73-282

ITERATIVE DIGITAL MODEL

FOR

AQUIFER EVALUATION

By

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INTRODUCTION

The "Iterative Digital Model for Aquifer Evaluation" (Pinder, 1970) was designed as a basic model to simulate two-dimensional aquifer problems. In using this model for various problems myself, and in assisting others in the use of the model, I have added several problem options and input-output features. The artesian and water-table options, of course, are a part of the original model. Some of the added features (for example, the method of treating the storage coefficient and leakage in combined artesian-water table problems, and the method of treating evapotranspiration) were adapted from Prickett and Lonnquist (1971). As with Pinder's original model, the updated version will require programming modifications for some applications.

All of the options in the program have not been fully tested. Thus, there may be some undiscovered errors in the logic. Furthermore, this updated model is subject to revision as experience dictates.*

The following documentation in part supplements and in part supersedes Pinder (1970).

*The card deck contains some changes not in the source listing starting on page 20. The only change affecting the user directly is a change to a maximum problem size of 50x50.

PROBLEM OPTIONS

Artesian Aquifer: The artesian aquifer is the easiest to model because the problem is usually linear. Water may be derived from storage, uniform areal recharge, recharge wells, constant head boundaries and leakage from confining beds in which the effects of storage are considered. Discharge may be from wells and constant head boundaries. Evapotranspiration is not considered (except possibly as negative uniform areal recharge) because the change in head in the water-table aquifer due to pumping of the artesian aquifer is not computed. Steady state can be simulated by setting the storage coefficient of the aquifer and the specific storage of the confining bed to zero, computing one time step of any length and iterating to a solution.

Water-Table Aquifer:: The transmissivity in the water-table problem is computed each iteration as the product of saturated thickness and hydraulic conductivity at each node. The program is set up to terminate computation for a given problem if the "well goes dry". Punched output consisting of the head matrix and mass balance parameters is produced so the user can decide whether to continue the run. For nodes that "go dry" other than pumping nodes, a saturated thickness of 1 foot is maintained so that water levels at these nodes can recover during the next pumping period.

In addition to the types of recharge and discharge available in the artesian aquifer problem, evapotranspiration can be included as a discharge from a water-table aquifer. The model assumes a linear decrease in evapotranspiration from the land surface to a given depth where ET ceases. Steady state can be simulated in the same manner as in the artesian problem.

Combined Water-Table - Artesian Aquifer: The model can simulate an aquifer that is part artesian and part water table or an artesian aquifer converting to a water-table aquifer and vice versa. As in the water-table problem, the hydraulic conductivity of the aquifer and its bottom elevation are specified. In addition the elevation of the top of the aquifer is needed to compute transmissivity when the aquifer is artesian, to determine when the storage coefficient changes from its artesian value to specific yield, and to limit the leakage when the head falls below the top of the aquifer.

OTHER PROGRAM FEATURES

Multiple Pumping Periods: A new pumping period is started by reading the length of the new period, the approximate DELT, and the well locations and pumping rates. A major assumption is made in treating leakage for multiple pumping periods: Dimensionless time for the previous pumping period is assumed to be large so that storage in the confining bed has a negligible effect on leakage from this period. For many real problems in which pumping periods are months to years in length, this is a reasonable assumption. Problems involving short pumping periods may require re-programming in order to treat leakage more realistically.

Solution Approaching Steady State: In some model simulations in which a steady state is possible, the solution may approach a steady state long before the designated pumping period is completed. To reduce unnecessary computation time and output, the program checks the magnitude of change in water level from one time step to the next. If the change at all nodes is less than some previously assigned difference (for example, 0.1 foot) the pumping period is terminated with all desired printed and punched output. The program proceeds to read the data for the next pumping period, if any.

Boundary Conditions: To treat an impermeable boundary specify zero hydraulic conductivity or transmissivity for the impermeable material. For the location of the boundary refer to figure 1 in Pinder (1970). If T (i-1,j) = T (i-1, j-1) = T (i, j-1) = 0, the boundary is located $-\frac{\Delta x_i}{2}$ and $-\frac{\Delta y_j}{2}$ from the node x_i y_j.

To simulate a constant-flux boundary with a value other than zero, place a recharging well at the appropriate nodes. Referring again to figure 1 in Pinder (1970) and with the conditions stated in the paragraph above, if a recharging well is placed at node x_i y_j, the recharge boundary is approximately

$+\frac{\Delta x_i}{2}$ and $+\frac{\Delta y_j}{2}$ from the node $x_i\ y_j$.

To simulate a constant-head boundary place a negative number (for example, -1) in the storage coefficient matrix at the constant-head nodes which must have a finite transmissivity. The boundary is at the constant head nodes.

Drawdown at a pumping well node: Withdrawal from a well is assumed to occur over the area of influence of the well node. Drawdown at a pumping node in the model, therefore, is considerably less than would be observed in a real well. The real well drawdown can be predicted by plotting drawdown versus the log of distance for nodes near the pumping node (excluding those directions in which other wells are within two nodes) and extrapolating to the radius of a real well. Alternatively, these data can be used in the Thiem equation to calculate the additional drawdown in a real, fully penetrating well.

Problem size: Computer storage requirements and computation time are directly proportional to the number of nodes in a problem. The dimensions of the arrays in the source listing and card deck may need to be changed to suit a given problem and minimize computer storage requirements.

The source program and scalar parameters will require about 57,000 bytes of storage. For a 20 x 20 or 400 node problem the arrays require about 26,000 bytes of storage;

for a 50 x 50 or 2,500 node problem, the arrays require about 173,000 bytes of storage. If computer storage is at a premium, five more arrays (WELL, RATE, M, S, SY) can be made half-word integers (INTEGER *2). This will require some program modifications and additional computation time because of the number of times multiplication factors must be used.

Logical unit numbers: The unit numbers for card reader, line printer and card punch are commonly 5, 6, and 7, respectively. At computer installations where other numbers are used, change the initialization of P, R, and PU in the BLOCK DATA routine.

APPLICATION

Formats: The format used on each data card is given with the first parameter on that card. Unless explicitly stated otherwise, the same format is used for input of the remaining parameters on that card.

The G format is conveniently used to read data normally read under I, F, and E formats. Mistakes on data input can be minimized by always right justifying the data on the field. The only exceptions are the character strings on cards 3 - 11 which are left-justified.

Except for the M matrix and the matrices specified as INTEGER *2, assume that the FORTRAN default typing of integer and real variables applies. The M matrix is explicitly made REAL *4. The INTEGER *2 matrices are made real variables by multiplication factors where needed. Except for the PHI and STRT matrices leave decimal points off the input card sets; convert matrices to their decimal values with the multiplication factors specified on cards 15 and 16.

Data Deck Instructions*

CARD	COLUMNS	FORMAT	VARIABLE	DEFINITION
1	1-80	10A8	HEADNG	Any title the user wishes to print on one line at the start of output
2	1-48	"	"	
3	1-8	A8	WATER	Punch WATERTABLE for watertable or combined water table-artesian aquifer[1]
4	1-8	A8	LEAK	Punch LEAKAGE for a problem including leakage from a stream, confining bed, etc.[1]
5	1-8	A8	CONVRT	Punch CONVERT for combined artesian-watertable aquifer[1]
6	1-8	A8	EVAP	Punch EVAPOTRANSPIRATION for a problem including ET[1]
7	1-8	A8	CHCK	Punch CHECK for a problem in which a mass balance is to be computed[1]
8	1-8	A8	PNCH	Punch PUNCH for punched output from each pumping period[1]
9	1-8	A8	NUM	Punch NUMERIC to print drawdown in numeric form[1]
10	1-8	A8	HEAD	Punch HEAD to print the head matrix[1]
11	1-8	A8	CONTR	Punch CONTOUR to generate alphameric map[1]; for no alphameric map, the remainder of this card can be left blank
	11-20	G10.0	SCALE	Multiplication factor to convert model length unit to unit used on alphameric map
	21-30		DINCH	Number of map units per inch
	31-40		SPACNG	Contour interval (L)
	41-48	A8	MESUR	Name of map length unit

*Footnotes are given at the end of the instructions.
Note that the origin is the upper left-hand corner of the model.

CARD	COLUMNS	FORMAT	VARIABLE	DEFINITION
12	1-10	G10.0	NPER	Number of pumping periods for this problem
	11-20		DIML	Number of rows
	21-30		DIMW	Number of columns
	31-40		KTH	Number of time steps between printouts. Even if the user erroneously assigns an interval between printouts greater than the number of time steps required for a given pumping period, the program will print out the results for the final time step.
	41-50		LENGTH	Number of iteration parameters (5 are commonly used)
	51-60		ERR	Error criteria for closure, that is, the head change between row and column computations for every node must be less than or equal to this value to terminate iteration for a time step (L) (for example, 0.01 foot)
	61-70		QRE	Uniform recharge rate (L/T); leave blank if not used
	71-80		SS	Specific storage of confining bed (1/L); leave blank if not used.
13	1-10	G10.0	ITMAX	Maximum number of iterations per time step (if exceeded, printed output is produced and the run is terminated)
	11-20		EROR	Change in head criteria for steady state (if the change in head at every node is less than this amount, the pumping period is terminated) (L)
	21-30		QET	Maximum evapotranspiration rate (L/T); only for problem with ET
	31-40		ETDIST	Depth at which ET ceases below land surface (L); only for problem with ET
	41-50		FACTX	Multiplication factor for transmissivity in X direction
	51-60		FACTY	Multiplication factor for transmissivity in Y direction (FACTX = FACTY =1 for isotropic problem)

CARD	COLUMNS	FORMAT	VARIABLE	DEFINITION
14	1-4	I4	IHED	Initial head[2]
	5-8		ISTO	Storage coefficient[2]
	9-12		ISYI	Specific yield[2]
	13-16		IRAT	Hydraulic conductivity of confining bed[2]
	17-20		IRIV	Head in sub- or superjacent aquifer[2]
	21-24		ITHK	Thickness of confining bed[2]
	25-28		IPER	Aquifer hydraulic conductivity[2, 5]
	29-32		IBOT	Elevation of bottom of aquifer[2]
	33-36		ITRA	Transmissivity of aquifer[2,5]
	37-40		IDLX	Space increment in X direction[2]
	41-44		IDLY	Space increment in Y direction[2]
	45-48		ITOP	Elevation of top of aquifer[2]
	49-52		ILND	Elevation of land surface[2]
15	1-10	G10.0	FACH	Initial head (L)[3]
	11-20		FACS	Storage coefficient[3]
	21-30		FACY	Specific yield[3]
	31-40		FACK	Hydraulic conductivity of confining bed (L/T)[3]
	41-50		FACR	Head in sub- or superjacent aquifer (L)[3]
	51-60		FACM	Thickness of confining bed (L)[3]
	61-70		FACP	Aquifer hydraulic conductivity (L/T)[3,5]
	71-80		FACB	Elevation of bottom of aquifer (L)[3]

CARD	COLUMNS	FORMAT	VARIABLE	
16	1-10	G10.0	FACT	Transmissivity of aquifer (L^2/T)[3,5]
	11-20		FACX	Space increments in x direction (L)[3]
	21-30		FACZ	Space increments in y direction (L)[3]
	31-40		FACO	Elevation of top of aquifer (L)[3]
	41-50		FACL	Elevation of land surface (L)[3]
17	1-20	G20.10	SUM	Parameters in which elapsed time and cumulative volumes for mass balance are stored. For the start of a problem insert three blank cards. For continuation of a previous run, remove the three blank cards and insert the first three cards of the punched output from the previous run.
	21-40		SUMP	
	41-60		PUMPT	
	61-80		CFLUXT	
18	1-20	G20.10	QRET	
	21-40		CHST	
	41-60		CHDT	
	61-80		FLUXT	
19	1-20		STORT	
	21-40		ETFLXT	

CARD SET				
1	1-80	8F10.4	PHI(I,J)	Head values for continuation of previous run[4]. For a new problem, card set 1 is not included.
2	1-80	8F10.4	STRT(I,J)	Starting head matrix[4] [always needed; do not use zero]
3	1-80	20F4.0	S(I,J)	Storage coefficient[4]. Set S(I,J) = -1 for constant-head boundary [needed for artesian, artesian -WT, or constant-head boundary problems]
4	1-80	20F4.0	SY(I,J)	Specific yield[4] [need in WT or WT-artesian conversion problems]
5	1-80	20F4.0	RATE(I,J)	Hydraulic conductivity of confining bed[4] [only for a problem with leakage]
6	1-80	20I4	RIVER(I,J)	Head in sub- or superjacent aquifer[4] [only for a problem with leakage]

CARD SET	COLUMNS	FORMAT	VARIABLE	DEFINITION
7	1-80	20F4.0	M(I,J)	Thickness of confining bed[4] [only for problem with leakage]
8	1-80	20F4.0	T(I,J)	Transmissivity for artesian aquifer problem[4,5]; otherwise, omit
9	1-80	20I4	PERM(I,J)	Hydraulic conductivity for water table or combined water table-artesian problem[4,5]; otherwise, omit
10	1-80	20I4	BOTTOM(I,J)	Elevation of bottom of aquifer for water table or combined water table-artesian problem[4]; otherwise, omit
11	1-80	20I4	TOP(I,J)	Elevation of top of aquifer in combined water table-artesian problem[4]; otherwise, omit
12	1-80	20I4	LAND(I,J)	Elevation of land surface for a problem including evapotranspiration[4]; otherwise, omit
13	1-80	8G10.0	DELX(J)	Grid spacing in x direction[4] [always needed]
14	1-80	8G10.0	DELY(I)	Grid spacing in y direction[4] [always needed]

CARD				
20	1-10	G10.0	KP	Number of the pumping period
	11-20		KPM1	Number of previous pumping period (for example, KPM1 = 0 if KP = 1 but for a continuation of a previous pumping period KPM1 = KP)
	21-30	G10.0	NWEL	Number of wells for this pumping period[6]
	31-40		TMAX	Number of days in this pumping period[6]
	41-50		NUMT	Number of time steps[6]
	51-60		CDLT	Multiplying factor for DELT[6] (commonly set = 1.5)
	61-70		DELT	Initial time step, in hours[6]

CARD SET	COLUMNS	FORMAT	VARIABLE	DEFINITION
15	1-10	G10.0	I	Row location of well
	11-20		J	Column location of well
	21-30		WELL (I,J)	Pumping rate (L^3/T), negative for a pumping well

(one well on each card)

If NWEL = 0, Card Set 15 is omitted

For each additional pumping period in a problem, insert Card 20 followed by Card Set 15.

CARD

21 To follow this problem with another, insert a blank card; otherwise, omit.

*FOOTNOTES

[1]For any option not used, insert a blank card or a card with some other characters in columns 1-8 keeping in mind that these characters will be printed beneath the title in the output.

[2]Insert 1 if a uniform value for the matrix is to be used; insert -1 if variable data are to be read for the matrix.

[3]The uniform value for this matrix where the corresponding variable on card 14 is assigned the value of 1; the multiplication factor for variable data read into this matrix where the corresponding variable on card 14 is assigned the value -1. See explanations for card sets 1-14 to determine whether this parameter is required in a given problem.

[4]Start data for each row on a new card. If this matrix is to have a uniform value, it has already been initialized to that value (that is, the appropriate factor on card 15 or 16) and this card set is omitted.

[5]Zero values must be placed around the perimeter of the PERM or T array for reasons inherent in the computational scheme. If 1 is specified on card 14 for IPER or ITRA, PERM = 0 or T = 0 is automatically inserted around the border of the model.

[6]The program has two options for the simulation period:

(1) to simulate a given number of time steps, set TMAX to a value larger than the expected simulation period. The program will use NUMT, CDLT and DELT as specified.

(2) to simulate a given pumping period, set NUMT larger than the number required for the simulation period (for example, 100). The program will compute the exact DELT (which will be $\leq$ DELT specified) and NUMT to arrive exactly at TMAX on the last time step.

Sample data deck is given at the end of the program listing.

Output

1. For each new problem, the title, problem options, scalar parameter values and initialized values of the matrices are printed on the first page. On the second and succeeding pages, matrices with variable data (if any) are printed out followed by the computed iteration parameters. Finally the DELT, NUMT, and wells for the first pumping period are printed.
2. For each time step in which printed output is desired:
    a. Information on the simulation time is printed first.
    b. If CHECK is specified on card 7, a mass balance for the model as a whole is computed and printed. The results are expressed as a cumulative volume from each source of water and each type of discharge of water; rates and the volume derived from storage for the current time step are given.
    c. The range in dimensionless time for a problem including the transient effects of leakage from a confining bed, maximum change in head for the time step and the sum of differences between rows and columns for each iteration are printed. The sum of differences for each iteration may provide useful information if the computations fail to converge

to a solution and could be used, rather than the maximum difference, as the error criteria for closure.

d. If CONTOUR is specified on card 11, an alphameric map of drawdown to scale is printed. The user specifies SCALE, the multiplication factor required to change from units used in the model (for example, feet) to units used on the map (for example, miles); DINCH, the number of map units per inch; SPACNG, the contour interval for drawdown; and MESUR, the name of the units used on the map. Since most models are wider than they are long, or can be oriented that way with the alphameric map in mind, the x direction is vertical and the y direction horizontal. The origin is the upper left-hand corner of the cell for row 2, column 2 and is located in the lower left hand corner of the page oriented to read the printing. With the page in this orientation, the right and top sides of the map include the node locations for the second to last row and column, respectively; the border is located to the nearest inch outside these node locations and may or may not fall on the cell boundaries depending on the scaling. The map is automatically centered on the page and is limited to a maximum of 12 inches in the y direction. If the user tries to print a map that requires more than 12 inches in the y direction, the program increases the number of map units per inch to fit the map within 12 inches. In the x direction, the map is limited only by the dimension of the NX vector (for example, when the dimension of NX is 100, the map is limited in the x direction to 100 - 1 = 99 inches). Several parameters (for example, N1, N2, N3, and XN1) are initialized in the BLOCK DATA routine to values that assume the line printer prints 6 lines per inch, 10 characters per inch, and 132 characters per line. These parameter values may need to be changed for a line printer with other specifications.

e. If HEAD is specified on card 10, the head matrix is printed out.

f. If NUMERIC is specified on card 9, the drawdown is printed out in numeric form.

3. If PUNCH is specified on card 8, the parameters for the mass balance and the head matrix are punched at the end of each pumping period.

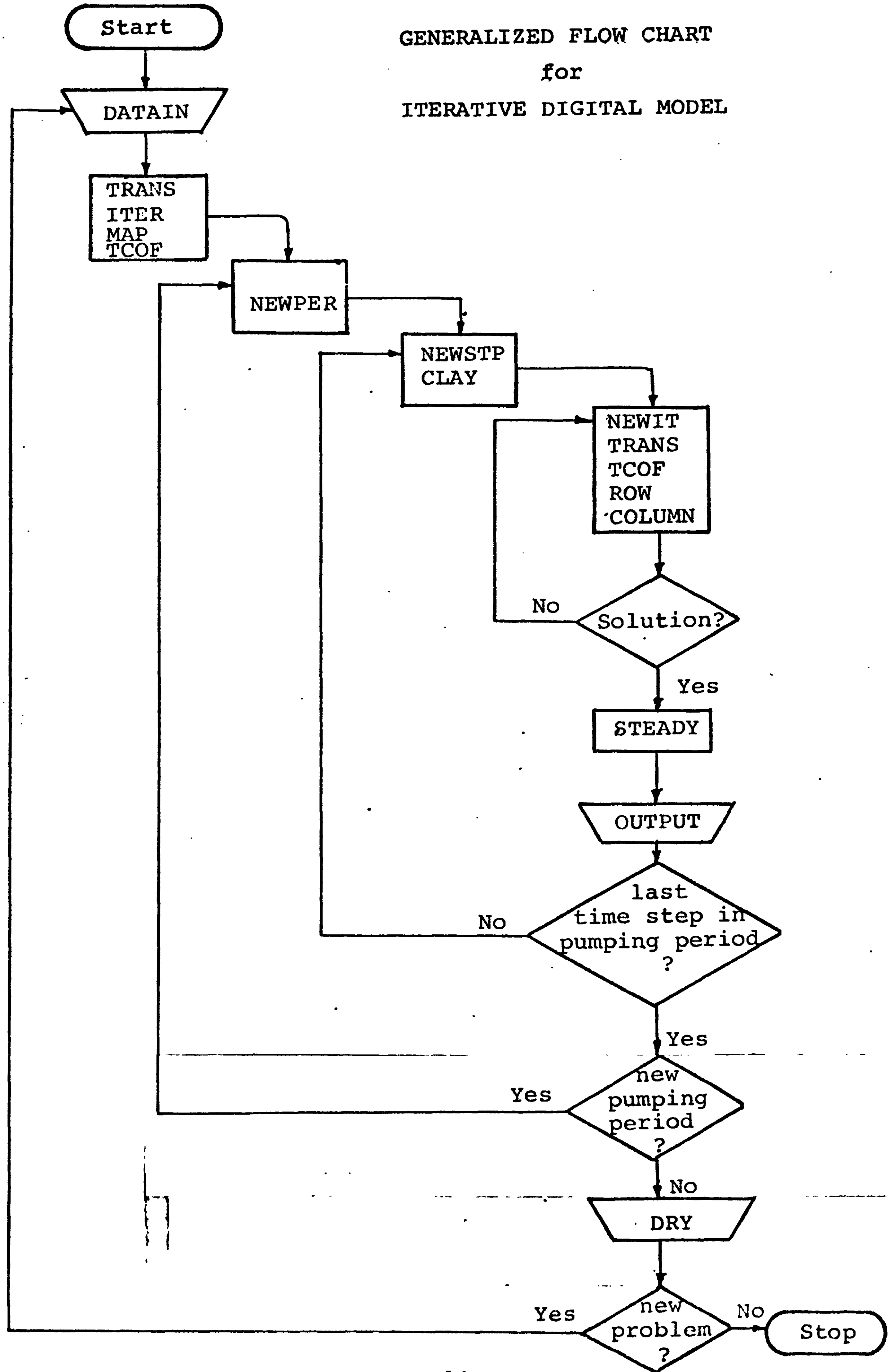
Sample Output for the problem given in the sample data deck follows the listing of the data deck.

REFERENCES

Pinder, G. F., 1970, An iterative digital model for aquifer evaluation: U. S. Geological Survey, Open-file report, 44 p.

Prickett, T. A., and Lonnquist, C. G., 1971, Selected digital computer techniques for groundwater resource evaluation: Urbana Illinois State Water Survey, Bull. 55, 62 p.

GENERALIZED FLOW CHART for ITERATIVE DIGITAL MODEL



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***************************************************************
AN ITERATIVE DIGITAL MODEL FOR AQUIFER EVALUATION
        UPDATED DECEMBER,1972
***************************************************************
SUBPROGRAMS AND ENTRIES

1. DATAIN                              3. COEF
     ITER                                   CLAY
     MAP                                    TRANS
     NEWPER                                 TCOF
                                            ETRATE
2. COMPUT                                   STORAG
     NEWSTP                                 LEAKAG
     NEWITI
     NEWITO                            4. CHECK
     ROW
     COLUMN                            5. PRNTA
     STEADY
     OUTPUT                            6. BLOCK DATA
     DRY
***************************************************************
MAIN PROGRAM
SPECIFICATIONS:
COMMON /DARRAY/ PHI(33,62),RHOP(20),CHK(10)
COMMON /SARRAY/ KEEP(33,62),T(33,62),Q(33,62),STRT(33,62),RATE(33,
162),M(33,62),WELL(33,62),S(33,62),SY(33,62),TR(33,62),TC(33,62),DE
2LX(62),DELY(33)
COMMON /HARRAY/ TOP(33,62),ISUR(33,62),LAND(33,62),RIVER(33,62),PE
1RM(33,62),BOTTOM(33,62)
COMMON /DPARAM/ WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONTR,EROR,LE
1AK
COMMON /SPARAM/ FACS,FACY,FACK,FACR,FACM,FACP,FACB,FACO,FACL,FACW,
1SLEAK,U,SS,TT,TMIN,ETDIST,QET,IFINAL,TMAX,CDLT,DELT,SUM,SUMP,NUMT,
2KT,KP,NPER,KTH,ITMAX,LENGTH,NWEL,QRE,ERR,DIML,DIMW,JNO1,INO1,R,P,P
3U,SUBS,STORE,TEST,ETQB,ETQD,FACTX,FACTY

REAL KEEP,M
REAL*8 PHI,DBLE,RHOP,CHK,WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONT
1R,EROR,LEAK
INTEGER DIML,DIMW,R,P,PU
INTEGER*2 TOP,ISUR,LAND,RIVER,PERM,BOTTOM

---READ AND WRITE DATA FOR A NEW PROBLEM---
10 CALL DATAIN

---COMPUTE ITERATION PARAMETERS---
CALL ITER

---INITIALIZE PARAMETERS FOR ALPHAMERIC MAP---
IF (CONTR.EQ.CHK(3)) CALL MAP

---COMPUTE T COEFFICIENTS FOR ARTESIAN PROBLEM---
```

```
      IF (WATER.NE.CHK(2)) CALL TCOF

      ---READ TIME PARAMETERS AND PUMPING DATA FOR A NEW PUMPING PERIOD-
   20 CALL NEWPER

      KT=0
      IFINAL=0
      IERR=0

      ---INITIALIZE TRANSMISSIVITY VALUES IN WATER TABLE PROBLEM---
      IF (WATER.EQ.CHK(2)) CALL TRANS (IERR)

      ---START NEW TIME STEP COMPUTATIONS---
   30 CALL NEWSTP

      ---COMPUTE LEAKAGE COEFFICIENTS---
      IF (LEAK.EQ.CHK(9)) CALL CLAY

      ---START NEW ITERATION IF MAXIMUM NO. ITERATIONS NOT EXCEEDED --
      CALL NEWIT0
      GO TO 50
   40 CALL NEWIT1

      ---COMPUTE TRANSMISSIVITY IN WT OR WT-ARTESIAN CONVERSION PROBLEM-
   50 IF (WATER.NE.CHK(2)) GO TO 70
      CALL TRANS (IERR)
      IF (IERR.EQ.0) GO TO 60
      CALL DRY
      GO TO 90

      ---COMPUTE T COEFFICIENTS IN WATER TABLE PROBLEM---
   60 CALL TCOF

      ---COMPUTE IMPLICITLY ALONG ROWS---
   70 CALL ROW

      ---COMPUTE IMPLICITLY ALONG COLUMNS---
      CALL COLUMN

      ---IF SOLUTION NOT OBTAINED START NEW ITERATION---
      IF (TEST.EQ.1.) GO TO 40

      ---CHECK FOR STEADY STATE---
      CALL STEADY

      ---PRINT OUTPUT AT DESIGNATED TIME STEPS---
      IF (MOD(KT,KTH).NE.0.AND.IFINAL.NE.1) GO TO 30
      CALL OUTPUT
      IF (IFINAL.NE.1) GO TO 30
      IF (PNCH.NE.CHK(1)) GO TO 80
      CALL DRY
```

```
      ---CHECK FOR NEW PUMPING PERIOD OR NEW PROBLEM---
80    IF (KP.LT.NPER) GO TO 20
90    READ (R,110,END=100) NEXT
      GO TO 10
100   STOP

      FORMAT:

110   FORMAT (I1)
      END
```

```
      SUBROUTINE DATAIN
C     -----------------
C
C     SPECIFICATIONS:
      COMMON /DARRAY/ PHI(33,62),RHOP(20),CHK(10)
      COMMON /SARRAY/ KEEP(33,62),T(33,62),Q(33,62),STRT(33,62),RATE(33,
     162),M(33,62),WELL(33,62),S(33,62),SY(33,62),TR(33,62),TC(33,62),DE
     2LX(62),DELY(33)
      COMMON /HARRAY/ TOP(33,62),ISUR(33,62),LAND(33,62),RIVER(33,62),PE
     1RM(33,62),BOTTOM(33,62)
      COMMON /DPARAM/ WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONTR,EROR,LE
     1AK
      COMMON /SPARAM/ FACS,FACY,FACK,FACR,FACM,FACP,FACB,FACO,FACL,FACW,
     1SLEAK,U,SS,TT,TMIN,ETDIST,QET,IFINAL,TMAX,CDLT,DELT,SUM,SUMP,NUMT,
     2KT,KP,NPER,KTH,ITMAX,LENGTH,NWEL,QRE,ERR,DIML,DIMW,JNO1,INO1,R,P,P
     3U,SUBS,STORE,TEST,ETQB,ETQD,FACTX,FACTY
      COMMON /CK/ ETFLXT,STORT,QRET,CHST,CHDT,FLUXT,PUMPT,CFLUXT
      COMMON /PR/ XLABEL(3),YLABEL(6),TITLE(4),XN1,SYM(28),PRNT(122),BLA
     1NK(60),DIGIT(122),VF1(6),VF2(6),VF3(7),NA(4),XN(100),YN(13),XSF,NX
     2D,WIDTH,SPACNG,N1,N2,N3,N4,N6,N8,NC
C
      REAL*4 O(100),KEEP,M
      REAL*8 PHI,DBLE,RHOP,CHK,WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONT
     1R,EROR,XLABEL,YLABEL,TITLE,XN1,HEADNG(16),MESUR,LEAK
      INTEGER DIML,DIMW,R,P,PU
      INTEGER*2 TOP,ISUR,LAND,RIVER,PERM,BOTTOM
C     ..................................................................
C
C     ---READ AND WRITE DATA---
      READ (R,590) HEADNG
      WRITE (P,580) HEADNG
      READ (R,720) WATER,LEAK,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD
      READ (R,630) CONTR,SCALE,DINCH,SPACNG,MESUR
      WRITE (P,870) WATER,LEAK,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONTR
      IF (CONTR.EQ.CHK(3)) WRITE (P,880) SCALE,MESUR,DINCH,SPACNG
      READ (R,620) NPER,DIML,DIMW,KTH,LENGTH,ERR,QRE,SS,ITMAX,EROR,QET,E
     1TDIST,FACTX,FACTY
      WRITE (P,660) NPER,DIMW,DIML,KTH,ERR,QRE,SS,ITMAX,EROR,QET,ETDIST
     1,FACTX,FACTY
      READ (R,550) IHED,ISTO,ISYI,IRAT,IRIV,ITHK,IPER,IBOT,ITRA,IDLX,IDL
     1Y,ITOP,ILND
      WRITE(P,560) IHED,ISTO,ISYI,IRAT,IRIV,ITHK,IPER,IBOT,ITRA,IDLX,IDL
     1Y,ITOP,ILND
      READ (R,620) FACH,FACS,FACY,FACK,FACR,FACM,FACP,FACB,FACT,FACX,FAC
     1Z,FACO,FACL
      WRITE(P,570) FACH,FACS,FACY,FACK,FACR,FACM,FACP,FACB,FACT,FACX,FAC
     1Z,FACO,FACL
C     ..................................................................
C
C     ---INITIALIZE MATRICES TO CONSTANT VALUES----
      DO 10 I=1,DIML
      DELY(I)=FACZ
```

```
      DO 10 J=1,DIMW                                                    DAT 480
      STRT(I,J)=FACH                                                    DAT 490
      PHI(I,J)=FACH                                                     DAT 500
      S(I,J)=FACS                                                       DAT 510
      SY(I,J)=FACY                                                      DAT 520
      RATE(I,J)=FACK                                                    DAT 530
      RIVER(I,J)=IRIV                                                   DAT 540
      M(I,J)=FACM                                                       DAT 550
      PERM(I,J)=IPER                                                    DAT 560
      IF (I.EQ.1.OR.I.EQ.DIML.OR.J.EQ.1.OR.J.EQ.DIMW) PERM(I,J)=0       DAT 570
      BOTTOM(I,J)=IBOT                                                  DAT 580
      ISUR(I,J)=STRT(I,J)*10.                                           DAT 590
      TOP(I,J)=ITOP                                                     DAT 600
      LAND(I,J)=ILND                                                    DAT 610
      T(I,J)=FACT                                                       DAT 620
      IF (I.EQ.1.OR.I.EQ.DIML.OR.J.EQ.1.OR.J.EQ.DIMW) T(I,J)=0.0        DAT 630
      DELX(J)=FACX                                                      DAT 640
      Q(I,J)=0.0                                                        DAT 650
   10 CONTINUE                                                          DAT 660
      ..................................................................DAT 750
      ---DATA TO CONTINUE PREVIOUS COMPUTATIONS INSERTED HERE---         DAT 760
      READ (R,860) SUM,SUMP,PUMPT,CFLUXT                                DAT 770
      READ (R,860) QRET,CHST,CHDT,FLUXT,STORT,ETFLXT                    DAT 780
      IF (SUM.EQ.0.0) GO TO 30                                          DAT 790
      WRITE (P,610) SUM                                                 DAT 800
      DO 20 I=1,DIML                                                    DAT 810
      READ (R,730) (PHI(I,J),J=1,DIMW)                                  DAT 820
   20 WRITE (P,690) I,(PHI(I,J),J=1,DIMW)                               DAT 830
   30 IF (IHED.NE.-1) GO TO 60                                          DAT 840
      WRITE (P,600)                                                     DAT 850
      DO 50 I=1,DIML                                                    DAT 860
      READ (R,730) (STRT(I,J),J=1,DIMW)                                 DAT 870
      DO 35 J=1,DIMW                                                    DAT 874
      STRT(I,J)=STRT(I,J)*FACH                                          DAT 875
   35 ISUR(I,J)=STRT(I,J)*10.                                           DAT 876
      IF (SUM.NE.0.0) GO TO 50                                          DAT 880
      DO 40 J=1,DIMW                                                    DAT 890
   40 PHI(I,J)=STRT(I,J)                                                DAT 900
   50 WRITE (P,690) I,(STRT(I,J),J=1,DIMW)                              DAT 910
      ..................................................................DAT 920
   60 IF (ISTO.NE.-1) GO TO 90                                          DAT 930
      WRITE (P,710)                                                     DAT 940
      DO 80 I=1,DIML                                                    DAT 950
      READ (R,640) (S(I,J),J=1,DIMW)                                    DAT 960
      DO 70 J=1,DIMW                                                    DAT 970
   70 S(I,J)=S(I,J)*FACS                                                DAT 980
   80 WRITE (P,700) I,(S(I,J),J=1,DIMW)                                 DAT 990
      ..................................................................DAT1000
   90 IF (ISYI.NE.-1) GO TO 120                                         DAT1010
      WRITE (P,890)                                                     DAT1020
      DO 110 I=1,DIML                                                   DAT1030
      READ (R,640) (SY(I,J),J=1,DIMW)                                   DAT1040
```

```
      DO 100 J=1,DIMW
  100 SY(I,J)=SY(I,J)*FACY
  110 WRITE (P,700) I,(SY(I,J),J=1,DIMW)
      ...............................................................
  120 IF (IPAT.NE.-1) GO TO 150
      WRITE (P,650)
      DO 140 I=1,DIML
      READ (R,640) (RATE(I,J),J=1,DIMW)
      DO 130 J=1,DIMW
  130 RATE(I,J)=RATE(I,J)*FACK
  140 WRITE (P,680) I,(RATE(I,J),J=1,DIMW)
      ...............................................................
  150 IF (IRIV.NE.-1) GO TO 180
      WRITE (P,810)
      DO 170 I=1,DIML
      READ (R,550) (RIVER(I,J),J=1,DIMW)
      DO 160 J=1,DIMW
  160 O(J)=RIVER(I,J)*FACR
  170 WRITE (P,690) I,(O(J),J=1,DIMW)
      ...............................................................
  180 IF (ITHK.NE.-1) GO TO 210
      WRITE (P,850)
      DO 200 I=1,DIML
      READ (R,640) (M(I,J),J=1,DIMW)
      DO 190 J=1,DIMW
  190 M(I,J)=M(I,J)*FACM
  200 WRITE (P,690) I,(M(I,J),J=1,DIMW)
      ...............................................................
  210 IF (WATER.EQ.CHK(2)) GO TO 240
      IF (ITRA.NE.-1) GO TO 300
      WRITE (P,670)
      DO 230 I=1,DIML
      READ (R,640) (T(I,J),J=1,DIMW)
      DO 220 J=1,DIMW
  220 T(I,J)=T(I,J)*FACT
  230 WRITE (P,700) I,(T(I,J),J=1,DIMW)
      GO TO 300
      ...............................................................

      ---READ PERM AND BOTTOM FOR WATER TABLE OR ARTESIAN-WT CONVERSION
         PROBLEM---
  240 IF (IPER.NE.-1) GO TO 270
      WRITE (P,740)
      DO 260 I=1,DIML
      READ (R,550) (PERM(I,J),J=1,DIMW)
      DO 250 J=1,DIMW
  250 O(J)=PERM(I,J)*FACP
  260 WRITE (P,680) I,(O(J),J=1,DIMW)
      ...............................................................
  270 IF (IBOT.NE.-1) GO TO 300
      WRITE (P,750)
      DO 290 I=1,DIML
```

```
      READ (R,550) (BOTTOM(I,J),J=1,DIMW)
      DO 280 J=1,DIMW
  280 O(J)=BOTTOM(I,J)*FACB
  290 WRITE (P,690) I,(O(J),J=1,DIMW)
      ..............................................................
  300 IF (ITOP.NE.-1) GO TO 330
      WRITE (P,760)
      DO 320 I=1,DIML
      READ (R,550) (TOP(I,J),J=1,DIMW)
      DO 310 J=1,DIMW
  310 O(J)=TOP(I,J)*FACO
  320 WRITE (P,690) I,(O(J),J=1,DIMW)
      ..............................................................
  330 IF (ILND.NE.-1) GO TO 360
      WRITE (P,770)
      DO 350 I=1,DIML
      READ (R,550) (LAND(I,J),J=1,DIMW)
      DO 340 J=1,DIMW
  340 O(J)=LAND(I,J)*FACL
  350 WRITE (P,690) I,(O(J),J=1,DIMW)
      ..............................................................
  360 IF (IDLX.NE.-1) GO TO 380
      READ (R,620) (DELX(J),J=1,DIMW)
      DO 370 J=1,DIMW
  370 DELX(J)=DELX(J)*FACX
      WRITE (P,790) (DELX(J),J=1,DIMW)
  380 IF (IDLY.NE.-1) GO TO 400
      READ (R,620) (DELY(I),I=1,DIML)
      DO 390 I=1,DIML
  390 DELY(I)=DELY(I)*FACZ
      WRITE (P,800) (DELY(I),I=1,DIML)
  400 JN01=DIMW-1
      IN01=DIML-1
      ETQB=0.0
      ETQD=0.0
      SLEAK=0.0
      RETURN
      ..............................................................

      ---COMPUTE AND PRINT ITERATION PARAMETERS---
      ********************
      ENTRY ITER
      ********************
      HMIN=2.
      XVAL=3.1415**2/(2.*DIMW**2)
      YVAL=3.1415**2/(2.*DIML**2)
      DO 410 I=2,DIML
      DO 410 J=2,DIMW
      IF (T(I,J).EQ.0.) GO TO 410
      XPART=XVAL*(1/(1+DELX(J)**2/DELY(I)**2))
      YPART=YVAL*(1/(1+DELY(I)**2/DELX(J)**2))
      HMIN=AMIN1(HMIN,XPART,YPART)
```

```
410 CONTINUE
    ALPHA=EXP(ALOG(1/HMIN)/(LENGTH-1))
    RHOP(1)=HMIN
    DO 420 NTIME=2,LENGTH
420 RHOP(NTIME)=RHOP(NTIME-1)*ALPHA
    WRITE (P,780) LENGTH,(RHOP(J),J=1,LENGTH)
    RETURN
    ..............................................................

    ---INITIALIZE DATA FOR ALPHAMERIC PLOT---
    ********************
    ENTRY MAP
    ********************
    WIDTH=0.
    DO 430 J=2,JN01
430 WIDTH=WIDTH+DELX(J)
    YDIM=0.
    DO 440 I=2,IN01
440 YDIM=YDIM+DELY(I)
450 XSF=DINCH*SCALE
    NYD=YDIM/XSF
    IF (NYD*XSF.LE.YDIM-DELY(IN01)/2.) NYD=NYD+1
    IF (NYD.LE.12) GO TO 460
    DINCH=YDIM/12.
    GO TO 450
460 NXD=WIDTH/XSF
    IF (NXD*XSF.LE.WIDTH-DELX(JN01)/2.) NXD=NXD+1
    N4=NXD*N1+1
    N5=NXD+1
    N6=NYD+1
    N8=N2*NYD+1
    NA(1)=N4/2-1
    NA(2)=N4/2
    NA(3)=N4/2+3
    NC=(N3-N8-10)/2
    ND=NC+N8
    NE=MAX0(N5,N6)
    VF1(3)=DIGIT(ND)
    VF2(3)=DIGIT(ND)
    VF3(3)=DIGIT(NC)
    XLABEL(3)=MESUR
    YLABEL(6)=MESUR
    DO 480 I=1,NE
    NNX=N5-I
    NNY=I-1
    IF (NNY.GE.N6) GO TO 470
    YN(I)=XSF*NNY/SCALE
470 IF (NNX.LT.0) GO TO 480
    XN(I)=XSF*NNX/SCALE
480 CONTINUE
    RETURN
    ..............................................................
```

```
      ---READ TIME PARAMETERS AND PUMPING DATA FOR A NEW PUMPING PERIOD-
      ************************
      ENTRY NEWPER
      ************************

      READ (R,620) KP,KPM1,NWEL,TMAX,NUMT,CDLT,DELT

      ---COMPUTE ACTUAL DELT AND NUMT---
      DT=DELT/24.
      TM=0.0
      DO 490 I=1,NUMT
      DT=CDLT*DT
      TM=TM+DT
      IF (TM.GE.TMAX) GO TO 500
490   CONTINUE
      GO TO 510
500   DELT=TMAX/TM*DELT
      NUMT=I
510   WRITE (P,820) KP,TMAX,DELT,NUMT,CDLT
      DELT=DELT*3600.
      TMAX=TMAX*86400.
      ---READ AND WRITE WELL PUMPING RATES---
      WRITE (P,830) NWEL
      IF (KP.GT.KPM1) SUMP=0.
      DO 520 I=1,DIML
      DO 520 J=1,DIMW
      IF (KP.EQ.KPM1) GO TO 520
      STRT(I,J)=PHI(I,J)
520   WELL(I,J)=0.
      IF (NWEL.EQ.0) GO TO 540
      DO 530 II=1,NWEL
      READ (R,620) I,J,QW
      WELL(I,J)=QW
530   WRITE (P,840) I,J,WELL(I,J)
540   RETURN
      ..............................................................

      FORMATS:

550   FORMAT (20I4)
560   FORMAT (   '-    IHED        ISTO        ISYI        IRAT        IRIV
     1ITHK        IPER        IBOT        ITRA        IDLX        IDLY        ITOP
     2     ILND'//I7,12I10)
570   FORMAT (   '-    FACH        FACS        FACY        FACK        FACR
     1FACM        FACP        FACB        FACT        FACX        FACZ        FACO
     2     FACL'//' ',13G10.3//'0EXAMPLE OF RELATION BETWEEN ''I'' PARAME
     3TERS AND ''FAC'' PARAMETERS:'/'    IF IHED = 1, FACH = UNIFORM STAR
     4TING HEAD'/'    IF IHED =-1, FACH = MULTIPLICATION FACTOR FOR VARIA
     4BLE STARTING HEAD MATRIX'/'0MATRICES WITH VARIABLE DATA ARE PRINTE
     5D OUT IN FULL BELOW')
580   FORMAT (1H1,16A8)
```

```
  590 FORMAT (10A8)                                                      DAT3100
  600 FORMAT ('1',60X,'STARTING HEAD MATRIX')                            DAT3110
  610 FORMAT ('1',40X,' CONTINUATION - HEAD AFTER ',G20.7,' SEC PUMPING DAT3120
     1')                                                                 DAT3130
  620 FORMAT (8G10.0)                                                    DAT3140
  630 FORMAT (A8,2X,3G10.0,A8)                                           DAT3150
  640 FORMAT (20F4.0)                                                    DAT3160
  650 FORMAT (1H1,61X,11HRATE MATRIX)                                    DAT3170
  660 FORMAT ('-NUMBER OF PUMPING PERIODS =',I5//' NUMBER OF NODES IN CODAT3180
     1LUMN =',I5//' NUMBER OF NODES IN ROW =',I8//' PRINTOUT EVERY',I5,'DAT3190
     2 STEPS'//' ERROR CRITERIA FOR CLOSURE =',G15.7//' CONSTANT RECHARGDAT3200
     3E RATE(L/T) =',G15.7//' SPECIFIC STORAGE OF CONFINING BED =',G15.7DAT3210
     4//' MAXIMUM PERMITTED NUMBER OF ITERATIONS =',I10//' TERMINATION ODAT3220
     5F COMPUTATION WHEN MAX(PHI(T)-PHI(T-1)) )',G15.7//' EVAPOTRANSPIRADAT3230
     6TION RATE =',G15.7//' EFFECTIVE DEPTH OF ET =',G15.7//' MULTIPLICADAT3240
     7TION FACTOR FOR TRANSMISSIVITY IN X DIRECTION =',F6.2,'; IN Y DIREDAT3245
     8CTION =',F6.2)                                                     DAT3246
  670 FORMAT (1H1,64X,23HTRANSMISSIVITY MATRIX  )                        DAT3250
  680 FORMAT (1H0,I5,10E11.3/(1H ,5X,10E11.3))                           DAT3260
  690 FORMAT ('0',I2,2X,20F6.1/(5X,20F6.1))                              DAT3270
  700 FORMAT (1H0,I5,14F9.5/(1H ,5X,14F9.5))                             DAT3280
  710 FORMAT (1H1,54X,26HSTORAGE COEFFICIENT MATRIX)                     DAT3290
  720 FORMAT (A8)                                                        DAT3300
  730 FORMAT (8F10.4)                                                    DAT3310
  740 FORMAT (1H1,52X,29HHYDRAULIC CONDUCTIVITY MATRIX)                  DAT3320
  750 FORMAT (1H1,46X,40HELEVATION OF IMPERMEABLE BASE OF AQUIFER)       DAT3330
  760 FORMAT ('1',53X,' ELEVATION OF TOP OF AQUIFER')                    DAT3340
  770 FORMAT ('1',54X,'ELEVATION OF LAND SURFACE')                       DAT3350
  780 FORMAT (///1H0,I5,22H ITERATION PARAMETERS:,10D12.3)               DAT3360
  790 FORMAT (1H1,40X,40HGRID SPACING IN PROTOTYPE IN X DIRECTION//(1H0,DAT3370
     112F10.0))                                                          DAT3380
  800 FORMAT (1H0,40X,40HGRID SPACING IN PROTOTYPE IN Y DIRECTION//(1H0,DAT3390
     112F10.0))                                                          DAT3400
  810 FORMAT (1H1,60X,17HRIVER HEAD MATRIX)                              DAT3410
  820 FORMAT ('-PUMPING PERIOD NO.',I4,':',F10.2,' DAYS'/' -------------DAT3420
     1------------------------'//' DELT IN HOURS =',F12.3//' NUMBER OF DAT3430
     2TIME STEPS =',I5//' MULTIPLIER FOR TIME STEP =',F5.2)              DAT3440
  830 FORMAT ('-',18X,I4,' WELLS'/18X,'-----------'//10X,'I',9X,'J    PUDAT3450
     1MPING RATE'/)                                                      DAT3460
  840 FORMAT (' ',2I10,F13.2)                                            DAT3470
  850 FORMAT ('1',55X,'CONFINING BED THICKNESS')                         DAT3480
  860 FORMAT (4G20.10)                                                   DAT3490
  870 FORMAT ('-PROBLEM OPTIONS:  ',9(A8,4X))                            DAT3500
  880 FORMAT ('0ON ALPHAMERIC MAP:'/'  BASIC LENGTH UNIT IS MULTIPLIED BDAT3510
     1Y',F10.2,' TO GET ',A8/'  NUMBER OF MAP UNITS PER INCH =',F10.2/' DAT3520
     2 CONTOUR INTERVAL =',F10.2)                                        DAT3530
  890 FORMAT (1H1,56X,21HSPECIFIC YIELD MATRIX)                          DAT3540
      END                                                                DAT3550-
```

```
SUBROUTINE COMPUT
-----------------

SPECIFICATIONS:
COMMON /DARRAY/ PHI(33,62),RHOP(20),CHK(10)
COMMON /SARRAY/ KEEP(33,62),T(33,62),Q(33,62),STRT(33,62),RATE(33,
162),M(33,62),WELL(33,62),S(33,62),SY(33,62),TR(33,62),TC(33,62),DE
2LX(62),DELY(33)
COMMON /HARRAY/ TOP(33,62),ISUR(33,62),LAND(33,62),RIVER(33,62),PE
1RM(33,62),BOTTOM(33,62)
COMMON /DPARAM/ WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONTR,EROR,LE
1AK
COMMON /SPARAM/ FACS,FACY,FACK,FACR,FACM,FACP,FACB,FACO,FACL,FACW,
1SLEAK,U,SS,TT,TMIN,ETDIST,QET,IFINAL,TMAX,CDLT,DELT,SUM,SUMP,NUMT,
2KT,KP,NPER,KTH,ITMAX,LENGTH,NWEL,QRE,ERR,DIML,DIMW,JNO1,INO1,R,P,P
3U,SUBS,STORE,TEST,ETQB,ETQD,FACTX,FACTY
COMMON /CK/ ETFLXT,STORT,QRET,CHST,CHDT,FLUXT,PUMPT,CFLUXT

REAL*4 MINS,TEST3(102),DDN(100),KEEP,M
REAL*8 PHI,DBLE,RHOP,CHK,WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONT
1R,EROR,XLABEL,YLABEL,TITLE,G(63),BE(63),TEMP(63),IMK,K,DABS,D,W,T1
2,T2,T3,T4,RHO,A,B,C,PARAM,TEST2,DMAX1,LEAK
INTEGER DIML,DIMW,R,P,PU
INTEGER*2 TOP,ISUR,LAND,RIVER,PERM,BOTTOM

---START A NEW TIME STEP---
********************
ENTRY NEWSTP
********************
KT=KT+1
KOUNT=0
DO 10 I=1,DIML
DO 10 J=1,DIMW
KEEP(I,J)=PHI(I,J)
DELT=CDLT*DELT
SUM=SUM+DELT
SUMP=SUMP+DELT
DAYSP=SUMP/86400.
YRSP=DAYSP/365.
HRS=SUM/3600.
MINS=HRS*60.
DAYS=HRS/24.
YRS=DAYS/365.
RETURN

---INITIALIZE DATA FOR A NEW ITERATION---
************************
ENTRY NEWIT1
************************
IF (KOUNT.LT.ITMAX) GO TO 30
KOUNT=KOUNT+1
GO TO 260
```

```
 20 WRITE (6,430)
    STOP
 30 KOUNT=KOUNT+1
    IF (MOD(KOUNT,LENGTH)) 40,40,50
    ************************
    ENTRY NEWITO
    ************************
 40 NTH=0
 50 NTH=NTH+1
    PARAM=RHOP(NTH)
    TEST3(KOUNT+1)=0.
    TEST=0.
    RETURN

    ---COMPUTE IMPLICITLY ALONG ROWS---
    ***********************************************************************
    ENTRY ROW
    ************************
    DO 60 J=1,DIMW
    BE(J)=0.0
    G(J)=0.0
 60 TEMP(J)=PHI(1,J)
    DO 140 I=2,DIML
    DO 100 J=2,JNO1

    ---SKIP COMPUTATIONS IF NODE IS OUTSIDE AQUIFER BOUNDARY---
    IF (T(I,J)) 70,100,70
 70 T1=TR(I,J-1)/DELX(J)
    T2=TR(I,J)/DELX(J)
    T3=TC(I-1,J)/DELY(I)
    T4=TC(I,J)/DELY(I)
    IF (S(I,J).LT.0.) GO TO 80

    ---COMPUTE ET RATE (ETQ), STEADY AND TRANSIENT LEAKAGE FACTOR
    (SLEAK), AND STORAGE COEFFICIENT---
    IF (EVAP.EQ.CHK(6)) CALL ETRATE (I,J)
    IF (LEAK.EQ.CHK(9)) CALL LEAKAG (I,J)
    CALL STORAG (I,J)

    RHO=STORE/DELT
    GO TO 90
 80 RHO=1.0E40
    ---CALCULATE VALUES FOR PARAMETERS USED IN THOMAS ALGORITHM --
 90 IMK=PARAM*(T1+T2+T3+T4)
    A=T1
    B=-T1-T2-RHO-IMK-Q(I,J)*U-ETQB
    C=T2
    W=B-A*BE(J-1)
    BE(J)=C/W
    RW=-WELL(I,J)/(DELX(J)*DELY(I))
    D=-T3*PHI(I-1,J)+(T4+T3-IMK)*PHI(I,J)-T4*PHI(I+1,J)-RHO*KEEP(I,J)-
   1SLEAK-QRE+RW+ETQD-SUBS
```

```
      G(J)=(D-A*G(J-1))/W
  100 CONTINUE

      ---CALCULATE HEAD VALUES FOR ROWS OF MATRIX AND PLACE THEM IN
      TEMPORARY LOCATION TEMP;IF(I.GT.2) FIRST MAKE PHI(I-1,N04)=
      TEMP(N04)---
      N03=DIMW-2
      DO 130 KN04=1,N03
      N04=DIMW-KN04
      PHI(I-1,N04)=TEMP(N04)
      IF (T(I,N04)) 120,110,120
  110 TEMP(N04)=PHI(I,N04)
      GO TO 130
  120 TEMP(N04)=G(N04)-BE(N04)*TEMP(N04+1)
  130 CONTINUE
  140 CONTINUE
      RETURN

      ---COMPUTE IMPLICITLY ALONG COLUMNS---
      ..................................................................
      ENTRY COLUMN
      ************************
      DO 150 I=1,DIML
      BE(I)=0.0
      G(I)=0.0
  150 TEMP(I)=PHI(I,1)
      DO 230 J=2,DIMW
      DO 190 I=2,IN01

      ---SKIP COMPUTATIONS IF NODE IS OUTSIDE AQUIFER BOUNDARY---
      IF (T(I,J)) 160,190,160
  160 T1=TR(I,J-1)/DELX(J)
      T2=TR(I,J)/DELX(J)
      T3=TC(I-1,J)/DELY(I)
      T4=TC(I,J)/DELY(I)
      IF (S(I,J).LT.0.) GO TO 170

      ---COMPUTE ET RATE (ETQ), STEADY AND TRANSIENT LEAKAGE FACTOR
      (SLEAK), AND STORAGE COEFFICIENT---
      IF (EVAP.EQ.CHK(6)) CALL ETRATE (I,J)
      IF (LEAK.EQ.CHK(9)) CALL LEAKAG (I,J)
      CALL STORAG (I,J)

      RHO=STORE/DELT
      GO TO 180
  170 RHO=1.0E40
      ---CALCULATE VALUES FOR PARAMETERS USED IN THOMAS ALGORITHM---
  180 IMK=PARAM*(T1+T2+T3+T4)
      A=T3
      B=-T3-T4-RHO-IMK-Q(I,J)*U-ETQ8
      C=T4
      W=B-A*BE(I-1)
```

```
      BE(I)=C/W
      RW=-WELL(I,J)/(DELX(J)*DELY(I))
      D=-T1*PHI(I,J-1)+(T1+T2-IMK)*PHI(I,J)-T2*PHI(I,J+1)-RHO*KEEP(I,J)-
     1SLEAK-QRE+RW+ETQD-SUBS
      G(I)=(D-A*G(I-1))/W
  190 CONTINUE

      ---CALCULATE HEAD VALUES FOR COLUMNS OF MATRIX AND PLACE IN TEMP-
      ORARY LOCATION TEMP;IF(J.GT.2) FIRST MAKE PHI(NO4,J-1)=TEMP(NO4)--
      NO3=DIML-2
      DO 220 KNO4=1,NO3
      NO4=DIML-KNO4
      PHI(NO4,J-1)=TEMP(NO4)
      IF (T(NO4,J)) 210,200,210
  200 TEMP(NO4)=PHI(NO4,J)
      GO TO 220
  210 TEMP(NO4)=G(NO4)-BE(NO4)*TEMP(NO4+1)
      TCHK=TEMP(NO4)-PHI(NO4,J)
      IF (ABS(TCHK).GT.ERR) TEST=1.
      TEST3(KOUNT+1)=TEST3(KOUNT+1)+TCHK
  220 CONTINUE
  230 CONTINUE
      RETURN

      ******************************************************************

      ---CHECK FOR STEADY STATE---
      ************************
      ENTRY STEADY
      ************************
      TEST2=0.
      DO 240 I=2,INO1
      DO 240 J=2,JNO1
  240 TEST2=DMAX1(TEST2,DABS(DBLE(KEEP(I,J))-PHI(I,J)))
      IF (TEST2.GE.EROR) GO TO 250
      WRITE (P,400) KT
      IFINAL=1
      GO TO 260
  250 IF (KT.EQ.NUMT) IFINAL=1
  260 IF (CHCK.EQ.CHK(5)) CALL CHECK
      IF (KOUNT.GT.ITMAX) GO TO 270
      RETURN

      ---PRINT OUTPUT AT DESIGNATED TIME STEPS---
      ********************
      ENTRY OUTPUT
      ********************
  270 WRITE (P,410) KT,DELT,SUM,MINS,HRS,DAYS,YRS,DAYSP,YRSP,KOUNT
      IF (CHCK.EQ.CHK(5)) CALL CWRITE
      IF (TT.NE.0.) WRITE (P,390) TMIN,TT
      WRITE (P,360) TEST2
      KOUNT=KOUNT+1
```

```
      WRITE (P,370) (TEST3(J),J=1,KOUNT)
      IF (CONTR.EQ.CHK(3)) CALL PRNTA
      IF (HEAD.NE.CHK(8)) GO TO 290
C     ---PRINT HEAD MATRIX---
      WRITE (P,380)
      DO 280 I=1,DIML
  280 WRITE (P,350) I,(PHI(I,J),J=1,DIMW)
  290 IF (NUM.NE.CHK(4)) GO TO 320
C     ---PRINT DRAWDOWN---
      WRITE (P,340)
      DO 310 I=1,DIML
      DO 300 J=1,DIMW
  300 DDN(J)=ISUR(I,J)*0.1-PHI(I,J)
  310 WRITE (P,350) I,(DDN(J),J=1,DIMW)
  320 IF (KOUNT.GT.ITMAX) GO TO 20
      RETURN
C
C     ---PUNCHED OUTPUT---
C     ********************
      ENTRY DRY
C     ********************
      WRITE (PU,440) SUM,SUMP,PUMPT,CFLUXT
      WRITE (PU,440) QRET,CHST,CHDT,FLUXT,STORT,ETFLXT
      DO 330 I=1,DIML
  330 WRITE (PU,420) (PHI(I,J),J=1,DIMW)
      RETURN
C
C     ..................................................................
C
C     FORMATS:
C
  340 FORMAT (1H1,60X,'DRAWDOWN')
  350 FORMAT ('0',I2,2X,20F6.1/(5X,20F6.1))
  360 FORMAT ('0MAXIMUM CHANGE IN HEAD FOR THIS TIME STEP =',F10.3)
  370 FORMAT ('0SUM OF DIFFERENCES BETWEEN ROWS AND COLUMNS FOR EACH ITE
     1RATION:'/('0',10G12.4))
  380 FORMAT ('1',60X,'      HEAD MATRIX')
  390 FORMAT ('0DIMENSIONLESS TIME FOR THIS STEP RANGES FROM',G15.7,'  T
     1O',G15.7)
  400 FORMAT ('-*****STEADY STATE AT TIME STEP',I4,'*****')
  410 FORMAT (1H1,55X,17HTIME STEP NUMBER=,I10/50X,29HSIZE OF TIME STEP 
     1IN SECONDS=,F14.2//55X,'TOTAL SIMULATION TIME IN SECONDS=',F14.2/8
     20X,8HMINUTES=,F14.2/82X,6HHOURS=,F14.2/83X,5HDAYS=,F14.2/82X,'YEAR
     3S=',F14.2///45X,'DURATION OF CURRENT PUMPING PERIOD IN DAYS=',F14.
     42/82X,'YEARS=',F14.2///55X,'ITERATION NUMBER=',I10//)
  420 FORMAT (8F10.4)
  430 FORMAT (1H0,39HEXCEEDED PERMITTED NUMBER OF ITERATIONS/40H *******
     1*********************************)
  440 FORMAT (4G20.10)
      END
```

```
      SUBROUTINE COEF
      ---------------

C     SPECIFICATIONS:
      COMMON /DARRAY/ PHI(33,62),RHOP(20),CHK(10)
      COMMON /SARRAY/ KEEP(33,62),T(33,62),Q(33,62),STRT(33,62),RATE(33,
     162),M(33,62),WELL(33,62),S(33,62),SY(33,62),TR(33,62),TC(33,62),DE
     2LX(62),DELY(33)
      COMMON /HARRAY/ TOP(33,62),ISUR(33,62),LAND(33,62),RIVER(33,62),PE
     1RM(33,62),BOTTOM(33,62)
      COMMON /DPARAM/ WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONTR,EROR,LE
     1AK
      COMMON /SPARAM/ FACS,FACY,FACK,FACR,FACM,FACP,FACB,FACO,FACL,FACW,
     1SLEAK,U,SS,TT,TMIN,ETDIST,QET,IFINAL,TMAX,CDLT,DELT,SUM,SUMP,NUMT,
     2KT,KP,NPER,KTH,ITMAX,LENGTH,NWEL,QRE,ERR,DIML,DIMW,JNO1,INO1,R,P,P
     3U,SUBS,STORE,TEST,ETQB,ETQD,FACTX,FACTY

      REAL KEEP,M
      REAL*8 PHI,DBLE,RHOP,CHK,WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONT
     1R,EROR,LEAK
      INTEGER DIML,DIMW,R,P,PU
      INTEGER*2 TOP,ISUR,LAND,RIVER,PERM,BOTTOM
      DATA PIE/3.141593/

C     ---COMPUTE Q COEFFICIENTS---
C     ********************
      ENTRY CLAY
C     ********************
      TMIN=1.E40
      TT=0.0
      PRATE=0.
      DO 60 I=1,DIML
      DO 60 J=1,DIMW

C     ---SKIP COMPUTATIONS IF T, RATE OR M = 0, OR IF CONSTANT
C        HEAD BOUNDARY---
      IF (RATE(I,J).LE.0..OR.T(I,J).EQ.0..OR.M(I,J).EQ.0..OR.S(I,J).LT.0
     1.) GO TO 60

C     ---CHECK FOR SS = 0---
      IF (SS.NE.0.) GO TO 10
      SUMN=0.0
      DENOM=1.0
      GO TO 50
C     ---CHECK WHETHER VALUE FOR Q(I,J) WILL EQUAL VALUE FOR PREVIOUS
C        NODE---
   10 IF (RATE(I,J)*M(I,J).EQ.PRATE) GO TO 50
      DIMT=RATE(I,J)*SUMP/(M(I,J)*M(I,J)*SS*3)
      IF (DIMT.GT.TT) TT=DIMT
      IF (DIMT.LT.TMIN) TMIN=DIMT
      PPT=PIE*PIE*DIMT
```

```
      SUBROUTINE COEF
      --------------

      SPECIFICATIONS:
      COMMON /DARRAY/ PHI(33,62),RHOP(20),CHK(10)
      COMMON /SARRAY/ KEEP(33,62),T(33,62),Q(33,62),STRT(33,62),RATE(33,
     162),M(33,62),WELL(33,62),S(33,62),SY(33,62),TR(33,62),TC(33,62),DE
     2LX(62),DELY(33)
      COMMON /HARRAY/ TOP(33,62),ISUR(33,62),LAND(33,62),RIVER(33,62),PE
     1RM(33,62),BOTTOM(33,62)
      COMMON /DPARAM/ WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONTR,EROR,LE
     1AK
      COMMON /SPARAM/ FACS,FACY,FACK,FACR,FACM,FACP,FACB,FACO,FACL,FACW,
     1SLEAK,U,SS,TT,TMIN,ETDIST,QET,IFINAL,TMAX,CDLT,DELT,SUM,SUMP,NUMT,
     2KT,KP,NPER,KTH,ITMAX,LENGTH,NWEL,QRE,ERR,DIML,DIMW,JN01,IN01,R,P,P
     3U,SUBS,STORE,TEST,ETQB,ETQD,FACTX,FACTY

      REAL KEEP,M
      REAL*8 PHI,DBLE,RHOP,CHK,WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONT
     1R,EROR,LEAK
      INTEGER DIML,DIMW,R,P,PU
      INTEGER*2 TOP,ISUR,LAND,RIVER,PERM,BOTTOM
      DATA PIE/3.141593/

      ---COMPUTE Q COEFFICIENTS---
      ********************
      ENTRY CLAY
      ********************
      TMIN=1.E40
      TT=0.0
      PRATE=0.
      DO 60 I=1,DIML
      DO 60 J=1,DIMW

      ---SKIP COMPUTATIONS IF T, RATE OR M = 0, OR IF CONSTANT
         HEAD BOUNDARY---
      IF (RATE(I,J).LE.0..OR.T(I,J).EQ.0..OR.M(I,J).EQ.0..OR.S(I,J).LT.0
     1.) GO TO 60

      ---CHECK FOR SS = 0---
      IF (SS.NE.0.) GO TO 10
      SUMN=0.0
      DENOM=1.0
      GO TO 50
      ---CHECK WHETHER VALUE FOR Q(I,J) WILL EQUAL VALUE FOR PREVIOUS
         NODE---
   10 IF (RATE(I,J)*M(I,J).EQ.PRATE) GO TO 50
      DIMT=RATE(I,J)*SUMP/(M(I,J)*M(I,J)*SS*3)
      IF (DIMT.GT.TT) TT=DIMT
      IF (DIMT.LT.TMIN) TMIN=DIMT
      PPT=PIE*PIE*DIMT
```

```
      ---RECOMPUTE PPT IF DIMT WITHIN RANGE FOR SHORT TIME COMPUTATION--COF 530
      IF (DIMT.LT.1.0E-03) PPT=1.0/DIMT                                 COF 540
      CK=(2.3-PPT)/(2.*PPT)                                             COF 550
      SUMN=0.0                                                          COF 560
      DO 30 K=1,200                                                     COF 570
      POWER=K*K*PPT                                                     COF 580
      IF (POWER.LE.150.) GO TO 20                                       COF 590
      POWER=150                                                         COF 600
   20 PEX=EXP(-POWER)                                                   COF 610
      SUMN=SUMN+PEX                                                     COF 620
      IF (PEX.GT.0.00009) GO TO 30                                      COF 630
      IF (K.GT.CK) GO TO 40                                             COF 640
   30 CONTINUE                                                          COF 650
                                                                        COF 660
      ---COMPUTE DENOMINATER DEPENDING ON VALUE OF DIMT---              COF 670
   40 DENOM=1.0                                                         COF 680
      IF (DIMT.LT.1.0E-03) DENOM=SQRT(PIE*DIMT)                         COF 690
                                                                        COF 700
      ---HEAD VALUES ARE NOT INCLUDED IN COMPUTATION OF Q FACTOR SINCE  COF 710
         LEAKAGE IS CONSIDERED IMPLICITLY---                            COF 720
   50 Q1=RATE(I,J)/(M(I,J)*DENOM)                                       COF 730
      Q(I,J)=Q1+2.0*Q1*SUMN                                             COF 740
      PRATE=RATE(I,J)*M(I,J)                                            COF 750
   60 CONTINUE                                                          COF 760
      TMIN=TMIN*3.0                                                     COF 764
      TT=TT*3.0                                                         COF 765
      RETURN                                                            COF 770
                                                                        COF 780
      ---COMPUTE TRANSMISSIVITY IN WT OR WT-ARTESIAN CONVERSION PROBLEM-COF 790
      ********************                                              COF 800
      ENTRY TRANS(IERR)                                                 COF 810
      ********************                                              COF 820
      DO 70 I=2,INO1                                                    COF 830
      DO 70 J=2,JNO1                                                    COF 840
      HED=PHI(I,J)                                                      COF 850
      IF (CONVRT.EQ.CHK(7)) HED=AMIN1(SNGL(PHI(I,J)),TOP(I,J)*FACO)     COF 860
      T(I,J)=PERM(I,J)*FACP*(HED-BOTTOM(I,J)*FACB)                      COF 870
      IF (T(I,J).GE.0.) GO TO 70                                        COF 880
      IF (WELL(I,J).LT.0.) GO TO 80                                     COF 890
      T(I,J)=PERM(I,J)*FACP                                             COF 900
      PHI(I,J)=BOTTOM(I,J)*FACB+1.0                                     COF 910
   70 CONTINUE                                                          COF 920
      RETURN                                                            COF 930
   80 WRITE (P,260) I,J                                                 COF 935
      DO 90 I=2,INO1                                                    COF 940
      DO 90 J=2,JNO1                                                    COF 950
   90 PHI(I,J)=KEEP(I,J)                                                COF 960
      SUM=SUM-DELT                                                      COF 970
      SUMP=SUMP-DELT                                                    COF 980
      IERR=1                                                            COF1000
      RETURN                                                            COF1010
                                                                        COF1020
```

```
      ---COMPUTE T COEFFICIENTS---
      ********************
      ENTRY TCOF
      ********************
      DO 130 I=1,INO1
      DO 130 J=1,JNO1
      DENOM=(T(I,J)*DELX(J+1)+T(I,J+1)*DELX(J))
      IF (DENOM.NE.0.) GO TO 100
      TR(I,J)=0.
      GO TO 110
  100 TR(I,J)=(2.*T(I,J+1)*T(I,J))/DENOM*FACTX
  110 DENOM=(T(I,J)*DELY(I+1)+T(I+1,J)*DELY(I))
      IF (DENOM.NE.0.) GO TO 120
      TC(I,J)=0.
      GO TO 130
  120 TC(I,J)=(2.*T(I+1,J)*T(I,J))/DENOM*FACTY
  130 CONTINUE
      RETURN

      ---COMPUTE ET RATE---
      ********************
      ENTRY ETRATE(I,J)
      ********************
      ETQB=0.0
      ETQD=0.0
      IF (PHI(I,J).LE.LAND(I,J)*FACL-ETDIST) GO TO 140
      ETQB=QET/ETDIST
      ETQD=ETQB*(ETDIST-LAND(I,J)*FACL)
  140 RETURN

      ---COMPUTE STORAGE COEFFICIENT---
      ********************
      ENTRY STORAG(I,J)
      ********************
      SUBS=0.0
      IF (WATER.NE.CHK(2)) GO TO 200
      IF (CONVRT.NE.CHK(7)) GO TO 180
      X=KEEP(I,J)-PHI(I,J)
      IF (X) 150,160,160
  150 HED1=PHI(I,J)
      HED2=KEEP(I,J)
      GO TO 170
  160 HED1=KEEP(I,J)
      HED2=PHI(I,J)
  170 IF (HED1-TOP(I,J)*FACO) 180,180,190
  180 STORE=SY(I,J)
      GO TO 220
  190 IF (TOP(I,J)*FACO-HED2) 200,200,210
  200 STORE=S(I,J)
      GO TO 220
  210 STORE=SY(I,J)
      SUBS=(HED1-TOP(I,J)*FACO)*(S(I,J)-SY(I,J))/DELT
```

```
    IF (X.LT.0.) SUBS=-SUBS
220 RETURN

    ---COMPUTE STEADY AND TRANSIENT LEAKAGE FACTOR---
    ********************
    ENTRY LEAKAG(I,J)
    ********************
    HED1=STRT(I,J)
    IF (CONVRT.EQ.CHK(7)) HED1=AMAX1(STRT(I,J),TOP(I,J)*FACO)
    U=1.
    HED2=0.
    IF (CONVRT.NE.CHK(7).OR.PHI(I,J).GE.TOP(I,J)*FACO) GO TO 230
    HED2=TOP(I,J)*FACO
    U=0.
230 X=0.
    IF (M(I,J)) 250,250,240
240 X=RATE(I,J)/M(I,J)
250 SLEAK=X*(RIVER(I,J)*FACR-HED1)+Q(I,J)*(HED1-HED2)
    RETURN

    ---FORMATS---

260 FORMAT ('-*************WELL',I3,',',I3,' GOES DRY**************')
    END
```

```
      SUBROUTINE CHECK
      ----------------
      ---THIS SUBROUTINE COMPUTES A MASS BALANCE---

      SPECIFICATIONS:
      COMMON /DARRAY/ PHI(33,62),RHOP(20),CHK(10)
      COMMON /SARRAY/ KEEP(33,62),T(33,62),Q(33,62),STRT(33,62),RATE(33,
     162),M(33,62),WELL(33,62),S(33,62),SY(33,62),TR(33,62),TC(33,62),DE
     2LX(62),DELY(33)
      COMMON /HARRAY/ TOP(33,62),ISUR(33,62),LAND(33,62),RIVER(33,62),PE
     1RM(33,62),BOTTOM(33,62)
      COMMON /DPARAM/ WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONTR,EROR,LE
     1AK
      COMMON /SPARAM/ FACS,FACY,FACK,FACR,FACM,FACP,FACB,FACO,FACL,FACW,
     1SLEAK,U,SS,TT,TMIN,ETDIST,QET,IFINAL,TMAX,CDLT,DELT,SUM,SUMP,NUMT,
     2KT,KP,NPER,KTH,ITMAX,LENGTH,NWEL,QRE,ERR,DIML,DIMW,JNO1,INO1,R,P,P
     3U,SUBS,STORE,TEST,ETQB,ETQD,FACTX,FACTY
      COMMON /CK/ ETFLXT,STORT,QRET,CHST,CHDT,FLUXT,PUMPT,CFLUXT

      REAL KEEP,M
      REAL*8 PHI,DBLE,RHOP,CHK,WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONT
     1R,EROR,LEAK
      INTEGER DIML,DIMW,R,P,PU
      INTEGER*2 TOP,ISUR,LAND,RIVER,PERM,BOTTOM

      ---INITIALIZE VARIABLES---
      PUMP=0.
      STOR=0.
      FLUXS=0.0
      CHD1=0.0
      CHD2=0.0
      QREFLX=0.
      CFLUX=0.
      FLUX=0.
      ETFLUX=0.
      ..............................................................

      ---COMPUTE RATES,STORAGE AND PUMPAGE FOR THIS STEP---
      DO 230 I=2,DIML
      DO 230 J=2,DIMW
      IF (T(I,J).EQ.0..OR.S(I,J).LT.0.) GO TO 230
      AREA=DELX(J)*DELY(I)
      IF (WELL(I,J)) 10,30,20
      PUMP=PUMP-WELL(I,J)
      GO TO 30
      CFLUX=CFLUX+WELL(I,J)
      ---COMPUTE FLOW RATES TO AND FROM CONSTANT HEAD BOUNDARIES---
      IF (S(I,J-1).GE.0.) GO TO 60
      X=TR(I,J-1)*(STRT(I,J-1)-PHI(I,J))*DELY(I)
      IF (X) 40,60,50
      CHD1=CHD1+X
      GO TO 60
```

```
 50 CHD2=CHD2+X
 60 IF (S(I,J+1).GE.0.) GO TO 90
    X=TR(I,J)*(STRT(I,J+1)-PHI(I,J))*DELY(I)
    IF (X) 70,90,80
 70 CHD1=CHD1+X
    GO TO 90
 80 CHD2=CHD2+X
 90 IF (S(I-1,J).GE.0.) GO TO 120
    X=TC(I-1,J)*(STRT(I-1,J)-PHI(I,J))*DELX(J)
    IF (X) 100,120,110
100 CHD1=CHD1+X
    GO TO 120
110 CHD2=CHD2+X
120 IF (S(I+1,J).GE.0.) GO TO 150
    X=TC(I,J)*(STRT(I+1,J)-PHI(I,J))*DELX(J)
    IF (X) 130,150,140
130 CHD1=CHD1+X
    GO TO 150
140 CHD2=CHD2+X
150 QREFLX=QREFLX+QRE*AREA
    ---COMPUTE ET RATE---
    IF (EVAP.NE.CHK(6)) GO TO 180
    IF (PHI(I,J).GE.LAND(I,J)*FACL-ETDIST) GO TO 160
    ETQ=0.0
    GO TO 170
160 ETQ=QET/ETDIST*(PHI(I,J)+ETDIST-LAND(I,J)*FACL)
170 ETFLUX=ETFLUX+ETQ*AREA
    ---COMPUTE VOLUME FROM STORAGE---
180 STORE=S(I,J)
    IF (WATER.EQ.CHK(2)) STORE=SY(I,J)
    IF (CONVRT.NE.CHK(7)) GO TO 220
    X=KEEP(I,J)-PHI(I,J)
    IF (X) 190,200,200
190 HED1=PHI(I,J)
    HED2=KEEP(I,J)
    X=ABS(X)
    GO TO 210
200 HED1=KEEP(I,J)
    HED2=PHI(I,J)
210 STORE=S(I,J)
    IF (HED1-TOP(I,J)*FACO.LE.0.) STORE=SY(I,J)
    IF ((HED1-TOP(I,J)*FACO)*(HED2-TOP(I,J)*FACO).LT.0.0) STORE=(HED1-
   1TOP(I,J)*FACO)/X*S(I,J)+(TOP(I,J)*FACO-HED2)/X*SY(I,J)
220 STOR=STOR+STORE*(KEEP(I,J)-PHI(I,J))*AREA
    ---COMPUTE LEAKAGE RATE---
    IF(LEAK.NE.CHK(9)) GO TO 230
    HED1=STRT(I,J)
    IF (CONVRT.EQ.CHK(7)) HED1=AMAX1(STRT(I,J),TOP(I,J)*FACO)
    HED2=PHI(I,J)
    IF (CONVRT.EQ.CHK(7)) HED2=AMAX1(SNGL(PHI(I,J)),TOP(I,J)*FACO)
    XX=RATE(I,J)*(RIVER(I,J)*FACR-HED1)*AREA/M(I,J)
    FLUX=FLUX+XX
```

```
      FLUXS=FLUXS+Q(I,J)*(HED1-HED2)*AREA+XX
  230 CONTINUE
C     .................................................................
C
C     ---COMPUTE CUMULATIVE VOLUMES, TOTALS, AND DIFFERENCES---
      STORT=STORT+STOR
      ETFLXT=ETFLXT+ETFLUX*DELT
      FLUXT=FLUXT+FLUXS*DELT
      QRET=QRET+QREFLX*DELT
      CHDT=CHDT-CHD1*DELT
      CHST=CHST+CHD2*DELT
      PUMPT=PUMPT+PUMP*DELT
      CFLUXT=CFLUXT+CFLUX*DELT
      TOTL1=STORT+QRET+CFLUXT+CHST+FLUXT
      TOTL2=CHDT+PUMPT+ETFLXT
      DIFF=TOTL2-TOTL1
      PERCNT=DIFF/TOTL2*100.
      RETURN
C     .................................................................
C
C     ---PRINT RESULTS---
C     ************************
      ENTRY CWRITE
C     ************************
C
      WRITE (P,240) STORT,QRET,CFLUXT,CHST,FLUXT,TOTL1
      WRITE (P,250) ETFLXT,CHDT,PUMPT,TOTL2,DIFF,PERCNT
      WRITE (P,260) QREFLX,CFLUX,CHD2,CHD1,PUMP,ETFLUX,FLUXS,FLUX,STOR
C
C     FORMATS:
      RETURN
C
  240 FORMAT ('0MASS BALANCE:'//4X,' CUMULATIVE',25X,'L**3'//7X,' SOURCE
     1S: '/7X,' -------'/14X,' STORAGE =',F20.2/13X,' RECHARGE =',F20.2/
     28X,' CONSTANT FLUX =',F20.2/8X,' CONSTANT HEAD =',F20.2/14X,' LEAK
     3AGE =',F20.2/8X,' TOTAL SOURCES =',F20.2)
  250 FORMAT ('0',6X,' DISCHARGES:'/7X,' ----------'/3X,' EVAPOTRANSPIRA
     1TION =',F20.2/8X,' CONSTANT HEAD =',F20.2/6X,' QUANTITY PUMPED =',
     2F20.2/12X,' TOTAL OUT =',F20.2//4X,' TOTAL OUT-SOURCES =',F20.2/3X
     3,' PERCENT DIFFERENCE =',F20.2)
  260 FORMAT ('-',3X,' RATES FOR THIS TIME STEP',9X,'L**3/T'//13X,' RECH
     1ARGE =',F20.2/8X,' CONSTANT FLUX =',F20.2/5X,' CONSTANT HEAD IN ='
     2,F20.2/4X,' CONSTANT HEAD OUT =',F20.2/14X,' PUMPING =',F20.2/19X,
     3' ET =',F20.2/14X,' LEAKAGE:'/16X,' TOTAL =',F20.2/15X,' STEADY ='
     4,F20.2//' FOR THIS TIME STEP, STORAGE =',F14.2)
      END
```

```
      SUBROUTINE PRNTA
      ----------------

      SPECIFICATIONS:
      COMMON /DARRAY/ PHI(33,62),RHOP(20),CHK(10)
      COMMON /SARRAY/ KEEP(33,62),T(33,62),Q(33,62),STRT(33,62),RATE(33,
     162),M(33,62),WELL(33,62),S(33,62),SY(33,62),TR(33,62),TC(33,62),DE
     2LX(62),DELY(33)
      COMMON /HARRAY/ TOP(33,62),ISUR(33,62),LAND(33,62),RIVER(33,62),PE
     1RM(33,62),BOTTOM(33,62)
      COMMON /DPARAM/ WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONTR,EROR,LE
     1AK
      COMMON /SPARAM/ FACS,FACY,FACK,FACR,FACM,FACP,FACB,FACO,FACL,FACW,
     1SLEAK,U,SS,TT,TMIN,ETDIST,QET,IFINAL,TMAX,CDLT,DELT,SUM,SUMP,NUMT,
     2KT,KP,NPER,KTH,ITMAX,LENGTH,NWEL,QRE,ERR,DIML,DIMW,JNO1,INO1,R,P,P
     3U,SUBS,STORE,TEST,ETQB,ETQD,FACTX,FACTY
      COMMON /PR/ XLABEL(3),YLABEL(6),TITLE(4),XN1,SYM(28),PRNT(122),BLA
     1NK(60),DIGIT(122),VF1(6),VF2(6),VF3(7),NA(4),XN(100),YN(13),XSF,NX
     2D,WIDTH,SPACNG,N1,N2,N3,N4,N6,N8,NC

      REAL K,KEEP,M
      REAL*8 PHI,DBLE,RHOP,CHK,WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONT
     1R,EROR,XLABEL,YLABEL,TITLE,XN1,Z,LEAK
      INTEGER DIML,DIMW,R,P,PU
      INTEGER*2 TOP,ISUR,LAND,RIVER,PERM,BOTTOM

      ---INITIALIZE VARIABLES---
      DIST=WIDTH-DELX(JNO1)/2.
      JJ=JNO1
      LL=1
      Z=NXD*XSF
      WRITE (P,150) (TITLE(I),I=1,4)
      DO 140 I=1,N4

      ---LOCATE X AXES---
      IF (I.EQ.1.OR.I.EQ.N4) GO TO 10
      PRNT(1)=SYM(23)
      PRNT(N8)=SYM(23)
      IF ((I-1)/N1*N1.NE.I-1) GO TO 30
      PRNT(1)=SYM(25)
      PRNT(N8)=SYM(25)
      GO TO 30

      ---LOCATE Y AXES---
      DO 20 J=1,N8
      IF ((J-1)/N2*N2.EQ.J-1) PRNT(J)=SYM(25)
      IF ((J-1)/N2*N2.NE.J-1) PRNT(J)=SYM(24)

      ---COMPUTE LOCATION OF NODES AND DETERMINE APPROPRIATE SYMBOL---
      IF (DIST.LT.0..OR.DIST.LT.Z-XN1*XSF) GO TO 90
      YLEN=DELY(2)/2.
      DO 80 L=2,INO1
```

```
      J=YLEN*N2/XSF+1.5
      K=(ISUR(L,JJ)*.1-PHI(L,JJ))/SPACNG
      IF (K) 60,50,40
   40 K=AMOD(K,20.)
      N=K
      PRNT(J)=SYM(N+1)
      GO TO 70
   50 PRNT(J)=SYM(26)
      GO TO 70
   60 PRNT(J)=SYM(22)
   70 IF (S(L,JJ).LT.0.) PRNT(J)=SYM(27)
      IF (WELL(L,JJ).NE.0.) PRNT(J)=SYM(28)
   80 YLEN=YLEN+(DELY(L)+DELY(L+1))/2.
      DIST=DIST-(DELX(JJ)+DELX(JJ-1))/2.
      JJ=JJ-1
   90 CONTINUE

      ---PRINT AXES.LABELS, AND SYMBOLS---
      IF (I-NA(LL).EQ.0) GO TO 110
      IF ((I-1)/N1*N1-(I-1)) 120,100,120
  100 WRITE (P,VF1) (BLANK(J),J=1,NC),(PRNT(J),J=1,N8),XN(1+(I-1)/6)
      GO TO 130
  110 WRITE (P,VF2) (BLANK(J),J=1,NC),(PRNT(J),J=1,N8),XLABEL(LL)
      LL=LL+1
      GO TO 130
  120 WRITE (P,VF2) (BLANK(J),J=1,NC),(PRNT(J),J=1,N8)

      ---COMPUTE NEW VALUE FOR Z AND INITIALIZE PRNT---
  130 Z=Z-2.*XN1*XSF
      DO 140 J=1,N8
  140 PRNT(J)=SYM(11)

      ---NUMBER AND LABEL Y AXIS AND PRINT LEGEND---
      WRITE (P,VF3) (BLANK(J),J=1,NC),(YN(I),I=1,N6)
      WRITE (P,170) (YLABEL(I),I=1,6)
      WRITE (P,160) SPACNG
      RETURN

      ---FORMATS---

  150 FORMAT ('1',46X,4A8//)
  160 FORMAT ('-LEGEND'/' ------'//' R = CONSTANT HEAD BOUNDARY'/' W = W
     1ELL LOCATION'/' 0 = NO-FLOW BOUNDARY'/' * = CONE OF IMPRESSION'//'
     2 CONTOUR INTERVAL =',F10.2//' THE FOLLOWING 20 SYMBOLS, STARTING W
     3ITH BLANK, ARE CYCLED:   1 2 3 4 5 6 7 8 9   1 B 3 D 5 F 7 H 9')
  170 FORMAT ('0',39X,6A8)
      END
```

```
      BLOCK DATA
      ----------
      COMMON /DARRAY/ PHI(33,62),RHOP(20),CHK(10)
      COMMON /SARRAY/ KEEP(33,62),T(33,62),Q(33,62),STRT(33,62),RATE(33,
     162),M(33,62),WELL(33,62),S(33,62),SY(33,62),TR(33,62),TC(33,62),DE
     2LX(62),DELY(33)
      COMMON /HARRAY/ TOP(33,62),ISUR(33,62),LAND(33,62),RIVER(33,62),PE
     1RM(33,62),BOTTOM(33,62)
      COMMON /DPARAM/ WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONTR,EROR,LE
     1AK
      COMMON /SPARAM/ FACS,FACY,FACK,FACR,FACM,FACP,FACB,FACO,FACL,FACW,
     1SLEAK,U,SS,TT,TMIN,ETDIST,QET,IFINAL,TMAX,CDLT,DELT,SUM,SUMP,NUMT,
     2KT,KP,NPER,KTH,ITMAX,LENGTH,NWEL,QRE,ERR,DIML,DIMW,JN01,IN01,R,P,P
     3U,SUBS,STORE,TEST,ETQB,ETQD,FACTX,FACTY
      COMMON /PR/ XLABEL(3),YLABEL(6),TITLE(4),XN1,SYM(28),PRNT(122),BLA
     1NK(60),DIGIT(122),VF1(6),VF2(6),VF3(7),NA(4),XN(100),YN(13),XSF,NX
     2D,WIDTH,SPACNG,N1,N2,N3,N4,N6,N8,NC

      REAL KEEP,M
      REAL*8 PHI,DBLE,RHOP,CHK,WATER,CONVRT,EVAP,CHCK,PNCH,NUM,HEAD,CONT
     1R,EROR,XLABEL,YLABEL,TITLE,XN1,LEAK
      INTEGER DIML,DIMW,R,P,PU
      INTEGER*2 TOP,ISUR,LAND,RIVER,PERM,BOTTOM
      ******************************************************************
      DATA CHK/'PUNCH','WATERTAB','CONTOUR','NUMERIC','CHECK','EVAPOTRA'
     1,'CONVERT','HEAD','LEAKAGE',0.D0/,R,P,PU/5,6,7/,SUBS,U,TT/3*0.0/
      DATA SYM/1H ,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H ,1H1,1H8,1H3,1
     1HD,1H5,1HF,1H7,1HH,1H9,1H ,1H*,1HI,1H-,1H+,1H0,1HR,1HW/
      DATA PRNT/122*' '/,N1,N2,N3,XN1/6,10,133,.0833333333D0/,BLANK/60*'
     1 '/,NA(4)/1000/
      DATA XLABEL/' X DIS- ','TANCE IN',' MILES '/,YLABEL/'DISTANCE',' 
     1FROM OR','IGIN IN ','Y DIRECT','ION, IN ','MILES   '/,TITLE/'ALPHA
     2MER','IC CONTO','URS OF D','RAWDOWN '/
      DATA DIGIT/'1','2','3','4','5','6','7','8','9','10','11','12','13'
     1,'14','15','16','17','18','19','20','21','22','23','24','25','26',
     2'27','28','29','30','31','32','33','34','35','36','37','38','39','
     340','41','42','43','44','45','46','47','48','49','50','51','52','5
     43','54','55','56','57','58','59','60','61','62','63','64','65','66
     5','67','68','69','70','71','72','73','74','75','76','77','78',' 79
     6','80','81','82','83','84','85','86','87','88','89','90','91','92'
     7,'93','94','95','96','97','98','99','100','101','102','103',' 104'
     8,'105','106','107','108','109','110','111','112','113','114','115'
     9,'116','117','118','119','120','121','122'/
      DATA VF1/'(1H ',',','     ','A1,F','10.2',')'/
      DATA VF2/'(1H ',',','     ','A1,1','X,A8',')'/
      DATA VF3/'(1H0',',','     ','A1,F','3.1,','12F1','0.2)'/
      ******************************************************************
      END
```

DATA FOR EXAMPLE 1

```
Card 1   ------AQUIFER MODEL EXAMPLE: WATER TABLE AQUIFER WITH ET, QRE AND CONSTANT DISCH
     2   ARGE BOUNDARY, 10 DAYS PUMPING, 50 DAYS RECOVERY
     3   WATERTABLE
     4
     5
     6   EVAPOTRANSPIRATION
     7   CHECK
     8
     9   NUMERIC
    10
    11   CONTOUR              1      500      10   FEET
    12            2           6       10       6           5       .001     2.E-07
    13           50          .1   4.E-07      10           1         1
    14     1  -1   1    1     1   1    1   1   1   1   1   1   1                 .001       0
    15          100      .0002       .02
    16                    500.      500.                  105
    17
    18
    19
         1  -1   1   1   1   1   1   1   1   1
 Card    1  -1   1   1   1   1   1   1   1   1
 Set     1  -1   1   1   1   1   1   1   1   1
  3      1  -1   1   1   1   1   1   1   1   1
         1  -1   1   1   1   1   1   1   1   1
         1  -1   1   1   1   1   1   1   1   1
Card 20          1           0           1      10        100      1.5      6.0
Card Set 15      4           8          -6
Card 20          2           1           0    50.0        100      1.5      6.0
Card 21
```

DATA FOR EXAMPLE 2

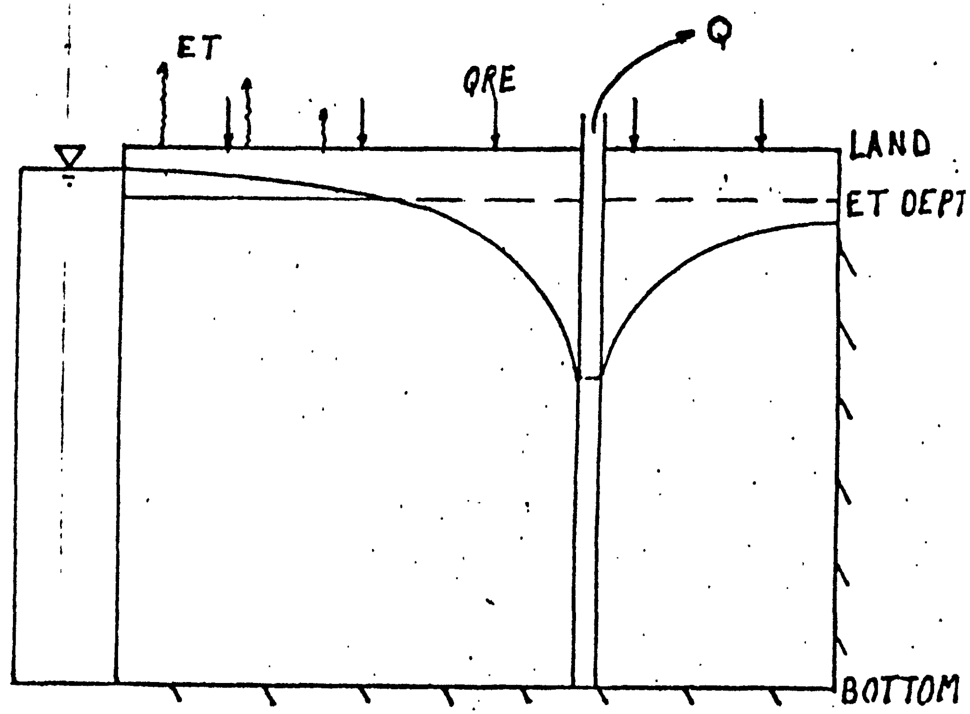
```
Card 1  -----AQUIFER MODEL EXAMPLE: ARTESIAN CONVERTING TO WATER TABLE AQUIFER INCLUDING
     2   LEAKAGE AND CONSTANT HEAD; 10 D PUMPING, 70D R.
     3  WATERTABLE
     4  LEAKAGE
     5  CONVERT
     6
     7  CHECK
     8
     9  NUMERIC
    10
    11  CONTOUR              1       500       10  FEET
    12          2            6        10        7            5      .001                 .00020
    13         50           .2                               1         1
    14    1  -1    1    1    1    1    1    1    1    1    1    1    1
    15        100        .0002       .02    2.E-07         100        10      .001            0
    16                    500.      500.       90
    17
    18
    19
          1  -1    1    1    1    1    1    1    1    1
  Card    1  -1    1    1    1    1    1    1    1    1
  Set     1  -1    1    1    1    1    1    1    1    1
          1  -1    1    1    1    1    1    1    1    1
  3       1  -1    1    1    1    1    1    1    1    1
          1  -1    1    1    1    1    1    1    1    1
Card 20         1          0          1     10.0       100      1.5      12.0
Card Set 15     4          8         -4
Card 20         2          1          0     70.0       100      1.5      12.0
```

------AQUIFER MODEL EXAMPLE: WATER TABLE AQUIFER WITH ET, QRE AND CONSTANT DISCHARGE BOUNDARY, 10 DAYS PUMPING, 50 DAYS RECOVERY

* Well goes dry, therefore this run terminates before end of pumping period

PROBLEM OPTIONS: WATERTAB EVAPOTRA CHECK NUMERIC CONTOUR

ON ALPHAMERIC MAP:
BASIC LENGTH UNIT IS MULTIPLIED BY 1.00 TO GET FEET
NUMBER OF MAP UNITS PER INCH = 500.00
CONTOUR INTERVAL = 10.00



NUMBER OF PUMPING PERIODS = 2

NUMBER OF NODES IN COLUMN = 6

NUMBER OF NODES IN ROW = 10

PRINTOUT EVERY 6 STEPS

ERROR CRITERIA FOR CLOSURE = 0.9999999E-03

CONSTANT RECHARGE RATE(L/T) = 0.2000000E-06

SPECIFIC STORAGE OF CONFINING BED = 0.0

MAXIMUM PERMITTED NUMBER OF ITERATIONS = 50

TERMINATION OF COMPUTATION WHEN MAX(PHI(T)-PHI(T-1))) 0.1000000D 00

EVAPOTRANSPIRATION RATE = 0.4000000E-06

EFFECTIVE DEPTH OF ET = 10.00000

MULTIPLICATION FACTOR FOR TRANSMISSIVITY IN X DIRECTION = 1.00; IN Y DIRECTION = 1.00

IHED	ISTO	ISYI	IRAT	IRIV	ITHK	IPER	IBOT	ITRA	IDLX	IDLY	ITOP	ILND
1	-1	1	1	1	1	1	1	1	1	1	1	1

FACH	FACS	FACY	FACK	FACR	FACM	FACP	FACB	FACT	FACX	FACZ	FACO	FACL
100.	0.200E-03	0.200E-01	0.0	0.0	0.0	0.100E-02	0.0	0.0	500.	500.	0.0	105.

EXAMPLE OF RELATION BETWEEN 'I' PARAMETERS AND 'FAC' PARAMETERS:
IF IHED = 1, FACH = UNIFORM STARTING HEAD
IF IHED =-1, FACH = MULTIPLICATION FACTOR FOR VARIABLE STARTING HEAD MATRIX

MATRICES WITH VARIABLE DATA ARE PRINTED OUT IN FULL BELOW

STORAGE COEFFICIENT MATRIX

1	0.00020	-0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
2	0.00020	-0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
3	0.00020	-0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
4	0.00020	-0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
5	0.00020	-0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
6	0.00020	-0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020

5 ITERATION PARAMETERS: 0.247D-01 0.623D-01 0.157D 00 0.396D 00 0.100D 01

PUMPING PERIOD NO. 1: 10.00 DAYS

DELT IN HOURS = 4.973

NUMBER OF TIME STEPS = 7

MULTIPLIER FOR TIME STEP = 1.50

1 WELLS

I	J	PUMPING RATE
4	8	-6.00

```
                              TIME STEP NUMBER=          6
                     SIZE OF TIME STEP IN SECONDS=      203935.75

                         TOTAL SIMULATION TIME IN SECONDS=      558095.75
                                                  MINUTES=        9301.59
                                                    HOURS=         155.03
                                                     DAYS=           6.46
                                                    YEARS=           0.02

                   DURATION OF CURRENT PUMPING PERIOD IN DAYS=          6.46
                                                    YEARS=           0.02

                         ITERATION NUMBER=        13

MASS BALANCE:

   CUMULATIVE                          L**3

      SOURCES:
      -------
              STORAGE =          2491614.00
             RECHARGE =           781330.06
        CONSTANT FLUX =               0.0
        CONSTANT HEAD =           272577.56
              LEAKAGE =               0.0
        TOTAL SOURCES =          3545521.00

      DISCHARGES:
      ----------
   EVAPOTRANSPIRATION =           196954.63
        CONSTANT HEAD =               0.0
      QUANTITY PUMPED =          3348574.00
            TOTAL OUT =          3545528.00

   TOTAL OUT-SOURCES =                7.00
   PERCENT DIFFERENCE =               0.00

   RATES FOR THIS TIME STEP           L**3/T

             RECHARGE =               1.40
        CONSTANT FLUX =               0.0
     CONSTANT HEAD IN =               0.88
    CONSTANT HEAD OUT =               0.0
              PUMPING =               6.00
                   ET =               0.12
             LEAKAGE:
                TOTAL =               0.0
               STEADY =               0.0

FOR THIS TIME STEP, STORAGE =      782403.69

MAXIMUM CHANGE IN HEAD FOR THIS TIME STEP =      15.836

SUM OF DIFFERENCES BETWEEN ROWS AND COLUMNS FOR EACH ITERATION:

  -26.39      -1.324      0.2420      0.2042E-01 -0.1158E-01  0.1259E-01  0.1256E-01  0.5992E-02  0.1221E-02 -0.1723E-03

  0.6372E-03  0.3986E-03  0.1881E-03  0.3977E-04
```

ALPHAMERIC CONTOURS OF DRAWDOWN

```
+----------+----------+----------+----------+  4000.00
|                                           |
|    2          2          3          3     |
|                                           |
+                                           +  3500.00
|                                           |
|    2          3          W          3     |
|                                           |
+                                           +  3000.00
|                                           |
|    1          2          2          2     |
|                                           |
+                                           +  2500.00
|                                           |
|    1          1          1          1     |
|                                           |   X DIS-
|                                           |  TANCE IN
+                                           +   2000.00
|                                           |
|                                           |    FEET
|                                           |
+                                           +  1500.00
|                                           |
|                                           |
|                                           |
+                                           +  1000.00
|                                           |
|                                           |
|                                           |
+                                           +   500.00
|                                           |
|    R          R          R          R     |
|                                           |
+----------+----------+----------+----------+     0.0

0.0     500.00    1000.00    1500.00    2000.00

    DISTANCE FROM ORIGIN IN Y DIRECTION, IN   FEET
```

R = CONSTANT HEAD BOUNDARY
W = WELL LOCATION
∩ = NO-FLOW BOUNDARY
* = CONE OF IMPRESSION

CONTOUR INTERVAL = 10.00

THE FOLLOWING 20 SYMBOLS, STARTING WITH BLANK, ARE CYCLED: 1 2 3 4 5 6 7 8 9 1 B 3 D 5 F 7 H 9

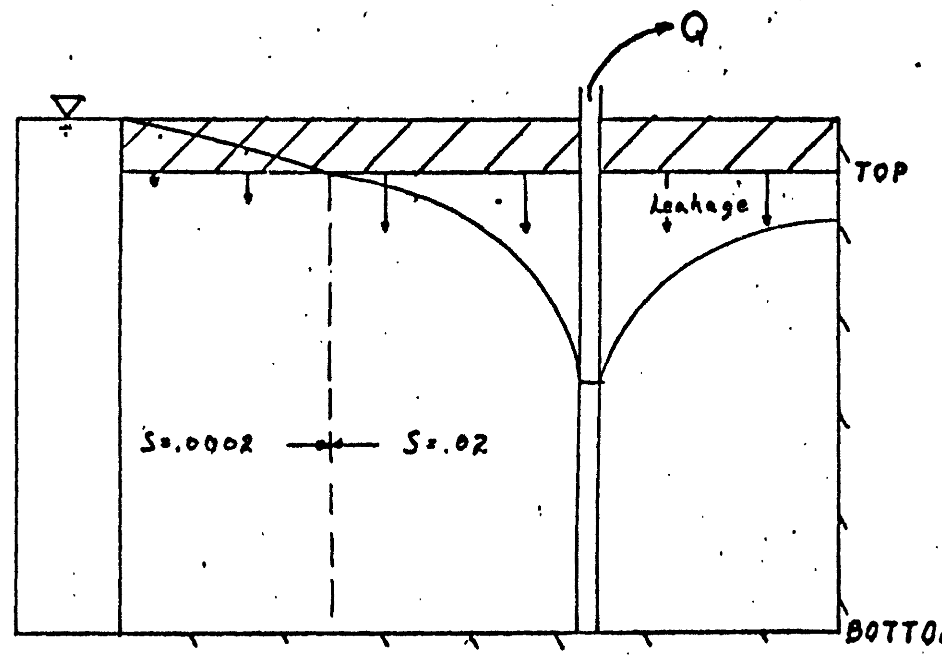
1	-0.0	90.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
2	-0.0	-0.0	2.1	4.7	8.2	12.8	18.3	23.4	24.8	-0.0
3	-0.0	-0.0	2.2	4.9	8.7	14.1	21.7	30.8	29.9	-0.0
4	-0.0	-0.0	2.3	5.1	9.3	15.9	27.5	62.3	38.8	-0.0
5	-0.0	-0.0	2.3	5.3	9.5	15.9	25.2	37.0	35.5	-0.0
6	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

*************WELL 4. 8 GOES DRY**************

-----AQUIFER MODEL EXAMPLE: ARTESIAN CONVERTING TO WATER TABLE AQUIFER INCLUDING LEAKAGE AND CONSTANT HEAD: 10 D PUMPING, 100 ...

PROBLEM OPTIONS: WATERTAB LEAKAGE CONVERT CHECK NUMERIC CONT...

ON ALPHAMERIC MAP:
BASIC LENGTH UNIT IS MULTIPLIED BY 1.00 TO GET FEET
NUMBER OF MAP UNITS PER INCH = 500.00
CONTOUR INTERVAL = 10.00



NUMBER OF PUMPING PERIODS = 2

NUMBER OF NODES IN COLUMN = 6

NUMBER OF NODES IN ROW = 10

PRINTOUT EVERY 7 STEPS

ERROR CRITERIA FOR CLOSURE = 0.9999999E-03

CONSTANT RECHARGE RATE(L/T) = 0.0

SPECIFIC STORAGE OF CONFINING BED = 0.2000000E-03

MAXIMUM PERMITTED NUMBER OF ITERATIONS = 50

TERMINATION OF COMPUTATION WHEN MAX(PHI(T)-PHI(T-1))) 0.2000000

EVAPOTRANSPIRATION RATE = 0.0

EFFECTIVE DEPTH OF ET = 0.0

MULTIPLICATION FACTOR FOR TRANSMISSIVITY IN X DIRECTION = 1.00: IN Y DIRECTION = 1.00

IHED	ISTO	ISYI	IRAT	IRIV	ITHK	IPER	IBOT	ITRA	IDLX	IDLY	ITOP	ILND
1	-1	1	1	1	1	1	1	1	1	1	1	1

FACH	FACS	FACY	FACK	FACR	FACM	FACP	FACB	FACT	FACX	FACZ	FACO	FACL
100.	0.200E-03	0.200E-01	0.200E-06	100.	10.0	0.100E-02	0.0	0.0	500.	500.	90.0	0.0

EXAMPLE OF RELATION BETWEEN 'I' PARAMETERS AND 'FAC' PARAMETERS:
IF IHED = 1, FACH = UNIFORM STARTING HEAD
IF IHED =-1, FACH = MULTIPLICATION FACTOR FOR VARIABLE STARTING HEAD MATRIX

MATRICES WITH VARIABLE DATA ARE PRINTED OUT IN FULL BELOW

STORAGE COEFFICIENT MATRIX

1	0.00020	-0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
2	0.00020	-0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
3	0.00020	-0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
4	0.00020	-0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
5	0.00020	-0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
6	0.00020	-0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020

5 ITERATION PARAMETERS: 0.247D-01 0.623D-01 0.157D 00 0.396D 00 0.100D 01

PUMPING PERIOD NO. 1: 10.00 DAYS

DELT IN HOURS = 7.699

NUMBER OF TIME STEPS = 6

MULTIPLIER FOR TIME STEP = 1.50

1 WELLS

I	J	PUMPING RATE
4	8	-4.00

```
                                 TIME STEP NUMBER=          6
                          SIZE OF TIME STEP IN SECONDS=      315717.00

                               TOTAL SIMULATION TIME IN SECONDS=     863999.31
                                                        MINUTES=      14399.98
                                                          HOURS=        240.00
                                                           DAYS=         10.00
                                                          YEARS=          0.03

                          DURATION OF CURRENT PUMPING PERIOD IN DAYS=     10.00
                                                          YEARS=          0.03

                               ITERATION NUMBER=          8

MASS BALANCE:

   CUMULATIVE                           L**3

      SOURCES:
      -------
               STORAGE =          1507567.00
              RECHARGE =                0.0
         CONSTANT FLUX =                0.0
         CONSTANT HEAD =           930800.25
               LEAKAGE =          1017590.00
         TOTAL SOURCES =          3455957.00

      DISCHARGES:
      ----------
    EVAPOTRANSPIRATION =                0.0
         CONSTANT HEAD =                0.0
      QUANTITY PUMPED =           3455997.00
             TOTAL OUT =          3455997.00

     TOTAL OUT-SOURCES =              40.00
    PERCENT DIFFERENCE =               0.00

     RATES FOR THIS TIME STEP          L**3/T

              RECHARGE =               0.0
         CONSTANT FLUX =               0.0
      CONSTANT HEAD IN =               1.36
     CONSTANT HEAD OUT =               0.0
               PUMPING =               4.00
                    ET =               0.0
              LEAKAGE:
                 TOTAL =               1.23
                STEADY =               0.0

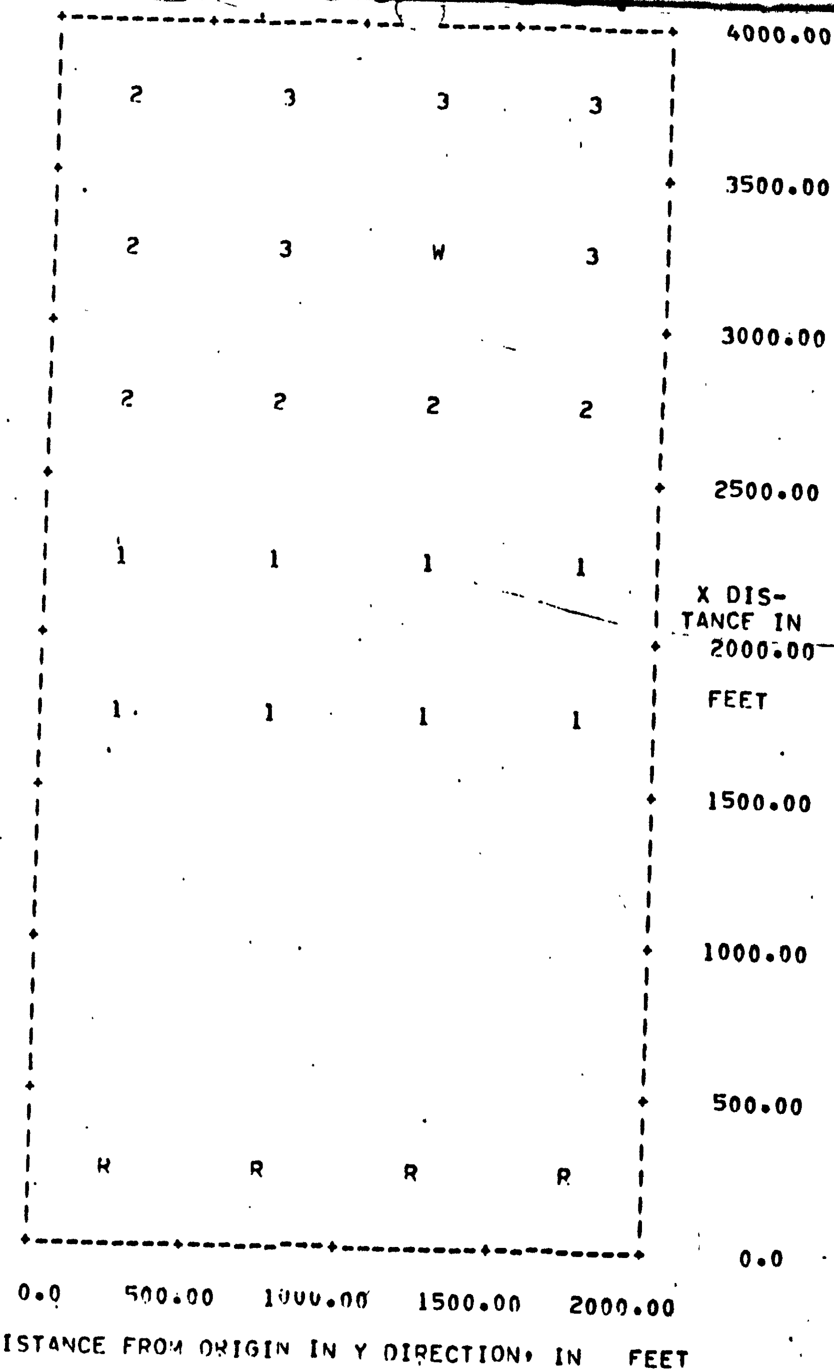
FOR THIS TIME STEP, STORAGE =     446022.19

DIMENSIONLESS TIME FOR THIS STEP RANGES FROM    8.639992       TO    8.639992

MAXIMUM CHANGE IN HEAD FOR THIS TIME STEP =      7.820

SUM OF DIFFERENCES BETWEEN ROWS AND COLUMNS FOR EACH ITERATION:

  -20.96      -1.183     -0.1355     -0.3326E-01 -0.9862E-02 -0.4955E-01  0.2520E-02 -0.8850E-03  0.5067E-04
```



R = CONSTANT HEAD BOUNDARY
W = WELL L ATION
0 = NO-FLOW BOUNDARY
* = CONE OF IMPRESSION

CONTOUR INTERVAL = 10.00

THE FOLLOWING 20 SYMBOLS, STARTING WITH BLANK, ARE CYCLED: 1 2 3 4 5 6 7 8 9 1 B 3 D 5 F 7 H 9

1	-0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
2	-0.0	-0.0	3.7	7.5	11.7	16.5	21.8	26.5	28.0	-0.0
3	-0.0	-0.0	3.7	7.7	12.0	17.4	24.2	31.8	31.7	-0.0
4	-0.0	-0.0	3.8	7.9	12.5	18.8	28.4	50.2	37.8	-0.0
5	-0.0	-0.0	3.8	8.0	12.7	18.8	26.8	36.0	35.7	-0.0
6	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

PUMPING PERIOD NO. 21 70.00 DAYS

DELT IN HOURS = 9.883

NUMBER OF TIME STEPS = 10

MULTIPLIER FOR TIME STEP = 1.50

0 WELLS

I J PUMPING RATE

```
SIZE OF TIME STEP IN SECONDS=     607874.13

          TOTAL SIMULATION TIME IN SECONDS=     2580887.00
                                   MINUTES=       43014.77
                                     HOURS=         716.91
                                      DAYS=          29.87
                                     YEARS=           0.08

    DURATION OF CURRENT PUMPING PERIOD IN DAYS=      19.87
                                         YEARS=       0.05

          ITERATION NUMBER=        7

MASS BALANCE:

  CUMULATIVE                         L**3

    SOURCES:
    --------
            STORAGE =                   5.30
           RECHARGE =                   0.0
      CONSTANT FLUX =                   0.0
      CONSTANT HEAD =             1620607.00
            LEAKAGE =             1836131.00
      TOTAL SOURCES =             3456743.00

    DISCHARGES:
    -----------
  EVAPOTRANSPIRATION =                  0.0
       CONSTANT HEAD =                  0.0
     QUANTITY PUMPED =            3455997.00
           TOTAL OUT =            3455997.00

  TOTAL OUT-SOURCES =                -746.00
 PERCENT DIFFERENCE =                  -0.02

  RATES FOR THIS TIME STEP           L**3/T

           RECHARGE =                   0.0
      CONSTANT FLUX =                   0.0
   CONSTANT HEAD IN =                   0.00
  CONSTANT HEAD OUT =                   0.0
            PUMPING =                   0.0
                 ET =                   0.0
            LEAKAGE:
              TOTAL =                   0.00
             STEADY =                   1.23

FOR THIS TIME STEP, STORAGE =       -1166.26

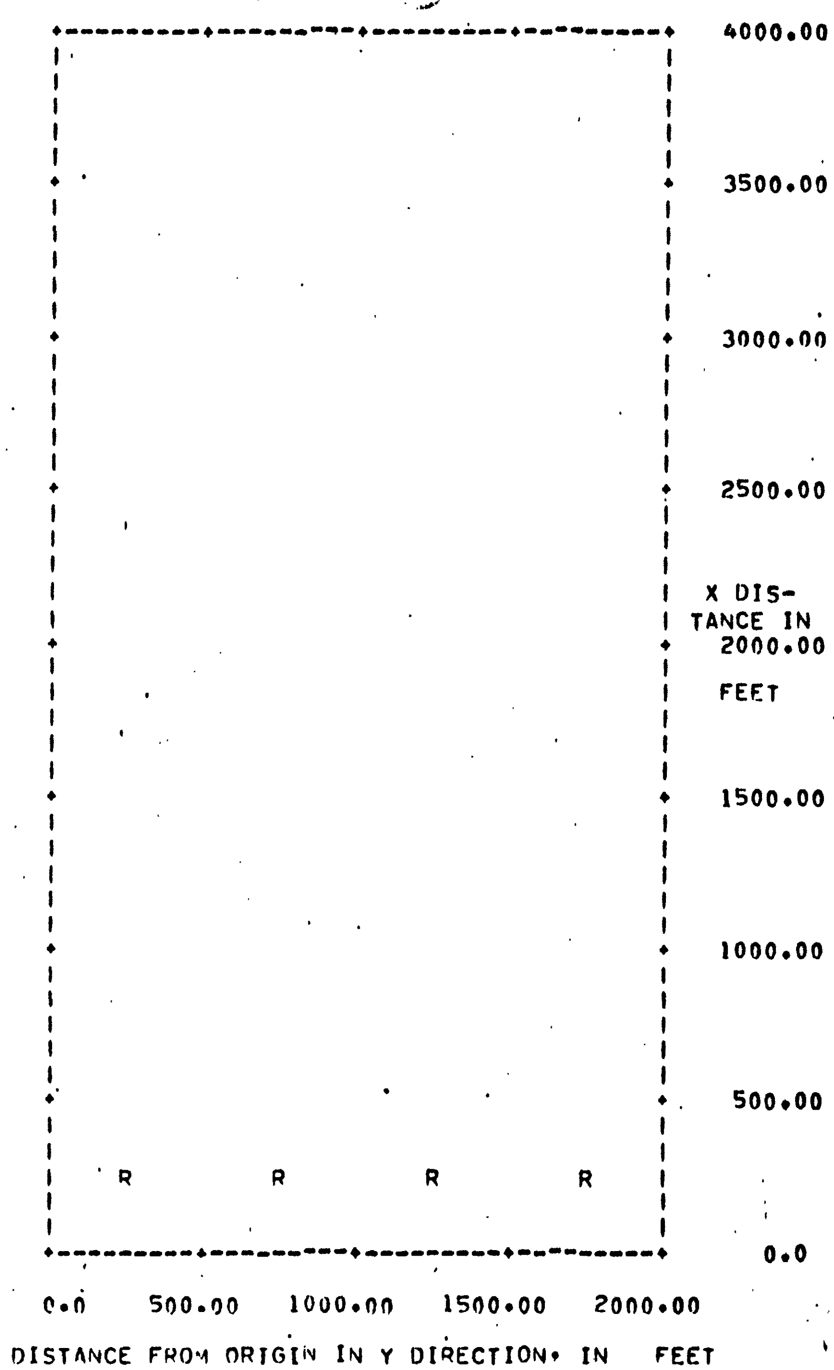
DIMENSIONLESS TIME FOR THIS STEP RANGES FROM    17.16888      TO    17.16888

MAXIMUM CHANGE IN HEAD FOR THIS TIME STEP =      1.568

SUM OF DIFFERENCES BETWEEN ROWS AND COLUMNS FOR EACH ITERATION:

   7.288      0.9456      0.1581      0.5599E-01  0.1834E-01  0.2173      0.2139E-01  0.3879E-02
```

ALPHAMERIC CONTOURS OF DRAWDOWN



R = CONSTANT HEAD BOUNDARY
W = WELL LOCATION
0 = NO-FLOW BOUNDARY
* = CONE OF IMPRESSION

CONTOUR INTERVAL = 10.00

THE FOLLOWING 20 SYMBOLS, STARTING WITH BLANK, ARE CYCLED: 1 2 3 4 5 6 7 8 9 1 B 3 D 5 F 7 H 9

DRAWDOWN

1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
2	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0
3	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0
4	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0
5	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0
6	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0

*****STEADY STATE AT TIME STEP 3*****

```
                                        TIME STEP NUMBER=         8
                                   SIZE OF TIME STEP IN SECONDS=      911811.19

                                      TOTAL SIMULATION TIME IN SECONDS=      3492698.00
                                                              MINUTES=         58211.63
                                                                HOURS=           970.19
                                                                 DAYS=            40.42
                                                                YEARS=             0.11

                              DURATION OF CURRENT PUMPING PERIOD IN DAYS=            30.42
                                                                YEARS=             0.08

                                      ITERATION NUMBER=         1

MASS BALANCE:

   CUMULATIVE                          L**3

      SOURCES:
      -------
            STORAGE =                 -6.30
           RECHARGE =                  0.0
      CONSTANT FLUX =                  0.0
      CONSTANT HEAD =             1620657.00
            LEAKAGE =             1836196.00
      TOTAL SOURCES =             3456846.00

      DISCHARGES:
      ----------
  EVAPOTRANSPIRATION =                 0.0
      CONSTANT HEAD =                  0.0
    QUANTITY PUMPED =             3455997.00
          TOTAL OUT =             3455997.00

   TOTAL OUT-SOURCES =               -849.00
  PERCENT DIFFERENCE =                 -0.02


   RATES FOR THIS TIME STEP            L**3/T

           RECHARGE =                  0.0
      CONSTANT FLUX =                  0.0
    CONSTANT HEAD IN =                 0.00
   CONSTANT HEAD OUT =                 0.0
            PUMPING =                  0.0
                 ET =                  0.0
           LEAKAGE:
              TOTAL =                  0.00
             STEADY =                  1.23

FOR THIS TIME STEP, STORAGE =        -11.60

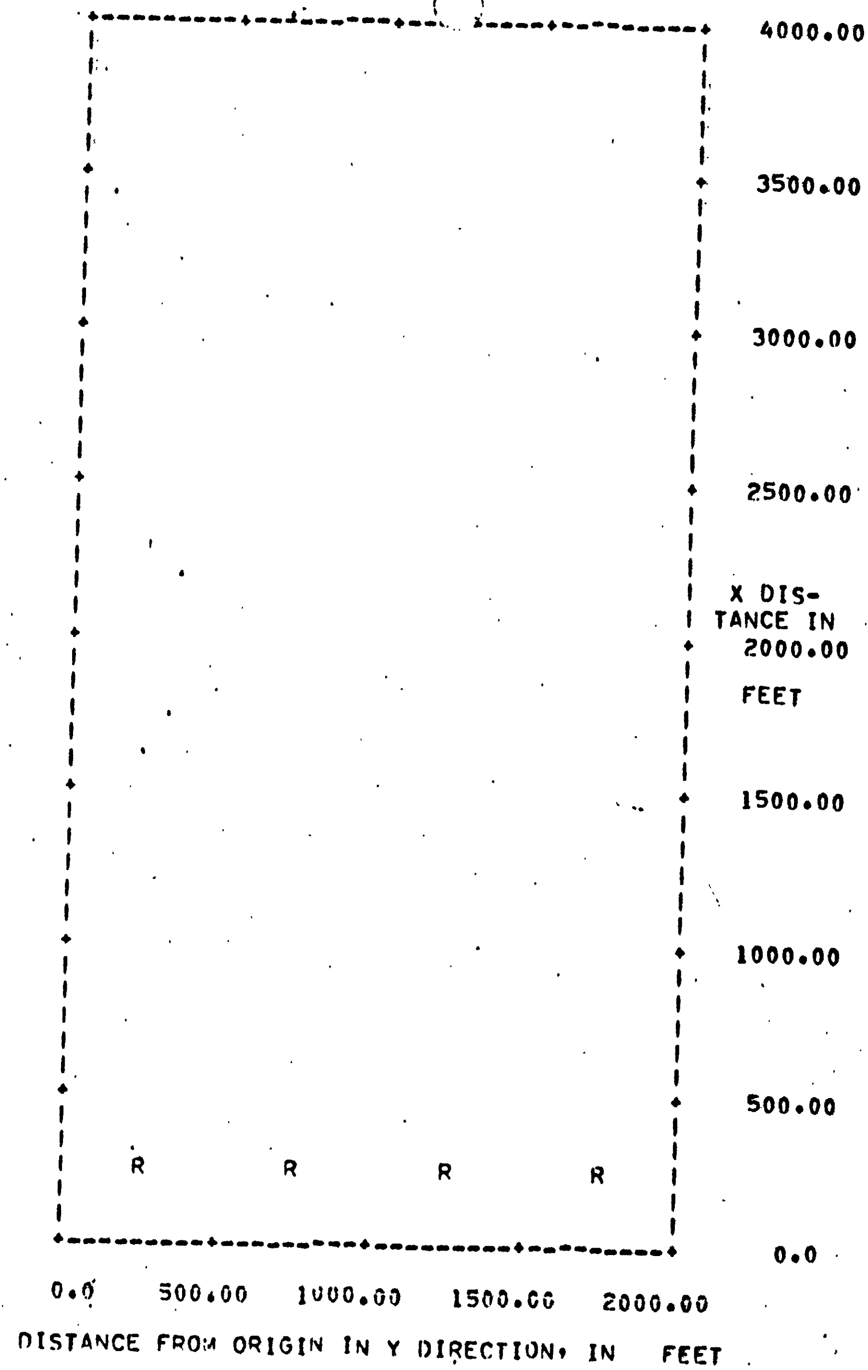
DIMENSIONLESS TIME FOR THIS STEP RANGES FROM    26.28700    TO    26.28700

MAXIMUM CHANGE IN HEAD FOR THIS TIME STEP =      0.013

SUM OF DIFFERENCES BETWEEN ROWS AND COLUMNS FOR EACH ITERATION:

 0.7803E-01  0.8461E-02
```

ALPHAMERIC CONTOURS OF DRAWDOWN



P = CONSTANT HEAD BOUNDARY
W = WELL LOCATION
0 = NO-FLOW BOUNDARY
* = CONE OF IMPRESSION

CONTOUR INTERVAL = 10.00

THE FOLLOWING 20 SYMBOLS, STARTING WITH BLANK, ARE CYCLED: 1 2 3 4 5 6 7 8 9 1 B 3 D 5 F 7 H 9

DRAWDOWN

1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
2	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0
3	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0
4	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0
5	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0
6	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0