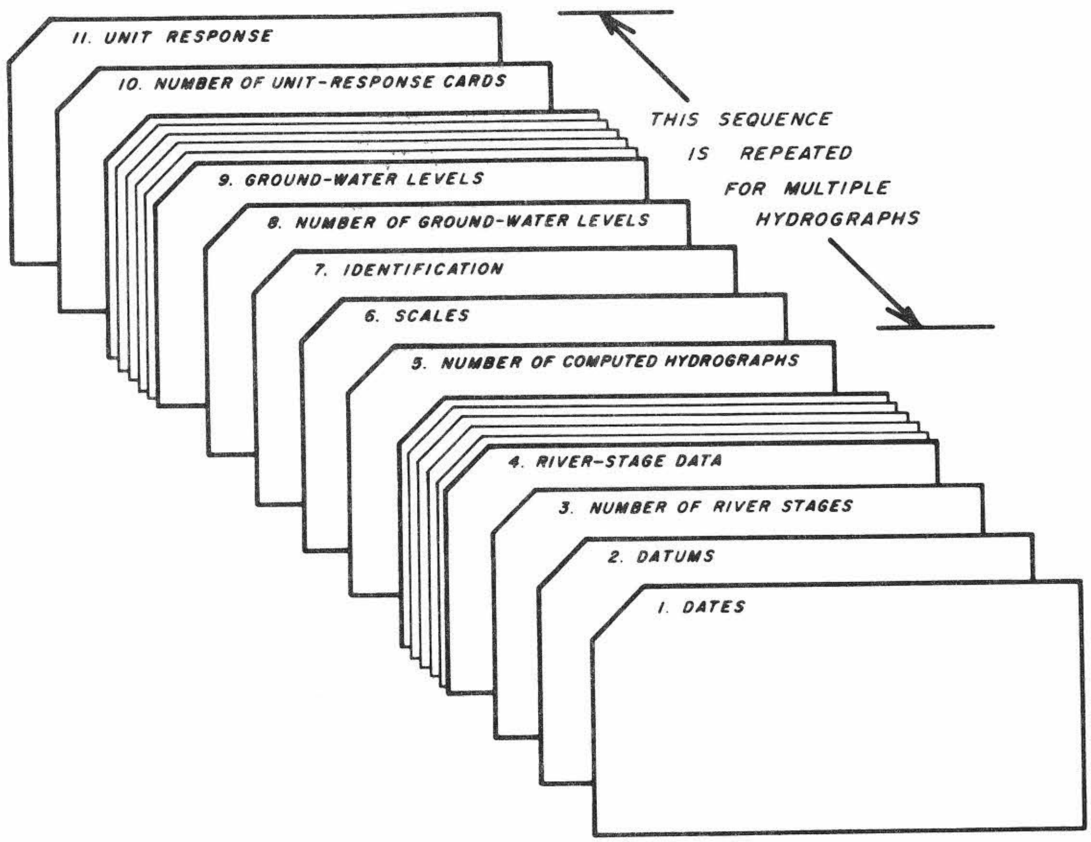

Figure 7.--Input-data deck for RIVER-INDUCED FLUCTUATIONS program.

1. DATES

One card—specifying by months and year the beginning and ending date of the hydrograph. The hydrograph will begin on or after the beginning date, depending on whether the antecedent effect of changes in river stage has been satisfied. If an ending date is not specified, the hydrograph will be computed to the ending date of the river-stage data.

2. DATUMS

One card—specifying datums for the river stage and ground-water hydrographs with respect to zero of the gage and land surface, respectively.

3. NUMBER OF RIVER STAGES

One card—containing the number of consecutive daily river stages to be read.

4. RIVER-STAGE DATA

A group of cards—containing river-stage data. The stage record must begin prior to the ground-water record to obtain computed ground-water levels concurrent with the observed period of ground-water levels. The duration of antecedent river stage depends upon the unit response of the aquifer to river-stage change. (See section 12.)

5. NUMBER OF COMPUTED HYDROGRAPHS

One card—designating the number of hydrographs to be computed. Items 6 through 11 are repeated for multiple hydrographs.

6. SCALES

One card—specifying five pairs of scales, each pair consisting of a horizontal (feet of water) scale and a vertical (time) scale. The program selects a pair of scales based on the maximum variation in river stage and ground-water level. Ordinarily, the time scale is selected by the programmer and the same time scale is paired with each of five different horizontal scales.

7. IDENTIFICATION

One card—containing heading for hydrograph.

8. NUMBER OF GROUND-WATER LEVELS

One card—designating the number of ground-water levels to be read.

9. GROUND-WATER LEVELS

A group of cards—containing observed ground-water levels.

10. NUMBER OF UNIT-RESPONSE CARDS

One card—specifying the number of unit-response cards to be read.

11. UNIT RESPONSE

A group of cards—containing data on response of the aquifer at a specified point to a unit change in stream stage. This deck can be punched directly as the output from GROUND-WATER FLOW.

The duration of the unit response required for computations depends upon the transmissivity, storage, and distance from the stream. The program will compile daily coefficients for distributing daily river-stage changes until the unit response reaches 0.98. Commonly, an exceedingly long period is required for the unit response to reach 0.98. Satisfactory results have been obtained by using a maximum unit response of 0.64.

EVAPOTRANSPIRATION

General Features

EVAPOTRANSPIRATION computes the depth to the potentiometric surface for several rates of steady flow of water through unsaturated materials from the water table to the land surface. Steady evapotranspiration rates are computed through a layered confining bed from an aquifer as a function of depth to water. These computations can be used as the input variable ETCON in the GROUND-WATER FLOW program. The method of computation is based on a paper by Stallman and Reed (1966). A manual method of computation and application to electrical analogs is given in Bedinger, Reed, and others (1965). A listing of the program EVAPOTRANSPIRATION is given in table 6.

Figure 8 shows how the tension curve for a given rate of steady flow is simplified so that only two parameters are necessary to characterize it—the limiting tension and the tension

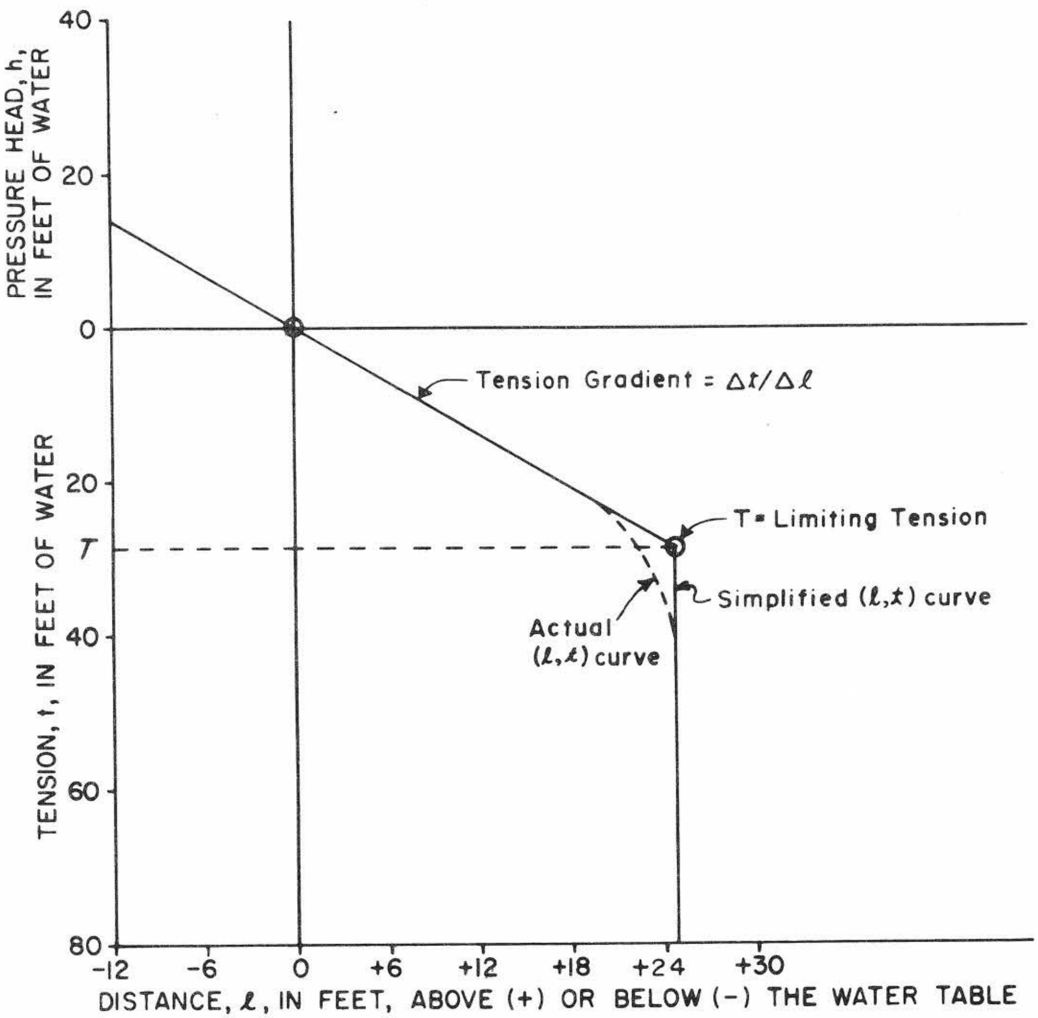

Figure 8.--Diagram showing simplified relation between tension (or pressure) and distance above or below the water table.

gradient. Methods for calculating these two parameters are given in Bedinger, Reed, and others (1965). Input data are limiting tensions and tension gradients for six velocities and for as many as 14 types of meterial. The program uses these data and coded lithologic logs to define the six depths to potentiometric surface associated with the six velocities. The largest velocity assigned should be equal to the potential evapotranspiration for the locality. The least velocity assigned should be greater than zero but should be less than any rate deemed significant in the study. The program then computes chords, change in evapotranspiration rate per foot change in potentiometric surface ($\Delta ET/\Delta H$), to the evapotranspiration rate versus depth relationship, beginning with a specified depth below the average and computing in 2-foot increments to a specified depth above the average.

Selection of initial values of $\Delta ET/\Delta H$ for input in GROUND-WATER FLOW must be based on an estimate of the change in potentiometric surface. Computed values of head change from GROUND-WATER FLOW are used to estimate successive values of $\Delta ET/\Delta H$ until the ΔH used in selecting $\Delta ET/\Delta H$ is sensibly equal to ΔH computed by GROUND-WATER FLOW.

Samples of output from the EVAPOTRANSPIRATION program are given in figure 9.

```
       ROW      COLUMN
         7        11
AVERAGE DEPTH TO WATER   18.00  FEET
TYPE OF MATERIAL         THICKNESS
  SILTY SAND               2.0
  SANDY SILT               5.0
  SILTY CLAY               3.0
  CLAY-SILT               10.0
DEPTH TO WATER              ET              DELTA ET/DELTA H
    19.039688            0.000100
    16.265854            0.000550
    15.197010            0.001000
    12.967006            0.002700
    10.558612            0.005500
     8.706005            0.008200
    28.000000            0.000100              0.000017
    26.000000            0.000100              0.000021
    24.000000            0.000100              0.000028
    22.000000            0.000100              0.000042
    20.000000            0.000100              0.000084
    18.000000            0.000269              0.000056
    16.000000            0.000662              0.000197
    14.000000            0.001913              0.000411
    12.000000            0.003824              0.000593
    10.000000            0.006314              0.000756
     8.000000            0.008200              0.000793
     6.000000            0.008200              0.000661
       ROW      COLUMN
         8        12
AVERAGE DEPTH TO WATER   18.00  FEET
TYPE OF MATERIAL         THICKNESS
  SILTY SAND              15.0
DEPTH TO WATER              ET              DELTA ET/DELTA H
    19.097595            0.000100
    16.587372            0.000550
    15.777225            0.001000
    14.540004            0.002700
    13.777004            0.005500
    13.420012            0.008200
    28.000000            0.000100              0.000020
    26.000000            0.000100              0.000025
    24.000000            0.000100              0.000033
    22.000000            0.000100              0.000049
    20.000000            0.000100              0.000098
    18.000000            0.000297              0.000096
    16.000000            0.000876              0.000290
    14.000000            0.004682              0.001096
    12.000000            0.008200              0.001317
    10.000000            0.008200              0.000988
     8.000000            0.008200              0.000790
     6.000000            0.008200              0.000659
```

FIGURE 9.—SAMPLE OUTPUT FROM EVAPOTRANSPIRATION PROGRAM

Preparation of Input Data

An outline of the input data deck for EVAPOTRANSPIRATION is given below. The outline is keyed to table 3, which contains information for coding input data. The input data deck is shown diagrammatically in figure 10.

1. LIMITING TENSIONS

Fifteen cards—specifying limiting tensions for lithologic classes and velocities.

2. VELOCITIES

One card—specifying six different velocities.

3. TENSION GRADIENTS

Fourteen cards—specifying tension gradients for velocities in each lithologic class.

4. LITHOLOGY

Three cards—specifying the type of material in each lithologic class for printout.

5. RANGE

One card—specifying the range of water levels (above and below the initial water level) for which $\Delta ET/\Delta H$ is to be computed.

6. LOCATION, DEPTH TO WATER LEVEL, CODED LITHOLOGY

One or two cards, repeated for each log, specifying location, depth to water, and lithology and thickness of each unit of the aquitard.

7. TERMINATION

A blank card used to indicate the end of data deck.

Table 3.—*Input data for EVAPOTRANSPIRATION program*

Outline reference	Number of cards	Columns	Format	Program variable	Input item	Remarks
1. LIMITING TENSIONS	1 card	-------	-------	------------------	--------------------------------	Blank card.
	14 cards	1-4	--------	ET(I,1,2)	Vacant.	
		5-8 9-12 13-16 17-20 21-24 25-28	F4.1 F4.1 F4.1 F4.1 F4.1 F4.1	ET(I,2,2) ET(I,3,2) ET(I,4,2) ET(I,5,2) ET(I,6,2) ET(I,7,2)	Array containing limiting tensions, ET, for each of 14 lithology classes, I, numbered 2 through 15, at each of 6 velocities, numbered 2 through 7. One lithology class is coded per card. Velocities are ordered from lowest to highest on each card.	
2. VELOCITIES	1 card	1-8	Blank		Vacant.	
		9-16 17-24 25-32 33-40 41-48 49-56	F8.7 F8.7 F8.7 F8.7 F8.7 F8.7	ET(1,2,1) ET(1,3,1) ET(1,4,1) ET(1,5,1) ET(1,6,1) ET(1,7,1)	Velocities ordered from least, ET(1,2,1), to greatest, ET(1,7,1). The middle subscript is the velocity number.	
3. TENSION GRADIENTS	14 cards	1-8	Blank		Vacant.	
		9-16 17-24 25-32 33-40 41-48 49-56	F8.7 F8.7 F8.7 F8.7 F8.7 F8.7	ET(I,2,1) ET(I,3,1) ET(I,4,1) ET(I,5,1) ET(I,6,1) ET(I,7,1)	Array containing tension gradients, ET, for each of 14 lithology classes, I, numbered 2 through 15, at each of 6 velocities, numbered 2 through 7. One lithology class is coded per card. Velocities are ordered from lowest to highest on each card.	
4. LITHOLOGY	3 cards	1-12	Blank	LITH(I),I=1 to 3	Vacant.	Code LITH(1), LITH(2), and LITH(3) blank.
		13-24	3A4	LITH(I),I=4 to 6	Class 2 lithology.	
		25-36	3A4	LITH(I),I=7 to 9	Class 3 lithology.	
		37-48	3A4	LITH(I),I=10 to 12	Class 4 lithology.	
		49-60	3A4	LITH(I),I=13 to 15	Class 5 lithology.	
		61-72	3A4	LITH(I),I=16 to 18	Class 6 lithology.	
		73-80,1-4	3A4	LITH(I),I=19 to 21	Class 7 lithology.	
		5-16	3A4	LITH(I),I=22 to 24	Class 8 lithology.	
		17-28	3A4	LITH(I),I=25 to 27	Class 9 lithology.	
		29-40	3A4	LITH(I),I=28 to 30	Class 10 lithology.	
		41-52	3A4	LITH(I),I=31 to 33	Class 11 lithology.	
		53-64	3A4	LITH(I),I=34 to 36	Class 12 lithology.	
		65-76	3A4	LITH(I),I=37 to 39	Class 13 lithology.	
		77-80,1-8	3A4	LITH(I),I=40 to 42	Class 14 lithology.	
		9-20	3A4	LITH(I),I=43 to 45	Class 15 lithology.	

Table 3.—*Input data for EVAPOTRANSPIRATION program*—Continued

Outline reference	Number of cards		Columns	Format	Program variable	Input item	Remarks
5. RANGE	1 card		1-2	F2.0	RANGE	Number of feet above and below average water level for which $\Delta ET/\Delta H$ is computed.	
6. LOCATION, DEPTH TO WATER LEVEL, CODED LITHOLOGY	1 or 2 cards	1st card	1-2	I2	M	Y-coordinate of data point.	This sequence is repeated for each log.
			3-4	I2	N	X-coordinate of data point.	
			5-8	F4.2	DTW	Reference depth to water for calculating $\Delta ET/\Delta H$.	
			9-10	I2	LCD(1)	LCD, class number of lithologic units, listed in order from land surface down.	
			11-14	F4.1	TH(1)	TH, thickness of lithologic units, listed in order from land surface down.	
			15-16	I2	LCD(2)		
			17-20	F4.1	TH(2)		
			21-22	I2	LCD(3)		
			23-26	F4.1	TH(3)		
			27-28	I2	LCD(4)		
			29-32	F4.1	TH(4)		
			33-34	I2	LCD(5)		
			35-38	F4.1	TH(5)		
			39-40	I2	LCD(6)		
			41-44	F4.1	TH(6)		
			45-46	I2	LCD(7)		
			47-50	F4.1	TH(7)		
			51-52	I2	LCD(8)		
			53-56	F4.1	TH(8)		
			57-58	I2	LCD(9)		
			59-62	F4.1	TH(9)		
			63-64	I2	LCD(10)		
			65-68	F4.1	TH(10)		
			69-70	I2	LCD(11)		
			71-74	F4.1	TH(11)		
			75-76	I2	LCD(12)		
			77-80	F4.1	TH(12)		
		2d card	1-2	I2	LCD(13)		2d card may be omitted if TH(12) is zero.
			3-6	F4.1	TH(13)		
			7-8	I2	LCD(14)		
			9-12	F4.1	TH(14)		
			13-14	I2	LCD(15)		
			15-18	F4.1	TH(15)		
			19-20	I2	LCD(16)		
			21-24	F4.1	TH(16)		
			25-26	I2	LCD(17)		
			27-30	F4.1	TH(17)		
			31-32	I2	LCD(18)		
			33-36	F4.1	TH(18)		
			37-38	I2	LCD(19)		
			39-42	F4.1	TH(19)		
			43-44	I2	LCD(20)		
			45-48	F4.1	TH(20)		
			49-50	I2	LCD(21)		
			51-54	F4.1	TH(21)		
			55-56	I2	LCD(22)		
			57-60	F4.1	TH(22)		
			61-62	I2	LCD(23)		
			63-66	F4.1	TH(23)		
			67-68	I2	LCD(24)		
			69-72	F4.1	TH(24)		
			73-74	I2	LCD(25)		
			75-78	F4.1	TH(25)		
7. TERMINATION	1 card		------	------	------------	--------------------------------	Blank card to indicate end of data.

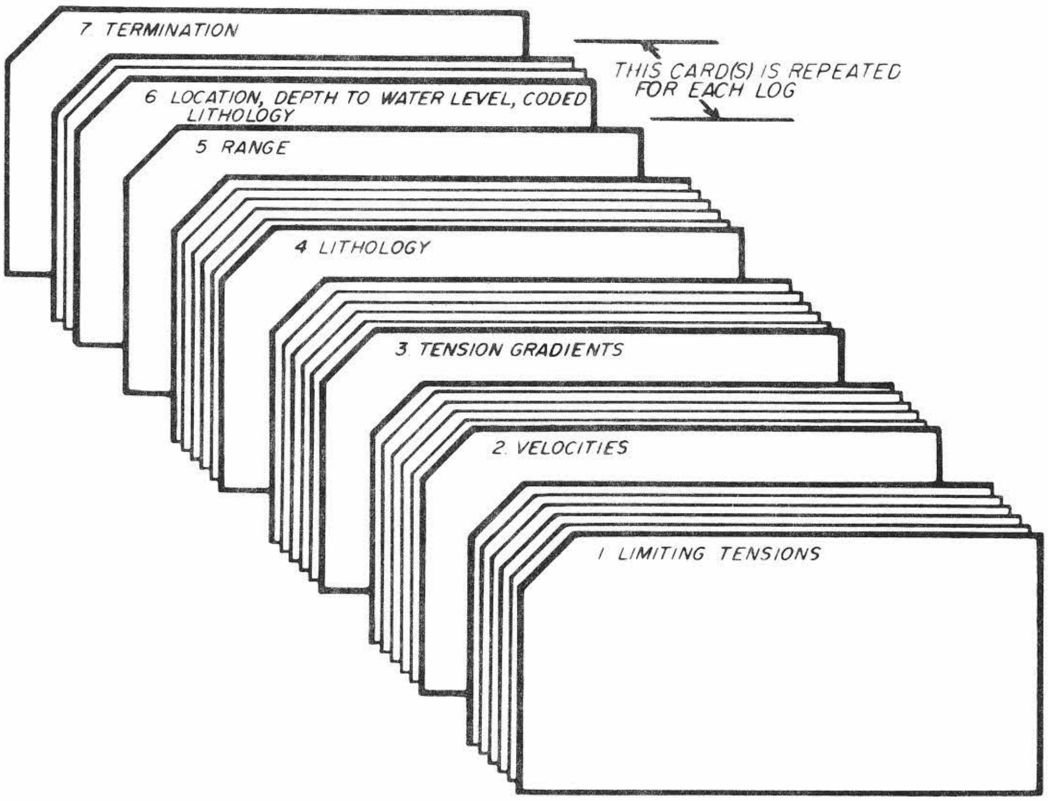

Figure 10.--Input-data deck for EVAPOTRANSPIRATION program.

INPUT-DATA FORMATS

Specifications for coding input data for GROUND-WATER FLOW, RIVER-INDUCED FLUCTUATIONS, and EVAPOTRANSPIRATION are given in tables 1, 2, and 3. The "Format" column specifies the Fortran IV format for coding the indicated parameter. The position of the parameter on the card is specified under "Columns." Four format modes are used in the programs—they are F, decimal number; E, floating point form of decimal number; I, integer; and A, alphameric.

F format

The general form of decimal-point format is Fw.d, where w designates the width of the field and d designates the number of decimal positions to the right of the decimal. A coded decimal point overrides the position indicated by d in the format.

E format

The exponent format consists of a decimal-point number followed by E±XX, where ±XX indicates a power of 10 multiplier of the floating-point number. The general form of exponent format is Ew.d, in which w is the width of the field and d implies the number of decimal positions to the right of the decimal in the decimal-point number. A coded decimal overrides the implied decimal.

I format

Integer format contains numbers without a decimal point. These numbers should be right justified. Leading, trailing, and imbedded blanks in the field are interpreted as zeros.

A format

Alphameric format may contain alphabetic and numeric characters. "A" format is used for transmitting symbols used in alphameric representations of numerical data and in identification of output data.

Repeat count

An unsigned integer constant preceding the format designation F, E, I, or A is a repeat count used to denote the number of consecutive times the format code is to be used. If this constant is omitted, the code is used only once.

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TABLE 4.—GROUND-WATER FLOW PROGRAM LISTING

```
C     ***************************************************************** GW00010
C                                                                       GW00020
C                        PROGRAM GWFLOW(1)                              GW00030
C                        PROGRAM GWFLOW(1)                              GW00050
C                        PROGRAM GWFLOW(1)                              GW00040
C                        PROGRAM GWFLOW(1)                              GW00060
C        PROGRAMMED BY M.S. BEDINGER, J.E. REED, AND J.D. GRIFFIN       GW00080
C                 DATE OF THIS VERSION -- 9 NOVEM    1971               GW00090
C                                                                       GW00070
C     ***************************************************************** GW00100
C     ***************************************************************** GW00110
C     ***************************************************************** GW00120
C                                                                       GW00130
C     DIRECTIONS FOR CHANGING NUMBER OF ROWS (M) AND COLUMNS (N) IN     GW00140
C        NETWORK                                                        GW00150
C        CHANGE VALUES OF M AND N IN THE FIRST CARD OF THE DATA DECK    GW00160
C        CHANGE DIMENSIONS OF FOLLOWING PARAMETERS TO (M,N):            GW00170
C             PZ,PS,HO,AM,SAM,T,S,HOS,Q,C,IV,DEL,QT,AND ACCRET          GW00180
C        CHANGE DIMENSIONS OF FOLLOWING PARAMETERSTO(M):                GW00190
C             CSD,CPZ,CPS,CET                                           GW00200
C        CHANGE DIMENSIONS OF FOLLOWING PARAMETERS TO (N):              GW00210
C             RSD,RPZ,RPS,RET,W,AND G                                   GW00220
C        CHANGE DIMENSIONS OF H TO (M,N,3)                              GW00230
C        CHANGE DIMENSIONS OF YY1,YY2,XX1,XX2 TO THE GREATER OF (M,N)   GW00231
C        CHANGE FORMAT STATEMENT 166 TO:                                GW00240
C             166 FORMAT (NI1) --WHERE N IS THE NUMBER OF COLUMNS       GW00250
C        CHANGE FOURTH LINE OF FORMAT STATEMENT 167 TO:                 GW00260
C             3YSTEM',/(5X,NI1)) -- WHERE N IS THE NUMBER OF COLUMNS    GW00270
C             COLUMNS                                                   GW00280
C        CHANGE THE FOLLOWING FORMATS IN SUBROUTINE ALPHA:              GW00290
C           6 FORMAT (44X,NA1)--WHERE N IS NUMBER OF COLUMNS            GW00300
C           7 FORMAT (NA1)-- WHERE N IS NUMBER OF COLUMNS               GW00310
C        CHANGE DIMENSION OF IV ARRAY IN SUBROUTINE BETA TO (M,N):      GW00311
C             INTEGER*2 IV(M,N)--WHERE M,N IS NUMBER OF ROWS,COLUMNS    GW00312
C        CHANGE FORMAT 16 IN SUBROUTINE BETA:                           GW00313
C          16 FORMAT(45X,NA1)--WHERE N IS THE NUMBER OF COLUMNS         GW00314
C                                                                       GW00320
C     DIRECTIONS FOR CHANGING NUMBER OF TIME INCREMENTS :               GW00330
C             CHANGE VALUES OF TTIME IN DATA DECK                       GW00340
C             CHANGE DIMENSION SATATEMENTS FOR TTIME, DTIME, TIM, AND   GW00350
C             TTTEM                                                     GW00360
C     ***************************************************************** GW00370
      INTEGER*2 IV(34,80)
      DIMENSION PZ(34,80), PS(34,80), HO(34,80), AM(34,80), SAM(34,80), GW00390
     1T(34,80), HOS(34,80), Q(34,80), C(34,80), DEL(34,80), QT(34,80), A GW00400
     2CCRET(34,80), S(34,80)                                            GW00410
      DIMENSION CSD(34), CPZ(34), CPS(34)                               GW00420
      DIMENSION RSD(80), RPZ(80), RPS(80), W(80), G(80)                 GW00430
      DIMENSION H(34,80,3)                                              GW00440
      DIMENSION DTIME(80), TTIME(80), TTTEM(80), TIM(80), CTIME(10)     GW00450
      DIMENSION IF(40), JF(40)                                          GW00460
      DIMENSION TAT(64,2), TCARD(80)                                    GW00470
```

```
      INTEGER*2 IJQ(20,2)
      DIMENSION SAT(64,2), PSAT(64,2), SAMAT(64,2), PZAT(64,2), AMAT(64,
     12)
      DIMENSION ACCAT(64,2), DELCAT(64,2)
      DIMENSION QPER(40)
      DIMENSION IJS(480,2)
      DIMENSION YY1(80), YY2(80), XX1(80), XX2(80), Q1(3), Q2(3), Q3(3),
     1Q4(3)
      DIMENSION IPCO(5)
      DIMENSION CET(34),RET(80)
      IRD=5
      IPT=6
      SWQ=0.
      SRSD=0.0
      SRPZ=0.0
      SRPS=0.0
      QSTR=0.0
      SCET = 0.
      LC=10
      L=70
      ELEV=00.0
      READ (IRD,165) XM,YM,M,N,TM,SM
      M1=M-1
      N1=N-1
      L1=L-1
      WQ=0.
      DO 2 I=1,M
      DO 1 J=1,N
      IV(I,J)=3
      HOS(I,J)=0.0
      Q(I,J)=0.0
      C(I,J)=0.0
      H(I,J,1)=ELEV
      H(I,J,2)=ELEV
    1 H(I,J,3)=ELEV
      W(I)=1.0
    2 G(I)=0.0
      READ (IRD,166) ((IV(I,J),J=1,N),I=1,M)
      WRITE (IPT,216)
      WRITE (IPT,167) ((IV(I,J),J=1,N),I=1,M)
      IF (XM.EQ.0.0.OR.YM.EQ.0.0) GO TO 3
      X=XM
      Y=YM
      IXMIN=0
      IXMAX=100
      IXINF=0
      XINF=0.0
      IYMAX=100
      IYMIN=0
      YINF=0.0
      GO TO 4
    3 READ (IRD,168) IXMIN,IXMAX,XINF,X,IYMIN,IYMAX,YINF,Y
```

```
    4 CONTINUE
      READ (IRD,169) IPS,ISAM,IPZ,IAM,PSM,SAMM,PZM,AMM
      IF (TM-1) 6,5,5
    5 WRITE (IPT,170) TM
    6 CONTINUE
      IF (SM.EQ.0) GO TO 7
      WRITE (IPT,171) SM
    7 CONTINUE
      IF (IPS-2) 8,9,9
    8 WRITE (IPT,172) PSM
    9 CONTINUE
      IF (ISAM-2) 10,11,11
   10 WRITE (IPT,173) SAMM
   11 CONTINUE
      IF (IPZ-2) 12,13,13
   12 WRITE (IPT,174) PZM
   13 CONTINUE
      IF (IAM-2) 14,15,15
   14 WRITE (IPT,175) AMM
   15 CONTINUE
      DO 17 I=1,M
      DO 16 J=1,N
      S(I,J)=0.0
      T(I,J)=0.0
      PS(I,J)=0.0
      PZ(I,J)=0.0
      HO(I,J)=0.0
      AM(I,J)=0.0
   16 SAM(I,J)=0.0
   17 CONTINUE
      IF (TM-1) 18,19,19
   18 CALL ALPHA (TAT,T,M,N,IRD,IPT,IALPHA)
      WRITE (IPT,176) (TAT(IAT,1),TAT(IAT,2),IAT=1,IALPHA)
      GO TO 22
   19 DO 21 I=1,M
      DO 21 J=1,N
      IF (IV(I,J).EQ.3) GO TO 20
      T(I,J)=TM
      GO TO 21
   20 T(I,J)=0.0
   21 CONTINUE
   22 CONTINUE
      IF (SM.EQ.0) GO TO 25
      DO 24 I=1,M
      DO 24 J=1,N
      IF (IV(I,J).EQ.3) GO TO 23
      S(I,J)=SM
      GO TO 24
   23 S(I,J)=0.0
   24 CONTINUE
      GO TO 26
   25 CALL ALPHA (SAT,S,M,N,IRD,IPT,IALPHA)
      WRITE (IPT,177) (SAT(IAT,1),SAT(IAT,2),IAT=1,IALPHA)
```

```
26 CONTINUE
   IF (IPS-2) 28,27,28
27 CALL ALPHA (PSAT,PS,M,N,IRD,IPT,IALPHA)
   WRITE (IPT,178) (PSAT(IAT,1),PSAT(IAT,2),IAT=1,IALPHA)
28 CONTINUE
   IF (ISAM-2) 30,29,30
29 CALL ALPHA (SAMAT,SAM,M,N,IRD,IPT,IALPHA)
   WRITE (IPT,179) (SAMAT(IAT,1),SAMAT(IAT,2),IAT=1,IALPHA)
30 CONTINUE
   IF (IPZ-2) 31,34,35
31 DO 33 I=1,M
   DO 33 J=1,N
   IF (IV(I,J).EQ.3) GO TO 32
   PZ(I,J)=PZM
   GO TO 33
32 PZ(I,J)=0.0
33 CONTINUE
   GO TO 35
34 CALL ALPHA (PZAT,PZ,M,N,IRD,IPT,IALPHA)
   WRITE (IPT,180) (PZAT(IAT,1),PZAT(IAT,2),IAT=1,IALPHA)
35 CONTINUE
   IF (IAM-2) 36,39,40
36 DO 38 I=1,M
   DO 38 J=1,N
   IF (IV(I,J).EQ.3) GO TO 37
   AM(I,J)=AMM
   GO TO 38
37 AM(I,J)=0.0
38 CONTINUE
   GO TO 40
39 CALL ALPHA (AMAT,AM,M,N,IRD,IPT,IALPHA)
   WRITE (IPT,181) (AMAT(IAT,1),AMAT(IAT,2),IAT=1,IALPHA)
40 CONTINUE
   READ (IRD,182) (IF(I),JF(I),I=1,20)
   WRITE (IPT,183) ELEV,M,N,X
   IF (IXMIN.GT.0.OR.IXMAX.LT.100) GO TO 41
   GO TO 42
41 WRITE (IPT,184) IXMIN,IXMAX,XINF
42 IF (IYMIN.GT.0.OR.IYMAX.LT.100) GO TO 43
   GO TO 44
43 WRITE (IPT,185) IYMIN,IYMAX,YINF
44 READ (IRD,215) (TTIME(K),K=1,L)
   READ (IRD,215) (CTIME(KC),KC=1,LC)
   DO 49 KC=1,LC
   DO 48 K=2,L
   IF (CTIME(KC).EQ.0.0) GO TO 50
   IF (TTIME(K).EQ.CTIME(KC)) GO TO 49
   IF (TTIME(K).GT.CTIME(KC)) GO TO 45
   GO TO 48
45 TTEMP=TTIME(K)
   TTIME(K)=CTIME(KC)
   K2=K+2
```

TABLE 4.—GROUND-WATER FLOW PROGRAM LISTING—CONTINUED

```
      K1=K+1
      TTTEM(K+1)=TTEMP
      DO 46 KO=K2,L
   46 TTTEM(KO)=TTIME(KO-1)
      DO 47 KT=K1,L
   47 TTIME(KT)=TTTEM(KT)
      GO TO 49
   48 CONTINUE
   49 CONTINUE
   50 CONTINUE
      DTIME(1)=0.0
      DO 51 K=2,L
      IF (TTIME(K).EQ.0.0) GO TO 52
   51 DTIME(K)=TTIME(K)-TTIME(K-1)
   52 CONTINUE
      READ (IRD,218) (IPCO(IC),IC=1,5)
      KT=1
      READ (IRD,186) NQSET
      WRITE (IPT,216)
      WRITE (IPT,187) NQSET
      READ (IRD,188) (QPER(I),I=1,NQSET)
      WRITE (IPT,189)
      WRITE (IPT,190) (I,QPER(I),I=1,NQSET)
      DO 163 N5=1,NQSET
      WRITE (IPT,207) N5
      DO 53 K=2,L
      IF (TTIME(K).LT.QPER(N5)) GO TO 53
      DTIME(K)=QPER(N5)-TTIME(K-1)
      GO TO 54
   53 CONTINUE
      GO TO 55
   54 TTIME(K)=QPER(N5)
   55 CONTINUE
      DO 56 I=1,M
      DO 56 J=1,N
      ACCRET(I,J)=0.0
   56 DEL(I,J)=0.0
      READ (IRD,191) IAC,IET,ACCON,ETCON
      IF (IAC-2) 57,58,58
   57 WRITE (IPT,192) ACCON
   58 CONTINUE
      IF (IET-2) 59,60,60
   59 WRITE (IPT,193) ETCON
   60 CONTINUE
      IF (IAC-2) 61,64,65
   61 DO 63 I=1,M
      DO 63 J=1,N
      IF (IV(I,J).EQ.3) GO TO 62
      ACCRET(I,J)=ACCON
      GO TO 63
   62 ACCRET(I,J)=0.0
   63 CONTINUE
```

```
      GO TO 65
   64 CALL ALPHA (ACCAT,ACCRET,M,N,IRD,IPT,IALPHA)
      WRITE (IPT,194) (ACCAT(IAT,1),ACCAT(IAT,2),IAT=1,IALPHA)
   65 CONTINUE
      IF (IFT-2) 66,69,70
   66 DO 68 I=1,M
      DO 68 J=1,N
      IF (IV(I,J).EQ.3) GO TO 67
      DEL(I,J)=ETCON
      GO TO 68
   67 DEL(I,J)=0.0
   68 CONTINUE
      GO TO 70
   69 CALL ALPHA (DELCAT,DEL,M,N,IRD,IPT,IALPHA)
      WRITE (IPT,195) (DELCAT(IAT,1),DELCAT(IAT,2),IAT=1,IALPHA)
   70 CONTINUE
      DO 71 I=1,M
      DO 71 J=1,N
   71 Q(I,J)=0.0
      READ (IRD,186) NQ
      WRITE (IPT,196) NQ
      IF (NQ.EQ.0) GO TO 74
      DO 73 NUD=1,NQ
      READ (IRD,198) QU
      WRITE (IPT,197) QU
      READ (IRD,206) IQUN
      READ (IRD,199) (IJQ(I,1),IJQ(I,2),I=1,IQUN)
      WRITE (IPT,200)
      WRITE (IPT,201) (IJQ(I,1),IJQ(I,2),I=1,IQUN)
      DO 72 I=1,IQUN
      IQ=IJQ(I,1)
      JQ=IJQ(I,2)
   72 Q(IQ,JQ)=QU
   73 CONTINUE
   74 CONTINUE
      READ (IRD,186) NSTGE
      WRITE (IPT,202) NSTGE
      IF (NSTGE.EQ.0) GO TO 79
      DO 78 NUD=1,NSTGE
      READ (IRD,204) XSTAGE
      WRITE (IPT,203) XSTAGE
      READ (IRD,206) IXSTN
      READ (IRD,205) (IJS(I,1),IJS(I,2),I=1,IXSTN)
      WRITE (IPT,200)
      WRITE (IPT,201) (IJS(I,1),IJS(I,2),I=1,IXSTN)
      DO 77 I=1,IXSTN
      IST=IJS(I,1)
      JST=IJS(I,2)
      IF (IV(IST,JST)-2) 75,76,77
   75 HOS(IST,JST)=XSTAGE
      IF (ISAM.EQ.1) SAM(IST,JST)=SAMM
      IF (IPS.EQ.1) PS(IST,JST)=PSM
```

TABLE 4.—GROUND-WATER FLOW PROGRAM LISTING—CONTINUED

```
      GO TO 77
   76 H(IST,JST,1)=XSTAGE
      H(IST,JST,2)=XSTAGE
      H(IST,JST,3)=XSTAGE
   77 CONTINUE
   78 CONTINUE
   79 CONTINUE
C     CYCLE THROUGH NETWORK BY ROWS
      DO 161 K=2,L
      QS=0.
      DO 114 I=2,M1
      DO 89 J=2,N1
      IF (J.EQ.IXMIN) GO TO 80
      IF (J.EQ.IXMAX) GO TO 81
      IF (J.LT.IXMIN.OR.J.GT.IXMAX) GO TO 82
      IF (J.GT.IXMIN.AND.J.LT.IXMAX) GO TO 83
   80 XX1(J)=XINF
      XX2(J)=X
      GO TO 84
   81 XX1(J)=X
      XX2(J)=XINF
      GO TO 84
   82 XX1(J)=XINF
      XX2(J)=XINF
      GO TO 84
   83 XX1(J)=X
      XX2(J)=X
   84 CONTINUE
      IF (I.EQ.IYMIN) GO TO 85
      IF (I.EQ.IYMAX) GO TO 86
      IF (I.LT.IYMIN.OR.I.GT.IYMAX) GO TO 87
      IF (I.GT.IYMIN.AND.I.LT.IYMAX) GO TO 88
   85 YY1(J)=YINF
      YY2(J)=Y
      GO TO 89
   86 YY1(J)=Y
      YY2(J)=YINF
      GO TO 89
   87 YY1(J)=YINF
      YY2(J)=YINF
      GO TO 89
   88 YY1(J)=Y
      YY2(J)=Y
   89 CONTINUE
      DO 104 J=2,N1
      X1=XX1(J)
      X2=XX2(J)
      Y1=YY1(J)
      Y2=YY2(J)
      RSD(J)=(S(I,J)*(Y1+Y2)*(X1+X2))/(2.*DTIME(K))
      RET(J) = DEL(I,J)*(Y1+Y2)*(X1+X2)/8.
      RPZ(J)=0.0
```

```
      IF (AM(I,J).NE.0.0) RPZ(J)=(PZ(I,J)*(Y1+Y2)*(X1+X2))/(8.*AM(I,J))  GW03610
      RPS(J)=0.0                                                           GW03620
      IF (SAM(I,J).NE.0.0) RPS(J)=(PS(I,J)*(Y1+Y2)*(X1+X2))/(8.*SAM(I,J) GW03630
     1)                                                                    GW03640
      IF (IV(I,J)-2) 90,98,99                                              GW03650
C     IV(I,J,K) = 1, H IS NOT SPECIFIED                                    GW03660
C     IV(I,J,K) = 2, H IS SPECIFIED                                        GW03670
C     IV(I,J,K) = 3, NODE IS OUTSIDE FLOW SYSTEM                           GW03680
   90 C(I,J)=((T(I,J)+T(I,J+1))*(Y1+Y2))/(4.*X2)                           GW03690
      A=((T(I,J-1)+T(I,J))*(Y1+Y2))/(4.*X1)                                GW03700
      B=-(A+C(I,J))-RSD(J)-RPZ(J)-RPS(J)-RET(J)                            GW03710
      IF (IV(I,J-1).NE.3) GO TO 92                                         GW03720
      IF (IV(I,J+1).NE.3) GO TO 91                                         GW03730
C     J-1 AND J+1 ARE OUTSIDE AQUIFER                                      GW03740
      C(I,J)=0.0                                                           GW03750
      A=0.0                                                                GW03760
      B=-RSD(J)-RPZ(J)-RPS(J)-RET(J)                                       GW03770
      GO TO 93                                                             GW03780
C     J-1 IS OUTSIDE AQUIFER, J+1 IS INSIDE AQUIFER                        GW03790
   91 C(I,J)=C(I,J)*2.                                                     GW03800
      A=0.0                                                                GW03810
      B=-C(I,J)-RSD(J)-RPZ(J)-RPS(J)-RET(J)                                GW03820
      GO TO 93                                                             GW03830
   92 IF (IV(I,J+1).NE.3) GO TO 93                                         GW03840
C     J-1 IS INSIDE AQUIFER ,J+1 IS OUTSIDE                                GW03850
      A=A*2.                                                               GW03860
      C(I,J)=0.0                                                           GW03870
      B=-A-RSD(J)-RPZ(J)-RPS(J)-RET(J)                                     GW03880
   93 CONTINUE                                                             GW03890
      QPZ=0.0                                                              GW03900
      IF (AM(I,J).NE.0.0) QPZ=(PZ(I,J)*HO(I,J)*(Y1+Y2)*(X1+X2))/(4.*AM(I GW03910
     1,J))                                                                 GW03920
      QPS=0.0                                                              GW03930
      IF (SAM(I,J).NE.0.0) QPS=(PS(I,J)*HOS(I,J)*(Y1+Y2)*(X1+X2))/(4.*SA GW03940
     1M(I,J))                                                              GW03950
      WQ=Q(I,J)-QPZ-QPS+DEL(I,J)*H(I,J,1)*(Y1+Y2)*(X1+X2)/8.-(ACCRET(I,J GW03960
     1)*(Y1+Y2)*(X1+X2))/4.                                                GW03970
      IF (IV(I-1,J).EQ.3) GO TO 94                                         GW03980
      IF (IV(I+1,J)-2) 96,96,95                                            GW03990
   94 IF(IV(I+1,J).EQ.3) D=(-RSD(J)+RPZ(J)+RPS(J))*H(I,J,1)+WQ             GW04000
      IF (IV(I+1,J).EQ.3) GO TO 97                                         GW04010
      D=((T(I,J)+T(I+1,J))/Y2*(X1+X2)/2.-RSD(J)+RPZ(J)+RPS(J))*H(I,J,1)- GW04020
     1((T(I,J)+T(I+1,J))/Y2*(X1+X2)/2.)*H(I+1,J,1)+WQ                      GW04030
      GO TO 97                                                             GW04040
   95 D=-((T(I-1,J)+T(I,J))/Y1*(X1+X2)/2.)*H(I-1,J,1)+((T(I-1,J)+T(I,J)) GW04050
     1/Y1*(X1+X2)/2.-RSD(J)+RPZ(J)+RPS(J))*H(I,J,1)+WQ                     GW04060
      GO TO 97                                                             GW04070
   96 IF (IV(I-1,J).NE.3.OR.IV(I+1,J).NE.3) D=-((T(I-1,J)+T(I,J))*(X1+X2 GW04080
     1)/(4.*Y1))*H(I-1,J,1)+((T(I-1,J)+T(I,J))*(X1+X2)/(4.*Y1)+(T(I,J)+T GW04090
     2(I+1,J))*(X1+X2)/(4.*Y2)-RSD(J)+RPZ(J)+RPS(J))*H(I,J,1)-((T(I,J)+T GW04100
     3(I+1,J))*(X1+X2)/(4.*Y2))*H(I+1,J,1)+WQ                              GW04110
   97 IF (IV(I,J-1).EQ.3.OR.IV(I,J+1).EQ.3) WQ=WQ/2.                       GW04120
```

```
      IF (IV(I-1,J).EQ.3.OR.IV(I+1,J).EQ.3) WQ=WQ/2.                    GW04130
      SWQ=SWQ+WQ*DTIME(K)/2.                                            GW04140
      W(J)=B-A*C(I,J-1)/W(J-1)                                          GW04150
      G(J)=(D-A*G(J-1))/W(J)                                            GW04160
      IF (ABS(G(J)).LT.1.0E-20) G(J)=0.                                 GW04170
      GO TO 99                                                          GW04180
   98 G(J)=H(I,J,2)                                                     GW04190
      W(J)=1.0                                                          GW04200
      C(I,J)=0.0                                                        GW04210
   99 IF (N1-J) 100,100,103                                             GW04220
C     IF (N-J) IS ZERO, COLUMN HAS BEEN RUN COMPUTING W AND G           GW04230
  100 CONTINUE                                                          GW04240
      IF (IV(I,N).EQ.1) H(I,N,2)=G(N)                                   GW04250
      DO 102 JIN=1,N1                                                   GW04260
      JDUM=N-JIN                                                        GW04270
      IF (H(I,JDUM+1,2).GE.1.0E-20.OR.H(I,JDUM+1,2).LE.-1.0E-20) GO TO 1 GW04280
     101                                                                GW04290
      H(I,JDUM+1,2)=0.0                                                 GW04300
  101 CONTINUE                                                          GW04310
      IF (IV(I,JDUM).EQ.1) H(I,JDUM,2)=G(JDUM)-(C(I,JDUM)*H(I,JDUM+1,2)) GW04320
     1/W(JDUM)                                                          GW04330
  102 CONTINUE                                                          GW04340
  103 CONTINUE                                                          GW04350
  104 CONTINUE                                                          GW04360
      DO 113 J=2,N1                                                     GW04370
      DO 112 KX=1,2                                                     GW04380
      IF (IV(I,J).NE.2) GO TO 113                                       GW04390
      IF (IV(I-1,J).EQ.3) GO TO 105                                     GW04400
      Q1(KX)=(T(I-1,J)/2.+T(I,J)/2.)*((H(I-1,J,KX)-H(I,J,KX))/YY1(J))*(X GW04410
     1X1(J)/2.+XX2(J)/2.)                                               GW04420
      IF (IV(I-1,J-1).EQ.3.AND.IV(I-1,J+1).EQ.3) GO TO 106              GW04430
      IF (IV(I-1,J-1).EQ.3.OR.IV(I-1,J+1).EQ.3) Q1(KX)=Q1(KX)/2.        GW04440
      GO TO 106                                                         GW04450
  105 Q1(KX)=0.                                                         GW04460
  106 IF (IV(I+1,J).EQ.3) GO TO 107                                     GW04470
      Q2(KX)=(T(I,J)/2.+T(I+1,J)/2.)*(H(I+1,J,KX)-H(I,J,KX))/YY2(J)*(XX1 GW04480
     1(J)/2.+XX2(J)/2.)                                                 GW04490
      IF (IV(I+1,J-1).EQ.3.AND.IV(I+1,J+1).EQ.3) GO TO 108              GW04500
      IF (IV(I+1,J-1).EQ.3.OR.IV(I+1,J+1).EQ.3) Q2(KX)=Q2(KX)/2.        GW04510
      GO TO 108                                                         GW04520
  107 Q2(KX)=0.                                                         GW04530
  108 IF (IV(I,J-1).EQ.3) GO TO 109                                     GW04540
      Q3(KX)=(T(I,J-1)/2.+T(I,J)/2.)*(H(I,J-1,KX)-H(I,J,KX))/XX1(J)*(YY1 GW04550
     1(J)/2.+YY2(J)/2.)                                                 GW04560
      IF (IV(I-1,J-1).EQ.3.AND.IV(I+1,J-1).EQ.3) GO TO 110              GW04570
      IF (IV(I-1,J-1).EQ.3.OR.IV(I+1,J-1).EQ.3) Q3(KX)=Q3(KX)/2.        GW04580
      GO TO 110                                                         GW04590
  109 Q3(KX)=0.                                                         GW04600
  110 IF (IV(I,J+1).EQ.3) GO TO 111                                     GW04610
      Q4(KX)=(T(I,J)/2.+T(I,J+1)/2.)*(H(I,J+1,KX)-H(I,J,KX))/XX2(J)*(YY1 GW04620
     1(J)/2.+YY2(J)/2.)                                                 GW04630
      IF (IV(I-1,J+1).EQ.3.AND.IV(I+1,J+1).EQ.3) GO TO 112              GW04640
```

TABLE 4.—GROUND-WATER FLOW PROGRAM LISTING—CONTINUED

```
      IF (IV(I-1,J+1).EQ.3.OR.IV(I+1,J+1).EQ.3) Q4(KX)=Q4(KX)/2.
      GO TO 112
  111 Q4(KX)=0.
  112 CONTINUE
      QS=QS+(Q1(1)+Q1(2)+Q2(1)+Q2(2)+Q3(1)+Q3(2)+Q4(1)+Q4(2))/2.
  113 CONTINUE
  114 CONTINUE
C     CYCLE THROUGH NETWORK BY COLUMNS
      DO 151 J=2,N1
      DO 124 I=2,M1
      IF (J.EQ.IXMIN) GO TO 115
      IF (J.EQ.IXMAX) GO TO 116
      IF (J.LT.IXMIN.OR.J.GT.IXMAX) GO TO 117
      IF (J.GT.IXMIN.AND.J.LT.IXMAX) GO TO 118
  115 XX1(I)=XINF
      XX2(I)=X
      GO TO 119
  116 XX1(I)=X
      XX2(I)=XINF
      GO TO 119
  117 XX1(I)=XINF
      XX2(I)=XINF
      GO TO 119
  118 XX1(I)=X
      XX2(I)=X
  119 CONTINUE
      IF (I.EQ.IYMIN) GO TO 120
      IF (I.EQ.IYMAX) GO TO 121
      IF (I.LT.IYMIN.OR.I.GT.IYMAX) GO TO 122
      IF (I.GT.IYMIN.AND.I.LT.IYMAX) GO TO 123
  120 YY1(I)=YINF
      YY2(I)=Y
      GO TO 124
  121 YY1(I)=Y
      YY2(I)=YINF
      GO TO 124
  122 YY1(I)=YINF
      YY2(I)=YINF
      GO TO 124
  123 YY1(I)=Y
      YY2(I)=Y
  124 CONTINUE
      DO 141 I=2,M1
      X1=XX1(I)
      X2=XX2(I)
      Y1=YY1(I)
      Y2=YY2(I)
      CSD(I)=(S(I,J)*(Y1+Y2)*(X1+X2))/(2.*DTIME(K))
      CET(I) = DEL(I,J)*(Y1+Y2)*(X1+X2)/8.
      CPZ(I)=0.0
      IF (AM(I,J).NE.0.0) CPZ(I)=(PZ(I,J)*(Y1+Y2)*(X1+X2))/(8.*AM(I,J))
      CPS(I)=0.0
```

```
      IF (SAM(I,J).NE.0.0) CPS(I)=(PS(I,J)*(Y1+Y2)*(X1+X2))/(8.*SAM(I,J)  GW05170
     1)                                                                   GW05180
      IF (IV(I,J)-2) 125,133,134                                          GW05190
  125 C(I,J)=((T(I,J)+T(I+1,J))*(X1+X2))/(4.*Y2)                          GW05200
      A=((T(I-1,J)+T(I,J))*(X1+X2))/(4.*Y1)                               GW05210
      B=-(A+C(I,J))-CSD(I)-CPZ(I)-CPS(I)-CET(I)                           GW05220
      IF (IV(I-1,J).NE.3) GO TO 127                                       GW05230
      IF (IV(I+1,J).NE.3) GO TO 126                                       GW05240
      C(I,J)=0.0                                                          GW05250
      A=0.0                                                               GW05260
      B=-CSD(I)-CPZ(I)-CPS(I)-CET(I)                                      GW05270
      GO TO 128                                                           GW05280
  126 C(I,J)=C(I,J)*2.                                                    GW05290
      A=0.0                                                               GW05300
      B=-C(I,J)-CSD(I)-CPZ(I)-CPS(I)-CET(I)                               GW05310
      GO TO 128                                                           GW05320
  127 IF (IV(I+1,J).NE.3) GO TO 128                                       GW05330
      A=A*2.                                                              GW05340
      C(I,J)=0.0                                                          GW05350
      B=-A-CSD(I)-CPZ(I)-CPS(I)-CET(I)                                    GW05360
  128 CONTINUE                                                            GW05370
      QPZ=0.0                                                             GW05380
      IF (AM(I,J).NE.0.0) QPZ=(PZ(I,J)*HO(I,J)*(Y1+Y2)*(X1+Y2))/(4.*AM(I  GW05390
     1,J))                                                                GW05400
      QPS=0.0                                                             GW05410
      IF (SAM(I,J).NE.0.0) QPS=(PS(I,J)*HOS(I,J)*(Y1+Y2)*(X1+X2))/(4.*SA  GW05420
     1M(I,J))                                                             GW05430
      WQ=Q(I,J)-QPZ-QPS+(DEL(I,J)*H(I,J,2)*(Y1+Y2)*(X1+X2))/8.-(ACCRET(I  GW05440
     1,J)*(Y1+Y2)*(X1+X2))/4.                                             GW05450
      IF (IV(I,J-1).EQ.3) GO TO 129                                       GW05460
C     IF(IV(I,J-1      ).EQ.3) GO TO 116                                  GW05470
      IF (IV(I,J+1)-2) 131,131,130                                        GW05480
  129 IF(IV(I,J+1).EQ.3) D=(-CSD(I)+CPZ(I)+CPS(I))*H(I,J,2)+WQ            GW05490
      IF (IV(I,J+1).EQ.3) GO TO 132                                       GW05500
      D=((T(I,J)+T(I,J+1))/X2*(Y1+Y2)/2.-CSD(I)+CPZ(I)+CPS(I))*H(I,J,2)-  GW05510
     1((T(I,J)+T(I,J+1))/X2*(Y1+Y2)/2.)*H(I,J+1,2)+WQ                     GW05520
      GO TO 132                                                           GW05530
  130 D=-((T(I,J-1)+T(I,J))/X1*(Y1+Y2)/2.)*H(I,J-1,2)+((T(I,J-1)+T(I,J))  GW05540
     1/X1*(Y1+Y2)/2.-CSD(I)+CPZ(I)+CPS(I))*H(I,J,2)+WQ                    GW05550
      GO TO 132                                                           GW05560
  131 IF (IV(I,J-1).NE.3.OR.IV(I,J+1).NE.3) D=-((T(I,J-1)+T(I,J))*(Y1+Y2  GW05570
     1)/(4.*X1))*H(I,J-1,2)+((T(I,J-1)+T(I,J))*(Y1+Y2)/(4.*Y1)+(T(I,J)+T  GW05580
     2(I,J+1))*(Y1+Y2)/(4.*X2)-CSD(I)+CPZ(I)+CPS(I))*H(I,J,2)-((T(I,J)+T  GW05590
     3(I,J+1))*(Y1+Y2)/(4.*X2))*H(I,J+1,2)+WQ                             GW05600
  132 IF (IV(I,J-1).EQ.3.OR.IV(I,J+1).EQ.3) WQ=WQ/2.                      GW05610
      IF (IV(I-1,J).EQ.3.OR.IV(I+1,J).EQ.3) WQ=WQ/2.                      GW05620
      SWQ=SWQ+WQ*DTIME(K)/2.                                              GW05630
      W(I)=B-A*C(I-1,J)/W(I-1)                                            GW05640
      G(I)=(D-A*G(I-1))/W(I)                                              GW05650
      IF (ABS(G(I)).LT.1.0E-20) G(I)=0.                                   GW05660
      GO TO 134                                                           GW05670
  133 G(I)=H(I,J,3)                                                       GW05680
```

```
      W(I)=1.0                                                          GW05690
      C(I,J)=0.0                                                        GW05700
  134 IF (M1-I) 135,135,140                                             GW05710
  135 CONTINUE                                                          GW05720
      IF (IV(M,J).EQ.1) H(M,J,3)=G(M)                                   GW05730
      M2=M-2                                                            GW05740
      DO 139 IM=1,M2                                                    GW05750
      IDUM=M-IM                                                         GW05760
      IF (H(IDUM+1,J,3).GE.1.0E-20.OR.H(IDUM+1,J,3).LE.-1.0E-20) GO TO 1 GW05770
     136                                                                GW05780
      H(IDUM+1,J,3)=0.0                                                 GW05790
  136 CONTINUE                                                          GW05800
      IF (IV(IDUM,J).EQ.1) H(IDUM,J,3)=G(IDUM)-C(IDUM,J)*H(IDUM+1,J,3)/W GW05810
     1(IDUM)                                                            GW05820
      IF(IV(IDUM,J).NE.1) GO TO 139                                     GW05830
      IF (IV(IDUM,J-1).NE.3.AND.IV(IDUM,J+1).NE.3) GO TO 137            GW05840
      CSD(IDUM)=CSD(IDUM)/2.                                            GW05850
      CPZ(IDUM)=CPZ(IDUM)/2.                                            GW05860
      CPS(IDUM)=CPS(IDUM)/2.                                            GW05870
      CET(IDUM) = CET(IDUM)/2.                                          GW05880
  137 IF (IV(IDUM-1,J).NE.3.AND.IV(IDUM+1,J).NE.3) GO TO 138            GW05890
      CSD(IDUM)=CSD(IDUM)/2.                                            GW05900
      CPZ(IDUM)=CPZ(IDUM)/2.                                            GW05910
      CPS(IDUM)=CPS(IDUM)/2.                                            GW05920
      CET(IDUM) = CET(IDUM)/2.                                          GW05930
  138 SRSD=SRSD+(H(IDUM,J,3)-H(IDUM,J,1))*CSD(IDUM)*DTIME(K)/2.         GW05940
      SHED=(H(IDUM,J,1)+2.*H(IDUM,J,2)+H(IDUM,J,3))/4.                  GW05950
      SRPZ=SRPZ+SHED*CPZ(IDUM)*DTIME(K)*2.                              GW05960
      SRPS=SRPS+SHED*CPS(IDUM)*DTIME(K)*2.                              GW05970
      SCET = SCET+SHED*CET(IDUM)*DTIME(K)                               GW05980
  139 CONTINUE                                                          GW05990
  140 CONTINUE                                                          GW06000
  141 CONTINUE                                                          GW06010
      DO 150 I=2,M1                                                      GW6015
      DO 149 KX=2,3                                                     GW06020
      IF (IV(I,J).NE.2) GO TO 150                                       GW06030
      IF (IV(I-1,J).EQ.3) GO TO 142                                     GW06040
      Q1(KX)=(T(I-1,J)/2.+T(I,J)/2.)*((H(I-1,J,KX)-H(I,J,KX))/YY1(I))*(X GW06050
     1X1(I)/2.+XX2(I)/2.)                                               GW06060
      IF (IV(I-1,J-1).EQ.3.AND.IV(I-1,J+1).EQ.3) GO TO 143              GW06070
      IF (IV(I-1,J-1).EQ.3.OR.IV(I-1,J+1).EQ.3) Q1(KX)=Q1(KX)/2.        GW06080
      GO TO 143                                                         GW06090
  142 Q1(KX)=0.                                                         GW06100
  143 IF (IV(I+1,J).EQ.3) GO TO 144                                     GW06110
      Q2(KX)=(T(I,J)/2.+T(I+1,J)/2.)*(H(I+1,J,KX)-H(I,J,KX))/YY2(I)*(XX1 GW06120
     1(I)/2.+XX2(I)/2.)                                                 GW06130
      IF (IV(I+1,J-1).EQ.3.AND.IV(I+1,J+1).EQ.3) GO TO 145              GW06140
      IF (IV(I+1,J-1).EQ.3.OR.IV(I+1,J+1).EQ.3) Q2(KX)=Q2(KX)/2.        GW06150
      GO TO 145                                                         GW06160
  144 Q2(KX)=0.                                                         GW06170
  145 IF (IV(I,J-1).EQ.3) GO TO 146                                     GW06180
      Q3(KX)=(T(I,J-1)/2.+T(I,J)/2.)*(H(I,J-1,KX)-H(I,J,KX))/XX1(I)*(YY1 GW06190
     1(I)/2.+YY2(I)/2.)                                                 GW06200
```

```
      IF (IV(I-1,J-1).EQ.3.AND.IV(I+1,J-1).EQ.3) GO TO 147               GW06210
      IF (IV(I-1,J-1).EQ.3.OR.IV(I+1,J-1).EQ.3) Q3(KX)=Q3(KX)/2.         GW06220
      GO TO 147                                                          GW06230
  146 Q3(KX)=0.                                                          GW06240
  147 IF (IV(I,J+1).EQ.3) GO TO 148                                      GW06250
      Q4(KX)=(T(I,J)/2.+T(I,J+1)/2.)*(H(I,J+1,KX)-H(I,J,KX))/XX2(I)*(YY1 GW06260
     1(I)/2.+YY2(I)/2.)                                                  GW06270
      IF (IV(I-1,J+1).EQ.3.AND.IV(I+1,J+1).EQ.3) GO TO 149               GW06280
      IF (IV(I-1,J+1).EQ.3.OR.IV(I+1,J+1).EQ.3) Q4(KX)=Q4(KX)/2.         GW06290
      GO TO 149                                                          GW06300
  148 Q4(KX)=0.                                                          GW06310
  149 CONTINUE                                                           GW06320
      QT(I,J)=Q1(3)+Q2(3)+Q3(3)+Q4(3)                                    GW06330
      QS=QS+(QT(I,J)+Q1(2)+Q2(2)+Q3(2)+Q4(2))/2.                         GW06340
  150 CONTINUE                                                           GW06350
  151 CONTINUE                                                           GW06360
      QS=QS/2.                                                           GW06365
      QTT=QS*DTIME(K)                                                    GW06370
      QSTR=QSTR+QTT                                                      GW06380
C     CBAL -- CUMULATIVE RESIDUAL FROM MASS BALANCE COMPUTATION          GW06390
      CBAL=-SRSD-SWQ-QSTR-SRPZ-SRPS-SCET                                 GW06400
      BAL=(CBAL*100.)/((ABS(SRSD)+ABS(SRPZ)+ABS(SRPS)+ABS(QSTR)+ABS(SWQ) GW06410
     1+ABS(SCET))/2.)                                                    GW06420
      IDF=K                                                              GW06430
      TIM(IDF)=TTIME(K)                                                  GW06440
C     IPCO(1)=1 --PRINT HEADS AT DESIGNATED NODES AT EACH COMPUTATION    GW06450
      IF (IPCO(1).NE.1) GO TO 154                                        GW06460
      WRITE (IPT,208) TIM(IDF)                                           GW06470
      WRITE (IPT,217) BAL                                                GW06480
      WRITE (IPT,209)                                                    GW06490
      DO 153 I=1,20                                                      GW06500
      JT=JF(I)                                                           GW06510
      IT=IF(I)                                                           GW06520
      IF (IT.GT.0.OR.JT.GT.0) GO TO 152                                  GW06530
      GO TO 153                                                          GW06540
  152 WRITE (IPT,211) IT,JT,H(IT,JT,3)                                   GW06550
  153 CONTINUE                                                           GW06560
C     IPCO(2) -- PUNCH CARDS FOR RIVER-INDUCED FLUCTUATIONS PROGRAM      GW06570
  154 IF (IPCO(2).NE.1) GO TO 156                                        GW06580
      DO 155 I=1,20                                                      GW06590
      IT=IF(I)                                                           GW06600
      JT=JF(I)                                                           GW06610
      IF (IT.EQ.0.OR.JT.EQ.0) GO TO 156                                  GW06620
      DUHF=H(IT,JT,3)                                                    GW06630
      WRITE (8,210) DUHF,TIM(IDF),IT,JT                                  GW06640
  155 CONTINUE                                                           GW06650
  156 CONTINUE                                                           GW06660
      DO 158 KC=1,LC                                                     GW06670
      IF (TTIME(K).EQ.CTIME(KC)) GO TO 157                               GW06680
      GO TO 158                                                          GW06690
  157 CONTINUE                                                           GW06700
C     IPCO(3)=1 --PRINT MAP OF HEADS IN SYMBOLIC FORM AT CTIMES          GW06710
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      IF (IPCO(3).EQ.1) CALL BETA (H,M,N,TTIME,PS,Q,IV,K,L,BAL)            GW06720
C     IF IPCO(5)=1-- PRINT FLOW TO FULLY PENETRATING STREAMS               GW06721
      IF (IPCO(5).NE.1)GO TO 221                                           GW06722
      WRITE (IPT,220) QS                                                   GW06723
C     IPCO(4)=1 --PRINT ALL HEAD VALUES AT CTIMES                          GW06730
  221 IF (IPCO(4).NE.1) GO TO 159                                          GW06740
      WRITE (IPT,216)                                                      GW06750
      WRITE (IPT,212) TTIME(K)                                             GW06760
      WRITE (IPT,217) BAL                                                  GW06770
      WRITE (IPT,213)                                                      GW06780
      WRITE (IPT,214) ((J,I,H(I,J,3),J=1,N),I=1,M)                         GW06790
      GO TO 159                                                            GW06800
  158 CONTINUE                                                             GW06810
  159 CONTINUE                                                             GW06820
      DO 160 I=1,M                                                         GW06830
      DO 160 J=1,N                                                         GW06840
  160 H(I,J,1)=H(I,J,3)                                                    GW06850
      IF (TTIME(K).EQ.QPER(NS)) GO TO 162                                  GW06860
  161 CONTINUE                                                             GW06870
  162 LIMIT=IDF                                                            GW06880
  163 CONTINUE                                                             GW06890
      STOP                                                                 GW06900
C                                                                          GW06910
C                                                                          GW06920
  165 FORMAT (2F10.1,2I5,2F10.1)                                           GW06930
  166 FORMAT (80I1)                                                        GW06940
  167 FORMAT (//45X,'NODE LEVEL MAP OF FLOW SYSTEM',//45X,'EXPLANATION',   GW06950
     1//45X,'1 -- INSIDE FLOW SYSTEM WITH HEAD NOT SPECIFIED',/45X,'2 --   GW06960
     2INSIDE FLOW SYSTEM WITH HEAD SPECIFIED',/,45X,'3 -- OUTSIDE FLOW S   GW06970
     3YSTEM',//(50X,80I1))                                                 GW06980
  168 FORMAT (2I2,2F10.1,2I2,2F10.1)                                       GW06990
  169 FORMAT (4I1,4E8.1)                                                   GW07000
  170 FORMAT (//45X,'TRANSMISSIVITY -- ',F10.1)                            GW07010
  171 FORMAT (//45X,'COEFFICIENT OF STORAGE -- ',F12.6)                    GW07020
  172 FORMAT (//45X,'CONDUCTIVITY OF STREAM AND LAKE BED MATERIAL -- ',F   GW07030
     112.6)                                                                GW07040
  173 FORMAT (//45X,'THICKNESS OF STREAM AND LAKE BED MATERIAL -- ',F5.0   GW07050
     1)                                                                    GW07060
  174 FORMAT (//45X,'CONDUCTIVITY OF AQUITARD -- ',F12.6)                  GW07070
  175 FORMAT (//45X,'THICKNESS OF AQUITARD -- ',F5.0)                      GW07080
  176 FORMAT (//45X,'TRANSMISSIVITY MAP OF AQUIFER',/45X,'EXPLANATION',/   GW07090
     1/45X,'SYMBOL',3X,'TRANSMISSIVITY',/(47X,A1,14X,F10.1))               GW07100
  177 FORMAT (//45X,'COEFFICIENT OF STORAGE MAP OF AQUIFER',//45X,'SYMBO   GW07110
     1L',3X,'COEFFICIENT OF STORAGE',/(47X,A1,14X,F10.8))                  GW07120
  178 FORMAT (//45X,'MAP OF CONDUCTIVITY OF STREAM AND LAKE BED MATERIAL   GW07130
     1',//45X,'SYMBOL',5X,'HYDRAULIC CONDUCTIVITY',/(47X,A1,14X,F12.6))    GW07140
  179 FORMAT (//45X,'MAP OF THICKNESS OF STREAM AND LAKE BED MATERIAL',/   GW07150
     1/45X,'SYMBOL',13X,'THICKNESS',/(47X,A1,18X,F5.0))                    GW07160
  180 FORMAT (//45X,'MAP OF VERTICAL CONDUCTIVITY OF AQUITARD',//45X,'SY   GW07170
     1MBOL',8X,'HYDRAULIC CONDUCTIVITY',/(47X,A1,14X,F12.6))               GW07180
  181 FORMAT (//45X,'MAP OF THICKNESS OF AQUITARD',//45X,'SYMBOL',14X,'T   GW07190
     1HICKNESS',/(47X,A1,19X,F5.0))                                        GW07200
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182 FORMAT (40I2)                                                      GW07210
183 FORMAT (//45X,'INITIAL ELEVATION OF POTENTIOMETRIC SURFACE -- ',F5 GW07220
   1.0,//45X,'NUMBER OF ROWS -- ',I5,3X,'NUMBER OF COLUMNS -- ',I5,//4 GW07230
   25X,'NODE SPACING -- ',F10.1,'FEET')                                GW07240
184 FORMAT (/30X,'IN THE AREA TO THE LEFT OF COLUMN',1X,I2,1X,'AND TO  GW07250
   1THE RIGHT OF ',1X,I2,1X,'THE NODE SPACING IS',1X,F10.1,1X,'FEET')  GW07260
185 FORMAT (/30X,'IN THE AREA ABOVE ROW',1X,I2,1X,'AND BELOW ROW',1X,I GW07270
   12,1X,'THE NODE SPACING IS',1X,F10.1,1X,'FEET')                     GW07280
186 FORMAT (I3)                                                        GW07290
187 FORMAT (//45X,'NUMBER OF BOUNDARY SETS -- ',I3)                    GW07300
188 FORMAT (12F6.1)                                                    GW07310
189 FORMAT (45X,'BOUNDARY SET',5X,'DURATION')                          GW07320
190 FORMAT (50X,I2,6X,F12.2)                                           GW07330
191 FORMAT (2I1,2E8.1)                                                 GW07340
192 FORMAT (45X,'ACCRETION RATE TO AQUIFER, IN FEET PER DAY -- ',F12.6 GW07350
   1)                                                                  GW07360
193 FORMAT (45X,'CHANGE IN EVAPOTRANSPIRATION,',/45X,'IN FEET PER DAY, GW07370
   1 PER CHANGE IN HEAD, IN FEET -- ',F12.6)                           GW07380
194 FORMAT (//45X,'MAP OF ACCRETION TO AQUIFER',/45X,'SYMBOL',3X,'ACCR GW07390
   1ETION, IN FEET PER DAY',/(47X,A1,14X,F12.6))                       GW07400
195 FORMAT (//45X,'MAP OF CHANGE IN EVAPOTRANSPIRATION PER UNIT CHANGE GW07410
   1 IN HEAD',/45X,'SYMBOL',3X,'CHANGE IN EVAPOTRANSPIRATION, IN FEET  GW07420
   2PER DAY',/61X,'PER FOOT CHANGE IN HEAD',/(47X,A1,14X,F12.6))       GW07430
196 FORMAT (///45X,'NUMBER OF WITHDRAWAL RATES -- ',I3)                GW07440
197 FORMAT (//45X,'WITHDRAWAL RATE, CUBIC FEET PER DAY -- ',F12.2)     GW07450
198 FORMAT (E10.3)                                                     GW07460
199 FORMAT (40I2)                                                      GW07470
200 FORMAT (44X,4(3X,'ROW',1X,'COL'))                                  GW07480
201 FORMAT (47X,I2,2X,I2,4X,I2,2X,I2,4X,I2,2X,I2,4X,I2,2X,I2)          GW07490
202 FORMAT (//45X,'NUMBER OF STREAM STAGES -- ',I3)                    GW07500
203 FORMAT (45X,'STREAM STAGE -- ',F12.6)                              GW07510
204 FORMAT (F5.0)                                                      GW07520
205 FORMAT (40I2)                                                      GW07530
206 FORMAT (I2)                                                        GW07540
207 FORMAT (////45X,'BOUNDARY CONDITIONS FOR SET',I5)                  GW07550
208 FORMAT (//45X,'TIME, IN DAYS -- ',F12.5)                           GW07560
209 FORMAT (/45X,'ROW',3X,'COLUMN',8X,'HEAD')                          GW07570
210 FORMAT (F10.8,F10.5,50X,2I5)                                       GW07580
211 FORMAT (46X,I2,5X,I2,5X,F12.5)                                     GW07590
212 FORMAT (//,45X,'TIME, IN DAYS -- ',F10.1)                          GW07600
213 FORMAT (/,1X,4(2X,'COL',2X,'ROW',2X,'HEAD',5X))                    GW07610
214 FORMAT (/(5(2I5,E11.3)))                                           GW07620
215 FORMAT (10E8.3)                                                    GW07630
216 FORMAT (1H1)                                                       GW07640
217 FORMAT (/45X,'CUMULATIVE MASS BALANCE RESIDUAL, PERCENT OF TOTAL F GW07650
   1LUX -- ',E10.3)                                                    GW07660
218 FORMAT (5I1)                                                       GW07670
220 FORMAT (//45X,'FLOW TO STREAM, IN CUBIC FEET PER DAY_ ',E11.3)     GW07675
    END                                                                GW07680
    SUBROUTINE ALPHA (AT,PAR,M,N,IRD,IPT,NS)                           GW07690
    DIMENSION AT(64,2)                                                 GW07700
    DIMENSION PAR(M,N)                                                 GW07710
    DIMENSION CARD(80)                                                 GW07720
    IRD=5                                                              GW07730
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      IPT=6                                                             GW07740
      READ (IRD,8) NS                                                   GW07750
      READ (IRD,5) (AT(IAT,1),AT(IAT,2),IAT=1,NS)                       GW07760
      WRITE (IPT,9)                                                     GW07770
      DO 4 MIX=1,M                                                      GW07780
      READ (IRD,7) (CARD(KIX),KIX=1,N)                                  GW07790
      WRITE (IPT,6) (CARD(KIX),KIX=1,N)                                 GW07800
      DO 3 J=1,N                                                        GW07810
      DO 1 I=1,NS                                                       GW07820
      IF (CARD(J).EQ.AT(I,1)) GO TO 2                                   GW07830
    1 CONTINUE                                                          GW07840
    2 PAR(MIX,J)=AT(I,2)                                                GW07850
    3 CONTINUE                                                          GW07860
    4 CONTINUE                                                          GW07870
      RETURN                                                            GW07880
C                                                                       GW07890
C                                                                       GW07900
    8 FORMAT (I2)                                                       GW07940
    9 FORMAT (1H1)                                                      GW07950
    5 FORMAT (8(A1,E8.1))                                               GW07910
    6 FORMAT (44X,80A1)                                                 GW07920
    7 FORMAT (80A1)                                                     GW07930
      END                                                               GW07960
      SUBROUTINE BETA (H,M,N,TTIME,PS,Q,IV,K,L,BAL)                     GW07970
      DIMENSION TOW(80), SYMBOL(25)                                     GW07980
      DIMENSION H(M,N,3), TTIME(L), HEDRGE(30)                          GW07990
      DIMENSION PS(M,N), Q(M,N), PNT(80)                                GW08000
      INTEGER*2 IV(34,80)                                               GW08010
      DATA SYMBOL/' ','$','*','=','A','B','C','D','E','F','G','H','I','J GW08020
     1','K','L','M','N','O','P','Q','R','S','T','U'/                    GW08030
      DATA TOW/'1','2','3','4','5','6','7','8','9','0','1','2','3','4','GW08040
     15','6','7','8','9','0','1','2','3','4','5','6','7','8','9','0','1'GW08050
     2,'2','3','4','5','6','7','8','9','0','1','2','3','4','5','6','7','GW08060
     38','9','0','1','2','3','4','5','6','7','8','9','0','1','2','3','4'GW08070
     4,'5','6','7','8','9','0','1','2','3','4','5','6','7','8','9','0'/ GW08080
      IRD=5                                                             GW08090
      IPT=6                                                             GW08100
C     EXAMINE HEADS TO DETERMINE MAXIMUM AND MINIMUM HEADS              GW08110
      XMX=0.0                                                           GW08120
      XMN=9999999.                                                      GW08130
      M1=M-1
      N1=N-1                                                            GW08140
      DO 1 I=2,M1
      DO 1 J=2,N1
      IF (H(I,J,3).GT.XMX) XMX=H(I,J,3)                                 GW08170
    1 IF (H(I,J,3).LT.XMN) XMN=H(I,J,3)                                 GW08180
      XIT=20.0                                                          GW08190
      DIV=ABS((XMX-XMN)/XIT)                                            GW08200
      IXIT=XIT+5.                                                       GW08210
      WRITE (IPT,18) TTIME(K)                                           GW08220
      WRITE (IPT,22) BAL                                                GW08230
      WRITE (IPT,19)                                                    GW08240
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      HEDRGE(5)=XMN                                                     GW08250
      DO 2 I=6,IXIT                                                     GW08260
    2 HEDRGE(I)=HEDRGE(I-1)+DIV                                         GW08270
      DO 4 I=5,IXIT                                                     GW08280
      IF (I.EQ.IXIT) GO TO 3                                            GW08290
      GO TO 4                                                           GW08300
    3 WRITE (IPT,21) SYMBOL(I),HEDRGE(I)                                GW08310
      WRITE (IPT,20)                                                    GW08320
      GO TO 5                                                           GW08330
    4 WRITE (IPT,17) SYMBOL(I),HEDRGE(I),HEDRGE(I+1)                    GW08340
C     RUN THROUGH  MATRIX  ONE ROW AT A TIME                            GW08350
    5 DO 15 I=1,M                                                       GW08360
      DO 14 J=2,N1                                                      GW08370
      PNT(N)=TOW(I)                                                     GW08380
      PNT(1)=TOW(I)                                                     GW08390
      IF (I.EQ.1.OR.I.EQ.M) GO TO 6                                     GW08400
      GO TO 7                                                           GW08410
    6 WRITE (IPT,16) (TOW(IT),IT=1,N)                                   GW08420
      GO TO 15                                                          GW08430
C     CHECK IF POINT IS LOCATION OF WELL, STREAM, LAKE                  GW08440
    7 IF (IV(I,J).EQ.3) GO TO 8                                         GW08450
      IF (IV(I,J).EQ.2) GO TO 9                                         GW08460
      IF (Q(I,J).GT.0.0) GO TO 10                                       GW08470
      IF (PS(I,J).GT.0.0) GO TO 11                                      GW08480
      GO TO 12                                                          GW08490
    8 IH=1                                                              GW08500
      GO TO 13                                                          GW08510
    9 IH=2                                                              GW08520
      GO TO 13                                                          GW08530
   10 IH=3                                                              GW08540
      GO TO 13                                                          GW08550
   11 IH=4                                                              GW08560
      GO TO 13                                                          GW08570
C     SELECT SYMBOL FOR HEAD                                            GW08580
   12 IH=ABS((H(I,J,3)-XMN)/DIV)+5.0                                    GW08590
   13 PNT(J)=SYMBOL(IH)                                                 GW08600
   14 CONTINUE                                                          GW08610
C     WRITE ONE LINE                                                    GW08620
      WRITE (IPT,16) (PNT(J),J=1,N)                                     GW08630
   15 CONTINUE                                                          GW08640
      RETURN                                                            GW08650
C                                                                       GW08660
C                                                                       GW08670
   16 FORMAT (45X,80A1)                                                 GW08680
   17 FORMAT  (47X,A1,6X,F10.2,'-',F10.2)                               GW08690
   18 FORMAT ('1',45X' MAP OF HEAD DISTRIBUTION IN AQUIFER',//45X,'TIME GW08700
     1-- ',F10.2,//45X,'$ -- FULLY PENETRATING STREAM OR LAKE',//45X,'= GW08710
     2-- PARTIALLY PENETRATING STREAM OR LAKE',//45X,'* -- PUMPING WELL GW08720
     3'/)                                                               GW08730
   19 FORMAT (//45X,'SYMBOL',13X,'HEAD,IN FEET',//)                     GW08740
   20 FORMAT (//)                                                       GW08750
   21 FORMAT  (47X,A1,6X,F12.2)                                         GW08760
   22 FORMAT (/45X,'CUMULATIVE MASS BALANCE RESIDUAL, PERCENT OF TOTAL F GW08770
     1LUX -- ',F10.3)                                                   GW08780
      END                                                               GW08790
```

TABLE 5.—RIVER—INDUCED FLUCTUATIONS PROGRAM LISTING

```
C     ***************************************************************************
C     ***************************************************************************
C
C
C                        RIVEP-INDUCED FLUCTUATIONS PROGRAM
C                        RIVEP-INDUCED FLUCTUATIONS PROGRAM
C                        RIVER-INDUCED FLUCTUATIONS PROGRAM
C
C          PROGRAMMED BY M.S. BEDINGER, J.E. REED, AND J.D. GRIFFIN
C                   UTILIZING  PROGRAM BY BRENT LOWELL
C
C                        DATF OF THIS VERSION -- 30 JULY 1971
C     ***************************************************************************
C     ***************************************************************************
C   DIMENSIONS THAT MAY INCREASE WITH AMOUNT OF INPUT
C********************************************************************************
C  ARRAY NAME       *     MINIMUM DIMENSION
C********************************************************************************
C   IYR             *
C   MON             *     3000+ICNT
C   IDAY            *
C********************************************************************************
C   WI              *
C   ICODE           *
C   IDAP            *     3*(ICNT-KCNT)
C   PLOTH           *
C   IOFF            *
C   IPLT            *
C********************************************************************************
C   SO              *
C   OBS             *
C   DATHLD          *
C   DIFF            *     ICNT
C   DUH             *
C   COEF            *
C   DELTA           *
C********************************************************************************
C   NMON            *
C   NIDAY           *
C   NIYR            *     NICNT
C   SIGN            *
C   DOBS            *
C********************************************************************************
C   TIM             *     LIMIT
C   DUHF            *
C********************************************************************************
C   HYDR            *     ICNT-KCNT
C********************************************************************************
C     ---------------------------------------------------------------------------
      DIMENSION   DUHF(100) , DUH(1000), COFF(1000), DFLTA(1000),
     1HYDR(1000),       SO(1000), DIFF(1000), OBS(1000), DATHLD(1000), TI
     2M(100), NMON(1000), NIDAY(1000), NIYR(1000), SIGN(1000),DOBS(1000)
```

```
      INTEGER*2 JD(1000)                                                RI 00200
      DIMENSION TEMP(31)                                                RI 00210
      COMMON /HYORG/ W1(3000),ICODE(3000),IYR(4000),MON(4000),IDAY(4000)RI 02730
     1,HSCAL(5),VSCAL(5),IMON(2),NYR(2)
      COMMON /DDORG/ NA(46),MN(13),MDAY(12)
      INTEGER*2 ICODE,IYR,MON,IDAY                                      RI 00240
      COMMON /HEAD/ IC1,IC2,IC3,IC4,IC5,IC6,IC7,IC8,IC9,IC10,IC11,IC12,IRI 00250
     1C13,IC14,IC15,IC16,IC17,IC18,IC19,IC20                            RI 00260
      EQUIVALENCE (COEF(1),W1(1)),(DUH(1),DELTA(1),ICODE(1))            RI 00270
   60 READ (5,31) (IMON(I),NYR(I),I=1,2)                                RI 00680
   61 READ (5,33) RIVDAT,OBSDAT                                         RI 00750
      DO 50 I=1,1000
   50 SO(I)=0.
      DO 54 I=1,2000
      IYR(I)=NA(37)
      MON(I)=NA(37)
   54 IDAY(I)=NA(37)
C     ICNT - NUMBER OF RIVER STAGES TO BE READ IN                       RI 00760
   62 READ (5,34) ICNT                                                  RI 00770
C     READ IN DATA                                                      RI 00780
C          MON(I) = MONTH OF MEASUREMENT                                RI 00790
C         IDAY(I) = DAY OF MEASUREMENT                                  RI 00800
C          IYR(I) = YEAR OF MEASUREMENT                                 RI 00810
C           SO(I) = RIVER STAGE OR LEVEL IN FEET OF ELEVATION ABOVE     RI 00820
C                   MEAN SEA LEVEL                                      RI 00830
      I=0                                                               RI 00840
    4 READ (5,35) IYRD,IMOND,(TEMP(J),J=1,10)                           RI 00850
      IF (MOD(IYRD,4).EQ.0.AND.IMOND.EQ.2) MDAY(2)=29                   RI 00860
      ISTOPM=MDAY(IMOND)                                                RI 00870
   63 READ (5,36) (TEMP(J),J=11,ISTOPM)                                 RI 00880
      MDAY(2)=28                                                        RI 00890
      DO 5 J=1,ISTOPM                                                   RI 00900
      I=I+1                                                             RI 00910
      IYR(I)=IYRD                                                       RI 00920
      MON(I)=IMOND                                                      RI 00930
      IDAY(I)=J                                                         RI 00940
    5 SO(I)=TEMP(J)                                                     RI 00950
      IF (I.LT.ICNT) GO TO 4                                            RI 00960
C     NRUNS IS NUMBER OF RUNS TO BE MADE
   51 FORMAT (I4)
   64 READ (5,51) NRUNS
      DO 52 IZ=1,NRUNS
      ITIME=1                                                           RI 00310
    1 DO 2 I=1,1000                                                     RI 00320
      DUH(I)=0.                                                         RI 00340
      COEF(I)=0.                                                        RI 00350
      DELTA(I)=0.                                                       RI 00360
      HYDR(I)=0.                                                        RI 00370
      DIFF(I)=0.                                                        RI 00390
      OBS(I)=-34.                                                       RI 00400
    2 DATHLD(I)=0.                                                      RI 00410
      DO 3 I=1,2000                                                     RI 00430
```

```
      W1(I)=0.                                                          RI 00440
    3 ICODE(I)=NA(37)                                                   RI 00450
C     HSCAL - SCALE IN FEET ACROSS A 10-INCH HYDROGRAPH.  PROGRAM SELECTRI 00490
C        ONE OF FIVE SCALES READ IN                                     RI 00500
C     VSCAL - TIME SCALE INTERVAL.  PROGRAM SELECTS ONE OF FIVE SCALES  RI 00510
C        CORRESPONDING TO THE HSCAL (I.E. IF HSCAL (2) IS SELECTED,     RI 00520
C        VSCAL(2) WILL BE SELECTED                                      RI 00530
C     VSCAL THAT CAN BE USED --                                         RI 00540
C        1.  = 1 DAY PER LINE                                           RI 00550
C        2.5 = 2.5 DAYS PER LINE                                        RI 00560
C        5.  = 5 DAYS PER LINE                                          RI 00570
C        10. = 10 DAYS PER LINE                                         RI 00580
C        30. = 30 DAYS PER LINE                                         RI 00590
   65 READ (5,30) (HSCAL(I),I=1,5),(VSCAL(I),I=1,5)                     RI 00600
      IF (HSCAL(1).EQ.0.) GO TO 27                                      RI 00610
C     IMON(I), NYR(I) , I=1,2 - BEGINNING AND ENDING DATES ( MONTH AND  RI 00620
C        YEAR) OF HYDROGRAPH, RESPECTIVELY.  HYDROGRAPH WILL BEGIN AT   RI 00630
C        IMON(1), NYR(1) IF EFFECT OF ANTECEDENT RIVER STAGES HAVE BEEN RI 00640
C        ACCOUNTED FOR                                                  RI 00650
C     IF IMON(2), NYR(2) IS CODED BLANK, HYDROGRAPH WILL PLOT TO END OF RI 00660
C        DATA                                                           RI 00670
   66 READ (5,32) IC1,IC2,IC3,IC4,IC5,IC6,IC7,IC8,IC9,IC10,IC11,IC12,IC1RI 00690
     13,IC14,IC15,IC16,IC17,IC18,IC19,IC20                              RI 00700
C     RIVDAT - DATUM FOR RIVER HYDROGRAPH WITH REFERENCE TO ZERO OF     RI 00710
C        GAGE                                                           RI 00720
C     OBSDAT - DATUM FOR GROUNDWATER HYDROGRAPH WITH REFERENCE TO       RI 00730
C        LAND SURFACE                                                   RI 00740
C     NICNT - NUMBER OF GROUND-WATER LEVELS TO BE READ IN               RI 00970
   67 READ (5,37) NICNT                                                 RI 00980
C     DOBS(1) MUST NOT BE AT AN EARLIER DATE THAN SO(1)                 RI 00990
C     AND DOBS(NICNT) MUST NOT BE A LATER DATE THAN SO(ICNT)            RI 01000
   68 READ (5,38) (NMON(I),NIDAY(I),NIYR(I),SIGN(I),DOBS(I),I=1,NICNT)  RI 01010
      DO 8 I=1,NICNT                                                    RI 01020
      DO 6 J=1,ICNT                                                     RI 01030
      IF (NIYR(I).EQ.IYR(J).AND.NMON(I).EQ.MON(J).AND.NIDAY(I).EQ.IDAY(JRI 01040
     1)) GO TO 7                                                        RI 01050
    6 CONTINUE                                                          RI 01060
    7 OBS(J)=DOBS(I)                                                    RI 01070
      JD(I)=J                                                           RI 01080
      DOBS(I)=OBSDAT-DOBS(I)                                            RI 01090
    8 CONTINUE                                                          RI 01100
      DO 9 I=1,ICNT                                                     RI 01110
      OBS(I)=OBSDAT-OBS(I)                                              RI 01120
    9 CONTINUE                                                          RI 01130
      SUMOB=0.                                                          RI 01140
      DO 10 I=2,NICNT                                                   RI 01150
      SUMOB=SUMOB+(JD(I)-JD(I-1))*(DOBS(I)+DOBS(I-1))/2.                RI 01160
   10 CONTINUE                                                          RI 01170
      AOBS=SUMOB/(JD(NICNT)-JD(1))                                      RI 01180
C                                                                       RI 01190
C     COMPUTE DIFFERENCES BETWEEN STREAM STAGES AND STORE IN ARRAY DIFF RI 01200
C                                                                       RI 01210
```

TABLE 5.—RIVER-INDUCED FLUCTUATIONS PROGRAM LISTING—CONTINUED

```
      IK=ICNT-1
      DO 11 I=2,IK
   11 DATHLD(I)=SO(I)-RIVDAT
      DO 12 I=2,IK
   12 DIFF(I-1)=DATHLD(I)-DATHLD(I-1)
   69 READ (5,41) KLIMIT
      LIMIT=KLIMIT+1
C     DUHF(I) MUST BE A MONOTONIC SEQUENCE WITH TIM(1) = DUHF(1) = 0.
   70 READ (5,42) (DUHF(I),TIM(I),I=2,LIMIT)
C     AND WITH DUHF(LIMIT) = 1. OR WITH TIM(LIMIT) > OR = ICNT*ITIME
      DUHF(1)=0.
      TIM(1)=0.
      DO 17 K=1,ICNT
      TIMF=FLOAT(K)*FLOAT(ITIME)
      DO 16 J=1,LIMIT
      IF (TIMF-TIM(J)) 13,14,15
   13 DUH(K)=DUHF(J-1)+((TIMF-TIM(J-1))/(TIM(J)-TIM(J-1)))*(DUHF(J)-DUHF
     1(J-1))
      GO TO 17
   14 DUH(K)=DUHF(J)
      GO TO 17
   15 IF (TIME.GE.TIM(LIMIT)) DUH(K)=DUHF(LIMIT)
   16 CONTINUF
   17 CONTINUE
C     WRITE (6,43)
C
C     CALCULATE COEFFICIENT OF DISTRIBUTIVE EFFECT AND STORE
C        IN ARRAY COEF
C
      COEF(1)=DUH(1)
      DO 18 J=2,ICNT
      COEF(J)=DUH(J)-DUH(J-1)
C     STOP CALCULATING COEF WHEN DUH EQUALS OR EXCEEDS .98
C     ALTERNATE STOP OCCURS WHEN LAST DUH IS REACHED
      IF (DUH(J).GE.0.98) GO TO 19
      GO TO 18
   18 CONTINUE
   19 KCNT=TIM(LIMIT)/FLOAT(ITIME)
C     KCNT - VARIABLE INDICATING THE NUMBER OF SIGNIFICANT ANTECEDENT
C       RIVER STAGES IN COMPUTING RIVER INDUCED WATER LEVELS
C     WRITE (6,31) KCNT
C     WRITE (6,45) (DUH(I),I=1,KCNT)
C     WRITE (6,45) (COEF(J),J=1,KCNT)
      J2=ICNT-KCNT
      IKIC=1
      DO 21 I=1,ICNT
      DELTA(I)=0.
      IB=1
      IC=I
C     ARRAY ARRAY CONTAINS VALUES PRODUCED BY MULTIPLYING COEF*DIFF
C     ARRAY DELTA CONTAINS THE SUMMATION OF VALUES ACROSS EACH ROW OF
C        ARRAY ARRAY
```

```
      DO 20 J=1,IKIC                                                    RI 01740
      TEMJG=COFF(IB)*DIFF(IC)                                           RI 01750
      DELTA(I)=DELTA(I)+TEMJG                                           RI 01760
      IB=IB+1                                                           RI 01770
      IC=IC-1                                                           RI 01780
   20 CONTINUE                                                          RI 01790
      IKIC=IKIC+1                                                       RI 01800
      IF (IKIC.GE.KCNT) IKIC=KCNT                                       RI 01810
   21 CONTINUE                                                          RI 01820
C     ARRAY HYDR CONTAINS THE VALUES TO BE PLACED ON HYDROGRAPH - THIS  RI 01830
C        IS OBTAINED BY SUCCESIVELY ADDING THE DAILY VALUES CONTAINED INRI 01840
C        ARRAY DELTA                                                    RI 01850
      HYDR(1)=DELTA(KCNT-1)                                             RI 01860
      L=KCNT-1                                                          RI 01870
      DO 22 I=2,J2                                                      RI 01880
      L=L+1                                                             RI 01890
      HYDR(I)=HYDR(I-1)+DELTA(L)                                        RI 01900
   22 CONTINUE                                                          RI 01910
C     WRITE(6,45) (HYDR(I),I=1,1000)
   45 FORMAT (10E11.3)
      KLUD=JD(1)                                                        RI 01920
      KLOD=JD(NICNT)                                                    RI 01930
      SUMHY=0.                                                          RI 01940
      DO 23 I=KLUD,KLOD                                                 RI 01950
      SUMHY=SUMHY+HYDR(I-1)                                             RI 01960
   23 CONTINUE                                                          RI 01970
      AHYDR=SUMHY/(JD(NICNT)-JD(1))                                     RI 01980
      WRITE (6,39) AHYDR                                                RI 01990
      JDUM=J2+1                                                         RI 02000
      DO 24 I=2,JDUM                                                    RI 02010
   24 HYDR(I-1)=HYDR(I-1)+AOBS-AHYDR                                    RI 02020
C     SET THE VALUES CONTAINED IN IYR,MON,IDAY BACK IN SAME ARRAY BY    RI 02030
C        3000 POSITIONS(AS LONG AS LESS THAN 1000 DAYS OF RECORD ARE    RI 02040
C        USED). THIS IS DONE TO AVOID DESTRUCTION WHEN VALUES ARE       RI 02050
C        REPLACED BELOW TO GO INTO SUBROUTINE HYDROG                    RI 02060
C     VALUES MUST BE SET BACK AT LEAST THREE TIMES THE NUMBER OF DAYS   RI 02070
      DO 25 I=1,ICNT                                                    RI 02080
      IYR(I+3000)=IYR(I)                                                RI 02090
      MON(I+3000)=MON(I)                                                RI 02100
   25 IDAY(I+3000)=IDAY(I)                                              RI 02110
      J=0                                                               RI 02120
      K=0                                                               RI 02130
C     THE FOLLOWING TO STATEMENT  26 SETS RIVER CHANGES, CALCULATED     RI 02140
C        WELL FLUCTUATIONS, PLOTTING SYMBOL, AND DATES INTO ARRAYS      RI 02150
C        FOR USE BY SUBROUTINE HYDROG WHICH WILL PLOT THE HYDROGRAPHS.  RI 02160
      DO 26 I=KCNT,IK                                                   RI 02170
      J=J+1                                                             RI 02180
      K=K+1                                                             RI 02190
C     RIVER HYDROGRAPH VALUES                                           RI 02200
      IYR(J)=IYR(I+3000)                                                RI 02210
      MON(J)=MON(I+3000)                                                RI 02220
      IDAY(J)=IDAY(I+3000)                                              RI 02230
```

```
      ICODE(J)=28
      W1(J)=DATHLD(I)
      J=J+1
C     WELL HYDROGRAPH VALUES
      IYR(J)=IYR(I+3000)
      MON(J)=MON(I+3000)
      IDAY(J)=IDAY(I+3000)
      ICODE(J)=13
      W1(J)=HYDR(K)
C     OBSERVED WATER LEVELS IN CALCULATED WELL
      J=J+1
      IYR(J)=IYR(I+3000)
      MON(J)=MON(I+3000)
      IDAY(J)=IDAY(I+3000)
      ICODE(J)=25
      W1(J)=OBS(I)
   26 CONTINUE
C     CALL TO HYDROG TO PLOT HYDROGRAPHS - VARIABLE ARGUMENT J2 TRANSMIT
C        THE NUMBER OF VALUES IN EACH ARRAY TO THE SUBROUTINE.
      J2=J2*3
      CALL HYDROG (J2,RIVDAT,OBSDAT)
      DO 53 IJ=1,ICNT
      IYR(IJ)=IYR(IJ+3000)
      MON(IJ)=MON(IJ+3000)
   53 IDAY(IJ)=IDAY(IJ+3000)
   52 CONTINUE
      WRITE (6,40)
   27 STOP
C
C
   30 FORMAT (10F5.0)
   31 FORMAT (4I5)
   32 FORMAT (20A4)
   33 FORMAT (2F10.1)
   34 FORMAT (I5)
   35 FORMAT (9X,2I2,1X,10F6.2)
   36 FORMAT (14X,10F6.2,/,14X,11F6.2)
   37 FORMAT (I5)
   38 FORMAT (19X,3I2,A1,F6.2,1X,3I2,A1,F6.2,1X,3I2,A1,F6.2,1X,3I2,A1,F6
     1.2)
   39 FORMAT (5X,F10.2)
   40 FORMAT (1H1)
   41 FORMAT (I2)
   42 FORMAT (F10.8,F10.5)
   43 FORMAT (//,1H ,15HVALUES OF D(U)H,//)
      END
      SUBROUTINE HYDROG (NY,RIVDAT,OBSDAT)
C     SUBROUTINE HYDROG TO PLOT HYDROGRAPH.
      DIMENSION SCTOP(11), IDAP(3000), PLOTH(3000), IOFF(3000), IPLT(300
```

```
     10), IPT(100)                                                      RI 02710
      INTEGER*2 ICODE,IYR,MON,IDAY                                      RI 02720
      COMMON /HYORG/ W1(3000),ICODE(3000),IYR(4000),MON(4000),IDAY(4000)RI 02730
     1,HSCAL(5),VSCAL(5),IMON(2),NYR(2)
      COMMON /DDORG/ NA(46),MN(13),MDAY(12)
      COMMON /HEAD/ IC1,IC2,IC3,IC4,IC5,IC6,IC7,IC8,IC9,IC10,IC11,IC12,IRI 02750
     1C13,IC14,IC15,IC16,IC17,IC18,IC19,IC20                            RI 02760
      DO 1 I=1,3000                                                     RI 02770
C     IDAP(I) = NA(37)                                                  RI 02780
C     IDAP(I) = 0                                                       RI 02790
      PLOTH(I)=0.                                                       RI 02800
      IOFF(I)=0                                                         RI 02810
    1 IPLT(I)=NA(37)                                                    RI 02820
      DO 2 I=1,100                                                      RI 02830
    2 IPT(I)=NA(37)                                                     RI 02840
      WRITE (6,76)                                                      RI 02850
C     CHANGE VERTICAL SCALE VALUES(VSCAL) TO VALUES USED IN PROGRAM     RI 02860
      DO 3 I=1,5                                                        RI 02870
      IF (VSCAL(I).EQ.1.) VSCAL(I)=5.1                                  RI 02880
      IF (VSCAL(I).EQ.2.5) VSCAL(I)=2.                                  RI 02890
      IF (VSCAL(I).EQ.5.) VSCAL(I)=1.                                   RI 02900
      IF (VSCAL(I).EQ.10.) VSCAL(I)=.5                                  RI 02910
      IF (VSCAL(I).EQ.30.) VSCAL(I)=.1666667                            RI 02920
    3 IF (VSCAL(I).EQ.5.1) VSCAL(I)=5.                                  RI 02930
C     SCTOP ARRAY--STORAGE FOR HORIZONTAL SCALE PRINTED BEFORE AND      RI 02940
C                  AFTER EACH HYDROGRAPH                                RI 02950
C     IDAP ARRAY--LINES ON WHCIH DATA ARE PLOTTED (VERTICAL).           RI 02960
C     PLOTH ARRAY--PLOT POSITION OF DATA ON THE HORIZONTAL.             RI 02970
C     IOFF ARRAY--NUMBER OF TIMES PLOT IS OFF SCALE.                    RI 02980
C     IPLT ARRAY--CHARACTER OF PLOTTED POINT.                           RI 02990
C     IPT ARRAY--100 CHARACTER ARRAY FOR ARRANGING AND PRINTING         RI 03000
C                A LINE OF THE HYDROGRAPH.                              RI 03010
C     IF HIGH AND LOW WATER LEVELS ARE AT FRONT OF RECORDS AND THEY ARE RI 03020
C     NOT IN TIME SEQUENCE, MOVE STARTING POSITION UNTIL ORDERED DATA   RI 03030
C     ARE ENCOUNTERED.                                                  RI 03040
C     JYXX - POSITION OF FIRST PROPERLY TIME SEQUENCED WATER LEVEL IN   RI 03050
C         DATA ARRAYS.                                                  RI 03060
      JYXX=1                                                            RI 03070
C     AYRR - USED FOR CHECK OF DATA BEING IN TIME SEQUENCE.             RI 03080
      AYRR=IYR(1)*12.0+MON(1)+IDAY(1)/100.                              RI 03090
C     AYRR = (FLOAT(IYR(1)) * 12.) + FLOAT(MON(1))+(FLOAT(IDAY(1))/100.)RI 03100
      DO 4 I=2,NY                                                       RI 03110
C     BYRR - USED FOR CHECK OF DATA BEING IN TIME SEQUENCE.             RI 03120
C     BYRR = (FLOAT(IYR(I)) * 12.) + FLOAT(MON(I))+(FLOAT(IDAY(I))/100.)RI 03130
      BYRR=IYR(I)*12.0+MON(I)+IDAY(I)/100.                              RI 03140
      IF (AYRR.GT.BYRR) JYXX=I                                          RI 03150
    4 AYRR=BYRR                                                         RI 03160
C     DETERMINE MAXIMUM AND MINIMUM WATER LEVELS.                       RI 03170
C     SET PLOT RANGE (TIME)                                             RI 03180
C         LOWER TIME LIMIT.                                             RI 03190
C     KY - POSITION OF FIRST WATER LEVEL IN DATA ARRAY (DATE SORTED).   RI 03200
      KY=0                                                              RI 03210
```

TABLE 5.—RIVER—INDUCED FLUCTUATIONS PROGRAM LISTING—CONTINUED

```
C       JYR - USED FOR SORTING FIRST WATER LEVEL (DATE FROM CONTROL CARD).
        JYR=(NYR(1)*12)+IMON(1)
        DO 5 I=JYXX,NY
C       KYR - USED FOR SORTING FIRST WATER LEVEL (DATE FROM DATA ARRAY).
        KYR=(IYR(I)*12)+MON(I)
        IF (KYR.GE.JYR) GO TO 6
      5 CONTINUE
      6 KY=I
C            UPPER TIME LIMIT.
C       JY - POSITION OF LAST WATER LEVEL IN DATA ARRAY (DATE SORTED).
        JY=0
        IF (NYR(2).LT.1) GO TO 8
C       JJYR - USED FOR SORTING LAST WATER LEVEL(DATE FROM CONTROL CARD).
        JJYR=(NYR(2)*12)+IMON(2)
        DO 7 I=KY,NY
C       KKYR - USED FOR SORTING LAST WATER LEVEL(DATE FROM DATA ARRAY).
        KKYR=(IYR(I)*12)+MON(I)
        IF (KKYR.GT.JJYR) GO TO 9
      7 CONTINUE
      8 JY=NY
        GO TO 10
      9 JY=I-1
     10 CONTINUE
C       DETERMINE MAXIMUM AND MINIMUM WATER-LEVELS FOR HYDROGRAPHS
C       BMX - MAXIMUM WATER LEVEL.
        BMX=(-100000.)
C       BMI - MINIMUM WATER LEVEL.
        BMI=100000.
        DO 11 I=KY,JY
        BMX=AMAX1(BMX,W1(I))
        BMI=AMIN1(BMI,W1(I))
     11 CONTINUE
C       DIFF - DIFFERENCE BETWEEN MAXIMUM AND MINIMUM WATER LEVEL.
        DIFF=BMX-BMI
        DO 12 I=1,5
        IF (HSCAL(I).GT.DIFF) GO TO 14
     12 CONTINUE
        I=5
     13 IF (HSCAL(I).GE.0.5) GO TO 14
        I=I-1
        GO TO 13
C       SCALH - HORIZONTAL SCALE FOR HYDROGRAPH(SELECTED FROM HSCAL
C              ARRAY).
     14 SCALH=HSCAL(I)
C       SCALV - VERTICAL SCALE FOR HYDROGRAPH(SELECTED FROM VSCAL
C              ARRAY).
        SCALV=VSCAL(I)
C       DETERMINE RANGE OF SCALE
        IF (SCALH.LE.10.) GO TO 15
C       KMM, DMI, IMI, CMI - USED TO DETERMINE LOWEST EVEN SCALE VALUE.
        KMM=BMI/10.
        DMI=KMM*10
```

```
      IF ((DMI+(-10.)+SCALH).LT.BMX.AND.(DMI+(-1.)+SCALH).GE.BMX) GO TO
     115
      BMI=DMI+(-10.)
      BMX=BMI+SCALH
      GO TO 16
   15 BMI=BMI+(-1.5)
      IMI=BMI
      CMI=IMI
C     IMX - MAXIMUM SCALE VALUE, EQUAL TO LOWEST SCALE VALUE
C            PLUS SCALH.
      IMX=CMI+SCALH
      GO TO 17
   16 IMX=BMX
      IMI=BMI
   17 SCTOP(11)=IMX
      SCTOP(1)=IMI
      DO 18 I=2,10
   18 SCTOP(I)=SCTOP(I-1)-((SCTOP(1)-SCTOP(11))/10.)
C     DETERMINE PLOT POSITION - PLOTH--POSITION ON LINE, IDAP--LINE OF
C     DO 954 I = 1,2000
C     IDAP(I) = 0
C     954 PLOTH(I) = 0.
C          PLOT, IOFF--TIMES PLOT IS OFF SCALE.
      J=0
      DO 28 I=KY,JY
      J=J+1
C     SLOTH, LOTH, KOTH - USED TO DETERMINE PLOT POSITION OF WATER LEVEL
C                         ON HORIZONTAL LINE(PLOTH VALUE).
      SLOTH=(W1(I)-SCTOP(11))/(SCALH/100.)
      LOTH=SLOTH
      KOTH=SLOTH*100.
      KOTH=KOTH-(LOTH*100)
      IF (KOTH.GE.50) PLOTH(J)=PLOTH(J)+1.
      IF (KOTH.LE.(-50)) PLOTH(J)=PLOTH(J)-1.
C     IL - SWITCH FOR CHANGING PLOT SYMBOL ON OFF SCALE PLOT.
      IL=0
      PLOTH(J)=LOTH+100+IFIX(PLOTH(J))
      IF (PLOTH(J).GE.101.) IL=1
      IOFF(J)=0
   19 IF (PLOTH(J).LE.100.) GO TO 20
      PLOTH(J)=PLOTH(J)-100.
      IOFF(J)=IOFF(J)+1
      GO TO 19
   20 IF (PLOTH(J).LT.0.) PLOTH(J)=PLOTH(J)+100.
      IF (SCALV.GE.5.) GO TO 22
C     IVT - DATE(YEAR AND MONTH) CONVERTED TO SINGLE NUMBER FOR
C            DETERMINING LINE FOR PLOT.
      IVT=((IYR(I)-IYR(KY))*12)+(MON(I)-MON(KY))
C     AVT - IVT IN REAL NUMBER FORM.
      AVT=IVT
C     AINES - LINE OF PLOT MINUS DAY INCREMENT.
      AINES=AVT*(SCALV*6.)
```

TABLE 5.—RIVER-INDUCED FLUCTUATIONS PROGRAM LISTING—CONTINUED

```
      IF (SCALV.LT..17) GO TO 21
C     DAYV - DAY INCREMENT FOR DETERMINING LINE OF PLOT(IDAP =
C             AINES + DAYV).
      DAYV=IDAY(I)
      DAYV=DAYV*(SCALV/5.)
C     IDV, JDV, ADV, IDA - VARIABLES USED IN DETERMINING LINEINCREMENT
C                          FOR IDAP.
      IDV=DAYV
      JDV=DAYV*100.
      ADV=JDV-(IDV*100)
      IF (ADV.GE.1.) DAYV=DAYV+1.
      IDA=DAYV
      DAYV=IDA
      IF (DAYV.GT.(SCALV*6.)) DAYV=DAYV-1.
C     LINE ON WHICH DATA IS TO BE PLOTTED--IDAP(J)
      IDAP(J)=AINES+DAYV
      GO TO 27
C     SET UP IDAP(LINE OF PLOT VALUE) FOR DAILY HYDROGRAPH.
   21 IDAP(J)=AINES+1.
      GO TO 27
   22 IVT=0
C     MDA - MONTH OF WATER LEVEL BEING EXAMINED.
      MDA=MON(I)
C     NDA - MONTH OF FIRST WATER LEVEL TO BE OUTPUT.
      NDA=MON(KY)
      IF (MDA.LT.NDA) GO TO 24
      IF ((MDA-NDA).EQ.0) GO TO 26
      MDA=MDA-1
      DO 23 IR=NDA,MDA
   23 IVT=IVT+MDAY(IR)
      GO TO 26
   24 NDA=NDA-1
      DO 25 IS=MDA,NDA
   25 IVT=IVT-MDAY(IS)
   26 AVT=IVT+((IYR(I)-IYR(KY))*365)
      AINES=AVT*(SCALV/5.)
      DAYV=IDAY(I)
      IDAP(J)=AINES+DAYV
      JMM=4
C     KZZ - EQUAL TO KY-FIRST DATA VALUE ARRAY POSITION.
      KZZ=KY
C     JZZ - EQUAL TO ARRAY POSITION OF DATA VALUE BEING EXAMINED.
      JZZ=I
C     CHECK FOR LEAP YEAR.
C     860 DO 862 IG = JMM,96,4
C     DO 862 NZZ = KZZ,JZZ
C     862 IF (IYR(NZZ) .EQ. IG) GO TO 863
C     IF (IYR(NZZ) .EQ. IG) GO TO 863
C     862 CONTINUE
C     GO TO 826
C     863 JMM = IG + 4
C     IF (IYR(KY) .EQ. IG .AND. MON(KY) .GT. 2) GO TO 826
C     IF (MON(I) .GT. 2) IDAP(J) = IDAP(J) + 1
```

```
C     GO TO 860
      IYRJG=IYR(I)
      IF (MOD(IYRJG,4).EQ.0.AND.MON(I).GE.2) IDAP(J)=IDAP(J)+1
   27 IPLT(J)=NA(39)
      IF (IL.EQ.1) IPLT(J)=NA(40)
C     ICDE - EQUAL TO ICODE OF DATA VALUE BEING EXAMINED.
      ICDE=ICODE(I)
      IF (ICDE.NE.37) IPLT(J)=NA(ICDE)
C     IF (IL .EQ. 1 .AND. ICDE .NE. 37) IPLT(J) = NA(ICDE + 13)
      IF (IL.EQ.1.AND.ICDE.NE.37) IPLT(J)=NA(ICDE+1)
      IF ((ICDE.EQ.11.OR.ICDE.EQ.24).AND.W1(I).EQ..0) IPLT(J)=NA(37)
      IF (ICDE.EQ.25.AND.W1(I).EQ.34.) IPLT(J)=NA(37)
   28 CONTINUE
C     IDAP(J)--VERTICAL LINE OF PLOT, PLOTH(J)--VALUE OF PLOTTED POINT
C     IPLT--CHARACTER OF PLOTTED POINT
C     ITV--TOTAL NUMBER OF LINES
C     MYEAR, KYEAR - YEAR OF FIRST MEASUREMENT TO BE PLOTTED.
      MYEAR=IYR(KY)+1900
C     IBG - MONTH OF FIRST MEASUREMENT TO BE PLOTTED.
      IBG=MON(KY)
C     KOUT - COUNTER FOR SPACING LINES, PRINTING MONTHS ON PROPER LINES.
      KOUT=0
      IF (SCALV.GE.5.) GO TO 29
      IK=SCALV*6.
C     ITV - TOTAL NUMBER OF LINES OF HYDROGRAPH.
      ITV=(((IYR(JY)-IYR(KY))*12)+(MON(JY)-MON(KY))+1)*IK
      GO TO 37
   29 ITV=0
C     MDX, NDX, IK - VARIABLES USED IN CALCULATING LINES ON A DAILY
C                    HYDROGRAPH.
      MDX=MON(JY)
      NDX=MON(KY)
      IK=MDAY(NDX)
      IF (MDX.LT.NDX) GO TO 31
      DO 30 I=NDX,MDX
   30 ITV=ITV+MDAY(I)
      GO TO 33
   31 NDX=NDX-1
      DO 32 I=MDX,NDX
   32 ITV=ITV-MDAY(I)
   33 ITV=((IYR(JY)-IYR(KY))*365)+ITV
      DO 36 IJ=4,96,4
      DO 34 JI=KY,JY
      IF (IYR(JI).EQ.IJ) GO TO 35
   34 CONTINUE
      GO TO 36
   35 ITV=ITV+1
   36 CONTINUE
   37 WRITE (6,77) IC1,IC2,IC3,IC4,IC5,IC6,IC7,IC8,IC9,IC10,IC11,IC12,IC
     113,IC14,IC15,IC16,IC17,IC18,IC19,IC20
      WRITE (6,78)
C     SET ALL MINUS SCALE VALUES TO PLUS VALUES.
```

```
C     DO 213 I = 1,11
C     IF (SCTOP(I) .GE. 0.)  GO TO 213
C     SCTOP(I) = SCTOP(I) * (-1.)
C     213 CONTINUE
C     DETERMINE PROPER SCALE TITLE TO PRINT.
      WRITE (6,79)
C     PRINT SCALE VALUES.
      WRITE (6,80) (SCTOP(I),I=1,11)
      J=1
C     PRINT PLOT BOUNDRY.
      WRITE (6,81)
C     IAS - COUNTER TO PRINT OUT LEFT HAND EDGE OF HYDROGRAPH, EITHER
C           AN * OR NUMBER FOR OFF-SCALE INDICATOR.
      IAS=42
C     JAS - COUNTER TO SET-UP LINE.
      JAS=7
      KYEAR=MYEAR
C     STATEMENTS THROUGH 1000 ARRANGES AND PLOTS HYDROGRAPH.
      DO 75 I=1,ITV
C     BLANK PLOT ARRAY (IPT).
      DO 38 K=1,100
   38 IPT(K)=NA(37)
C     SET INTO IPT ARRAY INTERMEDIATE LINES OF DOTS.
      IF (KOUT.EQ.IK.AND.SCALV.GE.1.) GO TO 39
      GO TO 41
   39 DO 40 IOJ=1,100
   40 IPT(IOJ)=NA(38)
      GO TO 48
   41 IF (SCALV.LT..17) GO TO 42
      IF (SCALV.EQ.0.5.AND.JAS.EQ.I) GO TO 43
      GO TO 46
   42 IF (I.GT.3.AND.(IBG.EQ.5.OR.IBG.EQ.11).AND.I.LT.(ITV-2)) GO TO 44
      GO TO 46
   43 IF (JAS.EQ.ITV) GO TO 46
      JAS=JAS+6
   44 DO 45 JOI=1,100
   45 IPT(JOI)=NA(38)
      GO TO 48
   46 DO 47 ITY=10,90,10
   47 IPT(ITY)=NA(38)
   48 IPT(100)=NA(42)
      KOUT=KOUT+1
C     PDAY - LENGTH OF MONTH IN DAYS(FROM MDAY ARRAY).
      PDAY=MDAY(IBG)
C     IF DAILY SCALE, DETERMINE NUMBER OF PLOT LINES FOR MONTH.
      IF (SCALV.GE.5.) IK=PDAY*(SCALV/5.)
      IF (SCALV.LT..17) GO TO 50
C     CHECK FOR LEAP YEAR.
      DO 49 NIT=1900,2000,4
   49 IF (IBG.EQ.2.AND.KYEAR.EQ.NIT) IK=(PDAY*(SCALV/5.))+1.
      IF (KOUT.LE.IK) GO TO 51
      KOUT=1
```

```
   50 IF (SCALV.LT..17.AND.I.EQ.1) GO TO 51
      IBG=IBG+1
      IF (IBG.EQ.13) IBG=1
C     CHECK FOR PLOTTING OF VALUE ON LINE.
   51 IF (IDAP(J).EQ.I) GO TO 52
      GO TO 60
C     SET PLOT SYMBOL ON LINE.
C     IP - PLOT POSITION ON HORIZONTAL LINE FROM PLOTH ARRAY TO PUT
C          INTO IPT ARRAY.
   52 IP=PLOTH(J)
      IPT(IP)=IPLT(J)
C     NR - COUNTER FOR MORE THAN ONE NUMBER AT A POSITION.
      NR=2
C     CHECK FOR MORE THAN ONE VALUE ON LINE.
   53 IF (J.EQ.(JY-KY+1)) GO TO 56
      IF (IDAP(J).NE.IDAP(J+1)) GO TO 55
C     CHECK FOR MORE THAN ONE PLOT AT SAME POSITION ON LINE.
      IF (PLOTH(J).EQ.PLOTH(J+1)) GO TO 54
      J=J+1
C     SET ADDITIONAL VALUES ON LINE.
      IP=PLOTH(J)
      IPT(IP)=IPLT(J)
      GO TO 53
C     SET IN NUMBER IF MORE THAN ONE VALUE IS AT SAME POSITION.
   54 NR=NR+1
      IPT(IP)=NA(NR)
      J=J+1
      GO TO 53
C     NDP - VARIABLE TO MOVE OR NOT TO MOVE TO NEXT LINE OF HYDROGRAPH
C           CONTROL IS IDAP ARRAY.
   55 NDP=1
      GO TO 57
   56 NDP=0
C     SET NUMBER FOR OFF-SCALE INDICATOR IN LEFT-HAND COLUMN OF PLOT
C          OR * IF NOT OFF SCALE.
   57 IF (IOFF(J).LT.1) GO TO 58
      IAS=1+IOFF(J)
C     ISA - COUNTER FROM IOFF ARRAY, FOR OBTAINING CORRECT IAS VALUE--
C           OFF-SCALE INDICATOR IN LEFT COLUMN.
C     ISA = IOFF(J)
C     DO 741 IE= 1, ISA
C     741 IAS = IAS + 1
      GO TO 59
C     742 IF (IPT(IP) .EQ. NA(37)) GO TO 745
C     IAS = 42
   58 IAS=42
      IF (IPT(IP).EQ.NA(37)) GO TO 59
C     J - LINE COUNTER.
   59 J=NDP+J
C     NK - INDEX FOR PRINTING MONTH(MN ARRAY).
   60 NK=IBG
C     JOUT, AOUT, MOUT, LOUT--VARIABLES USED TO DETERMINE WHETHER OR
```

TABLE 5.—RIVER—INDUCED FLUCTUATIONS PROGRAM LISTING—CONTINUED

```
C                               NOT TO PRINT DAYS AT SIDE OF HYDROGRAPH.
      JOUT=0
      IF (SCALV.LT..17) GO TO 72
      IF (KOUT.NE.1) NK=13
      IF (SCALV.GE.5.) GO TO 63
      AOUT=KOUT
      AOUT=(AOUT/SCALV)*5.
      MOUT=AOUT
      LOUT=AOUT*100.
      JOUT=LOUT-(MOUT*100)
      IF (JOUT.GE.1) GO TO 64
C     NOUT - DAY COUNTER, PRINTED ON SIDE OF HYDROGRAPH.
      NOUT=AOUT
      IF (IBG.EQ.2.AND.NOUT.GT.28) NOUT=28
      DO 61 IKT=1900,2000,4
   61 IF (KYEAR.EQ.IKT.AND.IBG.EQ.2.AND.NOUT.EQ.28) NOUT=29
      IF (IBG.EQ.1.OR.IBG.EQ.3.OR.IBG.EQ.5.OR.IBG.EQ.7.OR.IBG.EQ.8.OR.IB
     1G.EQ.10.OR.IBG.EQ.12) GO TO 62
      GO TO 64
   62 IF (NOUT.NE.30) GO TO 64
      NOUT=31
      GO TO 64
   63 AOUT=KOUT
      NOUT=AOUT*(5./SCALV)
C     THIS SECTION OF CODE AVERAGES MULTIPLE RIVER STAGE VALUES ON ONE
C     LINE AND PLOTS THE AVERAGE FOR THE ON-PLOT VALUES
   64 CONTINUE
      PTKT=0.0
      IPTEM1=0
      DO 65 ILIM=1,100
      IF (IPT(ILIM).NE.NA(28)) GO TO 65
      IPTEM2=IPT(ILIM)
      IPT(ILIM)=NA(37)
      IPTEM1=ILIM+IPTEM1
      PTKT=PTKT+1.0
   65 CONTINUE
      IF (PTKT.EQ.0) GO TO 66
      IPTEM1=IPTEM1/PTKT+0.5
      IPT(IPTEM1)=IPTEM2
   66 CONTINUE
      IF (KOUT.NE.1) GO TO 68
C     896 IF (KOUT .NE. 1) GO TO 888
      IF (JOUT.GE.1) GO TO 67
C     A LINE WITH MONTH AND DAY PRINTED - MN, NOUT.
      WRITE (6,82) MN(NK),NOUT,NA(IAS),(IPT(KJK),KJK=1,100),NOUT,MN(NK)
      GO TO 75
C     A LINE WITH MONTH PRINTED - MN.
   67 WRITE (6,83) MN(NK),NA(IAS),(IPT(KJK),KJK=1,100),MN(NK)
      GO TO 75
   68 IF (I.EQ.2) GO TO 70
      IF (KOUT.EQ.2.AND.IBG.EQ.1) GO TO 70
      IF (JOUT.GE.1) GO TO 69
```

```
C       A LINE WITH DAY PRINTED - NOUT.                                 RI 06870
        WRITE (6,84) NOUT,NA(IAS),(IPT(KJK),KJK=1,100),NOUT             RI 06880
        GO TO 75                                                        RI 06890
C       A LINE WITH NO SIDE TIME SCALE.                                 RI 06900
     69 WRITE (6,85) NA(IAS),(IPT(KJK),KJK=1,100)                       RI 06910
        GO TO 75                                                        RI 06920
     70 IF (JOUT.GE.1) GO TO 71                                         RI 06930
C       A LINE WITH YEAR AND DAY PRINTED - MYEAR, NOUT.                 RI 06940
        WRITE (6,86) MYEAR,NOUT,NA(IAS),(IPT(KJK),KJK=1,100),NOUT,MYEAR RI 06950
        GO TO 74                                                        RI 06960
C       A LINE WITH YEAR PRINTED - MYEAR.                               RI 06970
     71 WRITE (6,87) MYEAR,NA(IAS),(IPT(KJK),KJK=1,100),MYEAR           RI 06980
        GO TO 74                                                        RI 06990
C       MONTHLY HYDROGRAPH.                                             RI 07000
     72 IF (NK.EQ.1) GO TO 73                                           RI 07010
        IF (I.EQ.1) GO TO 73                                            RI 07020
C       A LINE WITH MONTH PRINTED - MN.                                 RI 07030
        WRITE (6,88) MN(NK),NA(IAS),(IPT(KJK),KJK=1,100),MN(NK)         RI 07040
        GO TO 75                                                        RI 07050
C       A LINE WITH YEAR AND MONTH PRINTED - MYEAR, MN.                 RI 07060
     73 WRITE (6,89) MYEAR,MN(NK),NA(IAS),(IPT(KJK),KJK=1,100),MN(NK),MYEARI 07070
       1R                                                               RI 07080
     74 KYEAR=MYEAR                                                     RI 07090
        MYEAR=MYEAR+1                                                   RI 07100
     75 CONTINUE                                                        RI 07110
        WRITE (6,80) (SCTOP(I),I=1,11)                                  RI 07120
        WRITE (6,81)                                                    RI 07130
        WRITE (6,90) RIVDAT,OBSDAT                                      RI 07140
        DEBUG  SUBCHK
        RETURN                                                          RI 07150
C                                                                       RI 07160
C                                                                       RI 07170
     76 FORMAT (1H1)                                                    RI 07180
     77 FORMAT (20A4)                                                   RI 07190
     78 FORMAT (//////)                                                 RI 07200
     79 FORMAT (/,50X,22H WATER LEVELS IN FEET /)                       RI 07210
     80 FORMAT (8X,11(F7.1,3X))                                         RI 07220
     81 FORMAT (13X,101(1H*))                                           RI 07230
     82 FORMAT (4X,A4,1X,I2,2X,A1,100A1,2X,I2,1X,A4)                    RI 07240
     83 FORMAT (4X,A4,5X,A1,100A1,5X,A4)                                RI 07250
     84 FORMAT (9X,I2,2X,A1,100A1,2X,I2)                                RI 07260
     85 FORMAT (13X,A1,100A1)                                           RI 07270
     86 FORMAT (4X,I4,1X,I2,2X,A1,100A1,2X,I2,1X,I4)                    RI 07280
     87 FORMAT (4X,I4,5X,A1,100A1,5X,I4)                                RI 07290
     88 FORMAT (7X,A4,2X,A1,100A1,2X,A4)                                RI 07300
     89 FORMAT (1X,I4,2X,A4,2X,A1,100A1,2X,A4,2X,I4)                    RI 07310
     90 FORMAT (///,13X,22HEXPLANATION OF SYMBOLS//16X,44HR = RIVER LEVEL RI 07320
       1HYDROGRAPH, 0.0 POINT EQUALS,F10.2,24HFEET ABOVE ZERO OF GAGE./16XRI 07330
       2,26HC = CALCULATED HYDROGRAPH /16X,50HO = OBSERVED WATER LEVEL IN RI 07340
       3WELL, 0.0 POINT EQUALS,F10.2,24HFEET BELOW LAND SURFACE.//21X,62HARI 07350
       4 NUMBER INDICATES THE NUMBER OF SYMBOLS THAT FALL AT A POINT./21X,RI 07360
       578HPOINTS PLOTTED OFF SCALE ARE INDICATED BY THE NEXT LETTER IN ALRI 07370
       6PHABETIC ORDER.)                                                RI 07380
```

TABLE 5.—RIVER—INDUCED FLUCTUATIONS PROGRAM LISTING—CONTINUED

```
 END                                                                   RI 07390
 BLOCK DATA
 COMMON /DDORG/ NA(46),MN(13),MDAY(12)
 DATA NA/'0','1','2','3','4','5','6','7','8','9','A','B','C','D',
*'F','F','G','H','I','J','K','L','M','N','O','P','Q','R','S','T',
*'U','V','W','X','Y','Z',' ','.','+','-','/','*',',',', 19','     ',
*'    '/
 DATA MN/'JAN.','FFB.','MAR.','APR.','MAY ','JUNF','JUI Y','AUG.',
*'SEP.','OCT.','NOV.','DEC.','     '/
 DATA MDAY/31,28,31,30,31,30,31,31,30,31,30,31/
 END
```

TABLE 6.—EVAPOTRANSPIRATION PROGRAM LISTING

```
C**********************************************************************
C**********************************************************************
C
C
C                         EVAPOTRANSPIRATION PROGRAM
C                         EVAPOTRANSPIRATION PROGRAM
C                         EVAPOTRANSPIRATION PROGRAM
C
C
C                            PROGRAMMED BY J. E. REED
C
C
C                     DATE OF THIS VERSION -- 30 JULY 1971
C**********************************************************************
C**********************************************************************
      DIMENSION ET(15,7,2), LITH(45), ETCRV(6,6), LCD(25), TH(25)
      READ (5,22) ((ET(I,J,2),J=1,7),I=1,15)
      READ (5,23) ((ET(I,J,1),J=1,7),I=1,15)
      READ (5,24) (LITH(I),I=1,45)
      READ (5,25) RANGE
      READ (5,26) M,N,DTW,((LCD(I),TH(I)),I=1,12)
    1 WRITE (6,27)
      WRITE (6,28) M,N
      WRITE (6,29) DTW
      WRITE (6,30)
      IF (TH(12).EQ.0.) GO TO 2
      READ (5,31) ((LCD(I),TH(I)),I=13,25)
    2 DO 9 J=2,7
      ETCRV(J-1,2)=ET(1,J,1)
      TTOP=500.
      DEPTH=0.
      DO 4 I=1,25
      IF (TH(I).EQ.0.) GO TO 5
      IC=LCD(I)
      IF (J.GT.2) GO TO 3
      LIC=3*IC
      WRITE (6,32) LITH(LIC-2),LITH(LIC-1),LITH(LIC),TH(I)
    3 CONTINUE
      IF (TTOP.GT.ET(IC,J,2)) TTOP=ET(IC,J,2)
      DEPTH=DEPTH+TH(I)
      TTOP=TTOP-TH(I)*ET(IC,J,1)
    4 CONTINUE
    5 IF (TTOP-0.) 6,6,7
    6 DEPTH=DEPTH+TTOP
      GO TO 8
    7 IF (TTOP.GT.ET(2,J,2)) TTOP=ET(2,J,2)
      DEPTH=DEPTH+TTOP/ET(2,J,1)
    8 ETCRV(J-1,1)=DEPTH
    9 CONTINUE
      WRITE (6,33)
      WRITE (6,34) ((ETCRV(I,J),J=1,2),I=1,6)
      N=1
```

```
      M=1
   10 IF (DTW.GE.ETCRV(1,1)) GO TO 14
      IF (DTW.LE.ETCRV(6,1)) GO TO 12
      DO 11 I=1,5
      IF ((DTW.LT.ETCRV(I,1)).AND.(DTW.GT.ETCRV(I+1,1))) GO TO 13
   11 CONTINUE
   12 ETV=ETCRV(6,2)
      GO TO 15
   13 ETV=ETCRV(I,2)+((ETCRV(I+1,2)-ETCRV(I,2))*(DTW-ETCRV(I,1)))/(ETCRV
     1(I+1,1)-ETCRV(I,1))
      GO TO 15
   14 ETV=(ETCRV(1,2))
   15 IF (N.GT.1) GO TO 16
      N=N+1
      DAT1=DTW
      DAT2=ETV
      DTW=DTW+RANGE
      GO TO 10
   16 IF ((DTW-DAT1).NE.0.) DEL=(ETV-DAT2)/(DTW-DAT1)
      IF ((DTW-DAT1).EQ.0.) GO TO 18
      IF (M.GT.1) GO TO 19
   17 DEL=-DEL
      WRITE (6,35) DTW,ETV,DEL
      IF (DTW.LT.(DAT1-RANGE)) GO TO 20
      DTW=DTW-2.
      GO TO 10
   18 XDEL=DEL
      XETV=ETV
      DTW=DTW-2.
      M=M+1
      GO TO 10
   19 DEL=(XDEL+DEL)/2.
      ETV=XETV
      DTW=DTW+2.
      M=M-1
      GO TO 17
   20 READ (5,26) M,N,DTW,((LCD(I),TH(I)),I=1,12)
      IF (M.EQ.0) GO TO 21
      GO TO 1
   21 STOP
C
   22 FORMAT (7F4.1)
   23 FORMAT (7F8.7)
   24 FORMAT (20A4)
   25 FORMAT (F2.0)
   26 FORMAT (2I2,F4.2,12(I2,F4.1))
   27 FORMAT (9X,'ROW',4X,'COLUMN')
   28 FORMAT (10X,I2,5X,I2)
   29 FORMAT (3X,'AVERAGE DEPTH TO WATER',2X,F5.2,2X,'FEET')
   30 FORMAT (3X,'TYPE OF MATERIAL',5X,'THICKNESS')
   31 FORMAT (13(I2,F4.1),2X)
   32 FORMAT (5X,3A4,9X,F5.1)
```

TABLE 6.—EVAPOTRANSPIRATION PROGRAM LISTING—CONTINUED

```
33 FORMAT (3X,'DEPTH TO WATER',12X,'ET',11X,'DELTA ET/DELTA H')
34 FORMAT (5X,F10.6,10X,F10.6)
35 FORMAT (5X,2(F10.6,10X),F10.6)
   END
```