A DIGITAL COMPUTER MODEL FOR EVALUATION OF THE WICHITA WELL FIELD AREA OF THE EQUUS BEDS

a part of the

LITTLE ARKANSAS RIVER BASIN STUDY

Prepared by

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ABSTRACT

A digital computer model for aquifer evaluation developed by G. F. Pinder and J. D. Bredenhoeft, U.S. Geological Survey, was modified and applied in a study of the Wichita well field of the Equus Beds aquifer. The model basically consists of a numerical algorithm for solution of the differential equations describing two-dimensional, unsteady state flow in a ground-water reservoir. Permeability and storage coefficient are allowed to vary with position in the aquifer. However, transmissibility (the product of permeability and saturated thickness) is held constant with time and, therefore, the model strictly applies only to confined aquifers. Provision is made in the model for withdrawal of water through wells, recharge by precipitation, and interchange of water with surface sources such as streams or lakes.

In this application, an 18-year period of history (July 1940-January 1959) was simulated. Computed changes in water-table levels were compared to field measured values. This was done through comparison of water-level contour maps and observation well hydrographs (in 13 wells) to calculated contour maps and hydrographs. The matches were generally good.

INTRODUCTION

1) Background

On March 27, 1969, Mr. Jack Pinney, in a report to Mr. Bill Steps, Assistant Chief Engineer of the Water Resources Board of Kansas, stated, "It is essential in the Little Ark Study to know the safe yield of the ground and surface water. The basin has an extensive aquifer which, for the most part, has excellent recharge characteristics. It would seem logical to try to encourage development of this aquifer to yield levels which can be sustained on a long-term basis. Intelligent planning and management of the water resources of the basin would be dependent upon knowing the well locations and the pumping patterns which would optimize the recharge and natural discharge of the basin and best control the movement of the pollutants in the aquifer. This type of knowledge can best be gained from an aquifer model which simulates the characteristics of the aquifer and its response to various types of management practices."

On May 23, 1969, the author met with Mr. Krause, Executive Director of the Water Resources Board of Kansas to become acquainted with the Water Resources Board objectives for the Little Arkansas River Basin. The following are the objectives described by Mr. Krause:

1) To more clearly define, within the authority and responsibility of the Water Board, the water uses, future needs, and specific problems of the basin looking to a comprehensive plan for the area.

2) To determine the magnitude of the probable long-range deficiencies or excess of water supply in the area.

3) To seek solution of the present and anticipated future water control problems of the area, with alternative solutions where possible.

4) To make recommendations as to future legal, financial, physical and social efforts required to most effectively utilize the water resources of the Little Arkansas River Basin for the benefit of the citizens of Kansas.

On June 16, 1969, a meeting was held at the U.S. Geological Survey office in Lawrence, Kansas. Water Resources Board staff; U.S. Geological Survey staff; Dr. Bredenhoeft with the U.S. Geological Survey, Washington, D. C.; Dr. Green with the University of Kansas; and the author were present. Mr. Krause opened the meeting and described the need for a mathematical model to help meet the objectives of the Kansas Water Resources Board. Then Dr. Bredenhoeft described a similar basin study (hydrologic and economic) in the State of Arizona. Later he sent a copy of his computer program which was used in that study.

On July 2, Mr. Steps, Dr. Winslow, Dr. Green, and the author met to make a decision concerning this project. As a result of this meeting it was decided to modify and use the Pinder-Bredenhoeft model in a study of the Equus Beds aquifer.

2) Objective of this Study

A general basin simulator would include the elements shown in Figure 1. The Pinder-Bredehoeft model (1) allows a detailed description of the ground-water portion of this system, while also treating recharge from precipitation and stream-aquifer interaction in a "lumped parameter" manner.

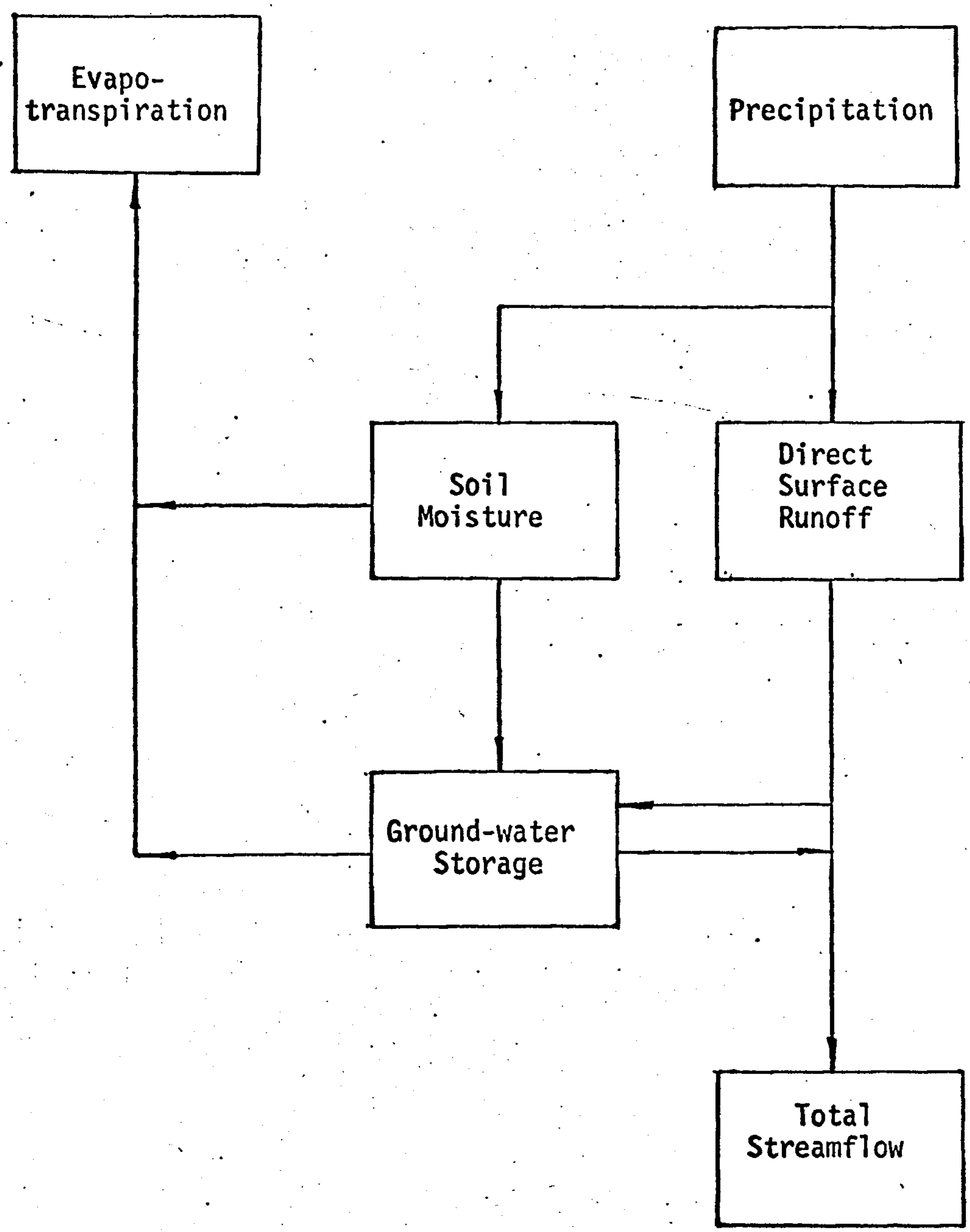


Figure 1.--Elements of a general basin model.

It was the objective of this study to modify the Pinder-Bredehoft model to make it more general, and then to apply the model to the Wichita well-field area of the Equus Beds. The model was to be tested by a comparison of computed results to historical record in the well-field area.

3) Acknowledgment

The author sincerely wishes to extend his appreciation to the following:

Dr. J. D. Bredehoeft of the United States Geological Survey, Washington, D. C., who made available a copy of the computer program for this study. The discussion with him at Lawrence, Kansas, was very helpful.

Dr. D. W. Green of the University of Kansas who co-directed this study, and spent hours assisting in the modification of the program and analyzing the results.

Dr. J. Winslow of the United States Geological Survey, Lawrence, Kansas, who co-directed this study, and spent hours assisting in data collection and analyzing the results.

Mr. C. W. Lane, District Chief, Water Resources Division of the U.S. Geological Survey, Lawrence, Kansas, and his staff; especially Mr. Robert Roberts, Mr. J. McNellis, Mr. C. Morgan, and Mr. C. Bayne.

The Office of the Water Resources Board, Topeka, Kansas, for providing financial support for this study.

THEORETICAL DEVELOPMENT

1) Differential and Difference Equations

The differential equation for nonsteady flow of a compressible fluid in an elastic non-homogeneous porous medium can be written (1)

$$\partial/\partial x\ (T_x \partial h/\partial x) + \partial/\partial y\ (T_y\ \partial h/\partial y) = S\ \partial h/\partial t + W(x,y,t) \qquad (1)$$

where T is the transmissivity (L^2/T) (ft^2/hr)

h is the hydraulic head (L) (ft)

S is the storage coefficient (dimensionless)

t is time (hr)

W is a source-sink term, volume flux per unit area (L/T) (ft/hr)

The source/sink term, W(x,y,t), may be used to account for well production, recharge from precipitation, and flow between the aquifer and streams or lakes.

Equation (1) cannot generally be solved analytically. Therefore, finite difference schemes are used. A rectangular net or grid as indicated in Figure 2 is superimposed on a plan view of the aquifer.

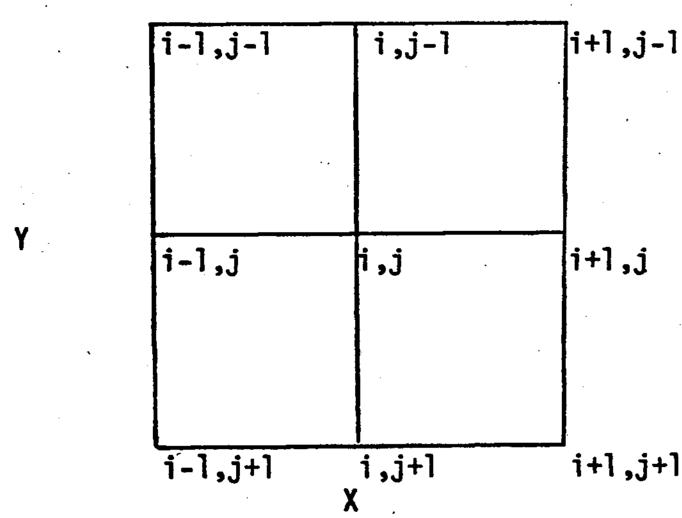


Figure 2.--Nodal Array for Digital Model

Equation (1) may be written (see Figure 2 for grid node identification).

$$T_{x(i-\frac{1}{2}j)}\left(\frac{h_{i-1jk}-h_{ijk}}{(\Delta x)^2}\right)+T_{x(i+\frac{1}{2}j)}\left(\frac{h_{i+1jk}-h_{ijk}}{(\Delta x)^2}\right)$$

$$+T_{y(ij-\frac{1}{2})}\left(\frac{h_{ij-1k}-h_{ijk}}{(\Delta y)^2}\right)+T_{y(ij+\frac{1}{2})}\left(\frac{h_{ij+ik}-h_{ijk}}{(\Delta y)^2}\right) \qquad (2)$$

$$= S\left(\frac{h_{ijk}-h_{ijk-1}}{\Delta t}\right)+\frac{q_{wijk}}{\Delta x\Delta y}-K_s\left(\frac{2H_{r(ij)}-h_{ijk}-h_{ijk-1}}{2M_{r(ij)}}\right)+R_{ijk}$$

where i is the index in the x dimension

j is the index in the y dimension

k is the index in the t dimension

K_s is the hydraulic conductivity of the stream bottom (L/T) (ft/hr)

M_r is the thickness of the stream bottom (L) (ft)

q_{wijk} is a rate of withdrawal or injection at the node during the time increment (k-1) to k (L^3/T) (ft^3/hr)

Δt is the increment in the t dimension (T) (hr)

$\Delta x, \Delta y$ are space increments (L) (ft)

$H_r(ij)$ is the hydraulic head in the lakes and streams (L) (ft)

R_{ijk} is a recharge term to account for precipitation (L/T) (ft/hr)

Note that the source/sink term, W(x,y,t), has been broken down into terms for well production, stream or lake interaction, and recharge from precipitation.

Equation (2) is an implicit finite difference equation in that the space derivitive terms are written at the "new" time level. It is also possible to write explicit finite difference forms (space derivitives written at "old" time level). These are simple to solve but yield a stable solution only for very small time step sizes.

Equation (2) must be applied to each grid point in the system. This results in a set of simultaneous algebraic equations, there being as many equations as grid points in the system. For large systems with many grid points, the number of simultaneous equations may become unwieldly because of the work involved in solution. Therefore, a scheme termed the alternating direction implicit (ADI) procedure has become popular. This technique offers a compromise between the completely implicit and completely explicit methods. It is stable for all size time steps and requires less work than the completely implicit procedure.

In the ADI procedure, hydraulic head values are first calculated for each node in the matrix by solving the equations for half of a time step, $\Delta t/2$, with the x-direction derivitives written implicitly and the y-direction derivitives written explicitly. This means that the finite difference equations can be solved row by row. Next, the time step is increased by $\Delta t/2$ and the equations are solved with the x-direction derivitives written explicitly and the y-direction derivitives written implicitly. The difference equations are thus solved column by column. This completes the calculation for one complete time step, Δt, and the process is repeated for the next step.

Equation (2) for the x-direction implicit is (for a row calculation)

$$\frac{T_x(i-\frac{1}{2}j)}{(\Delta x)^2} h_{i-1jk} - \left[\frac{T_x(i-\frac{1}{2}j)}{(\Delta x)^2} + \frac{T_x(i+\frac{1}{2}j)}{(\Delta x)^2} + \frac{S}{\Delta t} + \frac{K_s}{2M_r(ij)}\right] h_{ijk}$$

$$+ \frac{T_x(ij-\frac{1}{2})}{(\Delta x)^2} h_{i+1jk}$$

$$= \frac{T_y(ij-\frac{1}{2})}{(\Delta y)^2} h_{ij-1k-\frac{1}{2}} + \left[\frac{T_y(ij-\frac{1}{2})}{(\Delta y)^2} + \frac{T_y(ij+\frac{1}{2})}{(\Delta y)^2} - \frac{S}{\Delta t} + \frac{K_s}{2M_r(ij)}\right] h_{ijk-\frac{1}{2}} \tag{3}$$

$$+ \frac{T_y(ij+\frac{1}{2})}{\Delta t/2} h_{ij+1k-\frac{1}{2}} + \frac{q_{wijk}}{\Delta x \Delta y} - \frac{K_s}{M_r(ij)} H_r(ij)$$

The equation for the calculation of columns is of the same form but with the y-derivitive terms written implicitly and the x-direction terms written explicitly (note that all unknown values occur on the left hand side of the equation, the values on the right were determined at the previous time step). For a detailed explanation of a simplified technique for solving equations of this kind see Peaceman and Rachford. (2)

The equations must, of course, be solved subject to the boundary conditions. The handling of boundary and initial conditions is discussed in the following section.

2) Computer Program

A FORTRAN computer program to solve the finite difference equations was previously developed by Pinder and Bredehoeft. (1) This program was modified to make the program compatible with the GE 635 at the University of Kansas. In addition, other modifications were made to generalize the model for this study. A listing of the program along with information on input data format is given in the Appendices.

3) Input Data

The aquifer system to be evaluated is overlaid with a grid system. The intersection of any two lines on the grid is considered a node location. Four matrices are generated by entering for each node location the transmissibility, storage coefficient, initial head in the aquifer, and hydraulic conductivities of streams or lake bottoms over their thickness. The initial head in the aquifer is the initial condition on the problem.

Production or injection wells must be "moved" to the nearest node location. Production (injection) rates are entered along with the time period for which that particular rate is to hold. Usually it is convenient to enter yearly production rates. It is necessary that the pumping periods be the same for all wells. For example, if a field had five wells and the desired simulation period was three years, it might be convenient to break the pumping into three one-year periods. Three "cards" would be entered giving the rates of the individual wells for each year of the three-year period. Along with production data, the amount of recharge due to precipitation for each pumping period is entered.

Other input data include the Δx and Δy increment sizes, the dimensions of the system, the size of the initial time step, and the total length of the simulation period. The time step size is automatically incremented in the program in order to decrease the number of calculations. Information controlling the output is also included as part of the input information.

4) Boundary Conditions

As written, the user must input zero transmissibility values along the outside edge of the system, i.e., outside row and column nodes. This, in effect, makes a no-flow boundary one-half a grid interval inside this outer row and column of nodes. Aquifer geometries other than rectangular can be generated by putting zero transmissibility along the boundaries of the aquifer. This is illustrated in Figure 3.

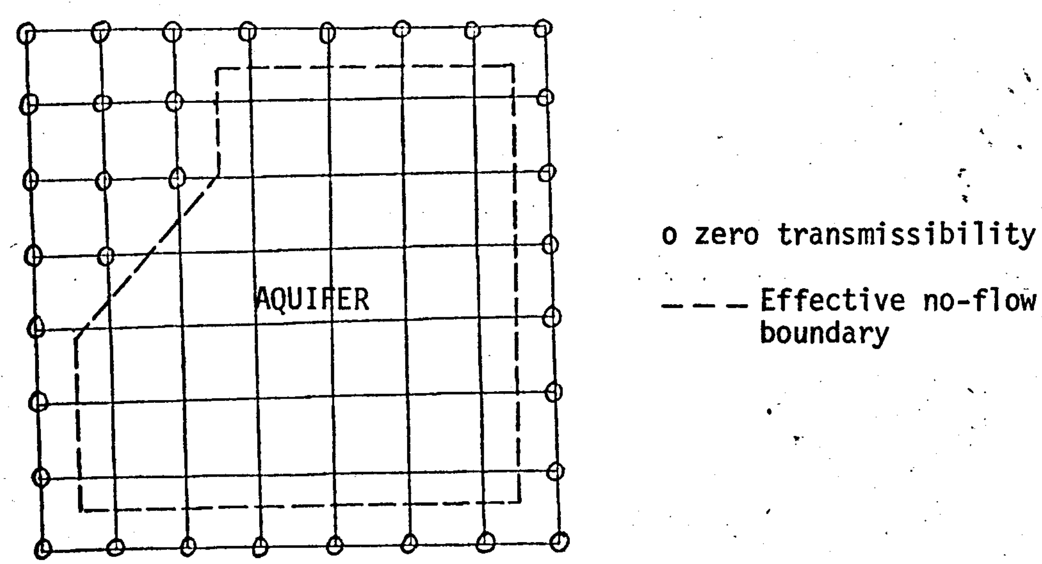


Figure 3.--Definition of boundaries.

In many applications it may be desirable to have flow across particular boundaries. This can be accomplished in two ways.

1. Input or production wells can be placed along the flow boundaries (these should be placed one node location "in" from the zero transmissibility nodes). The flow rates of these wells would be set equal to the estimated flow across the particular boundary.

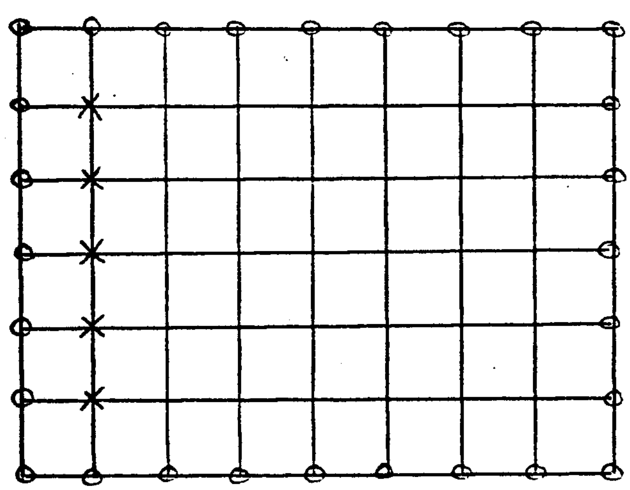
2. The stream/lake term can be used to simulate flow across a boundary. The flow can be expressed by

$$\frac{q_x}{\Delta x \Delta y} = \frac{T\Delta y \;\; (H_r(ij) - h_{ij}}{\Delta x \Delta y \qquad \Delta x} \qquad \text{(L/T)}$$

or

$$\frac{q_x}{\Delta x \Delta y} = \frac{T(H_r(ij) - h_{ij})}{(\Delta x)^2} \qquad (4)$$

Thus, $(T/\Delta x^2)$, (or $T/\Delta y^2$), is read in place of K_s/M_r. Again these values of $(T/\Delta x^2)$, along with $H_r(ij)$, are read in to locations one node "in" from the zero transmissibility nodes. This procedure is equivalent to setting a constant hydraulic head boundary at the node location of the zero transmissibility node. For example, if $(T/\Delta x^2)$ values and $H_r(ij)$ values were read in along the boundary as shown in Figure 4, this would be equivalent to setting a constant-head boundary at the nodes along the left-hand boundary. Flow into or out of the



o Zero transmissibility

x $T/\Delta x^2$ and $H_r(ij)$

Figure 4.--Simulation of constant head boundary.

system at each node (x) would be governed by the T and $H_r(ij)$ values at that particular node. The flow would increase or decrease as h_{ij} decreased or increased.

5) Major Modifications to the Pinder-Bredehoeft Model

1) Providing the possibility having a different initial aquifer head at each grid point.

2) Providing for variable pumping rates for specified periods.

3) Providing for precipitation which reaches the aquifer during each pumping period.

4) Providing the possibility of having a production and recharge well at any grid node.

5) Providing the possibility of having variable head along the streams or lakes.

6) Using the "stream" term to simulate a constant pressure boundary.

6) Output

The output of the program consists of numerical values and an alphameric contour map of the drawdown in the aquifer at pre-selected time steps. In order to estimate the precision of the calculations, a mass balance may also be computed at selected time levels. The input data (transmissibilities, production rates, etc.) are also listed with the output.

APPLICATION OF THE MODEL

1) Experimental Data

The Wichita Well Field was chosen to test the digital model. Figure 5 shows the Little Arkansas River Basin. Figure 6 shows the area covered in this study and the 294 computer grid nodes superimposed on the 294 square miles of the area. The circles show the actual location of the Wichita Wells. The pumping locations of these wells were moved to the closest grid nodes. In some cases pumping rates for more than one well were located at a node. This is shown by a square on the figure. The east boundary of the digital model was the Little Arkansas River. The water level contour map for July 1940 is also superimposed on the area.

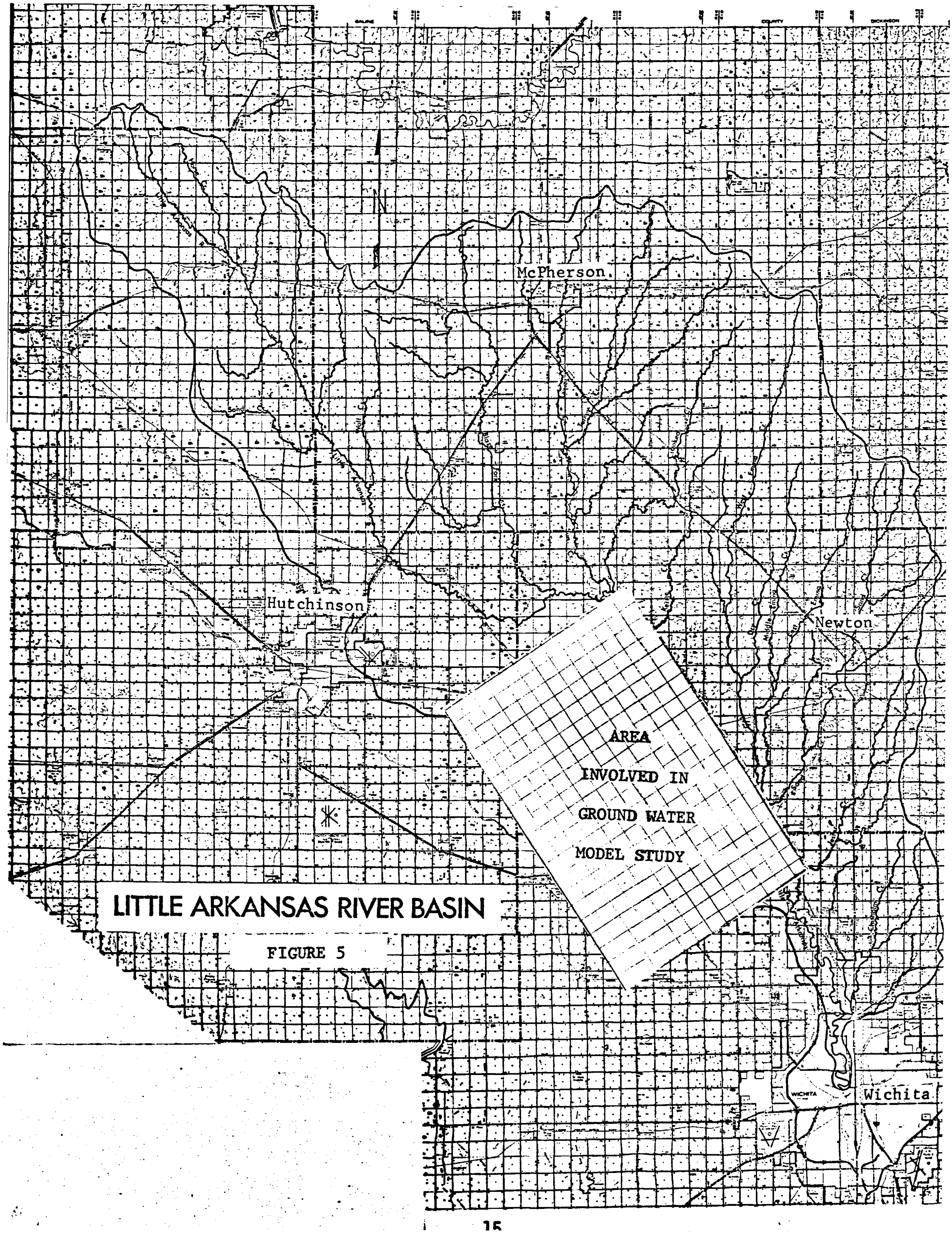
To test the validity of the digital model describing the "Equus Beds" aquifer, it was necessary to have experimental data in the area. For this purpose, measured data reported by the United States Geological Survey were used (3, 4, 5).

a) Initial water table elevation:

Initial water table elevation (initial aquifer head) was taken from water level contour map of July 1940 prepared by the U.S. Geological Survey. A copy of this map is shown in Figure 6.

b) Transmissibility:

Transmissibility data are taken from a transmissibility map prepared by Charles W. Lane, Figure 7.



LITTLE ARKANSAS RIVER BASIN

FIGURE 5

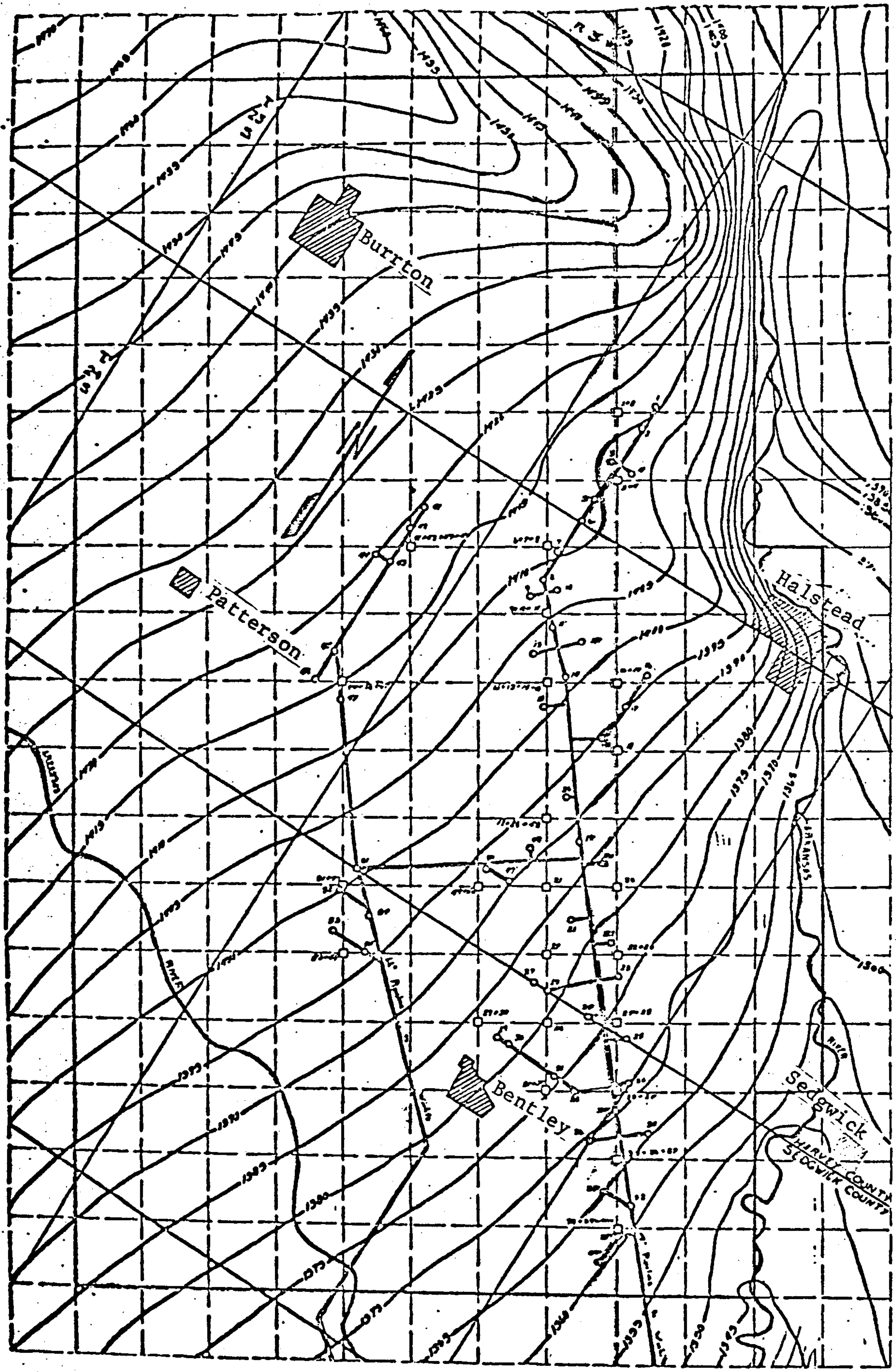


Figure 6. Ground-Water Level Contour Map of the Model Area-July, 1940

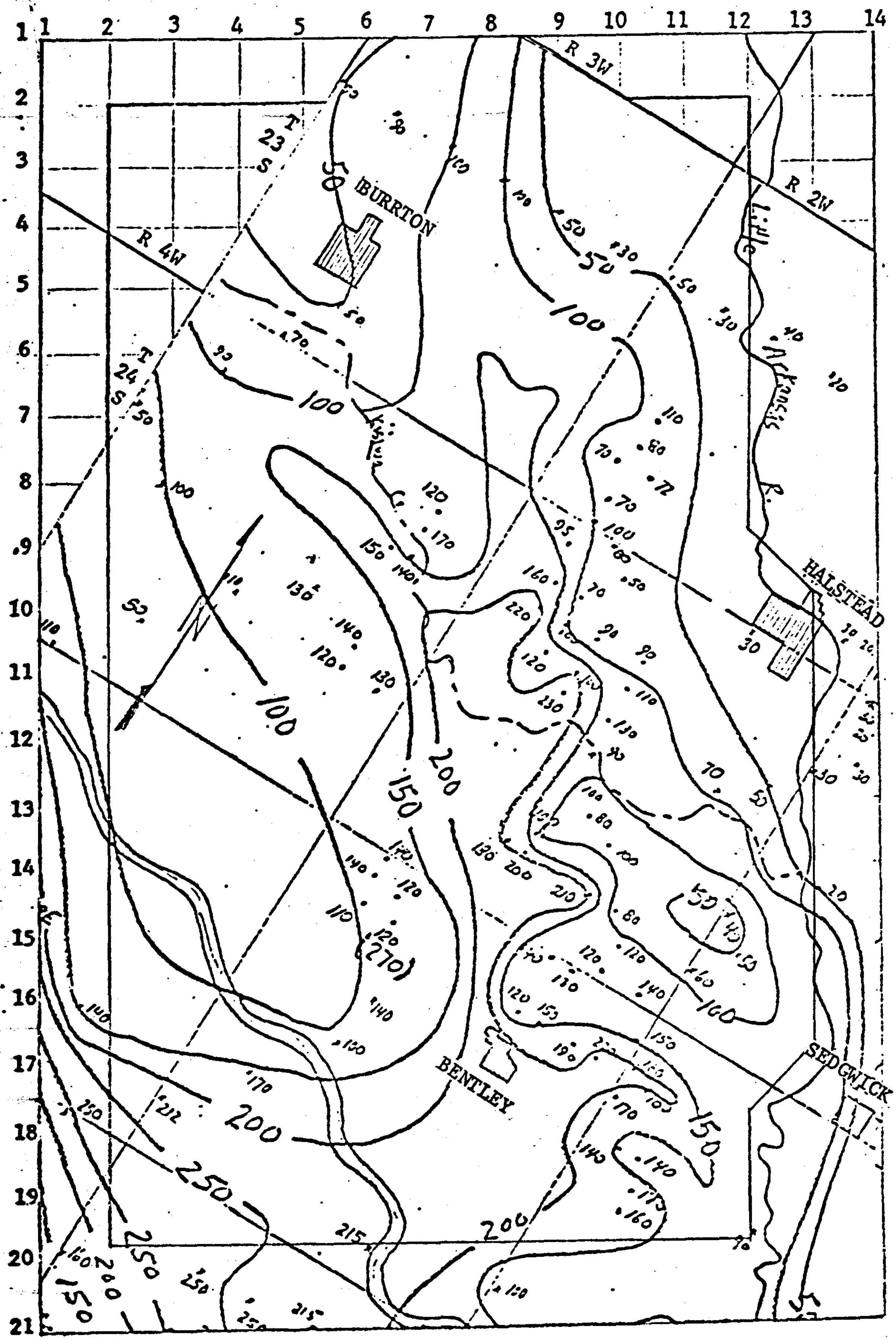


Figure 7. Computed Transmissibility Contour Map of the Model Area

c) Storage coefficient:

Storage coefficient values of .1, .15, and .2 (estimated) were used in 3 runs. The effect of changing S will be shown in the following section.

d) Hydraulic conductivity of streams or lake bottoms:

Hydraulic conductivity of the media between Little Arkansas River and the aquifer was estimated from the transmissibility data.

e) Streams or lake heads:

The water head in the Little Arkansas River was taken from the July 1940 water level contour map, Figure 6.

f) Well production rates:

The yearly water production of each well in the Wichita Well Field was taken from files of the U.S. Geological Survey, Lawrence, Kansas. The main source of this data was the Water Division of the City of Wichita, Kansas. The "small-city" municipal and irrigation water consumption were not considered.

g) Annual recharge from precipitation:

Annual precipitation in inches/year at Wichita were used for the yearly average precipitation. The source is the U.S. Weather Bureau. The fraction of that precipitation actually reaching the aquifer was estimated.

2) Comparison of Computed Results to Measured Data

The computer model was used to simulate an 18 year history of the "Equus Beds" aquifer, from July 1940 to January 1959. The computed results (drawdown or rise) were compared with measured data in three ways:

a) Comparing the measured water level contour maps with computed water level contour maps at different times.

b) Comparing the yearly average of water level in observation wells with the computed water level at the closest grid node to the location of that observation well.

c) Comparing the measured water flow from the aquifer to the river with computed values. For this purpose seepage run data taken in September of 1961 were used for comparison with computed results for January of 1959. No actual seepage run was available until 1960 but the model was run only to 1959 because of data limitations. This is the reason for the two year lag. This was considered to be a qualitative comparison.

Computed water level change maps are shown in Figures 8, 9, and 10. These maps show contours of equal changes in water levels between July 1940 and January 1945, January 1951 and January 1959, respectively. For these computer runs, a storage coefficient value of .15 was used. For comparison purposes, water level change maps based on actual field data are shown in Figures 11, 12, and 13. When compared with Figures 8, 9, and 10, it can be seen that the general shape and magnitudes of the drawdowns and rises for the measured and computed contours are comparable. Probably the poorest fit is in the north part of the area near Burrton. However, it is noted that there is a scarcity of data in that part of the field.

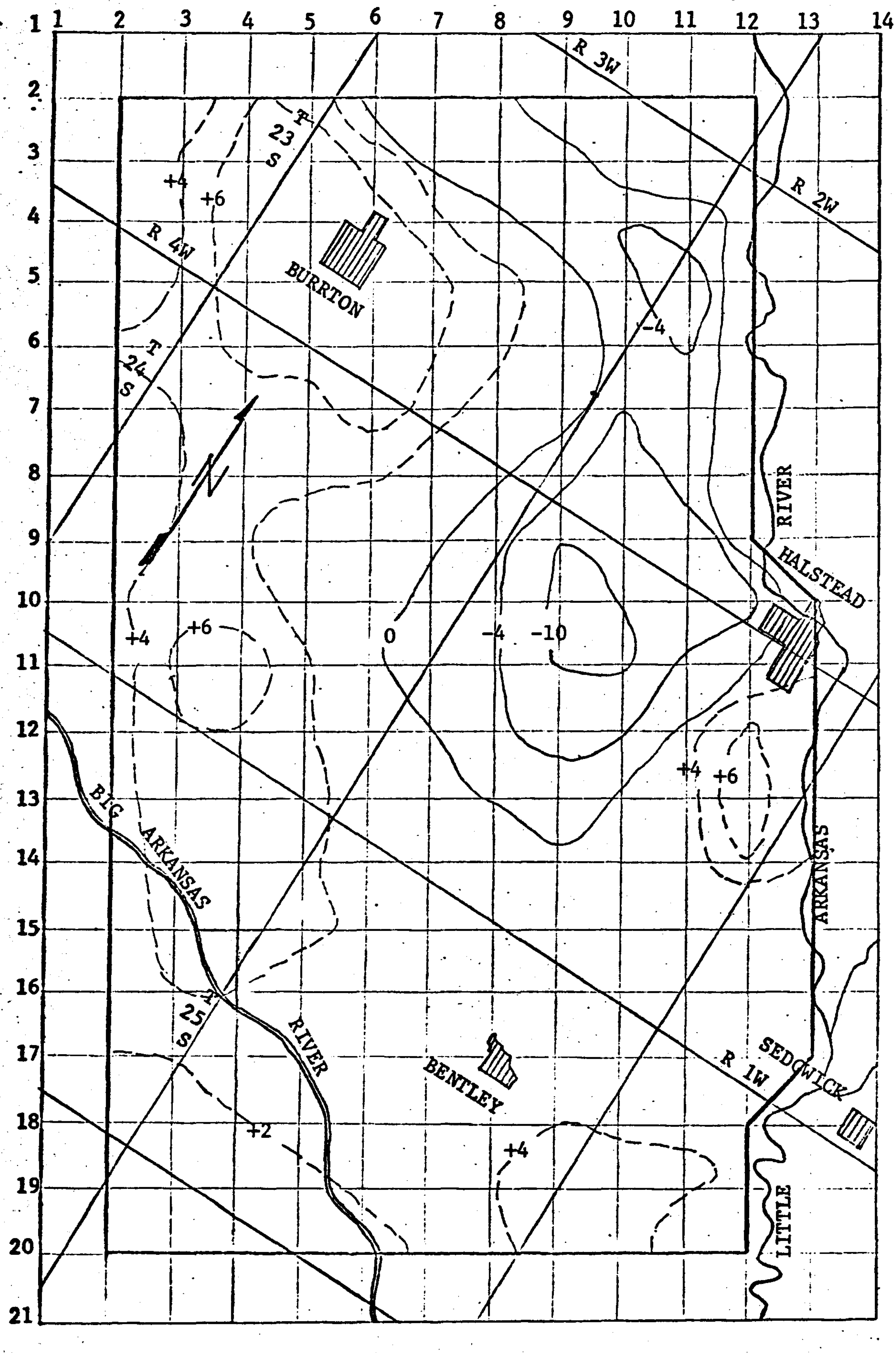


Figure 8. Computed Changes in Ground-Water Levels in the Model Area Between July, 1940 and January, 1945.

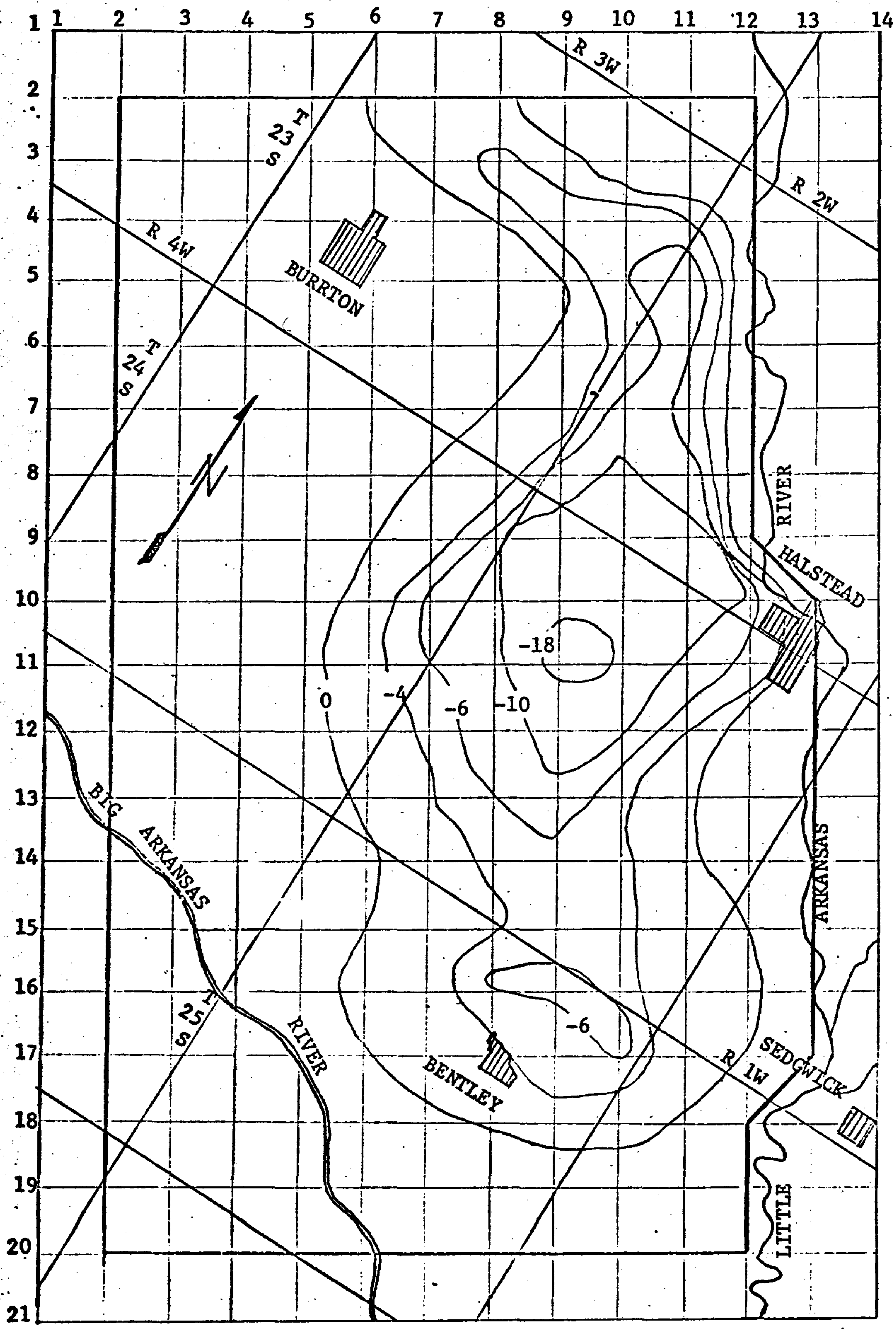


Figure 9. Computed Changes in Ground-Water Levels in the Model Area Between July, 1940 and January, 1951.

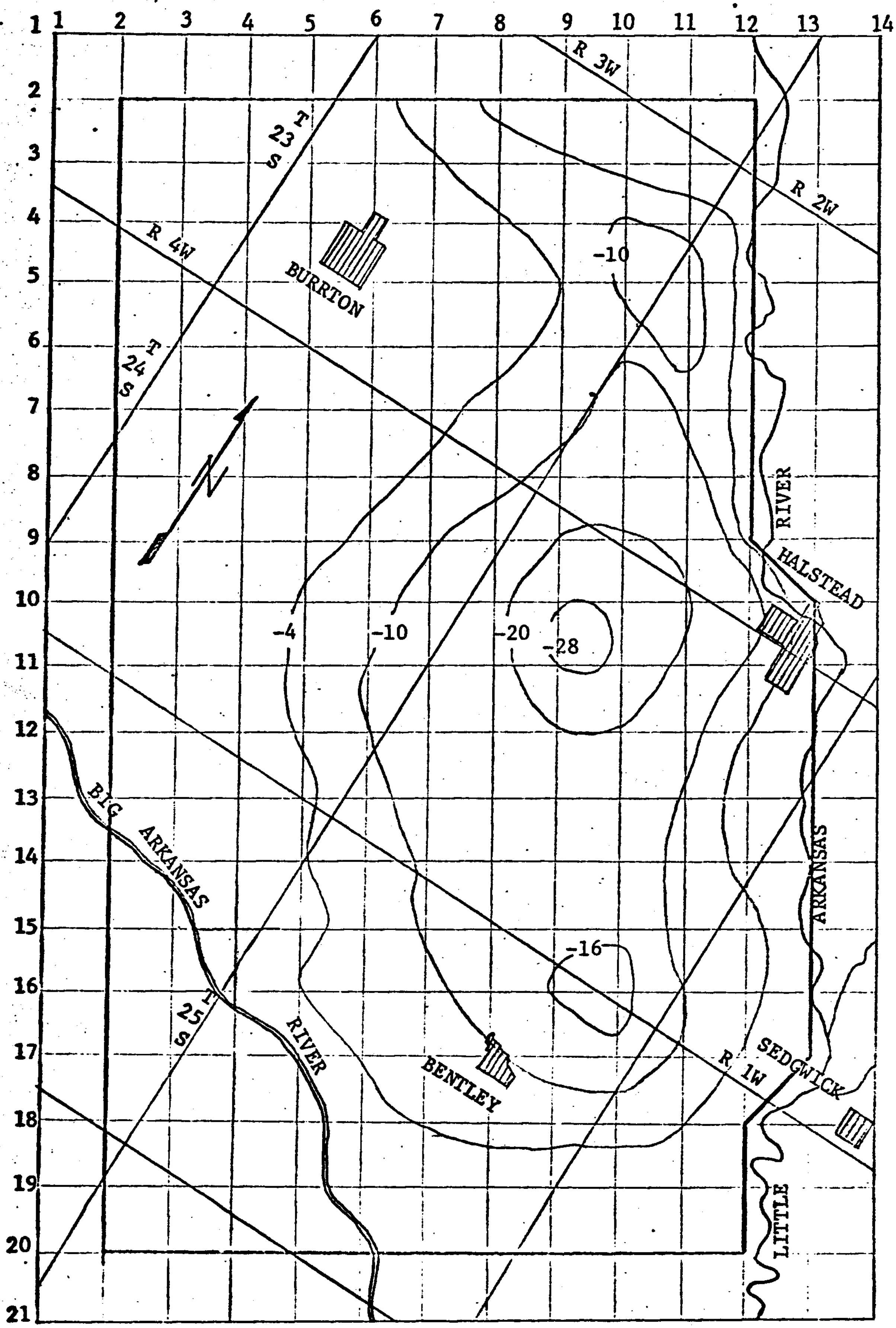


Figure 10. Computed Changes in Ground-Water Levels in the Model Area Between July, 1940 and January, 1959.

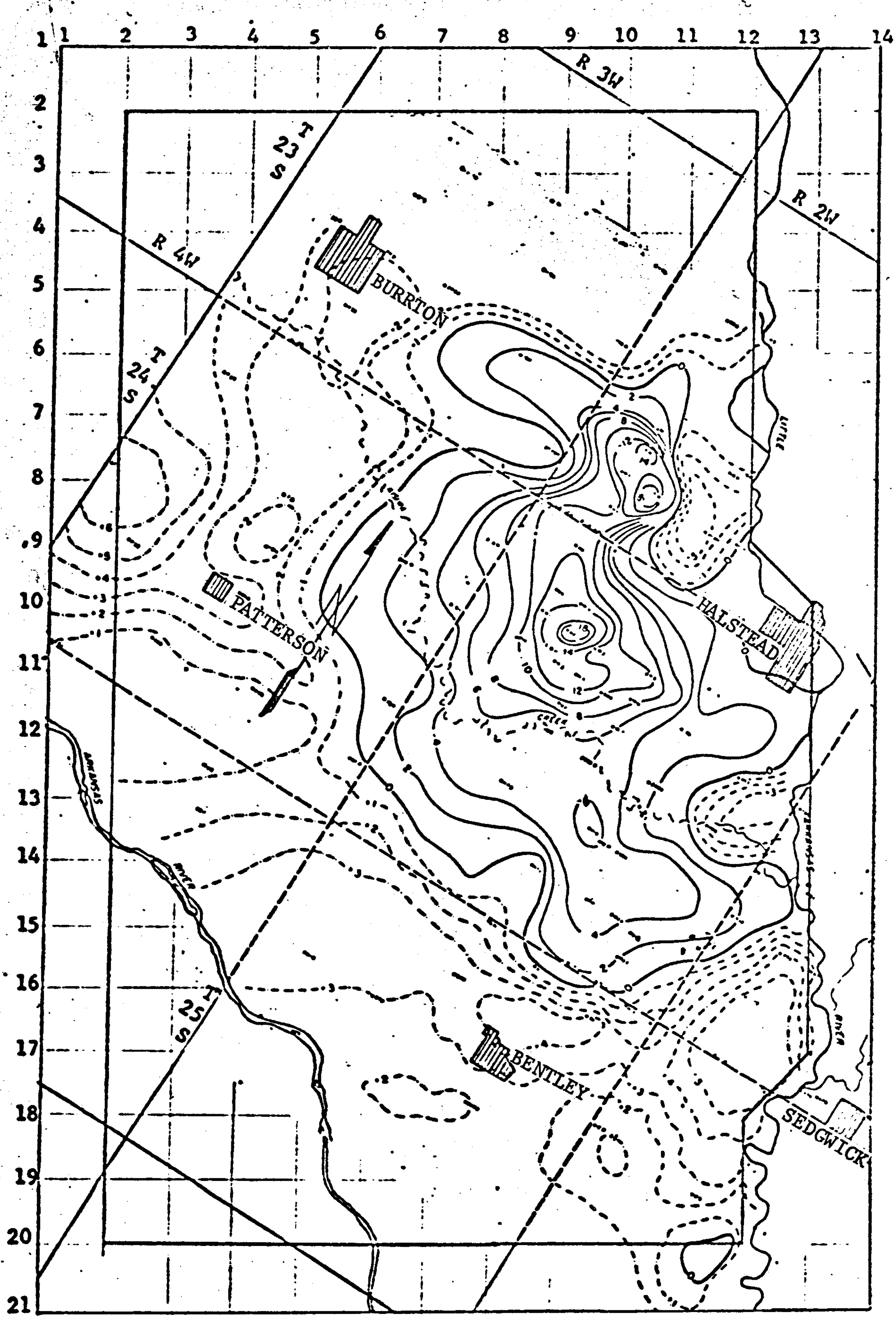


Figure 11. Measured Changes in Ground-Water Levels in the Model Area Between July, 1940 to January, 1945.

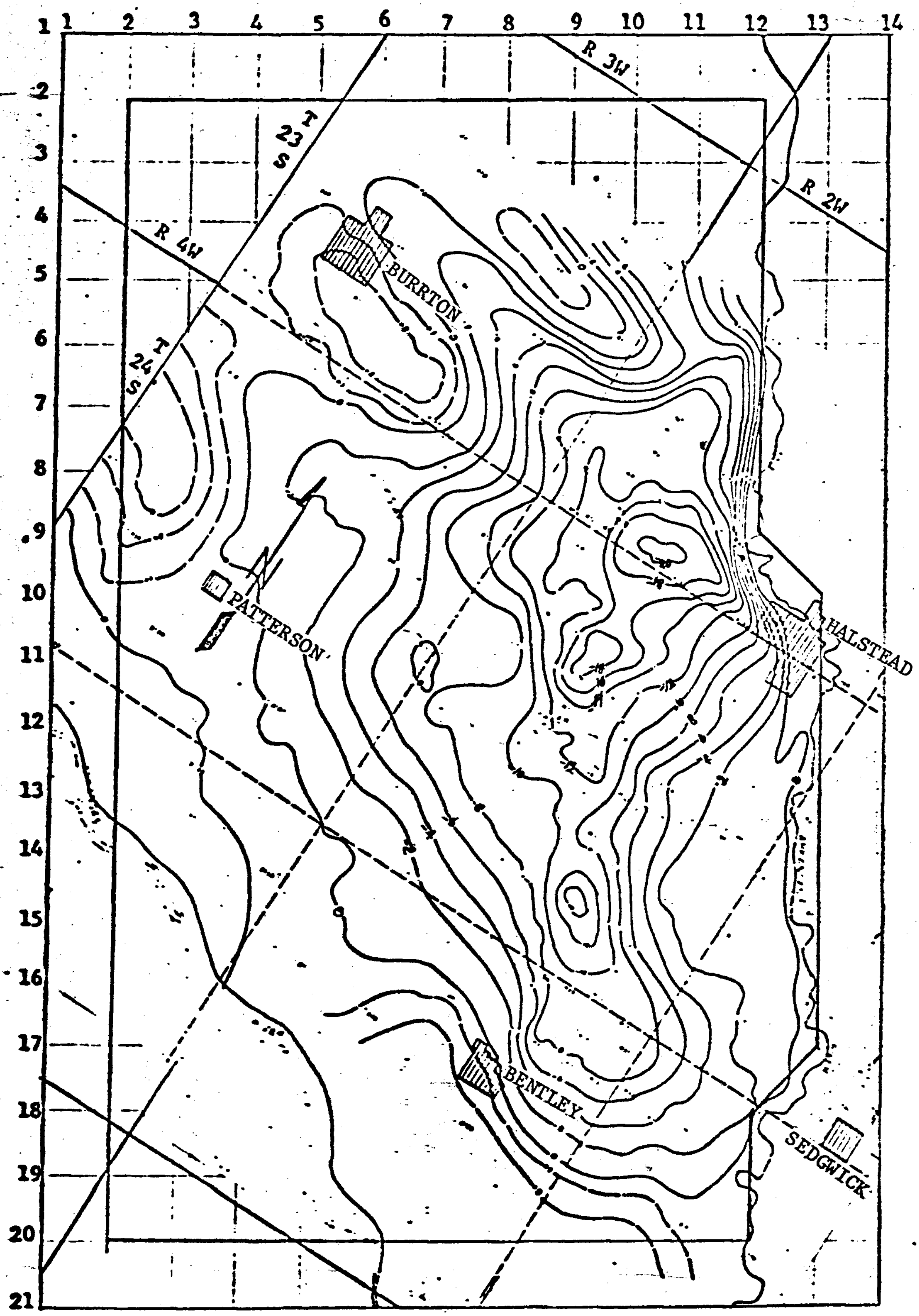


Figure 12. Measured Changes in Ground-Water Levels in the Model Area Between July, 1940 to January, 1951.

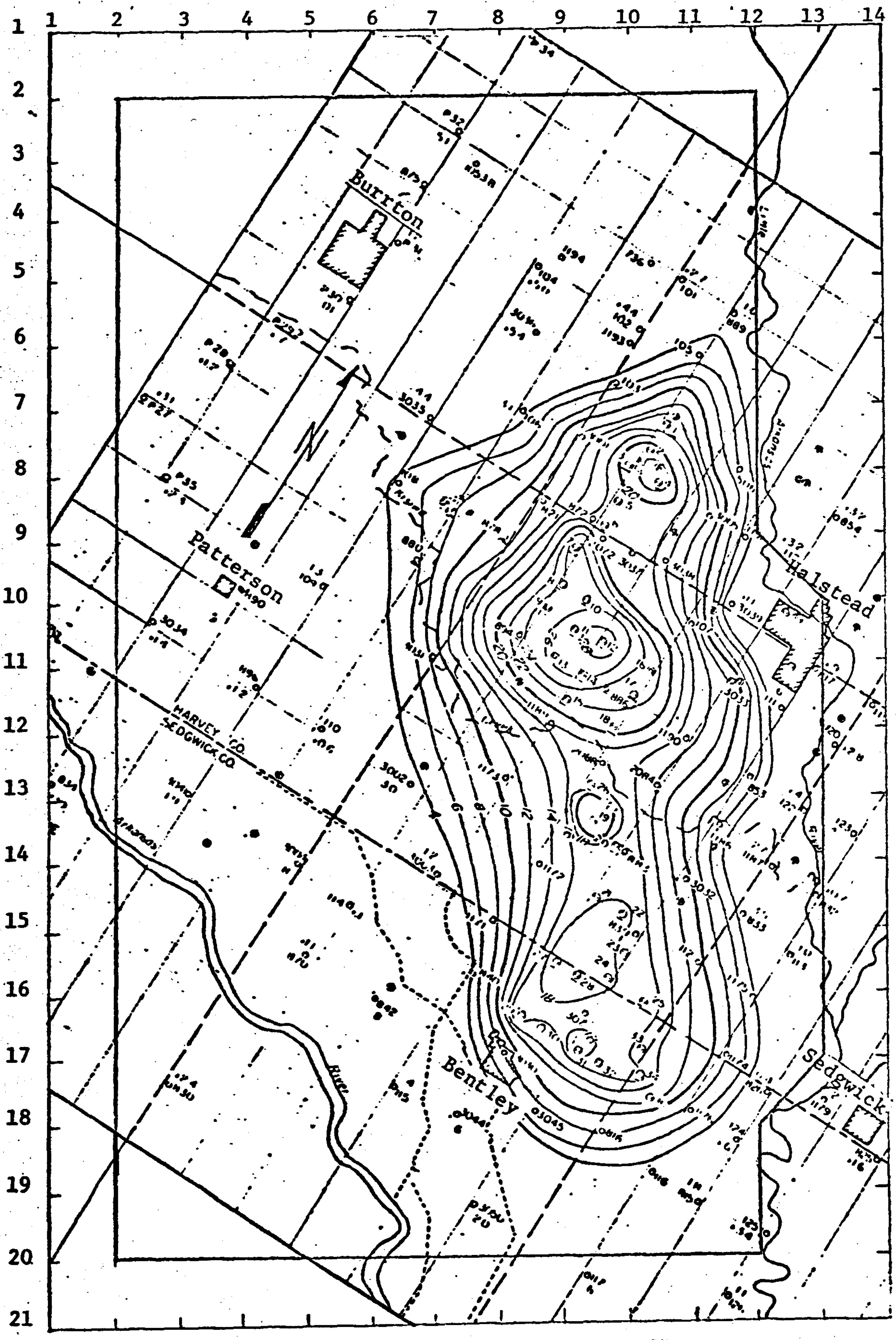


Figure 13. Measured Changes in Ground-Water Levels in the Model Area Between July, 1940 to January, 1959.

The calculated results were checked by a comparison to measured hydrographs in 13 observation wells. The wells selected are shown in Figure 14, and are identified by reference to Table I. Observation well locations (for comparison to the computations) were moved to the nearest grid location. The hydrographs for the wells were actually water level fluctuations and were determined by calculating yearly averages. The U.S. Geological Survey has developed a computer program to compute and plot yearly average water levels or water level changes, using any desired year as a base. This program was used to generate the plots for the comparison.

In the history matching process, storage coefficient values of 0.10, 0.15 and 0.20 were used. A typical result is shown in Figure 15. In general, the "best" fit was given by using .15 as the storage coefficient value.

The comparisons of computed to measured hydrographs for four typical wells are shown in Figures 16 through 19. The agreement, in general, is quite good. There are, to be sure, differences in the magnitudes of the water level changes. Part of this difference is due to the plotting procedure. The "basis" for the measured results is the average water level for 1940. For the calculated results, the basis is the water level on a specific date, July 1, 1940. This correction, if made, would improve the fit to the data. While there are differences in magnitude of water level change, the agreement in trend between the computed and measured hydrographs is excellent.

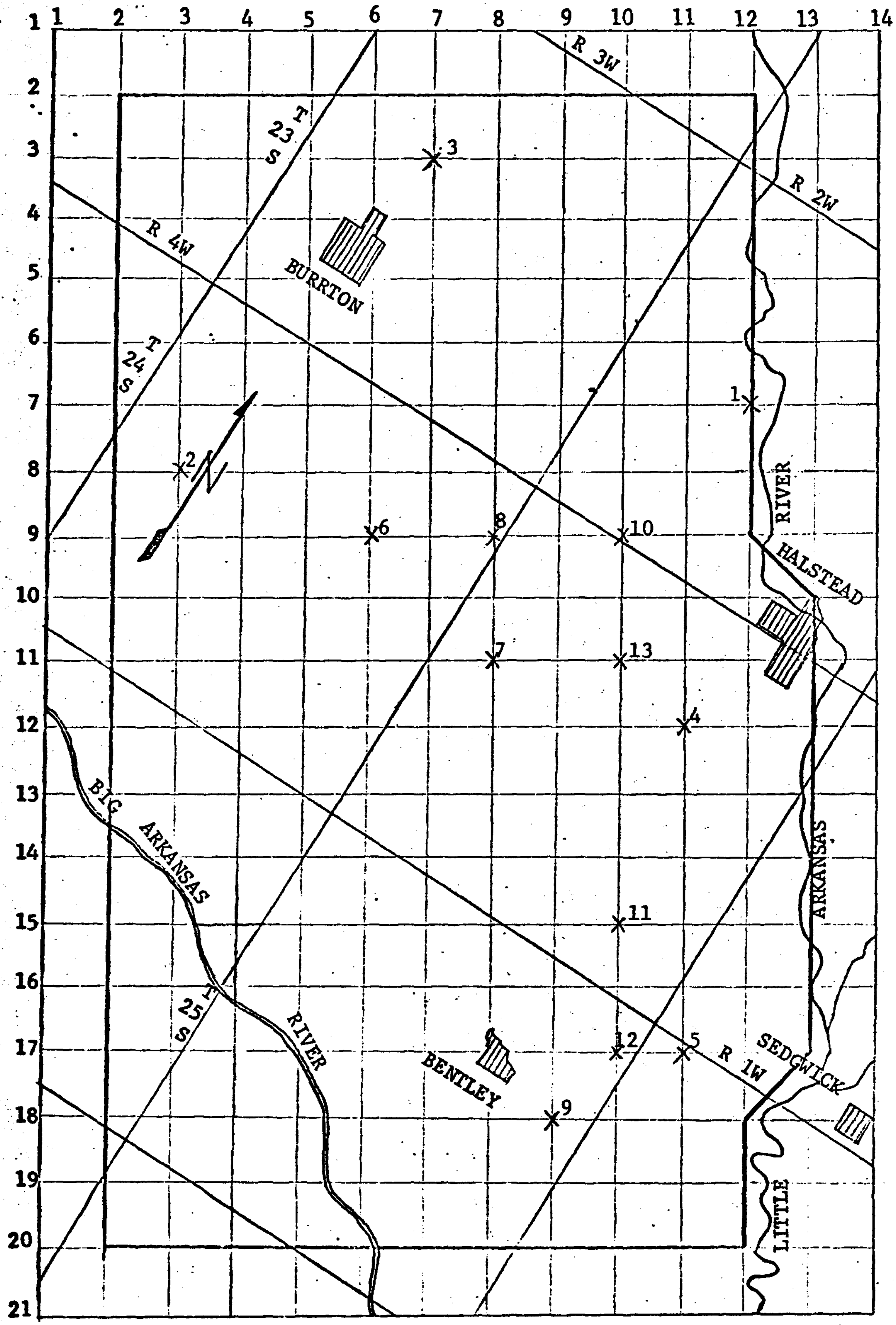


Figure 14. Observation Wells Which Were Moved to the Closest Grid Node.

Table I.
Observation Wells Location

Column 1*	Column 2*	Column 3*	Column 4*
1	506	23 2W28AB	12,7
2	P35	24 3W17CC	3,8
3	P32	23 3W8DD2	7,3
4	853	24 2W13BBB	11,12
5	1174	24 1W32CCC	11,7
6	880	24 3W11DD2	6,9
7	894	24 2W18AA	8,11
8	878	24 3W1DDD2	8,9
9	816	25 1W7CC	9,8
10	872	23 2W31DDD	10,9
11	839	24 2W35AA	10,15
12	33	25 2W1CBB	10,17
13	886	24 2W16BAA	10,11

*Column 1: Well number in Figure 14.

*Column 2: Well number of map of Wichita Well Field, Bulletin 119, Part 1, Plot 1.

*Column 3: Well number in report by G. J. Stramel on the Equus Beds, 1956, pages 15-18.

*Column 4: Node location in Figures 6 and 14.

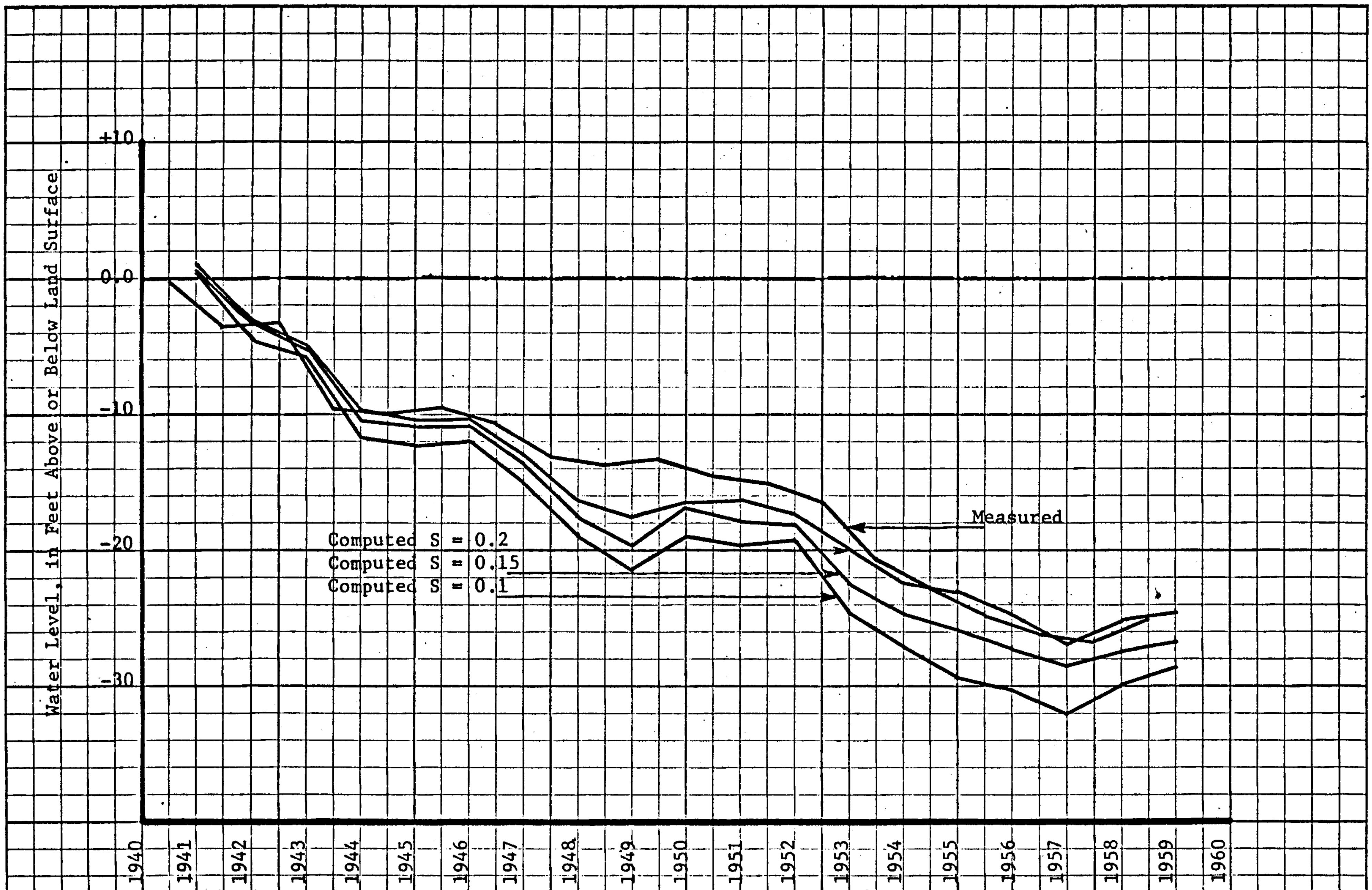


Figure 15. Measured Changes in Water Level Stages at Observation Well No. 6 Compared with Computed Changes in Stage for Various Assumed Storage Coefficients.

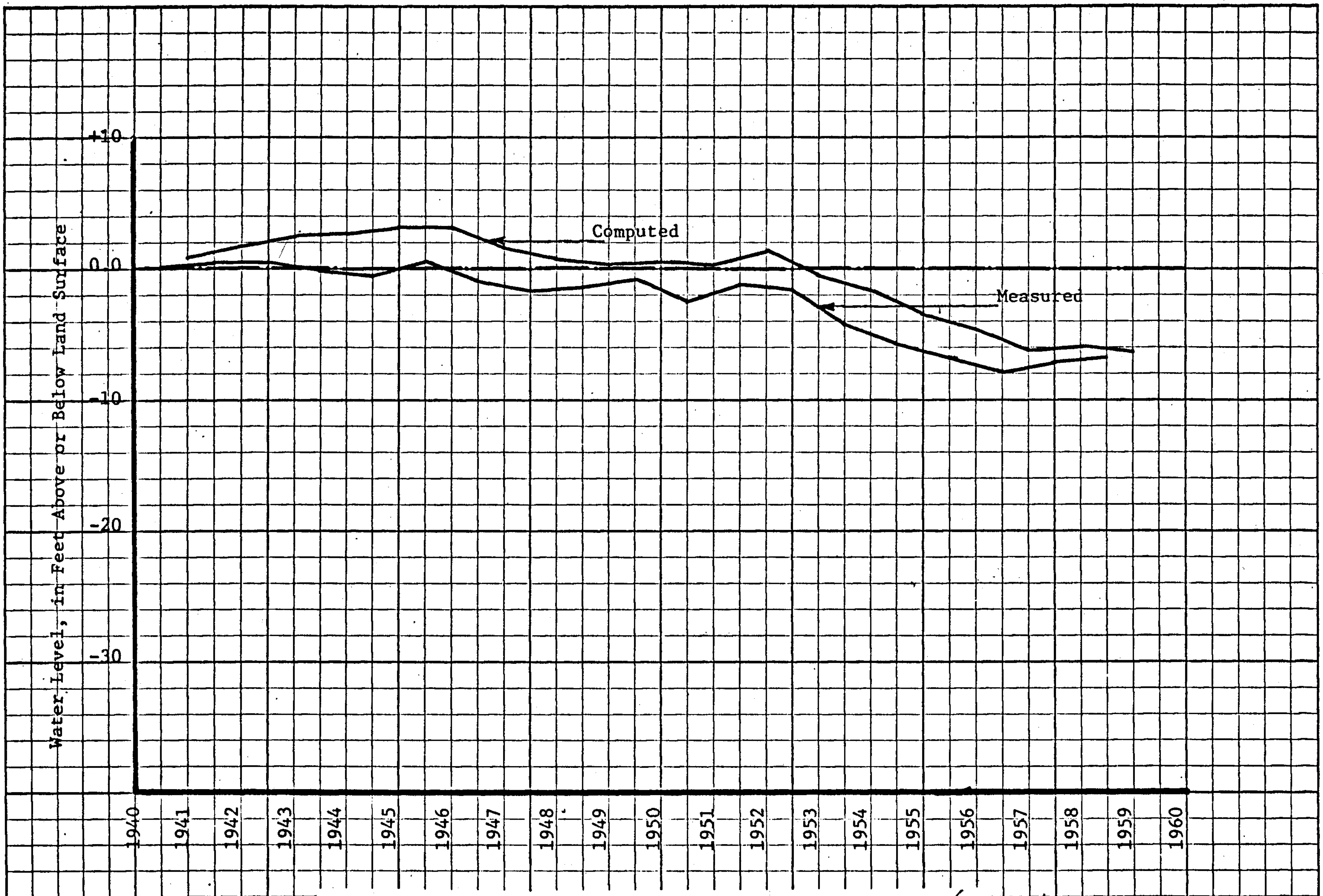


Figure 16. Measured and Computed Hydrograph, Well No. ~~13~~ 6

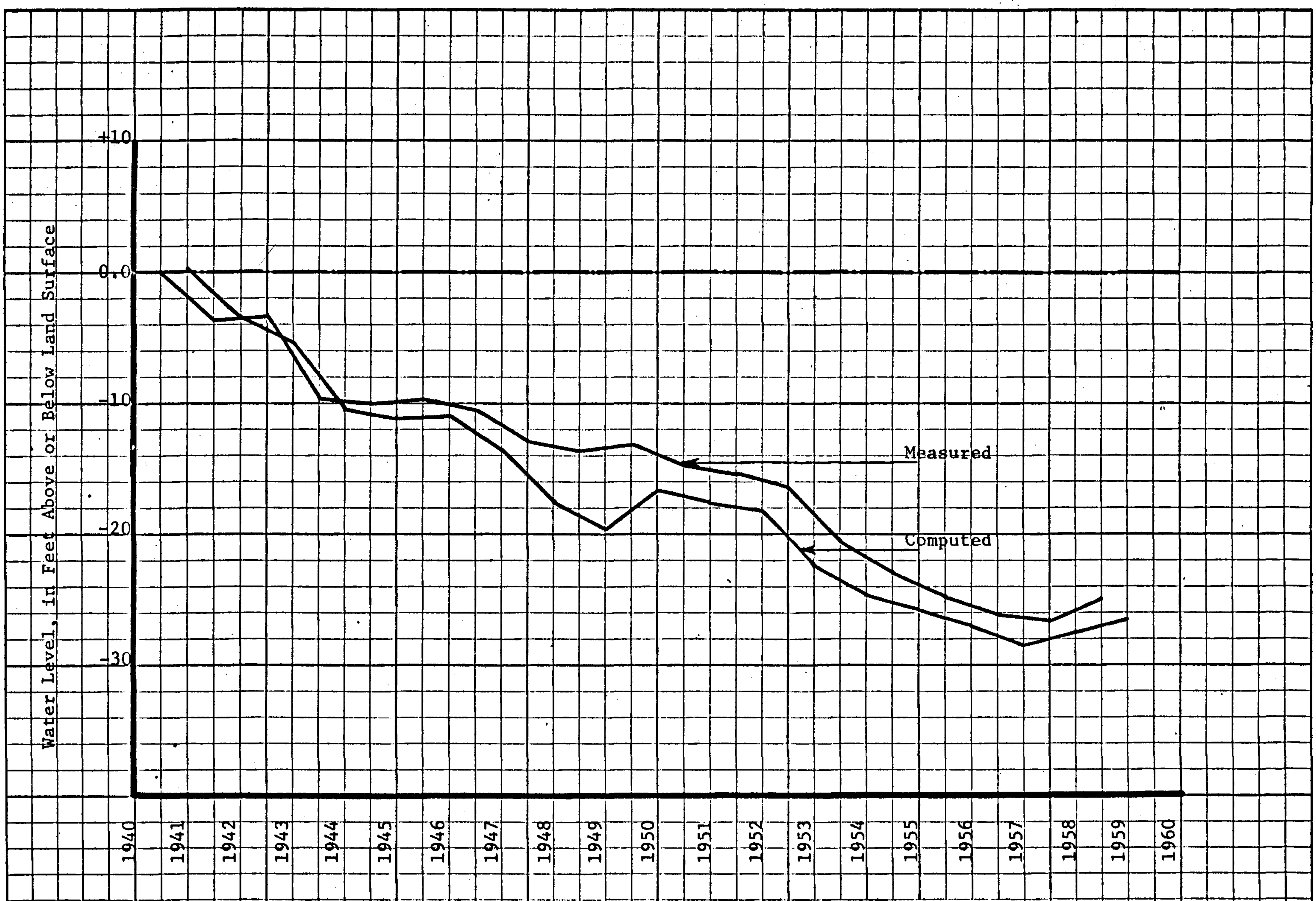


Figure 17: Measured and Computed Hydrograph, Well No. 6 13

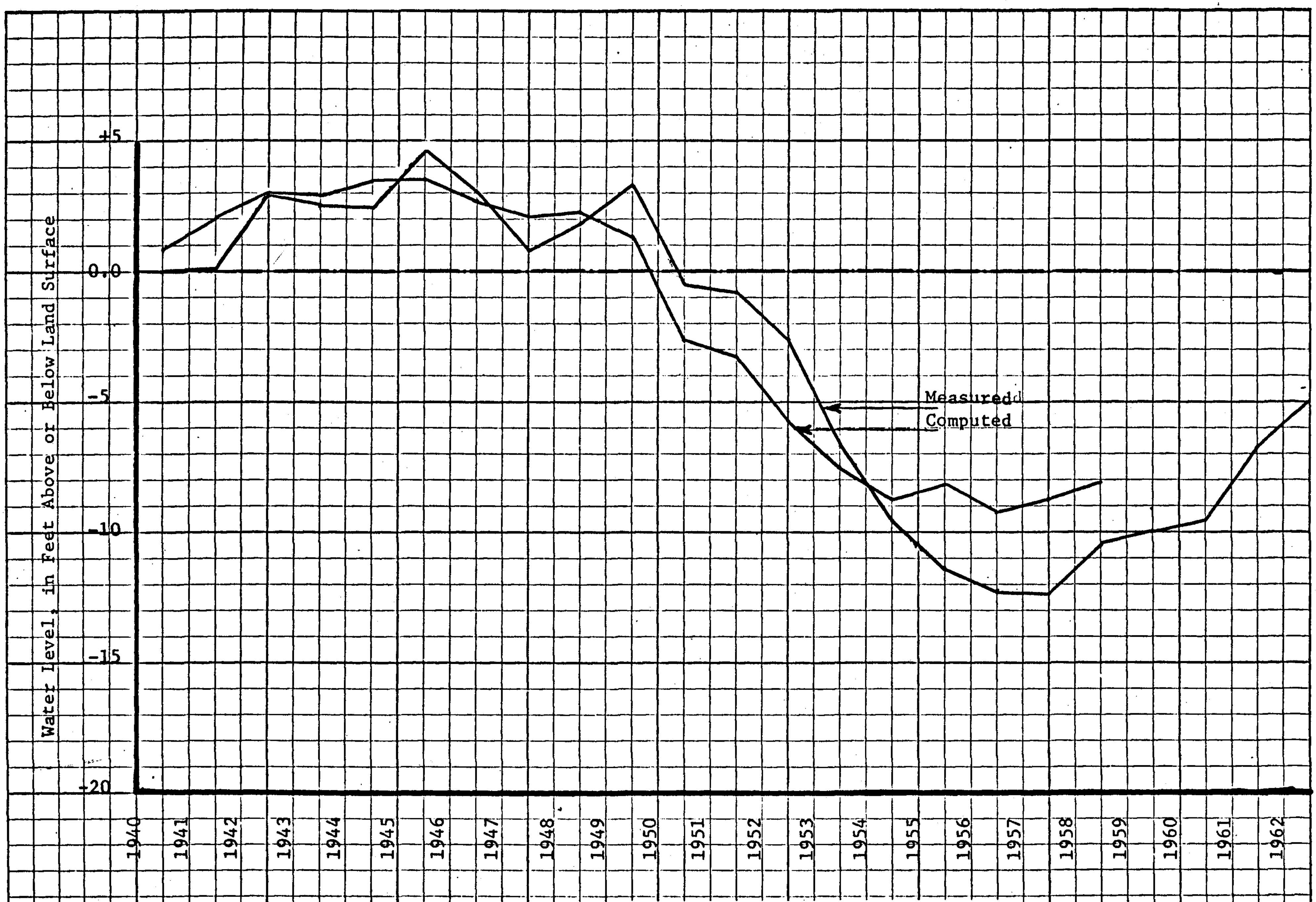


Figure 18. Measured and Computed Hydrograph, Well No. 9

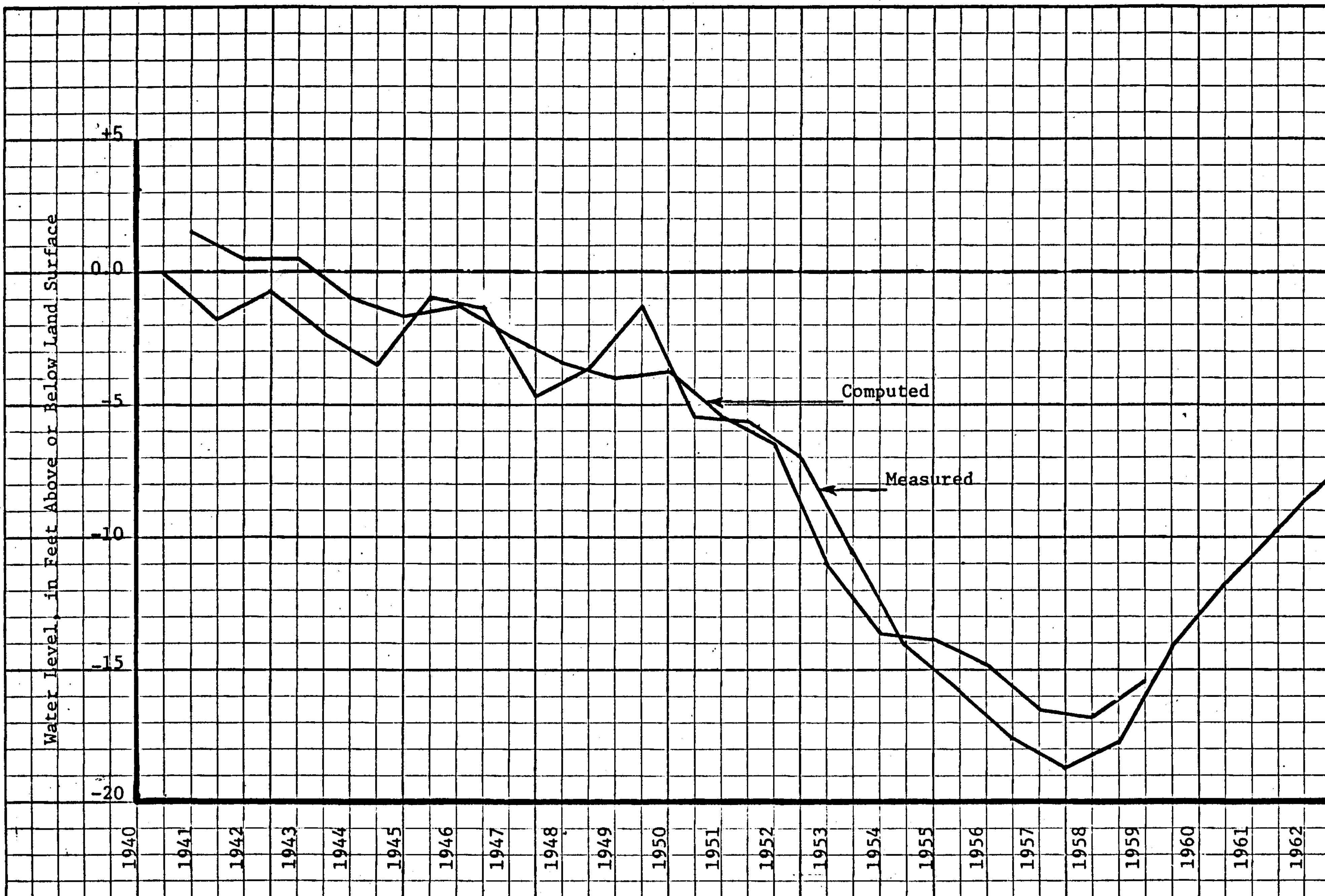


Figure 19. Measured and Computed Hydrograph, Well No. 11

A third check on the computed results consisted of a study of the amount of water being discharged from the aquifer to the Little Arkansas River. The U.S. Geological Survey conducted seepage runs on the Little Arkansas River during September 1960. There were no seepage-run data available during the period of the history match (July 1, 1940 to January 1, 1959). Therefore, it was decided to use the 1960 data for a comparison to the calculations. Since the calculations ended over a year and one-half before the date of the seepage run, it was realized that this could only be a qualatitive check.

The data used for the comparison are shown in Table II. The river site locations are on file at the U.S. Geological Survey office, Lawrence, Kansas. The computed and measured discharges at several sites are shown in Table III. The calculated discharges were determined using the equation

$$Q = K_s/M_r(H_{r(ij)} - h_{ij}) \Delta x \Delta y$$

While it is seen that there are large differences at several locations, the "order of magnitude" comparison is good. This comparison perhaps does indicate the need for a better description of the stream-aquifer interaction in the computer model.

Table II
River Discharge Calculation

River Site	Discharge (cfs)	Differ-ence	Valley Miles	Differ-ence	cfs/mile	Discharge to the River cfs/mile
R-1	17.6	3.2	39.2	3.3	.96	.48
R-2	20.8		35.9			
R-3	22.6	1.8	34.8	1.1	1.63	.81
R-4	23.2	.6	33.5	1.3	.46	.23
R-5	25.2	2.0	32.5	1.0	2.0	1.0
R-6	26.0	.8-.05	30.0	2.5	.3	.15
R-7	27.4	1.4	29.0	1.0	1.4	.7
R-8	27.8	.4	27.9	1.1	.36	.18
R-9	29.6	1.8	26.9	1.0	1.8	.9
R-10	31.9	2.3-.05	25.7	1.2	1.87	.93
R-11	34.4	2.5	24.3	1.4	1.78	.89
R-12	51.7	17.3-16.44	22.2	2.1	4.09	2.04
R-13	58.1	6.4	21.0	1.2	5.33	2.6
R-14	60.5	2.4	19.8	1.2	2.0	1.0
R-15	66.1	5.6	17.4	1.9	2.94	1.47
R-16	79.4	13.3+.32	15.6	2.3	5.28	2.64

Table III
Computed and Measured Discharge to the River
Computed Results are Based on .1 Storage Coefficient

Location (Row Index in grid system)	Computed discharge to the river, 1958 (cfs)	Measured discharge to the river, 1961 (cfs)
1	--	
2	.48	
3	.48	.48
4	.6	
5	.92	.81
6	.86	
7	1.01	.23
8	1.15	1.0
9	1.01	.15
10	.43	.7
11	.55	.18
12	.43	.9
13	.55	.93
14	.37	.89
15	.63	
16	.63	
17	.63	2.04
18	2.03	
19	0	
20	1.39	1.0
21	--	

CONCLUSIONS

1. The Pinder-Bredehoeft computer program was successfully modified for application to the Wichita Well field of the Equus Beds aquifer.
2. An 18 year history match of the well field resulted in a good fit to observed field data.
3. The computer aquifer model is a versatile tool that can be used to make predictions of future behavior of an aquifer under assumed conditions of stress. It is, potentially, a significant management tool.

RECOMMENDATIONS

1) It is known that the "Equus Beds" aquifer is an unconfined aquifer, thus the saturated thickness changes in time. The transmissibility which has been considered constant with time, must in fact, change with time. Therefore, it is recommended that transmissibility be considered as a product of permeability and saturated thickness:

$$T = Kh$$

where:

T = Transmissibility

K = Permeability

h = Saturated thickness

The saturated thickness should be changed and updated after each time step. Thus, T would change with time.

2) Evapotranspiration should be considered in the model.

3) The storage coefficient value used in the program should be checked.

4) The history match should be extended to the present date. If the "match" proved to be satisfactory, then the model could be used with reliability to make predictions of future behavior.

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4. G. J. Strammel, "Progress Report on the Ground-Water Hydrology of the Equus-Beds Area, Kansas", 1956.
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APPENDIX A

Data Cards Information

Card #1

Column	Contents
1-10	Variable format used for input transmissibility, storage coefficient, and initial head in the aquifer, AFMT(I).

Card #2

Column	
1-10	Variable format used for input hydraulic conductivities of streams and lakes wherever they occur, BFMT(I).

Card #3

Column	
1-10	Variable format used for input pumping or recharge rate, CFMT(I).

Card #4

Column	
1-10	Desired period of pumping in years, TMAX.
11-20	Number of nodes in a column of the matrix (no decimal point), DIML.
21-30	Number of nodes in a row of the matrix (no decimal point), DIMW.
31-40	Maximum number of time steps (no decimal point), NUMT.
41-50	Vertical leakage into the aquifer in feet per second, QRE.
51-60	Size of initial time increment in seconds, DELT.
61-70	Distance between nodes in feet (X direction), DELX.

Card #5

Column	Contents
1-10	Number of time steps between print out of row values (no decimal point), KTH.
11-20	Number of time steps between print out of column values (no decimal point), LTH.
21-30	Percentage of rainfall which reaches the aquifer, PRECFA.
31-40	Distance between nodes in the Y direction (feet), DELY.

Cards #6-26	Initial head in aquifer (feet), STRT(I,j). (1)
Cards #27-47	Transmissibility values (gallon/day-ft). A value of zero is assigned to all nodes beyond the perimeter of the aquifer and to nodes along the limiting rows and columns of the matrix, T(I,j). (1)
Cards #48-68	Storage coefficient values (dimensionless), S(I,j). (1)
Cards #69-89	Hydraulic conductivity of streams or lake bottoms over their thickness (1/sec), KOVSRM(I,j). (2)
Cards #90-110	The head of streams or lakes, (feet), HEAD(I,j). (1)

Card #111

Column	
1-10	Time period of pumping rate which follows (year), PTIME.
11-20	Yearly average rainfall (inch/year), PRECIP.
21-30	Initial time step (second), DELT.

. . . .

(1) Data card should be prepared according to the punched format on the first data card.
(2) Data card should be prepared according to the punched format on the second data card.

Cards #112-154	Pumping rate matrix (gal/year* 10^3) during the time period read from card #111. (In this program the time periods in the second half of 1940). RATE(I,j). (3)
Card #155	Same as card #111 with the data belonging to 1941, PTIME, PRECIP, DELT.
Cards #156-177	Same as cards #112-154 with pumping rate matrix belonging to 1941, RATE(I,j).
Card #158	Same as card #111 with the data belonging to 1942, PTIME, PRECIP, DELT.
Cards #198-219	Same as cards #112-154 with pumping rate matrix belonging to 1942, RATE(I,j).

The rest of data cards up to card #555 are pumping rate matrix belonging to 1943-1958 in the same manner.

The pumping rate data cards are in a form which gives enough flexibility to shoot down a well or digging a new well during the history of the basin.

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(3) Data card should be prepared according to the punched format on the third data card.

APPENDIX B

SAMPLE INPUT DATA

```
INPUT PARAMETER
LENGTH OF INITIAL TIME STEPIN SECONDS= 0.200E 04
MAXIMUM PERMITTED PERIOD OF PUMPING IN YEARS=      18.5
MAXIMUM PERMITTED NUMBER OF TIME STEPS (ITERATIONS)=    100000
FLUX DUE TO VERTICAL LEAKAGE FROM A CONFINING LAYER IN CFS= 0.
GRID SPACING IN PROTOTYPE IN FEET= 0.528E 04
NUMBER OF NODES IN COLUMN OF MATRIX=  21
NUMBER OF NODES IN ROW OF MATRIX=  14
```

TRANSMISSIBILITY MATRIX,(GPD/FT)*10**-3

1	0,	0,	0,	0,	0,	[illegible]	0,	0,	0,	0,	0,	0,	0,	0,
2	0,	100,0	55,0	45,0	45,0	90,0	[illegible]	100,0	30,0	15,0	10,0	10,0	0,	0,
3	0,	100,0	75,0	45,0	45,0	70,0	100.0	100,0	40,0	15,0	10,0	10,0	0,	0,
4	0,	100,0	90,0	50,0	47,0	65,0	105,0	100,0	50,0	15,0	10,0	10,0	0,	0,
5	0,	100,0	100,0	75,0	50,0	65,0	110,0	120,0	90,0	30,0	20,0	15,0	0,	0,
6	0,	103,0	104,0	90,0	75,0	80,0	120,0	150,0	130,0	100,0	40,0	25,0	0,	0,
7	0,	105,0	105,0	145,0	120,0	110,0	125,0	160,0	125,0	100,0	50,0	25,0	0,	0,
8	0,	106,0	105,0	140,0	160,0	140,0	120,0	170,0	125,0	70,0	50,0	25,0	0,	0,
9	0,	107,0	100,0	110,0	140,0	150,0	150,0	180,0	95,0	80,0	45,0	25,0	0,	0,
10	0,	107,0	90,0	110,0	135,0	150,0	200,0	190,0	100,0	90,0	45,0	30,0	25,0	0,
11	0,	106,0	93,0	95,0	120,0	130,0	205,0	200,0	100,0	100,0	50,0	30,0	30,0	0,
12	0,	104,0	95,0	96,0	105,0	140,0	200,0	200,0	150,0	130,0	80,0	40,0	25,0	0,
13	0,	102,0	97,0	97,0	100,0	140,0	200,0	200,0	100,0	100,0	100,0	50,0	30,0	0,
14	0,	100,0	99,0	98,0	98,0	140,0	175,0	200,0	210,0	75,0	100,0	100,0	20,0	0,
15	0,	120,0	100,0	99,0	99,0	120,0	150,0	200,0	120,0	100,0	50,0	100,0	100,0	0,
16	0,	140,0	120,0	100,0	100,0	140,0	150,0	150,0	140,0	140,0	100,0	100,0	100,0	0,
17	0,	210,0	175,0	150,0	150,0	150,0	200,0	200,0	200,0	100,0	140,0	110,0	105,0	0,
18	0,	250,0	240,0	205,0	200,0	200,0	200,0	200,0	200,0	150,0	150,0	125,0	0,	0,
19	0,	250,0	240,0	250,0	220,0	220,0	220,0	205,0	195,0	165,0	145,0	100,0	0,	0,
20	0,	220,0	250,0	250,0	215,0	220,0	200,0	140,0	140,0	120,0	100,0	90,0	0,	0,
21	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,

STORAGE COEFFICIENT MATRIX

1	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
2	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
3	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
4	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
5	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
6	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
7	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
8	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
9	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
10	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
11	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
12	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
13	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
16	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
17	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
18	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
19	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
21	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

INITIAL VALUE OF HYDRAULIC HEAD IN AQUIFER (FEET)+1000 FT=ALTITUDE

1	472.0	469.0	466.0	464.0	463.0	463.0	450.0	435.0	430.0	425.0	410.0	392.0	395.0	402.0
2	470.0	466.0	463.0	458.0	456.0	457.0	457.0	445.0	438.0	427.0	412.0	391.0	394.0	402.0
3	466.0	464.0	459.0	454.0	449.0	448.0	450.0	451.0	445.0	435.0	418.0	390.0	390.0	401.0
4	462.0	460.0	455.0	449.0	443.0	440.0	441.0	440.0	443.0	440.0	425.0	390.0	392.0	398.0
5	457.0	454.0	450.0	445.0	440.0	436.0	434.0	431.0	430.0	430.0	422.0	386.0	393.0	397.0
6	450.0	447.0	445.0	440.0	437.0	433.0	429.0	426.0	424.0	420.0	414.0	383.0	392.0	397.0
7	446.0	444.0	441.0	437.0	433.0	428.0	425.0	422.0	417.0	413.0	405.0	380.0	391.0	393.0
8	442.0	440.0	436.0	433.0	430.0	425.0	422.0	418.0	414.0	408.0	400.0	374.0	380.0	394.0
9	438.0	435.0	432.0	430.0	426.0	422.0	418.0	414.0	411.0	408.0	402.0	371.0	375.0	377.0
10	433.0	430.0	427.0	425.0	422.0	418.0	416.0	410.0	406.0	404.0	401.0	390.0	368.0	374.0
11	428.0	426.0	422.0	419.0	417.0	415.0	411.0	406.0	402.0	398.0	392.0	384.0	365.0	372.0
12	426.0	422.0	418.0	415.0	412.0	410.0	406.0	402.0	398.0	392.0	385.0	375.0	363.0	370.0
13	422.0	418.0	413.0	410.0	407.0	405.0	402.0	398.0	393.0	386.0	380.0	369.0	362.0	366.0
14	418.0	414.0	408.0	405.0	403.0	400.0	397.0	393.0	387.0	382.0	376.0	367.0	360.0	363.0
15	414.0	410.0	403.0	401.0	398.0	396.0	393.0	388.0	383.0	377.0	372.0	366.0	357.0	361.0
16	410.0	403.0	399.0	397.0	395.0	392.0	388.0	384.0	380.0	374.0	368.0	363.0	354.0	358.0
17	402.0	398.0	396.0	393.0	390.0	387.0	384.0	380.0	375.0	371.0	366.0	359.0	352.0	357.0
18	398.0	395.0	392.0	388.0	385.0	382.0	379.0	375.0	371.0	366.0	360.0	350.0	349.0	354.0
19	394.0	390.0	387.0	384.0	381.0	377.0	374.0	371.0	367.0	362.0	355.0	347.0	349.0	353.0
20	390.0	384.0	382.0	378.0	376.0	373.0	369.0	367.0	362.0	358.0	352.0	344.0	347.0	352.0
21	385.0	382.0	378.0	374.0	372.0	368.0	366.0	362.0	358.0	355.0	350.0	341.0	346.0	351.0

THE VALUE OF HYDRAULIC HEAD IN RIVER OR LAKE (FEET)

1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	469.0	466.0	464.0	463.0	463.0	450.0	435.0	430.0	425.0	410.0	381.0	0.	0.
3	0.	466.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	379.0	0.	0.
4	0.	462.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	381.0	0.	0.
5	0.	457.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	379.0	0.	0.
6	0.	450.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	376.0	0.	0.
7	0.	446.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	375.0	0.	0.
8	0.	442.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	368.0	0.	0.
9	0.	438.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	365.0	0.	0.
10	0.	433.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	366.0	0.
11	0.	428.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	362.0	0.
12	0.	426.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	361.0	0.
13	0.	422.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	359.0	0.
14	0.	418.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	357.0	0.
15	0.	414.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	357.0	0.
16	0.	410.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	354.0	0.
17	0.	402.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	352.0	0.
18	0.	398.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	349.0	0.	0.
19	0.	394.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	346.0	0.	0.
20	0.	386.0	378.0	374.0	372.0	368.0	366.0	362.0	358.0	355.0	350.0	343.0	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

HYDRAULIC CONDUCTIVITY OF STREAM OR LAKE BOTTOM OVER ITS THICKNESS

1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.432E-08	0.245E-08	0.243E-08	0.281E-08	0.288E-08	0.409E-08	0.445E-08	0.132E-08	0.801E-09	0.542E-09	0.215E-08	0.	0.
3	0.	0.255E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.215E-08	0.	0.
4	0.	0.255E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.215E-08	0.	0.
5	0.	0.205E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.331E-08	0.	0.
6	0.	0.175E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.520E-08	0.	0.
7	0.	0.203E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.520E-08	0.	0.
8	0.	0.208E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.520E-08	0.	0.
9	0.	0.194E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.520E-08	0.	0.
10	0.	0.194E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.520E-08	0.
11	0.	0.188E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.666E-08	0.
12	0.	0.167E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.520E-08	0.
13	0.	0.186E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.666E-08	0.
14	0.	0.205E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.442E-08	0.
15	0.	0.236E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.226E-07	0.
16	0.	0.257E-08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.226E-07	0.
17	0.	0.117E-07	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.226E-07	0.
18	0.	0.139E-07	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.243E-07	0.	0.
19	0.	0.139E-07	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.226E-07	0.	0.
20	0.	0.168E-07	0.189E-07	0.189E-07	0.149E-07	0.162E-07	0.141E-07	0.507E-08	0.507E-08	0.396E-08	0.715E-08	0.250E-07	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 0.50

PRECIP(INCHES/YR) = 36.77

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 4.41

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX.CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-0.40	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-0.41	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-0.74	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-0.70	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-0.93	-0.49	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-0.23	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-0.25	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-0.27	-0.13	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	-0.38	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	-0.47	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 1.50

PRECIP(INCHES/YR) = 33.25

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 3.99

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.43	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.86	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-2.19	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-2.16	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-2.95	-1.29	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-0.79	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-0.85	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-1.06	-0.41	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.18	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.73	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 2.50

PRECIP(INCHES/YR) = 42.13

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 5.06

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.59	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.86	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-2.68	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-2.58	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-3.68	-1.39	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-0.91	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-1.47	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-1.37	-0.59	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.30	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.69	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 3.50

PRECIP(INCHES/YR) = 29.94

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 3.59

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.89	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.11	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-2.94	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-3.36	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-4.13	-2.84	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.39	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-1.10	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-1.52	-0.49	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.61	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.78	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 4,50

PRECIP(INCHES/YR) = 43,53

PRECIP; RECHARGE TO AQUIFER (INCHS/YR)= 5,22

DELT(INIT TIME STEP IN SEC) = 2000,

RATE MATRIX,CU,FT/SEC

1	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,	(
3	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,	(
5	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
7	0,	0,	0,	0,	0,	0,	0,	0,	0,	-1,88	0,	0,	0,	0
8	0,	0,	0,	0,	0,	0,	0,	0,	0,	-2,88	0,	0,	0,	0
9	0,	0,	0,	0,	0,	0,	0,	0,	-3,35	0,	0,	0,	0,	0
10	0,	0,	0,	0,	0,	0,	0,	0,	-3,64	0,	0,	0,	0,	0
11	0,	0,	0,	0,	0,	0,	0,	0,	-4,94	-2,11	0,	0,	0,	0
12	0,	0,	0,	0,	0,	0,	0,	0,	0,	-1,56	0,	0,	0,	0
13	0,	0,	0,	0,	0,	0,	0,	0,	-1,54	0,	0,	0,	0,	0
14	0,	0,	0,	0,	0,	0,	0,	0,	-0,98	-0,82	0,	0,	0,	0
15	0,	0,	0,	0,	0,	0,	0,	0,	0,	-2,15	0,	0,	0,	0
16	0,	0,	0,	0,	0,	0,	0,	0,	0,	-2,23	0,	0,	0,	0
17	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0
18	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0
19	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0
20	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0
21	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 5.50

PRECIP(INCHES/YR) = 36.71

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 4.41

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.41	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-3.23	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-3.55	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-3.81	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-5.57	-1.37	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.23	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-1.38	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-1.31	-0.72	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.82	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.96	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 6.50

PRECIP(INCHES/YR) = 23.67

PRECIP, RECHARGE TO AQUIFER (INCHS/YR)= 2.84

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.81	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.69	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-3.78	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-3.45	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-5.38	-2.00	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.20	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-1.38	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-1.76	-0.75	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.81	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.25	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 7.50

PRECIP(INCHES/YR) = 25.93

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 3.11

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-0.93	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.79	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-4.27	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-3.53	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-5.70	-2.94	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.19	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-1.49	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-1.56	-0.78	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.75	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.12	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 8.50

PRECIP(INCHES/YR) = 31.35

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 3.76

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.21	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.57	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-4.03	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-4.40	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-5.86	-2.75	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.61	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-1.63	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-1.77	-0.79	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.84	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.57	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 9,50

PRECIP(INCHES/YR) = 38,17

PRECIP, RECHARGE TO AQUIFER (INCHS/YR)= 4,58

DELT(INIT TIME STEP IN SEC) = 2000,

RATE MATRIX,CU,FT/SEC

1	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,
3	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,
5	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,
7	0,	0,	0,	0,	0,	0,	0,	0,	0,	-0,47	0,	0,	0,	0,
8	0,	0,	0,	0,	0,	0,	0,	0,	0,	-2,26	0,	0,	0,	0,
9	0,	0,	0,	0,	0,	0,	0,	0,	-3,27	0,	0,	0,	0,	0,
10	0,	0,	0,	0,	0,	0,	0,	0,	-3,51	0,	0,	0,	0,	0,
11	0,	0,	0,	0,	0,	0,	0,	0,	-6,06	-1,78	0,	0,	0,	0,
12	0,	0,	0,	0,	0,	0,	0,	0,	0,	-0,72	0,	0,	0,	0,
13	0,	0,	0,	0,	0,	0,	0,	0,	-1,44	0,	0,	0,	0,	0,
14	0,	0,	0,	0,	0,	0,	0,	0,	-1,87	-0,82	0,	0,	0,	0,
15	0,	0,	0,	0,	0,	0,	0,	0,	-1,50	-1,24	0,	0,	0,	0,
16	0,	0,	0,	0,	0,	0,	0,	-2,43	-0,59	-1,35	0,	0,	0,	0,
17	0,	0,	0,	0,	0,	0,	0,	0,	-0,91	-1,04	0,	0,	0,	0,
18	0,	0,	0,	0,	0,	0,	0,	0,	0,	-0,16	0,	0,	0,	0,
19	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
20	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
21	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 10.50

PRECIP(INCHES/YR) = 30.87

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 3.70

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.10	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.33	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-2.84	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-2.80	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-5.89	-1.97	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.08	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-2.03	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-1.32	-0.63	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	-0.51	-1.72	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	-2.77	-0.51	-0.94	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	-2.34	-2.06	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.75	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 11,50

PRECIP(INCHES/YR) = 50,48

PRECIP, RECHARGE TO AQUIFER (INCHS/YR)= 6,06

DELT(INIT TIME STEP IN SEC) = 2000,

RATE MATRIX,CU,FT/SEC

1	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,
3	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,
5	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,
7	0,	0,	0,	0,	0,	0,	0,	0,	0,	-2,09	0,	0,	0,	0,
8	0,	0,	0,	0,	0,	0,	0,	0,	0,	-2,60	0,	0,	0,	0,
9	0,	0,	0,	0,	0,	0,	0,	0,	-3,16	0,	0,	0,	0,	0,
10	0,	0,	0,	0,	0,	0,	0,	0,	-3,68	0,	0,	0,	0,	0,
11	0,	0,	0,	0,	0,	0,	0,	0,	-7,08	-2,02	0,	0,	0,	0,
12	0,	0,	0,	0,	0,	0,	0,	0,	0,	-1,20	0,	0,	0,	0,
13	0,	0,	0,	0,	0,	0,	0,	0,	-2,38	0,	0,	0,	0,	0,
14	0,	0,	0,	0,	0,	0,	0,	0,	-2,25	-0,63	0,	0,	0,	0,
15	0,	0,	0,	0,	0,	0,	0,	0,	-1,19	-1,80	0,	0,	0,	0,
16	0,	0,	0,	0,	0,	0,	0,	-2,77	0,	-1,40	0,	0,	0,	0,
17	0,	0,	0,	0,	0,	0,	0,	0,	-2,52	-2,12	0,	0,	0,	0,
18	0,	0,	0,	0,	0,	0,	0,	0,	0,	-1,74	0,	0,	0,	0,
19	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
20	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
21	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 12.50

PRECIP(INCHES/YR) = 20.03

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 2.40

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.00	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.33	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-3.57	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-4.18	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-6.97	-2.82	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.42	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-2.58	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-2.26	-0.93	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	-1.03	-2.62	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	-2.28	-0.44	-2.03	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	-3.14	-2.17	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.91	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 13.50

PRECIP(INCHES/YR) = 19.11

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 2.29

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.04	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.83	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-3.94	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-1.85	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-7.89	-2.75	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.29	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-2.40	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-1.77	-1.00	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	-0.54	-2.51	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	-2.56	-0.61	-2.45	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	-3.14	-2.35	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.74	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 14.50

PRECIP(INCHES/YR) = 14.53

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 1.74

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.60	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.90	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-3.64	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-4.20	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-7.38	-2.38	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.43	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-2.89	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-1.44	-0.52	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	-0.54	-1.76	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	-2.54	-0.51	-2.08	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	-3.14	-2.10	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.67	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 15.50

PRECIP(INCHES/YR) = 23.77

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 2.85

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.22	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.51	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-3.15	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-3.13	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-6.96	-2.53	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.41	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-2.57	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-0.80	-0.84	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	-1.31	-1.74	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	-1.74	-0.42	-2.06	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	-2.75	-2.16	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.82	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 16.50

PRECIP(INCHES/YR) = 12.73

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 1.53

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-0.82	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.95	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-2.02	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-3.58	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-6.94	-2.59	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.24	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-2.47	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-0.61	-0.88	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	-0.96	-1.82	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	-0.98	-0.28	-2.70	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	-3.07	-2.30	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.69	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 17,50

PRECIP(INCHES/YR) = 37,15

PRECIP, RECHARGE TO AQUIFER (INCHS/YR)= 4,46

DELT(INIT TIME STEP IN SEC) = 2000,

RATE MATRIX,CU,FT/SEC

1	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,
3	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,
5	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,
7	0,	0,	0,	0,	0,	0,	0,	0,	0,	-1,18	0,	0,	0,	0,
8	0,	0,	0,	0,	0,	0,	0,	0,	0,	-2,73	0,	0,	0,	0,
9	0,	0,	0,	0,	0,	0,	0,	0,	-2,67	0,	0,	0,	0,	0,
10	0,	0,	0,	0,	0,	0,	0,	0,	-3,98	0,	0,	0,	0,	0,
11	0,	0,	0,	0,	0,	0,	0,	0,	-5,74	-2,20	0,	0,	0,	0,
12	0,	0,	0,	0,	0,	0,	0,	0,	0,	-1,26	0,	0,	0,	0,
13	0,	0,	0,	0,	0,	0,	0,	0,	-2,47	0,	0,	0,	0,	0,
14	0,	0,	0,	0,	0,	0,	0,	0,	-0,53	-1,05	0,	0,	0,	0,
15	0,	0,	0,	0,	0,	0,	0,	0,	-1,53	-1,97	0,	0,	0,	0,
16	0,	0,	0,	0,	0,	0,	0,	-1,07	-0,36	-2,10	0,	0,	0,	0,
17	0,	0,	0,	0,	0,	0,	0,	0,	-3,19	-2,33	0,	0,	0,	0,
18	0,	0,	0,	0,	0,	0,	0,	0,	0,	-1,71	0,	0,	0,	0,
19	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
20	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
21	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,

PTIME(MAX TIME FOR RATES THAT FOLLOW) = 18.50

PRECIP(INCHES/YR) = 31.66

PRECIP. RECHARGE TO AQUIFER (INCHS/YR)= 3.80

DELT(INIT TIME STEP IN SEC) = 2000.

RATE MATRIX,CU.FT/SEC

1	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.
3	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.
5	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.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-2.18	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.74	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	-2.74	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	-4.34	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	-6.19	-1.96	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.27	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	-1.92	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	-0.17	-0.97	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	-0.97	-1.43	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	-1.78	-0.35	-2.74	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	-2.33	-2.52	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	-1.54	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

APPENDIX C

COMPUTER PROGRAMMING LISTING

```
C         TO PROVIDE THE POTENTIAL DISTRIBUTION IN A CONFINED AQUIFER AFTER
C        A DESIGNATED PERIOD OF TIME.
C         THE PROGRAM CAN ALSO BE USED TO APPROXIMATE AN UNCONFINED AQUIFER
C        IF TRANSMISSIBILITY IS ALMOST CONSTANT WITH TIME  I.E.,
C        TRANSMISSIBILITY ALMOST CONSTANT WITN CNANGING AEAD
C
C        METHOD
C         THE ALTERNATING DIRECTION IMPLICIT TECHNIQUE IS USED TO SOLVE
C        THE LINEAR EQUATIONS.
C
C        DESCRIPTION OF PARAMETERS
C        A=COEFFICIENT IN FINITE DIFFERENCE EQUATION
C        B=COEFFICIENT IN FINITE DIFFERENCE EOUQTION
C        BE(I)=DUMMY VARIABLE DEFINED AS C/W
C        C=COEFFICIENT IN FINITE DIFFERENCE EQUATION
C        D=DUMMY VARIABLE REPRESENTING PARAMETERS OF EQUATION WHOSE VALUES
C        ARE KNOWN FROM PREVIOUS ITERATION
C        DAYS=NUMBER OF DAYS SINCE PUMPING STARTED
C        DELT= LENGTH OF INITIAL TIME STEP (SECONDS)
C        DELX=DISTANCE BETWEEN NODES IN THE PROTOTYPE IN THE X DIRECTION
C                (FEET)
C        DELY=DISTANCE BETWEEN NODES IN THE PROTOTYPE IN THE Y DIRECTION
C                (FEET)
C        DIFSUM TIME PERIOD FOR USE IN MATERIAL BALANCE CALC  INCREMENT
C         BETWEEN ACCUMULATED TIME ANF TIME OF PREVIOUS MAT. BAL. CALC
C        DIML=NUMBER OF NODES IN COLUMN OF MATRIX
C        DIMW=NUMBER OF NODES IN ROW OF MATRIX
C        FACTOR=MULTIPLICATION FACTOR FOR ADJUSTING STORAGE COEFFICIENT
C        G   DUMMY VARIABLE DEFINED AS  D-A*G J-1  /W  THOMAS ALGORITHM
C        HEAD I,J   POTENTIAL AT POINT OF RECHARGE OR WITNDRAWAL
C        HRS=NUMBER OF HOURS SINCE PUMPING STARTED
C        KTH=NUMBER OF TIME STEPS BETWEEN PRINTOUTS(ROWS)
C        LTH=NUMBER OF TIME STEPS BETWEEN PRINTOUTS(COLUMNS)
C        M=THICKNESS OF STREAM BED OR LAKE BOTTOM (FEET)
C        K= HYDRAULIC CONDUCTIVITY OF RTREAM OR LAKE BOTTOM,ALSO MAY BE
C        USED ALONG BOUNDARY
C        KOVERM(I,J)=K/M ,1/SEC
C        NUMT=MAXIMUM NUMBER OF TIME STEPS
C        PHI(I,J)=HEAD IN AQUIFER AT NODE (I,J) IN FEET
C        PRECFY = FRACTION OF PRECIPITATION THAT REACHES AQUIFER
C        PRNT(I,J)=ARRAY FOR PRINTING OUT HEAD MATRIX IN CONTOUR FORM
C        PRECIP = INCHES OF RAINFALL PER YEAR
C        PTIME = MAX TIME FOR THE CORRESPONDING PUMPING SCHEDULE (YEAR)
C        ORE= RECHARGE FLUX FROM THE CONFINING LAYER (CU.FT./SEC.*FT**2
C        RATE(I,J) = RATE OF PUMPING (READ IN AS GAL/YEAR*1000)
C                    READ OUT AS CU. FT./SEC.
C        POSITIVE IF IT IS PRODUCTION WELL   (SIGNS REVERSED IN PROGRAM)
C        RHO=DUMMY VARIABLE DEFINED AS S(I,J)/DELT
C        RR=VARIABLE ACCOUNTING FOR VERTICAL LEAKAGE
C        RW=VARIABLE ACCOUNTING FOR PUMPING
```

```
C       S(I,J)=STORAGE COEFFICIENT (DIMENSIONLESS)
C       STRT= INITIAL VALUE OF HYDRAULIC HEAD IN AQUIFER (FEET)
C       SUM=DURATION OF PUMPING IN SECONDS
C       SUMB=
C       SUMO=
C       SUMN=
C       SYM(J)=LINEAR ARRAY CONTAINING SYMBOLS FOR PRINTING OUT HEAD
C             MATRIX
C       T(I,J) = TRANSMISSIBILITY (FEET**2/SECOND) READ IN AS (GAL/DAY/FT
C         * 10**-3)
C       TEMP(I)=TEMPORY LOCATION OF CURRENTLY CALCULATED VALUES OF HEAD
C       TMAX = MAX ALLOTED PUMPING PERIOD (READ IN AS YEARS)CAUSES PROG TO
C        TERMINATE
C       W=DUMMY VARIABLE DEFINED AS B-A*BE(J-1)
C
        COMMON PHI,SUM,DELX,DIML,DIMW,STRT,RATE,S,TPER,DIFSUM,PRECIP,PRECF
       1A,PUMP,T,HEAD,KOVERM,SUMB,RR
        DIMENSION AFMT(10), BFMT(10), CFMT(10)
        INTEGER DIML,DIMW
        REAL T(32,48),S(32,48),RATE(32,48),MINS,STRT(32,48),HEAD(32,48),KO
       1VERM(32,48)
        DOUBLE PRECISION PHI(32,48),D,G(51),TEMP(51),BE(51),W,T1,T2,T3,T4,
       1RHO,A,B,C,DELT
        READ (5,1) (AFMT(I),I=1,10)
        READ (5,1) (BFMT(I),I=1,10)
        READ (5,1) (CFMT(I),I=1,10)
      1 FORMAT (10A6)
C
C
C       READ IN FROM PARAMETER CARD DIML,DIMW,DELT,DELX,NUMT,QRE,QW,TMAX,
C       STRT,M,KTH,LTH,FACTOR
        READ (5,60) TMAX,DIML,DIMW,NUMT,QRE,DELT,DELX,KTH,LTH,PRECPA,DELY
C
C
C       PRINT PARAMETER VALUES
        WRITE (6,48) DELT,TMAX,NUMT,QRE,DELX,DIML,DIMW
C       READ IN INITIAL HEAD MATRIX
C       SET HEAD MATRIX TO INITIAL VALUE STRT (I,J)
        READ (5,AFMT) ((STRT(I,J),J=1,DIMW),I=1,DIML)
C
        TMAX=TMAX*3600.*24.*365.
C
C
C       READ TRANSMISSIBILITY AND STORAGE COEFFICIENT VALUES
        READ (5,AFMT) ((T(I,J),J=1,DIMW),I=1,DIML)
        READ (5,AFMT) ((S(I,J),J=1,DIMW),I=1,DIML)
C
C
C       PRINT TRANSMISSIBILITY AND STORAGE COEFFICIENT VALUES
        WRITE (6,49)
```

```
      DO 2 I=1,DIML
    2 WRITE (6,50) I,(T(I,J),J=1,DIMW)
      WRITE (6,52)
      DO 3 I=1,DIML
    3 WRITE (6,53) I,(S(I,J),J=1,DIMW)
      WRITE (6,59)
      DO 4 I=1,DIML
    4 WRITE (6,50) I,(STRT(I,J),J=1,DIMW)
C
C
C     INITIALIZE VARIABLES
      KT=1
      SUM=0.0
      TPER=0.
      SUMOLD=0.
      PUMP=0.
      SUMB=0.
C
C     READ IN LOCATIONS OF STREAMS, LAKES,AND WELLS
      READ (5,BFMT) ((KOVERM(I,J),J=1,DIMW),I=1,DIML)
      DO 5 I=1,DIML
      DO 5 J=1,DIMW
      T(I,J)=T(I,J)*(133.68/(24.*3600.))
    5 PHI(I,J)=STRT(I,J)
      READ (5,AFMT) ((HEAD(I,J),J=1,DIMW),I=1,DIML)
      WRITE (6,55)
      DO 6 I=1,DIML
    6 WRITE (6,62) I,(KOVERM(I,J),J=1,DIMW)
      WRITE (6,56)
      DO 7 I=1,DIML
    7 WRITE (6,50) I,(HEAD(I,J),J=1,DIMW)
    8 KEY=0
      DIFSUM=SUM-SUMOLD
      SUMOLD=SUM
      IF (SUM.EQ.0.) GO TO 9
      WRITE (6,51) KT,DELT,SUM,MINS,HRS,DAYS
      CALL PRNT1
      CALL CHECK
      CALL PRNTA
    9 IF (PTIME.GE.TMAX) GO TO 45
      READ (5,61) PTIME,PRECIP,DELT
      PREREC=PRECIP*PRECFA
      WRITE (6,54) PTIME,PRECIP,PREREC,DELT
      PTIME=PTIME*3600.*24.*365.
      DO 10 I=1,DIML
   10 READ (5,CFMT) (RATE(I,J),J=1,DIMW)
      DO 11 I=1,DIML
      DO 11 J=1,DIMW
C
C
```

```
   11 RATE(I,J)=-RATE(I,J)*133.68/(365.*24.*3600.)
C     PRINT RATE MATRIX
      WRITE (6,47)
      DO 12 I=1,DIML
   12 WRITE (6,53) I,(RATE(I,J),J=1,DIMW)
      SUM=SUM+DELT
      GO TO 15
C
C
C     CALCULATE THE HEAD AT EACH POINT IN THE MATRIX AFTER DESIGNATED
C     PERIODS OF PUMPING
C     CONSIDER CALCULATIONS FOR ROWS
   13 SUM=SUM+DELT
      IF (KEY.EQ.1) SUM=SUM-DELT
      IF (KEY.EQ.1) GO TO 8
      TSUM=SUM+DELT
C     CHECK SUM TO SEE IF IT EXCEEDS PRODUCTION TIME OF CURRENT SET OF
C       RATES  IF YES RESET DELT SO THAT SUM WILL EQUAL PTIME AT END
C       OF Y-DIRECTION IMPLICIT CALC
      IF (TSUM-PTIME) 15,14,14
   14 KEY=1
      SUM=SUM-DELT
      DELT=(PTIME-SUM)/2.0
      SUM=SUM+DELT
   15 HRS=SUM/3600.
      MINS=HRS*60.
      DAYS=HRS/24.0
      JNO1=DIMW-1
      SUMO=0.
      SUMN=0.
      DO 27 I=2,DIML
      DO 19 J=2,JNO1
C     CALCULATION FOR MATERIAL BALANCE PURPOSES
      SUMO=SUMO+DELT*DELX*DELY*KOVERM(I,J)*(HEAD(I,J)-PHI(I,J))
C
C
C     DETERMINE WHETHER NODE IS OUTSIDE AQUIFER BOUNDARY
      IF (T(I,J)) 16,19,16
C
C
C     CALCULATE VALUES FOR DELXX AND DELYY
   16 DELYY=DELY
      RHO=S(I,J)/DELT
      DELXX=DELX
C
C     ....................................................................
C
C     CALCULATE AVERAGE VALUES OF T BETWEEN ADJACENT NODES
C     NODE CONFIGURATION    T1=LEFT, T2=RIGHT, T3=UPPER, T4=LOWER
      T1=(T(I,J-1)+T(I,J))/(2.*DELXX**2)
```

```
      T2=(T(I,J+1)+T(I,J))/(2.*DELXX**2)
      T3=(T(I-1,J)+T(I,J))/(2.*DELYY**2)
      T4=(T(I+1,J)+T(I,J))/(2.*DELYY**2)
      IF (T(I,J-1).EQ.0.0) T1=0.0
      IF (T(I,J+1).EQ.0.0) T2=0.0
      IF (T(I-1,J).EQ.0.0) T3=0.0
      IF (T(I+1,J).EQ.0.0) T4=0.0
C
C
C     CHECK WHETHER NODE IS ALONG A STREAM OR ON A LAKE
C
C
C     CALCULATE VALUES FOR PARAMETERS A,B,C, AND BE
      B=-T1-T2-RHO-KOVERM(I,J)/2.0
      A=T1
      C=T2
      W=B-A*BE(J-1)
      BE(J)=C/W
C
C
C     CHECK NODE FOR POSSIBLE WELL LOCATION
      RR=QRE
      RW=0.0
      IF (RATE(I,J)) 17,18,17
   17 RW=-RATE(I,J)/(DELXX*DELYY)
   18 D=-T3*PHI(I-1,J)+(T4+T3-RHO)*PHI(I,J)-T4*PHI(I+1,J)+RW-RR-KOVERM(I
     1,J)*(HEAD(I,J)-PHI(I,J)/2.0)-PRECIP*PRECFA/(12.*3600.*365.*24.)
      G(J)=(D-A*G(J-1))/W
   19 CONTINUE
C
C
C     CALCULATE HEAD VALUES FOR ROWS OF MATRIX AND PLACE THEM IN
C     TEMPORARY LOCATION TEMP
      NO3=DIMW-2
      IF (I.GT.2) GO TO 23
      DO 22 KNO4=1,NO3
      NO4=DIMW-KNO4
      IF (T(I,NO4)) 21,20,21
   20 TEMP(NO4)=STRT(I,NO4)
      GO TO 22
   21 TEMP(NO4)=G(NO4)-BE(NO4)*TEMP(NO4+1)
   22 CONTINUE
      GO TO 27
   23 DO 26 KNO4=1,NO3
      NO4=DIMW-KNO4
      PHI(I-1,NO4)=TEMP(NO4)
      IF (T(I,NO4)) 25,24,25
   24 TEMP(NO4)=STRT(I,NO4)
      GO TO 26
   25 TEMP(NO4)=G(NO4)-BE(NO4)*TEMP(NO4+1)
```

```
   26 CONTINUE
   27 CONTINUE
C
C
C
C      PRINT OUT HEAD DISTRIBUTION AT EVERY KTH TIME STEP
       IF (MOD(KT,KTH)) 29,28,29
   28 WRITE (6,51) KT,DELT,SUM,MINS,HRS,DAYS
C
C
C      IF A CHECK OF THE ACCURACY OF THE COMPUTATIONS IS DESIRED, REMOVE
C      THE C FROM COLUMN 1 ON THE FOLLOWING CARD
C      CALL CHECK
C
C
C      IF NUMERICAL OUTPUT IS DESIRED REMOVE THE C FROM COLUMN 1 ON THE
C      FOLLOWING CARD
       CALL PRNT1
C
C
C      IF SYMBOLIC OUTPUT IS DESIRED REMOVE THE C FROM COLUMN 1 ON THE
C      FOLLOWING CARD
       CALL PRNTA
   29 CONTINUE
C
C
C      FOLLOW SIMILIAR PROCEDURE FOR COLUMNS OF MATRIX AS THAT CONSIDERED
C      FOR ROWS
       KT=KT+1
       SUM=SUM+DELT
       HRS=SUM/3600.
       MINS=HRS*60.
       DAYS=HRS/24.
       INO1=DIML-1
       DO 41 J=2,DIMW
       DO 33 I=2,INO1
       IF (T(I,J)) 30,33,30
C
C
C      CALCULATE VALUES FOR DELXX AND DELYY
   30 DELXX=DELX
       RHO=S(I,J)/DELT
       DELYY=DELY
C
C      ..........................................................
C
C      CALCULATE AVERAGE VALUES OF T BETWEEN ADJACENT NODES
       T1=(T(I,J-1)+T(I,J))/(2.*DELXX**2)
       T2=(T(I,J+1)+T(I,J))/(2.*DELXX**2)
       T3=(T(I-1,J)+T(I,J))/(2.*DELYY**2)
       T4=(T(I+1,J)+T(I,J))/(2.*DELYY**2)
```

```
      IF (T(I,J-1).EQ,0,0) T1=0,0
      IF (T(I,J+1).EQ,0,0) T2=0,0
      IF (T(I-1,J).EQ,0,0) T3=0,0
      IF (T(I+1,J).EQ,0,0) T4=0,0
C
C
C     CHECK WHETHER NODE IS ALONG A STREAM OR ON A LAKE
C
C
C     CALCULATE VALUES FOR PARAMETERS A,B,C,AND BE
      A=T3
      C=T4
      B=-T4-T3-RHO-KOVERM(I,J)/2.
      W=B-A*BE(I-1)
      BE(I)=C/W
C
C
C     CHECK NODE FOR POSSIBLE WELL LOCATION
      RR=QRE
      RW=0.0
      IF (RATE(I,J)) 31,32,31
   31 RW=-RATE(I,J)/(DELXX*DELYY)
   32 D=-T1*PHI(I,J-1)+(T1+T2-RHO)*PHI(I,J)-T2*PHI(I,J+1)+RW-RR-KOVERM(I
     1,J)*(HEAD(I,J)-PHI(I,J)/2.0)-PRECIP*PRECFA/(12.*3600.*365.*24.)
      G(I)=(D-A*G(I-1))/W
   33 CONTINUE
C
C
C     CALCULATE HEAD VALUES FOR COLUMNS OF MATRIX AND PLACE IN TEMPORARY
C     LOCATION TEMP
      NO3=DIML-2
      IF (J.GT.2) GO TO 37
      DO 36 KNO4=1,NO3
      NO4=DIML-KNO4
      IF (T(NO4,J)) 35,34,35
   34 TEMP(NO4)=STRT(NO4,J)
      GO TO 36
   35 TEMP(NO4)=G(NO4)-BE(NO4)*TEMP(NO4+1)
   36 CONTINUE
      GO TO 41
   37 DO 40 KNO4=1,NO3
      NO4=DIML-KNO4
      PHI(NO4,J-1)=TEMP(NO4)
      IF (T(NO4,J)) 39,38,39
   38 TEMP(NO4)=STRT(NO4,J)
      GO TO 40
   39 TEMP(NO4)=G(NO4)-BE(NO4)*TEMP(NO4+1)
   40 CONTINUE
   41 CONTINUE
C
```

```
C
C     PRINT OUT HEAD DISTRIBUTION AT EVERY LTH TIME STEP
      IF (MOD(KT,LTH)) 43,42,43
   42 WRITE (6,51) KT,DELT,SUM,MINS,HRS,DAYS
C
C
C     IF A CHECK OF THE ACCURACY OF THE COMPUTATIONS IS DESIRED, REMOVE
C     THE C FROM COLUMN 1 ON THE FOLLOWING CARD
C     CALL CHECK
C
C
C     IF NUMERICAL OUTPUT IS DESIRED REMOVE THE C FROM COLUMN 1 ON THE
C     FOLLOWING CARD
      CALL PRNT1
C
C
C     IF SYMBOLIC OUTPUT IS DESIRED REMOVE THE C FROM COLUMN 1 ON THE
C     FOLLOWING CARD
      CALL PRNTA
   43 CONTINUE
C
C     CALCULATION FOR MATERIAL BALANCE PURPOSES
      DO 44 I=1,DIML
      DO 44 J=1,DIMW
   44 SUMN=SUMN+DELT*DELX*DELY*KOVERM(I,J)*(HEAD(I,J)-PHI(I,J))
      SUMB=SUMB+SUMO+SUMN
C
C     ADJUST LENGTH OF TIME STEP
      DELT=DELT+.25*DELT
      KT=KT+1
C
C
C     DETERMINE WHETHER DESIRED PUMPING PERIOD HAS ELAPSED
C     OR THE LIMITING NUMBER FOR TIME STEPS HAS BEEN REACHED. IF EITHER
C     HAS OCCURRED TERMINATE PROGRAM
      IF (KT.LT.NUMT) GO TO 13
      WRITE (6,57) NUMT
   45 WRITE (6,58)
      DO 46 I=1,DIML
   46 WRITE (6,50) I,(PHI(I,J),J=1,DIMW)
      STOP
C
C
   47 FORMAT (1H0,41X,21HRATE MATRIX,CU.FT/SEC)
   48 FORMAT (1H1,16X,15HINPUT PARAMETER//38HLENGTH OF INITIAL TIME STEP
     1IN SECONDS=,G10.3//45HMAXIMUM PERMITTED PERIOD OF PUMPING IN YEARS
     2=,G10.3//53HMAXIMUM PERMITTED NUMBER OF TIME STEPS (ITERATIONS)= ,
     3I9//59HFLUX DUE TO VERTICAL LEAKAGE FROM A CONFINING LAYER IN CFS=
     4,G10.3//34HGRID SPACING IN PROTOTYPE IN FEET=,G10.3//36HNUMBER OF
     5NODES IN COLUMN OF MATRIX=,I4//33HNUMBER OF NODES IN ROW OF MATRIX
```

```
   6=,I4//)                                                               40
49 FORMAT (1H1,34X,39HTRANSMISSIBILITY MATRIX,(GPD/FT)*10**-3)           40
50 FORMAT (1H0,I4,(1X,20F6.1))                                            40
51 FORMAT (1H1,35X,16HITERATION NUMBER,I10/30X,28HSIZE OF TIME STEPIN    40
  1 SECONDS=,G10.3/20X,48HDURATION OF PUMPING AT THIS PRINTOUT IN SEC    40
  2ONDS=,G10.3/56X,8HMINUTES=,G10.3/56X,6HHOURS=,G10.3/56X,5HDAYS=,F1    40
  30.3)                                                                   41
52 FORMAT (1H1,54X,26HSTORAGE COEFFICIENT MATRIX)                         41
53 FORMAT (1H ,I4,(1X,20F6.2))                                            41
54 FORMAT (1H1,40HPTIME(MAX TIME FOR RATES THAT FOLLOW) = ,F13.2//19H    41
  1PRECIP(INCHES/YR) =,F10.2//39HPRECIP. RECHARGE TO AQUIFER (INCHS/Y    41
  2R)=,F10.2//30HDELT(INIT TIME STEP IN SEC) = ,F10.0)                   41
55 FORMAT (1H1,33X,66HHYDRAULIC CONDUCTIVITY OF STREAM OR LAKE BOTTOM    41
  1 OVER ITS THICKNESS)                                                   41
56 FORMAT (1H1,35X,51HTHE VALUE OF HYDRAULIC HEAD IN RIVER OR LAKE (F    41
  1EET))                                                                  41
57 FORMAT (1H ,8I10)                                                      42
58 FORMAT (1H1,34X,52HHEAD IN THE AQUIFER AT THE END OF THE PERIOD IN    42
  1 FEET)                                                                 42
59 FORMAT (1H1,15X,66HINITIAL VALUE OF HYDRAULIC HEAD IN AQUIFER (FEE    42
  1T)+1000 FT=ALTITUDE)                                                   42
60 FORMAT (F10.0,3I10,3F10.0/2I10,2F10.0)                                 42
61 FORMAT (8F10.2)                                                        42
62 FORMAT (1H0,I4,(1X,14E9.3))                                            42
   END                                                                    42

155 WORDS OF MEMORY USED BY THIS COMPILATION
```

```
      SUBROUTINE PRNTA                                                   A
C     THIS SUBROUTINE PRINTS OUT THE HEAD MATRIX AS ALPHABETIC CONTOURS  A
      COMMON PHI,SUM,DELX,DIML,DIMW,STRT,RATE,S,TPER,DIFSUM,PRECIP,PRECFA
     1A,PUMP,T(32,48),HEAD(32,48),KOVERM,SUMB,RR                         A
      INTEGER DIML,DIMW                                                  A
      REAL RATE(32,48),SYM(39),PRNT(51),STRT(32,48),K,S(32,48),KOVERM(32A
     1,48)                                                               A
      DOUBLE PRECISION PHI(32,48)                                        A
      WRITE (6,5)                                                        A
      DATA SYM/2H35,2H34,2H33,2HW ,2H31,2H30,2H29,2H28,2H27,2H26,2H25,2HA
     124,2H23,2H22,2H21,2H20,2H19,2H18,2H17,2H16,2H15,2H14,2H13,2H12,2H1A
     21,2H10,2H9 ,2H8 ,2H7 ,2H6 ,2H5 ,2H4 ,2H3 ,2H2 ,2H1 ,2H0 ,2H+ ,2H* A
     3,2H  /                                                             A
      DO 4 IB=1,DIML                                                     A
      DO 3 JB=1,DIMW                                                     A
      K=PHI(IB,JB)-(STRT(IB,JB)-36.49)                                   A
      IF (K.GT.36.49) PRNT(JB)=SYM(39)                                   A
      IF (K.GT.36.49) GO TO 1                                            A
      IF (K.LT.1.) GO TO 2                                               A
      N=K                                                                A
      PRNT(JB)=SYM(N)                                                    A
    1 IF (RATE(IB,JB).GT.0.) PRNT(JB)=SYM(9)                             A
      IF (RATE(IB,JB).LT.0.) PRNT(JB)=SYM(4)                             A
      IF (PHI(IB,JB).EQ.STRT(IB,JB)) PRNT(JB)=SYM(37)                    A
      GO TO 3                                                            A
    2 PRNT(JB)=SYM(38)                                                   A
    3 CONTINUE                                                           A
    4 WRITE (6,6) (PRNT(JB),JB=1,DIMW)                                   A
      WRITE (6,7)                                                        A
      RETURN                                                             A
C                                                                        A
C                                                                        A
    5 FORMAT (1H1,50X,32HALPHABETIC CONTOURS FOR DRAWDOWN)               A
    6 FORMAT (1H0,32A3)                                                  A
    7 FORMAT (9HOLEGEND.,/50HDRAWDOWN FROM 0-35 FEET REPRESENTED BY SYMBA
     10LS 0-Z/57HDRAWDOWN GREATER THAN 35 FEET REPRESENTED BY THE SYMBOLA
     2 */60HAREA OF INCREASED HEAD(GREATER THAN ORIGINAL) INDICATED BY  A
     3)                                                                  A
      END                                                                A

890 WORDS OF MEMORY USED BY THIS COMPILATION
```

```
      SUBROUTINE PRNT1                                                  B
C     THIS SUBROUTINE PRINTS OUT THE HEAD MATRIX IN NUMERICAL FORM      B
      COMMON PHI,SUM,DELX,DIML,DIMW,STRT,RATE,S,TPER,DIFSUM,PRECIP,PRECFB
     1A,PUMP,T(32,48),HEAD(32,48),KOVERM,SUMB,RR                        B
      REAL RATE(32,48),DDN(51),STRT(32,48),S(32,48),KOVERM(32,48)       B
      INTEGER DIML,DIMW                                                 B
      DOUBLE PRECISION PHI(32,48)                                       B
      WRITE (6,8)                                                       B
      IF (DIMW.LT.32) GO TO 1                                           B
      LIMROW=DIMW/2                                                     B
      GO TO 2                                                           B
    1 LIMROW=DIMW                                                       B
    2 DO 4 I=1,DIML                                                     B
      DO 3 J=1,LIMROW                                                   B
    3 DDN(J)=STRT(I,J)-PHI(I,J)                                         B
    4 WRITE (6,9) I,(DDN(K),K=1,LIMROW)                                 B
      IF (DIMW.LT.32) GO TO 7                                           B
      WRITE (6,10)                                                      B
      LIMRO1=LIMROW+1                                                   B
      LIMRO2=DIMW                                                       B
      DO 6 I=1,DIML                                                     B
      DO 5 J=LIMRO1,LIMRO2                                              B
    5 DDN(J)=STRT(I,J)-PHI(I,J)                                         B
    6 WRITE (6,9) I,(DDN(K),K=LIMRO1,LIMRO2)                            B
    7 RETURN                                                            B
C                                                                       B
C                                                                       B
    8 FORMAT (1H0,38X,20HDRAWDOWN IN FEET(1) //)                        B
    9 FORMAT (1H ,I4,26F5.1)                                            B
   10 FORMAT (1H1,58X,20HDRAWDOWN IN FEET(2) //)                        B
      END                                                               B

2892 WORDS OF MEMORY USED BY THIS COMPILATION
```

```
      SUBROUTINE CHECK                                                  C
C     THIS SUBROUTINE COMPUTES THE ERROR IN THE SOLUTION ON A MASS      C
C     BALANCE BASIS                                                     C
      COMMON PHI,SUM,DELX,DIML,DIMW,STRT,RATE,S,TOTL,DIFSUM,PRECIP,PRECFC
     1A,PUMP,T(32,48),HEAD(32,48),KOVERM,SUMB,RR                        C
      INTEGER DIML,DIMW                                                 C
      REAL RATE(32,48),S(32,48),STRT(32,48),KOVERM(32,48)               C
      DOUBLE PRECISION PHI(32,48)                                       C
      TOTL=0.                                                           C
      DO 1 IC=1,DIML                                                    C
      DO 1 JC=1,DIMW                                                    C
      TOTL=TOTL+S(IC,JC)*DELX**2*(STRT(IC,JC)-PHI(IC,JC))+RR*DIFSUM*DELXC
     1*DELX                                                             C
      IF (T(IC,JC).EQ.0.) GO TO 1                                       C
      TPER=TPER+PRECIP*PRECFA*DELX**2*DIFSUM/(12.*3600.*365.*24.)       C
    1 IF (RATE(IC,JC).LT.0.0) PUMP=PUMP-RATE(IC,JC)*DIFSUM              C
      TOTL=TOTL+TPER+SUMB                                               C
      DIFF=PUMP-TOTL                                                    C
      PERCNT=(DIFF/PUMP)*100.                                           C
      DIFSUM=DIFSUM/(24.*3600.)                                         C
      WRITE (6,2) TOTL,PUMP,DIFF,PERCNT,DIFSUM,SUMB,TPER                C
      RETURN                                                            C
C                                                                       C
C                                                                       C
    2 FORMAT (65H0QUANTITY PUMPED ACCORDING TO CONE OF DEPRESSION IN CUBC
     1IC FEET = ,G15.5 /59HQUANTITY PUMPED ACCORDING TO WELL DISCHARGE IC
     2N CUBIC FEET =,G15.5 /51HESTIMATE FROM PUMPING LESS ESTIMATE FROM C
     3DRAWDOWN =,G15.5 /41HDIFFERENCE AS A PERCENT OF VOLUME PUMPED=,G15C
     4.5 /17HTIME PERIOD,DAYS=,G15.5 /26HNET BOUNDARY EFFECT,CU.FT=,G15.C
     55 /20HPRECIPITATION,CU.FT=,G15.5)                                 C
      END                                                               C
```

2888 WORDS OF MEMORY USED BY THIS COMPILATION

ITERATION NUMBER 335
SIZE OF TIME STEPIN SECONDS= 0.394E 07
DURATION OF PUMPING AT THIS PRINTOUT IN SECONDS= 0.142E 09
MINUTES= 0.237E 07
HOURS= 0.394E 05
DAYS= 1642.500

DRAWDOWN IN FEET(1)

1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	-1.3	-3.2	-6.3	-4.9	0.5	6.7	0.8	-3.6	-8.5	-7.8	-1.8	0.	0.
3	0.	-0.8	-4.6	-7.7	-8.9	-5.4	1.2	5.8	1.9	-3.9	-5.3	-2.4	0.	0.
4	0.	-1.0	-4.6	-8.4	-10.8	-9.4	-4.4	-2.1	3.7	4.1	2.5	-3.0	0.	0.
5	0.	-2.4	-4.9	-7.4	-8.8	-8.4	-6.4	-5.7	-2.6	3.3	6.4	-3.9	0.	0.
6	0.	-4.4	-5.0	-7.0	-6.3	-6.2	-6.0	-4.7	-1.7	1.3	4.2	-3.7	0.	0.
7	0.	-2.7	-4.2	-5.3	-5.7	-6.4	-4.8	-2.8	-1.8	4.0	1.7	-4.4	0.	0.
8	0.	-2.4	-4.9	-5.1	-4.3	-4.9	-2.4	-0.5	2.4	7.6	2.7	-5.0	0.	0.
9	0.	-3.3	-4.9	-4.0	-3.9	-2.9	-0.7	1.9	10.0	9.1	7.2	-6.1	0.	0.
10	0.	-4.0	-5.6	-4.6	-3.4	-2.0	2.2	3.2	12.0	10.0	8.3	5.7	-3.4	0.
11	0.	-3.7	-6.3	-6.4	-4.1	-0.5	1.4	3.4	13.2	11.2	3.4	0.8	-3.3	0.
12	0.	-3.5	-6.0	-6.0	-4.7	-1.4	-0.1	1.7	5.3	5.1	-1.1	-6.3	-4.7	0.
13	0.	-3.1	-6.4	-6.6	-5.4	-2.4	-0.7	0.4	2.9	-0.5	-3.3	-8.8	-3.4	0.
14	0.	-2.2	-6.6	-6.8	-4.9	-3.5	-2.0	-0.9	-0.8	-0.3	-3.1	-6.4	-4.0	0.
15	0.	-0.9	-6.2	-5.7	-5.2	-3.1	-1.9	-2.6	-1.9	1.6	-1.7	-1.9	-2.6	0.
16	0.	-2.4	-4.5	-4.0	-2.6	-2.2	-2.5	-2.5	-0.6	1.8	-1.3	-1.0	-2.6	0.
17	0.	-2.4	-2.2	-2.5	-2.4	-2.3	-2.1	-2.5	-3.1	-1.3	-0.3	-1.2	-2.6	0.
18	0.	-1.1	-1.5	-2.6	-2.7	-2.8	-3.0	-3.8	-3.9	-3.5	-2.7	-3.4	0.	0.
19	0.	-1.8	-1.7	-1.6	-1.9	-3.0	-3.5	-4.0	-4.4	-4.5	-4.6	-2.7	0.	0.
20	0.	-3.2	-1.1	-1.7	-1.2	-1.1	-3.1	-3.5	-5.2	-4.8	-3.4	-2.2	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

QUANTITY PUMPED ACCORDING TO CONE OF DEPRESSION IN CUBIC FEET = 0.30260E 10
QUANTITY PUMPED ACCORDING TO WELL DISCHARGE IN CUBIC FEET = 0.30255E 10
ESTIMATE FROM PUMPING LESS ESTIMATE FROM DRAWDOWN = -0.48816E 06
DIFFERENCE AS A PERCENT OF VOLUME PUMPED= -0.16135E-01
TIME PERIOD,DAYS= 365.00
NET BOUNDARY EFFECT,CU.FT= -0.51274E 10
PRECIPITATION,CU.FT= 0.10117E 11

APPENDIX D
SAMPLE OUTPUT

ITERATION NUMBER 743
SIZE OF TIME STEPIN SECONDS= 0.394E 07
DURATION OF PUMPING AT THIS PRINTOUT IN SECONDS= 0.331E 09
MINUTES= 0.552E 07
HOURS= 0.920E 05
DAYS= 3832.500

DRAWDOWN IN FEET(1)

1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	-1.5	-3.5	-6.6	-5.2	0.5	6.9	1.1	-3.3	-8.9	-8.9	-1.8	0.	0.
3	0.	-1.2	-5.3	-8.6	-9.7	-5.7	1.4	6.4	2.6	-3.5	-5.5	-2.1	0.	0.
4	0.	-1.6	-5.6	-9.6	-11.8	-9.6	-3.9	-1.1	5.2	6.1	4.6	-2.1	0.	0.
5	0.	-3.1	-5.9	-8.5	-9.5	-8.2	-5.4	-4.0	-0.4	6.0	9.2	-2.8	0.	0.
6	0.	-5.1	-5.8	-7.7	-6.5	-5.3	-4.3	-2.3	1.1	4.5	7.1	-2.5	0.	0.
7	0.	-3.2	-4.7	-5.4	-5.1	-4.9	-2.4	0.4	1.8	7.9	5.2	-3.0	0.	0.
8	0.	-2.8	-5.1	-4.8	-3.2	-2.7	0.8	3.4	6.6	11.3	7.0	-3.2	0.	0.
9	0.	-3.4	-4.9	-3.3	-2.3	-0.1	3.2	6.4	14.4	14.8	13.0	-3.6	0.	0.
10	0.	-4.0	-5.4	-3.7	-1.4	1.3	6.6	8.3	16.9	16.4	14.9	10.3	-2.0	0.
11	0.	-3.7	-6.1	-5.3	-1.9	3.0	6.1	9.1	20.7	17.8	9.8	5.5	-2.0	0.
12	0.	-3.5	-5.7	-5.0	-2.5	2.2	4.6	7.3	11.7	10.7	4.4	-2.1	-3.3	0.
13	0.	-3.0	-6.2	-5.6	-3.3	1.0	3.9	6.0	9.5	5.1	1.5	-5.2	-2.2	0.
14	0.	-2.0	-6.3	-6.0	-3.0	-0.3	2.5	4.7	5.4	4.5	0.9	-3.6	-2.8	0.
15	0.	-0.7	-5.9	-4.9	-3.5	-0.1	2.6	3.6	4.5	5.3	1.4	0.1	-2.0	0.
16	0.	-2.1	-4.0	-3.2	-1.1	0.6	2.2	6.1	6.5	5.4	1.5	0.7	-2.2	0.
17	0.	-[illegible].1	-1.7	-1.7	-1.1	-0.0	1.7	3.4	5.2	6.6	3.3	0.5	-2.1	0.
18	0.	-0.8	-1.0	-1.9	-1.6	-1.1	-0.4	0.0	1.2	2.8	0.4	-2.5	0.	0.
19	0.	-1.5	-1.2	-1.0	-1.0	-1.8	-1.9	-1.7	-1.5	-1.4	-2.7	-2.2	0.	0.
20	0.	-2.9	-0.8	-1.4	-0.7	-0.5	-2.2	-2.2	-3.6	-3.2	-2.4	-1.9	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

QUANTITY PUMPED ACCORDING TO CONE OF DEPRESSION IN CUBIC FEET = 0.87893E 10
QUANTITY PUMPED ACCORDING TO WELL DISCHARGE IN CUBIC FEET = 0.87890E 10
ESTIMATE FROM PUMPING LESS ESTIMATE FROM DRAWDOWN = -0.26189E 06
DIFFERENCE AS A PERCENT OF VOLUME PUMPED= -0.29797E-02
TIME PERIOD,DAYS= 365.00
NET BOUNDARY EFFECT,CU.FT= -0.12540E 11
PRECIPITATION,CU.FT= 0.21412E 11

ITERATION NUMBER 1287
SIZE OF TIME STEPIN SECONDS= 0.394E 07
DURATION OF PUMPING AT THIS PRINTOUT IN SECONDS= 0.583E 09
MINUTES= 0.972E 07
HOURS= 0.162E 06
DAYS= 6752.500

DRAWDOWN IN FEET(1)

1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	-0.7	-2.5	-5.5	-3.9	2.0	8.4	2.7	-1.4	-6.9	-7.1	-1.0	0.	0.
3	0.	-0.1	-3.8	-6.7	-7.4	-3.2	4.1	9.2	5.7	-0.2	-2.6	-1.1	0.	0.
4	0.	-0.2	-3.6	-7.1	-8.8	-6.2	-0.3	2.6	9.2	10.3	8.3	-1.0	0.	0.
5	0.	-1.3	-3.5	-5.4	-5.9	-4.1	-1.1	0.5	4.3	10.8	13.1	-1.7	0.	0.
6	0.	-2.9	-2.9	-4.1	-2.3	-0.7	0.6	2.8	6.3	9.5	11.2	-1.4	0.	0.
7	0.	-0.8	-1.4	-1.4	-0.5	0.2	3.1	6.0	7.3	13.2	9.5	-1.7	0.	0.
8	0.	-0.1	-1.5	-0.4	1.8	2.9	6.8	9.6	12.6	15.9	11.4	-1.8	0.	0.
9	0.	-0.5	-1.0	1.5	3.3	6.1	10.0	13.6	21.7	21.4	18.4	-1.6	0.	0.
10	0.	-0.9	-1.2	1.6	4.7	8.1	14.2	16.7	27.6	24.9	21.9	14.7	-0.9	0.
11	0.	-0.4	-1.7	0.2	4.6	10.5	14.2	17.9	30.5	26.9	17.9	11.1	-0.8	0.
12	0.	-0.1	-1.1	0.8	4.4	10.1	13.0	16.2	21.1	20.2	12.9	4.2	-1.7	0.
13	0.	0.3	-1.6	0.2	3.8	9.1	12.5	15.0	18.5	14.5	9.9	1.0	-0.5	0.
14	0.	1.0	-1.9	-0.3	4.0	7.8	11.1	13.5	13.8	14.2	9.1	2.2	-0.8	0.
15	0.	2.0	-2.1	0.3	3.1	7.6	11.1	12.4	14.4	15.4	9.5	4.9	-1.0	0.
16	0.	-0.1	-1.0	1.2	4.7	7.6	9.8	13.7	16.1	17.4	9.8	5.2	-1.2	0.
17	0.	-0.9	0.6	1.8	3.6	5.9	8.5	10.9	13.6	15.9	10.0	4.1	-1.3	0.
18	0.	0.1	0.7	0.7	2.0	3.5	5.2	6.4	8.1	9.2	5.1	-1.0	0.	0.
19	0.	-0.9	-0.1	0.7	1.4	1.3	2.2	3.2	3.8	3.5	0.8	-1.3	0.	0.
20	0.	-2.6	-0.3	-0.6	0.4	1.0	-0.2	0.8	-0.1	0.1	-0.5	-1.5	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

QUANTITY PUMPED ACCORDING TO CONE OF DEPRESSION IN CUBIC FEET = 0.18940E 11
QUANTITY PUMPED ACCORDING TO WELL DISCHARGE IN CUBIC FEET = 0.18940E 11
ESTIMATE FROM PUMPING LESS ESTIMATE FROM DRAWDOWN = -17152.
DIFFERENCE AS A PERCENT OF VOLUME PUMPED= -0.90562E-04
TIME PERIOD,DAYS= 365.00
NET BOUNDARY EFFECT,CU.FT= -0.19286E 11
PRECIPITATION,CU.FT= 0.34083E 11