Texas Water Development Board

Summary of a GWSIM-IV Model Run Simulating the Effects of the Edwards Aquifer Authority Critical Period Management Plan for the Regional Water Planning Process

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ASSUMPTIONS USED TO CREATE THE 1999 HDR EDWARDS MODEL RUN

On February 4, 1999, HDR submitted a request on behalf of the Texas Natural Resource Conservation Commission (TNRCC) and the South Central Texas Regional Water Planning Group (Region L) to the Texas Water Development Board (TWDB) for assistance in updating the Edwards Aquifer Model (GWSIM-IV). The TWDB staff conducted the aquifer simulation implementing all the assumptions outlined in HDR's letter. All additional assumptions were coordinated with HDR during the course of this study, and HDR coordinated this with the TNRCC, Edwards Aquifer Authority (EAA), and the South Central Texas RWPG. The assumptions used in the model run are summarized below:

1. Use the **existing version** of the TWDB model GWSIM-IV – the calibrated data set, etc, (excluding the pumpage and recharge data).

2. Edwards Aquifer Authority's **Critical Period Management Plan was simulated** (Table 1). The model simulated reductions in municipal pumpage based on specified trigger levels in three monitoring wells, in accordance with reduction multipliers applied to "winter base" pumpage. In the Model code, reduction multipliers are activated based on heads of three index wells from the previous time step, which then computes monthly pumpage from winter base values and reduction multipliers. A restriction was added in the model code for capping the monthly pumpage derived from winter base to the monthly base municipal value for all cells when reduction multipliers get activated (see item 11 below). The term "winter base" refers to the base withdrawals, determined by the EAA (TAC, §709.15) from withdrawal reports for the three lowest months of November 1995 through February 1996. The period of simulation was 1934 to 1996.

TABLE 1

Critical Period Management Rule for Edwards Aquifer

Area	Stage	Trigger Level	Reduction Multiplier	Trigger Well
East	I	≤ 650	1.7	J-17 Well #68-37-203
	II	≤ 642	1.6	
	III	≤ 636	1.4	
	IV	≤ 632	1.4	
	V	≤ 628	1.4 (used here)	
Medina	I	≤ 670	1.7	Hondo Well #69-47-306
	II	≤ 660	1.6	
	III	≤ 655	1.4	
Uvalde[1]	I	≤ 845	1.7	J-27 Well #69-50-302
	II	≤ 840	1.6	

[1] In the model, 20 ft was subtracted from the cell value (calibration result from previous studies)

3. **Recharge estimates** for the basins/subbasins developed by HDR for the period of 1934-96 were used. Monthly recharge estimates reflect long-term recharge enhancement due to existing projects. The basin/subbasin recharge values were distributed to model cells based on the calibrated data set.

   Hueco Springs discharge was simulated by reducing the recharge in two cells based on a relationship with the index well J-17, as determined by HDR in an earlier study.

4. **Starting condition** of January 1992 was used (existing measured values from a previous simulation study).

5. Edwards Aquifer Authority provided the **basic data regarding the proposed permits** within EAA's boundary – annual withdrawals under proposed permits, municipal winter base values, location, uses type, owner, etc. All users with proposed permit values are included. If a user did not have a permit value, EAA said this meant that no permit value was assigned or offered. The locations (x, y coordinates) not provided by the EAA or not found in the TWDB's Groundwater database (GWDB) were determined from the location of the permit addresses. Each permit location was assigned a row and column by matching the x,y coordinates to the model grid.

   Winter base values were used if they existed for Municipal Users. Eighteen proposed permits had missing winter base values (see item 13 below). Winter base values absent in the original EAA data were calculated from the municipal and industrial distribution factors used for construction of model data files. The permit amount was multiplied by lowest monthly percentage (see Table 4) to obtain an estimated winter base value.

6. **Annual base pumpage of 400,000 acre-feet** (ac-ft) was used for the proposed permits. Limited Kinney County pumpage for all categories is slightly beyond the 400,000 ac-ft cap.

7. Creation of the pumpage data set included adding all 'use type' values together and merging with master well file to break out by permit. If the owner had 5 wells, each permit value was divided by five.

8. Permit values for AG, IRR, IND, and MUN categories added up to 484,699 ac-ft. Annual pumpage limitation of 400,000 acre-feet that was derived per HDR's request. An amount of 12,000 Domestic and stock was added to this amount for a total of 496,699 ac-ft, which is 96,699 over the 400,000 ac-ft limitation. The excess amount of 96,699 ac-ft was subtracted from the total of all irrigation permits. Irrigation permit amounts were reduced proportionally to approximately 59% of the original permit value. The adjusted permit totals and model data file totals are listed in Tables 2 and 3.

Table 2. Comparison of permit values and model file totals.

Use	Permit Values	Model Files
Municipal (excluding SAWS) in ac-ft	71,008	70,959
SAWS in ac-ft	148,074	148,222
Industrial in ac-ft	29,125	29,101
Irrigation in ac-ft	236,492	139,795
Domestic & Livestock (including 300 ac-ft for Kinney county) in ac-ft (* *see item 9 below*)	12,300	12,300
TOTAL in ac-ft	496,999	400,377

Table 3. Model file totals by area.

Area	Category			
	Industrial	Irrigation	Municipal	Total
Atascosa	0	1,946	0	1,946
Bexar[2]	23,884	19,213	45,899	88,995
Comal	1,131	717	8,696	10,544
Hays	1,285	422	6,958	8,665
Medina	1,221	51,294	5,017	57,532
Uvalde	1,581	66,205	4,389	72,175
Saws	40,021	0	108,202	148,222
Total	69,122	139,795	179,161	388,079

[2]SAWS pumpage is not included with Bexar County

9. Domestic and stock totals for the model were taken from *the Edwards aquifer Hydrologic Report for 1997* (EAA 1998) and were included in the total permit values to calculate the Irrigation Reduction amount. The 1995 domestic and stock distribution totaling 11,550 ac-ft was multiplied with a factor of 1.065 to raise this to a 1997 total. Approximately 12,300 ac-ft were assigned to the model for domestic and stock, including 300 ac-ft for Kinney County

10. Kinney County pumpage included 300 ac-ft of domestic and stock, 1,000 ac-ft of municipal and 600 ac-ft of irrigation (EAA 1998). Kinney County Municipal and Irrigation values are taken from EAA's 1997 values. Based on 1994 TWDB irrigation survey, all irrigation pumpage within Kinney County was distributed to a single cell. This coincided with the cell containing the municipal pumpage.

11. Monthly Distribution Factors: Annual pumpage values for use types municipal, industrial, and irrigation were distributed to monthly values based on distribution factors generated from 1978 to 1989 average historical use data used in a previous TWDB simulation study. The distributions were broken by county (see Tables 4 - 6 attached).

12. SAWS usage was distributed by permit location. SAWS pumpage was broken out by use into 73% (residential and apartments) and 27% (industrial and commercial) in anticipation of future model runs using other scenarios. Reduction multipliers were applied towards both fractions of pumpage.

13. Special Permit-Specific Assumptions:

- Municipal Winter Base: City of Castroville (ME00537) did not have a winter base value listed; however, this number was found by looking at the TWDB Water Use Survey Database. The winter base for Castroville was 34.34 ac-ft (11,191,000 gallons) in November 1995. Other permits with missing (nine) winter base values were: BE00149, BE00157, BE00190, BE00219, BE00229, CO00150, HA00236, ME00456, ME00537, and UV00638. The missing municipal winter base use numbers were determined by using maximum amount multiplied by the lowest monthly percentage from municipal and industrial pumpage distribution by County from historical TWDB GWSIM-IV data files. This represents approximately 183.9 acre-feet for the nine permits.

- Accounts with winter base use but without a proposed permit amount were dropped from the base use file. These are: BE00037, BE00065, BE00114, BE00166, BE00283, BE00292, HA00215, HA00218, HA00219, HA00223, HA00228, HA00232, ME00373, ME00393, ME00566, and ME00591. These base use amounts totaled 416.68 acre-feet.

- All permits classified as agricultural (AG) were included with industrial. These Users are ME00495, ME00495, ME00501, BE00043, BE00043, and BE00043, BE00043, BE00043, CO00122, CO00138, CO00138, Driscill Feedlot in Sabinal included in Industrial.

- ME00537 City of Castroville permit was classified as municipal and irrigation; for model run it was classified as municipal use.

- BE00081 Living Water Spring Water was classified as irrigation and industrial was included as Industrial.

- Atascosa County Irrigation permits were distributed using Medina County distribution due to similarity in irrigation practices.

TABLE 4

M&I Pumpage Distribution from Edwards GWSIM Data files 1978 to 1994												
County	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Bexar	6.7%	6.3%	7.3%	8.1%	8.4%	9.1%	11.2%	11.4%	9.1%	8.3%	7.1%	6.9%
Comal	7.1%	6.5%	7.2%	8.2%	8.4%	8.9%	10.4%	11.2%	8.9%	8.5%	7.5%	7.2%
Hays	6.9%	6.8%	7.4%	8.1%	8.2%	8.6%	10.1%	10.7%	9.6%	8.8%	7.7%	7.1%
Kinney	6.8%	6.5%	7.7%	8.4%	8.6%	9.2%	10.8%	11.2%	9.3%	8.0%	6.9%	6.6%
Medina	5.8%	5.6%	6.8%	8.2%	8.9%	10.3%	12.1%	12.1%	9.6%	8.2%	6.4%	6.1%
Uvalde	5.7%	5.7%	8.2%	9.7%	8.9%	9.5%	11.4%	11.5%	9.5%	8.0%	6.3%	5.6%

TABLE 5

Irrigation Pumpage Distribution from Edwards GWSIM Data files 1978 to 1994												
County	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Bexar	4.0%	2.0%	6.0%	7.3%	9.9%	15.1%	13.9%	18.0%	10.6%	8.3%	3.0%	2.0%
Comal	0.0%	0.0%	10.0%	0.0%	0.0%	25.0%	25.0%	25.0%	15.0%	0.0%	0.0%	0.0%
Hays	0.0%	0.0%	10.0%	0.0%	0.0%	25.0%	25.0%	25.0%	15.0%	0.0%	0.0%	0.0%
Kinney	4.0%	2.0%	8.3%	7.0%	6.0%	13.2%	17.8%	15.3%	13.0%	8.4%	3.0%	0.0%
Medina	4.0%	2.0%	6.0%	7.2%	11.0%	14.4%	13.2%	18.2%	10.8%	8.2%	3.0%	2.0%
Uvalde	4.0%	2.0%	8.2%	7.4%	6.5%	15.1%	18.7%	14.4%	10.8%	8.0%	3.0%	2.0%

TABLE 6

SAWS M&I Pumpage Distribution From Edwards GWSIM Data Files 1976 –1990											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
6.8%	6.3%	7.4%	7.9%	8.3%	9.3%	11.0%	11.5%	9.1%	8.3%	7.1%	7.1%

Reference: Edwards Aquifer Authority, 1998, Edwards Aquifer Hydrologic Report for 1997, San Antonio, TX.

DESCRIPTION OF APPENDICIES

Figure 1 shows the Edwards (Balcones Fault Zone) aquifer GWSIM-IV finite difference grid. Appendix 1 contains Figures 2 though 8 which are graphs showing the results of the present model run.

Appendix 2 contains the simulated well levels for the Bexar County Index well (J-17), Medina Index Well (Hondo Well), Uvalde Index Well (J-27). Additionally, Appendix 2 contains the simulated discharges of Comal Springs, San Marcos Springs, San Pedro Springs, and Leona Springs.

The source codes for this run are in Appendix 3.

TWDB staff has produced another run with one variation to the requested model run. This run simulated the effects of not restricting the monthly pumpage value derived from winter base to the monthly base muncipal value for all cells when reduction multipliers were activated (as described in item 2 of the assumptions). Appendix 4 contains graphs of this run (Figures 9-15).

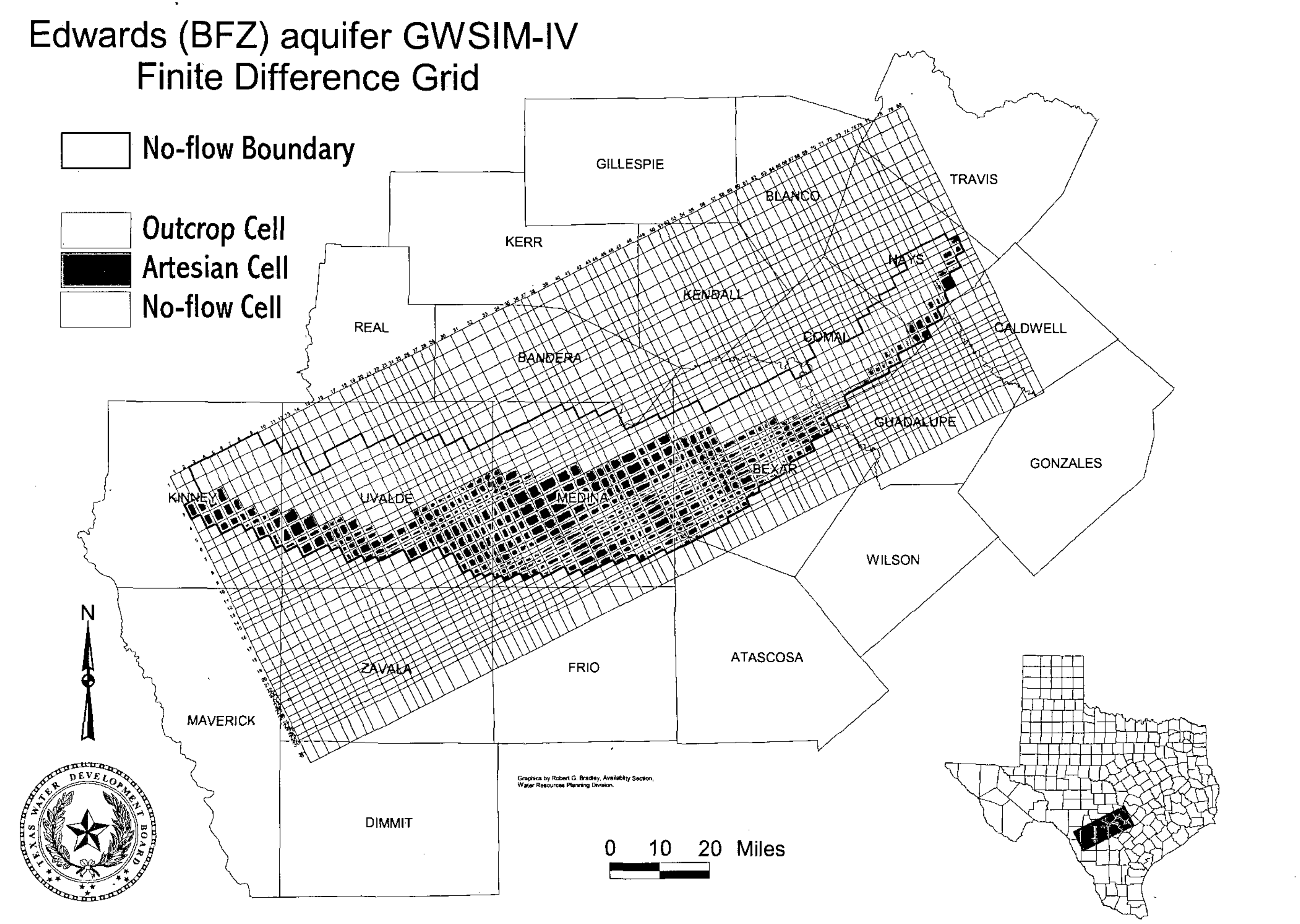

Figure 1. Edwards (Balcones Fault Zone) aquifer GWSIM-IV Finite Difference Grid.

APPENDIX 1

GRAPHED RESULTS OF CRITICAL PERIOD MANAGEMENT PLAN MODEL RUN WHEN PUMPAGE WAS FORCED TO STAY AT 400,000 AC-FT/YR (FIGURES 2-8)

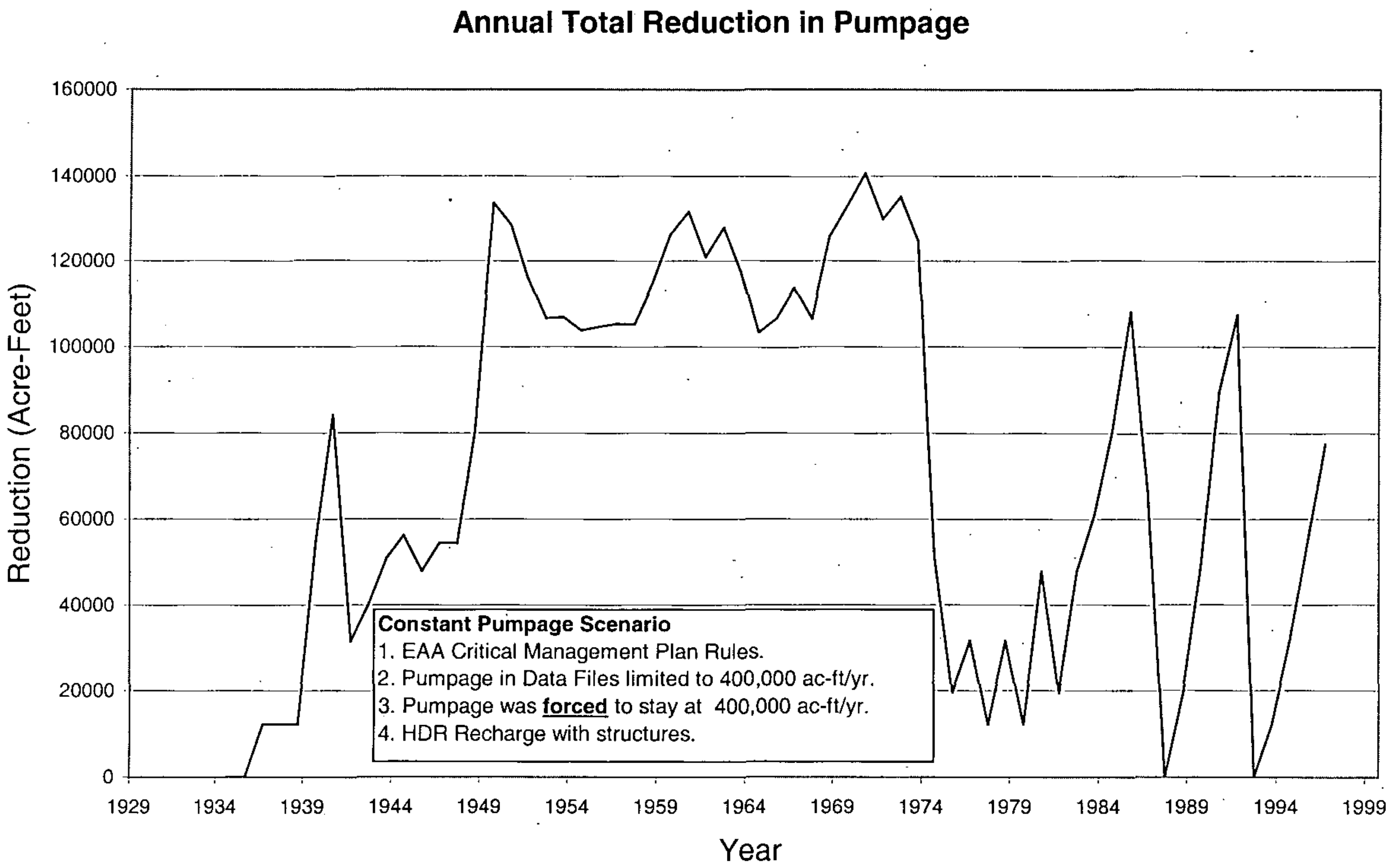

Figure 2. Annual total reduction in pumpage under the Critical Period Management Plan when total pumpage is forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.

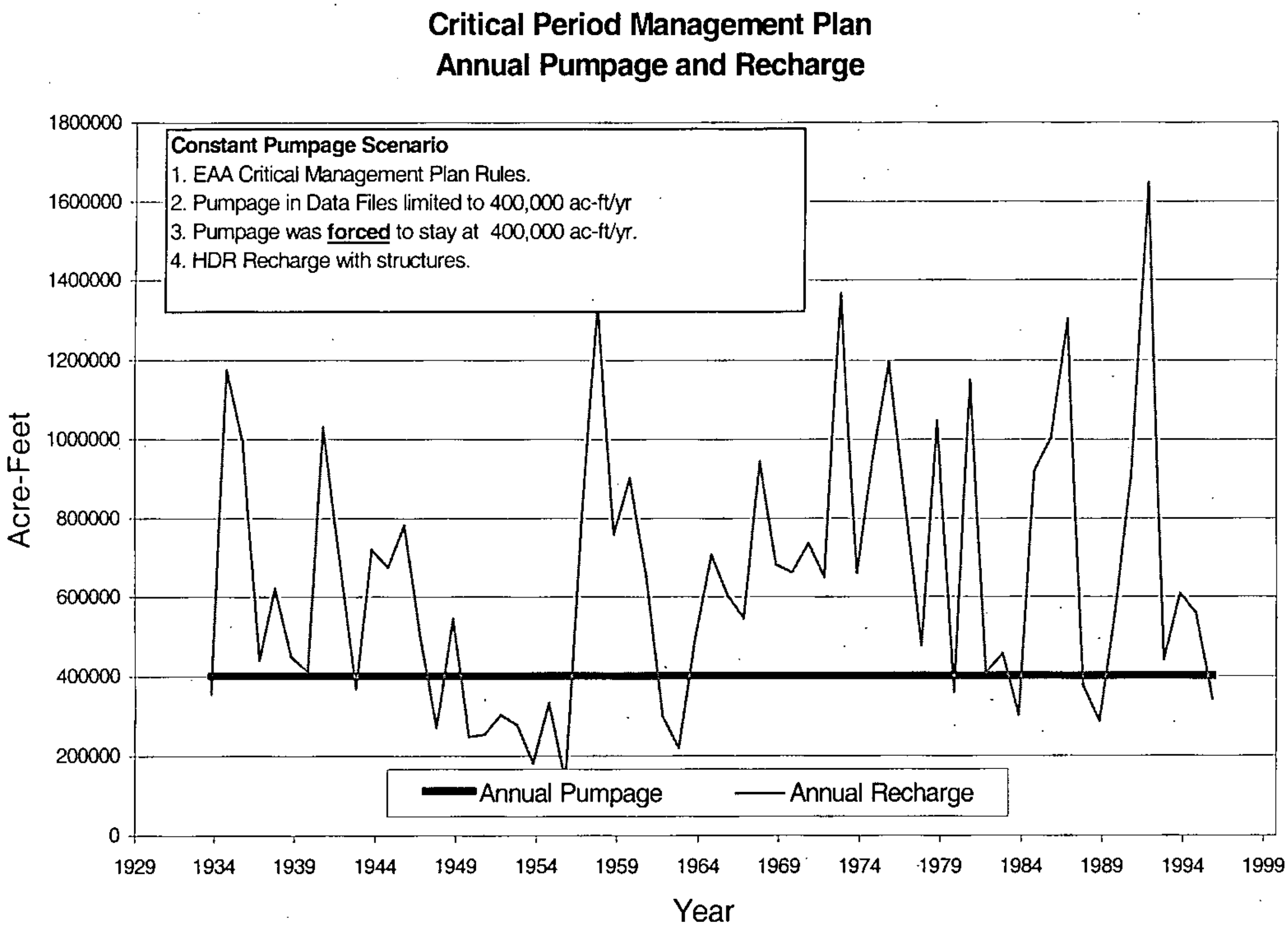

Figure 3. Annual pumpage and recharge under the Critical Period Management Plan when total pumpage is forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.

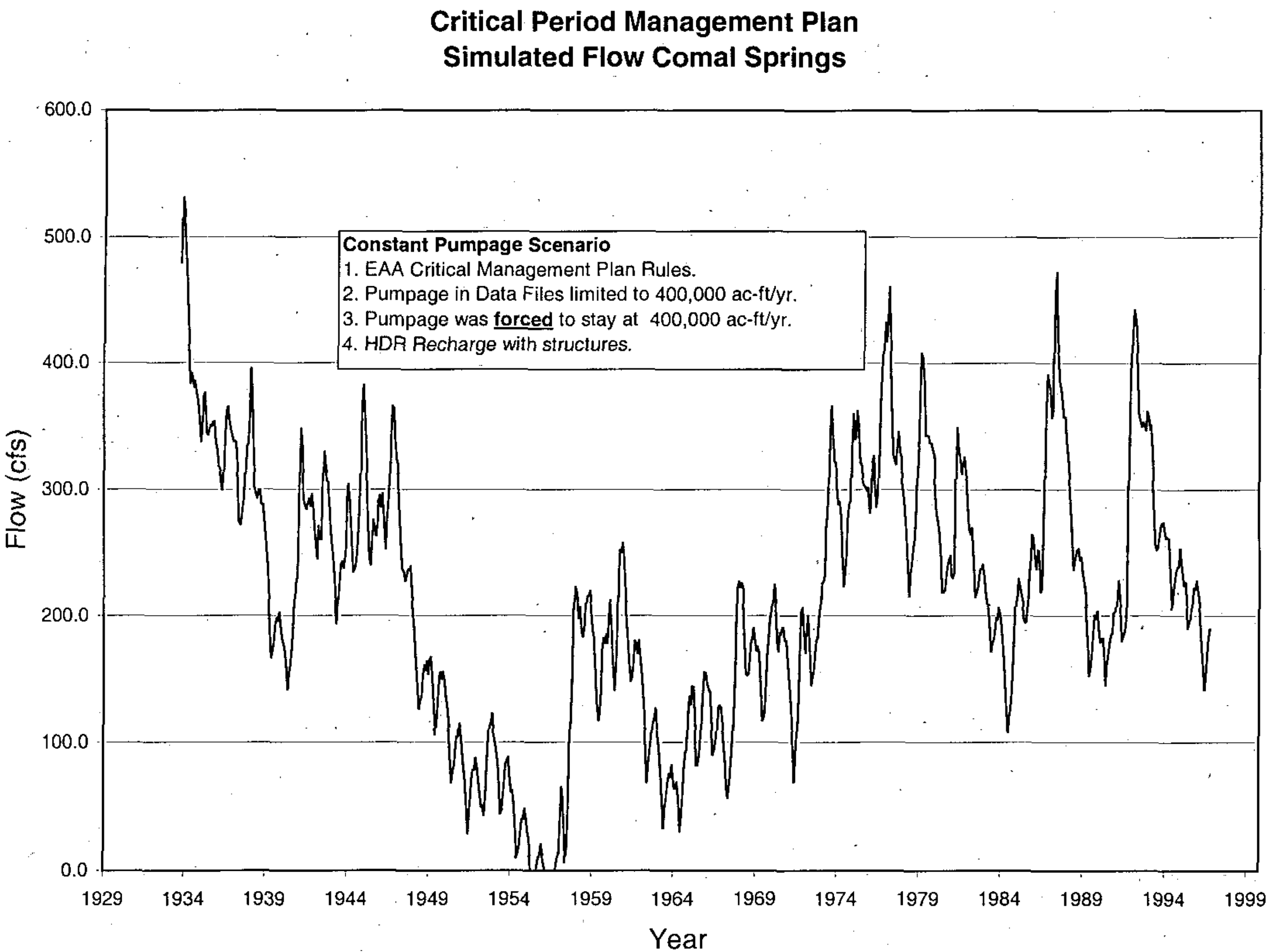

Figure 4. Simulated flow from Comal Springs when total pumpage is forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.

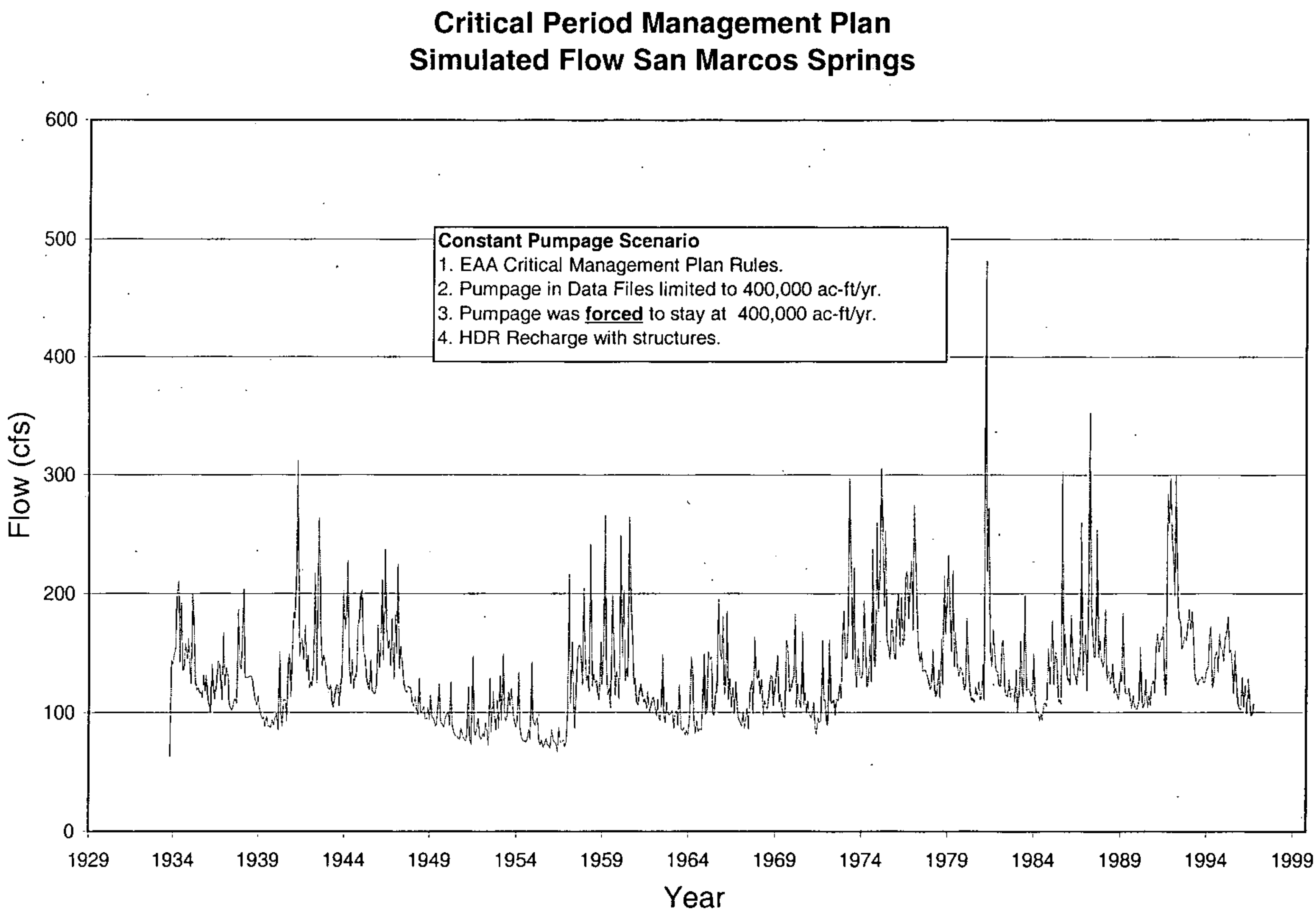

Figure 5. Simulated flow of San Marcos Springs when total pumpage is forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.

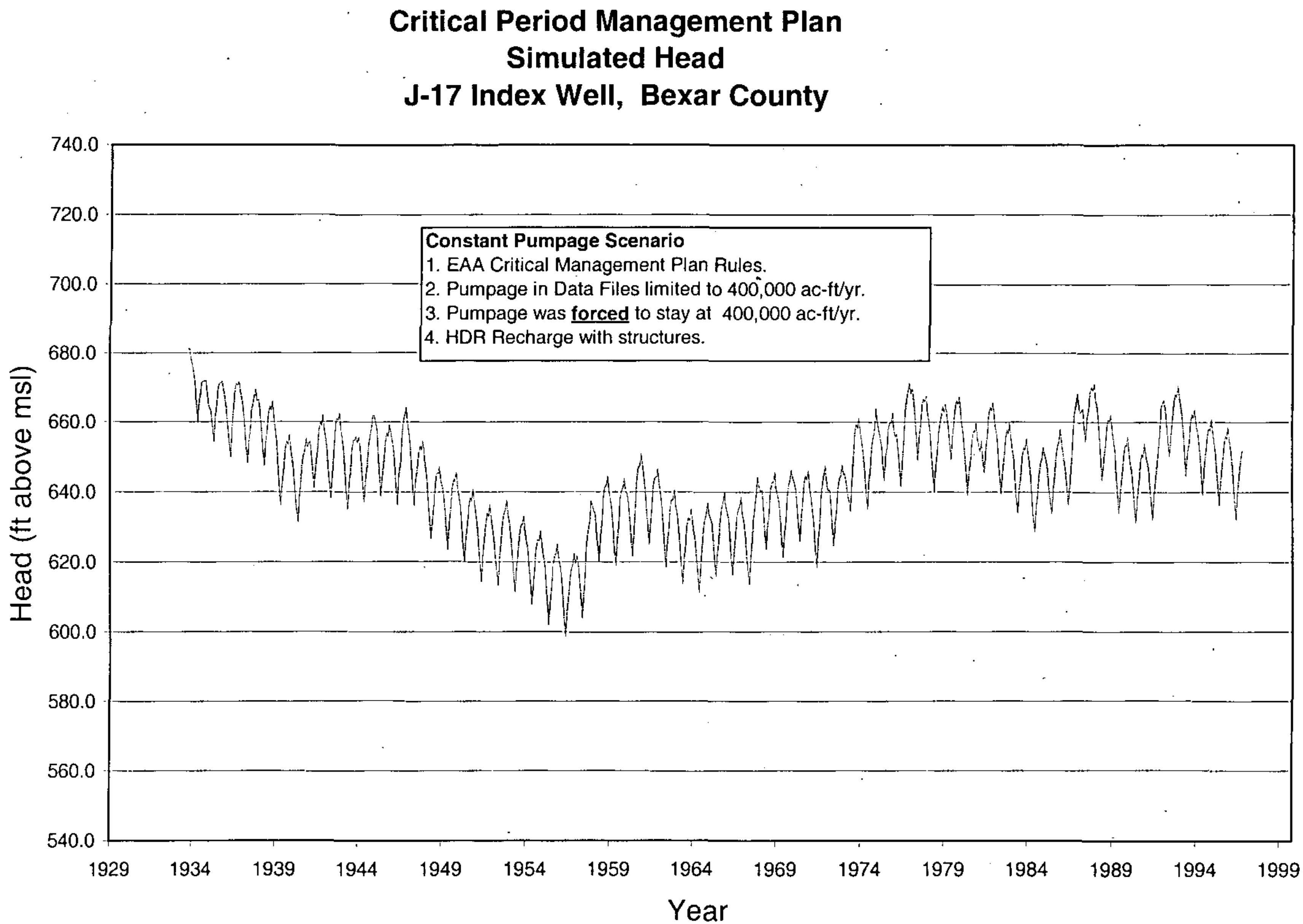

Figure 6. Simulated Head of J-17 index well, Bexar County when total pumpage is forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.

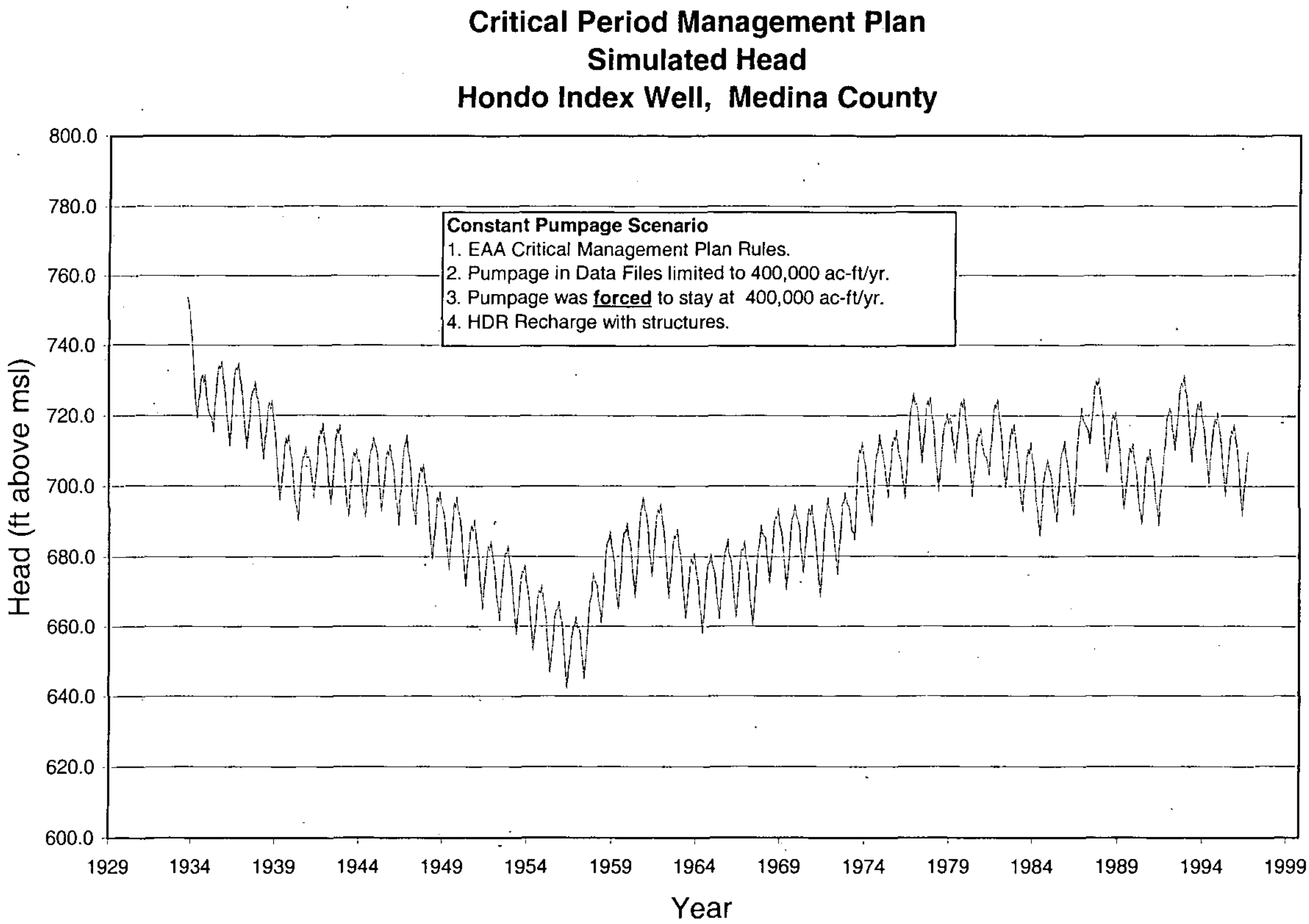

Figure 7. Simulated head of the Hondo index well, Medina County when total pumpage is forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.

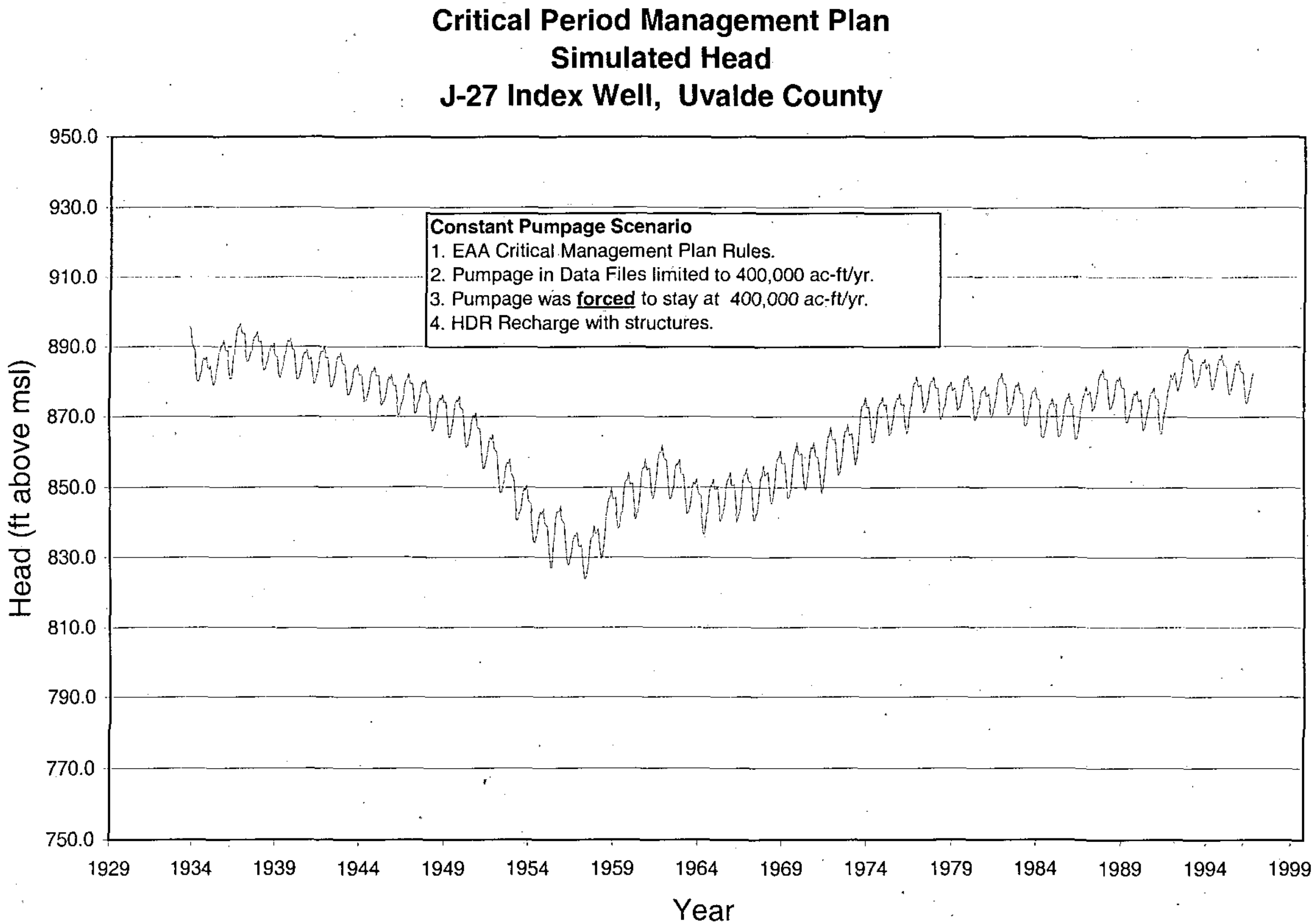

Figure 8. Simulated head of the J-27 index well, Uvalde County when total pumpage is forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.

APPENDIX 2

MODEL RUN RESULTS

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
1	Jan. 1, 1934	681.4	754.0	895.8	29,167.1	3,861.8	1,108.7	1,660.3
2	Feb. 1, 1934	681.2	751.8	895.0	32,307.3	8,769.4	1,091.4	1,658.5
3	Mar. 1, 1934	678.7	745.7	890.7	31,650.9	8,546.2	945.8	1,342.8
4	April 1, 1934	676.7	742.1	889.6	30,219.7	9,054.2	825.3	1,219.1
5	May 1, 1934	674.7	737.4	889.0	28,628.6	9,381.0	713.1	1,156.0
6	Jun. 1, 1934	671.7	730.2	883.8	26,861.1	12,074.8	550.6	791.6
7	Jul. 1, 1934	666.2	725.1	880.0	25,298.4	12,817.3	310.1	506.0
8	Aug. 1, 1934	660.3	719.1	880.0	23,360.9	8,650.3	55.6	471.5
9	Sept. 1, 1934	666.3	724.0	881.5	23,834.7	11,694.3	227.6	546.3
10	Oct. 1, 1934	668.1	726.0	882.7	23,659.1	8,250.3	346.9	639.3
11	Nov. 1, 1934	671.6	730.7	885.5	23,174.3	8,332.6	503.5	838.0
12	Dec. 1, 1934	671.9	731.7	886.6	23,456.6	9,644.7	535.9	935.5
13	Jan. 1, 1935	671.7	729.4	885.9	22,866.4	8,818.6	510.9	905.0
14	Feb. 1, 1935	672.2	731.8	887.0	22,536.2	9,916.2	560.6	973.6
15	Mar. 1, 1935	669.0	726.4	883.7	21,630.5	8,329.2	428.7	763.1
16	April 1, 1935	665.7	723.4	883.2	20,555.9	7,577.4	260.5	694.2
17	May 1, 1935	664.1	721.1	884.4	21,177.2	12,148.3	143.6	710.0
18	Jun. 1, 1935	663.4	719.9	880.5	22,718.3	10,513.2	74.1	496.9
19	Jul. 1, 1935	659.3	719.5	878.7	22,904.6	7,747.1	9.6	362.0
20	Aug. 1, 1935	654.2	715.2	880.0	20,975.6	7,236.4	0.0	443.2
21	Sept. 1, 1935	661.4	722.1	882.7	20,881.3	7,384.7	18.9	599.6
22	Oct. 1, 1935	664.8	726.0	885.1	21,055.6	7,086.8	168.3	783.4
23	Nov. 1, 1935	670.0	732.1	888.7	21,322.5	7,163.6	406.2	1,055.2
24	Dec. 1, 1935	671.2	734.4	890.4	21,278.6	6,861.5	498.6	1,203.8
25	Jan. 1, 1936	671.3	733.4	890.3	21,474.9	8,042.1	500.7	1,214.5
26	Feb. 1, 1936	672.1	735.6	891.8	21,484.5	7,192.5	549.2	1,317.9
27	Mar. 1, 1936	669.3	731.0	888.9	20,528.2	8,022.4	432.3	1,134.2
28	April 1, 1936	667.0	728.7	888.6	20,129.6	6,805.4	300.3	1,094.4
29	May 1, 1936	663.9	725.2	888.6	19,377.3	6,490.0	162.9	1,085.0
30	Jun. 1, 1936	659.8	719.8	883.9	19,177.9	6,092.5	13.7	765.2
31	Jul. 1, 1936	654.5	716.3	880.6	18,588.3	8,609.1	0.0	520.8
32	Aug. 1, 1936	649.8	711.3	881.0	18,237.0	7,385.2	0.0	512.4
33	Sept. 1, 1936	658.7	718.8	886.3	19,553.1	6,754.4	0.0	720.7
34	Oct. 1, 1936	663.2	723.9	889.4	20,709.1	7,677.5	88.4	1,029.0
35	Nov. 1, 1936	669.3	731.0	893.4	21,963.9	8,739.8	346.8	1,334.1
36	Dec. 1, 1936	671.1	733.9	895.4	22,221.6	8,666.1	482.4	1,511.6
37	Jan. 1, 1937	670.6	732.9	895.3	21,540.5	7,829.8	477.2	1,535.6
38	Feb. 1, 1937	671.9	735.2	896.8	21,155.9	6,712.3	527.2	1,640.8
39	Mar. 1, 1937	668.9	730.9	894.0	20,869.8	10,183.5	411.7	1,459.3
40	April 1, 1937	666.8	729.0	893.8	20,564.1	7,456.7	297.5	1,423.0
41	May 1, 1937	664.6	726.0	893.8	20,550.6	8,424.1	190.3	1,416.9
42	Jun. 1, 1937	659.8	720.1	889.0	20,485.9	7,928.3	21.9	1,094.3
43	Jul. 1, 1937	653.9	716.1	885.6	19,017.5	6,575.9	0.0	825.9
44	Aug. 1, 1937	648.2	710.6	885.9	16,723.2	6,312.4	0.0	809.6

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
45	Sept. 1, 1937	654.9	716.1	887.3	16,551.9	6,221.5	0.0	905.2
46	Oct. 1, 1937	657.9	718.9	888.7	16,643.8	6,565.5	0.0	1,012.0
47	Nov. 1, 1937	663.5	724.8	891.6	17,384.8	6,831.1	103.3	1,222.6
48	Dec. 1, 1937	665.6	727.0	892.8	17,853.5	6,573.4	217.6	1,332.6
49	Jan. 1, 1938	667.6	727.3	892.8	18,930.6	11,385.8	262.0	1,329.7
50	Feb. 1, 1938	669.6	730.0	894.4	20,315.6	8,607.9	411.7	1,443.3
51	Mar. 1, 1938	666.1	725.8	891.4	20,434.7	8,306.6	277.3	1,262.2
52	April 1, 1938	666.5	724.9	891.3	21,887.0	9,936.7	207.0	1,226.1
53	May 1, 1938	664.0	722.5	891.4	24,082.7	12,412.2	149.2	1,227.2
54	Jun. 1, 1938	658.8	716.8	886.6	22,860.1	7,911.6	17.1	909.8
55	Jul. 1, 1938	652.6	712.6	883.1	20,245.7	7,886.6	0.0	644.8
56	Aug. 1, 1938	647.4	707.5	883.4	18,374.8	7,906.7	0.0	627.7
57	Sept. 1, 1938	654.4	713.2	884.9	18,010.7	7,944.5	0.0	720.4
58	Oct. 1, 1938	657.3	716.0	886.3	17,834.3	7,965.9	0.0	831.0
59	Nov. 1, 1938	662.8	721.8	889.2	18,232.0	7,780.3	75.6	1,043.5
60	Dec. 1, 1938	664.6	724.0	890.4	18,258.1	7,300.9	177.0	1,149.5
61	Jan. 1, 1939	663.4	721.8	889.7	17,556.4	6,720.4	127.6	1,122.1
62	Feb. 1, 1939	666.1	724.8	891.0	17,518.6	6,467.4	243.0	1,197.6
63	Mar. 1, 1939	661.0	719.2	887.7	16,739.6	6,972.8	56.6	992.3
64	April 1, 1939	657.9	716.7	887.2	15,856.5	6,303.3	0.5	928.7
65	May 1, 1939	654.3	712.7	886.8	14,754.3	5,985.3	0.0	895.8
66	Jun. 1, 1939	647.7	705.4	881.6	13,320.5	5,735.4	0.0	564.0
67	Jul. 1, 1939	641.4	701.2	881.1	11,658.0	5,878.3	0.0	401.5
68	Aug. 1, 1939	636.1	696.0	882.6	10,158.4	5,371.0	0.0	512.1
69	Sept. 1, 1939	643.1	702.2	884.7	10,511.0	5,920.3	0.0	640.1
70	Oct. 1, 1939	646.4	705.3	887.3	10,872.3	5,397.3	0.0	797.0
71	Nov. 1, 1939	652.1	711.3	890.4	11,628.3	5,399.8	0.0	1,052.0
72	Dec. 1, 1939	654.7	713.9	891.7	12,045.0	5,298.0	0.0	1,172.1
73	Jan. 1, 1940	653.4	712.0	891.2	11,934.8	5,737.7	0.0	1,155.1
74	Feb. 1, 1940	656.6	715.0	892.5	12,320.0	5,441.1	0.0	1,236.1
75	Mar. 1, 1940	652.1	710.1	889.3	11,653.6	5,754.4	0.0	1,035.4
76	April 1, 1940	649.3	707.8	888.9	11,057.2	6,063.3	0.0	979.5
77	May 1, 1940	646.2	704.4	889.0	10,767.1	5,209.9	0.0	968.4
78	Jun. 1, 1940	640.8	698.3	884.1	10,367.6	9,230.6	0.0	658.6
79	Jul. 1, 1940	635.9	694.9	880.5	9,744.4	6,061.8	0.0	423.9
80	Aug. 1, 1940	631.3	690.1	880.7	8,618.9	5,374.9	0.0	407.6
81	Sept. 1, 1940	638.5	696.2	882.3	9,279.1	6,790.1	0.0	491.4
82	Oct. 1, 1940	641.9	699.4	883.9	9,836.4	6,744.5	0.0	591.1
83	Nov. 1, 1940	647.7	705.4	886.9	10,446.6	5,634.8	0.0	794.6
84	Dec. 1, 1940	650.5	708.4	888.3	11,465.3	8,768.7	0.0	909.9
85	Jan. 1, 1941	651.9	708.3	887.9	12,768.8	9,104.7	0.0	903.0
86	Feb. 1, 1941	655.3	711.5	889.2	13,727.0	6,897.6	0.0	994.9
87	Mar. 1, 1941	652.7	708.0	886.2	14,130.9	8,994.9	0.0	804.1
88	April 1, 1941	654.1	708.6	886.2	16,269.7	11,248.5	0.0	771.4
89	May 1, 1941	654.4	707.7	886.8	19,474.0	10,893.6	0.0	799.1

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
90	Jun. 1, 1941	650.0	703.4	882.3	21,161.7	13,860.9	0.0	548.8
91	Jul. 1, 1941	645.9	701.3	879.2	20,285.2	19,004.4	0.0	347.3
92	Aug. 1, 1941	641.0	696.7	879.7	17,811.2	8,943.6	0.0	355.1
93	Sept. 1, 1941	648.1	703.2	881.9	17,497.9	9,664.1	0.0	466.2
94	Oct. 1, 1941	651.5	706.8	883.8	17,312.8	9,925.3	0.0	594.7
95	Nov. 1, 1941	657.1	713.1	887.2	17,614.3	8,790.2	0.0	829.8
96	Dec. 1, 1941	659.9	716.3	888.8	17,809.1	10,572.8	0.0	968.2
97	Jan. 1, 1942	658.9	714.6	888.4	17,455.6	8,154.4	0.0	968.0
98	Feb. 1, 1942	662.1	718.1	890.0	18,052.6	9,048.0	50.7	1,067.2
99	Mar. 1, 1942	657.8	713.5	887.0	17,320.1	7,335.6	3.1	885.3
100	April 1, 1942	655.5	711.7	886.7	16,152.2	7,720.7	0.0	839.2
101	May 1, 1942	652.1	708.5	886.6	15,546.3	7,421.9	0.0	829.5
102	Jun. 1, 1942	646.6	702.2	881.7	14,910.8	8,455.6	0.0	533.2
103	Jul. 1, 1942	642.3	699.2	878.1	16,484.9	13,202.9	0.0	299.3
104	Aug. 1, 1942	638.1	694.7	878.4	15,853.0	7,584.7	0.0	285.3
105	Sept. 1, 1942	646.1	701.4	880.6	15,848.3	12,690.7	0.0	388.3
106	Oct. 1, 1942	652.1	706.4	882.6	18,636.5	16,079.1	0.0	520.4
107	Nov. 1, 1942	658.9	713.5	886.0	20,041.5	10,208.8	0.0	746.1
108	Dec. 1, 1942	661.2	716.3	887.5	19,450.1	8,445.1	26.3	882.0
109	Jan. 1, 1943	660.5	714.7	887.0	18,707.8	9,047.0	4.3	876.6
110	Feb. 1, 1943	662.7	717.6	888.4	18,599.4	8,597.3	84.5	967.6
111	Mar. 1, 1943	657.8	712.6	885.3	17,217.8	7,557.8	5.4	771.8
112	April 1, 1943	655.0	710.4	885.0	16,203.6	7,331.9	0.0	721.6
113	May 1, 1943	651.9	707.1	884.8	15,405.8	7,288.9	0.0	707.5
114	Jun. 1, 1943	646.0	700.4	879.8	14,596.4	7,561.7	0.0	418.5
115	Jul. 1, 1943	640.3	696.6	876.1	13,358.3	6,591.2	0.0	182.3
116	Aug. 1, 1943	635.0	691.3	876.3	11,800.4	6,362.3	0.0	161.0
117	Sept. 1, 1943	642.4	697.3	877.9	12,745.8	7,183.7	0.0	243.6
118	Oct. 1, 1943	646.3	700.8	879.7	13,683.8	7,542.2	0.0	349.3
119	Nov. 1, 1943	652.3	707.0	882.8	14,620.1	7,442.7	0.0	541.8
120	Dec. 1, 1943	654.9	709.7	884.0	14,788.4	6,434.8	0.0	641.2
121	Jan. 1, 1944	654.8	708.2	883.5	14,452.2	7,587.1	0.0	623.5
122	Feb. 1, 1944	656.0	710.8	885.0	14,945.2	7,997.3	0.0	708.9
123	Mar. 1, 1944	654.0	706.9	882.0	15,550.2	12,350.9	0.0	543.4
124	April 1, 1944	655.8	707.7	881.9	17,638.5	10,341.0	0.0	513.7
125	May 1, 1944	652.8	704.9	881.9	18,490.0	11,258.6	0.0	518.1
126	Jun. 1, 1944	647.8	699.4	877.4	17,740.8	13,888.4	0.0	260.2
127	Jul. 1, 1944	642.3	696.0	874.0	16,241.1	8,332.5	0.0	48.8
128	Aug. 1, 1944	637.0	691.0	874.5	14,278.4	7,551.5	0.0	40.8
129	Sept. 1, 1944	644.3	697.3	876.4	14,388.0	8,834.4	0.0	143.8
130	Oct. 1, 1944	647.7	700.8	878.2	14,590.1	7,315.1	0.0	259.6
131	Nov. 1, 1944	653.5	706.9	881.4	15,308.5	8,087.9	0.0	456.5
132	Dec. 1, 1944	656.3	710.1	882.9	16,323.4	7,883.9	0.0	564.7
133	Jan. 1, 1945	658.5	710.8	882.9	17,528.5	10,506.4	0.0	573.5
134	Feb. 1, 1945	662.0	714.0	884.4	19,489.8	10,917.6	41.6	672.8

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
135	Mar. 1, 1945	662.1	711.9	881.5	22,065.8	12,120.5	15.0	518.9
136	April 1, 1945	660.2	711.2	881.5	23,260.5	12,384.2	4.8	500.0
137	May 1, 1945	658.0	708.9	881.7	22,042.6	9,271.8	0.0	511.6
138	Jun. 1, 1945	651.4	702.7	876.8	19,823.2	8,817.1	0.0	245.9
139	Jul. 1, 1945	644.9	698.5	873.2	17,293.4	7,819.6	0.0	28.7
140	Aug. 1, 1945	638.8	692.8	873.5	14,919.1	7,430.1	0.0	9.2
141	Sept. 1, 1945	645.4	698.4	875.1	14,620.5	7,262.5	0.0	86.7
142	Oct. 1, 1945	648.9	701.6	876.7	15,824.5	8,813.4	0.0	186.3
143	Nov. 1, 1945	654.6	707.7	879.9	16,785.6	7,260.7	0.0	376.0
144	Dec. 1, 1945	657.0	710.3	881.2	16,388.9	7,071.7	0.0	476.8
145	Jan. 1, 1946	655.8	708.6	880.7	16,010.0	7,078.4	0.0	466.5
146	Feb. 1, 1946	659.4	712.0	882.1	16,682.4	7,633.6	0.0	540.3
147	Mar. 1, 1946	657.0	708.1	879.0	17,674.0	10,536.5	0.0	380.2
148	April 1, 1946	654.9	706.8	878.6	17,954.1	8,369.0	0.0	339.6
149	May 1, 1946	652.3	703.7	878.9	17,400.6	9,422.4	0.0	339.1
150	Jun. 1, 1946	647.0	697.8	874.4	18,041.9	12,897.1	0.0	89.4
151	Jul. 1, 1946	641.1	693.8	870.3	16,650.3	8,762.8	0.0	0.1
152	Aug. 1, 1946	636.1	688.7	870.8	15,399.7	14,458.8	0.0	0.0
153	Sept. 1, 1946	644.6	695.6	872.9	16,830.5	10,396.3	0.0	0.0
154	Oct. 1, 1946	648.6	699.6	875.2	17,596.9	9,330.0	0.0	73.8
155	Nov. 1, 1946	656.0	706.7	878.7	18,544.5	9,810.8	0.0	293.8
156	Dec. 1, 1946	660.5	711.1	880.3	21,051.9	8,425.0	0.0	415.7
157	Jan. 1, 1947	662.1	712.1	880.5	22,217.5	10,888.2	44.7	434.0
158	Feb. 1, 1947	664.4	714.8	882.3	22,097.5	7,777.7	173.8	537.5
159	Mar. 1, 1947	659.9	710.0	879.5	20,711.2	11,096.8	19.7	399.8
160	April 1, 1947	656.9	708.0	879.3	19,649.6	9,078.0	0.0	372.6
161	May 1, 1947	653.6	704.5	879.3	19,401.2	13,694.9	0.0	368.2
162	Jun. 1, 1947	647.0	697.7	874.6	17,685.4	8,340.0	0.0	105.2
163	Jul. 1, 1947	641.2	693.8	870.8	15,674.2	9,485.4	0.0	0.3
164	Aug. 1, 1947	636.1	688.7	871.3	14,432.0	8,712.7	0.0	0.0
165	Sept. 1, 1947	642.8	694.6	873.4	14,279.6	7,627.7	0.0	0.0
166	Oct. 1, 1947	645.5	697.4	875.2	13,850.8	7,228.0	0.0	84.8
167	Nov. 1, 1947	651.0	703.3	878.4	14,055.3	7,118.8	0.0	278.5
168	Dec. 1, 1947	653.2	705.7	879.7	14,405.0	7,475.2	0.0	375.5
169	Jan. 1, 1948	651.8	703.6	879.0	14,362.7	7,342.2	0.0	357.7
170	Feb. 1, 1948	654.9	706.5	880.3	14,546.8	7,405.5	0.0	422.9
171	Mar. 1, 1948	650.0	701.5	876.9	13,549.2	6,668.5	0.0	251.9
172	April 1, 1948	647.1	699.1	876.4	12,531.0	6,390.5	0.0	198.2
173	May 1, 1948	643.5	695.3	876.1	11,529.7	6,948.6	0.0	172.4
174	Jun. 1, 1948	637.2	688.2	870.2	10,130.3	6,264.9	0.0	3.3
175	Jul. 1, 1948	631.3	684.1	866.1	8,850.3	5,967.5	0.0	0.0
176	Aug. 1, 1948	626.5	679.2	866.2	7,683.5	7,885.2	0.0	0.0
177	Sept. 1, 1948	633.4	685.2	868.1	8,011.7	6,075.6	0.0	0.0
178	Oct. 1, 1948	636.6	688.4	870.1	8,280.3	6,166.0	0.0	0.0
179	Nov. 1, 1948	642.5	694.4	873.9	9,217.2	6,399.4	0.0	16.3

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
180	Dec. 1, 1948	645.2	697.2	875.3	9,764.2	5,752.1	0.0	103.2
181	Jan. 1, 1949	645.2	695.6	874.7	9,546.4	5,759.1	0.0	88.6
182	Feb. 1, 1949	647.1	698.6	876.3	9,967.7	6,373.6	0.0	166.1
183	Mar. 1, 1949	643.0	694.2	873.9	9,345.7	5,729.2	0.0	32.7
184	April 1, 1949	641.8	692.9	873.9	9,998.1	7,038.0	0.0	24.5
185	May 1, 1949	639.2	690.5	874.1	10,144.7	5,814.0	0.0	35.3
186	Jun. 1, 1949	634.1	684.8	868.3	9,252.9	5,799.9	0.0	0.0
187	Jul. 1, 1949	628.8	681.2	864.1	7,954.6	5,395.1	0.0	0.0
188	Aug. 1, 1949	623.6	676.0	864.5	6,482.8	5,487.5	0.0	0.0
189	Sept. 1, 1949	630.7	682.1	866.7	7,173.0	6,538.2	0.0	0.0
190	Oct. 1, 1949	634.6	685.8	868.8	8,326.2	7,596.6	0.0	0.0
191	Nov. 1, 1949	641.0	692.5	873.0	9,230.3	5,600.8	0.0	0.0
192	Dec. 1, 1949	643.6	695.3	874.7	9,417.2	5,526.5	0.0	56.9
193	Jan. 1, 1950	642.9	693.8	874.3	9,093.9	5,331.8	0.0	58.3
194	Feb. 1, 1950	645.9	697.1	875.9	9,453.5	5,799.1	0.0	140.8
195	Mar. 1, 1950	641.6	692.5	872.6	9,057.2	5,997.9	0.0	8.4
196	April 1, 1950	638.7	690.3	872.2	8,302.8	6,128.5	0.0	0.0
197	May 1, 1950	636.1	686.9	871.9	7,688.7	5,420.4	0.0	0.0
198	Jun. 1, 1950	630.2	680.6	865.9	6,990.4	7,716.0	0.0	0.0
199	Jul. 1, 1950	624.5	676.5	861.4	5,533.9	5,471.4	0.0	0.0
200	Aug. 1, 1950	619.8	671.4	861.4	4,207.3	5,043.0	0.0	0.0
201	Sept. 1, 1950	626.7	677.4	863.2	4,691.8	4,917.1	0.0	0.0
202	Oct. 1, 1950	629.9	680.4	864.9	5,031.6	4,916.6	0.0	0.0
203	Nov. 1, 1950	636.0	686.6	868.7	5,804.6	4,785.0	0.0	0.0
204	Dec. 1, 1950	638.4	689.1	870.3	6,345.2	4,729.4	0.0	0.0
205	Jan. 1, 1951	637.2	687.2	869.5	6,359.8	5,344.0	0.0	0.0
206	Feb. 1, 1951	640.8	690.6	871.2	6,951.2	4,883.4	0.0	0.0
207	Mar. 1, 1951	636.6	685.9	867.1	6,587.6	4,752.2	0.0	0.0
208	April 1, 1951	633.8	683.6	866.3	5,863.7	4,633.5	0.0	0.0
209	May 1, 1951	630.3	680.1	866.4	5,054.3	4,997.9	0.0	0.0
210	Jun. 1, 1951	625.0	673.9	860.0	4,362.5	7,420.8	0.0	0.0
211	Jul. 1, 1951	619.6	670.0	855.1	3,230.6	4,778.8	0.0	0.0
212	Aug. 1, 1951	614.3	664.7	855.4	1,787.1	4,460.4	0.0	0.0
213	Sept. 1, 1951	621.6	670.8	857.2	2,697.9	8,965.7	0.0	0.0
214	Oct. 1, 1951	625.3	674.2	858.8	3,539.8	5,177.4	0.0	0.0
215	Nov. 1, 1951	631.1	680.2	862.5	4,305.8	4,928.7	0.0	0.0
216	Dec. 1, 1951	634.0	683.2	864.1	4,775.5	5,427.6	0.0	0.0
217	Jan. 1, 1952	633.0	681.6	863.3	4,798.5	5,822.1	0.0	0.0
218	Feb. 1, 1952	636.5	684.7	865.0	5,337.8	4,858.6	0.0	0.0
219	Mar. 1, 1952	632.3	680.2	860.8	4,940.3	4,738.4	0.0	0.0
220	April 1, 1952	629.7	678.0	860.2	4,304.1	5,072.6	0.0	0.0
221	May 1, 1952	626.4	674.6	860.0	3,689.4	4,869.1	0.0	0.0
222	Jun. 1, 1952	621.4	668.6	853.5	3,044.1	5,618.4	0.0	0.0
223	Jul. 1, 1952	617.3	665.7	848.7	3,074.1	5,153.2	0.0	0.0
224	Aug. 1, 1952	613.2	661.5	848.5	2,633.7	4,375.9	0.0	0.0

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
225	Sept. 1, 1952	620.9	667.2	850.1	3,640.8	7,872.5	0.0	0.0
226	Oct. 1, 1952	625.4	671.7	851.8	4,917.8	5,085.1	0.0	0.0
227	Nov. 1, 1952	631.8	678.1	855.5	5,909.8	7,205.5	0.0	0.0
228	Dec. 1, 1952	634.1	681.0	857.1	6,797.9	5,945.2	0.0	0.0
229	Jan. 1, 1953	634.9	680.6	856.5	7,038.3	5,222.1	0.0	0.0
230	Feb. 1, 1953	637.7	683.3	858.0	7,432.5	6,751.1	0.0	0.0
231	Mar. 1, 1953	633.2	678.5	853.9	6,588.4	5,273.4	0.0	0.0
232	April 1, 1953	630.6	676.3	853.1	6,212.1	8,005.6	0.0	0.0
233	May 1, 1953	627.5	672.9	852.5	5,808.3	5,663.4	0.0	0.0
234	Jun. 1, 1953	621.8	666.4	845.8	5,267.7	9,089.0	0.0	0.0
235	Jul. 1, 1953	616.3	662.6	840.8	4,220.3	5,893.4	0.0	0.0
236	Aug. 1, 1953	611.3	657.6	840.5	2,719.1	5,645.6	0.0	0.0
237	Sept. 1, 1953	618.0	662.8	842.3	2,868.3	5,988.1	0.0	0.0
238	Oct. 1, 1953	621.6	666.2	844.0	3,383.0	7,205.2	0.0	0.0
239	Nov. 1, 1953	627.8	673.3	848.0	4,168.7	6,445.2	0.0	0.0
240	Dec. 1, 1953	630.6	675.9	849.6	5,056.8	7,352.9	0.0	0.0
241	Jan. 1, 1954	630.7	675.2	849.0	5,226.1	5,983.8	0.0	0.0
242	Feb. 1, 1954	633.3	677.8	850.6	5,393.2	5,629.7	0.0	0.0
243	Mar. 1, 1954	628.8	673.1	846.4	4,516.4	5,345.4	0.0	0.0
244	April 1, 1954	626.0	670.7	845.6	3,756.2	5,744.5	0.0	0.0
245	May 1, 1954	623.5	667.4	845.4	3,814.8	8,190.6	0.0	0.0
246	Jun. 1, 1954	618.2	661.9	838.8	3,234.0	5,338.4	0.0	0.0
247	Jul. 1, 1954	612.7	658.0	834.2	1,947.2	4,846.2	0.0	0.0
248	Aug. 1, 1954	607.7	653.0	834.3	613.0	4,654.7	0.0	0.0
249	Sept. 1, 1954	614.3	658.0	835.9	842.8	4,647.0	0.0	0.0
250	Oct. 1, 1954	617.6	661.1	837.6	1,125.8	4,562.8	0.0	0.0
251	Nov. 1, 1954	623.8	667.1	841.4	1,885.7	4,777.1	0.0	0.0
252	Dec. 1, 1954	626.4	670.5	843.0	2,406.9	5,264.2	0.0	0.0
253	Jan. 1, 1955	625.9	669.4	842.3	2,458.2	4,703.0	0.0	0.0
254	Feb. 1, 1955	629.0	672.2	844.0	2,975.3	8,702.4	0.0	0.0
255	Mar. 1, 1955	624.7	667.6	839.9	2,532.2	5,842.8	0.0	0.0
256	April 1, 1955	622.0	665.6	839.2	1,854.5	5,431.3	0.0	0.0
257	May 1, 1955	619.7	662.5	838.7	1,498.9	5,650.7	0.0	0.0
258	Jun. 1, 1955	613.6	656.3	832.1	554.5	5,848.6	0.0	0.0
259	Jul. 1, 1955	607.7	652.0	827.2	3.1	4,722.7	0.0	0.0
260	Aug. 1, 1955	602.0	646.6	827.0	0.0	4,426.7	0.0	0.0
261	Sept. 1, 1955	608.8	651.7	833.1	0.0	4,711.1	0.0	0.0
262	Oct. 1, 1955	612.4	655.1	836.3	0.0	4,285.5	0.0	0.0
263	Nov. 1, 1955	619.0	661.5	841.0	0.0	4,487.4	0.0	0.0
264	Dec. 1, 1955	621.2	664.5	843.1	462.7	4,795.8	0.0	0.0
265	Jan. 1, 1956	622.4	664.7	843.0	710.7	4,463.8	0.0	0.0
266	Feb. 1, 1956	625.2	667.2	844.8	1,256.8	4,409.7	0.0	0.0
267	Mar. 1, 1956	621.1	663.2	840.8	838.8	4,259.4	0.0	0.0
268	April 1, 1956	618.7	661.1	840.2	451.5	5,265.5	0.0	0.0
269	May 1, 1956	615.9	657.9	839.8	58.0	4,675.9	0.0	0.0

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
270	Jun. 1, 1956	609.5	651.4	833.1	0.0	4,540.7	0.0	0.0
271	Jul. 1, 1956	603.2	647.0	828.2	0.0	4,513.2	0.0	0.0
272	Aug. 1, 1956	598.4	642.0	828.0	0.0	4,068.7	0.0	0.0
273	Sept. 1, 1956	605.8	647.4	829.5	0.0	5,417.7	0.0	0.0
274	Oct. 1, 1956	609.3	650.7	831.2	0.0	4,602.7	0.0	0.0
275	Nov. 1, 1956	615.4	656.8	835.0	0.0	4,568.4	0.0	0.0
276	Dec. 1, 1956	618.3	659.9	836.6	0.0	4,727.3	0.0	0.0
277	Jan. 1, 1957	619.3	660.2	836.0	0.0	4,315.3	0.0	0.0
278	Feb. 1, 1957	622.5	662.9	837.5	430.5	4,658.7	0.0	0.0
279	Mar. 1, 1957	619.4	659.3	833.3	811.9	6,303.5	0.0	0.0
280	April 1, 1957	621.7	660.1	833.0	2,270.2	13,218.6	0.0	0.0
281	May 1, 1957	619.3	657.8	833.6	3,978.9	6,573.1	0.0	0.0
282	Jun. 1, 1957	614.2	652.9	828.2	3,419.6	9,752.5	0.0	0.0
283	Jul. 1, 1957	609.0	649.6	823.9	2,097.5	6,341.7	0.0	0.0
284	Aug. 1, 1957	603.9	644.8	824.1	402.6	5,258.1	0.0	0.0
285	Sept. 1, 1957	611.2	650.4	826.1	1,083.8	7,806.2	0.0	0.0
286	Oct. 1, 1957	616.4	655.0	828.3	3,208.0	9,258.9	0.0	0.0
287	Nov. 1, 1957	624.7	662.8	832.7	6,002.4	9,584.9	0.0	0.0
288	Dec. 1, 1957	628.2	666.9	835.4	7,804.8	9,405.9	0.0	0.0
289	Jan. 1, 1958	631.3	669.1	836.0	9,400.8	7,503.7	0.0	0.0
290	Feb. 1, 1958	637.6	675.6	839.2	12,228.4	12,443.5	0.0	0.0
291	Mar. 1, 1958	636.0	673.1	836.7	13,516.6	9,059.0	0.0	0.0
292	April 1, 1958	634.5	672.6	837.3	13,269.9	7,709.5	0.0	0.0
293	May 1, 1958	633.9	671.7	838.2	12,958.3	8,042.6	0.0	0.0
294	Jun. 1, 1958	628.5	667.2	832.9	12,054.2	7,159.8	0.0	0.0
295	Jul. 1, 1958	624.7	664.9	829.6	12,598.5	14,703.7	0.0	0.0
296	Aug. 1, 1958	620.1	660.8	830.6	11,389.8	7,426.4	0.0	0.0
297	Sept. 1, 1958	627.2	666.8	834.0	11,150.0	8,114.3	0.0	0.0
298	Oct. 1, 1958	631.3	671.7	837.8	11,663.1	7,626.9	0.0	0.0
299	Nov. 1, 1958	638.1	679.8	843.3	12,670.5	7,772.7	0.0	0.0
300	Dec. 1, 1958	641.2	683.7	846.5	13,082.7	7,114.9	0.0	0.0
301	Jan. 1, 1959	641.9	684.7	847.3	13,153.7	6,730.0	0.0	0.0
302	Feb. 1, 1959	644.6	687.5	849.8	13,373.9	9,746.9	0.0	0.0
303	Mar. 1, 1959	640.1	683.1	846.6	12,341.6	7,523.1	0.0	0.0
304	April 1, 1959	637.4	681.2	846.6	11,460.8	9,690.2	0.0	0.0
305	May 1, 1959	634.9	678.4	847.1	11,194.6	16,215.1	0.0	0.0
306	Jun. 1, 1959	628.6	671.9	841.7	9,769.8	8,372.4	0.0	0.0
307	Jul. 1, 1959	623.2	668.5	838.0	8,039.5	6,980.6	0.0	0.0
308	Aug. 1, 1959	618.9	664.6	838.8	7,147.5	7,334.3	0.0	0.0
309	Sept. 1, 1959	625.7	670.6	841.6	7,435.4	6,333.2	0.0	0.0
310	Oct. 1, 1959	630.1	675.2	844.1	8,642.1	12,114.5	0.0	0.0
311	Nov. 1, 1959	637.7	683.2	849.1	10,552.9	9,642.9	0.0	0.0
312	Dec. 1, 1959	640.0	686.7	851.6	11,067.2	6,959.7	0.0	0.0
313	Jan. 1, 1960	641.1	686.9	851.9	10,865.1	8,270.9	0.0	0.0
314	Feb. 1, 1960	643.7	689.9	854.3	11,260.7	7,778.8	0.0	0.0

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
315	Mar. 1, 1960	639.9	685.7	850.8	10,859.9	6,795.4	0.0	0.0
316	April 1, 1960	639.4	684.7	850.8	12,128.7	15,193.2	0.0	0.0
317	May 1, 1960	636.9	682.4	851.1	12,911.3	8,932.0	0.0	0.0
318	Jun. 1, 1960	631.6	676.3	845.1	11,877.9	12,380.6	0.0	0.0
319	Jul. 1, 1960	625.7	672.5	840.8	9,911.2	7,691.6	0.0	0.0
320	Aug. 1, 1960	621.5	668.1	841.6	8,570.0	8,395.3	0.0	0.0
321	Sept. 1, 1960	629.4	675.3	844.3	9,558.1	7,874.0	0.0	0.0
322	Oct. 1, 1960	634.8	680.4	847.1	10,831.8	16,125.5	0.0	0.0
323	Nov. 1, 1960	643.1	688.8	852.1	14,019.7	11,562.7	0.0	0.0
324	Dec. 1, 1960	646.6	692.8	854.9	15,304.2	9,943.5	0.0	0.0
325	Jan. 1, 1961	647.7	693.9	855.5	15,241.3	7,503.5	0.0	0.0
326	Feb. 1, 1961	651.1	697.2	858.0	15,673.4	7,889.3	0.0	0.0
327	Mar. 1, 1961	647.2	693.5	854.8	15,046.6	6,631.7	0.0	0.0
328	April 1, 1961	644.6	691.5	855.2	13,610.1	6,481.7	0.0	0.0
329	May 1, 1961	640.4	688.1	855.5	12,232.3	7,014.3	0.0	0.0
330	Jun. 1, 1961	634.4	681.6	849.7	11,013.7	7,595.5	0.0	0.0
331	Jul. 1, 1961	629.5	678.7	846.7	9,932.3	7,030.5	0.0	0.0
332	Aug. 1, 1961	624.8	674.2	847.6	9,017.5	6,598.7	0.0	0.0
333	Sept. 1, 1961	631.8	680.6	850.2	9,187.8	6,855.5	0.0	0.0
334	Oct. 1, 1961	635.6	684.3	853.0	9,949.8	6,281.5	0.0	0.0
335	Nov. 1, 1961	641.7	690.9	857.6	10,931.6	7,195.3	0.0	0.0
336	Dec. 1, 1961	644.1	693.6	860.0	10,843.6	6,122.4	0.0	0.0
337	Jan. 1, 1962	644.0	692.2	859.8	10,331.0	6,488.1	0.0	0.0
338	Feb. 1, 1962	646.5	695.3	862.0	10,971.7	6,855.6	0.0	0.0
339	Mar. 1, 1962	642.0	690.6	858.3	10,448.3	6,916.1	0.0	0.0
340	April 1, 1962	639.2	688.2	857.9	9,594.0	6,333.8	0.0	0.0
341	May 1, 1962	635.7	684.6	857.6	8,708.5	5,903.1	0.0	0.0
342	Jun. 1, 1962	629.8	677.9	851.3	7,342.0	6,779.6	0.0	0.0
343	Jul. 1, 1962	623.9	673.6	846.6	5,783.2	5,773.0	0.0	0.0
344	Aug. 1, 1962	618.3	668.0	846.9	4,208.4	5,684.8	0.0	0.0
345	Sept. 1, 1962	625.3	673.9	848.7	5,083.1	9,095.8	0.0	0.0
346	Oct. 1, 1962	628.9	677.1	850.6	5,736.6	6,018.2	0.0	0.0
347	Nov. 1, 1962	634.8	683.2	854.8	6,425.3	5,558.3	0.0	0.0
348	Dec. 1, 1962	637.8	686.2	856.7	7,033.6	6,658.7	0.0	0.0
349	Jan. 1, 1963	637.5	685.1	856.2	7,241.6	6,061.7	0.0	0.0
350	Feb. 1, 1963	640.6	688.1	858.0	7,716.4	5,977.8	0.0	0.0
351	Mar. 1, 1963	636.2	683.4	854.1	7,123.7	6,022.5	0.0	0.0
352	April 1, 1963	633.4	681.1	853.6	6,346.1	6,231.0	0.0	0.0
353	May 1, 1963	630.1	677.5	853.6	5,795.8	5,253.7	0.0	0.0
354	Jun. 1, 1963	624.4	671.0	847.3	4,790.6	6,111.5	0.0	0.0
355	Jul. 1, 1963	618.6	666.9	842.6	3,402.9	6,160.7	0.0	0.0
356	Aug. 1, 1963	613.5	662.1	842.6	2,037.4	5,428.1	0.0	0.0
357	Sept. 1, 1963	620.4	667.1	844.2	3,004.6	7,538.8	0.0	0.0
358	Oct. 1, 1963	623.9	670.8	846.0	3,531.9	5,266.7	0.0	0.0
359	Nov. 1, 1963	630.1	677.0	849.7	4,148.1	5,167.3	0.0	0.0

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
360	Dec. 1, 1963	632.6	679.6	851.4	4,599.3	5,365.3	0.0	0.0
361	Jan. 1, 1964	631.6	677.8	850.7	4,457.2	4,933.6	0.0	0.0
362	Feb. 1, 1964	635.2	681.2	852.5	5,035.3	5,209.4	0.0	0.0
363	Mar. 1, 1964	630.9	676.7	848.5	4,584.5	4,939.0	0.0	0.0
364	April 1, 1964	628.2	674.5	847.9	3,905.0	5,755.9	0.0	0.0
365	May 1, 1964	625.8	671.4	847.7	3,917.8	8,982.8	0.0	0.0
366	Jun. 1, 1964	620.9	666.0	841.3	4,204.0	8,332.0	0.0	0.0
367	Jul. 1, 1964	615.9	662.6	836.7	3,354.3	5,757.7	0.0	0.0
368	Aug. 1, 1964	611.0	657.8	836.6	1,875.3	4,993.7	0.0	0.0
369	Sept. 1, 1964	618.5	663.4	840.2	2,517.8	5,727.0	0.0	0.0
370	Oct. 1, 1964	622.9	667.5	843.4	3,621.0	5,128.0	0.0	0.0
371	Nov. 1, 1964	629.5	675.0	848.1	4,826.0	5,266.2	0.0	0.0
372	Dec. 1, 1964	632.1	678.2	850.4	5,628.5	5,222.2	0.0	0.0
373	Jan. 1, 1965	633.4	678.2	850.3	5,755.9	6,687.2	0.0	0.0
374	Feb. 1, 1965	637.1	681.3	852.6	7,772.0	9,160.6	0.0	0.0
375	Mar. 1, 1965	633.9	678.0	849.3	8,253.5	5,960.3	0.0	0.0
376	April 1, 1965	632.0	676.6	849.4	7,882.1	6,250.5	0.0	0.0
377	May 1, 1965	631.0	674.5	849.9	8,759.2	9,222.5	0.0	0.0
378	Jun. 1, 1965	626.0	669.5	844.4	8,719.3	8,779.5	0.0	0.0
379	Jul. 1, 1965	620.6	666.3	840.4	6,968.0	8,969.7	0.0	0.0
380	Aug. 1, 1965	615.6	661.9	841.1	5,013.3	6,061.7	0.0	0.0
381	Sept. 1, 1965	622.3	667.2	843.3	5,021.9	5,933.9	0.0	0.0
382	Oct. 1, 1965	625.6	671.1	845.5	5,494.9	7,133.3	0.0	0.0
383	Nov. 1, 1965	631.7	677.4	849.7	6,375.7	7,112.1	0.0	0.0
384	Dec. 1, 1965	635.3	681.1	852.0	7,979.3	11,880.5	0.0	0.0
385	Jan. 1, 1966	636.7	682.0	852.3	8,921.8	9,217.9	0.0	0.0
386	Feb. 1, 1966	639.7	685.1	854.3	9,429.8	8,812.2	0.0	0.0
387	Mar. 1, 1966	636.3	681.1	850.7	9,397.7	11,010.4	0.0	0.0
388	April 1, 1966	634.0	679.3	850.5	8,898.9	6,942.4	0.0	0.0
389	May 1, 1966	632.2	676.6	850.8	8,598.6	7,465.9	0.0	0.0
390	Jun. 1, 1966	626.6	670.7	844.6	8,478.3	11,299.2	0.0	0.0
391	Jul. 1, 1966	621.1	667.0	840.1	7,045.9	6,734.3	0.0	0.0
392	Aug. 1, 1966	616.3	662.5	841.6	5,512.8	7,854.2	0.0	0.0
393	Sept. 1, 1966	623.0	668.0	844.4	5,708.9	6,359.2	0.0	0.0
394	Oct. 1, 1966	626.9	672.4	847.0	6,116.0	7,410.4	0.0	0.0
395	Nov. 1, 1966	632.9	679.0	851.5	6,826.9	5,992.3	0.0	0.0
396	Dec. 1, 1966	635.1	682.0	853.7	7,701.5	7,710.0	0.0	0.0
397	Jan. 1, 1967	635.8	681.7	853.6	7,820.8	6,418.4	0.0	0.0
398	Feb. 1, 1967	638.6	684.5	855.6	7,758.0	5,843.7	0.0	0.0
399	Mar. 1, 1967	634.0	679.8	851.8	6,993.7	5,627.4	0.0	0.0
400	April 1, 1967	631.3	677.8	851.5	6,189.7	5,407.9	0.0	0.0
401	May 1, 1967	627.8	674.3	851.2	5,263.7	6,087.7	0.0	0.0
402	Jun. 1, 1967	621.9	667.6	845.2	3,928.6	5,257.2	0.0	0.0
403	Jul. 1, 1967	617.1	664.3	840.6	3,474.3	5,851.1	0.0	0.0
404	Aug. 1, 1967	613.5	660.2	840.7	4,098.6	6,367.2	0.0	0.0

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
405	Sept. 1, 1967	621.1	666.1	842.8	4,958.6	5,235.2	0.0	0.0
406	Oct. 1, 1967	625.3	670.5	845.2	5,680.1	7,171.8	0.0	0.0
407	Nov. 1, 1967	632.5	678.0	850.0	7,322.2	7,740.3	0.0	0.0
408	Dec. 1, 1967	635.5	681.7	852.7	8,262.2	6,018.3	0.0	0.0
409	Jan. 1, 1968	639.0	684.0	853.4	10,470.0	9,985.8	0.0	0.0
410	Feb. 1, 1968	644.5	689.2	856.2	13,501.7	8,300.3	0.0	0.0
411	Mar. 1, 1968	641.6	686.5	853.3	13,789.6	7,759.1	0.0	0.0
412	April 1, 1968	640.3	685.8	853.8	13,536.7	8,264.7	0.0	0.0
413	May 1, 1968	640.5	685.4	854.5	13,722.1	6,994.9	0.0	0.0
414	Jun. 1, 1968	634.5	680.1	849.0	13,479.4	7,814.9	0.0	0.0
415	Jul. 1, 1968	628.6	676.8	845.3	11,324.4	5,924.9	0.0	0.0
416	Aug. 1, 1968	623.5	672.1	846.0	9,342.6	6,743.1	0.0	0.0
417	Sept. 1, 1968	630.3	678.4	848.7	9,279.1	6,420.9	0.0	0.0
418	Oct. 1, 1968	633.7	681.9	851.5	9,353.6	6,233.2	0.0	0.0
419	Nov. 1, 1968	639.7	688.3	856.0	10,252.6	6,986.4	0.0	0.0
420	Dec. 1, 1968	642.6	691.5	858.2	10,780.1	8,026.8	0.0	0.0
421	Jan. 1, 1969	642.6	690.8	858.4	11,077.1	7,899.1	0.0	0.0
422	Feb. 1, 1969	645.6	693.9	860.6	11,560.7	6,465.1	0.0	0.0
423	Mar. 1, 1969	641.3	689.4	856.9	11,090.6	7,364.6	0.0	0.0
424	April 1, 1969	638.9	687.4	856.7	10,475.9	8,017.5	0.0	0.0
425	May 1, 1969	637.1	685.1	857.0	10,649.0	9,035.1	0.0	0.0
426	Jun. 1, 1969	632.3	679.7	851.4	10,296.3	6,607.8	0.0	0.0
427	Jul. 1, 1969	626.4	675.6	846.9	8,724.1	7,071.5	0.0	0.0
428	Aug. 1, 1969	621.2	670.4	847.2	7,110.1	6,318.4	0.0	0.0
429	Sept. 1, 1969	628.1	676.4	849.1	7,290.7	5,906.2	0.0	0.0
430	Oct. 1, 1969	631.7	680.0	852.3	7,502.8	5,845.0	0.0	0.0
431	Nov. 1, 1969	638.5	687.1	857.0	8,866.5	9,809.5	0.0	0.0
432	Dec. 1, 1969	641.9	690.9	859.7	10,212.3	9,373.6	0.0	0.0
433	Jan. 1, 1970	643.3	691.9	860.3	11,084.7	7,127.8	0.0	0.0
434	Feb. 1, 1970	646.4	695.1	862.7	11,944.6	7,318.6	0.0	0.0
435	Mar. 1, 1970	643.9	691.5	859.3	12,336.8	7,697.0	0.0	0.0
436	April 1, 1970	642.9	690.7	859.2	12,858.6	7,956.9	0.0	0.0
437	May 1, 1970	640.4	688.5	859.6	13,649.3	11,146.6	0.0	0.0
438	Jun. 1, 1970	635.1	682.7	853.7	12,679.5	6,349.1	0.0	0.0
439	Jul. 1, 1970	629.9	679.3	849.3	10,898.6	7,614.6	0.0	0.0
440	Aug. 1, 1970	625.8	675.0	849.6	10,454.8	6,659.8	0.0	0.0
441	Sept. 1, 1970	633.4	681.5	852.4	11,328.6	6,337.6	0.0	0.0
442	Oct. 1, 1970	636.7	684.9	854.8	11,270.2	10,232.9	0.0	0.0
443	Nov. 1, 1970	642.3	691.0	859.1	11,594.4	6,454.7	0.0	0.0
444	Dec. 1, 1970	644.7	693.8	861.2	11,584.4	7,132.1	0.0	0.0
445	Jan. 1, 1971	643.4	691.8	860.8	10,983.0	6,046.9	0.0	0.0
446	Feb. 1, 1971	646.2	694.9	862.8	10,944.8	6,749.5	0.0	0.0
447	Mar. 1, 1971	641.4	689.9	858.9	9,984.3	6,089.0	0.0	0.0
448	April 1, 1971	638.5	687.6	858.5	8,927.0	5,808.4	0.0	0.0
449	May 1, 1971	635.0	683.9	858.2	8,061.7	6,041.9	0.0	0.0

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
450	Jun. 1, 1971	628.9	676.9	852.6	6,833.9	6,633.4	0.0	0.0
451	Jul. 1, 1971	622.9	672.7	848.2	5,242.1	5,363.3	0.0	0.0
452	Aug. 1, 1971	618.4	668.0	849.8	4,211.9	4,989.4	0.0	0.0
453	Sept. 1, 1971	626.3	675.2	853.1	5,688.8	5,852.5	0.0	0.0
454	Oct. 1, 1971	630.9	680.0	856.4	6,662.1	5,585.1	0.0	0.0
455	Nov. 1, 1971	638.4	688.0	861.3	8,503.8	5,700.5	0.0	0.0
456	Dec. 1, 1971	642.3	692.1	864.2	10,538.3	9,784.4	0.0	0.0
457	Jan. 1, 1972	644.8	693.7	864.7	12,314.4	6,683.7	0.0	0.0
458	Feb. 1, 1972	647.6	696.9	867.0	12,542.6	6,762.0	0.0	0.0
459	Mar. 1, 1972	643.1	692.4	863.6	11,347.5	5,605.7	0.0	0.0
460	April 1, 1972	640.4	690.3	863.4	10,384.5	5,396.2	0.0	0.0
461	May 1, 1972	640.7	688.6	863.6	11,494.4	9,860.3	0.0	0.0
462	Jun. 1, 1972	634.9	683.2	857.7	12,157.1	6,582.1	0.0	0.0
463	Jul. 1, 1972	629.4	679.6	853.3	10,593.1	6,621.3	0.0	0.0
464	Aug. 1, 1972	624.4	674.8	854.0	8,834.4	6,787.4	0.0	0.0
465	Sept. 1, 1972	631.4	681.3	856.5	9,152.0	5,930.5	0.0	0.0
466	Oct. 1, 1972	634.9	685.2	859.0	9,403.5	6,801.5	0.0	0.0
467	Nov. 1, 1972	641.2	692.0	863.5	10,138.1	6,698.1	0.0	0.0
468	Dec. 1, 1972	643.8	695.3	865.8	10,959.1	7,601.7	0.0	0.0
469	Jan. 1, 1973	644.6	695.2	865.9	11,104.7	6,806.9	0.0	0.0
470	Feb. 1, 1973	647.8	698.4	868.0	12,067.2	10,130.3	0.0	0.0
471	Mar. 1, 1973	644.8	694.5	864.6	12,651.9	11,307.6	0.0	0.0
472	April 1, 1973	645.4	694.5	864.9	13,743.5	8,821.0	0.0	0.0
473	May 1, 1973	642.6	692.3	865.2	13,858.7	8,881.7	0.0	0.0
474	Jun. 1, 1973	638.6	687.4	859.6	14,183.0	10,369.5	0.0	0.0
475	Jul. 1, 1973	637.0	686.8	856.2	16,400.2	18,069.9	0.0	0.0
476	Aug. 1, 1973	634.3	684.7	857.6	16,958.9	13,305.2	0.0	0.0
477	Sept. 1, 1973	643.5	692.9	861.1	17,967.7	8,808.8	0.0	0.0
478	Oct. 1, 1973	650.1	699.2	865.3	21,021.6	13,512.8	0.0	0.0
479	Nov. 1, 1973	657.4	707.3	870.5	22,266.8	8,159.7	0.0	0.0
480	Dec. 1, 1973	659.6	710.5	873.0	20,744.2	7,374.5	0.0	24.9
481	Jan. 1, 1974	658.2	709.3	873.5	19,610.5	9,377.4	0.0	60.1
482	Feb. 1, 1974	661.4	712.7	875.5	19,521.2	8,009.3	23.1	182.1
483	Mar. 1, 1974	656.9	708.2	872.7	18,484.2	7,825.8	0.4	46.8
484	April 1, 1974	654.0	706.1	872.6	17,583.6	8,151.4	0.0	22.6
485	May 1, 1974	651.4	703.2	872.8	17,666.9	11,797.2	0.0	27.2
486	Jun. 1, 1974	645.9	697.4	867.0	17,015.1	9,646.9	0.0	0.0
487	Jul. 1, 1974	640.0	693.5	862.6	15,036.9	7,386.2	0.0	0.0
488	Aug. 1, 1974	634.9	688.6	863.0	13,594.4	7,575.3	0.0	0.0
489	Sept. 1, 1974	642.7	695.3	865.3	14,262.1	9,610.2	0.0	0.0
490	Oct. 1, 1974	646.9	699.4	867.7	15,168.7	7,646.4	0.0	0.0
491	Nov. 1, 1974	653.0	705.9	872.0	16,829.0	14,469.0	0.0	0.2
492	Dec. 1, 1974	655.6	709.2	873.8	17,532.0	8,491.6	0.0	76.3
493	Jan. 1, 1975	657.2	709.8	873.8	17,685.9	8,427.6	0.0	93.4
494	Feb. 1, 1975	664.2	714.9	875.6	20,233.4	15,852.7	46.1	196.2

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
495	Mar. 1, 1975	660.3	711.8	872.9	21,900.1	11,225.3	16.7	67.7
496	April 1, 1975	657.7	710.1	873.2	20,686.9	12,760.9	0.0	59.7
497	May 1, 1975	656.4	708.0	873.5	20,787.2	18,618.8	0.0	80.7
498	Jun. 1, 1975	652.7	703.7	868.7	22,005.0	15,525.6	0.0	0.4
499	Jul. 1, 1975	647.9	701.1	864.7	21,474.2	11,492.2	0.0	0.0
500	Aug. 1, 1975	643.3	696.7	865.2	19,542.2	15,448.9	0.0	0.0
501	Sept. 1, 1975	650.5	703.2	867.6	19,456.1	9,915.6	0.0	0.0
502	Oct. 1, 1975	653.1	706.1	869.7	18,732.2	9,476.3	0.0	0.0
503	Nov. 1, 1975	658.4	711.9	873.6	18,454.8	8,814.7	0.0	62.1
504	Dec. 1, 1975	660.0	714.2	875.3	18,391.2	10,873.7	0.1	175.8
505	Jan. 1, 1976	659.8	713.1	875.0	18,193.0	10,375.6	0.0	180.8
506	Feb. 1, 1976	662.9	716.1	876.5	18,340.7	8,975.3	89.8	263.7
507	Mar. 1, 1976	657.4	710.6	873.3	17,164.9	8,794.6	5.5	103.0
508	April 1, 1976	655.8	708.8	873.1	17,503.5	11,423.3	0.0	63.2
509	May 1, 1976	656.6	707.7	873.5	19,613.3	12,175.4	0.0	70.2
510	Jun. 1, 1976	650.7	702.6	867.9	19,860.7	9,460.3	0.0	0.2
511	Jul. 1, 1976	645.7	700.0	864.9	18,536.1	12,003.2	0.0	0.0
512	Aug. 1, 1976	641.5	696.4	865.9	17,429.3	9,496.8	0.0	0.0
513	Sept. 1, 1976	649.4	703.7	870.1	17,976.0	9,883.6	0.0	0.0
514	Oct. 1, 1976	654.9	709.2	873.0	19,751.6	13,077.1	0.0	23.9
515	Nov. 1, 1976	663.4	717.8	877.2	22,487.5	13,340.6	62.5	263.5
516	Dec. 1, 1976	666.7	721.8	879.3	23,898.1	10,864.5	255.1	420.7
517	Jan. 1, 1977	668.9	723.6	879.6	25,142.7	12,886.6	347.5	459.7
518	Feb. 1, 1977	671.4	726.6	881.3	26,283.8	13,896.8	489.4	578.8
519	Mar. 1, 1977	668.3	723.0	878.6	25,383.8	10,260.5	378.7	431.2
520	April 1, 1977	669.9	723.6	878.6	26,839.6	16,728.0	332.5	413.6
521	May 1, 1977	667.3	721.7	879.0	28,011.8	14,224.4	316.4	435.5
522	Jun. 1, 1977	661.7	716.1	874.4	25,539.2	11,724.7	95.0	191.0
523	Jul. 1, 1977	655.0	712.1	871.0	22,611.8	9,360.6	0.2	11.1
524	Aug. 1, 1977	648.9	706.5	871.6	19,968.6	8,669.1	0.0	2.0
525	Sept. 1, 1977	655.9	712.5	873.6	19,648.8	9,216.1	0.0	82.6
526	Oct. 1, 1977	658.8	715.5	875.2	19,472.5	8,184.0	0.0	190.7
527	Nov. 1, 1977	664.7	721.8	878.7	20,411.3	8,302.0	144.3	389.9
528	Dec. 1, 1977	666.9	724.5	880.3	21,013.1	8,217.9	281.1	514.0
529	Jan. 1, 1978	665.8	722.7	879.9	20,060.7	8,021.8	235.4	514.5
530	Feb. 1, 1978	667.8	725.4	881.4	19,799.2	7,690.3	323.5	604.5
531	Mar. 1, 1978	663.1	720.3	878.3	18,651.0	7,232.1	153.0	429.9
532	April 1, 1978	660.6	718.1	878.0	18,135.4	7,465.5	15.5	389.1
533	May 1, 1978	657.3	714.7	878.1	17,372.8	9,381.5	0.0	384.2
534	Jun. 1, 1978	651.0	707.7	873.3	16,185.4	7,701.9	0.0	117.1
535	Jul. 1, 1978	645.0	703.5	869.1	14,618.6	6,888.7	0.0	0.6
536	Aug. 1, 1978	639.8	698.3	869.6	13,114.5	7,047.0	0.0	0.0
537	Sept. 1, 1978	647.4	704.6	871.9	14,254.8	8,318.2	0.0	0.1
538	Oct. 1, 1978	650.9	708.0	873.7	14,767.4	6,817.4	0.0	78.7
539	Nov. 1, 1978	656.8	714.2	877.0	15,483.8	9,871.5	0.0	277.2

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
540	Dec. 1, 1978	659.5	717.2	878.6	15,916.4	7,478.4	0.0	390.2
541	Jan. 1, 1979	662.0	718.2	878.5	17,088.7	13,097.5	24.8	395.7
542	Feb. 1, 1979	664.7	720.9	879.9	19,147.5	10,088.6	170.4	489.7
543	Mar. 1, 1979	662.8	717.5	877.2	19,983.4	11,908.4	79.9	340.4
544	April 1, 1979	665.2	719.5	877.8	22,886.6	14,168.3	113.6	340.9
545	May 1, 1979	662.8	717.5	878.1	24,823.6	11,031.5	101.9	374.3
546	Jun. 1, 1979	659.5	713.6	874.5	24,599.4	9,156.0	6.1	154.3
547	Jul. 1, 1979	654.7	711.4	871.7	23,464.6	13,369.0	0.0	13.2
548	Aug. 1, 1979	649.1	706.6	872.5	20,857.5	8,400.6	0.0	16.5
549	Sept. 1, 1979	656.4	713.1	874.5	20,856.3	10,220.0	0.0	127.9
550	Oct. 1, 1979	659.5	716.3	876.2	20,811.5	8,651.7	0.0	243.0
551	Nov. 1, 1979	664.6	722.0	879.5	20,512.4	7,919.3	150.6	439.4
552	Dec. 1, 1979	666.4	724.3	880.9	20,459.0	8,397.3	257.9	552.0
553	Jan. 1, 1980	665.3	722.3	880.3	20,169.9	8,289.4	220.1	539.8
554	Feb. 1, 1980	667.5	724.9	881.7	19,898.5	7,984.2	308.8	621.0
555	Mar. 1, 1980	662.7	719.7	878.5	18,522.0	7,206.4	136.8	438.7
556	April 1, 1980	659.3	716.9	878.1	17,168.3	7,503.8	10.5	389.7
557	May 1, 1980	656.1	713.3	878.4	16,795.2	10,913.3	0.0	384.4
558	Jun. 1, 1980	650.5	706.7	873.3	16,356.2	8,120.1	0.0	115.7
559	Jul. 1, 1980	644.7	702.6	869.0	15,185.8	7,209.5	0.0	0.3
560	Aug. 1, 1980	639.0	697.0	869.1	13,308.0	6,696.1	0.0	0.0
561	Sept. 1, 1980	645.9	702.7	871.1	13,322.9	6,849.1	0.0	0.0
562	Oct. 1, 1980	649.0	705.9	873.0	13,419.5	6,561.2	0.0	30.0
563	Nov. 1, 1980	654.6	711.9	876.3	14,084.4	7,435.1	0.0	225.8
564	Dec. 1, 1980	657.5	715.0	877.7	14,625.0	6,947.3	0.0	333.3
565	Jan. 1, 1981	657.2	714.1	877.4	14,876.3	7,678.8	0.0	329.6
566	Feb. 1, 1981	660.0	716.8	878.8	15,075.6	6,701.8	0.0	407.8
567	Mar. 1, 1981	655.3	712.0	875.6	14,112.6	6,900.5	0.0	246.5
568	April 1, 1981	653.1	710.4	875.9	13,995.8	8,568.5	0.0	224.4
569	May 1, 1981	651.5	708.7	876.4	14,241.6	6,683.1	0.0	253.1
570	Jun. 1, 1981	654.6	708.6	872.6	18,163.8	29,326.3	0.0	33.5
571	Jul. 1, 1981	649.5	707.0	869.6	21,212.1	13,300.2	0.0	0.0
572	Aug. 1, 1981	645.2	703.2	870.7	20,153.8	16,576.9	0.0	0.0
573	Sept. 1, 1981	652.6	710.0	873.6	19,879.6	9,300.6	0.0	58.6
574	Oct. 1, 1981	655.8	713.7	875.6	18,995.3	8,402.4	0.0	198.8
575	Nov. 1, 1981	661.8	720.4	879.3	19,469.6	10,364.5	35.4	419.1
576	Dec. 1, 1981	664.5	723.6	881.0	19,807.8	9,291.2	163.2	555.7
577	Jan. 1, 1982	663.4	722.0	880.8	19,059.3	8,227.1	132.0	566.0
578	Feb. 1, 1982	665.8	724.8	882.5	18,708.1	8,154.8	228.5	672.2
579	Mar. 1, 1982	661.2	719.9	879.5	17,543.4	7,521.9	65.3	499.9
580	April 1, 1982	658.2	717.6	879.3	16,344.0	7,436.4	1.3	460.4
581	May 1, 1982	656.1	714.5	879.1	16,101.3	9,610.9	0.0	448.9
582	Jun. 1, 1982	651.1	708.9	874.2	16,411.3	9,777.2	0.0	176.4
583	Jul. 1, 1982	644.8	704.7	870.5	14,859.0	7,341.1	0.0	5.3
584	Aug. 1, 1982	639.3	699.2	870.8	13,079.1	6,994.3	0.0	0.0

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585	Sept. 1, 1982	646.2	705.0	872.7	13,224.9	6,895.3	0.0	27.0
586	Oct. 1, 1982	649.4	708.0	874.4	13,531.6	7,833.9	0.0	126.3
587	Nov. 1, 1982	655.0	713.8	877.6	14,084.5	6,856.1	0.0	317.3
588	Dec. 1, 1982	657.8	716.6	879.0	14,449.5	7,314.2	0.0	417.7
589	Jan. 1, 1983	656.6	714.6	878.5	14,409.1	7,295.0	0.0	407.8
590	Feb. 1, 1983	659.8	717.7	879.8	14,613.4	6,636.0	0.0	482.3
591	Mar. 1, 1983	655.4	713.1	876.8	14,079.6	8,271.3	0.0	319.1
592	April 1, 1983	652.5	710.8	876.5	13,219.3	6,094.0	0.0	281.4
593	May 1, 1983	649.8	707.4	876.3	12,726.2	7,232.6	0.0	265.8
594	Jun. 1, 1983	644.3	701.2	871.3	12,686.1	9,832.3	0.0	19.3
595	Jul. 1, 1983	638.8	697.5	867.2	11,836.3	7,350.9	0.0	0.0
596	Aug. 1, 1983	633.9	692.6	867.6	10,442.2	6,879.7	0.0	0.0
597	Sept. 1, 1983	641.1	698.7	869.8	10,821.7	12,085.1	0.0	0.0
598	Oct. 1, 1983	644.4	701.9	872.2	11,031.2	7,198.5	0.0	0.5
599	Nov. 1, 1983	650.3	708.1	875.8	11,501.8	7,302.7	0.0	179.5
600	Dec. 1, 1983	652.8	710.8	877.3	12,044.1	7,289.2	0.0	297.5
601	Jan. 1, 1984	651.8	709.1	877.0	11,972.7	6,938.7	0.0	296.6
602	Feb. 1, 1984	655.4	712.5	878.4	12,513.8	7,072.5	0.0	376.2
603	Mar. 1, 1984	651.5	708.1	875.2	12,217.6	9,180.9	0.0	214.9
604	April 1, 1984	648.8	706.0	874.9	11,649.1	6,562.7	0.0	170.6
605	May 1, 1984	645.6	702.5	874.7	10,719.2	6,102.7	0.0	154.0
606	Jun. 1, 1984	639.2	695.4	868.9	9,329.8	6,108.7	0.0	2.5
607	Jul. 1, 1984	633.0	690.9	864.1	7,781.9	5,658.6	0.0	0.0
608	Aug. 1, 1984	628.5	685.8	864.0	6,586.1	6,046.1	0.0	0.0
609	Sept. 1, 1984	635.6	691.8	865.6	7,297.7	5,691.1	0.0	0.0
610	Oct. 1, 1984	638.8	694.8	867.3	7,689.7	6,540.8	0.0	0.0
611	Nov. 1, 1984	644.7	700.8	871.1	8,640.2	6,575.8	0.0	0.0
612	Dec. 1, 1984	647.9	703.9	873.3	9,435.2	6,399.0	0.0	35.5
613	Jan. 1, 1985	649.5	705.0	873.4	11,090.1	9,415.5	0.0	57.9
614	Feb. 1, 1985	652.9	708.0	875.2	12,585.2	7,534.0	0.0	164.6
615	Mar. 1, 1985	650.5	704.8	872.7	13,073.6	9,074.2	0.0	39.4
616	April 1, 1985	649.3	704.3	872.9	13,934.7	10,849.5	0.0	36.3
617	May 1, 1985	646.7	702.1	873.5	13,629.7	7,487.6	0.0	60.9
618	Jun. 1, 1985	642.0	696.9	868.1	13,198.8	9,201.2	0.0	0.1
619	Jul. 1, 1985	637.9	694.3	864.1	12,905.4	9,077.4	0.0	0.0
620	Aug. 1, 1985	633.6	689.9	864.5	11,987.3	6,596.6	0.0	0.0
621	Sept. 1, 1985	640.6	696.0	866.7	11,842.6	6,784.9	0.0	0.0
622	Oct. 1, 1985	644.0	699.5	868.9	11,899.6	6,506.4	0.0	0.0
623	Nov. 1, 1985	650.7	706.5	873.2	13,226.0	18,431.4	0.0	32.6
624	Dec. 1, 1985	653.1	709.8	874.9	14,131.2	8,508.6	0.0	152.1
625	Jan. 1, 1986	654.7	710.2	874.9	14,871.9	10,173.3	0.0	167.2
626	Feb. 1, 1986	658.0	713.2	876.5	16,053.1	7,739.3	0.0	261.1
627	Mar. 1, 1986	654.2	709.1	873.6	15,927.3	7,897.7	0.0	113.4
628	April 1, 1986	651.4	707.0	873.3	15,013.4	7,468.4	0.0	80.8
629	May 1, 1986	648.6	703.5	873.2	14,428.5	11,100.3	0.0	70.7

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
630	Jun. 1, 1986	645.9	698.9	867.6	15,323.8	9,286.3	0.0	0.1
631	Jul. 1, 1986	641.1	696.6	863.3	15,317.0	8,040.6	0.0	0.0
632	Aug. 1, 1986	636.2	691.6	863.5	13,345.9	7,978.0	0.0	0.0
633	Sept. 1, 1986	643.2	697.8	866.1	13,535.8	7,476.0	0.0	0.0
634	Oct. 1, 1986	648.4	702.5	869.0	15,064.4	8,942.9	0.0	0.0
635	Nov. 1, 1986	656.8	711.0	873.6	17,913.5	8,207.6	0.0	53.1
636	Dec. 1, 1986	663.0	716.7	875.9	21,723.6	15,847.1	44.6	203.5
637	Jan. 1, 1987	664.8	718.6	876.3	23,789.0	8,003.5	202.2	256.9
638	Feb. 1, 1987	668.4	722.5	878.6	23,462.8	9,293.0	320.7	383.5
639	Mar. 1, 1987	665.1	719.2	876.3	23,163.8	10,084.7	226.5	277.7
640	April 1, 1987	662.6	717.9	876.7	21,735.1	7,221.5	99.5	285.0
641	May 1, 1987	663.0	717.2	877.5	22,054.6	10,468.0	38.6	321.9
642	Jun. 1, 1987	664.0	716.5	874.0	27,425.6	21,496.7	43.6	118.2
643	Jul. 1, 1987	659.4	715.7	871.5	28,715.5	11,068.3	9.3	5.6
644	Aug. 1, 1987	654.4	711.9	872.7	25,416.5	10,166.2	0.0	36.0
645	Sept. 1, 1987	661.4	718.6	875.1	24,420.6	8,902.8	19.4	171.8
646	Oct. 1, 1987	664.0	721.9	877.2	23,520.2	8,967.3	136.8	309.1
647	Nov. 1, 1987	668.8	727.8	880.7	23,124.8	15,477.8	354.8	533.9
648	Dec. 1, 1987	670.4	730.1	882.4	22,482.2	8,855.5	444.7	674.0
649	Jan. 1, 1988	669.1	728.3	882.1	21,772.3	9,786.4	395.4	679.8
650	Feb. 1, 1988	671.3	731.0	883.8	21,734.6	8,823.3	485.3	787.6
651	Mar. 1, 1988	666.9	726.1	880.9	20,599.6	8,376.3	330.6	613.4
652	April 1, 1988	664.7	723.8	880.7	19,839.2	8,746.8	190.1	572.4
653	May 1, 1988	661.0	720.1	880.6	18,865.7	11,368.3	45.2	559.5
654	Jun. 1, 1988	654.8	713.1	875.6	17,674.1	7,739.3	0.0	270.7
655	Jul. 1, 1988	648.7	709.0	872.2	16,071.0	8,244.5	0.0	43.5
656	Aug. 1, 1988	643.4	703.8	872.6	14,394.2	7,537.2	0.0	34.3
657	Sept. 1, 1988	650.3	709.5	874.3	14,826.0	7,943.8	0.0	127.3
658	Oct. 1, 1988	653.3	712.4	876.2	15,022.8	8,626.0	0.0	235.3
659	Nov. 1, 1988	658.9	718.2	879.4	15,340.1	7,059.9	0.0	432.8
660	Dec. 1, 1988	660.9	720.5	880.7	15,400.0	7,357.7	17.4	541.3
661	Jan. 1, 1989	660.3	718.6	880.3	14,875.7	6,911.1	2.0	527.7
662	Feb. 1, 1989	662.3	721.3	881.7	14,994.4	6,748.1	81.9	610.7
663	Mar. 1, 1989	657.4	715.9	878.5	14,255.8	8,217.8	3.4	430.5
664	April 1, 1989	654.8	713.6	878.3	13,847.9	7,652.6	0.0	388.0
665	May 1, 1989	651.5	710.1	878.1	13,331.0	11,189.9	0.0	377.1
666	Jun. 1, 1989	645.2	703.1	872.9	12,004.3	7,612.9	0.0	91.0
667	Jul. 1, 1989	639.2	698.8	868.4	10,546.8	7,047.0	0.0	0.0
668	Aug. 1, 1989	633.9	693.2	868.5	9,282.8	7,052.4	0.0	0.0
669	Sept. 1, 1989	641.1	699.1	870.3	9,704.7	7,375.9	0.0	0.0
670	Oct. 1, 1989	644.3	702.0	872.0	10,255.1	6,756.4	0.0	0.8
671	Nov. 1, 1989	650.5	708.1	875.2	11,234.2	6,280.1	0.0	160.4
672	Dec. 1, 1989	653.5	711.0	876.6	12,181.0	6,962.9	0.0	261.4
673	Jan. 1, 1990	653.1	709.3	876.0	12,042.8	6,444.1	0.0	249.6
674	Feb. 1, 1990	655.9	712.6	877.4	12,390.4	6,235.8	0.0	321.1

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
675	Mar. 1, 1990	651.0	707.5	874.4	11,619.0	6,279.5	0.0	162.1
676	April 1, 1990	648.1	705.2	874.5	10,894.4	6,767.2	0.0	135.5
677	May 1, 1990	646.1	702.5	875.0	11,051.3	9,445.8	0.0	151.2
678	Jun. 1, 1990	641.4	697.1	869.6	11,076.4	7,063.7	0.0	3.6
679	Jul. 1, 1990	636.3	693.8	866.0	10,314.7	6,298.8	0.0	0.0
680	Aug. 1, 1990	631.1	688.9	866.9	8,830.9	6,528.1	0.0	0.0
681	Sept. 1, 1990	638.7	695.5	869.5	9,817.4	7,864.4	0.0	0.0
682	Oct. 1, 1990	642.4	699.3	871.8	10,365.7	6,285.8	0.0	0.0
683	Nov. 1, 1990	648.2	705.6	875.5	10,844.5	6,979.2	0.0	154.9
684	Dec. 1, 1990	651.1	708.6	877.1	11,236.7	6,461.1	0.0	275.5
685	Jan. 1, 1991	650.0	707.1	876.9	11,312.3	7,493.7	0.0	282.2
686	Feb. 1, 1991	654.2	710.8	878.5	12,282.2	7,754.7	0.0	369.1
687	Mar. 1, 1991	650.5	706.6	875.4	12,388.6	7,100.8	0.0	215.0
688	April 1, 1991	648.7	705.0	875.2	12,822.3	9,293.8	0.0	178.8
689	May 1, 1991	646.6	702.3	875.1	13,843.4	10,142.7	0.0	171.6
690	Jun. 1, 1991	641.7	696.6	869.6	13,425.2	9,174.4	0.0	3.9
691	Jul. 1, 1991	636.8	693.4	865.1	12,435.3	9,836.2	0.0	0.0
692	Aug. 1, 1991	631.9	688.5	865.3	10,981.7	9,803.4	0.0	0.0
693	Sept. 1, 1991	639.0	694.7	868.2	11,161.2	10,522.2	0.0	0.0
694	Oct. 1, 1991	642.5	698.4	870.9	11,384.2	7,468.6	0.0	0.0
695	Nov. 1, 1991	648.4	704.9	874.9	11,913.3	6,961.5	0.0	111.2
696	Dec. 1, 1991	652.9	709.3	877.6	16,164.5	17,335.5	0.0	268.7
697	Jan. 1, 1992	657.4	712.6	878.8	20,263.6	15,781.5	0.0	361.6
698	Feb. 1, 1992	664.4	719.7	882.0	23,610.0	18,083.7	104.2	547.9
699	Mar. 1, 1992	665.6	720.3	880.4	25,867.0	15,121.3	145.5	487.9
700	April 1, 1992	666.5	722.2	881.7	26,924.4	14,208.5	182.7	552.2
701	May 1, 1992	663.6	720.6	882.8	26,607.8	12,014.7	151.4	639.1
702	Jun. 1, 1992	659.6	716.2	879.3	26,058.9	18,299.2	11.3	431.6
703	Jul. 1, 1992	654.6	714.0	877.2	24,523.5	11,603.4	0.0	293.6
704	Aug. 1, 1992	650.0	710.1	878.4	21,903.0	10,888.1	0.0	351.5
705	Sept. 1, 1992	657.2	716.9	880.9	21,592.0	10,679.9	0.0	489.9
706	Oct. 1, 1992	660.7	720.7	882.9	21,315.2	9,299.8	1.6	644.1
707	Nov. 1, 1992	666.0	726.8	886.4	21,487.5	9,565.1	218.6	899.8
708	Dec. 1, 1992	668.3	729.7	888.1	21,391.3	9,981.8	343.0	1,043.8
709	Jan. 1, 1993	667.3	728.0	887.8	21,127.5	9,765.4	313.5	1,052.4
710	Feb. 1, 1993	671.0	731.7	889.4	22,013.8	10,605.2	449.4	1,156.0
711	Mar. 1, 1993	667.1	727.5	886.6	21,771.4	11,405.3	329.4	981.7
712	April 1, 1993	664.8	725.5	886.4	21,169.4	10,353.1	204.0	949.0
713	May 1, 1993	662.3	722.5	886.5	21,347.4	11,287.0	79.8	945.7
714	Jun. 1, 1993	656.9	716.7	881.8	20,286.5	10,214.1	2.7	634.9
715	Jul. 1, 1993	650.4	712.4	878.3	17,844.0	8,057.3	0.0	397.6
716	Aug. 1, 1993	644.6	706.8	878.6	15,603.8	7,678.3	0.0	382.2
717	Sept. 1, 1993	651.2	712.4	880.2	15,353.0	7,469.6	0.0	466.4
718	Oct. 1, 1993	654.2	715.2	881.6	15,458.1	7,840.6	0.0	566.2
719	Nov. 1, 1993	660.0	721.2	884.6	16,035.8	7,749.6	0.0	776.8

Time Step	Date	Bexar (J-17) Well Level (ft above msl)	Medina (Hondo) Well Level (ft above msl)	Uvalde (J-27) Well Level (ft above msl)	Comal Spring Flow (ac-ft)	San Marcos Spring Flow (ac-ft)	San Pedro Spring Flow (ac-ft)	Leona Spring Flow (ac-ft)
720	Dec. 1, 1993	662.4	723.7	885.9	16,446.1	7,976.3	71.2	890.3
721	Jan. 1, 1994	661.2	721.6	885.3	16,651.0	7,624.7	50.7	872.4
722	Feb. 1, 1994	664.0	724.4	886.6	16,649.3	7,691.9	143.9	953.9
723	Mar. 1, 1994	659.9	719.8	883.7	16,152.5	8,213.5	17.6	760.1
724	April 1, 1994	657.5	717.8	884.7	15,922.0	8,455.6	0.0	759.6
725	May 1, 1994	655.1	715.1	885.3	15,937.9	9,944.4	0.0	817.1
726	Jun. 1, 1994	650.2	709.7	880.8	15,882.3	10,494.7	0.0	538.7
727	Jul. 1, 1994	644.2	705.8	877.7	14,264.2	7,318.2	0.0	326.3
728	Aug. 1, 1994	639.1	700.9	878.1	12,503.0	7,718.8	0.0	328.0
729	Sept. 1, 1994	646.7	707.3	880.2	13,161.9	8,932.9	0.0	433.6
730	Oct. 1, 1994	650.3	710.6	882.0	13,760.0	9,245.4	0.0	556.7
731	Nov. 1, 1994	656.0	716.6	885.3	14,281.1	8,133.0	0.0	784.1
732	Dec. 1, 1994	658.4	719.2	886.7	14,504.6	10,166.3	0.0	909.6
733	Jan. 1, 1995	657.7	717.8	886.3	14,501.0	9,372.5	0.0	902.5
734	Feb. 1, 1995	661.3	721.4	887.8	15,405.8	9,310.0	22.2	1,000.4
735	Mar. 1, 1995	657.2	717.0	884.9	15,029.8	8,688.2	0.5	818.2
736	April 1, 1995	654.4	714.8	884.7	14,205.6	9,826.8	0.0	778.1
737	May 1, 1995	651.1	711.3	884.6	13,635.6	10,075.8	0.0	767.2
738	Jun. 1, 1995	646.3	705.4	879.8	13,777.1	10,998.7	0.0	467.9
739	Jul. 1, 1995	641.1	701.9	876.3	12,854.9	9,111.3	0.0	243.0
740	Aug. 1, 1995	636.3	697.0	876.6	11,580.1	9,313.5	0.0	230.4
741	Sept. 1, 1995	643.4	703.1	878.6	11,859.2	8,412.4	0.0	327.8
742	Oct. 1, 1995	646.9	706.6	880.3	12,015.8	7,014.4	0.0	444.6
743	Nov. 1, 1995	653.2	713.0	883.7	12,860.5	9,254.6	0.0	657.8
744	Dec. 1, 1995	656.0	716.1	885.2	13,512.8	7,133.4	0.0	790.9
745	Jan. 1, 1996	655.1	714.7	884.8	13,460.2	6,510.4	0.0	784.4
746	Feb. 1, 1996	658.7	717.8	886.1	13,843.0	6,272.1	0.0	872.5
747	Mar. 1, 1996	654.6	713.4	883.1	13,527.0	6,235.4	0.0	681.9
748	April 1, 1996	652.0	711.2	882.7	13,029.6	7,923.9	0.0	633.9
749	May 1, 1996	648.5	707.5	882.4	12,299.3	6,303.9	0.0	610.6
750	Jun. 1, 1996	642.6	700.7	877.1	11,019.4	7,527.2	0.0	313.1
751	Jul. 1, 1996	637.0	696.7	873.8	9,787.1	5,977.3	0.0	77.1
752	Aug. 1, 1996	632.0	691.5	874.0	8,604.6	7,888.9	0.0	64.0
753	Sept. 1, 1996	639.5	697.6	876.2	9,186.6	6,548.6	0.0	161.8
754	Oct. 1, 1996	643.5	701.2	877.8	10,234.0	5,936.0	0.0	281.6
755	Nov. 1, 1996	649.1	707.2	881.0	11,071.0	6,003.3	0.0	469.8
756	Dec. 1, 1996	651.9	710.1	882.5	11,509.3	6,598.3	0.0	581.4

APPENDIX 3

SOURCE CODES

Explanation of code files

exec-hdr99.for	This is the basic model with a few changes from previous simulation studies. Spring flows and heads are printed out. Minor Heads would be printed out to a file only if that option is selected. Modifications by Nadira Kabir on March and April 1999 reflects the Edwards Aquifer Authority Critical Period Management Plan as outlined in TAC §709.5. Hueco Springs are included.
blkdat.for	This subroutine includes format statements for reading certain input data.
calib.for	This subroutine adjusts the values of hydraulic conductivity and storage coefficient.
flux.for	This subroutine prints a map indicating the groundwater flows between nodes at the end of each time step.
getpmp99.for	This subroutine is called for each major time step, and it reads the pumpage and recharge data. This was modified for this model run.
hydro.for	This subroutine produces a hydrograph of water levels for specified cells.
output99.for	This subroutine prints most of the model results. The mass balances are also computed in this subroutine.
physdt.for	This subroutine reads the physical data describing the aquifer.
ploth.for	This subroutine produces print plots of head or saturated thickness.
plots.for	This subroutine produces plots similar by subroutine ploth.for. A map of simulated errors or head changes may be produced.
qsolve.for	This subroutine solves the system of equations for the concentrations using the iterative alternating direction implicit procedure.
qread.for	
qual.for	This subroutine reads data related to mass transport and calls mass transport related subroutines.
solve.for	This routine solves the system of equations for the non-steady state head using the iterative alternating direction implicit procedure.

sumflo.for	This subroutine calculates groundwater flows and saves heads
xsect.for	This subroutine produces a printer plot of cross-sections along rows or columns.

Descriptions of the data files

The file named "input" was modified by including the new recharge estimates for the basins/subbasins developed by HDR for the period of 1934-96. This file also contains the physical data used in previous runs. All file units are acre-feet.

The following pumpage files are formatted as 12 months X 31 Rows X 8 lines for 80 columns.

UNIT=50,FILE='dom.97'	The domestic pumpage file based on 1997 use.
UNIT=51,FILE='Kmunir.avg'	Kinney County muncipal and irrigation pumpage (1997 TWDB and EAA data)
UNIT=53,FILE='UPrm4k.irr'	Uvalde County Irrigation Pumpage (modified permit data)
UNIT=54,FILE='MPrm4k.irr'	Medina County Irrigation Pumpage (modified permit data)
UNIT=55,FILE='BPrm4k.irr	Bexar and Atascosa Counties Irrigation Pumpage (modified permit data)
UNIT=57,FILE='UPermt.ind'	Uvalde County Industrial Pumpage (permit data)
UNIT=58,FILE='MPermt.ind'	Medina County Industrial Pumpage (permit data
UNIT=59,FILE='BPermt.ind'	Bexar, Hays, Comal Counties Industrial pumpage (permit data)
UNIT=60,FILE='SAWSPm.ind'	Saws Industrial Pumpage (permit data, 27% of total SAWS Permit Value)
UNIT=62,FILE='UPerm.mun'	Uvalde County Muncipal Pumpage (permit data)
UNIT=63,FILE='MPerm.mun'	Medina County Muncipal Pumpage (permit data)
UNIT=64,FILE='BPerm.mun'	Bexar County Muncipal Pumpage (permit data)
UNIT=65,FILE='CPerm.mun'	Comal County Muncipal Pumpage (permit data)
UNIT=66,FILE='HPerm.mun'	Hays County Muncipal Pumpage (permit data)
UNIT=67,FILE='SAWSPm.mun'	SAWS Muncipal Pumpage (permit data, 73% of total SAWS Permit Value)

The following winter base files are formatted as 1 month X 31 rows X 8 lines for 80 columns.

UNIT=69,FILE='UPermt.wb'	Uvalde County Winter Base values
UNIT=70,FILE='MPermt.wb'	Medina County Winter Base values
UNIT=71,FILE='BPermt.wb'	Bexar County Winter Base values
UNIT=74,FILE='CPermt.wb'	Comal County Winter Base values
UNIT=75,FILE='HPermt.wb'	Hays County Winter Base values
UNIT=72,FILE='SAWSPm.wb'	SAWS Winter Base values

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C                          PROGRAM GWSIM - IV
C                    GROUND WATER SIMULATION PROGRAM
C                  TEXAS DEPARTMENT OF WATER RESOURCES
C
C                                 BY
C                           TOMMY KNOWLES
C                  DATA COLLECTION AND EVALUATION SECTION
C                  DATA AND ENGINEERING SERVICES DIVISION
C*********************************************************************
c This is the basic model with a few minor changes.  Spring flows and heads
c are printed out.  Minor heads would be printed out to a file only if
c that option is selected.
c  3/5/99  -- This version reflects the "Management Plan", executed for HDR,
c   * NK *    with permitted data provided by EAA. Hueco springs are included.
C                Also changed 2 subroutns.
c             Program name: exec-hdr99.f
c             changed subrtns: getpmp99.for    output99.for
C**********************************************************************
      COMMON /ITCOM/ NR,NC,ISTEP,NPARM,IN,OUT,OUT1,OPT(30),ITER,NSAVE,
     1ISAVE(25),JSAVE(25),KHYD,NCOLS,MCOLS(25),NROWS,MROWS(25)
     2,IN1,IN2,IN3,IN4,IN5,IN6
     3,NSTEPS,NBLK,IRWC(4,60),NSPRG,ISPRG(25),JSPRG(25),KSSH,KQUAL
      COMMON /RLCOM/ FMT(20),TITLE(20),DELX(200),DELY(200),PRMITR(10),
     1 B(200),G(200),SUMS(18,2), ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,
     2 DELMAJ,E,XLGTNM,FLXNAM(2),FLXFCT,DELMJ2,TIME,STRFCT,SCALE,
     3 TITMOD(20),VFMT(20,7)
      INTEGER OPT,FLAG,OUT,OUT1
      real mdmpfact
C*********************************************************************
C     THE FOLLOWING CARDS MUST BE CHANGED IF THE FINITE DIFFERENCE GRID
C     CONTAINS MORE THAN 31 ROWS OR 31 COLUMNS
C*********************************************************************
      PARAMETER (NROW=31,NCOL=80)
      DIMENSION FLAG(NROW,NCOL),BOTLEL(NROW,NCOL),H(NROW,NCOL),
     1HO(NROW,NCOL),P(NROW,NCOL,2),SF1(NROW,NCOL),T(NROW,NCOL,2),
     1 THIK(NROW,NCOL), QSUM(NROW,NCOL),
     2 Q(NROW,NCOL),RHG(NROW,NCOL),DL(NROW,NCOL)
     1,R(NROW,NCOL),RD(NROW,NCOL),TOPAQ(NROW,NCOL),SURF(NROW,NCOL)
     1,HDUM(NROW,NCOL),Q1(NROW,NCOL),Q2(NROW,NCOL),Q3(NROW,NCOL)
     1,Q4(NROW,NCOL),Q5(NROW,NCOL),Q7(NROW,NCOL),qdum(nrow,ncol)
     1,Q6(NROW,NCOL),Q8(NROW,NCOL),Q9(NROW,NCOL),Q10(nrow,ncol)
     1,Q11(nrow,ncol),Q12(NROW,NCOL),q13(nrow,ncol),q14(nrow,ncol)
     1, q15(nrow,ncol),q16(nrow,ncol),q17(nrow,ncol)
C
      DIMENSION QDUMB(NROW,NCOL), QDUMC(NROW,NCOL), QDUMH(NROW,NCOL),
     1  QDUMM(NROW,NCOL), QDUMU(NROW,NCOL), QDUMSI(NROW,NCOL),
     2  QDUMSM(NROW,NCOL)
C*********************************************************************
      DIMENSION DUM1(2), DUM2(2)
      EQUIVALENCE (DUM1(2),B(1)), (DUM2(2),G(1))
      DUM1(1)=0.0
      DUM2(1)=0.0
C*********************************************************************
C     DEFINE INPUT AND OUTPUT DEVICE NUMBERS
```

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C***********************************************************************
      IN=7
      OPEN(UNIT=7,FILE='input',STATUS='OLD')
      IN1=11
      OPEN(UNIT=11,FORM='UNFORMATTED',STATUS='scratch')
      IN2=12
      OPEN(UNIT=12,FORM='UNFORMATTED',STATUS='scratch')
      IN3=13
      OPEN(UNIT=13,FORM='UNFORMATTED',STATUS='scratch')
      IN4=14
      OPEN(UNIT=14,FORM='UNFORMATTED',STATUS='scratch')
      IN5=15
      OPEN(UNIT=15,FORM='UNFORMATTED',STATUS='SCRATCH')
      IN6=16
      OPEN(UNIT=16,FORM='UNFORMATTED',STATUS='SCRATCH')
      OUT=8
      OPEN(UNIT=8,FILE='modout',STATUS='UNKNOWN')
      OUT1=10
      OPEN(UNIT=10,FILE='modout2',STATUS='UNKNOWN')
C     *******OUTPUT FILES ADDED FOR SPRING HEADS AND FLOWS*************
C     Units 17,18, 19 & 21 are in Output.  Units 20 & 25 are in Getpmp
C
      OPEN(UNIT=17,FILE='spr_hds.dat',STATUS='UNKNOWN')
      OPEN(UNIT=18,FILE='spr_flw.dat',STATUS='UNKNOWN')
      OPEN(UNIT=19,FILE='wls.dat',STATUS='UNKNOWN')
      OPEN(UNIT=20,FILE='PmpRch.dat',STATUS='UNKNOWN')
      OPEN(UNIT=21,FILE='Lkgout.dat',STATUS='Unknown')
      OPEN(UNIT=25,FILE='factor.dat',STATUS='unknown')
c     OPEN(UNIT=23,FILE='rech-pump.dat',STATUS='unknown')
c     OPEN(UNIT=27,FILE='saws.dat',STATUS='unknown')
C
C     *********  Input Files *******
c     *** Used dom.97 data from EAA's Report
      OPEN(UNIT=50,FILE='dom.97',STATUS='old')
      OPEN(UNIT=51,FILE='Kmunir.avg',STATUS='old')
      OPEN(UNIT=53,FILE='UPrm4k.irr',STATUS='old')
      OPEN(UNIT=54,FILE='MPrm4k.irr',STATUS='old')
      OPEN(UNIT=55,FILE='BPrm4k.irr',STATUS='old')
c     OPEN(UNIT=56,FILE='Kirr.avg',STATUS='old')
      OPEN(UNIT=57,FILE='UPermt.ind',STATUS='old')
      OPEN(UNIT=58,FILE='MPermt.ind',STATUS='old')
      OPEN(UNIT=59,FILE='BPermt.ind',STATUS='old')
      OPEN(UNIT=60,FILE='SAWSPm.ind',STATUS='old')
      OPEN(UNIT=62,FILE='UPerm.mun',STATUS='old')
      OPEN(UNIT=63,FILE='MPerm.mun',STATUS='old')
      OPEN(UNIT=64,FILE='BPerm.mun',STATUS='old')
      OPEN(UNIT=65,FILE='CPerm.mun',STATUS='old')
      OPEN(UNIT=66,FILE='HPerm.mun',STATUS='old')
      OPEN(UNIT=67,FILE='SAWSPm.mun',STATUS='old')
      OPEN(UNIT=69,FILE='UPermt.wb',STATUS='old')
      OPEN(UNIT=70,FILE='MPermt.wb',STATUS='old')
      OPEN(UNIT=71,FILE='BPermt.wb',STATUS='old')
      OPEN(UNIT=74,FILE='CPermt.wb',STATUS='old')
      OPEN(UNIT=75,FILE='HPermt.wb',STATUS='old')
      OPEN(UNIT=72,FILE='SAWSPm.wb',STATUS='old')
C***********************************************************************
C     READ TITLE CARD AND
```

```
C     READ PARAMETER CARD
C***********************************************************************
      READ (IN,650) TITLE
      WRITE(OUT,710) TITMOD,TITLE
      READ (IN,520) NSTEPS,NSP,NR,NC, NPARM, NSPRG
      READ (IN,530) DELMAJ,ERROR,TIMACL,PMPFCT,PMPNAM,XLGTNM,FLXNAM,PERF
     1 CT,FLXFCT,STRFCT, SCALE
C***********************************************************************
C     CALCULATE SIZE OF FIRST MINOR TIME STEP
C***********************************************************************
      DELTA=1.0
      N=NSP
   10 N=N-1
      IF (N) 30,30,20
   20 DELTA=DELTA+TIMACL**N
      GO TO 10
   30 DELTA=DELMAJ/DELTA
      WRITE (OUT,660) NSTEPS,NSP,DELMAJ,DELTA,ERROR,NC,NR,NPARM,NSPRG,S
     1TRFCT,TIMACL,PMPFCT,PMPNAM,PERFCT,FLXFCT,FLXNAM,XLGTNM
C***********************************************************************
C      READ PHYSICAL DATA
C***********************************************************************
      CALL PHYSDT(NROW,NCOL,FLAG,BOTLEL,H,HO,P,SF1,T,THIK,SURF,
     1TOPAQ,R,RD)
   40 TIME=0.0
      NBLK=1
      IRWC(1,1)=1
      IRWC(2,1)=NR
      IRWC(3,1)=1
      IRWC(4,1)=NC
      TIMAC2=TIMACL
      DELMJ2=DELMAJ
      DEL=DELTA
C***********************************************************************
C      CALCULATE ITERATION PARAMETERS
C***********************************************************************
      HA=2.
      HC=3.14159*3.14159/(2*NR*NR)
      HB=3.14159*3.14159/(2*NC*NC)
      DO 50 I=1,NR
      DO 50 J=1,NC
      IF (FLAG(I,J).GT.2) GO TO 50
      HF=DELX(J)*DELX(J)/(DELY(I)*DELY(I))
      HD=HB/(1.+HF)
      F=HC/(1.+1./HF)
      HA=AMIN1(HA,HD,F)
   50 CONTINUE
      F=EXP(ALOG(1./HA)/(NPARM-1))
      PRMITR(1)=HA
      DO 60 I=2,NPARM
   60 PRMITR(I)=PRMITR(I-1)*F
      WRITE (OUT,510) (PRMITR(I),I=1,NPARM)
      TIME1=0.
c     do 65 i=1,31
c 65    read(21,75)(base(i,j),j=1,80)
c 75  format(10x,10f7.2)
c     do 76 i=1,nr
```

```
c      do 76 j=1,nc
c 76  saws(i,j)=0
c     do 77 i=1,27
c       read(27,*)irow,icol
c 77  saws(irow,icol)=1
c     read(65,*)(bexmun(i),i=1,12)
c     read(66,*)(commun(i),i=1,12)
c     read(71,*)(pumpnb(i),i=1,12)
c     comalfact=0.0
c     udmpfact=1.0
c     mdmpfact=1.0
c     factor=.84526
      dyfactor=0.0
      factor=1.0
C     *************  Hueco Springs
      fhueco=0.0
C*********************************************************************
C     BEGIN MAJOR TIME STEP LOOP
C*********************************************************************
      IDEC = 12
      DO 490 ISTEP=1,NSTEPS
      WRITE(OUT,710)TITMOD,TITLE
      WRITE (OUT,720) ISTEP
      DELTA=DEL
      NSP1=NSP
      DELMAJ=DELMJ2
      TIMACL=TIMAC2
C **  ********************
C     3/5/99  MODIFIED BY NK
C      EAA'S CRITICAL PERIOD MANAGEMENT RULES
C     CHOOSE A FACTOR BASED ON HEAD LEVEL OF WELLS J-17 (East),
C           69-47-306 (Medina) and J-27 (Uvalde)
C     PASSES FACTOR TO GETPMP.FOR SUBROUTINE TO MULTIPLY
C      WINTER BASE PUMPAGE
C********
C     ***  INDEX WELL J-17
C
       if(h(25,51) .gt. 650.) then
        comalfact=1.0
       else if(h(25,51) .gt. 642.) then
        comalfact=1.7
       else if(h(25,51) .gt. 636.) then
        comalfact=1.6
       else
        comalfact=1.4
       endif
c
C      *** Uvalde index well
C      **  20 feet subtracted from head to match calibrated head (by PM)
C
       if((h(12,15)-20.) .gt. 845.) then
        udmpfact=1.0
       else if((h(12,15)-20.) .gt. 840.) then
        udmpfact=1.7
       else
        udmpfact=1.6
      endif
```

```
C
C      *** Medina Index well
C
       IF((h(18,33)) .gt. 670.) THEN
        mdmpfact=1.0
       else if((h(18,33)) .gt. 660.) then
        mdmpfact=1.7
       else if((h(18,33)) .gt. 655.) then
        mdmpfact=1.6
       else
        mdmpfact=1.4
       ENDIF
C
c    **** Hueco Springs calculation
      fhueco = 36.31*h(25,51) - 23486.
      if (fhueco .le. 0.) fhueco = 0.0
      write(10,*) istep, h(25,51), fhueco
C
C***********************************************************************
C     READ OPTIONS FOR THIS TIME STEP
C***********************************************************************
c     if (istep.lt.6) then
      READ (IN,670) OPT,NSP2,DELMJ1,TIMAC1
     1,(B(J),J=1,6)
c     else
c     READ (40,670) OPT,NSP2,DELMJ1,TIMAC1
c    1,(B(J),J=1,6)
c     endif
      WRITE (OUT,680) (B(J),J=1,6)
      IF(OPT(14).GT.0.OR.OPT(15).GT.0) KOUT1=1
      DO 70 I=1,30
      IF (OPT(I).GT.0) WRITE (OUT,550) I,OPT(I)
      IF (OPT(1).GT.0.AND.I.EQ.1) WRITE (OUT,690) NSP2,DELMJ1,TIMAC1
   70 CONTINUE
   80 CONTINUE
      NSP1=NSP
      IF (OPT(1).LT.1) GO TO 120
C***********************************************************************
C      ADJUST TIME STEP PARAMETERS
C***********************************************************************
      TIMACL=TIMAC1
      DELTA=1.
      N=NSP2
   90 N=N-1
      IF (N) 110,110,100
  100 DELTA=DELTA+TIMACL**N
      GO TO 90
  110 DELTA=DELMJ1/DELTA
      NSP1=NSP2
      DELMAJ=DELMJ1
  120 CONTINUE
      DO 130 I=1,16
      SUMS(I,1)=0.
      IF(ISTEP.EQ.1)SUMS(I,2)=0.
  130 CONTINUE
      DO 140 I=1,NR
      DO 140 J=1,NC
```

```
  140 QSUM(I,J)=0.0
C***********************************************************************
C       READ EXTERNAL FLUX (PUMPAGE AND RECHARGE)
C***********************************************************************
      CALL GETPMP(NROW,NCOL,FLAG,Q,Q1,Q2,Q3,q4,q5,q7,qdum,RHG,
     * comalfact,dyfactor,q6,q8,q9,q10,q11,q12,factor,
     * udmpfact,mdmpfact,q13,q14,q15,q16,q17, fhueco,
     1 QDUMB, QDUMC, QDUMH, QDUMM, QDUMU, QDUMSI, QDUMSM)
C***********************************************************************
C      READ ENDING HEADS FOR CONSTANT-HEAD CELLS
C***********************************************************************
      IF (OPT(24).LT.1) GO TO 210
      WRITE(OUT,790)
      IFL=OPT(24)
      IF(OPT(24).GT.5) OPT(24)=OPT(24)-5
      DO 150 I=1,20
      FMT(I)=VFMT(I,4)
  150 IF(OPT(24).GT.2) FMT(I)=VFMT(I,5)
      IF(IFL.LT.5) GO TO 160
      READ (IN,590) FMT
      WRITE (OUT,780) (FMT(I),I=1,10)
  160 IF(OPT(24).GT.2) GO TO 190
      DO 180 I=1,NR
      READ (IN,FMT) (B(J),J=1,NC)
      DO 180 J=1,NC
      IF (FLAG(I,J)) 170,170,180
  170 DL(I,J)=(B(J)-H(I,J))/DELMAJ
      IF(OPT(24).EQ.2)DL(I,J)=B(J)/DELMAJ
  180 CONTINUE
      GO TO 210
  190 READ (IN,FMT) II,III,JJ,JJJ,HA
      IF (II.LT.1) GO TO 210
      DO 200 I=II,III
      DO 200 J=JJ,JJJ
      HB=HA-H(I,J)
      IF(OPT(24).EQ.4)HB=HA
  200 DL(I,J)=HB/DELMAJ
      GO TO 190
  210 CONTINUE
C***********************************************************************
C      READ LIMITS OF STATISTICAL GRID BLOCKS
C***********************************************************************
      IF (OPT(27).LT.1) GO TO 240
      DO 220 I=1,20
  220 FMT(I)=VFMT(I,5)
      IF(OPT(27).LT.5) GO TO 230
      READ (IN,650) FMT
      WRITE (OUT,780) (FMT(I),I=1,10)
  230 NBLK=NBLK+1
      READ (IN,FMT) (IRWC(J,NBLK),J=1,4)
      IF (IRWC(1,NBLK).GT.0) GO TO 230
      NBLK=NBLK-1
  240 CONTINUE
C***********************************************************************
C     SAVE HEADS AT BEGINNING OF TIME STEP
C***********************************************************************
      REWIND IN4
```

```
      WRITE (IN4) H
C*********************************************************************
C      BEGIN MINOR TIME STEP LOOP
C*********************************************************************
      DO 470 MINOR=1,NSP1
      TIME=TIME+DELTA
C*********************************************************************
C       CALCULATE TRANSMISSIVITIES
C*********************************************************************
      DO 260 I=1,NR
      DO 260 J=1,NC
      T1=THIK(I,J)
      IF(FLAG(I,J).EQ.1) T1=H(I,J)-BOTLEL(I,J)
      T(I,J,1)=0.0
      IF(J.EQ.NC) GO TO 250
      T2=THIK(I,J+1)
      IF(FLAG(I,J+1).EQ.1) T2=H(I,J+1)-BOTLEL(I,J+1)
      T2=2.*(T2*DELX(J)+T1*DELX(J+1))/(DELX(J)+DELX(J+1))**2
      T(I,J,1)=T2*P(I,J,1)*DELY(I)
  250 T(I,J,2)=0.0
      IF(I.EQ.NR) GO TO 260
      T2=THIK(I+1,J)
      IF(FLAG(I+1,J).EQ.1) T2=H(I+1,J)-BOTLEL(I+1,J)
      T2=2.*(T2*DELY(I)+T1*DELY(I+1))/(DELY(I)+DELY(I+1))**2
      T(I,J,2)=T2*P(I,J,2)*DELX(J)
  260 CONTINUE
  270 CONTINUE
C*********************************************************************
C       WRITE HEADS FOR BEGINNING OF TIME STEP
C*********************************************************************
      IF(MINOR.EQ.1.AND.KQUAL.GT.0) CALL SUMFLO(H,HO,T,R,RD,B,DELTA,
     1DELMAJ,NC,NR,NROW,NCOL,1,IN5,IN6)
C*********************************************************************
C      PREDICT HEAD FOR NEXT TIME STEP
C*********************************************************************
      DO 310 J=1,NC
      DO 310 I=1,NR
      D=H(I,J)-HO(I,J)
      HO(I,J)=H(I,J)
      IF(KSSH.GT.0) GO TO 310
      IF (FLAG(I,J)) 280,280,290
  280 H(I,J)=H(I,J)+DELTA*DL(I,J)
      IF(H(I,J).LT.BOTLEL(I,J))H(I,J)=BOTLEL(I,J)+0.1
      GO TO 310
  290 CONTINUE
      IF (FLAG(I,J).GT.2) GO TO 310
      F=0.0
      IF (ABS(DL(I,J)).LT.1.E-4) GO TO 300
      IF(MINOR.GT.2)F=D/DL(I,J)
      IF(F.GT.5.0)F=5.0
      IF(F.LT.0.0)F=0.0
  300 DL(I,J)=D
      H(I,J)=H(I,J)+D*F
  310 CONTINUE
C*********************************************************************
C      REFINE ESTIMATES OF HEADS BY IADI METHOD
C
```

```
C      CALL SUBROUTINE SOLVE TO PERFORM THE IADI PROCEDURE
C*****************************************************************
      CALL SOLVE(NROW,NCOL,FLAG,H,HO,T,SF1,Q,R,RD,TOPAQ)
  320 CONTINUE
      TIM=TIME/DELMJ2
  330 CONTINUE
      WRITE (OUT,560) TIME,TIM,E,ITER
      DO 450 J=1,NC
      DO 450 I=1,NR
      SUMCHD=0.
      IFL=FLAG(I,J)+1
      GO TO (340,350,350,450), IFL
C*****************************************************************
C     DETERMINE FLOWS WITH CONSTANT HEAD CELLS
C*****************************************************************
  340 IF(I.GT.1)SUMCHD=SUMCHD-T(I-1,J,2)*(H(I-1,J)-H(I,J))*DELTA
      IF(I.LT.NR)SUMCHD=SUMCHD+T(I,J,2)*(H(I,J)-H(I+1,J))*DELTA
      IF(J.GT.1)SUMCHD=SUMCHD-T(I,J-1,1)*(H(I,J-1)-H(I,J))*DELTA
      IF(J.LT.NC)SUMCHD=SUMCHD+T(I,J,1)*(H(I,J)-H(I,J+1))*DELTA
      IF(SUMCHD.GT.0.)SUMS(6,1)=SUMS(6,1)+SUMCHD
      IF(SUMCHD.LT.0.)SUMS(5,1)=SUMS(5,1)-SUMCHD
      GO TO 450
  350 CONTINUE
      IF(KSSH.GT.0) HO(I,J)=H(I,J)
       GO TO (450,351,352,450),IFL
  351  HC=AMIN1(H(I,J),TOPAQ(I,J))
       HA=SF1(I,J)*(HC-HO(I,J))
       HB=SF1(I,J )/STRFCT*(H(I,J)-HC)
       GO TO 353
  352  HC=AMAX1(H(I,J),TOPAQ(I,J))
       HA=SF1(I,J)*STRFCT*(H(I,J)-HC)
       HB=SF1(I,J)  *(HC-HO(I,J))
  353  IF(HA.GT.0.)  SUMS(7,1)=SUMS(7,1)+ HA
       IF(HB.GT.0.)  SUMS(17,1)=SUMS(17,1)  + HB
       IF(HA.LT.0.)  SUMS(8,1)=SUMS(8,1)  - HA
       IF(HB.LT.0.)  SUMS(18,1) = SUMS(18,1)  - HB
      HA=R(I,J)*(H(I,J)-RD(I,J))*DELTA
      IF(R(I,J)) 360,380,370
  360 QSUM(I,J)=QSUM(I,J)-HA
      GO TO 380
  370 IF(H(I,J).LT.RD(I,J)) GO TO 380
      QSUM(I,J)=QSUM(I,J)+HA
  380 CONTINUE
C*****************************************************************
C      CHECK FOR CHANGE OF NODE TYPE
C*****************************************************************
      ITYPE=FLAG(I,J)+1
      GO TO (420,390,410,430),ITYPE
  390 IF(H(I,J).LE.TOPAQ(I,J)) GO TO 430
      IF(H(I,J).LE.SURF(I,J)) GO TO 400
      HA=RHG(I,J)*PMPFCT
      RHG(I,J)=0.0
      Q(I,J)=Q(I,J)+HA
      SUMS(10,1)=SUMS(10,1)+HA*(DELMAJ-TIME+TIME1)
      WRITE(OUT,770) I,J,HA,XLGTNM
C*****************************************************************
C      NODE CHANGED FROM WATER TABLE TO ARTESIAN
```

```
C*********************************************************************
  400 SF1(I,J)=SF1(I,J)/STRFCT
      WRITE (OUT,750) I,J,H(I,J)
      FLAG(I,J)=2
      GO TO 430
  410 IF(H(I,J).GT.TOPAQ(I,J)) GO TO 430
C*********************************************************************
C      NODE CHANGED FROM ARTESIAN TO WATER TABLE
C*********************************************************************
      SF1(I,J)=SF1(I,J)*STRFCT
      WRITE (OUT,760) I,J,H(I,J)
      FLAG(I,J)=1
      GO TO 430
  420 IF(H(I,J).GT.TOPAQ(I,J)) GO TO  430
      THIK(I,J)=H(I,J)-BOTLEL(I,J)
  430 CONTINUE
C*********************************************************************
C     IF H IS BELOW BOTTOM ELEVATION, REDUCE PUMPAGE, IF POSSIBLE.
C*********************************************************************
      IF (H(I,J).GT.BOTLEL(I,J)) GO TO 450
      HA=Q(I,J)+RHG(I,J)*PMPFCT
      Q(I,J)=-RHG(I,J)*PMPFCT
      IF(HA.LT.1.)HA=0.
      SUMS(9,1)=SUMS(9,1)+HA*(DELMAJ-TIME+TIME1)
C*********************************************************************
C      SET MINIMUM THICKNESS TO 0.1
C*********************************************************************
      H(I,J)=BOTLEL(I,J)+0.1
      WRITE (OUT,700) I,J,HA,XLGTNM
  440 CONTINUE
  450 CONTINUE
C*********************************************************************
C      SUM FLOW FOR THIS TIME STEP
C*********************************************************************
      IF(KQUAL.GT.0) CALL SUMFLO(H,HO,T,R,RD,B,DELTA,DELMAJ,NC,NR,NROW,
     1 NCOL,2,IN5,IN6)
C*********************************************************************
C     PRINT MAP OF FLOWS - MINOR TIME STEP
C*********************************************************************
      IF (OPT(12).GT.0) CALL FLUX (NROW,NCOL,H,T)
C*********************************************************************
C     INCREASE SIZE OF TIME STEP
C*********************************************************************
      DELTA=DELTA*TIMACL
      IF (OPT(13).LT.1) GO TO 470
C*********************************************************************
C     WRITE WATER LEVELS AT END OF MINOR TIME STEP.
C*********************************************************************
      WRITE (OUT,710) TITMOD,TITLE
      WRITE (OUT,740) TIME
C*********************************************************************
      DO 460 I=1,NR
  460 WRITE (OUT,580) I,(H(I,J),J=1,NC)
C*********************************************************************
C     END MINOR TIME STEP LOOP
C*********************************************************************
  470 CONTINUE
```

```
      TIME1=TIME
  480 CONTINUE
C***********************************************************************
C     WRITE RESULTS
C***********************************************************************
c
          rewind 69
          rewind 70
          rewind 71
          rewind 72
          rewind 74
          rewind 75
      IF (ISTEP .EQ. IDEC) THEN
          IDEC=IDEC+12
          REWIND 50
          REWIND 51
          REWIND 53
          REWIND 54
          REWIND 55
          REWIND 57
          REWIND 58
          REWIND 59
          REWIND 60
          REWIND 62
          REWIND 63
          REWIND 64
          REWIND 65
          REWIND 66
          REWIND 67
      ENDIF
C
C***********************************************************************
      CALL OUTPUT(NROW,NCOL,FLAG,H,HO,P,BOTLEL,SF1,T,THIK,TOPAQ,
     1 SURF, QSUM,R,dyfactor,comalfact)
C***********************************************************************
C      CALL QUAL TO PERFORM MASS TRANSPORT
C***********************************************************************
      IF(KQUAL.GT.0) CALL QUAL(R,RD,DL,TOPAQ,SURF,THIK,BOTLEL,H,HO,
     1HDUM,SF1,Q,T,P,RHG,QSUM,FLAG,NROW,NCOL,NSP1,TIMACL)
C***********************************************************************
C     END MAJOR TIME STEP LOOP.
C***********************************************************************
  490 CONTINUE
C***********************************************************************
C     PRINT HYDROGRAPHS
C***********************************************************************
      IF (KHYD.GT.0) CALL HYDRO (NROW,NCOL,FLAG,H,HO,T)
  500 WRITE (OUT,730)
      IF(KOUT1.GT.0) END FILE OUT1
      STOP
C***********************************************************************
C
C
C
C
  510 FORMAT (//T20,'ITERATION PARAMETERS'//(T25,5F10.5))
  520 FORMAT (10I5)
```

```
530 FORMAT (4F10.0,4A6)
540 FORMAT (20I1)
550 FORMAT (T20,'TIME STEP OPTION',I5,' EQUALS',I5)
560 FORMAT (' TIME =',E20.8,' DAYS OR ',F7.2,' MAJOR TIME STEPS,','HE
   1AD CHANGE SUM = ',F8.2,' FEET, ITERATIONS =',I5)
570 FORMAT (1H1)
580 FORMAT (1H0,I4,5X,10F10.3/(10X,10F10.3))
590 FORMAT (20A4)
600 FORMAT (14H1ERROR MESSAGE,I5,/,15H0LAST CARD READ,/,5X,1H/,20A4,1H
   1/)
610 FORMAT (1H0,T4,'NODE',T12,'ROW',T18,'COL',T24,'FLAG',T33,'SURFAC',
   1T45,'TOP',1X,'OF',T54,'BOTTOM',T65,'THIK-',T75,'INIT-',T85,'PERM',
   2T95,'PERM',T103,'STORAGE'/T4,'TYPE',T32,'ELEVATION',T44,'AQUIFER',
   3T53,'ELEVATION',T65,'NESS',T75,'HEAD',T85,'X-DIR',T95,'Y-DIR',T104
   4,'COEF'/1X,28(4H----))
620 FORMAT (1X,2A4,I4,2I6,3X,5F10.2,2F10.0,E10.4)
630 FORMAT (5H NODE,2I3,37H CHANGED TO OUTCROP FOR HEAD EQUAL TOF10.3)
640 FORMAT (26I3)
650 FORMAT (20A4)
660 FORMAT (T20,'NUMBER OF MAJOR TIME STEPS',T65,I5,/T20,'NUMBER OF MI
   1NOR TIME STEPS',T65,I5/T20,'SIZE OF MAJOR TIME STEPS',T60,F10.3,5X
   2,'DAYS'/T20,'SIZE OF FIRST MINOR TIME STEP',T60,F10.3,5X,'DAYS'/T2
   30,'ERROR CRITERIA',T60,F10.2/T20,'NUMBER OF COLUMNS',T65,I5,/T20,'
   1NUMBER OF ROWS',T65,I5/T20,'NUMBER OF ITERATION PARAMETERS',T65,I5
   1/T20,'NUMBER OF SPRINGS/RIVER CELLS',T65,I5/T20,'STORAGE RATIO',T6
   10,F10.3
   5/T20,'TIME ACCELERATION FACTOR',T60,F10.3/T20,'FLUX CONVERSION FAC
   6TOR',T50,E20.8/T20,'EXTERNAL FLUX UNITS',T64,A6/T20,'PERMEABILITY
   7CONVERSION UNITS',T60,F10.6/T20,'PLOTTED FLOWS FACTOR',T50,E20.8/T
   820,'PLOT FLOWS UNITS NAME',T58,2A6/T20,'LENGTH UNIT NAME',T64,A6/)
670 FORMAT (30I1,I5,2F10.0,6A4)
680 FORMAT (1H0,50X,6A4)
690 FORMAT (T35,'NUMBER OF MINOR TIME STEPS',T80,I5/T35,'LENGTH OF MAJ
   1OR TIME STEP',T75,F10.2/T35,'TIME ACCELERATION FACTOR',T75,F10.3)
700 FORMAT (T5,' NODE',2I3,' DEWATERED, PUMPAGE REDUCED',E20.8,A6,'**3
   1/DAY')
710 FORMAT(1H1,T25,20A4//T25,20A4/)
720 FORMAT (1H0,50X,'SIMULATING TIME STEP',I5)
730 FORMAT (1H0,'*** JOB TERMINATED ***')
740 FORMAT (' SIMULATED HEADS AT END OF',F10.3,' DAYS')
750 FORMAT (T5,'NODE',2I3,' CHANGED TO ARTESIAN FOR HEAD =',F10.3)
760 FORMAT (T5,'NODE',2I3,' CHANGED TO WATER TABLE FOR HEAD =',F10.3)
770 FORMAT (T5,'NODE',2I3,' SURFACE FLOW, RECHARGE REDUCED',E20.8,A6
   1,'**3/DAY')
780 FORMAT (T70,'FORMAT IS',T80,10A4/)
790 FORMAT(T20,'READ CONSTANT HEADS'/)
    END
    include 'blkdat.for'
    include 'calib.for'
    include 'flux.for'
    include 'getpmp99.for'
    include 'hydro.for'
    include 'output99.for'
    include 'physdt.for'
    include 'ploth.for'
    include 'plots.for'
    include 'qsolve.for'
```

```
include 'qread.for'
include 'qual.for'
include 'solve.for'
include 'sumflo.for'
include 'xsect.for'
```

blkdat.for

```
      BLOCK DATA
     COMMON/RLCOM/FMT(20),TITLE(20),DELX(200),DELY(200),PRMITR(10),
     1    B(200),G(200),SUMS(18,2),ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,
     2    DELMAJ,E,XLGTNM,FLXNAM(2),FLXFCT,DELMJ2,TIME,STRFCT,
     3    SCALE,TITMOD(20),VFMT(20,7)
     DATA TITMOD/'TEXA','S WA','TER ','DEVE','LOPM','ENT ','BOAR',
     1'D   ','    ',' GRO','UND ','WATE','R SI','MULA','TION',' MOD',
     2'EL  ',' - G','WSIM','-IV'/
      DATA VFMT/'(15F','5.0)',18*'  ','(4X,','I1,8','F5.0',')',16*'  ',
     1'(5I5',',8F5','.0)',17*'  ','(10X',',10F','7.2)',
     217*'  ','(4I5',',2F1','0.0)',17*'  ','(2I5',',2F1','0.0)',17*'  ',
     3'(8X,','10F7','.1)',17*'  '/
      END
```

```
      SUBROUTINE CALIB(NROW,NCOL,FLAG,P,S,THIK,BOTLEL,H,IOPT7)
      COMMON /ITCOM/ NR,NC,ISTEP,NPARM,IN,OUT,OUT1,OPT(30),ITER,NSAVE,
     1ISAVE(25),JSAVE(25),KHYD,NCOLS,MCOLS(25),NROWS,MROWS(25)
     2,IN1,IN2,IN3,IN4,IN5,IN6
     1,NSTEPS,NBLK,IRWC(4,60),NSPRG,ISPRG(25),JSPRG(25),KSSH,KQUAL
      COMMON /RLCOM/ FMT(20),TITLE(20),DELX(200),DELY(200),PRMITR(10),B
     1(200),G(200),SUMS(18,2),
     2                              ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,
     3DELMAJ,E,XLGTNM,FLXNAM(2),FLXFCT
     1,DELMJ2,TIME,STRFCT,SCALE
     1,TITMOD(20),VFMT(20,7)
      INTEGER OPT,FLAG,OUT,OUT1
      DIMENSION FLAG(NROW,NCOL),P(NROW,NCOL,2),S(NROW,NCOL)
     1,THIK(NROW,NCOL),BOTLEL(NROW,NCOL),H(NROW,NCOL)
      DIMENSION NB(100),NP(5)
      EQUIVALENCE (B(1),NB(1))
C       MEANING OF OPTION 7
C***********************************************************************
C       MEANING OF IOPT7
C       1  NO MAPS
C       2 PERM AND TRANS MAPS
C       3  S MAP
C       4  BOTH MAPS
C***********************************************************************
   10 NP(1)=0
      NP(2)=0
      NP(3)=0
      GO TO (50,20,30,40),IOPT7
   20 NP(1)=1
      NP(2)=1
      GO TO 50
   30 NP(3)=1
      GO TO 50
   40 NP(1)=1
      NP(2)=1
      NP(3)=1
   50 CONTINUE
      NP(4)=NP(1)
      NP(5)=NP(2)
      WRITE (OUT,330)
   60 READ (IN,340) II,III,JJ,JJJ,K,HA
      IF (II.LT.1) GO TO 110
      WRITE (OUT,350) II,III,JJ,JJJ,K,HA
      DO 100 I=II,III
      DO 100 J=JJ,JJJ
      IF(K.GT.0) GO TO 80
      T1=THIK(I,J)
      IF(FLAG(I,J).EQ.1) T1=H(I,J)-BOTLEL(I,J)
      IF(K.EQ.-2) GO TO 70
      P(I,J,1)=0.
      IF(J.EQ.NC) GO TO 100
      T2=THIK(I,J+1)
      IF(FLAG(I,J+1).EQ.1) T2=H(I,J+1)-BOTLEL(I,J+1)
      P(I,J,1)=HA/((T1*DELX(J+1)+T2*DELX(J))/(DELX(J)+DELX(J+1)))
```

```
      GO TO 100
 70   P(I,J,2)=0.
      IF(I.EQ.NR) GO TO 100
      T2=THIK(I+1,J)
      IF(FLAG(I+1,J).EQ.1) T2=H(I+1,J)-BOTLEL(I+1,J)
      P(I,J,2)=HA/((T1*DELY(I+1)+T2*DELY(I))/(DELY(I)+DELY(I+1)))
 80   CONTINUE
      IF(K.EQ.3) GO TO 90
      P(I,J,K)=P(I,J,K)*HA
      IF(HA.LT.0.0) P(I,J,K)=-HA
      GO TO 100
 90   S(I,J)=S(I,J)*HA
      IF(HA.LT.0.)S(I,J)=-HA
100   CONTINUE
      GO TO 60
110   DO 320 K=1,5
      IF (NP(K).LT.1) GO TO 320
      IST=1
120   IEND=IST+31
      GO TO (130,140,150,160,170),K
130   WRITE (OUT,360)
      WRITE (OUT,420)
      GO TO 180
140   WRITE (OUT,370)
      WRITE (OUT,420)
      GO TO 180
150   WRITE (OUT,380)
      WRITE (OUT,420)
      WRITE (OUT,450)
      GO TO 180
160   WRITE (OUT,430)
      WRITE (OUT,420)
      GO TO 180
170   WRITE(OUT,440)
      WRITE (OUT,420)
180   CONTINUE
      IF(NR.LT.IEND)IEND=NR
      WRITE (OUT,390)
      DO 190 I=IST,IEND
190   NB(I)=IEND-I+IST
      WRITE (OUT,410) (NB(I),I=IST,IEND)
      DO 310 J=1,NC
      DO 300 I=IST,IEND
      L=IEND-I+IST
      NB(I)=0
      T1=THIK(L,J)
      IF(FLAG(L,J).EQ.1) T1=H(L,J)-BOTLEL(L,J)
      IFL=FLAG(L,J)+1
      M=K
      GO TO (260,260,200,270,280),M
200   GO TO (210,220,230,240),IFL
210   NB(I)=999
      GO TO 250
220   NB(I)=S(L,J)*1000.+0.5
      GO TO 250
230   NB(I)=S(L,J)*1.E6+0.5
      GO TO 250
```

```
  240 NB(I)=999999
  250 CONTINUE
      GO TO 300
  260 NB(I)=P(L,J,M)*0.1+0.5
      GO TO 290
  270 IF(J.EQ.NC) GO TO 290
      T2=THIK(L,J+1)
      IF(FLAG(L,J+1).EQ.1) T2=H(L,J+1)-BOTLEL(L,J+1)
      NB(I)=(T1*DELX(J+1)+T2*DELX(J))/(DELX(J)+DELX(J+1))
     1*P(L,J,1)*0.01+0.5
      GO TO 290
  280 IF(L.EQ.IEND) GO TO 290
      T2=THIK(L+1,J)
      IF(FLAG(L+1,J).EQ.1) T2=H(L+1,J)-BOTLEL(L+1,J)
      NB(I)=(T1*DELY(L+1)+T2*DELY(L))/(DELY(L)+DELY(L+1))
     1*P(L,J,2)*0.01+0.5
  290 IF(IFL.EQ.4) NB(I)=99999
  300 CONTINUE
  310 WRITE (OUT,410) (NB(I),I=IST,IEND),J
      IST=IEND+1
      IF (IST.LT.NR) GO TO 120
  320 CONTINUE
      RETURN
C
  330 FORMAT (///T20,'CALIBRATION ADJUSTMENTS'/T20,'ROW    ROW  COLUMN
     1COLUMN  PAGE  FACTOR'/T20,'START  END  START     END'/)
  340 FORMAT (5I5,F10.0)
  350 FORMAT (T20,I3,I7,I6,I8,I7,F10.3)
  360 FORMAT (1H1,T30,'PERMEABILITY IN X DIRECTION (1) TIMES 0.1'/)
  370 FORMAT (1H1,T30,'PERMEABILITY IN Y DIRECTION (2) TIMES 0.1'/)
  380 FORMAT (1H1,T30,'STORAGE COEFFICIENT'/T30,'TIMES 1,000 FOR WATER
     1TABLE CELLS'/T30,'TIMES 1,000,000 FOR ARTESIAN CELLS'/)
  390 FORMAT (5X,'ROWS')
  400 FORMAT (1H1,T20,'PAGE',I3/)
  410 FORMAT (1X,I3,32I4)
  420 FORMAT (1H+,T30,'BOUNDARY CELL = ****')
  430 FORMAT (1H1,T30,'TRANSMISSIVITY IN X-DIRECTION (1) TIMES 0.01'/)
  440 FORMAT (1H1,T30,'TRANSMISSIVITY IN Y-DIRECTION (2) TIMES 0.01'/)
  450 FORMAT (T30,'CONSTANT HEAD CELLS = 999')
      END
```

flux.for

```
      SUBROUTINE FLUX (NROW,NCOL,H,T)
       COMMON /ITCOM/ NR,NC,ISTEP,NPARM,IN,OUT,OUT1,OPT(30),ITER,NSAVE,
     1ISAVE(25),JSAVE(25),KHYD,NCOLS,MCOLS(25),NROWS,MROWS(25)
     2,IN1,IN2,IN3,IN4,IN5,IN6
     1,NSTEPS,NBLK,IRWC(4,60),NSPRG,ISPRG(25),JSPRG(25),KSSH,KQUAL
       COMMON /RLCOM/ FMT(20),TITLE(20),DELX(200),DELY(200),PRMITR(10),B
     1(200),G(200),SUMS(18,2),
     2                                ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,
     3DELMAJ,E,XLGTNM,FLXNAM(2),FLXFCT
     1,DELMJ2,TIME,STRFCT
     1,SCALE,TITMOD(20),VFMT(20,7)
       INTEGER OPT,OUT,OUT1
       DIMENSION H(NROW,NCOL),T(NROW,NCOL,2)
       DIMENSION NB(100)
       EQUIVALENCE (B(1),NB(1))
      DO 80 M=1,2
      WRITE(OUT,130)TITMOD,TITLE,ISTEP
      WRITE (OUT,120) FLXNAM,M
      WRITE (OUT,90)
      IST=1
10    IEND=IST+31
      IF(NR.LT.IEND)IEND=NR
      DO 20 I=IST,IEND
20    NB(I)=IEND-I+IST
      WRITE (OUT,110) (NB(I),I=IST,IEND)
      WRITE (OUT,110)
      DO 70 J=1,NC
      DO 60 I=IST,IEND
      L=IEND-I+IST
      HA=0.
      IF (L.EQ.NR.AND.M.EQ.2) GO TO 60
      IF (J.EQ.NC.AND.M.EQ.1) GO TO 60
      GO TO (40,30), M
30    HA=T(L,J,M)*(H(L,J)-H(L+1,J))*FLXFCT+0.5
      GO TO 50
40    HA=T(L,J,M)*(H(L,J)-H(L,J+1))*FLXFCT+0.5
50    IF(HA.LT.0.)HA=HA-1.
60    NB(I)=HA
70    WRITE (OUT,110) (NB(I),I=IST,IEND),J
      IST=IEND+1
      IF (IST.GT.NR) GO TO 80
      WRITE (OUT,100)
      GO TO 10
80    CONTINUE
      RETURN
C
90    FORMAT (5X,'ROWS')
100   FORMAT (1H1)
110    FORMAT (1X,32I4,I3)
120   FORMAT (/' FLOWS (',2A6,' ) IN DIRECTION ',I5/)
  130 FORMAT(1H1,T25,20A4//T25,20A4/T5,'FOR TIME STEP',I5//)
      END
```

```
      SUBROUTINE GETPMP(NROW,NCOL,FLAG,Q,q1,q2,q3,q4,q5,q7,qdum
     1 ,RHG,comalfact,dyfactor,q6,q8,q9,q10,q11,q12,factor,
     2 udmpfact,mdmpfact,q13,q14,q15,q16,q17, fhueco,
     6 QDUMB, QDUMC, QDUMH, QDUMM, QDUMU, QDUMSI, QDUMSM)
C     ****************************
C     *  4/7/99   MODIFIED BY NK
C     *  SUBROUTINE FILE IS NAMED:  GETPMP99.FOR
C     *  Changed to reflect the EAA'S CRITICAL PERIOD MANAGEMENT RULES
C     *      and to identify HUECO Springs
C     ****************************
      COMMON /ITCOM/ NR,NC,ISTEP,NPARM,IN,OUT,OUT1,OPT(30),ITER,NSAVE,
     1ISAVE(25),JSAVE(25),KHYD,NCOLS,MCOLS(25),NROWS,MROWS(25)
     2,IN1,IN2,IN3,IN4,IN5,IN6
     1,NSTEPS,NBLK,IRWC(4,60),NSPRG,ISPRG(25),JSPRG(25),KSSH,KQUAL
      COMMON /RLCOM/ FMT(20),TITLE(20),DELX(200),DELY(200),PRMITR(10),
     1 B(200),G(200),SUMS(18,2),
     2 ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,
     3 DELMAJ,E,XLGTNM,FLXNAM(2),FLXFCT
     1,DELMJ2,TIME,STRFCT,SCALE, TITMOD(20), VFMT(20,7)
      INTEGER OPT,FLAG,OUT,OUT1
      real mdmpfact,qdumu
      REAL QUWBSV, QMWBSV, QCWBSV, QPWBSV
      DIMENSION FLAG(NROW,NCOL),Q(NROW,NCOL),RHG(NROW,NCOL)
     1,Q1(NROW,NCOL),Q2(NROW,NCOL),qdum(nrow,ncol)
     1,Q3(NROW,NCOL),Q4(NROW,NCOL),Q5(NROW,NCOL)
     1,Q6(NROW,NCOL),Q8(NROW,NCOL),Q9(NROW,NCOL)
     1,Q10(NROW,NCOL),Q11(NROW,NCOL),Q12(NROW,NCOL)
     1,Q7(NROW,NCOL),Q13(NROW,NCOL),Q14(NROW,NCOL),Q15(NROW,NCOL)
     1,Q16(NROW,NCOL),Q17(NROW,NCOL)
      DIMENSION   QDUMB(NROW,NCOL), QDUMC(NROW,NCOL),
     2   QDUMM(NROW,NCOL), QDUMH(NROW,NCOL), QDUMSM(NROW,NCOL),
     2   QDUMSI(NROW,NCOL), QDUMU(NROW,NCOL)
C
C      *****
C       FOR WINTER BASE PUMPAGES  NK  3/23/99
C      *******
       QUWBSV = 0.0
       QMWBSV = 0.0
       QCWBSV = 0.0
       QUWBSV1 = 0.0
       QMWBSV1 = 0.0
       QCWBSV1 = 0.0
       QPWBSV = 0.0
       QINCSVSM = 0.0
       QINCSVSI = 0.0
       QINCSVB = 0.0
       QINCSVC = 0.0
       QINCSVH = 0.0
       QWBTMP = 0.0
C
       QUWB = 0.
       QMWB = 0.
       QBWB = 0.
C     ********************
```

```
      DO 5 I=1,NR
      DO 5 J=1,NC
      RHG(I,J)=0.
5     Q(I,J)=0.
       IF(OPT(10).LT.1) GO TO 11
       REWIND IN2
       READ (IN2) Q,RHG
11    CONTINUE
C     **********************
C      Set Factors = 1 for checking base pumpage as read in the program
C      Set as Comment statements for simulation
C      comalfact=1.0
C      mdmpfact=1.0
C      udmpfact=1.0
C     *************************
      write (25,582) istep, udmpfact,mdmpfact,comalfact
 582  FORMAT (' FACTORS for Time Step', T30, I5, 3F12.1)
      write(*,*)istep,udmpfact,mdmpfact,comalfact
C     write (*,*) 'Reduction, Initial', QUWBSV, QMWBSV, QCWBSV, QPWBSV
      numb=mod(istep,12)
      if(numb.eq.0) numb=12
      comtot=0
C     Compute annual pumpage and recharge
C     ***************
      IF (MOD(ISTEP,12) .EQ. 1) THEN
        ANNPMP = 0.
        ANNRCH = 0.
      ENDIF
C***********************************************************************
C      READ PUMPAGE FOR ALL CELLS
C***********************************************************************
      IF (OPT(2).LT.1) GO TO 30
       DO 18 I=1,20
18     FMT(I)=VFMT(I,4)
      IF(OPT(2).LT.5) GO TO 19
       READ (IN,450) FMT
       WRITE (OUT,470) (FMT(I),I=1,10)
C
C     Base Pumpage and Winter Base - NK 3/99
19    DO 20 I=1,NR
           READ(50,FMT) (Q(I,J),J=1,NC)
           READ(51,FMT) (Q6(I,J),J=1,NC)
           READ(53,FMT) (Q2(I,J),J=1,NC)
           READ(54,FMT) (Q3(I,J),J=1,NC)
           READ(55,FMT) (Q4(I,J),J=1,NC)
C
           READ(57,FMT) (Q7(I,J),J=1,NC)
           READ(58,FMT) (Q8(I,J),J=1,NC)
           READ(59,FMT) (Q9(I,J),J=1,NC)
C
           if (udmpfact.eq. 1.) then
            READ(62,FMT) (Q11(I,J),J=1,NC)
           else
            READ(62,FMT) (QDUMU(I,J),J=1,NC)
            READ(69,FMT) (Q11(I,J),J=1,NC)
               endif
C
```

```
          if (mdmpfact.eq. 1.) then
           READ(63,FMT)  (Q12(I,J),J=1,NC)
          else
           READ(63,FMT)  (QDUMM(I,J),J=1,NC)
           READ(70,FMT)  (Q12(I,J),J=1,NC)
          endif
C
          if (comalfact .eq. 1.) then
           READ(64,FMT)  (Q13(I,J),J=1,NC)
           READ(65,FMT)  (Q14(I,J),J=1,NC)
           READ(66,FMT)  (Q15(I,J),J=1,NC)
           READ(67,FMT)  (Q16(I,J),J=1,NC)
           READ(60,FMT)  (Q10(I,J),J=1,NC)
          else
           READ(64,FMT)  (QDUMB(I,J),J=1,NC)
           READ(65,FMT)  (QDUMC(I,J),J=1,NC)
           READ(66,FMT)  (QDUMH(I,J),J=1,NC)
           READ(67,FMT)  (QDUMSM(I,J),J=1,NC)
           READ(60,FMT)  (QDUMSI(I,J),J=1,NC)
C
           READ(71,FMT)  (Q13(I,J),J=1,NC)
           READ(74,FMT)  (Q14(I,J),J=1,NC)
           READ(75,FMT)  (Q15(I,J),J=1,NC)
           READ(72,FMT)  (Q16(I,J),J=1,NC)
        endif
C
C      *******
C      IF ((I .EQ. NR) .AND. (J .EQ. NC)) THEN
C      IF (I .EQ. NR) THEN
C      write(25,*) istep, udmpfact,mdmpfact,comalfact
C      WRITE (25,*)' ISTEP',ISTEP,' ROW=',I,'  TOT BEG REDUCTION',QPWBSV
C      ENDIF
C      ********
       DO 580 J = 1, NC
       JD = J
       if (udmpfact .GT. 1.) then
        Q11(I,J) = Q11(I,J)*udmpfact
        QUWB = Q11(I,J)
        IF (Q11(I,J) .GT. QDUMU(I,J)) THEN
C         REDUCTION IN PUMPAGE (from MANAGEMENT PLAN's value)
          QUWBSV = Q11(I,J) - QDUMU(I,J)
          Q11(I,J)=QDUMU(I,J)
        ENDIF
        QPWBSV = QPWBSV + QUWBSV
       endif
C      **************
C      Incremental value check       NK    4/6/99
C      IF (J .EQ. NC) THEN
C      WRITE (25,*) 'UVALDE REDUCTION',QUWBSV, ' TOT REDUCTION', QPWBSV
C      ENDIF
C      *************
C
       if (mdmpfact. GT. 1.) then
        Q12(I,J) = Q12(I,J)*mdmpfact
         QMWB = Q12(I,J)
        IF (Q12(I,J) .GT. QDUMM(I,J)) THEN
C        REDUCTION IN PUMPAGE (from MANAGEMENT PLAN's value)
```

```
          QMWBSV = Q12(I,J) - QDUMM(I,J)
          Q12(I,J)=QDUMM(I,J)
         ENDIF
         QPWBSV = QPWBSV + QMWBSV
        endif
C       **************
C       Incremental value check        NK    4/6/99
C       IF (J .EQ. NC) THEN
C       WRITE (25,*) 'MEDINA REDUCTION',QMWBSV, ' TOT REDUCTION', QPWBSV
C       ENDIF
C       *************
C

        if (comalfact .GT. 1.) then
         Q13(I,J)  = Q13(I,J)*comalfact
         Q14(I,J)  = Q14(I,J)*comalfact
         Q15(I,J)  = Q15(I,J)*comalfact
         QWBTMP = Q16(I,J)
         Q16(I,J)  = QWBTMP*0.73*comalfact
         Q10(I,J)  = QWBTMP*0.27*comalfact
C
C        REDUCTION IN PUMPAGE (from MANAGEMENT PLAN's value)
C

         QBWB = Q13(I,J)
         IF (Q13(I,J) .GT. QDUMB(I,J)) THEN
          QINCSVB = Q13(I,J) - QDUMB(I,J)
          Q13(I,J)=QDUMB(I,J)
         ENDIF
         QCWBSV = QCWBSV + QINCSVB
C       **************
C       Incremental value check        NK    4/6/99
C       IF (J .EQ. NC) THEN
C      WRITE (25,*) 'BEXAR REDUCTION',QINCSVB,' TOT EAST REDCTN',QCWBSV
C       ENDIF
C       *************
C

         IF (Q14(I,J) .GT. QDUMC(I,J)) THEN
          QINCSVC = Q14(I,J) - QDUMC(I,J)
          Q14(I,J)=QDUMC(I,J)
         ENDIF
         QCWBSV = QCWBSV + QINCSVC
C       **************
C       Incremental value check        NK    4/6/99
C       IF (J .EQ. NC) THEN
C       WRITE (25,*) 'COMAL REDUCTION',QINCSVC,' TOT EAST REDCTN',QCWBSV
C       ENDIF
C       *************
C

         IF (Q15(I,J) .GT. QDUMH(I,J)) THEN
          QINCSVH = Q15(I,J) - QDUMH(I,J)
          Q15(I,J)=QDUMH(I,J)
         ENDIF
         QCWBSV = QCWBSV + QINCSVH
C       **************
C       Incremental value check        NK    4/6/99
C       IF (J .EQ. NC) THEN
C       WRITE (25,*) 'HAYS REDUCTION',QINCSVH, ' TOT EAST REDCTN',QCWBSV
C       ENDIF
```

```
C       *************
C
         IF (Q16(I,J) .GT. QDUMSM(I,J)) THEN
          QINCSVSM = Q16(I,J) - QDUMSM(I,J)
          Q16(I,J)=QDUMSM(I,J)
         ENDIF
         QCWBSV = QCWBSV + QINCSVSM
C       **************
C       Incremental value check        NK    4/6/99
C       IF (J .EQ. NC) THEN
C       WRITE (25,*)'SAWS-MUN REDUCTION',QINCSVSM,' TOT EAST REDCTN',
C     $   QCWBSV
C       ENDIF
C       *************
C
         IF (Q10(I,J) .GT. QDUMSI(I,J)) THEN
          QINCSVSI = Q10(I,J) - QDUMSI(I,J)
          Q10(I,J)=QDUMSI(I,J)
         ENDIF
         QCWBSV = QCWBSV + QINCSVSI
         QPWBSV = QPWBSV + QCWBSV
        endif
C       **************
C       Incremental value check        NK    4/6/99
C       IF (J .EQ. NC) THEN
C       WRITE (25,*) ' SAWS-IND REDUCTION =', QINCSVSI,
C     $   '   TOTAL EAST REDUCTION', QCWBSV
C     $  / '   TOTAL Winter Base Pumpage REDUCTION', QPWBSV
C       ENDIF
C
C       IF ((ISTEP .EQ. 211) .OR. (ISTEP .EQ. 212) .OR.
C     $   (ISTEP .EQ. 213)) THEN
C       WRITE (25,588) I,J, QUWBSV, QMWBSV,
C     $   QINCSVB, QINCSVC, QINCSVH, QINCSVSM, QINCSVSI, QPWBSV
C      WRITE (25,589)J,QUWB,QDUMU(I,J), QMWB,QDUMM(I,J), QBWB,QDUMB(I,J)
C589    FORMAT ('  J', I3, 'PMP from WB & BASE for U', 2F8.1, ' for M',
C     $      2F8.1, '  for B', 2F8.1)
C       ENDIF
C588   FORMAT (' I J', 2I5,2x, 'QREDUCTIONS', 8F8.1)
C
        QUWBSV1 = QUWBSV
        QMWBSV1 = QMWBSV
        QCWBSV1 = QCWBSV
        QUWBSV = 0.0
        QMWBSV = 0.0
        QCWBSV = 0.0
        QINCSVB = 0.0
        QINCSVC = 0.0
        QINCSVH = 0.0
        QINCSVSM = 0.0
        QINCSVSI = 0.0
C
       QUWB = 0.
       QMWB = 0.
       QBWB = 0.
C
C       *************
```

```
C     * * *****************************************************************
C
C       Irrigation, Industrial & Municipal Sums
         Q2(I,J)= Q2(I,J)+ Q3(i,j)+ Q4(i,j)+ Q6(i,j)
         Q7(I,J)= Q7(I,J)+ Q8(i,j)+ Q9(i,j)
         Q11(I,J)= Q11(I,J)+ Q12(i,j)+ Q13(I,J)+ Q14(I,J)+ Q15(I,J)+
     &       Q16(I,J)+ Q10(I,J)
C       TOTAL PUMPAGE
        Q(I,J) = Q(I,J)+ Q2(I,J)+ Q7(I,J)+ Q11(I,J)
C
C       ***************************************
 580    CONTINUE
        WRITE (*,*)' I J', I,JD, ' ISTEP',ISTEP, ' QREDUCTIONS',
     $  QUWBSV1, QMWBSV1, QCWBSV1, QPWBSV
C       WRITE (25,*)' I J', I,JD, ' ISTEP',ISTEP, ' QREDUCTIONS',
C    $  QUWBSV1, QMWBSV1, QCWBSV1, QPWBSV
C
 20    CONTINUE
C
C      Write the reductions in pumpage values.
       Write (25,584) istep, QUWBSV1, QMWBSV1, QCWBSV1, QPWBSV
 584   FORMAT (' QREDUCTIONS for Time Step', T30, I5, 4F12.1)
       Write (*,*) ' QREDUCTIONS',istep, QUWBSV1,QMWBSV1, QCWBSV1, QPWBSV
C
C**********************************************************************
C       READ PUMPAGE BY BLOCK
C**********************************************************************
 30    IF (OPT(3).LT.1) GO TO 60
       WRITE (OUT,350)
       WRITE (OUT,360)
       DO 38 I=1,20
38      FMT(I)=VFMT(I,5)
        IF(OPT(3).LT.5) GO TO 40
        READ (IN,450) FMT
        WRITE (OUT,470) (FMT(I),I=1,10)
40      READ(IN,FMT) II,III,JJ,JJJ,HA
       IF (II.LT.1) GO TO 60
       WRITE (OUT,380) II,III,JJ,JJJ,HA
       DO 50 I=II,III
       DO 50 J=JJ,JJJ
       IF (FLAG(I,J).GT.2) GO TO 50
       Q(I,J)=HA
50     CONTINUE
       GO TO 40
C**********************************************************************
C       READ PUMPAGE ADJUSTMENTS
C**********************************************************************
60     IF (OPT(4).LT.1) GO TO 90
       WRITE (OUT,390)
       WRITE (OUT,360)
        DO 69 I=1,20
69      FMT(I)=VFMT(I,5)
        IF(OPT(4).LT.5) GO TO 70
        READ (IN,450) FMT
        WRITE (OUT,470) (FMT(I),I=1,10)
70      READ (IN,FMT) II,III,JJ,JJJ,HA
       IF (II.LT.1) GO TO 90
```

```
      WRITE (OUT,380) II,III,JJ,JJJ,HA
      DO 80 I=II,III
      DO 80 J=JJ,JJJ
80    Q(I,J)=Q(I,J)*HA
      GO TO 70
90    CONTINUE
C************************************************************************
C      READ RECHARGE FOR ALL CELLS
C************************************************************************
      IF (OPT(5).LT.1) GO TO 110
       DO 98 I=1,20
98     FMT(I)=VFMT(I,7)
       IF(OPT(5).LT.5) GO TO 99
      READ (IN,450) FMT
       WRITE (OUT,470) (FMT(I),I=1,10)
99    DO 100 I=1,NR
         READ (IN,FMT) (RHG(I,J),J=1,NC)
100   continue
C
C     *******  Hueco Springs  ******   3/16/99
      RHG(18,65) = RHG(18,65) - (fhueco*0.5)
      RHG(19,65) = RHG(19,65) - (fhueco*0.5)
C
C     ***********************************
C     Pumpage and Recharge Totals for comparing with Input,with Factors = 1
C     **           ******  NK 4/99 ********
      SUMP = 0.
      SUMR = 0.
      DO 590 I = 1, NR
      DO 590 J = 1, NC
        SUMP = SUMP + Q(I,J)
        SUMR = SUMR + RHG(I,J)
 590  CONTINUE
        WRITE (*,*) istep, SUMP, SUMR
        WRITE (20,598) istep, SUMP, SUMR
 598  FORMAT (' Time Step',I4, ' Pumpage',F10.0, ' Recharge',T55, F10.0)
C     ***************************
C     Compute Annual values
      ANNPMP = ANNPMP + SUMP
      ANNRCH = ANNRCH + SUMR
      IF (MOD(ISTEP,12) .EQ. 0) THEN
        WRITE (*,*) ISTEP, ANNPMP, ANNRCH
        WRITE (20,599) ISTEP, ANNPMP, ANNRCH
 599  FORMAT(' Time Step',I4,' Ann Pumpage',F10.0,' Ann Recharge',F10.0)
      ENDIF
C
C************************************************************************
C      READ RECHARGE BY BLOCK
C************************************************************************
110   IF (OPT(6).LT.1) GO TO 140
       IFL=OPT(6)
       IF(OPT(6).GT.5) OPT(6)=OPT(6)-5
      WRITE (OUT,370)
       IF(OPT(6).EQ.2) WRITE (OUT,371)
      WRITE (OUT,360)
       DO 118 I=1,20
118    FMT(I)=VFMT(I,5)
```

```
      IF(IFL.LT.5) GO TO 120
      READ (IN,450) FMT
      WRITE (OUT,470) (FMT(I),I=1,10)
120   READ (IN,FMT) II,III,JJ,JJJ,HA
      IF(II.LT.1) GO TO 135
      WRITE (OUT,380) II,III,JJ,JJJ,HA
      DO 130 I=II,III
      DO 130 J=JJ,JJJ
      HB=1.
      IF(OPT(6).EQ.2) HB=DELX(J)*DELY(I)/PMPFCT
      IF (FLAG(I,J).GT.2) GO TO 130
      RHG(I,J)=HA*HB
130   CONTINUE
      GO TO 120
135   OPT(6)=OPT(6)-2
      GO TO 110
C*********************************************************************
C     READ RECHARGE ADJUSTMENTS
C*********************************************************************
140   IF (OPT(7).LT.1) GO TO 170
      WRITE (OUT,400)
      WRITE (OUT,360)
      DO 149 I=1,20
149   FMT(I)=VFMT(I,5)
      IF(OPT(7).LT.5) GO TO 150
      READ (IN,450) FMT
      WRITE(OUT,470) (FMT(I),I=1,10)
150   READ (IN,FMT) II,III,JJ,JJJ,HA
      IF (II.LT.1) GO TO 170
      WRITE (OUT,380) II,III,JJ,JJJ,HA
      DO 160 I=II,III
      DO 160 J=JJ,JJJ
160   RHG(I,J)=RHG(I,J)*HA
      GO TO 150
170   CONTINUE
180   CONTINUE
C*********************************************************************
C     STORE PUMPAGE AND RECHARGE
C*********************************************************************
      IF (OPT(9).LT.1) GO TO 190
      REWIND IN2
      WRITE (IN2) Q,RHG
190   CONTINUE
C*********************************************************************
C*********************************************************************
C     WRITE PUMPAGE AND RECHARGE
C*********************************************************************
200   IF (OPT(11).LT.1) GO TO 230
      WRITE (OUT,410) TITMOD,TITLE
      WRITE (OUT,420) ISTEP
      DO 210 I=1,NR
210   WRITE (OUT,430) I,(Q(I,J),J=1,NC)
      WRITE(OUT,410)TITMOD,TITLE
      WRITE (OUT,440) ISTEP
      DO 220 I=1,NR
220   WRITE (OUT,430) I,(RHG(I,J),J=1,NC)
230   CONTINUE
```

```
C***********************************************************************
C      CONVERT PUMPAGE AND RECHARGE UNITS
C***********************************************************************
      DO 340 I=1,NR
      DO 340 J=1,NC
      IF (FLAG(I,J).LT.1.OR.FLAG(I,J).GT.2) GO TO 340
      IF (Q(I,J)) 240,260,250
240   SUMS(2,1)=SUMS(2,1)-Q(I,J)
      GO TO 260
250   SUMS(1,1)=SUMS(1,1)+Q(I,J)
260   IF (RHG(I,J)) 270,290,280
270   SUMS(4,1)=SUMS(4,1)-RHG(I,J)
      GO TO 290
280   SUMS(3,1)=SUMS(3,1)+RHG(I,J)
290   HA=0.
      HB=0.
      IF (Q(I,J)) 300,310,310
300   HA=-Q(I,J)
      Q(I,J)=0.
310   IF (RHG(I,J)) 320,330,330
320   HB=-RHG(I,J)
      RHG(I,J)=0.
330   RHG(I,J)=RHG(I,J)+HA
      Q(I,J)=(Q(I,J)+HB-RHG(I,J))*PMPFCT
340   CONTINUE
c     write(*,345)istep,sums(3,1)
c45   format(i3,1x,f20.4)
C***********************************************************************
C     RETURN
C***********************************************************************
      RETURN
C
350   FORMAT (//T30,'BLOCK  PUMPAGE  ASSIGNMENT'/)
360   FORMAT (/T21,'ROW    ROW  COLUMN  COLUMN'T56,'VALUE'/T21,'START  E
     1ND  START    END'//)
370   FORMAT (//T30,'BLOCK  RECHARGE  ASSIGNMENT')
371    FORMAT(//T30,'PER UNIT AREA  -  (LENGTH PER TIME STEP)')
380    FORMAT (T21,I3,4X,I3,3X,I3,5X,I3,G19.4)
390   FORMAT (//T30,'BLOCK PUMPAGE ADJUSTMENTS')
400   FORMAT (//T30,'BLOCK RECHARGE ADJUSTMENTS')
  410 FORMAT(1H1,T25,20A4//T25,20A4/)
420    FORMAT (1H0,T21,'PUMPAGE FOR TIME STEP',I5/)
430   FORMAT (/I5,10F10.3/(5X,10F10.3))
440    FORMAT (1H0,T21,'RECHARGE FOR TIME STEP',I5/)
450   FORMAT (20A4)
460   FORMAT (4I5,F10.0)
470    FORMAT (T70,'FORMAT IS',T80,10A4/)
      END
```

```
      SUBROUTINE HYDRO (NROW,NCOL,FLAG,HSIM,H,H1)
"
       COMMON /ITCOM/ NR,NC,ISTEP,NPARM,IN,OUT,OUT1,OPT(30),ITER,NSAVE,
"
     1ISAVE(25),JSAVE(25),KHYD,NCOLS,MCOLS(25),NROWS,MROWS(25)
"
     2,IN1,IN2,IN3,IN4,IN5,IN6

     1,NSTEPS,NBLK,IRWC(4,60),NSPRG,ISPRG(25),JSPRG(25),KSSH,KQUAL
       COMMON /RLCOM/ FMT(20),TITLE(20),DELX(200),DELY(200),PRMITR(10),B
     1(200),G(200),SUMS(18,2),
     2                               ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,
     3DELMAJ,E,XLGTNM,FLXNAM(2),FLXFCT
     1,DELMJ2,TIME,STRFCT,SCALE
     1,TITMOD(20),VFMT(20,7)
       INTEGER OPT,FLAG,OUT,OUT1
       DIMENSION FLAG(NROW,NCOL),HSIM(NROW,NCOL),H(NROW,NCOL),H1(NROW,NC
     1OL),IX(21)
C***********************************************************************
C     THIS SUBROUTINE PRODUCES A HYDROGRAPH FOR SPECIFIED NODES.
C     FOR ARRAYS H AND H1, FIRST SUBSCRIPT INDICATES THE NUMBER OF THE
C     SPECIFIED NODE AND THE SECOND SUBSCRIPT INDICATES THE TIME PERIOD
C***********************************************************************
      REAL MAP(21)
      DATA KAT,IX(1),IXX/0,0,1/
      NYR=NSTEPS
      REWIND IN3
      DATA BLANK,SIM,OBS,XINC/1H ,1HS,1HO,5.0/,BOTH/1HB/
      READ (IN3) HSIM
      IX(1)=1
      DO 10 K=1,NSAVE
      I=ISAVE(K)
      J=JSAVE(K)
      H(K,1)=-1.E5
10    H1(K,1)=HSIM(I,J)
20    NYRS=NYR-20
C***********************************************************************
      IF (KAT.GT.0.AND.NYRS.LE.-20) RETURN
C***********************************************************************
      IF(NYRS.LE.0)NYRS=NYR
      NSTOP=0
      IF(KAT.LT.1)NSTOP=1
      IF (NYRS.EQ.NYR) GO TO 30
      NYRS=20
30    CONTINUE
      NYR=NYR-NYRS
      DO 60 N=1,NYRS
      IK=IXX+N
      READ (IN3) HSIM
      NSTOP=NSTOP+1
      READ (IN3) IOPT
      IX(IK)=IOPT
      DO 40 K=1,NSAVE
      I=ISAVE(K)
```

```
      J=JSAVE(K)
40    H(K,IK)=HSIM(I,J)
      IF (IOPT.LT.1) GO TO 60
      NSTOP=NSTOP+1
      READ (IN3) HSIM
      DO 50 K=1,NSAVE
      I=ISAVE(K)
      J=JSAVE(K)
50    H1(K,IK)=HSIM(I,J)
60    CONTINUE
      KAT=KAT+1
      IF (KAT.GT.1) GO TO 70
      IXY=0
      NYRS=NYRS+1
70    DO 140 N=1,NSAVE
      II=ISAVE(N)
       WRITE(OUT,170)TITMOD,TITLE
      JJ=JSAVE(N)
      IYX=NYRS-IXX+(KAT-1)*20
      WRITE (OUT,150) II,JJ,(J,J=IXY,IYX)
      HMAX=-1.E10
      DO 80 K=1,NYRS
      IOPT=IX(K)
      IF(IOPT.GT.0)HMAX=AMAX1(HMAX,H1(N,K))
80    HMAX=AMAX1(HMAX,H(N,K))
      HMAX=HMAX+2.0*XINC
      KOUNT=0
      JOUNT=0
90    DO 100 J=1,21
100   MAP(J)=BLANK
      JOUNT=JOUNT+1
      HMAX=HMAX-XINC
      DO 120 L=1,NYRS
      IOPT=IX(L)
      IF (ABS(H(N,L)-HMAX).GE.(XINC*0.5)) GO TO 110
      KOUNT=KOUNT+1
      MAP(L)=SIM
      IF (IOPT.LT.1) GO TO 120
      IF (ABS(H1(N,L)-HMAX).GE.(XINC*0.5)) GO TO 110
      KOUNT=KOUNT+1
      MAP(L)=BOTH
      GO TO 120
110   CONTINUE
      IF (IOPT.LT.1) GO TO 120
      IF (ABS(H1(N,L)-HMAX).GE.(XINC*0.5)) GO TO 120
      KOUNT=KOUNT+1
      MAP(L)=OBS
120   CONTINUE
130   CONTINUE
      WRITE (OUT,160) HMAX,MAP
      IF (KOUNT.GE.NSTOP.OR.JOUNT.GT.50) GO TO 140
      GO TO 90
140   CONTINUE
      IXX=0
      IXY=KAT*20+1
      GO TO 20
C
```

```
C
C
C
150    FORMAT (1H0,10X,'HYDROGRAPH FOR NODE (',I3,1H,,I3,1H),10X,'S=SIMUL
      1ATED',5X,'O=OBSERVED',5X,'B=OBSERVED=SIMULATED'//5X,'HEAD',11X,21I
      25/)
160    FORMAT (1H ,F10.3,12X,21(1X,A4))
  170 FORMAT(1H1,T25,20A4//T25,20A4/)
       END
```

```
SUBROUTINE  OUTPUT (NROW,NCOL,FLAG,H,HO,P,BOTLEL,SF1,T,THIK,
     1TOPAQ,SURF,QSUM,R,dyfactor,comalfact)
C
C      ****************
C      *  Subroutine:  OUTPUT99.FOR
C      *     3/29/99    Modified by NK
c      ****************
C
      COMMON /ITCOM/ NR,NC,ISTEP,NPARM,IN,OUT,OUT1,OPT(30),ITER,NSAVE,
     1ISAVE(25),JSAVE(25),KHYD,NCOLS,MCOLS(25),NROWS,MROWS(25)
     2,IN1,IN2,IN3,IN4,IN5,IN6
     1,NSTEPS,NBLK,IRWC(4,60),NSPRG,ISPRG(25),JSPRG(25),KSSH,KQUAL
      COMMON /RLCOM/ FMT(20),TITLE(20),DELX(200),DELY(200),PRMITR(10),B
     1(200),G(200),SUMS(18,2),
     2                              ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,
     3DELMAJ,E,XLGTNM,FLXNAM(2),FLXFCT
     1,DELMJ2,TIME,STRFCT,SCALE
     1,TITMOD(20),VFMT(20,7)
      INTEGER OPT,FLAG,OUT,OUT1
      DIMENSION FLAG(NROW,NCOL),H(NROW,NCOL),HO(NROW,NCOL)
     1,P(NROW,NCOL,2),BOTLEL(NROW,NCOL),SF1(NROW,NCOL),
     2THIK(NROW,NCOL),TOPAQ(NROW,NCOL),QSUM(NROW,NCOL)
     2,SURF(NROW,NCOL)
     2,T(NROW,NCOL,2)
     1,R(NROW,NCOL)
C*********************************************************************
C       SAVE HEADS FOR HYDROGRAPH ROUTINE
C*********************************************************************
      IF (KHYD.LT.1) GO TO 10
C   ******************************************************************
C   *  SAVE SIMULATED HEAD FOR HYDROGRAPH ROUTINE
C   ******************************************************************
      WRITE (IN3) H
      WRITE (IN3) OPT(22)
   10 CONTINUE
C*********************************************************************
C      PREFORM MASS BALANCE COMPUTATIONS.
C*********************************************************************
      DLT2J=DELMAJ/DELMJ2
      DO 40 I=1,NR
      DO 40 J=1,NC
      HA=QSUM(I,J)
      IF(R(I,J)) 20,40,30
   20 IF(HA.LT.0.0) SUMS(15,1)=SUMS(15,1) - HA
      IF(HA.GT.0.0) SUMS(14,1)=SUMS(14,1) + HA
      GO TO 40
   30 SUMS(11,1)= SUMS(11,1) + HA
   40 CONTINUE
      if(mod(istep,12).eq.0) dyfactor=0
C     if(istep.eq.1) then
C       rechttl=0
C       pumpttl=0
C       rechdef=0
```

```
C       endif
        DO 90 K=1,NSPRG
        IF(NSPRG.LT.1) GO TO 90
        I=ISPRG(K)
        J=JSPRG(K)
        HA=QSUM(I,J)
        HB=HA/PMPFCT*DLT2J
       1/DELMAJ
        IF(R(I,J)) 50,90,80
   50 IF(HA) 70,90,60
   60 SUMS(12,1)=SUMS(12,1)+ HA
        SUMS(14,1)=SUMS(14,1) - HA
        WRITE (OUT,580) I,J,H(I,J),HB,PMPNAM
        GO TO 90
   70 SUMS(13,1)=SUMS(13,1) - HA
        SUMS(15,1)=SUMS(15,1) + HA
        HB=-HB
        WRITE (OUT,600) I,J,H(I,J),HB,PMPNAM
        GO TO 90
   80 WRITE (OUT,590) I,J,H(I,J),HB,PMPNAM
c     *********************************************************************
C       NEXT TWO LINES INSERTED TO WRITE SPRING HEADS AND FLOWS TO FILE
c       Added by PDM in 1991
C     *********8********
        WRITE (17,591)ISTEP,H(I,J),I,J
        WRITE (18,592)ISTEP,HB,I,J
c
c       Comal Springflow value
c        if ((hb/(30.42*1.9835)).lt.60)write(*,*)istep,comalfact
c        EUWD Drought Management Plan
c       Previous 250,200,150,125
c        if ((hb/(30.42*1.9835)).gt.200) then
c             comalfact=1.0
c        else if((hb/(30.42*1.9835)).gt.150) then
c             comalfact=1.8
c        else if((hb/(30.42*1.9835)).gt.125) then
c             comalfact=1.6
c        else if((hb/(30.42*1.9835)).gt.100) then
c             comalfact=1.4
c        else
c             comalfact=1.4
c        endif
c       *****************************************************************
C
   90 CONTINUE
        WRITE(OUT,830) TITMOD,TITLE
        WRITE (OUT,480) ISTEP,ISTEP,XLGTNM,PMPNAM,XLGTNM,PMPNAM
        SUMS(16,1)=SUMS(8,1)-SUMS(7,1)+ PMPFCT*DELMAJ*(SUMS(2,1)-SUMS(1,1
       1 )+SUMS(3,1)-SUMS(4,1))+SUMS(6,1)-SUMS(5,1)+SUMS(9,1)-SUMS(10,1)
       2 -SUMS(11,1)-SUMS(12,1)+SUMS(13,1)-SUMS(14,1)+SUMS(15,1)
       3 +SUMS(18,1)-SUMS(17,1)
        DO 100 K=1,4
  100 SUMS(K,1)=SUMS(K,1)*DLT2J
        DO 110 K=1,18
  110 SUMS(K,2)=SUMS(K,2)+SUMS(K,1)
        DO 120 K=5,18
  120 SUMS(K,1)=SUMS(K,1)/DELMAJ
```

```
      DO 130 K=1,3,2
      B(1)=SUMS(K,1)*PMPFCT/DLT2J
      B(2)=SUMS(K,2)*PMPFCT*DELMJ2/TIME
      B(3)=SUMS(K+1,1)*PMPFCT/DLT2J
      B(4)=SUMS(K+1,2)*PMPFCT*DELMJ2/TIME
      B(6)=SUMS(K,1)-SUMS(K+1,1)
      B(5)=B(1)-B(3)
      B(8)=SUMS(K,2)-SUMS(K+1,2)
      B(7)=B(2)-B(4)
      IF (K.EQ.1) WRITE (OUT,490)
      IF (K.EQ.3) WRITE (OUT,500)
      WRITE (OUT,510) (B(L),SUMS(K,L),L=1,2),(B(L+2),SUMS(K+1,L),L=1,2),
     1    (B(L),L=5,8)
130   CONTINUE
      DO 140 K=5,7,2
      B(1)=SUMS(K,1)/PMPFCT*DLT2J
      HA=SUMS(K,2)/TIME
      B(2)=HA/PMPFCT*TIME/DELMJ2
      B(3)=SUMS(K+1,1)/PMPFCT*DLT2J
      HB=SUMS(K+1,2)/TIME
      B(4)=HB/PMPFCT*TIME/DELMJ2
      B(5)=SUMS(K,1)-SUMS(K+1,1)
      B(6)=B(1)-B(3)
      B(7)=HA-HB
      B(8)=B(2)-B(4)
      IF (K.EQ.5) WRITE (OUT,520) SUMS(K,1),B(1),HA,B(2),SUMS(K+1,1),B(3
     1 ),HB,B(4),(B(L),L=5,8)
      IF (K.EQ.7) WRITE (OUT,530) SUMS(K,1),B(1),HA,B(2),SUMS(K+1,1),B(3
     1 ),HB,B(4),(B(L),L=5,8)
140   CONTINUE
       B(1)=SUMS(17,1)/PMPFCT*DLT2J
       HA=SUMS(17,2)/TIME
       B(2)=HA/PMPFCT*TIME/DELMJ2
       B(3)=SUMS(18,1)/PMPFCT*DLT2J
       HB=SUMS(18,2)/TIME
       B(4)=HB/PMPFCT*TIME/DELMJ2
       B(5)=SUMS(17,1)-SUMS(18,1)
       B(6)=B(1)-B(3)
       B(7)=HA-HB
       B(8)=B(2)-B(4)
       WRITE (OUT,535) SUMS(17,1),B(1),HA,B(2),SUMS(18,1),B(3),HB,
     1 (B(L),L=4,8)
      DO 150 K=9,11
      B(1)=SUMS(K,1)/PMPFCT*DLT2J
      HA=SUMS(K,2)/TIME
      B(2)=HA/PMPFCT*TIME/DELMJ2
      IF(K.EQ.9) WRITE (OUT,540)
      IF(K.EQ.10) WRITE (OUT,550)
      IF(K .EQ.11) WRITE (OUT,560)
150   WRITE (OUT,570) SUMS(K,1),B(1),HA,B(2)
      DO 160 K=12,14,2
      B(1)=SUMS(K,1)/PMPFCT*DLT2J
      HA=SUMS(K,2)/TIME
      B(2)=HA/PMPFCT*TIME/DELMJ2
      B(3)=SUMS(K+1,1)/PMPFCT*DLT2J
      HB=SUMS(K+1,2)/TIME
      B(4)=HB/PMPFCT*TIME/DELMJ2
```

```
      B(5)=SUMS(K,1)-SUMS(K+1,1)
      B(6)=B(1)-B(3)
      B(7)=HA-HB
      B(8)=B(2)-B(4)
      IF(K.EQ.12) WRITE(OUT,610) SUMS(K,1),B(1),HA,B(2),SUMS(K+1,1),B(3
     1),HB,(B(L),L=4,8)
      IF(K.EQ.14) WRITE(OUT,620) SUMS(K,1),B(1),HA,B(2),SUMS(K+1,1),B(3
     1),HB,(B(L),L=4,8)
C     ***** Added to write out Leakage out of Cells **********
C     ***    NK   3/99   ****
C
      IF (K .EQ. 14) THEN
      WRITE (21,999) ISTEP, B(1)
      ENDIF
 999  FORMAT (1X, I5, '  LEAKAGE OUT OF CELLS', F15.2)
C     ***********************************************
 160  CONTINUE
      B(1)=SUMS(16,1)/PMPFCT*DLT2J
      HA=SUMS(16,2)/TIME
      B(2)=HA/PMPFCT*TIME/DELMJ2
      WRITE (OUT,630) SUMS(16,1),B(1),HA,B(2)
      IF (OPT(14).LT.1) GO TO 190
C***********************************************************************
C     SAVE HEAD DATA ON UNIT OUT1
C***********************************************************************
      WRITE (OUT1,740) ISTEP
      DO 170 I=1,NR
  170 WRITE (OUT1,730) I,(H(I,J),J=1,NC)
  180 CONTINUE
  190 IF (OPT(15).LT.1) GO TO 210
C***********************************************************************
C     WRITE PHYSICAL DATA
C***********************************************************************
      WRITE (OUT1,880)
      DO 200 I=1,NR
      DO 200 J=1,NC
      HA=SF1(I,J)/(DELX(J)*DELY(I))
      IF(FLAG(I,J).EQ.2) HA=HA*1.E6
      HB=P(I,J,1)/PERFCT
      HC=P(I,J,2)/PERFCT
      WRITE (OUT1,890) I,J,FLAG(I,J),SURF(I,J),TOPAQ(I,J),BOTLEL(I,J),
     1THIK(I,J),H(I,J),HB,HC,HA
  200 CONTINUE
  210 CONTINUE
C***********************************************************************
C     NEXT FOUR LINES ADDED TO PRINT WATER LEVELS TO A SEPARATE FILE
C     ADDED BY PDM 2/6/92
      DO 225 I=1,NR
      DO 225 J=1,NC
      IF((H(I,J) .NE. 0)) WRITE (19,651) I,J, H(I,J)
  225 CONTINUE
C***********************************************************************
      IF (OPT(16).LT.1) GO TO 230
C***********************************************************************
C     PRINT WATER LEVELS AT END OF MAJOR TIME STEP
C***********************************************************************
      WRITE(OUT,830) TITMOD,TITLE
```

```
      WRITE (OUT,700) ISTEP
      DO 220 I=1,NR
  220 WRITE (OUT,650) I,(H(I,J),J=1,NC)
  230 CONTINUE
C**********************************************************************
C       PLOT WATER LEVELS
C**********************************************************************
      IF(OPT(26).GT.0) CALL PLOTH(NROW,NCOL,FLAG,H,THIK,TOPAQ,BOTLEL,SF
     11,1)
C**********************************************************************
C       READ HEAD AT START OF TIME STEP
C**********************************************************************
      IF (OPT(18).LT.1.AND.OPT(19).LT.1) GO TO 270
      REWIND IN4
      READ (IN4) HO
C**********************************************************************
C         PRINT MAP OF WATER LEVEL CHANGES DURING THIS TIME STEP
C**********************************************************************
      IF (OPT(19).LT.1) GO TO 240
      CALL PLOTS (NROW,NCOL,FLAG,H,HO,2)
  240 CONTINUE
C**********************************************************************
C       LIST HEAD CHANGES DURING TIME STEP
C**********************************************************************
      IF (OPT(18).LT.1) GO TO 270
      WRITE(OUT,830) TITMOD,TITLE
      WRITE (OUT,720) ISTEP
      DO 260 I=1,NR
      DO 250 J=1,NC
  250 B(J)=H(I,J)-HO(I,J)
  260 WRITE (OUT,650) I,(B(J),J=1,NC)
  270 CONTINUE
C**********************************************************************
C       PLOT GROUND WATER FLOWS
C**********************************************************************
      IF (OPT(17).GT.0) CALL FLUX (NROW,NCOL,H,T)
      IF (OPT(20).LT.1.AND.OPT(21).LT.1) GO TO 310
C**********************************************************************
C       READ INITIAL WATER LEVELS
C**********************************************************************
      REWIND IN1
      READ (IN1) HO
      IF (OPT(20).LT.1) GO TO 300
C**********************************************************************
C      PRINT HEAD CHANGES THROUGH THIS TIME STEP
C**********************************************************************
      WRITE(OUT,830) TITMOD,TITLE
      WRITE (OUT,710) ISTEP
      DO 290 I=1,NR
      DO 280 J=1,NC
  280 B(J)=H(I,J)-HO(I,J)
  290 WRITE (OUT,650) I,(B(J),J=1,NC)
  300 CONTINUE
C**********************************************************************
C       PLOT WATER LEVELS CHANGES THROUGH THIS TIME STEP
C**********************************************************************
      IF (OPT(21).GT.0) CALL PLOTS (NROW,NCOL,FLAG,H,HO,3)
```

```
  310 CONTINUE
      IF (OPT(22).LT.1) GO TO 400
  320 CONTINUE
C***********************************************************************
C     READ MEASURED WATER LEVEL DATA
C***********************************************************************
      DO 330 I=1,20
  330 FMT(I)=VFMT(I,4)
      IF(OPT(22).LT.5) GO TO 340
      READ (IN,690) FMT
      WRITE (OUT,900) (FMT(I),I=1,10)
  340 DO 350 I=1,NR
      READ (IN,FMT) (HO(I,J),J=1,NC)
C***********************************************************************
C     LIST SIMULATED AND MEASURED WATER LEVELS
C     AND SIMULATION ERRORS
C***********************************************************************
  350 CONTINUE
      WRITE(OUT,830) TITMOD,TITLE
      WRITE (OUT,840) ISTEP
      DO 390 I=1,NR
      DO 370 J=1,NC
      B(J)=0.
      IFL=FLAG(I,J)+1
      GO TO (370,360,360,370), IFL
  360 B(J)=H(I,J)-HO(I,J)
  370 CONTINUE
      JST=1
  380 JEND=JST+9
      JEND=MIN0(JEND,NC)
      WRITE (OUT,650)
      WRITE (OUT,660) I,(H(I,J),J=JST,JEND)
      WRITE (OUT,670) (HO(I,J),J=JST,JEND)
      WRITE (OUT,670) (B(J),J=JST,JEND)
      JST=JEND+1
      IF (JST.GT.NC) GO TO 390
      GO TO 380
  390 CONTINUE
C***********************************************************************
C     PRINT MAP OF SIMULATION ERRORS
C***********************************************************************
      CALL PLOTS (NROW,NCOL,FLAG,H,HO,1)
C***********************************************************************
C     SAVE HEADS FOR HYDROGRAPH ROUTINE.
C***********************************************************************
      WRITE (IN3) HO
  400 CONTINUE
C***********************************************************************
C     PRINT CROSS-SECTIONS
C***********************************************************************
      IF (OPT(23).LT.1) GO TO 430
      IF(OPT(23).NE.2) GO TO 410
      OPT(22)=1
      REWIND IN1
      READ (IN1) HO
      GO TO 420
  410 IF(OPT(23).NE.3) GO TO 420
```

```
      OPT(22)=1
      REWIND IN4
      READ (IN4) HO
  420 CONTINUE
      CALL XSECT (NROW,NCOL,FLAG,H,HO,BOTLEL)
  430 CONTINUE
C***********************************************************************
C       LIST AND PLOT SATURATED THICKNESS
C***********************************************************************
      IF (OPT(25).LT.1) GO TO 470
      IF(OPT(25).EQ.3) GO TO 460
      WRITE(OUT,830) TITMOD,TITLE
      WRITE (OUT,850) ISTEP
      DO 450 I=1,NR
      DO 440 J=1,NC
      HO(I,J)=THIK(I,J)
      IF(FLAG(I,J).EQ.3) HO(I,J)=0.0
  440 IF(FLAG(I,J).EQ.1) HO(I,J)=H(I,J)-BOTLEL(I,J)
  450 WRITE (OUT,650) I,(HO(I,J),J=1,NC)
      IF(OPT(25).LT.2) GO TO 470
  460 CALL PLOTH(NROW,NCOL,FLAG,H,THIK,TOPAQ,BOTLEL,SF1,2)
  470 CONTINUE
C***********************************************************************
C       RETURN
C***********************************************************************
      RETURN
C***********************************************************************
C
C
C
C
  480 FORMAT (//T41,'FOR TIME STEP',I6,T80,'THROUGH TIME STEP',I6/T34,A6
     1,'**3/DAY',T55,A6,'/STEP',T74,A6,'**3/DAY',T99,A6/)
  490 FORMAT (/T6,'PUMPAGE')
  500 FORMAT (/T6,'RECHARGE')
  510 FORMAT (T10,'POSITIVE',T26,2(F20.1,F20.4)/T10,'NEGATIVE',T26,2(F20
     1.1,F20.4)/T10,'NET',T26,2(F20.1,F20.4))
  520 FORMAT (/T6,'CONSTANT HEAD FLOW',/T10,'TO CELLS',T26,2(F20.1,F20.4
     1)/T10,'FROM CELLS',T26,2(F20.1,F20.4)/T10,'NET',T26,2(F20.1,F20.4)
     2)
  530  FORMAT (/T6,'CHANGE IN STORAGE',/T10,'WATER TABLE',
     1/T10,'INCREASE',T26,2(F20.1,F20.4)
     1/T10,'DECREASE',T26,2(F20.1,F20.4)/T10,'NET',T26,2(F20.1,F20.4))
  535  FORMAT (/T10,'ARTESIAN',/T10,'INCREASE',T26,2(F20.1,F20.4)
     1/T10,'DECREASE',T26,2(F20.1,F20.4),
     2/T10,'NET',T26,2(F20.1,F20.4))
  540 FORMAT(/T6,'REDUCTION IN PUMPAGE')
  550 FORMAT (/T6,'REDUCTION IN RECHARGE')
  560 FORMAT (/T6,'SPRINGFLOW')
  570 FORMAT (1H+,T26,2(F20.1,F20.4)/)
  580 FORMAT (T6,'FOR CELL',2I3,' HEAD =',F10.3,' FLOW TO RIVER =',4X
     1,F20.4,1X,A6,'/STEP')
  590 FORMAT (T6,'FOR CELL',I3,I3,' HEAD =',F10.3,' FLOW FROM SPRINGS =
     1',F20.4,1X,A6,'/STEP')
  591 FORMAT (I3,',',F10.3,5X,I3,1X,I3)
  592 FORMAT (I3,',',F20.4,5X,I3,1X,I3)
  600 FORMAT (T6,'FOR CELL',2I3,' HEAD =',F10.3,' FLOW FROM RIVER =',
```

```
   12X,F20.4,1X,A6,'/STEP')
610 FORMAT (/T6,'RIVER FLOW'/T10,'TO RIVER',T26,2(F20.1,F20.4)/
   1T10,'FROM RIVER',T26,2(F20.1,F20.4)/T10,'NET',T26,2(F20.1,F20.4))
620 FORMAT (/T6,'LEAKAGE'/T10,' OUT OF CELLS',T26,2(F20.1,F20.4)/
   1T10,'INTO CELLS',T26,2(F20.1,F20.4)/T10,'NET',T26,
   12(F20.1,F20.4))
630 FORMAT (/T6,'MASS BALANCE',T26,2(F20.1,F20.4))
640 FORMAT (1H1)
650 FORMAT (1H0,I4,5X,10F10.3/(10X,10F10.3))
651 FORMAT (2I5, F10.3)
660 FORMAT (1H0,I4,5X,10F10.3)
670 FORMAT (10X,10F10.3)
680 FORMAT (20A4)
690 FORMAT (20A4)
700 FORMAT (T20,'WATER LEVELS FOR END OF TIME STEP',I5//)
710 FORMAT (1H0,T10,'WATER LEVEL CHANGES THROUGH TIME STEP',I5//)
720 FORMAT (1H0,T10,'WATER LEVEL CHANGES DURING TIME STEP',I5//)
730 FORMAT (I5,5X,10F7.1/(10X,10F7.1))
740 FORMAT (30H SIMULATED HEADS FOR TIME STEP,T40,I5)
750 FORMAT (1H+,T55,'PFACT =',F10.2)
760 FORMAT (1H+,T55,'RFACT =',F10.2)
770 FORMAT (1H+,T55,'NOOPT -',I10)
780 FORMAT (1H+,T55,'NSP2 =',I5,' DELMJ2 =',F10.1)
790 FORMAT (1H1,T20,'PUMPAGE VALUES (AC-FT) FOR TIME STEP',I5//)
800 FORMAT (1H1,T20,'RECHARGE VALUES (AC-FT) FOR TIME STEP',I5//)
810 FORMAT (' FOR NODE',2I3,' PUMPAGE REDUCED BY',F10.2,' AC-FT/TIME S
   1TEP')
820 FORMAT (1H1,T20,'NET PUMPAGE-RECHARGE VALUES (AC-FT) FOR TIME'1X,'
   1STEP',I5//)
830 FORMAT(1H1,T25,20A4//T25,20A4/)
840 FORMAT (T10,'FOR TIME STEP ',I5,T35,'SIMULATED WATER LEVELS'/T35,'
   1MEASURED WATER LEVELS'/T35,'SIMULATION ERRORS'/)
850 FORMAT (T5,'SATURATED THICKNESS AT END OF STEP',I5//)
860 FORMAT (1H0,'*** JOB TERMINATED ***')
870 FORMAT (' SIMULATED HEADS AT END OF',F10.3,' DAYS')
880 FORMAT ('(6X,I3,5F9.3,2F8.1,F10.5)')
890 FORMAT (3I3,5F9.3,2F8.1,F10.5)
900 FORMAT (T70,'FORMAT IS ',T80,10A4/)
    END
```

```
      SUBROUTINE PHYSDT(NROW,NCOL,FLAG,BOTLEL,H,HO,P,SF1,T,THIK,SURF,
     1TOPAQ,R,RD)
      COMMON /ITCOM/ NR,NC,ISTEP,NPARM,IN,OUT,OUT1,OPT(30),ITER,NSAVE,
     1ISAVE(25),JSAVE(25),KHYD,NCOLS,MCOLS(25),NROWS,MROWS(25)
     2,IN1,IN2,IN3,IN4,IN5,IN6
     1,NSTEPS,NBLK,IRWC(4,60),NSPRG,ISPRG(25),JSPRG(25)
     1,KSSH,KQUAL
      COMMON /RLCOM/ FMT(20),TITLE(20),DELX(200),DELY(200),PRMITR(10),B
     1(200),G(200),SUMS(18,2),
     2                                  ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,
     3DELMAJ,E,XLGTNM,FLXNAM(2),FLXFCT
     1,DELMJ2,TIME,STRFCT,SCALE,TITMOD(20),VFMT(20,7)
      INTEGER OPT,FLAG,OUT,OUT1
      DIMENSION FLAG(NROW,NCOL),H(NROW,NCOL),BOTLEL(NROW,NCOL),HO(NROW,
     1NCOL),P(NROW,NCOL,2),SF1(NROW,NCOL),T(NROW,NCOL,2),THIK(NROW,NCOL)
     2,SURF(NROW,NCOL),TOPAQ(NROW,NCOL)
     1,R(NROW,NCOL),RD(NROW,NCOL)
      DIMENSION TYPE(2,4)
      DATA TYPE/4HWATR,4H TBL,4HARTE,4HSIAN,4HBOUN,
     14HDARY,4HCONS,4HT HD/
C***********************************************************************
C     READ OPTIONS WHICH CONTROL GENERAL EXECUTION OF PROGRAM
C***********************************************************************
      READ (IN,630) OPT
      DO 10 I=1,20
      IF (OPT(I).GT.0) WRITE (OUT,590) I,OPT(I)
   10 CONTINUE
      KSSH=OPT(14)
      KQUAL=OPT(15)
C***********************************************************************
C     IF HYDROGRAPHS ARE REQUIRED, READ NUMBER OF AND COORDINATES OF
C     THE SPECIFIC NODES.
C***********************************************************************
      IF (OPT(1).LT.1) GO TO 20
      KHYD=OPT(1)
      READ (IN,660) NSAVE,(ISAVE(I),JSAVE(I),I=1,NSAVE)
   20 CONTINUE
C***********************************************************************
C     IF CROSS-SECTIONS ARE REQUESTED, READ NUMBER OF AND INDEX FOR THE
C     REQUESTED COLUMNS AND ROWS, RESPECTIVELY.
C***********************************************************************
      IF (OPT(2).LT.1) GO TO 30
      READ (IN,660) NCOLS,(MCOLS(I),I=1,NCOLS)
      READ (IN,660) NROWS,(MROWS(I),I=1,NROWS)
   30 CONTINUE
C***********************************************************************
C     READ GRID SPACINGS IN THE X AND Y DIMENSIONS, RESPECTIVELY.
C***********************************************************************
      DO 40 K=1,20
   40 FMT(K)=VFMT(K,1)
```

```
      IF(OPT(3).LT.5) GO TO 50
      OPT(3)=OPT(3)-5
      READ (IN,670) FMT
      WRITE (OUT,740) (FMT(K),K=1,10)
   50 IF(OPT(3).LT.1) GO TO 80
C*********************************************************************
C     READ AND WRITE CONSTANT GRID SPACINGS
C*********************************************************************
      READ (IN,FMT) HA,HB
      DO 60 I=1,NR
   60 DELY(I)=HB
      DO 70 J=1,NC
   70 DELX(J)=HA
      WRITE (OUT,730) HA,HB
      GO TO 90
   80 CONTINUE
      READ (IN,FMT) (DELX(J),J=1,NC)
      READ (IN,FMT) (DELY(I),I=1,NR)
      IF (OPT(4).LT.1) GO TO 90
      WRITE (OUT,690)
      WRITE (OUT,600) (DELX(J),J=1,NC)
      WRITE (OUT,700)
      WRITE (OUT,600) (DELY(I),I=1,NR)
   90 CONTINUE
      IF(SCALE.GT.-1.E-3) GO TO 120
      SCALE=1.E6
      DO 100 I=1,NR
  100 SCALE=AMIN1(DELY(I)*6.,SCALE)
      DO 110 J=1,NC
  110 SCALE=AMIN1(DELX(J)*10.,SCALE)
  120 WRITE (OUT,610) SCALE,XLGTNM
C*********************************************************************
C     READ PHYSICAL DATA FORMAT CARD
C*********************************************************************
      DO 130 K=1,20
  130 FMT(K)=VFMT(K,2)
      IF(OPT(5).LT.5) GO TO 140
      OPT(5)=OPT(5)-5
      READ (IN,670) FMT
      WRITE (OUT,740) (FMT(K),K=1,10)
  140 IF(OPT(5).LT.1) GO TO 160
C*********************************************************************
C     READ AND WRITE DEFAULT VALUES TO BE ASSIGNED TO ALL NODES
C*********************************************************************
      READ (IN,FMT) K,(B(N),N=1,8)
      IF(K.EQ.2) B(8)=B(8)/1.E6
      WRITE (OUT,720) K,(B(N),N=1,8)
      DO 150 J=1,NC
      DO 150 I=1,NR
      FLAG(I,J)=K
      SURF(I,J)=B(1)
      TOPAQ(I,J)=B(2)
      BOTLEL(I,J)=B(3)
      THIK(I,J)=B(4)
      H(I,J)=B(5)
      P(I,J,1)=B(6)
      P(I,J,2)=B(7)
```

```
  150 SF1(I,J)=B(8)
      GO TO 180
  160 CONTINUE
C*********************************************************************
C     READ NODE CARDS
C*********************************************************************
      DO 170 I=1,NR
      DO 170 J=1,NC
      READ (IN,FMT) FLAG(I,J),SURF(I,J),TOPAQ(I,J),BOTLEL(I,J),THIK(I,J
     1),H(I,J),P(I,J,1),P(I,J,2),SF1(I,J)
      IF(FLAG(I,J).EQ.2) SF1(I,J)=SF1(I,J)/1.E6
      IF(FLAG(I,J).EQ.3) H(I,J)=0
  170 CONTINUE
  180 CONTINUE
      IF (OPT(6).LT.1) GO TO 230
      DO 190 K=1,20
  190 FMT(K)=VFMT(K,3)
      IF(OPT(6).LT.5) GO TO 200
      READ (IN,670) FMT
C*********************************************************************
C      READ CORRECTIONS TO NODE CARDS
C*********************************************************************
      WRITE (OUT,740) (FMT(K),K=1,10)
  200 WRITE(OUT,710)
      WRITE (OUT,640)
  210 READ (IN,FMT) II,III,JJ,JJJ,K,(B(N),N=1,8)
      IF(II.LT.1) GO TO 230
      IF(K.EQ.2) B(8)=B(8)/1.E6
      IF(K.EQ.0)K=4
      DO 220 I=II,III
      DO 220 J=JJ,JJJ
      FLAG(I,J)=K
      IF(K.GT.3) FLAG(I,J)=0
      WRITE (OUT,650) TYPE(1,K),TYPE(2,K),I,J,FLAG(I,J),(B(N),N=1,8)
      SURF(I,J)=B(1)
      TOPAQ(I,J)=B(2)
      BOTLEL(I,J)=B(3)
      THIK(I,J)=B(4)
      H(I,J)=B(5)
      P(I,J,1)=B(6)
      P(I,J,2)=B(7)
  220 SF1(I,J)=B(8)
      GO TO 210
  230 CONTINUE
C*********************************************************************
C      READ PARAMETER ADJUSTMENT DATA
C*********************************************************************
      IF(OPT(7).GT.0) CALL CALIB(NROW,NCOL,FLAG,P,SF1,THIK,BOTLEL,H,OPT
     1(7))
      DO 320 K=1,2
      IF(K.EQ.1.AND.OPT(11).LT.1) GO TO 320
      IF(K.EQ.2.AND.OPT(12).LT.1) GO TO 320
      IFL=OPT(11)
      IF(K.EQ.2) IFL=OPT(12)
      IFL5=IFL
      IF(IFL.GT.5) IFL=IFL-5
C*********************************************************************
```

```
C       READ LEAKAGE TERMS
C*************************************************************************
      IF(K.EQ.1) WRITE (OUT,750)
      IF(K.EQ.2) WRITE ( OUT,760)
      IF(IFL.GT.2) GO TO 270
      DO 240 N=1,20
  240 FMT(N)=VFMT(N,4)
      IF(IFL5.LT.5) GO TO 250
      READ (IN,670) FMT
      WRITE (OUT,740) (FMT(N),N=1,10)
  250 DO 260 I=1,NR
      READ (IN,FMT) (B(J),G(J),J=1,NC)
      DO 260 J=1,NC
      R(I,J)=R(I,J)*G(J)
      IF(K.EQ.1) R(I,J)=G(J)
      RD(I,J)=RD(I,J)*B(J)
  260 IF(K.EQ.1) RD(I,J)=B(J)
      IF(IFL.EQ.1) GO TO 320
  270 DO 280 N=1,20
  280 FMT(N)=VFMT(N,5)
      IF(IFL5.LT.5) GO TO 290
      READ (IN,670) FMT
      WRITE (OUT,740) (FMT(I),I=1,10)
  290 WRITE (OUT,770)
  300 READ (IN,FMT) II,III,JJ,JJJ,HA,HB
      IF(II.LT.1) GO TO 320
      WRITE (OUT,780) II,III,JJ,JJJ,HA,HB
      DO 310 I=II,III
      DO 310 J=JJ,JJJ
      R(I,J)=R(I,J)*HB
      IF(K.EQ.1) R(I,J)=HB
      RD(I,J)=RD(I,J)*HA
  310 IF(K.EQ.1) RD(I,J)=HA
      GO TO 300
  320 CONTINUE
C*************************************************************************
C       WRITE LEAKAGE TERMS
C*************************************************************************
      IF(OPT(13).LT.1) GO TO 350
      WRITE(OUT,680)TITMOD,TITLE
      WRITE (OUT,790) XLGTNM
      DO 330 I=1,NR
  330 WRITE (OUT,570) I,(RD(I,J),J=1,NC)
      WRITE(OUT,680)TITMOD,TITLE
      WRITE (OUT,800) PMPNAM,XLGTNM
      DO 340 I=1,NR
      WRITE (OUT,570) I,(R(I,J),J=1,NC)
  340 CONTINUE
  350 CONTINUE
      DO 360 I=1,NR
      DO 360 J=1,NC
      IF(FLAG(I,J).LT.1) R(I,J)=0.0
      IF(R(I,J)) 358,360,359
358   R(I,J)=R(I,J)*DELX(J)*DELY(I)
      GO TO 360
359   R(I,J)=-R(I,J)*PMPFCT
360   CONTINUE
```

```
C***********************************************************************
C       READ SPRING OR RIVER CELL DATA
C***********************************************************************
      IF(NSPRG.LT.1) GO TO 410
      READ(IN,670)FMT
      DO 370 N=1,20
  370 FMT(N)=VFMT(N,6)
      WRITE(OUT,785)
      WRITE(OUT,740)(FMT(K),K=1,10)
      DO 400 N=1,NSPRG
      IF(NSPRG.LT.1) GO TO 400
      READ (IN,FMT) I,J,RD(I,J),R(I,J)
      HA=-R(I,J)
      IF(HA.GT.0.0) GO TO 380
      WRITE (OUT,850) I,J,RD(I,J),R(I,J)
     1,PMPNAM,XLGTNM
      GO TO 390
  380 WRITE (OUT,860) I,J,RD(I,J),HA
     1,PMPNAM,XLGTNM
  390 R(I,J)=R(I,J)*PMPFCT
      ISPRG(N)=I
  400 JSPRG(N)=J
  410 CONTINUE
      IF (KHYD.LT.1) GO TO 420
C***********************************************************************
C      SAVE ORIGINAL HEADS FOR HYDROGRAPH ROUTINE
C***********************************************************************
      REWIND IN3
      WRITE(IN3)H
  420 CONTINUE
C***********************************************************************
C       SAVE INITIAL WATER LEVELS
C***********************************************************************
      REWIND IN1
      WRITE(11)H
C***********************************************************************
C       CHECK INPUT DATA
C***********************************************************************
      DO 470 I=1,NR
      DO 470 J=1,NC
      IF(FLAG(I,J).GT.2) GO TO 470
      IF(H(I,J).GT.BOTLEL(I,J)) GO TO 430
      H(I,J)=BOTLEL(I,J)+0.1
      WRITE( OUT,810) I,J,H(I,J)
  430 IF(TOPAQ(I,J).LE.SURF(I,J)) GO TO 440
      TOPAQ(I,J)=SURF(I,J)
      WRITE (OUT,820) I,J,TOPAQ(I,J)
  440 IF(FLAG(I,J).EQ.1) GO TO 450
      IF(FLAG(I,J).LT.1) GO TO 450
      IF(H(I,J).GT.TOPAQ(I,J)) GO TO 460
      FLAG(I,J)=1
        SF1(I,J)=SF1(I,J)*STRFCT
      WRITE (OUT,830) I,J
      GO TO 460
  450 IF(H(I,J).LE.TOPAQ(I,J)) GO TO 460
      IF(FLAG(I,J).LT.1) GO TO 460
      FLAG(I,J)=2
```

```
        SF1(I,J)=SF1(I,J)/STRFCT
      WRITE (OUT,840) I,J
  460 CONTINUE
  470 CONTINUE
C***********************************************************************
C       ZERO PERMEABILITIES FOR BOUNDARY CELLS
C***********************************************************************
      DO 490 I=1,NR
      DO 490 J=1,NC
      IF(FLAG(I,J).EQ.3) P(I,J,1)=0.0
      IF(FLAG(I,J).EQ.3) P(I,J,2)=0.0
      IF(I.EQ.NR) GO TO 480
      IF(FLAG(I+1,J).EQ.3) P(I,J,2)=0.0
      IF(FLAG(I,J).EQ.0.AND.FLAG(I+1,J).EQ.0) P(I,J,2)=0.0
  480 IF(J.EQ.NC) GO TO 490
      IF(FLAG(I,J+1).EQ.3) P(I,J,1)=0.0
      IF(FLAG(I,J).EQ.0.AND.FLAG(I,J+1).EQ.0) P(I,J,1)=0.0
  490 CONTINUE
C***********************************************************************
C     WRITE PHYSICAL PARAMETERS
C***********************************************************************
      IF (OPT(8).LT.1) GO TO 510
      DO 500 I=1,NR
      WRITE(OUT,680)TITMOD,TITLE
      WRITE (OUT,640)
      DO 500 J=1,NC
      IFLG=FLAG(I,J)
      IF(IFLG.EQ.0)IFLG=4
      WRITE (OUT,650) TYPE(1,IFLG),TYPE(2,IFLG),I,J,FLAG(I,J),
     1SURF(I,J),TOPAQ(I,J),BOTLEL(I,J),THIK(I,J),H(I,J),P(I,J,1),
     2P(I,J,2),SF1(I,J)
  500 CONTINUE
  510 CONTINUE
C***********************************************************************
C       CONVERT UNITS
C***********************************************************************
      DO 520 I=1,NR
      DO 520 J=1,NC
      P(I,J,1)=P(I,J,1)*PERFCT
      P(I,J,2)=P(I,J,2)*PERFCT
      IF(KSSH.GT.0) SF1(I,J)=0.0
  520 SF1(I,J)=SF1(I,J)*DELX(J)*DELY(I)
C***********************************************************************
C       PLOT INITIAL WATER LEVELS
C***********************************************************************
      IF(OPT(9).GT.0) CALL PLOTH(NROW,NCOL,FLAG,H,THIK,TOPAQ,BOTLEL,SF1
     1,1)
C***********************************************************************
C       LIST AND PLOT INITIAL SATURATED THICKNESS
C***********************************************************************
      IF(OPT(10).EQ.3) GO TO 550
      IF (OPT(10).LT.1) GO TO 560
      WRITE(OUT,680)TITMOD,TITLE
      WRITE (OUT,580)
      DO 540 I=1,NR
      DO 530 J=1,NC
      HO(I,J)=THIK(I,J)
```

```
  530 IF(FLAG(I,J).EQ.1) HO(I,J)=H(I,J)-BOTLEL(I,J)
  540 WRITE (OUT,570) I,(HO(I,J),J=1,NC)
      IF(OPT(10).LT.2) GO TO 560
  550 CALL PLOTH(NROW,NCOL,FLAG,H,THIK,TOPAQ,BOTLEL,SF1,2)
  560 CONTINUE
C*********************************************************************
C       RETURN
C*********************************************************************
      RETURN
C*********************************************************************
C
C
C
C
  570 FORMAT (/I5,10F10.3/(5X,10F10.3))
  580 FORMAT (T5,'INITIAL SATURATED THICKNESS'/)
  590 FORMAT (T20,'GENERAL PROGRAM OPTION',I5,' EQUALS',I5)
  600 FORMAT (5X,10F10.1)
  610 FORMAT (/T20,'PLOT SCALE =',F12.3,1X,A6,' PER INCH'/)
  620 FORMAT (1H1)
  630 FORMAT (35I1)
  640 FORMAT (1H0,T4,'NODE',T12,'ROW',T18,'COL',T24,'FLAG',T33,'SURFACE
     1',T45,'TOP OF',T54,'BOTTOM',T65,'THIK-',T75,'WATER',T85,'PERM',
     2T95,'PERM',T103,'STORAGE'/T4,'TYPE',T32,'ELEVATION',T44,'AQUIFER',
     1T53,'ELEVATION',T65,'NESS',T75,'LEVEL',T85,'X-DIR',T95,'Y-DIR',
     4T104,'COEF'/1X,28(4H----))
  650 FORMAT (1X,2A4,I4,2I6,5X,5F10.2,2F10.0,E10.4)
  660 FORMAT (26I3)
  670 FORMAT (20A4)
  680 FORMAT(1H1,T25,20A4//T25,20A4/)
  690 FORMAT (1H0,'DISTANCE SPACINGS IN X-DIRECTION')
  700 FORMAT (1H0,'DISTANCE SPACINGS IN Y-DIRECTION')
  710 FORMAT (1H0,T30,'NODE CORRECTIONS',//)
  720 FORMAT (1H0,T25,'DEFAULT VALUES'//T25,'NODE TYPE',T55,I5/
     2T25,'LAND SURFACE',T50,F10.2/T25,'TOP OF AQUIFER',T50,F10.2/
     3T25,'BASE OF AQUIFER',T50,F10.2/T25,'SATURATED THICKNESS',T50,
     5F10.2/T25,'WATER LEVEL',T50,F10.2/T25,'PERMEABILITY(1)-X',T50,F10.
     62/T25,'PERMEABILITY(2)-Y',T50,F10.2/T25,'STORAGE COEFFICIENT',T50,
     7F10.6//)
  730 FORMAT (1H0,T20,'CONSTANT GRID SPACINGS'/T20,'DEL X =',F10.3,5X,'D
     1EL Y =',F10.3/)
  740 FORMAT (T70,'FORMAT IS',T80,10A4/)
  750 FORMAT (T20,'LEAKAGE TERMS ASSIGNMENT')
  760 FORMAT (T20,'LEAKAGE TERM ADJUSTMENT')
  770 FORMAT (T20,'ROW',T30,'ROW',T40,'COLUMN',T50,'COLUMN',T72,'REF.',
     2T86,'SLOPE'/T20,'START',T30,'END',T40,'START',T50,'END',T72,'HEAD'
     2//)
  780 FORMAT (T20,I3,T30,I3,T43,I3,T53,I3,T70,F10.0,T85,F10.1)
785     FORMAT(1H0,T20,'SPRING AND RIVER CELL DATA')
  790 FORMAT (T20,'REFERENCE HEADS ',A6//)
  800 FORMAT (T20,'SLOPES ',A6,'/',A6,'/STEP'//)
  810 FORMAT (T20,'FOR NODE',I3,',',I3,' HEAD BELOW BASE.  NEW HEAD =',
     2F10.3)
  820 FORMAT (T20,'FOR NODE',I3,',',I3,' TOP OF AQUIFER ABOVE LAND SURF
     3ACE. NEW TOP =',F10.3)
  830 FORMAT (T20,'FOR NODE',I3,',',I3,' CHANGED TO WATER TABLE')
  840 FORMAT (T20,'FOR NODE',I3,',',I3,' CHANGED TO ARTESIAN')
```

```
850 FORMAT (T20,'NODE',2I3,' IS SPRING. REFERENCE HEAD =',F10.3,' SLO
   1PE =',F10.0,1X,A6,'/',A6,'/STEP')
860 FORMAT (T20,'NODE',2I3,' IS RIVER. REFERENCE HEAD =',F10.3,
   1' SLOPE =',F10.0,1X,A6,'/',A6,'/STEP')
    END
```

ploth.for

```
      SUBROUTINE PLOTH(NROW,NCOL,FLAG,H,THIK,TOPAQ,BOTLEL,SF1,ICD)
C***********************************************************************
C     THIS SUBROUTINE PRODUCES A SYMBOLIC MAP OF VARIOUS PARAMETERS.
C     MAXIMUM NUMBER OF COLUMNS IS 100.
C      ICD=1 HEAD MAP
C      ICD=2 SATURATED THICKNESS MAP
C      ICD=3 QUALITY MAP
C***********************************************************************
      COMMON /ITCOM/ NR,NC,ISTEP,NPARM,IN,OUT,OUT1,OPT(30),ITER,NSAVE,
     1ISAVE(25),JSAVE(25),KHYD,NCOLS,MCOLS(25),NROWS,MROWS(25)
     2,IN1,IN2,IN3,IN4,IN5,IN6
     1,NSTEPS,NBLK,IRWC(4,60),NSPRG,ISPRG(25),JSPRG(25),KSSH,KQUAL
      COMMON /RLCOM/ FMT(20),TITLE(20),DELX(200),DELY(200),PRMITR(10),B
     1(200),G(200),SUMSS(18,2),
     2                               ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,
     3DELMAJ,E,XLGTNM,FLXNAM(2),FLXFCT
     1,DELMJ2,TIME,STRFCT,SCALE
     1,TITMOD(20),VFMT(20,7)
      INTEGER OPT,FLAG,OUT,OUT1
      DIMENSION IFREQ(26),SYMBOL(26),XRANGE(27),PLOTS(100),
     1PERCT(26),H(NROW,NCOL),TOPAQ(NROW,NCOL),BOTLEL(NROW,NCOL)
     1,SF1(NROW,NCOL) ,FLAG(NROW,NCOL) ,THIK(NROW,NCOL)
     1,TOT(26),TOT1(26),TOT2(26)
     1,XINTGR(10)
      DATA XINTGR/1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H0/
C***********************************************************************
C     XINCRE EQUALS THE RANGE FOR EACH PRINTER SYMBOL
C***********************************************************************
      DATA XINCRE,BLANK,IFIRST/10.0,4H    ,0/
      DATA SYMBOL/1HA,1HB,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ,1HK,1HL,
     11HM,1HN,1HO,1HP,1HQ,1HR,1HS,1HT,1HU,1HV,1HW,1HX,1HY,1HZ/
      DIMENSION IDUM(10)
      DATA IDUM/1,2,3,4,5,6,7,8,9,0/
      DIMENSION XROW(3), XCOL(2)
      DATA XROW/1HR,1HO,1HW/,XCOL/4HCOLU,4HMN  /
      ENTRY QPLOTH (NROW,NCOL,FLAG,H,QTITLE,ICD)
      DIMENSION QTITLE(20)
      HA=0
      HB=-1.E-6
      HC=1.E6
      M=0
      DO 20 I=1,NR
      DO 20 J=1,NC
      IF(FLAG(I,J).GT.2) GO TO 20
      IF(FLAG(I,J).EQ.0) GO TO 20
      M=M+1
      HD=H(I,J)
      IF(ICD.NE.2) GO TO 10
      HD=THIK(I,J)
      IF(FLAG(I,J).EQ.1) HD=H(I,J)-BOTLEL(I,J)
   10 HA=HA+HD
```

```
      HB=AMAX1(HB,HD)
      HC=AMIN1(HC,HD)
   20 CONTINUE
      HA=HA/M
      ERR=HC
      HB=(HB-HC)/26
      HC=0.1
      IF(HB.GT.0.1) HC=1.
      IF(HB.GT.1.) HC=5.
      IF(HB.GT.5.) HC=10.
      IF(HB.GT.10.) HC=25.
      IF(HB.GT.25.) HC=50.
      IF(HB.GT.50.) HC=100.
      HA=IFIX(HA/HC)*HC
      HB=IFIX(ERR/HC)*HC
      XRANGE(1)=-1.E6
      XRANGE(27)=1.E6
      ERR=HA-HC*12
      XRANGE(2)=AMAX1(ERR,HB)
      DO 30 I=3,26
   30 XRANGE(I)=XRANGE(2)+HC*(I-2)
      ORIGX=0.
      IF(SCALE.GT.0.) GO TO 50
      DO 40 J=1,NC
   40 G(J)=J
      JST=1
      J=NC+1
      GO TO 100
   50 CONTINUE
      B(1)=0
      DO 60 I=2,NR
   60 B(I)=B(I-1)+(DELY(I)+DELY(I-1))/2.
      G(1)=0.
      DO 70 J=2,NC
   70 G(J)=G(J-1)+(DELX(J)+DELX(J-1))/2.
      JST=1
      IF(G(NC)/SCALE.GT.50.) GO TO 310
      IF(B(NR)/SCALE.GT.50.) GO TO 310
   80 DO 90 J=JST,NC
      IF((G(J)-ORIGX).GT.9.9*SCALE) GO TO 100
   90 CONTINUE
      J=NC+1
  100 JEND=J-1
      GSAVE=G(JEND)
      IF(JST.EQ.JEND.AND.JST.NE.NC) GO TO 310
      WRITE(OUT,540)TITMOD,TITLE
      IF(ICD.EQ.3) WRITE (OUT,550) QTITLE
      IF(ICD.EQ.1) WRITE (OUT,460) ISTEP
      IF(ICD.EQ.2) WRITE(OUT,470) ISTEP
      IF(ICD.EQ.3) WRITE (OUT,480) ISTEP
      WRITE (OUT,640)
      IF(SCALE.LE.1.E-3) GO TO 120
      DO 110 J=JST,JEND
      K=(G(J)+SCALE/20.-ORIGX)/(SCALE/10.)+1
  110 G(J)=K+0.5
  120 WRITE (OUT,670)  XCOL
      DO 150 L=1,2
```

```
      DO 130 K=1,100
  130 PLOTS(K)=BLANK
      DO 140 J=JST,JEND
      KG=G(J)
      KL=J/10
      PLOTS(KG)=XINTGR(KL)
      IF(KL.EQ.0) PLOTS(KG)=BLANK
      IF(L.EQ.1) GO TO 140
      KL=MOD(J,10)
      IF(KL.EQ.0) KL=10
      PLOTS(KG)=XINTGR(KL)
  140 CONTINUE
  150 WRITE (OUT,660) PLOTS
      WRITE (OUT,630)
      WRITE (OUT,680)
      YDIS=B(1)
      DO 270 I=1,NR
      DO 160 K=1,100
  160 PLOTS(K)=BLANK
      DO 230 J=JST,JEND
      KG=G(J)
      IFL=FLAG(I,J)+1
      GO TO (170,180,180,230),IFL
  170 PLOTS(KG)=1H*
      GO TO 230
  180 ERR=H(I,J)
      IF(ICD.NE.2) GO TO 190
      ERR=THIK(I,J)
      IF(FLAG(I,J).EQ.1) ERR=H(I,J)-BOTLEL(I,J)
  190 CONTINUE
      DO 200 KK=2,26
      IF(ERR.LT.XRANGE(KK)) GO TO 210
  200 CONTINUE
      IERR=26
      GO TO 220
  210 IERR=KK-1
  220 PLOTS(KG)=SYMBOL(IERR)
  230 CONTINUE
      IF(SCALE.LT.1.) GO TO 260
      KK=0
      IF(I.EQ.1) GO TO 260
      IF(I.EQ.NR) GO TO 240
      IF((B(I+1)-YDIS).LT.SCALE/12.)GOTO  270
  240 KK=(B(I)-YDIS)/(SCALE/6.) +.5
      DO 250 KL=1,KK
      IF(KK.LT.1) GO TO 250
      WRITE (OUT,650)
  250 CONTINUE
  260 WRITE (OUT,620) I,PLOTS
      YDIS=YDIS+SCALE/6.*(KK+1)
  270 CONTINUE
      WRITE (OUT,630)
      WRITE (OUT,670) XCOL
      DO 300 L=1,2
      DO 280 K=1,100
  280 PLOTS(K)=BLANK
      DO 290 J=JST,JEND
```

```
      KG=G(J)
      KL=J/10
      PLOTS(KG)=XINTGR(KL)
      IF(KL.EQ.0) PLOTS(KG)=BLANK
      IF(L.EQ.1) GO TO 290
      KL=MOD(J,10)
      IF(KL.EQ.0) KL=10
      PLOTS(KG)=XINTGR(KL)
  290 CONTINUE
  300 WRITE (OUT,660) PLOTS
      JST=JEND
      ORIGX=GSAVE
      G(JST)=GSAVE
      IF(JST.LT.NC) GO TO 80
      GO TO 320
  310 WRITE (OUT,690)
  320 CONTINUE
      XNODE=0
      DO 330 I=1,26
      TOT(I)=0.
      TOT1(I)=0.
      TOT2(I)=0.
  330 IFREQ(I)=0.
      DO 420 I=1,NR
      DO 410 J=1,NC
      IFL=FLAG(I,J)+1
      GO TO (410,340,340,410),IFL
  340 ERR=H(I,J)
      IF(ICD.NE.2) GO TO 350
      ERR=THIK(I,J)
      IF(FLAG(I,J).EQ.1) ERR=H(I,J)-BOTLEL(I,J)
  350 CONTINUE
      XNODE=XNODE+1.
      DO 360 KK=2,26
      IF(ERR.LT.XRANGE(KK)) GO TO 370
  360 CONTINUE
      IERR=26
      GO TO 380
  370 IERR=KK-1
  380 IFREQ(IERR)=IFREQ(IERR)+1
      TOT1(IERR)=TOT1(IERR)+DELX(J)*DELY(I)
      IF(ICD.NE.2) GO TO 410
      IF(FLAG(I,J).EQ.2) GO TO 390
      TOT(IERR)=TOT(IERR)+SF1(I,J)*(H(I,J)-BOTLEL(I,J))
      GO TO 400
  390 TOT2(IERR)=TOT2(IERR)+SF1(I,J)*(H(I,J)- TOPAQ(I,J))
      TOT(IERR)=TOT(IERR)+SF1(I,J)*STRFCT*THIK(I,J)
  400 CONTINUE
  410 CONTINUE
  420 CONTINUE
      PERCT(1)=FLOAT(IFREQ(1))/XNODE*100.
      DO 430 I=2,26
  430 PERCT(I)=FLOAT(IFREQ(I))/XNODE*100.+PERCT(I-1)
      WRITE (OUT,490)
      TOT4=0.
      TOT5=0.
      TOT3=0.
```

```
      IF (ICD.EQ.2) WRITE (OUT,610) XLGTNM,XLGTNM
     1,XLGTNM
      WRITE (OUT,600)
      DO 440 I=1,26
      WRITE (OUT,510) SYMBOL(I),XRANGE(I),XRANGE(I+1),IFREQ(I),PERCT(I)
      IF(ICD.EQ.2) WRITE (OUT,580) TOT1(I),TOT(I),TOT2(I)
      TOT4=TOT4+TOT2(I)
      TOT3=TOT3+TOT1(I)
  440 TOT5=TOT5+TOT(I)
      WRITE (OUT,450)
      IF(ICD.EQ.2) WRITE (OUT,590) TOT3,TOT5,TOT4
C***********************************************************************
      RETURN
C
C
C
C
  450 FORMAT (4X,'*',8X,'CONSTANT HEAD'/)
  460 FORMAT (T5,'HEADS AT END OF TIME STEP',I5)
  470 FORMAT (T5,'SATURATED THICKNESS AT END OF TIME STEP',I5)
  480 FORMAT (T5,'QUALITY VALUES AT END OF TIME STEP',I5/)
  490 FORMAT (1H0,T25,'FREQUENCY DISTRIBUTION',//,' SYMBOL',12X,9HRANGE(
     1FT),12X,'FREQUENCY',5X,' PER CENT .LE.')
  500 FORMAT (5H MEAN,19X,F10.5,/19H STANDARD DEVIATION,5X,F10.5)
  510 FORMAT (1H ,3X,A1,8X,F8.3,4H TO ,F8.3,9X,I4,6X,F10.1)
  520 FORMAT (1H0,19X,100I1)
  530 FORMAT (11X,100I1)
  540 FORMAT(1H1,T25,20A4//T25,20A4/)
  550 FORMAT (25X,20A4/)
  560 FORMAT (1H+,A1)
  570 FORMAT (1H+,10X,2A4)
  580 FORMAT (1H+,T65,3E20.8)
  590 FORMAT (/T60,'TOTAL',3E20.8)
  600 FORMAT (//)
  610 FORMAT (1H+,T70,'AREA',1X,A6,'**2',T89,'VOLUME',1X,A6,'**3',
     1T109,'VOLUME',1X,A6,'**3'/T89,'SATURATED',T109,'PRESSURE')
  620 FORMAT (1H ,I5,4X,1H.,100A1)
  630 FORMAT (1H ,3X,A1,8X,F8.3,4H TO ,F8.3,9X,I4,6X,F10.1)
  640 FORMAT (1H0,19X,100I1)
  650 FORMAT (10X,1H.,100I1)
  660 FORMAT (11X,100A1)
  670 FORMAT (10X,2A4)
  680 FORMAT (T5,'ROW')
  690 FORMAT (' SCALE INCORRECT  PLOT TERMINATED'//)
      END
```

```
      SUBROUTINE PLOTS (NROW,NCOL,FLAG,HSIM,HOBS,N)
C**************************************************************************
C     THIS SUBROUTINE PRODUCES A SYMBOLIC MAP OF VARIOUS PARAMETERS.
C     MAXIMUM NUMBER OF COLUMNS IS 100.
C     N=1  SIMULATION ERROR MAP
C     N=2 HEAD CHANGE DURING THIS TIME STEP
C     N=3 HEAD CHANGE THROUGH THIS TIME STEP
C**************************************************************************
      COMMON /ITCOM/ NR,NC,ISTEP,NPARM,IN,OUT,OUT1,OPT(30),ITER,NSAVE,
     1ISAVE(25),JSAVE(25),KHYD,NCOLS,MCOLS(25),NROWS,MROWS(25)
     2,IN1,IN2,IN3,IN4,IN5,IN6
     1,NSTEPS,NBLK,IRWC(4,60),NSPRG,ISPRG(25),JSPRG(25),KSSR,KQUAL
      COMMON /RLCOM/ FMT(20),TITLE(20),DELX(200),DELY(200),PRMITR(10),B
     1(200),G(200),SUMSS(18,2),
     2                              ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,
     3DELMAJ,E,XLGTNM,FLXNAM(2),FLXFCT
     1,DELMJ2,TIME,STRFCT,SCALE
     1,TITMOD(20),VFMT(20,7)
      INTEGER OPT,FLAG,OUT,OUT1
      DIMENSION IFREQ(26),SYMBOL(26),XRANGE(27),PLOT(100),
     1PERCT(26),HSIM(NROW,NCOL),HOBS(NROW,NCOL),FLAG(NROW,NCOL)
     1,XINTGR(10)
      DATA XINTGR/1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H0/
C**************************************************************************
C     XINCRE EQUALS THE RANGE FOR EACH PRINTER SYMBOL
C**************************************************************************
      DATA XINCRE,BLANK,IFIRST/10.0,4H    ,0/
      DATA SYMBOL/1HA,1HB,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ,1HK,1HL,
     11HM,1HN,1HO,1HP,1HQ,1HR,1HS,1HT,1HU,1HV,1HW,1HX,1HY,1HZ/
      DIMENSION IDUM(10)
      DATA IDUM/1,2,3,4,5,6,7,8,9,0/
      DIMENSION XROW(3), XCOL(2)
      DATA XROW/1HR,1HO,1HW/,XCOL/4HCOLU,4HMN  /
      DIMENSION SUMS(10),IMAXS(4,3),HMAXS(2,3)
      ENTRY QPLOTS(NROW,NCOL,FLAG,HSIM,HOBS,QTITLE,N)
      DIMENSION QTITLE(20)
      HA=0
      HB=-1.E-6
      HC=1.E6
      M=0
      DO 10 I=1,NR
      DO 10 J=1,NC
      IF(FLAG(I,J).GT.2) GO TO 10
      IF(N.EQ.1.AND. ABS(HOBS(I,J)).LT.1.E-3) GO TO 10
      M=M+1
      HD=HSIM(I,J)-HOBS(I,J)
      HA=HA+HD
      HB=AMAX1(HB,HD)
      HC=AMIN1(HC,HD)
   10 CONTINUE
      HA=HA/M
      ERR=HC
      HB=(HB-HC)/26
```

```
      HC=0.1
      IF(HB.GT.0.1) HC=1.
      IF(HB.GT.1.) HC=5.
      IF(HB.GT.5.) HC=10.
      IF(HB.GT.10.) HC=25.
      IF(HB.GT.25.) HC=50.
      IF(HB.GT.50.) HC=100.
      HA=IFIX(HA/HC)*HC
      HB=IFIX(ERR/HC)*HC
      XRANGE(1)=-1.E6
      XRANGE(27)=1.E6
      ERR=HA-HC*12
      XRANGE(2)=AMAX1(ERR,HB)
      DO 20 I=3,26
   20 XRANGE(I)=XRANGE(2)+HC*(I-2)
      ORIGX=0.
      IF(SCALE.GT.0.) GO TO 40
      DO 30 J=1,NC
   30 G(J)=J
      JST=1
      J=NC+1
      GO TO 90
   40 CONTINUE
      B(1)=0
      DO 50 I=2,NR
   50 B(I)=B(I-1)+(DELY(I)+DELY(I-1))/2.
      G(1)=0.
      DO 60 J=2,NC
   60 G(J)=G(J-1)+(DELX(J)+DELX(J-1))/2.
      JST=1
      IF(G(NC)/SCALE.GT.50.) GO TO 360
      IF(B(NR)/SCALE.GT.50.) GO TO 360
   70 DO 80 J=JST,NC
      IF((G(J)-ORIGX).GT.9.9*SCALE) GO TO 90
   80 CONTINUE
      J=NC+1
   90 JEND=J-1
      GSAVE=G(JEND)
      IF(JST.EQ.JEND.AND.JST.NE.NC) GO TO 360
      WRITE(OUT,800)TITMOD,TITLE
      IF(N.GT.3) WRITE (OUT,810) QTITLE
      GO TO (100,110,120,130,140,150),N
  100 WRITE(OUT,690) ISTEP                                                 *
      GO TO 160
  110 WRITE(OUT,700) ISTEP                                                 *
      GO TO 160
  120 WRITE(OUT,710) ISTEP                                                 *
      GO TO 160
  130 WRITE (OUT,720) ISTEP
      GO TO 160
  140 WRITE (OUT,730) ISTEP
      GO TO 160
  150 WRITE (OUT,740) ISTEP
  160 CONTINUE
      WRITE (OUT,770)
      IF(SCALE.LE.1.E-3) GO TO 180
      DO 170 J=JST,JEND
```

```
      K=(G(J)+SCALE/20.-ORIGX)/(SCALE/10.)+1
  170 G(J)=K+0.5
  180 WRITE (OUT,830)  XCOL
      DO 210 L=1,2
      DO 190 K=1,100
  190 PLOT(K)=BLANK
      DO 200 J=JST,JEND
      KG=G(J)
      KL=J/10
      PLOT(KG)=XINTGR(KL)
      IF(KL.EQ.0) PLOT(KG)=BLANK
      IF(L.EQ.1) GO TO 200
      KL=MOD(J,10)
      IF(KL.EQ.0) KL=10
      PLOT(KG)=XINTGR(KL)
  200 CONTINUE
  210 WRITE (OUT,790) PLOT
      WRITE (OUT,760)
      WRITE (OUT,840)
      YDIS=B(1)
      DO 320 I=1,NR
      DO 220 K=1,100
  220 PLOT(K)=BLANK
      DO 280 J=JST,JEND
      KG=G(J)
      IFL=FLAG(I,J)+1
      GO TO (230,240,240,280),IFL
  230 PLOT(KG)=1H*
      GO TO 280
  240 ERR=HSIM(I,J)-HOBS(I,J)
      IF(N.EQ.1.AND. ABS(HOBS(I,J)).LT.1.E-3) GO TO 280
      DO 250 KK=2,26
      IF(ERR.LT.XRANGE(KK)) GO TO 260
  250 CONTINUE
      IERR=26
      GO TO 270
  260 IERR=KK-1
  270 PLOT(KG)=SYMBOL(IERR)
  280 CONTINUE
      IF(SCALE.LT.1.) GO TO 310
      KK=0
      IF(I.EQ.1) GO TO 310
      IF(I.EQ.NR) GO TO 290
      IF((B(I+1)-YDIS).LT.SCALE/12.)GOTO  320
  290 KK=(B(I)-YDIS)/(SCALE/6.) +.5
      DO 300 KL=1,KK
      IF(KK.LT.1) GO TO 300
      WRITE (OUT,780)
  300 CONTINUE
  310 WRITE (OUT,670) I,PLOT
      YDIS=YDIS+SCALE/6.*(KK+1)
  320 CONTINUE
      WRITE (OUT,760)
      WRITE (OUT,830) XCOL
      DO 350 L=1,2
      DO 330 K=1,100
  330 PLOT(K)=BLANK
```

```
      DO 340 J=JST,JEND
      KG=G(J)
      KL=J/10
      PLOT(KG)=XINTGR(KL)
      IF(KL.EQ.0) PLOT(KG)=BLANK
      IF(L.EQ.1) GO TO 340
      KL=MOD(J,10)
      IF(KL.EQ.0) KL=10
      PLOT(KG)=XINTGR(KL)
  340 CONTINUE
  350 WRITE (OUT,790) PLOT
      JST=JEND
      ORIGX=GSAVE
      G(JST)=GSAVE
      IF(JST.LT.NC) GO TO 70
      GO TO 370
  360 WRITE (OUT,850)
  370 CONTINUE
      DO 570 NBLKN=1,NBLK
      HMAX=-1.E6
      HMIN=1.E6
      DO 380 K=1,10
  380 SUMS(K)=0.
      DO 390 K=1,3
      HMAXS(1,K)=-1.E6
  390 HMAXS(2,K)=1.E6
      DO 400 I=1,26
  400 IFREQ(I)=0.
      XNODE=0.0
      IST=IRWC(1,NBLKN)
      IEND=IRWC(2,NBLKN)
      JST=IRWC(3,NBLKN)
      JEND=IRWC(4,NBLKN)
      DO 520 I=IST,IEND
      DO 510 J=JST,JEND
      IFL=FLAG(I,J)+1
      GO TO(510,410,410,510),IFL
  410 ERR=HSIM(I,J)-HOBS(I,J)
      IF(N.EQ.1.AND. ABS(HOBS(I,J)).LT.1.E-3) GO TO 510
      XNODE=XNODE+1.
      DO 420 KK=2,26
      IF(ERR.LT.XRANGE(KK)) GO TO 430
  420 CONTINUE
      IERR=26
      GO TO 440
  430 IERR=KK-1
  440 IFREQ(IERR)=IFREQ(IERR)+1
      DO 500 K=1,3
      GO TO (450,460,470), K
  450 HA=HSIM(I,J)
      GO TO 480
  460 HA=HOBS(I,J)
      GO TO 480
  470 HA=ERR
  480 HDUM=HMAXS(1,K)
      HMAX=AMAX1(HA,HMAXS(1,K))
      IF (HDUM.GE.HMAX) GO TO 490
```

```
      HMAXS(1,K)=HMAX
      IMAXS(1,K)=I
      IMAXS(2,K)=J
  490 HDUM=HMAXS(2,K)
      HMIN=AMIN1(HA,HMAXS(2,K))
      IF (HDUM.LE.HMIN) GO TO 500
      HMAXS(2,K)=HMIN
      IMAXS(3,K)=I
      IMAXS(4,K)=J
  500 CONTINUE
      SUMS(1)=SUMS(1)+1.
      SUMS(2)=SUMS(2)+HSIM(I,J)*HOBS(I,J)
      SUMS(3)=SUMS(3)+HSIM(I,J)*HSIM(I,J)
      SUMS(4)=SUMS(4)+HSIM(I,J)
      SUMS(5)=SUMS(5)+HOBS(I,J)*HOBS(I,J)
      SUMS(6)=SUMS(6)+HOBS(I,J)
      SUMS(7)=SUMS(7)+ERR*ERR
      SUMS(8)=SUMS(8)+ERR
      ERR=ABS(ERR)
      SUMS(9)=SUMS(9)+ERR*ERR
      SUMS(10)=SUMS(10)+ERR
  510 CONTINUE
  520 CONTINUE
      IF (NBLKN.GT.1) GO TO 540
      PERCT(1)=FLOAT(IFREQ(1))/XNODE*100.
      DO 530 I=2,26
  530 PERCT(I)=FLOAT(IFREQ(I))/XNODE*100.+PERCT(I-1)
      WRITE (OUT,750)
      WRITE (OUT,760) (SYMBOL(I),XRANGE(I),XRANGE(I+1),IFREQ(I),PERCT(I)
     1,I=1,26)
      WRITE (OUT,650)
  540 WRITE (OUT,580) NBLKN,IST,IEND,JST,JEND
      WRITE (OUT,600)
      DO 550 K=4,10,2
  550 SUMS(K)=SUMS(K)/SUMS(1)
      WRITE (OUT,590) (SUMS(K),K=4,10,2)
      SS=SUMS(7)
      DO 560 K=3,9,2
  560 SUMS(K)=SQRT((SUMS(1)*SUMS(K)-(SUMS(1)*SUMS(K+1))**2)/(SUMS(1)*(SU
     1MS(1)-1.)))
      WRITE (OUT,620) (SUMS(K),K=3,9,2)
      WRITE (OUT,630) (HMAXS(1,K),K=1,3),((IMAXS(L,K),K=1,3),L=1,2)
      WRITE (OUT,640) (HMAXS(2,K),K=1,3),((IMAXS(L,K),K=1,3),L=3,4)
      WRITE (OUT,610) SUMS(1)
      COV=(SUMS(2)-SUMS(1)*SUMS(4)*SUMS(6))/(SUMS(1)-1.)
      REG=COV/(SUMS(3)*SUMS(5))
      WRITE (OUT,660) SS,COV,REG
  570 CONTINUE
C***********************************************************************
      RETURN
C
C
C
C
  580 FORMAT (/T42,'FOR BLOCK',I3,' FROM ROW',I3,' TO',I3,' AND FROM','
     1COLUMN',I3,' TO',I3)
  590 FORMAT (T5,'MEAN',T31,4F20.4)
```

```
600 FORMAT (/T42,'SIMULATED',T63,'OBS/INIT',T81,'DIFFERENCE',T103,'ABS
   1 DIFF'/)
610 FORMAT (T5,'NUMBER OF CELLS',T31,F20.4)
620 FORMAT (T5,'STANDARD DEVIATION',T31,4F20.4)
630 FORMAT (T5,'MAXIMUM-VALUE',T31,3F20.4/T13,'ROW',T31,3I20/T13,'COLU
   1MN',T31,3I20)
640 FORMAT (T5,'MINIMUM-VALUE',T31,3F20.4/T13,'ROW',T31,3I20/T13,'COLU
   1MN',T31,3I20)
650 FORMAT (4X,'*',8X,'CONSTANT HEAD'/)
660 FORMAT (T5,'SUM OF SQUARED DIFFERENCES',T31,F20.4/T5,'COVARIANCE',
   1T31,F20.4/T5,'REGRESSION COEFFICIENT',T31,F20.4)
670 FORMAT (1H ,I5,4X,1H.,100A1)
680 FORMAT (22H0SUM OF ERRORS SQUARED,2X,F10.1)
690 FORMAT (39H0ERROR MAP FOR SIMULATION FOR TIME STEP,I4)
700 FORMAT (28H0HEAD CHANGES FOR TIME STEP ,I4)
710 FORMAT ('0HEAD CHANGES FROM BEGINNING OF SIMULATION',' THROUGH TIM
   1E STEP',I4)
720 FORMAT ('0QUALITY ERROR MAP FOR TIME STEP',I4)
730 FORMAT ('0QUALITY CHANGES DURING TIME STEP',I4)
740 FORMAT ('0QUALITY CHANGES FROM BEGINNING THRU TIME STEP',I4)
750 FORMAT (1H0,T25,'FREQUENCY DISTRIBUTION',//,' SYMBOL',12X,9HRANGE(
   1FT),12X,9HFREQUENCY,5X,'PER CENT .LE.'//)
760 FORMAT (1H ,3X,A1,8X,F8.3,4H TO ,F8.3,9X,I4,6X,F10.1)
770 FORMAT (1H0,19X,100I1)
780 FORMAT (10X,1H.,100I1)
790 FORMAT (11X,100A1)
800 FORMAT(1H1,T25,20A4//T25,20A4/)
810 FORMAT (25X,20A4/)
820 FORMAT (1H+,A1)
830 FORMAT (10X,2A4)
840 FORMAT (T5,'ROW')
850 FORMAT (' SCALE INCORRECT   PLOT TERMINATED'//)
    END
```

```
       SUBROUTINE QSOLVE(H,HO,T,SF1,R,Q1,Q2,Q,BOTLEL,RD,Q3,RHG,THIK,
     1B,G,FLAG,ERROR,DELMAJ,NROW,NCOL,NR,NC,ITER,ALPHA)
      DIMENSION Q1(NROW,NCOL),Q2(NROW,NCOL),THIK(NROW,NCOL),
     1RD(NROW,NCOL),RHG(NROW,NCOL),
     2 BOTLEL(NROW,NCOL),Q3(NROW,NCOL)
C*************************************************************************
C     THIS ROUTINE SOLVES FOR CONCENTRATIONS BY THE IDAI PROCEDURE
C*************************************************************************
      DIMENSION H(NROW,NCOL),HO(NROW,NCOL),T(NROW,NCOL,2),
     1 B(1),G(1),SF1(NROW,NCOL),Q(NROW,NCOL),R(NROW,NCOL)
C*************************************************************************
C       ALPHA IS A CALIBRATION VALUE WHICH WEIGHTS THE CONCENTRATION
C        OF THE FLUX BETWEEN CELL.  RANGE OF VALUES IS FROM 0.5 TO 1.0
C        A VALUE OF ONE MEANS NO AVERAGING OF CONCENTRATIONS
C        C(I->J)=ALPHA*C(I)+(1-ALPHA)*C(J)
C*************************************************************************
            DOUBLE PRECISION AA,BB,CC,DD,W
      INTEGER FLAG(NROW,NCOL)
      ISTEP=1
      ITER=0
10    CONTINUE
      ITER=ITER+1
      IF (ITER.GT.50) GO TO 810
      E=0.0
C*************************************************************************
C     ROW CALCULATIONS
C*************************************************************************
      DO 410 II=1,NR
      I=II
      IF(MOD(ISTEP+ITER,2).EQ.1)I=NR-I+1
      JSTRT=1
20    DO 30 JJ=JSTRT,NC
      IFL=FLAG(I,JJ)+1
      GO TO (30,40,40,30), IFL
30    CONTINUE
      GO TO 410
40    CONTINUE
      JJP1=JJ+1
50    DO 60 JJJ=JJP1,NC
      IFL=FLAG(I,JJJ)+1
      GO TO (70,60,60,70), IFL
60    CONTINUE
      JJJ=NC
      JSTRT=NC
      GO TO 80
70    JJJ=JJJ-1
      JSTRT=JJJ+1
80    CONTINUE
      DO 370 J=JJ,JJJ
      BB=R(I,J)/DELMAJ
      DD=RD(I,J)/DELMAJ*HO(I,J)
90    CONTINUE
      BB=BB+Q3(I,J)
      DD=DD+RHG(I,J)*Q(I,J)
```

```
      AA=0.0
      CC=0.0
      IF (J-JJ) 100,100,110
100   IF (J-1) 170,170,110
110   TT=T(I,J-1,1)
      HA=Q1(I,J-1)
      AA=-TT
      BB=BB+TT
      HB=HO(I,J-1)
      IF (HA) 120,170,130
120   FACT=ALPHA
      FACT1=1.-FACT
      GO TO 140
130   FACT1=ALPHA
      FACT=1.-FACT1
140   BB=BB-HA*FACT
      IF (FLAG(I,J-1)) 160,160,150
150   AA=AA-HA*FACT1
      GO TO 170
160   DD=DD+H(I,J-1)*(HA*FACT1+TT)
      AA=0.
170   IF (J-JJJ) 190,180,190
180   IF (J-NC) 190,260,260
190   TT=T(I,J,1)
      HA=Q1(I,J)
      CC=-TT
      BB=BB+TT
      HB=HO(I,J+1)
      IF (HA) 200,260,210
200   FACT1=ALPHA
      FACT=1.-ALPHA
      GO TO 220
210   FACT=ALPHA
      FACT1=1.-ALPHA
220   BB=BB+HA*FACT
230   IF (FLAG(I,J+1)) 250,250,240
240   CC=CC+HA*FACT1
      GO TO 260
250   DD=DD+H(I,J+1)*(TT-HA*FACT1)
      CC=0.
260   IF (I-1) 270,310,270
270   TT=T(I-1,J,2)
      HA=Q2(I-1,J)
      BB=BB+TT
      DD=DD+TT*H(I-1,J)
      HB=HO(I-1,J)
      IF (HA) 280,310,290
280   FACT=ALPHA
      FACT1=1.-FACT
      GO TO 300
290   FACT1=ALPHA
      FACT=1.-FACT1
300   BB=BB-HA*FACT
      DD=DD+HA*FACT1*H(I-1,J)
310   IF (I-NR) 320,360,320
320   TT=T(I,J,2)
      HA=Q2(I,J)
```

```
      BB=BB+TT
      DD=DD+TT*H(I+1,J)
      HB=HO(I+1,J)
      IF (HA) 330,360,340
330   FACT1=ALPHA
      FACT=1.-FACT1
      GO TO 350
340   FACT=ALPHA
      FACT1=1.-FACT
350   BB=BB+HA*FACT
      DD=DD-HA*FACT1*H(I+1,J)
360   W=BB-AA*B(J-1)
      B(J)=CC/W
370   G(J)=(DD-AA*G(J-1))/W
C**********************************************************************
C     RE-ESTIMATE CONCENTRATIONS
C**********************************************************************
      E=E+ABS(H(I,JJJ)-G(JJJ))
      H(I,JJJ)=G(JJJ)
      N=JJJ
380   N=N-1
      IF (N-JJ+1) 400,400,390
390   HA=G(N)-B(N)*H(I,N+1)
      E=E+ABS(HA-H(I,N))
      H(I,N)=HA
      GO TO 380
400   IF (JSTRT-NC) 20,410,410
410   CONTINUE
C**********************************************************************
C     COLUMN CALCULATIONS
C**********************************************************************
      DO 800 JJ=1,NC
      J=JJ
      IF(MOD(ISTEP+ITER,2).EQ.1)J=NC-J+1
      ISTRT=1
420   DO 430 II=ISTRT,NR
      IFL=FLAG(II,J)+1
      GO TO (430,440,440,430), IFL
430   CONTINUE
      GO TO 800
440   CONTINUE
      IIP1=II+1
450   DO 460 III=IIP1,NR
      IFL=FLAG(III,J)+1
      GO TO (470,460,460,470), IFL
460   CONTINUE
      III=NR
      ISTRT=NR
      GO TO 480
470   III=III-1
      ISTRT=III+1
480   CONTINUE
      DO 760 I=II,III
      BB=R(I,J)/DELMAJ
      DD=RD(I,J)/DELMAJ*HO(I,J)
      DD=DD+RHG(I,J)*Q(I,J)
      BB=BB+Q3(I,J)
```

```
      AA=0.0
      CC=0.0
      IF (J-1) 490,530,490
490   TT=T(I,J-1,1)
      HA=Q1(I,J-1)
      BB=BB+TT
      DD=DD+TT*H(I,J-1)
      HB=HO(I,J-1)
      IF (HA) 500,530,510
500   FACT=ALPHA
      FACT1=1.-FACT
      GO TO 520
510   FACT1=ALPHA
      FACT=1.-FACT1
520   BB=BB-HA*FACT
      DD=DD+HA*FACT1*H(I,J-1)
530   IF (J-NC) 540,580,540
540   TT=T(I,J,1)
      HA=Q1(I,J)
      BB=BB+TT
      DD=DD+TT*H(I,J+1)
      HB=HO(I,J+1)
      IF (HA) 550,580,560
550   FACT1=ALPHA
      FACT=1.-FACT1
      GO TO 570
560   FACT=ALPHA
      FACT1=1.-FACT
570   BB=BB+HA*FACT
      DD=DD-HA*FACT1*H(I,J+1)
580   IF (I-II) 590,590,600
590   IF (I-1) 660,660,600
600   TT=T(I-1,J,2)
      HA=Q2(I-1,J)
      BB=BB+TT
      AA=-TT
      HB=HO(I-1,J)
      IF (HA) 610,660,620
610   FACT=ALPHA
      FACT1=1.-FACT
      GO TO 630
620   FACT1=ALPHA
      FACT=1.-FACT1
630   BB=BB-HA*FACT
      IF (FLAG(I-1,J)) 650,650,640
640   AA=AA-HA*FACT1
      GO TO 660
650   DD=DD+H(I-1,J)*(HA*FACT1+TT)
      AA=0.
660   IF (I-III) 680,670,680
670   IF (I-NR) 680,750,750
680   TT=T(I,J,2)
      HA=Q2(I,J)
      BB=BB+TT
      CC=-TT
      HB=HO(I+1,J)
      IF (HA) 690,750,700
```

```
690    FACT1=ALPHA
       FACT=1.-ALPHA
       GO TO 710
700    FACT=ALPHA
       FACT1=1.-FACT
710    BB=BB+HA*FACT
720    IF (FLAG(I+1,J)) 740,740,730
730    CC=CC+HA*FACT1
       GO TO 750
740    DD=DD+H(I+1,J)*(TT-HA*FACT1)
       CC=0.
750    W=BB-AA*B(I-1)
       B(I)=CC/W
760    G(I)=(DD-AA*G(I-1))/W
C***********************************************************************
C      RE-ESTIMATE CONCENTRATIONS
C***********************************************************************
       E=E+ABS(H(III,J)-G(III))
       H(III,J)=G(III)
       N=III
770    N=N-1
       IF (N-II+1) 790,790,780
780    HA=G(N)-B(N)*H(N+1,J)
       E=E+ABS(H(N,J)-HA)
       H(N,J)=HA
       GO TO 770
790    IF (ISTRT-NR) 420,800,800
800    CONTINUE
       IF (E.GT.ERROR) GO TO 10
810    RETURN
C***********************************************************************
       END
```

```
      SUBROUTINE QREAD(QTITLE,A,IOPTQ,NROW,NCOL,NTYPE)
      DIMENSION A(NROW,NCOL),HEADNG(6,5),IOPTQ(4),QTITLE(20)
      INTEGER OUT
      COMMON /ITCOM/NR,NC,ISTEP,NPARM,IN,OUT,OUT1,OPT(30),ITER,NSAVE,
     1     ISAVE(25),JSAVE(25),KHYD,NCOLS,MCOLS(25),NROWS,MROWS(25),
     2     IN1,IN2,IN3,IN4,IN6,IN7,NSTEPS,NBLK,IRWC(4,60),NSPRNG,
     3     ISPRNG(25),JSPRNG(25),KSSH,KQUAL
      COMMON/RLCOM/FMT(20),TITLE(20),DELX(200),DELY(200),PRMITR(10),
     1     B(200),G(200),SUMS(18,2),ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,
     2     DELMAJ,E,XLGTNM,FLXNAM(2),FLXFCT,DELMJ2,TIME,STRFCT,
     3     SCALE,TITMOD(20),VFMT(20,7)
      DATA HEADNG/'DISP','ERSI','VITY',' COE','F. L','ONG.',2*' ',
     1     'RECH','ARGE',' QUA','LITY','INIT','IAL ','CONC','ENTR',
     2     'ATIO','N',4*' ','PORO','SITY','DISP','ERSI','VITY',' COE',
     3     'F. T','RANS'/
      IF(IOPTQ(1).LT.1) GO TO 140
      IF(IOPTQ(2).GT.0) WRITE(OUT,1120) TITMOD,TITLE,QTITLE
      IF(IOPTQ(2).GT.0) WRITE(OUT,1170)(HEADNG(I,NTYPE),I=1,6)
C***********************************************************************
C    READ VALUES FOR EACH CELL
C***********************************************************************
      DO 100 I=1,20
  100 FMT(I)=VFMT(I,4)
      IF(IOPTQ(1).LT.5) GO TO 110
      READ(IN,1160) FMT
      WRITE(OUT,1400)(FMT(I),I=1,10)
  110 DO 120 I=1,NR
      READ(IN,FMT)(A(I,J),J=1,NC)
  120 IF(IOPTQ(2).GT.0) WRITE(OUT,1210)I,(A(I,J),J=1,NC)
  140 IF(IOPTQ(3).LT.1) GO TO 190
C***********************************************************************
C    READ VALUES BY BLOCK
C***********************************************************************
      WRITE(OUT,1220)(HEADNG(I,NTYPE),I=1,6)
      DO 150 I=1,20
  150 FMT(I)=VFMT(I,5)
      IF(IOPTQ(3).LT.5) GO TO 160
      READ(IN,1160) FMT
      WRITE(OUT,1400)(FMT(I),I=1,10)
  160 WRITE(OUT,1230)
  170 READ(IN,FMT) II,III,JJ,JJJ,HA
      IF(II.LT.1) GO TO 190
      WRITE(OUT,1240)II,III,JJ,JJJ,HA
      DO 180 I=II,III
      DO 180 J=JJ,JJJ
  180 A(I,J)=HA
      GO TO 170
  190 IF(IOPTQ(4).LT.1) GO TO 250
C***********************************************************************
C    READ VALUE ADJUSTMENTS
C***********************************************************************
  200 WRITE(OUT,1250)(HEADNG(I,NTYPE),I=1,6)
      DO 210 I=1,20
  210 FMT(I)=VFMT(I,5)
```

```
      IF(IOPTQ(4).LT.5) GO TO 220
      READ(IN,1160) FMT
      WRITE(OUT,1400)(FMT(I),I=1,10)
  220 WRITE(OUT,1230)
  230 READ(IN,FMT) II,III,JJ,JJJ,HA
      IF(II.LT.1) GO TO 250
      WRITE(OUT,1240) II,III,JJ,JJJ,HA
      DO 240 I=II,III
      DO 240J=JJ,JJJ
  240 A(I,J)=A(I,J)*HA
      GO TO 230
  250 RETURN
 1160 FORMAT(20A4)
 1120 FORMAT(1H1,T25,20A4,//T25,20A4/,T25,20A4/)
 1170 FORMAT(1H0,T20,6A4,' FOR EACH CELL'//)
 1210 FORMAT(1H0,I5,10G10.2/(6X,10G10.2))
 1220 FORMAT(1H0,T20,6A4,' BY BLOCK'//)
 1250 FORMAT(1H0,T20,6A4,' ADJUSTMENTS'//)
 1230 FORMAT(/T21,'ROW    ROW  COLUMN  COLUMN',T56,'VALUE'/T21,
     1'START  END  START    END'//)
 1240 FORMAT(T21,I3,4X,I3,3X,I3,5X,I3,2G19.4)
 1400 FORMAT(T70,'FORMAT IS',T80,10A4/)
      END
```

```
      SUBROUTINE QUAL(R,RD,DL,TOPAQ,SURFAC,THIK,BOTLEL,H,HO,HBEGN,SF1,
     1Q,T,P,RHG,QSUM,FLAG,NROW,NCOL,NSTEP,TIMACL)
      COMMON /ITCOM/NR,NC,ISTEP,NPARM,IN,OUT,OUT1,OPT(30),ITER,NSAVE,
     1ISAVE(25),JSAVE(25),KHYD,NCOLS,MCOLS(25),NROWS,MROWS(25),IN1,
     2IN2,IN3,IN4,IN6,IN7,NSTEPS,NBLK,IRWC(4,60),NSPRNG,ISPRNG( 25),
     3JSPRNG(25),KSSH,KQUAL
      COMMON /RLCOM/ FMT(20),TITLE(20),DELX(200),DELY(200),PRMITR(10),B
     3(200),G(200),SUMS(18,2),ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,DELMAJ,
     2E,XLGTNM,FLXNAM(2),FLXFCT,DELMJ2,TIME,STRFCT,SCALE,
     4TITMOD(20),VFMT(20,7)
C*********************************************************************
C     THIS SUBROUTINE PERFORMS THE MASS TRANSPORT SIMULATION
C*********************************************************************
      DIMENSION R(NROW,NCOL), RD(NROW,NCOL), THIK(NROW,NCOL), BOTLEL(NRO
     1W,NCOL), H(NROW,NCOL), HO(NROW,NCOL), SF1(NROW,NCOL), Q(NROW,NCOL)
     1,T(NROW,NCOL,2),P(NROW,NCOL,2),SURFAC(NROW,NCOL),RHG(NROW,NCOL)
     2,QSUM(NROW,NCOL),IOPT(30),TOPAQ(NROW,NCOL),QTITLE(20),HBEGN(NROW,N
     2COL) ,DL(NROW,NCOL)
     7,IDCF(4)
      INTEGER FLAG(NROW,NCOL),OUT
      IN8=IN
      IN9=19
      DATA KOT/0/
C*********************************************************************
C     EQUIVALENT NAMES
C     R = CONCENTRATION AT TIME T
C     RD= CONCENTRATION AT TIME T+1
C      P = DISPERSIVITY COEFFICIENTS
C     T = COLLECTED TERMS
C     HBEGN = INITIAL CONCENTRATIONS AT T=0
C     TOPAQ  = FLOWS IN X-DIRECTION
C     DL     = FLOWS IN Y-DIRECTION
C     SURFAC = RECHARGE QUALITY CONCENTRATION
C     QERROR = MINIMUM QUALITY CHANGE ALLOWED FOR CONVERGENCE
C    SF1     = POROSITY
C     NSTEP  = NUMBER OF SMALL TIME STEP (MUST EQUAL NSP OF MAIN)
C     IOPT   = OPTIONS
C          1 = READ DISPERSIVITY COEFFICIENTS FOR EACH CELL
C          2 = WRITE DISPERSIVITY COEFFICIENTS FOR EACH CELL
C          3 = READ DISPERSIVITY COEFFICIENTS BY BLOCK
C          4 = READ DISPERSIVITY COEFFICIENT ADJUSTMENTS
C          5 = READ RECHARGE QUALITIES FOR EACH CELL
C          6 = WRITE RECHARGE QUALITIES FOR EACH CELL
C          7 = READ RECHARGE QUALITY BY BLOCK
C          8 = READ RECHARGE QUALITY ADJUSTMENTS
C          9 = LIST CONCENTRATIONS AT END OF STEP
C         10 = PLOT CONCENTRATIONS AT END OF STEP
C         11 = LIST CHANGES IN CONCENTRATIONS DURING THIS STEP
C         12 = PLOT CONCENTRATION CHANGES DURING THIS STEP
C         13 = PLOT CONCENTRATION CHANGES THROUGH THIS STEP
C         14 = READ MEASURED VALUES OF CONCENTRATIONS AND PLOT
C              ERROR MAP
```

```
C          15 = READ IN INITIAL CONCENTRATIONS FOR EACH CELL
C          16 = WRITE INITIAL CONCENTRATIONS FOR EACH CELL
C          17 = READ INITIAL CONCENTRATIONS BY BLOCK
C          18 = READ INITIAL CONCENTRATIONS ADJUSTMENTS
C          19 = LIST CONCENTRATION AT END OF SMALL TIME STEP
C          20 = LIST CHANGES IN CONCENTRATIONS THROUGH THIS STEP
C          21 = READ POROSITY FOR EACH CELL
C          22 = WRITE POROSITY FOR EACH CELL
C          23 = READ POROSITY BY BLOCK
C          24 = READ POROSITY ADJUSTMENTS
C*********************************************************************
      IF (KOT.GT.0) GO TO 10
      SUMD=0.0
      SUMI=0.0
      SUMO=0.0
      SUME=0.0
C*********************************************************************
C     READ TITLE, OPTIONS, CONVERGENCE CRITERION, AND STORAGE FACTOR
C*********************************************************************
      READ (IN8,1160) QTITLE
      READ(IN8,1110) IOPT,  QERROR,HA
      ALPHA=1.
      IF(HA.GT.1.E-5) ALPHA=HA
      GO TO 20
   10 READ (IN8,1110) IOPT
   20 CONTINUE
      WRITE (OUT,1120) TITLE,QTITLE
      WRITE(OUT,1140)ISTEP,QERROR,ALPHA
      DELTA=1.
      N=NSTEP
   30 N=N-1
      IF (N) 50,50,40
   40 DELTA=DELTA+TIMACL**N
      GO TO 30
   50 DELTA=DELMAJ/DELTA
      WRITE (OUT,1100) NSTEP,DELTA
      DEL=DELTA
      DO 60 I=1,30
   60 IF (IOPT(I).GT.0) WRITE (OUT,1150) I
C*********************************************************************
C     SAVE HYDRAULIC SIMULATION COEFFICIENTS ON 'IN7'
C*********************************************************************
      REWIND IN7
      WRITE(IN7) R,RD,P,T,SURFAC,HBEGN,DL,TOPAQ,SF1
      WRITE (IN7) H,HO
      IF (KOT.LT.1) GO TO 70
C*********************************************************************
C     FOR SECOND OR LATER TIME STEP, READ MASS TRANSPORT
C     COEFFICIENTS FROM 'IN9'
C*********************************************************************
      REWIND IN9
      READ (IN9) ((R(I,J),RD(I,J),P(I,J,1),P(I,J,2),SURFAC(I,J),HBEGN(I,
     1J),SF1(I,J),I=1,NR),J=1,NC)
      READ (IN9) H,HO
   70 CONTINUE
      I=IOPT(1)+IOPT(3)+IOPT(4)
      IF(I.LT.1) GO TO 110
```

```
C***********************************************************************
C     READ DISPERSIVITY COEFFICIENTS
C***********************************************************************
      DO 104 I=1,4
  104 IDCF(I)=0
      IF(IOPT(1).LT.1) GO TO 105
      IDCF(1)=IOPT(1)
      IDCF(2)=IOPT(2)
      CALL QREAD(QTITLE,P(1,1,1),IDCF,NROW,NCOL,1)
      CALL QREAD(QTITLE,P(1,1,2),IDCF,NROW,NCOL,5)
      IDCF(1)=0
  105 IF(IOPT(3).LT.1) GO TO 107
      IDCF(3)=IOPT(3)
      CALL QREAD(QTITLE,P(1,1,1),IDCF,NROW,NCOL,1)
      CALL QREAD(QTITLE,P(1,1,2),IDCF,NROW,NCOL,5)
      IDCF(3)=0
  107 IF(IOPT(4).LT.1) GO TO 110
      IDCF(4)=IOPT(4)
      CALL QREAD(QTITLE,P(1,1,1),IDCF,NROW,NCOL,1)
      CALL QREAD(QTITLE,P(1,1,2),IDCF,NROW,NCOL,5)
  110 I=IOPT(5)+IOPT(7)+IOPT(8)
      IF(I.LT.1) GO TO 120
C***********************************************************************
C     READ RECHARGE QUALITIES
C***********************************************************************
      CALL QREAD(QTITLE,SURFAC,IOPT(5),NROW,NCOL,2)
  120 I=IOPT(15)+IOPT(17)+IOPT(18)
      IF(I.LT.1) GO TO 130
C***********************************************************************
C     READ INITIAL CONCENTRATIONS
C***********************************************************************
      CALL QREAD(QTITLE,R,IOPT(15),NROW,NCOL,3)
  130 I=IOPT(21)+IOPT(23)+IOPT(24)
      IF(I.LT.1) GO TO 140
C***********************************************************************
C     READ POROSITY
C***********************************************************************
      CALL QREAD(QTITLE,SF1,IOPT(21),NROW,NCOL,4)
  140 CONTINUE
      KOT=KOT+1
      IF (KOT.GT.1) GO TO 90
C*********************************************************************
C      CALCULATE INITIAL VOLUME IN STORAGE
C*********************************************************************
      REWIND IN4
      READ(IN4) HO
      DO 80 J=1,NC
      DO 80 I=1,NR
      HO(I,J)=THIK(I,J)
      IF(FLAG(I,J).EQ.1)HO(I,J)=(HO(I,J)-BOTLEL(I,J))
      HO(I,J)=HO(I,J)*SF1(I,J)*DELX(J)*DELY(I)
   80 CONTINUE
   90 CONTINUE
      IF (ISTEP.GT.1) GO TO 550
      DO 540 J=1,NC
      DO 540 I=1,NR
  540 HBEGN(I,J)=R(I,J)
```

```
  550 CONTINUE
C*******************************************************************
C     ADD FLOWS FROM AQUIFER TO PUMPAGE
C*******************************************************************
      DO 560 J=1,NC
      DO 560 I=1,NR
      IF(QSUM(I,J).GT.0.) Q(I,J)=Q(I,J)+QSUM(I,J)/DELMAJ
  560 CONTINUE
C*******************************************************************
C      REWIND STORAGE DEVICE
C*******************************************************************
      CALL SUMFLO (TOPAQ,DL,T,R,RD,B,DELTA,DELMAJ,NC,NR,NROW,NCOL,5,IN6,
     1IN7)
      DO 600 I=1,NR
      DO 600 J=1,NC
      RD(I,J)=R(I,J)
      IF(FLAG(I,J).EQ.1) THIK(I,J)=H(I,J)-BOTLEL(I,J)
C*******************************************************************
C      CONVERT Q FROM NET WITHDRAWAL TO ASSIGNED PUMPAGE
C       PLUS SPRING FLOWS
C     PLUS FLOWS FROM AQUIFER
C*******************************************************************
      Q(I,J)=Q(I,J)+RHG(I,J)*PMPFCT
C*******************************************************************
C     RHG EQUALS RECHARGE PLUS FLOWS TO AQUIFER
C*******************************************************************
      RHG(I,J)=RHG(I,J)*PMPFCT
      IF(QSUM(I,J).LT.1.) RHG(I,J)=RHG(I,J)-QSUM(I,J)/DELMAJ
  600 CONTINUE
      DELTA=DEL
C*******************************************************************
C     SAVE CONCENTRATIONS AT BEGINNING OF TIME STEP
C*******************************************************************
      REWIND IN9
      WRITE (IN9) R
C*******************************************************************
C      BEGIN SMALL TIME STEPS
C*******************************************************************
      DO 920 NSMAL=1,NSTEP
      SUMST=0.0
      SUMEN=0.0
      SUMP=0.0
      SUMR=0.0
C*******************************************************************
C     READ GROUNDWATER FLOW
C*******************************************************************
      CALL SUMFLO (TOPAQ,DL,T,R,RD,B,DELTA,DELMAJ,NC,NR,NROW,NCOL,3,IN6,
     1IN7)
C*********************************************************************
C    CALCULATE DISPERSION TERMS
C*********************************************************************
      DO 590 I=1,NR
      DO 590 J=1,NC
      IF(FLAG(I,J).LT.3) GO TO 570
      T(I,J,1)=0.0
      T(I,J,2)=0.0
      GO TO 590
```

```
  570 HA=TOPAQ(I,J)/(THIK(I,J)*DELY(I)*SF1(I,J))
      HB=DL(I,J)/(THIK(I,J)*DELX(J)*SF1(I,J))
      HC=SQRT(HA*HA+HB*HB+1.E-5)
      IF(J.EQ.NC) GO TO 575
      IF(FLAG(I,J+1).LT.3) GO TO 571
      T(I,J,1)=0
      GO TO 575
  571 T(I,J,1)=(P(I,J,1)*HA*HA+P(I,J,2)*HB*HB)/HC*(THIK(I,J)+
     1THIK(I,J+1))*DELY(I)/(DELX(J)+DELX(J+1))
  575 IF(I.EQ.NR) GO TO 590
      IF(FLAG(I+1,J).LT.3) GO TO 576
      T(I,J,2)=0.
      GO TO 590
  576 T(I,J,2)=(P(I,J,2)*HA*HA+P(I,J,1)*HB*HB)/HC*(THIK(I,J)+
     1THIK(I+1,J))*DELX(J)/(DELY(I)+DELY(I+1))
  590 CONTINUE
C*********************************************************************
C     CALCULATE VOLUME AT END OF STEP
C*********************************************************************
      DO 690 I=1,NR
      DO 690 J=1,NC
      HA=0.0
      IF (FLAG(I,J).GT.2) GO TO 690
      H(I,J)=HO(I,J)
      IF (FLAG(I,J).LT.1) GO TO 690
      IF (J-1) 620,620,610
  610 HA=HA+TOPAQ(I,J-1)
  620 IF (J-NC) 630,640,640
  630 HA=HA-TOPAQ(I,J)
  640 IF (I-1) 660,660,650
  650 HA=HA+DL(I-1,J)
  660 IF (I-NR) 670,680,680
  670 HA=HA-DL(I,J)
  680 HA=HA-Q(I,J)+RHG(I,J)
      H(I,J)=HA*DELTA+HO(I,J)
  690 CONTINUE
C*********************************************************************
C     CALL QSOLVE TO PERFORM IADI PROCEDURE
C*********************************************************************
      CALL QSOLVE(RD,R,T,SF1,H,TOPAQ,DL,SURFAC,BOTLEL,HO,Q,RHG,THIK,
     1B,G,FLAG,QERROR,DELTA,NROW,NCOL,NR,NC,ITER,ALPHA)
C*********************************************************************
C     CALCULATE MASS BALANCE VALUES
C*********************************************************************
      ALPHA1=1.0-ALPHA
      DO 870 I=1,NR
      DO 870 J=1,NC
      IF(RD(I,J).LT.0.0)    RD(I,J)=0.0
      IF (FLAG(I,J).GT.2) GO TO 870
      HA=0.
      HB=0.0
      IF(FLAG(I,J).NE.0) GO TO 860
      IF(I-1) 730,730,700
  700 IF(FLAG(I-1,J).EQ.0) GO TO 730
      HC=T(I-1,J,2)*(RD(I-1,J)-RD(I,J))
      IF(HC.GT.0.)HA=HA+HC
      IF(HC.LT.0.) HB=HB-HC
```

```
      IF(DL(I-1,J))710,730,720
  710 HB=HB- DL(I-1,J)*(ALPHA*RD(I,J)+ALPHA1*RD(I-1,J))
      GO TO 730
  720 HA=HA+DL(I-1,J)*(ALPHA*RD(I-1,J)+ALPHA1*RD(I,J))
  730 IF(I-NR) 740,770,770
  740 IF(FLAG(I+1,J).EQ.0) GO TO 770
      HC=T(I,J,2)*(RD(I+1,J)-RD(I,J))
      IF(HC.GT.0.) HA=HA+HC
      IF(HC.LT.0.) HB=HB-HC
      IF(DL(I,J)) 750,770,760
  750 HA=HA - DL(I,J)*(ALPHA*RD(I+1,J)+ALPHA1*RD(I,J))
      GO TO 770
  760 HB=HB+DL(I,J)*(ALPHA*RD(I,J)+ALPHA1*RD(I+1,J))
  770 IF(J-1) 810,810,780
  780 IF(FLAG(I,J-1).EQ.0) GO TO 810
      HC=T(I,J-1,1)*(RD(I,J-1)-RD(I,J))
      IF(HC.GT.0.) HA=HA+HC
      IF(HC.LT.0.) HB=HB-HC
      IF(TOPAQ(I,J-1)) 790,810,800
  790 HB=HB-TOPAQ(I,J-1)*(ALPHA*RD(I,J)+ALPHA1*RD(I,J-1))
      GO TO 810
  800 HA=HA+TOPAQ(I,J-1)*(ALPHA*RD(I,J-1)+ALPHA1*RD(I,J))
  810 IF(J-NC) 820,850,850
  820 IF(FLAG(I,J+1).EQ.0) GO TO 850
      HC=T(I,J,1)*(RD(I,J+1)-RD(I,J))
      IF(HC.GT.0.) HA=HA+HC
      IF(HC.LT.0.) HB=HB-HC
      IF(TOPAQ(I,J)) 830,850,840
  830 HA=HA - TOPAQ(I,J)*(ALPHA*RD(I,J+1)+ALPHA1*RD(I,J))
      GO TO 850
  840 HB=HB + TOPAQ(I,J)*(ALPHA*RD(I,J)+ALPHA1*RD(I,J+1))
  850 SUMP=SUMP + HA*DELTA
      SUMR=SUMR+ HB * DELTA
  860 CONTINUE
      SUMST=SUMST+HO(I,J)*R(I,J)
      SUMEN=SUMEN+H(I,J)*RD(I,J)
      SUMP=SUMP+Q(I,J)*DELTA*RD(I,J)
      SUMR=SUMR+RHG(I,J)*DELTA*SURFAC(I,J)
  870 CONTINUE
      DMAS=SUMEN-SUMST
      SUMD=SUMD+DMAS
      SUMI=SUMI+SUMR
      SUMO=SUMO+SUMP
      SUMER=DMAS+SUMP-SUMR
      SUME=SUME+SUMER
      IF (NSMAL.EQ.1.OR.IOPT(19).GT.0) WRITE (OUT,1360)
      WRITE (OUT,1370) NSMAL,ITER,DELTA,SUMR,SUMP,DMAS,SUMER
      IF (IOPT(19).GT.0) GO TO 880
      GO TO 900
  880 WRITE(OUT,1120) TITMOD,TITLE,QTITLE
      WRITE (OUT,1390) NSMAL
C*********************************************************************
C      WRITE CONCENTRATIONS AT END OF TIME STEP
C*********************************************************************
      DO 890 I=1,NR
  890 WRITE (OUT,1210) I,(RD(I,J),J=1,NC)
  900 CONTINUE
```

```
      DO 910 I=1,NR
      DO 910 J=1,NC
      HO(I,J)=H(I,J)
  910 R(I,J)=RD(I,J)
      DELTA=DELTA*TIMACL
C**********************************************************************
C     END OF SMALL TIME STEP
C**********************************************************************
  920 CONTINUE
      DELTA=DEL
      IF (IOPT(19).GT.0) WRITE (OUT,1360)
      WRITE (OUT,1380) ISTEP,SUMI,SUMO,SUMD,SUME
C**********************************************************************
C     READ CONCENTRATIONS AT BEGINNING OF TIME STEP
C**********************************************************************
      REWIND IN9
      READ (IN9) R
      IF (IOPT(19).GT.0) GO TO 940
      IF (IOPT(9).LT.1) GO TO 940
C**********************************************************************
C     WRITE ENDING CONCENTRATIONS
C**********************************************************************
      WRITE(OUT,1120) TITMOD,TITLE,QTITLE
      WRITE (OUT,1290) ISTEP
      DO 930 I=1,NR
  930 WRITE (OUT,1210) I,(RD(I,J),J=1,NC)
C**********************************************************************
C     PLOT CONTOUR MAP OF CONCENTRATIONS
C**********************************************************************
  940 IF(IOPT(10).GT.0) CALL QPLOTH(NROW,NCOL,FLAG,RD,QTITLE,3)
      IF (IOPT(11).LT.1) GO TO 970
C**********************************************************************
C     LIST QUALITY CHANGES DURING THIS TIME STEP
C**********************************************************************
      WRITE(OUT,1120) TITMOD,TITLE,QTITLE
      WRITE (OUT,1300) ISTEP
      DO 960 I=1,NR
      DO 950 J=1,NC
  950 B(J)=RD(I,J)-R(I,J)
  960 WRITE (OUT,1210) I,(B(J),J=1,NC)
  970 IF (IOPT(20).LT.1) GO TO 1000
C**********************************************************************
C     LIST CHANGES IN CONCENTRATIONS THROUGH THIS STEP
C**********************************************************************
      WRITE(OUT,1120) TITMOD,TITLE,QTITLE
      WRITE (OUT,1310) ISTEP
      DO 990 I=1,NR
      DO 980 J=1,NC
  980 B(J)=RD(I,J)-HBEGN(I,J)
  990 WRITE (OUT,1210) I,(B(J),J=1,NC)
C**********************************************************************
C     PLOT QUALITY CHANGES DURING THIS TIME STEP
C**********************************************************************
 1000 IF(IOPT(12).GT.0) CALL QPLOTS(NROW,NCOL,FLAG,RD,R,QTITLE,5)
C**********************************************************************
C     PLOT QUALITY CHANGES THROUGH THIS TIME STEP
C**********************************************************************
```

```
      IF(IOPT(13).GT.0) CALL QPLOTS(NROW,NCOL ,FLAG,RD,HBEGN,QTITLE,6)
      IF (IOPT(14).LT.1) GO TO 1080
C*********************************************************************
C     READ OBSERVED CONCENTRATIONS
C*********************************************************************
      DO 1010 I=1,20
 1010 FMT(I)=VFMT(I,4)
      IF(IOPT(14).LT.5) GO TO 1020
      READ (IN8,1160) FMT
      WRITE (OUT,1400) (FMT(I),I=1,10)
 1020 DO 1030 I=1,NR
 1030 READ (IN8,FMT) (R(I,J),J=1,NC)
C*********************************************************************
C     LIST SIMULATED AND MEASURED CONCENTRATIONS
C     AND SIMULATION ERRORS
C*********************************************************************
      WRITE(OUT,1120) TITMOD,TITLE,QTITLE
      WRITE (OUT,1130) ISTEP
      DO 1070 I=1,NR
      DO 1050 J=1,NC
      B(J)=0.
      IFL=FLAG(I,J)+1
      GO TO (1050,1040,1040,1050), IFL
 1040 B(J)=RD(I,J)-R(I,J)
 1050 CONTINUE
      JST=1
 1060 JEND=JST+9
      JEND=AMIN0(JEND,NC)
      WRITE (OUT,1200)
      WRITE (OUT,1200) I,(RD(I,J),J=JST,JEND)
      WRITE (OUT,1190) (R(I,J),J=JST,JEND)
      WRITE (OUT,1190) (B(J),J=JST,JEND)
      JST=JEND+1
      IF (JST.GT.NC) GO TO 1070
      GO TO 1060
 1070 CONTINUE
C*********************************************************************
C     PRINT MAP OF SIMULATION ERRORS
C*********************************************************************
      CALL QPLOTS(NROW,NCOL,FLAG,RD,R,QTITLE,4)
 1080 CONTINUE
      DO 1090 J=1,NC
      DO 1090 I=1,NR
 1090 R(I,J)=RD(I,J)
C*********************************************************************
C     SAVE QUALTIY COEFFICIENTS ON 'IN9'
C*********************************************************************
      REWIND IN9
      WRITE (IN9) ((R(I,J),RD(I,J),P(I,J,1),P(I,J,2),SURFAC(I,J),HBEGN(I
     1,J),SF1(I,J),I=1,NR),J=1,NC)
      WRITE (IN9) H,HO
C*********************************************************************
C     READ HYDRAULIC SIMULATION COEFFICEINTS FROM 'IN7'
C*********************************************************************
      REWIND IN7
      READ(IN7)R,RD,P,T,SURFAC,HBEGN,DL,TOPAQ,SF1
      READ (IN7) H,HO
```

```
      RETURN
C***********************************************************************
C
C
 1100 FORMAT (T20,'NUMBER OF SMALL TIME STEPS IS',I5/T20,'FIRST STEP LEN
     1GTH IS',F10.4,' DAYS')
 1110 FORMAT(30I1,2F10.0)
 1120 FORMAT(1H1,T25,20A4//T25,20A4/T25,20A4/)
 1130 FORMAT (T10,'FOR TIME STEP ',I5,T35,'SIMULATED CONCENTRATIONS'/T35
     1,'MEASURED CONCENTRATIONS'/T35,'SIMULATION ERRORS'/)
 1140 FORMAT (T20,'FOR SIMULATION STEP',I4/T20,'CONVEGENCE',' CRITERION
     1=',F10.3/T20,'ALPHA =',F10.3)
 1150 FORMAT (1H0,T10,'OPTION',I4,' IN EFFECT')
 1160 FORMAT (20A4)
 1190 FORMAT (6X,10F10.2)
 1200 FORMAT (1H0,I5,10F10.2)
 1210 FORMAT (1H0,I5,10F10.2/(6X,10F10.2))
 1240 FORMAT (T21,I3,4X,I3,3X,I3,5X,I3,2G19.4)
 1290 FORMAT (1H0,T20,'QUALITY VALUES AT END OF SIMULATION'' PERIOD',I4/
     1)
 1300 FORMAT (1H0,T20,'QUALITY CHANGES DURING SIMULATION',' PERIOD',I4/)
 1310 FORMAT (1H0,T20,'QUALITY CHANGES THROUGH SIMULATION PERIOD',I4/)
 1320 FORMAT (1H0,T20,'NUMBER OF ITERATIONS =',I5/)
 1360 FORMAT (1H0,T4,'STEP',T13,'ITERATIONS',T29,'STEP',T46,'MASS',T61,'
     1MASS',T76,'INCREASE OF',T101,'MASS'/T28,'LENGTH',T47,'IN',T62,'OUT
     2',T76,'STORED MASS',T99,'RESIDUAL'/)
 1370 FORMAT (I7,T16,I3,T26,F8.2,T39,E14.5,E16.5,T75,E14.5,T96,E14.5)
 1380 FORMAT (1H0,T4,'TOTALS THROUGH MAJOR STEP',I5,T39,E14.5,E16.5,T75,
     1E14.5,T96,E14.5)
 1390 FORMAT (1H0,T20,'QUALITY VALUES AT END OF SMALL STEP',I5/)
 1400 FORMAT (T70,'FORMAT IS',T80,10A4/)
      END
```

```
      SUBROUTINE SOLVE(NROW,NCOL,FLAG,H,HO,T,SF1,Q,R,RD,TOPAQ)
C***********************************************************************0
C     THIS ROUTINE SOLVES FOR HEADS USING THE IADI PROCEDURE
C***********************************************************************0
      COMMON /ITCOM/ NR,NC,ISTEP,NPARM,IN,OUT,OUT1,OPT(30),ITER,NSAVE,
     1ISAVE(25),JSAVE(25),KHYD,NCOLS,MCOLS(25),NROWS,MROWS(25)
     2,IN1,IN2,IN3,IN4,IN5,IN6
     1,NSTEPS,NBLK,IRWC(4,60),NSPRG,ISPRG(25),JSPRG(25),KSSH,KQUAL
      COMMON /RLCOM/ FMT(20),TITLE(20),DELX(200),DELY(200),   PARM(10),B
     1(200),G(200),SUMS(18,2),
     2                              ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,
     3DELMAJ,E,XLGTNM,FLXNAM(2),FLXFCT
     1,DELMJ2,TIME,STRFCT,SCALE
     1,TITMOD(20),VFMT(20,7)
      INTEGER OPT,FLAG,OUT,OUT1
      DIMENSION H(NROW,NCOL),HO(NROW,NCOL),T(NROW,NCOL,2),SF1(NROW,NCOL
     1),Q(NROW,NCOL)  ,FLAG(NROW,NCOL)
     1,RD(NROW,NCOL),R(NROW,NCOL)
     1,TOPAQ(NROW,NCOL)
       DOUBLE PRECISION BB,CC,W
      ITER=0
10    CONTINUE
      ITER=ITER+1
      IF (ITER.GT.50) GO TO 380
      K=MOD(ITER,NPARM)+1
      PK=PARM(K)
      E=0.0
C***********************************************************************1410
C     ROW CALCULATIONS                                                  1510
C***********************************************************************1610
      DO 190 II=1,NR
      I=II
      IF(MOD(ISTEP+ITER,2).EQ.1)I=NR-I+1
      EE=1.
      IF(I.EQ.1)EE=0.0
      JSTRT=1
20    DO 30 JJ=JSTRT,NC
      IFL=FLAG(I,JJ)+1
      GO TO (30,40,40,30), IFL
30    CONTINUE
      GO TO 190
40    CONTINUE
      JJP1=JJ+1
50    DO 60 JJJ=JJP1,NC
      IFL=FLAG(I,JJJ)+1
      GO TO (70,60,60,70), IFL
60    CONTINUE
      JJJ=NC
      JSTRT=NC
      GO TO 80
70    JJJ=JJJ-1
```

```
      JSTRT=JJJ+1
80    CONTINUE
      AA=0.
      DD=0.
      BB=0.
      IF (JJ.EQ.1) GO TO 90
      IF (FLAG(I,JJ-1).GT.0) GO TO 90
      BB=T(I,JJ-1,1)
      DD=BB*H(I,JJ-1)
90    CONTINUE
      DO 150 J=JJ,JJJ
      TT=-AA
      BB=BB+TT
100   TT=T(I,J,1)
      CC=-TT
      BB=BB+TT
      IF(FLAG(I,J+1).EQ.0)DD=DD+TT*H(I,J+1)
110   TT=T(I-1,J,2)*EE
      BB=BB+TT
      DD=DD+TT*H(I-1,J)
120   TT=T(I,J,2)
      BB=BB+TT
      DD=DD+TT*H(I+1,J)
      DD=DD+BB*PK*H(I,J)
      BB=BB*(1.+PK)
130    RAT=1.
       IFL=FLAG(I,J)+1
       IF(IFL.EQ.2.AND.H(I,J).GT.TOPAQ(I,J)) RAT=1./STRFCT
       IF(IFL.EQ.3.AND.H(I,J).LT.TOPAQ(I,J)) RAT=STRFCT
       DD=DD-Q(I,J)+SF1(I,J)/DELTA*(HO(I,J)-TOPAQ(I,J)*(1.-RAT))
       BB=BB+SF1(I,J)/DELTA*RAT
       HA=R(I,J)
       IF(HA) 135,140,131
131    IF(H(I,J)-RD(I,J))140,140,132
132    BB=BB+HA
       DD=DD+HA*RD(I,J)
       GO TO 140
135    BB=BB-HA
       DD=DD-HA*RD(I,J)
140   W=BB-AA*B(J-1)
      B(J)=CC/W
      G(J)=(DD-AA*G(J-1))/W
      DD=0.
      BB=0.
150   AA=-T(I,J,1)
C***********************************************************************6710
C     RE-ESTIMATE HEADS                                                 6810
C***********************************************************************6910
      E=E+ABS(H(I,JJJ)-G(JJJ))
      H(I,JJJ)=G(JJJ)
      N=JJJ
160   N=N-1
      IF (N-JJ+1) 180,180,170
170   HA=G(N)-B(N)*H(I,N+1)
      E=E+ABS(HA-H(I,N))
      H(I,N)=HA
      GO TO 160
```

```
180    IF (JSTRT-NC) 20,190,190
190    CONTINUE
C***********************************************************************
C      COLUMN CALCULATIONS
C***********************************************************************
       DO 370 JJ=1,NC
       J=JJ
       IF(MOD(ISTEP+ITER,2).EQ.1)J=NC-J+1
       EE=1.
       IF(J.EQ.1)EE=0.
       ISTRT=1
200    DO 210 II=ISTRT,NR
       IFL=FLAG(II,J)+1
       GO TO (210,220,220,210), IFL
210    CONTINUE
       GO TO 370
220    CONTINUE
       IIP1=II+1
230    DO 240 III=IIP1,NR
       IFL=FLAG(III,J)+1
       GO TO (250,240,240,250), IFL
240    CONTINUE
       III=NR
       ISTRT=NR
       GO TO 260
250    III=III-1
       ISTRT=III+1
260    CONTINUE
       AA=0.
       DD=0.
       BB=0.
       IF (II.EQ.1) GO TO 270
       IF (FLAG(II-1,J).GT.0) GO TO 270
       BB=T(II-1,J,2)
       DD=BB*H(II-1,J)
270    CONTINUE
       DO 330 I=II,III
280    TT=T(I,J-1,1)*EE
       BB=BB+TT
       DD=DD+TT*H(I,J-1)
290    TT=T(I,J,1)
       BB=BB+TT
       DD=DD+TT*H(I,J+1)
       TT=-AA
       BB=BB+TT
300    TT=T(I,J,2)
       BB=BB+TT
       CC=-TT
       IF(FLAG(I+1,J).EQ.0)DD=DD+TT*H(I+1,J)
       DD=DD+BB*PK*H(I,J)
       BB=BB*(1.+PK)
310     RAT=1.
        IFL=FLAG(I,J)+1
        IF(IFL.EQ.2.AND.H(I,J).GT.TOPAQ(I,J)) RAT=1./STRFCT
        IF(IFL.EQ.3.AND.H(I,J).LT.TOPAQ(I,J)) RAT=STRFCT
        DD=DD-Q(I,J)+SF1(I,J)/DELTA*(HO(I,J)-TOPAQ(I,J)*(1.-RAT))
        BB=BB+SF1(I,J)/DELTA*RAT
```

```
       HA=R(I,J)
       IF(HA)315,320,311
311    IF(H(I,J)-RD(I,J)) 320,320,312
312    BB=BB+HA
       DD=DD+HA*RD(I,J)
       GO TO 320
315    DD=DD-HA*RD(I,J)
       BB=BB-HA
320   W=BB-AA*B(I-1)
      B(I)=CC/W
      G(I)=(DD-AA*G(I-1))/W
      DD=0.
      BB=0.
330   AA=-T(I,J,2)
C***********************************************************************
C     RE-ESTIMATE HEADS
C***********************************************************************
      E=E+ABS(H(III,J)-G(III))
      H(III,J)=G(III)
      N=III
340   N=N-1
      IF (N-II+1) 360,360,350
350   HA=G(N)-B(N)*H(N+1,J)
      E=E+ABS(H(N,J)-HA)
      H(N,J)=HA
      GO TO 340
360   IF (ISTRT-NR) 200,370,370
370   CONTINUE
      IF (E.GT.ERROR) GO TO 10
      IF (ITER.LT.4) GO TO 10
380   RETURN
      END
```

sumflo.for

```
      SUBROUTINE SUMFLO (H,HO,T,R,RD,B,DELTA,DELMAJ,NC,NR,NROW,NCOL,N,IN
"
     16,IN7)
"
C***********************************************************************
"
C     THIS SUBROUTINE CALCULATES GROUNDWATER FLOWS
"
C       AND SAVES HEADS
"
C***********************************************************************
      DIMENSION H(NROW,NCOL), HO(NROW,NCOL), B(1), T(NROW,NCOL,2), R(NRO
     1W,NCOL), RD(NROW,NCOL)
      GO TO (10,20,80,100,110), N
C      N=4  READ HEADS
10    REWIND IN6
      RETURN
20    REWIND IN7
      WRITE (IN7) ((R(I,J),RD(I,J),I=1,NR),J=1,NC)
      DO 70 J=1,NC
      DO 60 I=1,NR
      R(I,J)=0.0
      RD(I,J)=0.0
      IF (I-NR) 30,40,40
30    RD(I,J)=T(I,J,2)*(H(I,J)+HO(I,J)-H(I+1,J)-HO(I+1,J))*0.5
40    IF (J-NC) 50,60,60
50    R(I,J)=T(I,J,1)*(H(I,J)+HO(I,J)-H(I,J+1)-HO(I,J+1))*0.5
60    CONTINUE
      WRITE (IN6) (R(I,J),I=1,NR)
70    WRITE (IN6) (RD(I,J),I=1,NR)
      REWIND IN7
      READ (IN7) ((R(I,J),RD(I,J),I=1,NR),J=1,NC)
      RETURN
80    DO 90 J=1,NC
      READ (IN6) (H(I,J),I=1,NR)
      READ (IN6) (HO(I,J),I=1,NR)
90    CONTINUE
      RETURN
100   CONTINUE
      RETURN
110   REWIND IN6
      RETURN
      END
```

```
      SUBROUTINE XSECT (NROW,NCOL,FLAG,HSIM,HOBS,BOTLEL)
C***********************************************************************
C     THIS SUBROUTINE PRODUCES A PRINTER PLOT OF CROSS-SECTIONS ALONG
C     ROWS OR COLUMNS.  MAXIMUM NUMBER OF ROWS OR COLUMNS IS 100.
C***********************************************************************
      INTEGER IDUM(10)
      DATA IDUM/1,2,3,4,5,6,7,8,9,0/
      COMMON /ITCOM/ NR,NC,ISTEP,NPARM,IN,OUT,OUT1,OPT(30),ITER,NSAVE,
     1ISAVE(25),JSAVE(25),KHYD,NCOLS,MCOLS(25),NROWS,MROWS(25)
     2,IN1,IN2,IN3,IN4,IN5,IN6
     1,NSTEPS,NBLK,IRWC(4,60),NSPRG,ISPRG(25),JSPRG(25),KSSH,KQUAL
      COMMON /RLCOM/ FMT(20),TITLE(20),DELX(200),DELY(200),PRMITR(10),B
     1(200),G(200),SUMS(18,2),
     2                              ERROR,PMPFCT,PMPNAM,PERFCT,DELTA,
     3DELMAJ,E,XLGTNM,FLXNAM(2),FLXFCT
     1,DELMJ2,TIME,STRFCT,SCALE
     1,TITMOD(20),VFMT(20,7)
      INTEGER OPT,FLAG,OUT,OUT1
      DIMENSION HSIM(NROW,NCOL),HOBS(NROW,NCOL),PLOT(100),
     1FLAG(NROW,NCOL)
     2,BOTLEL(NROW,NCOL)
     1,XINTGR(10)
      DATA XINTGR/1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H0/
      EQUIVALENCE (PLOT(1),B(1))
      DATA SIM,OBS,BLANK,BOTH/1HS,1HO,1H ,1HB/
      DIMENSION XCOL(2)
      DATA XROW/3HROW/,XCOL/4HCOLU,2HMN/
      IOPT=OPT(22)
      DO 220 L=1,NCOLS
      IF (NCOLS.LT.1) GO TO 220
      ORIGX=0
      IF(SCALE.GT.0.) GO TO 20
      DO 10 I=1,NR
   10 G(I)=I
      JST=1
      J=NR+1
      GO TO 60
   20 G(1)=0
      DO 30 I=2,NR
   30 G(I)=G(I-1)+(DELY(I)+DELY(I-1))/2.
      JST=1
      IF(G(NR)/SCALE.GT.50.) GO TO 450
   40 DO 50 J=JST,NR
      IF((G(J)-ORIGX).GT.9.9*SCALE) GO TO 60
   50 CONTINUE
      J=NR+1
   60 JEND=J-1
      GSAVE=G(JEND)
      IF(JST.EQ.JEND.AND.JST.NE.NR) GO TO 230
      WRITE(OUT,540)TITMOD,TITLE,ISTEP
      J=MCOLS(L)
      WRITE (OUT,470) J
      WRITE (OUT,550)
      IF(SCALE.LE.1.E-3) GO TO 80
```

```
      DO 70 I=JST,JEND
      K=(G(I)+SCALE/20.-ORIGX) /(SCALE/10.)+1
   70 G(I)=K+0.5
   80 WRITE (OUT,570) XROW
      DO 110 LL=1,2
      DO 90 K=1,100
   90 PLOT(K)=BLANK
      DO 100 I=JST,JEND
      KG=G(I)
      KL=I/10
      PLOT(KG)=XINTGR(KL)
      IF(KL.EQ.0) PLOT(KG)=BLANK
      IF(LL.EQ.1) GO TO 100
      KL=MOD(I,10)
      IF(KL.EQ.0) KL=10
      PLOT(KG)=XINTGR(KL)
  100 CONTINUE
  110 WRITE (OUT,520) PLOT
      HMAX=-1.E5
      HMIN=1.E5
      DO 120 I=1,NR
      IF (FLAG(I,J).GT.2) GO TO 120
      HA=HSIM(I,J)
      IF(IOPT.GT.0.AND.ABS(HOBS(I,J)).GE.1.E-3) HA=HOBS(I,J)
      HB=HA
      IF(FLAG(I,J).EQ.1) HB=BOTLEL(I,J)
      HMAX=AMAX1(HMAX,HSIM(I,J),HA,HB)
      HMIN=AMIN1(HMIN,HSIM(I,J),HA,HB)
  120 CONTINUE
      HMAX=IFIX(HMAX+1.)
      HMIN=IFIX(HMIN-1.)
      XINC=(HMAX-HMIN)/40.
      XINC=FLOAT(IFIX((XINC+0.5)*2.))/2.0
      XXINC=XINC*0.5
      DO 180 LL=1,41
      DO 130 I=1,100
  130 PLOT(I)=BLANK
      DO 160 I=JST,JEND
      KG=G(I)
      IF (FLAG(I,J).GT.2) GO TO 160
      IF(ABS(BOTLEL(I,J)-HMAX).LE.XXINC) PLOT(KG)=1H+
      IF(ABS(HSIM(I,J)-HMAX).LE.XXINC) PLOT(KG)=SIM
      IF (IOPT.LT.1) GO TO 160
      IF (ABS(HOBS(I,J)-HMAX).LE.XXINC) GO TO 140
      GO TO 160
  140 IF(PLOT(KG).EQ.SIM) GO TO 150
      PLOT(KG)=OBS
      GO TO 160
  150 PLOT(KG)=BOTH
  160 CONTINUE
  170 WRITE (OUT,510) HMAX,PLOT
      HMAX=HMAX-XINC
  180 CONTINUE
      WRITE (OUT,570) XROW
      DO 210 LL=1,2
      DO 190 K=1,100
  190 PLOT(K)=BLANK
```

```
      DO 200 I=JST,JEND
      KG=G(I)
      KL=I/10
      PLOT(KG)=XINTGR(KL)
      IF(KL.EQ.0) PLOT(KG)=BLANK
      IF(LL.EQ.1) GO TO 200
      KL=MOD(I,10)
      IF(KL.EQ.0) KL=10
      PLOT(KG)=XINTGR(KL)
  200 CONTINUE
  210 WRITE (OUT,520) PLOT
      JST=JEND
      ORIGX=GSAVE
      G(JST)=GSAVE
      IF(JST.LT.NR) GO TO 40
  220 CONTINUE
  230 CONTINUE
      DO 440 L=1,NROWS
      IF (NROWS.LT.1) GO TO 440
      ORIGX=0
      IF(SCALE.GT.0) GO TO 250
      DO 240 J=1,NC
  240 G(J)=J
      JST=1
      J=NC+1
      GO TO 290
  250 G(1)=0
      DO 260 J=2,NC
  260 G(J)=G(J-1)+(DELX(J)+DELX(J-1))/2.
      JST=1
      IF(G(NC)/SCALE.GT.50.) GO TO 450
  270 DO 280 J=JST,NC
      IF((G(J)-ORIGX).GT.9.9*SCALE) GO TO 290
  280 CONTINUE
      J=NR+1
  290 JEND=J-1
      GSAVE=G(JEND)
      IF(JST.EQ.JEND.AND.JST.NE.NC) GO TO 460
      WRITE(OUT,540)TITMOD,TITLE,ISTEP
      I=MROWS(L)
      WRITE (OUT,530) I
      WRITE (OUT,550)
      IF(SCALE.LE.1.E-3) GO TO 310
      DO 300 J=JST,JEND
      K=(G(J)+SCALE/20. -ORIGX)/(SCALE/10.)+1
  300 G(J)=K+0.5
  310 CONTINUE
      WRITE (OUT,570) XCOL
      DO 340 LL=1,2
      DO 320 K=1,100
  320 PLOT(K)=BLANK
      DO 330 J=JST,JEND
      KG=G(J)
      KL=J/10
      PLOT(KG)=XINTGR(KL)
      IF(KL.EQ.0) PLOT(KG)=BLANK
      IF(LL.EQ.1) GO TO 330
```

```
      KL=MOD(J,10)
      IF(KL.EQ.0) KL=10
      PLOT(KG)=XINTGR(KL)
  330 CONTINUE
  340 WRITE(OUT,520) PLOT
      HMAX=-1.E5
      HMIN=1.E5
      DO 350 J=JST,JEND
      IF (FLAG(I,J).GT.2) GO TO 350
      HA=HSIM(I,J)
      IF(IOPT.GT.0.AND.ABS(HOBS(I,J)).GE.1.E-3) HA=HOBS(I,J)
      HB=HA
      IF(FLAG(I,J).EQ.1) HB=BOTLEL(I,J)
      HMAX=AMAX1(HMAX,HSIM(I,J),HA,HB)
      HMIN=AMIN1(HMIN,HSIM(I,J),HA,HB)
  350 CONTINUE
      HMAX=IFIX(HMAX+1.)
      HMIN=IFIX(HMIN-1.)
      XINC=(HMAX-HMIN)/40.
      XINC=FLOAT(IFIX((XINC+0.5)*2.))/2.0
      XXINC=XINC*0.5
      DO 400 LL=1,41
      DO 360 J=1,100
  360 PLOT(J)=BLANK
      DO 390 J=JST,JEND
      KG=G(J)
      IF (FLAG(I,J).GT.2) GO TO 390
      IF(ABS(BOTLEL(I,J)-HMAX).LE.XXINC) PLOT(KG)=1H+
      IF(ABS(HSIM(I,J)-HMAX).LE.XXINC) PLOT(KG)=SIM
      IF (IOPT.LT.1) GO TO 390
      IF (ABS(HOBS(I,J)-HMAX).LE.XXINC) GO TO 370
      GO TO 390
  370 IF(PLOT(KG).EQ.SIM) GO T O 380
      PLOT(KG)=OBS
      GO TO 390
  380 PLOT(KG)=BOTH
  390 CONTINUE
      WRITE (OUT,510) HMAX,PLOT
      HMAX=HMAX-XINC
  400 CONTINUE
      WRITE (OUT,570) XCOL
      DO 430 LL=1,2
      DO 410 K=1,100
  410 PLOT(K)=BLANK
      DO 420 J=JST,JEND
      KG=G(J)
      KL=J/10
      PLOT(KG)=XINTGR(KL)
      IF(KL.EQ.0) PLOT(KG)=BLANK
      IF(LL.EQ.1) GO TO  420
      KL=MOD(J,10)
      IF(KL.EQ.0) KL=10
      PLOT(KG)=XINTGR(KL)
  420 CONTINUE
  430 WRITE (OUT,520) PLOT
      JST=JEND
      ORIGX=GSAVE
```

```
      G(JST)=GSAVE
      IF(JST.LT.NC) GO TO 270
  440 CONTINUE
      RETURN
  450 WRITE (OUT,580)
  460 RETURN
C***********************************************************************
C
C
C
C
  470 FORMAT (25H0CROSS-SECTION FOR COLUMN,I3)
  480 FORMAT (1H0,24X,100I1)
  490 FORMAT (16X,100I1)
  500 FORMAT (7X,'HEAD',5X,100I1)
  510 FORMAT (1X,F10.2,5X,100A1)
  520 FORMAT (T17,100A1)
  530 FORMAT (22H0CROSS-SECTION FOR ROW,I3)
  540 FORMAT(1H1,T25,20A4//T25,20A4/T54,'FOR TIME STEP',I5//)
  550 FORMAT (1H+,T40,'S=SIMULATED',5X,'O=OBSERVED',5X,'B=OBSERVED=SIMUL
     1ATED',5X,'+=BASE')
  560 FORMAT (1H+,15X,2A4)
  570 FORMAT (1H0,T17,2A4)
  580 FORMAT (' SCALE INCORRECT  PLOT TERMINATED'//)
      END
```

APPENDIX 4

GRAPHED RESULTS OF THE ALTERNATIVE MODEL RUN WHEN PUMPAGE IS NOT LIMITED TO 400,000 AC-FT/YR

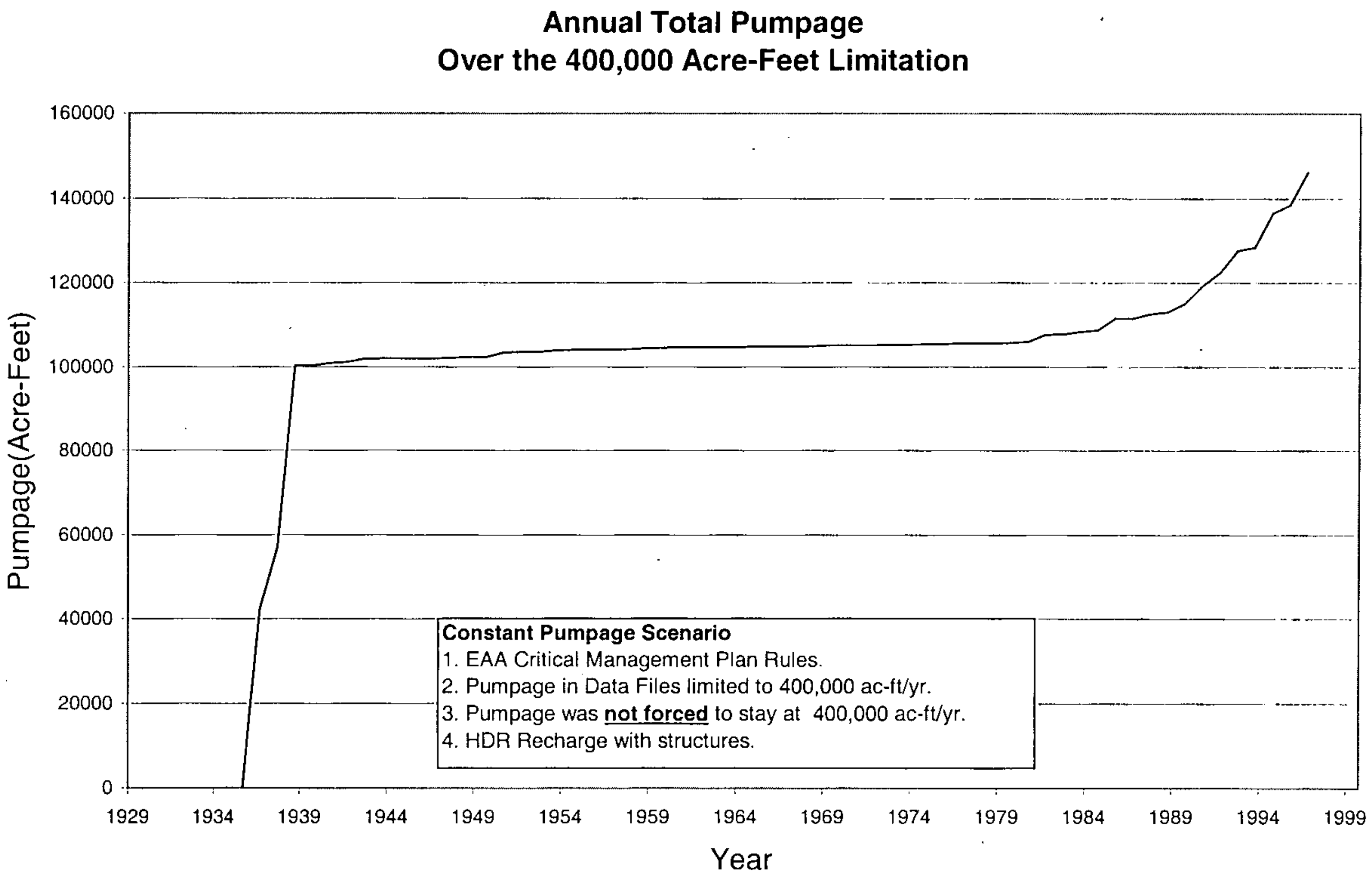

Figure 9. Annual total amount of pumpage exceeding 400,000 ac-ft/yr when total pumpage is not forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.

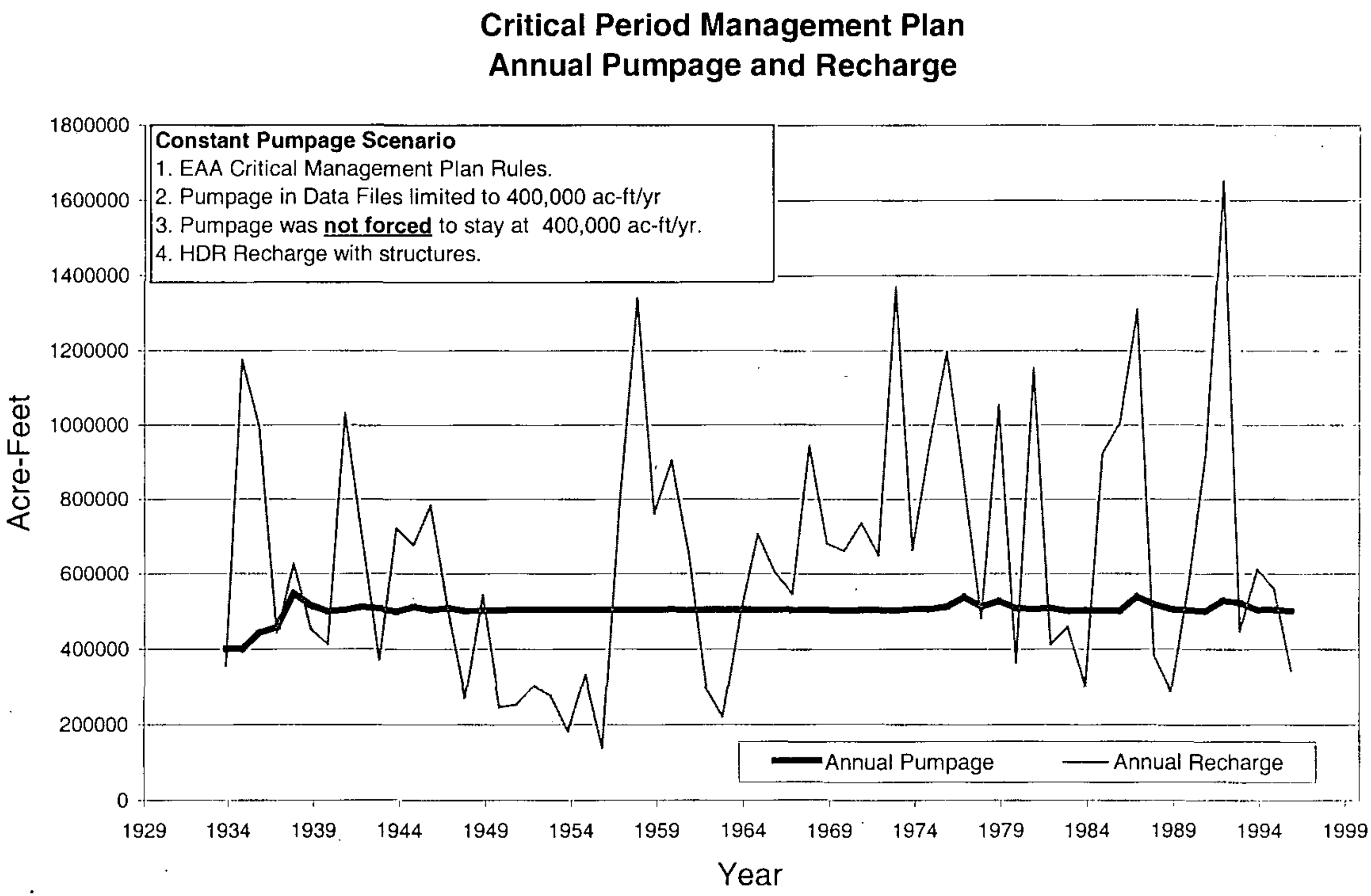

Figure 10. Annual pumpage and recharge under the Critical Period Management Plan when total pumpage is not forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.

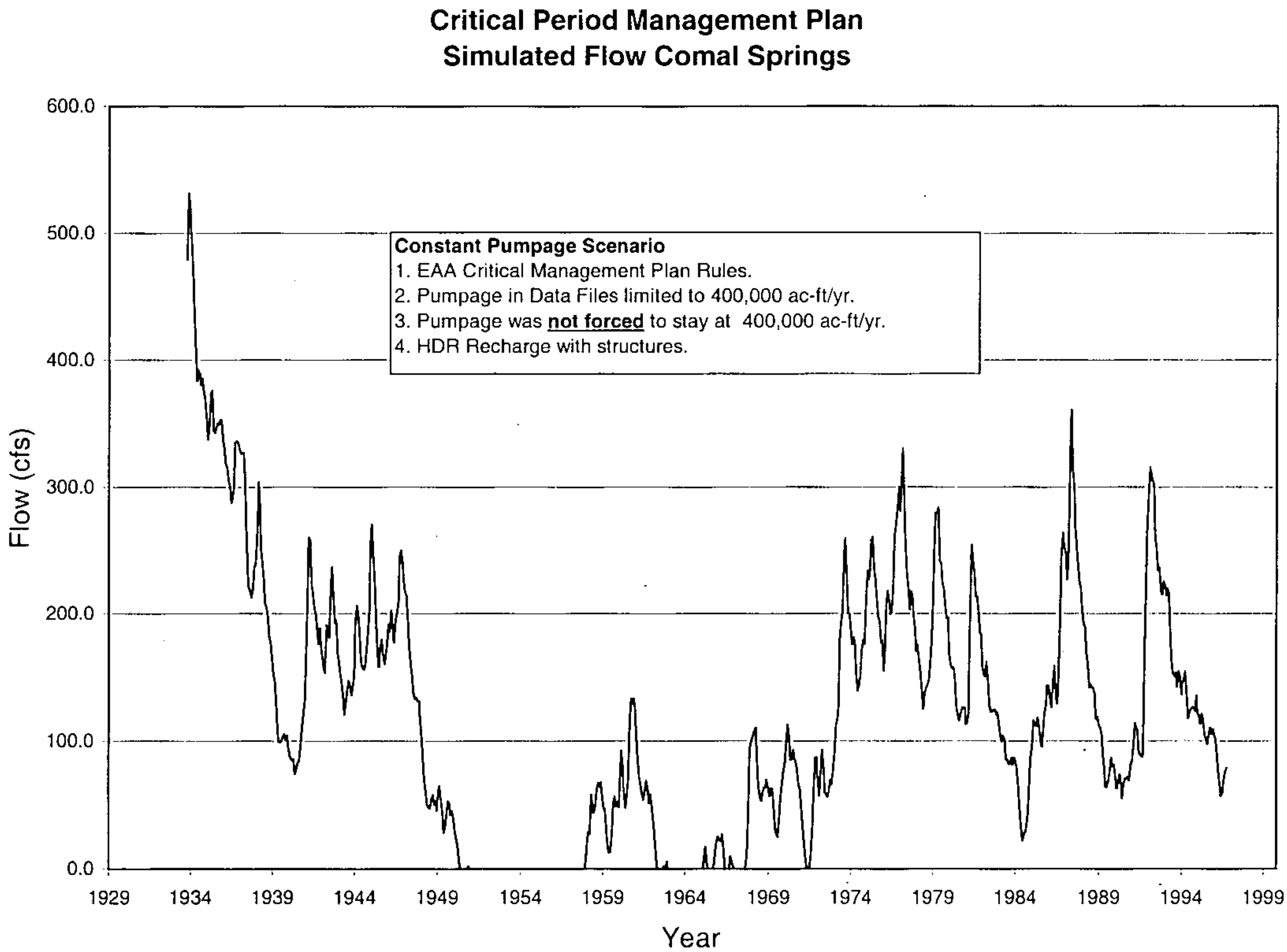

Figure 11. Simulated flow from Comal Springs when total pumpage is not forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.

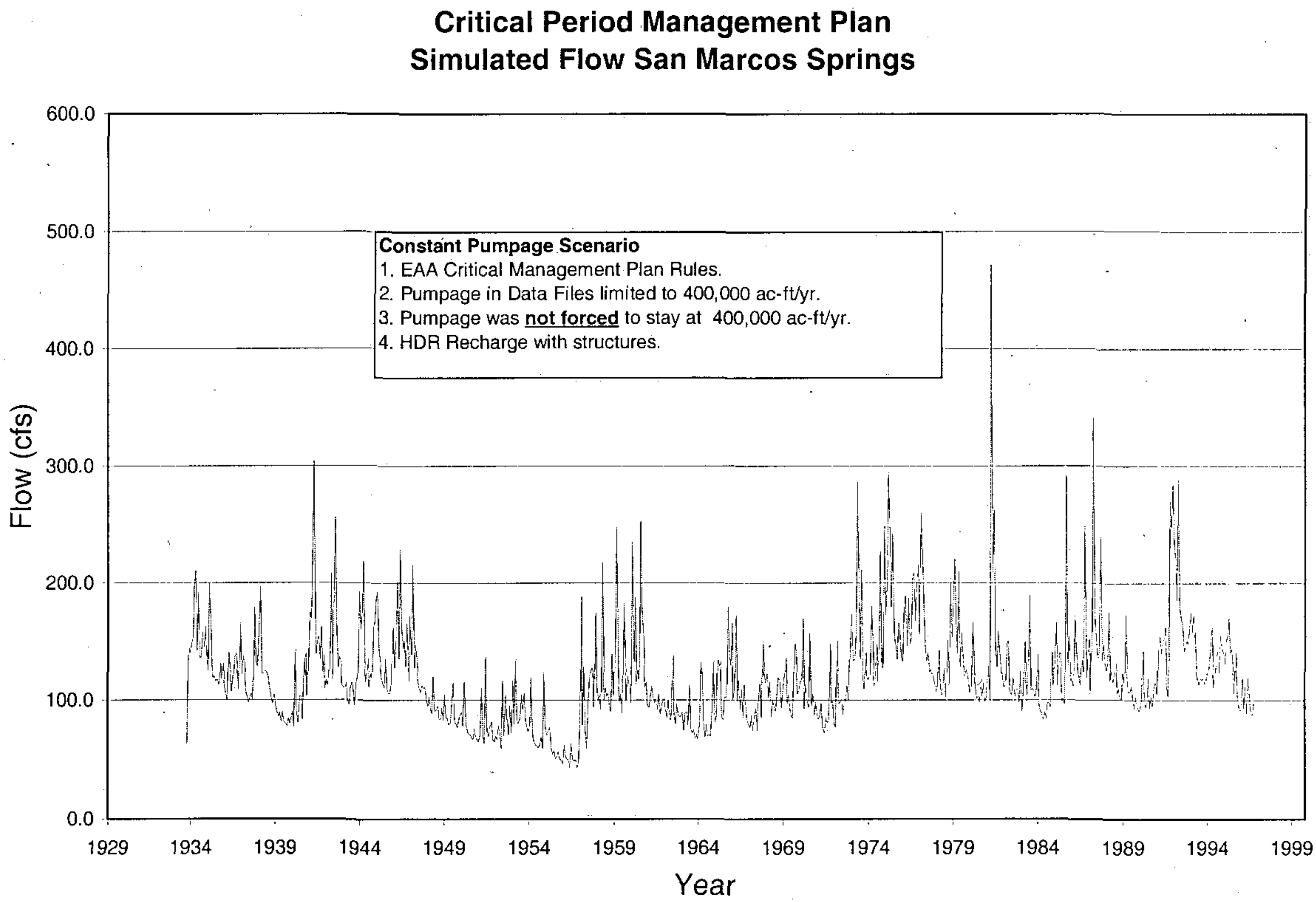

Figure 12. Simulated flow of San Marcos Springs when total pumpage is not forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.

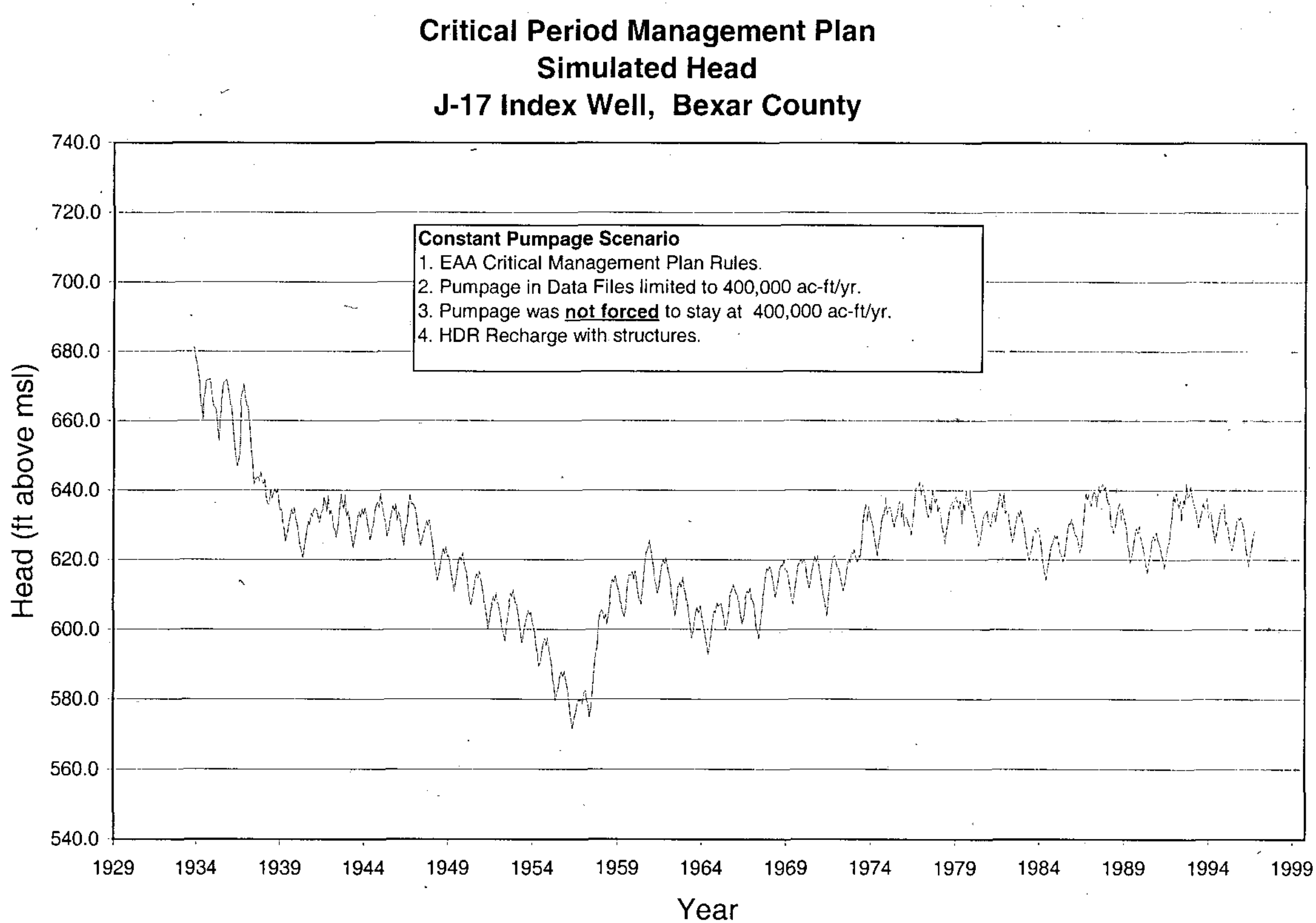

Figure 13. Simulated Head of J-17 index well, Bexar County when total pumpage is not forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.

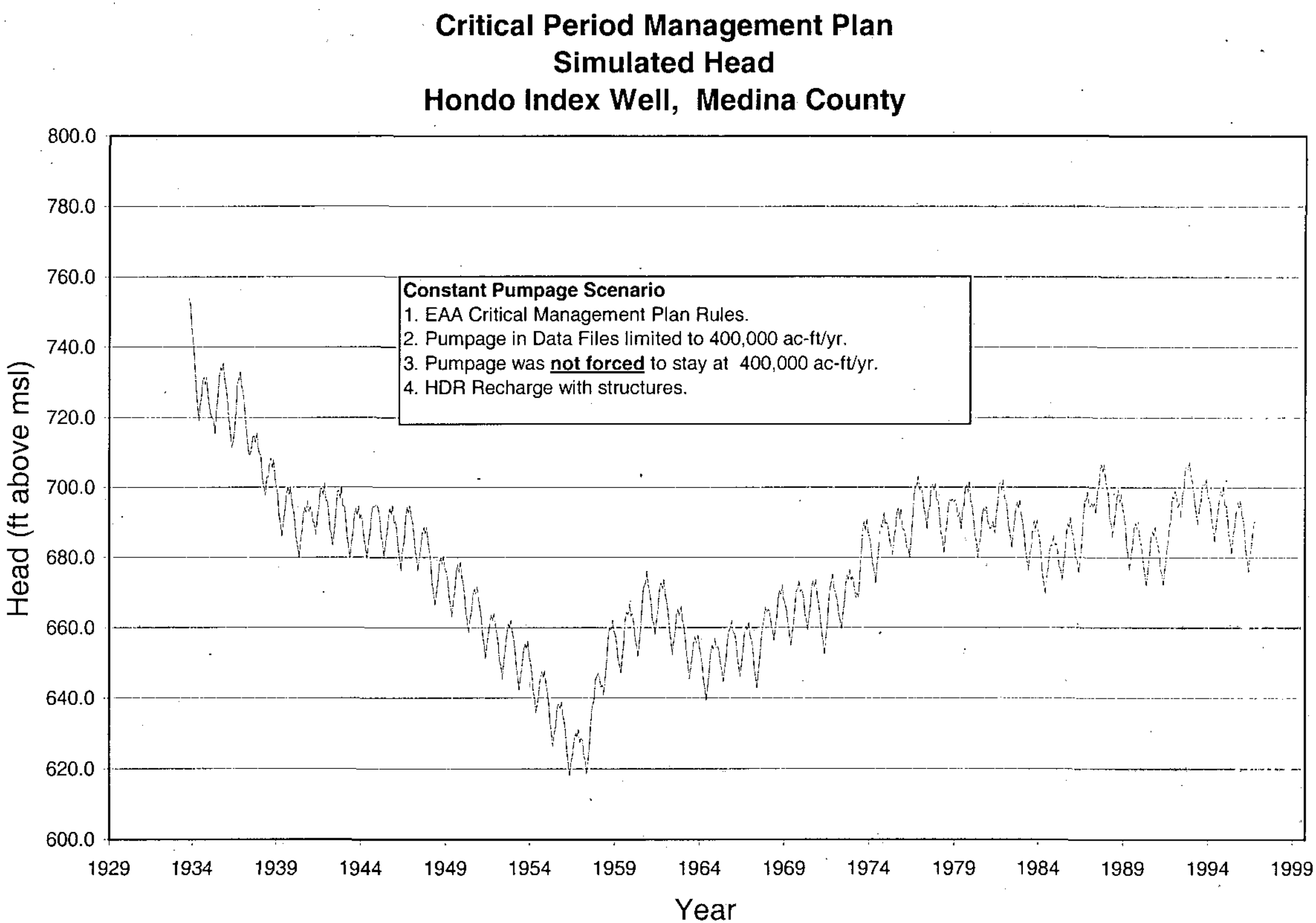

Figure 14. Simulated head of the Hondo index well, Medina County when total pumpage is not forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.

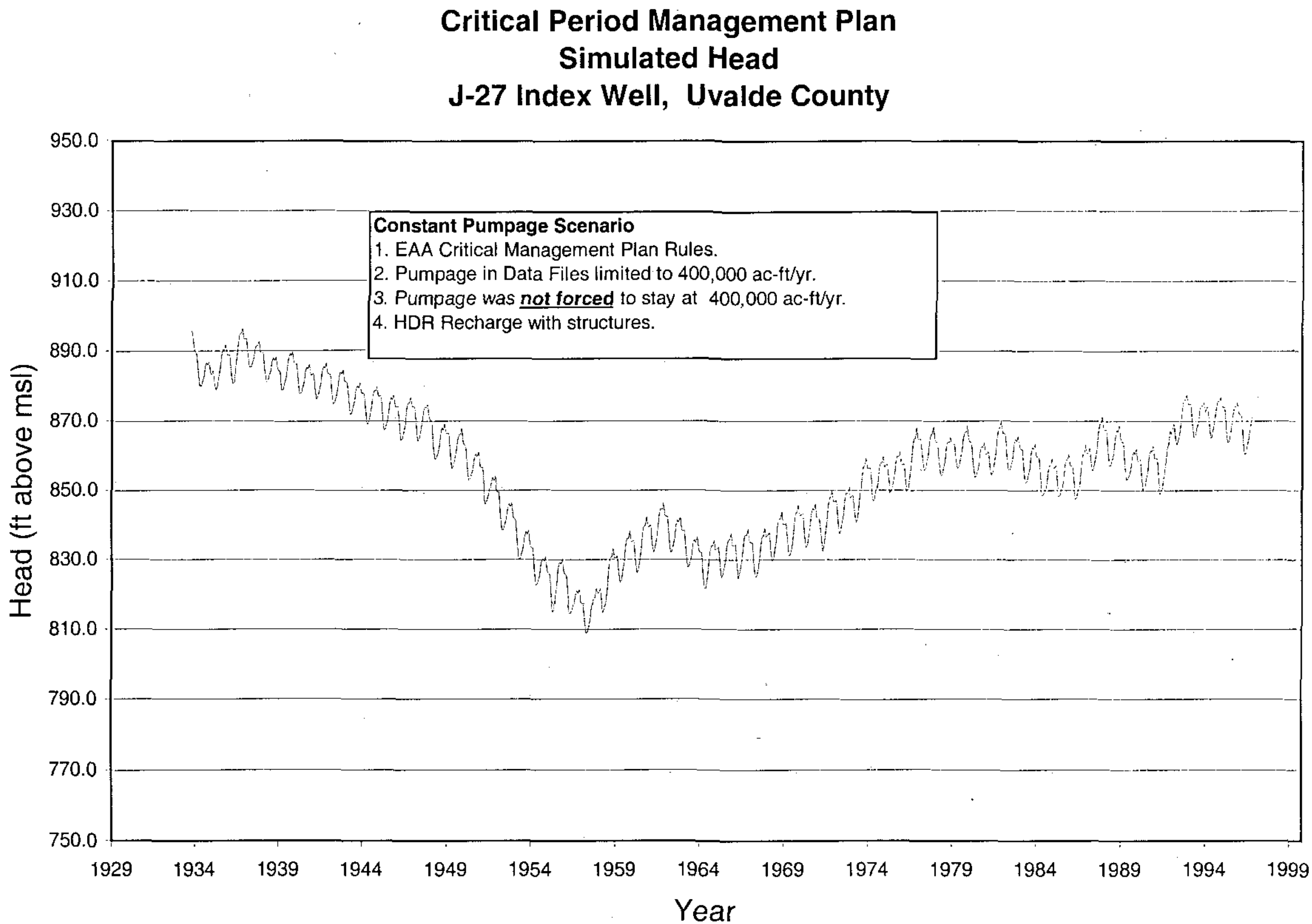

Figure 15. Simulated head of the J-27 index well, Uvalde County when total pumpage is not forced to stay at 400,000 ac-ft/yr after winter base multipliers are applied.