

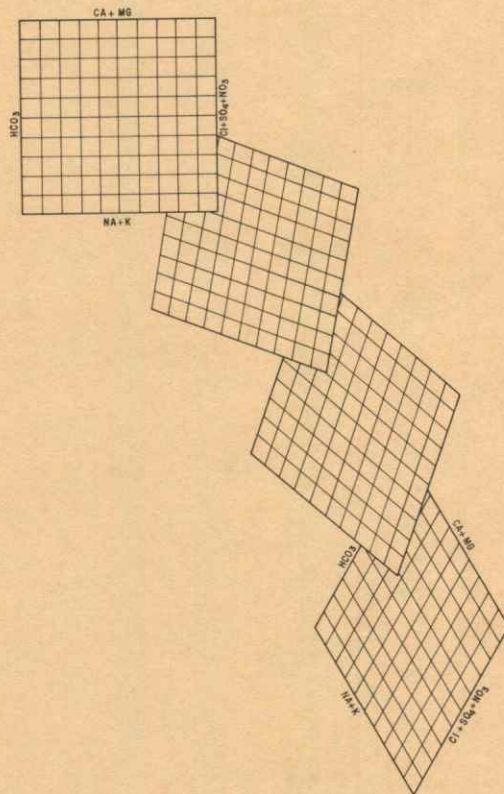
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MODIFIED PIPER DIAGRAMS BY THE DIGITAL COMPUTER

By

Jesse M. McNellis

Charles O. Morgan



State Geological Survey
The University of Kansas
Lawrence, Kansas

1969

Special Distribution Publication 45

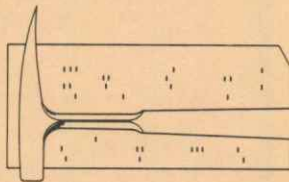
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Frank C. Foley, Director



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Special Distribution Publication No. 45

Prepared by the United States Geological Survey and the State Geological Survey of Kansas, with the cooperation of the Environmental Health Services of the Kansas State Department of Health and the Division of Water Resources of the Kansas State Board of Agriculture.

State Geological Survey
The University of Kansas, Lawrence, Kansas
1969

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MODIFIED PIPER DIAGRAMS BY THE DIGITAL COMPUTER

by

Jesse M. McNellis^{1/} and Charles O. Morgan^{1/}

ABSTRACT

Piper diagrams, used as aids in interpreting quality-of-water data, are produced accurately and efficiently by a digital computer. The computer produces the two triangular cation and anion diagrams and a square-grid modification of the original diamond-shaped diagram. Seven diagrams comprise the output from a quality-of-water data group. Three diagrams are square and the points plotted represent program-assigned sample identification numbers, aquifer identification numbers, and average position by aquifer number, respectively. Four diagrams are triangles to include cation and anion representations with sample and aquifer identification numbers.

INTRODUCTION

A trilinear diagram was developed by Piper (1953) as an aid for classifying water types and comparing the chemical relationships of water from different sources. Piper's diagram consists of two triangular-shaped grids, one for plotting the cations and one for the anions, and a diamond-shaped grid for a comparative plot of both cations and anions. The diamond-shaped grid of the original Piper diagram is not as simply reproduced by a digital computer as is a square-grid modification used by Dingman and Ferguson (1956).

The Piper diagram is especially useful for studying changes in chemical quality of water as the water travels through an aquifer (Back, 1961; Morgan and Winner, 1962). A mixture of two types of water, such as brackish and fresh, will plot on the diagram between known analyses of the two types.

The mainline program for the Piper diagram was programmed and tested by the authors at The University of Kansas Computation Center, Richard G. Hetherington, Director, as a part of the cooperative program between the U.S. Geological Survey and the State Geological Survey of Kansas.

Subroutines (PLOT5, PLOT4, RANGE, ORDER3) that plot the data were programmed for the IBM 1620 in Fortran II by Donald I. Good (1964). Revisions for use of these plotting subroutines on the IBM 7040 were made by Good and Owen T. Spitz, and subsequently by the authors

^{1/} Water Resources Division, U.S. Geological Survey

for use on the GE 635.

DESCRIPTION OF MAINLINE PROGRAM

The mainline PIPER program instructs the computer to read, sort, and calculate milliequivalents per liter (me/l) and percentages of related cations and anions of quality-of-water data.

The description of the program is facilitated by the listing of the FORTRAN IV statements and the corresponding comment cards (app. I) and the flow chart (fig. 1). Control cards (app. II), which are read before the quality-of-water data, include the following:

1. AQUNT -- An array of geologic unit names, formal and informal, used in Kansas, that requires 150 cards. These names are arranged in a (4(3A6, 2X)) format.
2. HINC, VINC -- Control data for the output scale of the Piper diagram. These data are arranged in a (2F10.0) format.
3. TITLE, I PLOT -- Data identification and diagrams to plot these data are arranged in a (6A6, 4X, 10I1) format.
4. Following a data group is a card with Z punched in column one in A1 format. This Z card causes the program to compute and plot Piper diagrams for a group.

Cards numbered PIP1980 through PIP2060 occupy the position in the program where the quality-of-water data are read. Data with a different format from that used in Kansas would require changing the above cards. The version of the program listed uses data that are arranged as described in appendix II of the report by Morgan and McNellis (1969). The unlisted version uses U.S. Geological Survey data cards, ABCQRS, described by Lang and Leonard (1967).

After a set of quality-of-water data is read, the type of analysis is checked. An analysis of water that, at a minimum, has had Ca, Mg, Na, HCO_3 , SO_4 , and Cl determined is called complete, and an analysis lacking any of these ions is called partial. If the analysis is partial, the program goes to the next data set; if complete, the data are stored in arrays until all the group is read. When a Z card is encountered, indicating the end of a data group, the program plots the diagram for the group. A new data group requires control card 3 at the beginning and a Z card at the end of the group.

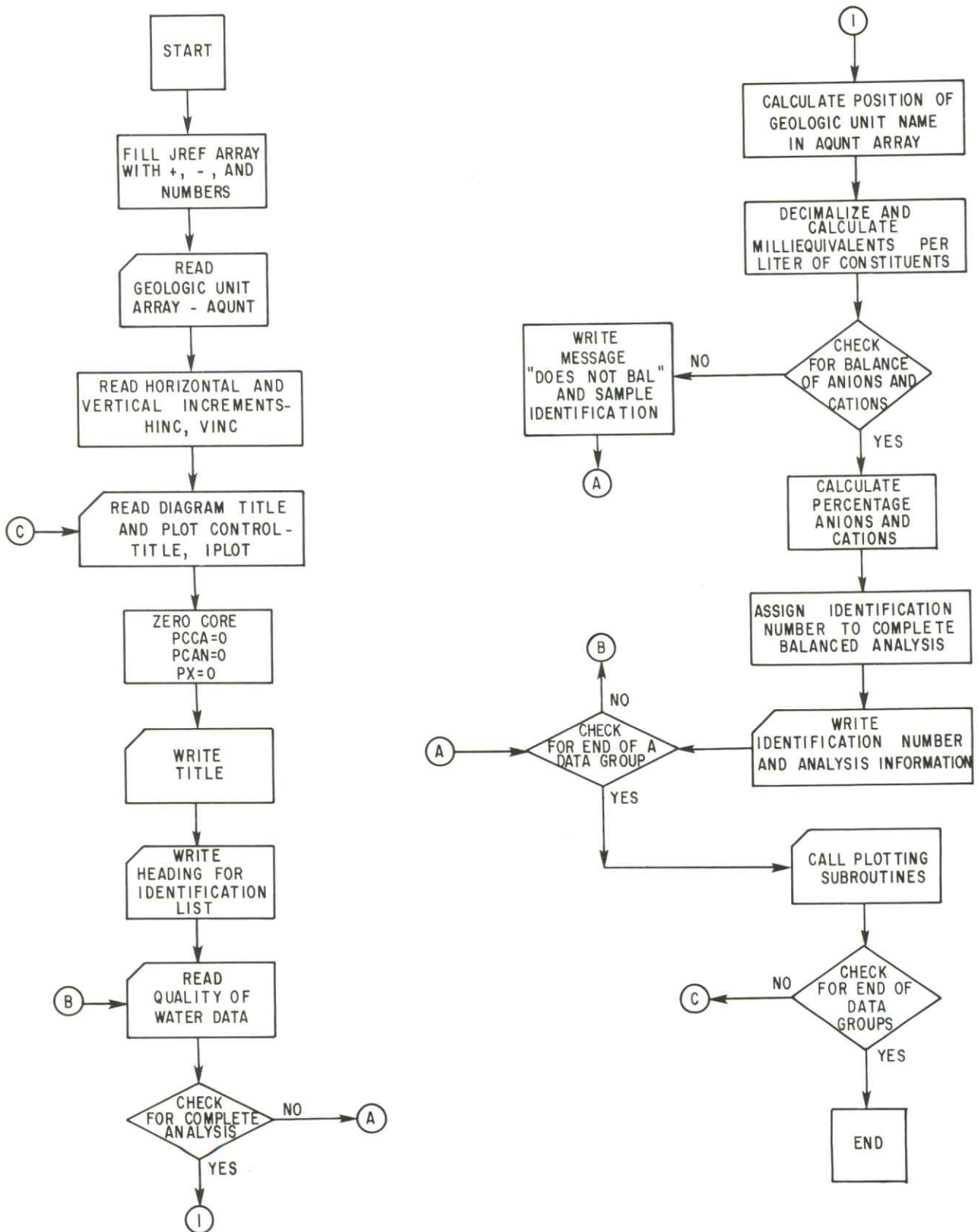


Figure 1.--Flow chart for FORTRAN IV PIPER program.

For a data set that is a complete analysis, the program instructs the computer to do the following:

1. Convert the chemical constituents from milligrams per liter (mg/l) to milliequivalents per liter.
2. Check for a cation and anion balance within 2, 3, or 5 percent. If the ions do not balance, a message "DOES NOT BAL" and data identifying the analysis are written.
3. Determine the percentages of related cations and anions. These two percentages are the "X" and "Y" coordinates representing the analysis on the plot.
4. Assign an identification number to each analysis that balances. This number is printed on the Piper plot with the plotted point.
5. Write information identifying each complete analysis, including the ones that did not balance.

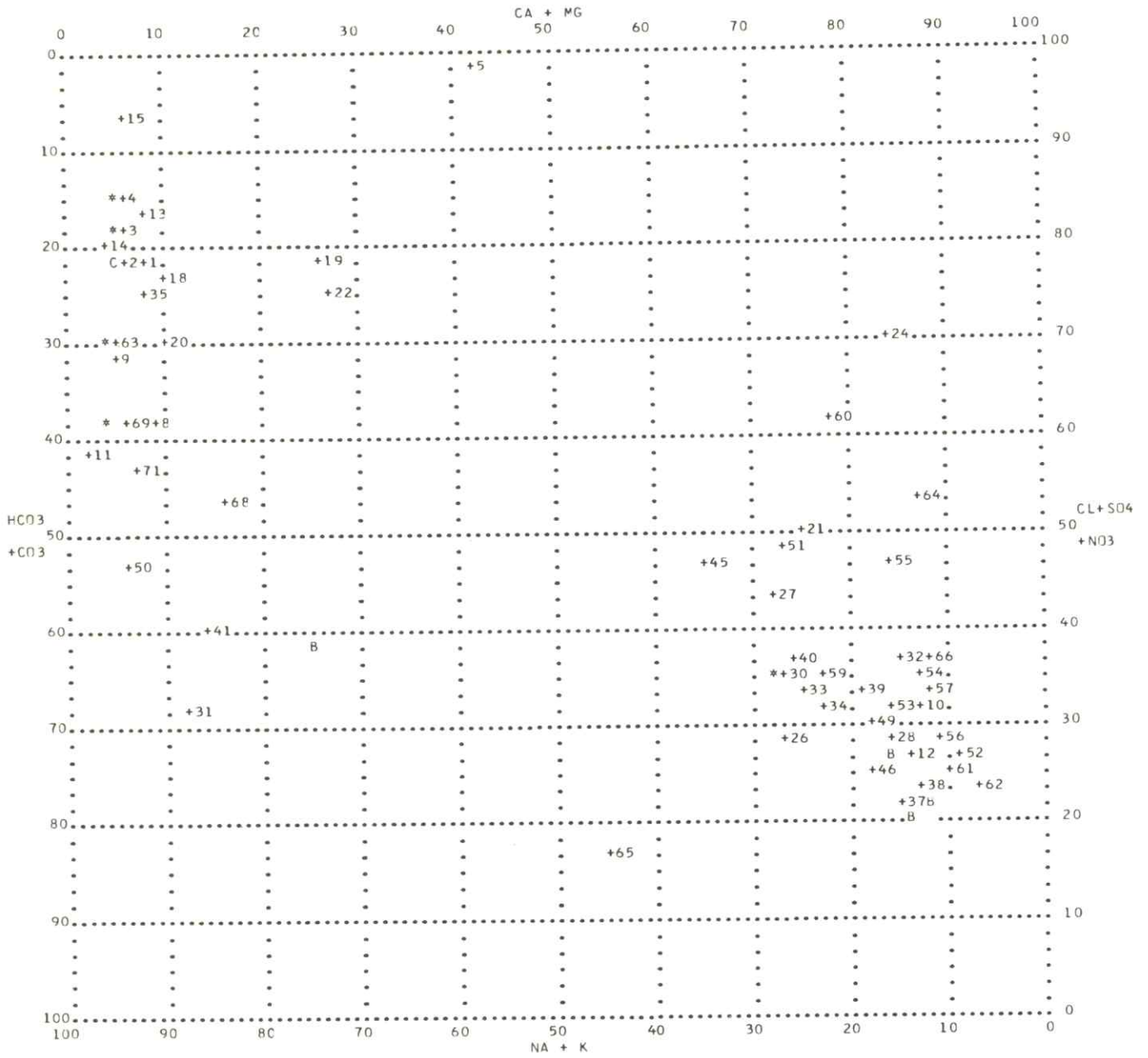
When all the data sets for a data group have been read and processed, the data are plotted on a 10-inch by 10-inch grid (fig. 2) using subroutines programmed by Donald I. Good (1964). The data on the plot are arranged with cations Ca+Mg and Na+K plotted in the horizontal "X" direction and the anions HCO_3+CO_3 and $\text{Cl}+\text{SO}_4+\text{NO}_3$ plotted in the vertical "Y" direction.

The scale of the cations Ca+Mg ranges from 0 (on the left side of the plot) to 100 percent (on the right), while Na+K ranges from 0 (on the right) to 100 percent (on the left). The scale of anions $\text{Cl}+\text{SO}_4+\text{NO}_3$ ranges from 0 (at the bottom) to 100 percent (at the top), and HCO_3+CO_3 increases from 0 (at the top) to 100 percent (at the bottom).

CONCLUDING REMARKS

The Piper diagram (fig. 2) and the identification list of analyses (table 1) are the computer output of quality-of-water data from Rush County, Kansas (app. II).

Accuracy of the plot, which is dependent upon the printer, is 0.5 of 1 percent in the horizontal direction and 0.8 of 1 percent in the vertical direction. Central processor time on the GE 635 was 0.25 minute for computation of milliequivalents per liter, checking cation and anion balance, and plotting the data points from the 71 analyses on the seven diagrams. The total job cost was \$3.00.



OVERPRINT VALUES

*	6	*	23	*	43	B	47
*	7	*	70	B	29	B	48
C	16	B	44		58	B	36
	17		67				25
	42						

Figure 2.--Piper diagram of Rush County quality-of-water data as calculated and printed by the digital computer.

Table 1.-- Identification list of analyses plotted on Piper diagram, figure 2.

RUSH COUNTY, KANSAS

LIST OF COMPLETE CHEMICAL ANALYSES OF WATER AND THEIR IDENTIFICATION NUMBERS

IDEN. NUMBER	WELL NUMBER	DATE	DEPTH	GEOLOGIC UNIT(S)	CA-MG	HCO3	CA	MG	CL	SO4	
1.	16 16W 32CCB	5 12 60	266	DAKOTA FM	8.28	22.48	3.89	4.39	59.54	17.93	
2.	16 17W 16DCC	5 12 60	370	DAKOTA FM	6.79	21.40	2.56	4.22	59.16	19.43	
3.	16 17W 22AAA	10 6 60	320	DAKOTA FM	6.04	19.01	2.73	3.32	63.94	17.03	
4.	16 18W 6DAC	5 13 60	230	DAKOTA FM	6.40	14.33	1.98	4.42	70.34	15.31	
5.	16 18W 60AC2	5 13 60	SEEP		42.89	1.03	33.20	9.69	89.39	9.57	
6.	16 18W 10CB	10 29 49	168	DAKOTA FM	5.58	15.57	2.87	2.70	69.01	15.41	
7.	16 18W 27CDD	5 12 60	209	DAKOTA FM	5.89	18.72	3.02	2.88	63.45	17.80	
8.	16 19W 17BAB	5 13 60	400	DAKOTA FM	9.87	37.85	2.36	7.51	39.87	22.17	
9.	16 20W 58BD	5 13 60	530	DAKOTA FM	5.45	32.41	1.88	3.58	46.32	21.17	
10.	16 20W 21DDC	5 13 60	54	PLEISTOCENE SER	EOLIAN-FLUV DEP	87.49	68.75	63.85	23.65	16.61	11.63
11.	17 16W 20AAA	10 13 60	315	DAKOTA FM	2.73	42.04	2.12	0.61	47.22	10.65	
12.	17 16W 24CCC	6 1 45	30	EOLIAN-FLUV DEP	CARLILE SH	86.50	72.65	74.65	11.85	10.66	10.41
13.	17 17W 28DCD	5 12 60	230	DAKOTA FM	8.91	17.44	2.96	5.96	65.62	16.89	
14.	17 18W 20DAA	10 12 60	300	DAKOTA FM	4.03	19.81	2.19	1.84	62.52	17.63	
15.	17 18W 28AAD	5 12 60	335	DAKOTA FM	6.90	6.60	3.06	3.84	83.58	9.81	
16.	17 18W 33ACD	8 26 57	300	DAKOTA FM	5.16	21.74	3.00	2.17	57.12	21.13	
17.	17 18W 33DBC	9 12 58	300	DAKOTA FM	5.17	21.01	2.29	2.87	57.68	21.29	
18.	17 18W 348BD	5 8 61	302	DAKOTA FM	10.64	23.27	7.09	3.54	56.10	20.61	
19.	17 19W 27DDC	5 16 60	320	DAKOTA FM	26.80	21.64	15.31	11.49	49.65	28.70	
20.	17 20W 5BCB	9 9 46	315	DAKOTA FM	10.66	30.70	5.25	5.42	37.28	31.96	
21.	17 20W 7CAD	4 24 61	53	PLEISTOCENE SER	EOLIAN-FLUV DEP	75.53	50.19	55.58	19.95	17.29	32.27
22.	17 20W 29CDD	5 13 60	285	DAKOTA FM	27.06	24.67	12.24	14.82	37.29	37.97	
23.	17 20W 36ABR	10 12 60	325	DAKOTA FM	4.90	30.02	3.06	1.83	46.71	23.23	
24.	18 16W 14BCC	7 21 65	73	PLEISTOCENE SER	FLUVIAL DEP	84.03	30.76	73.98	10.05	59.70	7.73
25.	18 16W 16RBR2	8 5 60	86	PLEISTOCENE SER	FLUVIAL DEP	86.81	79.95	74.86	11.94	8.70	10.14
26.	18 16W 18ACB	7 21 65	85	PLEISTOCENE SER	FLUVIAL DEP	73.67	70.91	63.25	10.42	8.34	20.67
27.	18 16W 198BA	8 19 60	55	PLEISTOCENE SER	FLUVIAL DEP	72.83	57.21	61.22	11.62	12.36	29.93
28.	18 16W 23AAA	11 5 58	75	PLEISTOCENE SER	FLUVIAL DEP	84.10	71.84	72.96	11.13	16.85	11.03
29.	18 16W 23AAA	5 25 61	75	PLEISTOCENE SER	FLUVIAL DEP	84.41	72.81	72.83	11.58	13.84	12.91
30.	18 16W 23ADD	8 24 60	R			73.97	64.68	63.04	10.94	11.85	22.58
31.	18 16W 28CDC	5 17 60	168	DAKOTA FM	12.40	67.99	3.34	9.07	9.73	22.17	
32.	18 17W 11CDA	8 17 60	86	PLEISTOCENE SER	FLUVIAL DEP	85.17	63.16	72.31	12.85	30.89	5.10
33.	18 17W 14CDC	8 19 60	70	PLEISTOCENE SER	FLUVIAL DEP	75.68	67.23	63.68	12.00	8.32	23.80
34.	18 17W 14CDC	7 21 65	70	PLEISTOCENE SER	FLUVIAL DEP	77.54	68.47	69.99	7.55	7.78	23.60
35.	18 17W 18CCC	10 7 60	224	DAKOTA FM	8.60	25.49	4.82	3.78	60.72	13.79	
36.	18 17W 22DAD	3 4 56		PLEISTOCENE SER	FLUVIAL DEP	86.09	80.27	74.73	11.36	5.34	14.25
37.	18 17W 22DAD	1 14 60		PLEISTOCENE SER	FLUVIAL DEP	85.01	77.78	75.21	9.80	6.51	15.63
38.	18 17W 27ABA	8 24 60	59	PLEISTOCENE SER	FLUVIAL DEP	87.26	77.05	75.49	11.77	7.08	13.94
39.	18 17W 28BCC	8 11 60	63	PLEISTOCENE SER	FLUVIAL DEP	81.80	66.67	70.70	11.10	8.49	24.22
40.	18 17W 30ABB	7 21 65	75	PLEISTOCENE SER	FLUVIAL DEP	74.53	63.18	63.58	10.95	14.41	21.89
41.	18 17W 34BCA	10 11 60	175	DAKOTA FM	14.87	59.81	7.95	6.92	17.75	22.28	
42.	18 18W 9AAB	10 12 60	265	DAKOTA FM	5.24	22.32	3.16	2.08	56.13	21.53	
43.	18 18W 25BCB	8 22 60	67	PLEISTOCENE SER	FLUVIAL DEP	72.17	64.18	62.83	9.34	13.58	21.57
44.	18 18W 26DDA	10 12 60	187	DAKOTA FM	25.43	60.93	16.21	9.21	26.79	12.24	
45.	18 18W 27CCB	7 26 65	67	PLEISTOCENE SER	FLUVIAL DEP	65.70	53.17	55.06	10.63	14.69	31.81
46.	18 18W 28AAC	1 31 61	83	PLEISTOCENE SER	FLUVIAL DEP	82.19	74.26	69.57	12.62	10.48	15.20
47.	18 18W 28AAC	6 20 61	83	PLEISTOCENE SER	FLUVIAL DEP	88.39	77.61	75.23	13.17	7.55	14.77
48.	18 18W 28AAC	7 61 83	83	PLEISTOCENE SER	FLUVIAL DEP	88.86	77.76	76.67	12.19	7.25	14.93
49.	18 18W 30DDC	8 11 60	70	PLEISTOCENE SER	FLUVIAL DEP	82.74	69.96	74.24	8.51	11.44	14.70
50.	18 18W 31DDA	10 11 60	150	DAKOTA FM	6.51	53.18	4.51	2.01	28.51	18.18	
51.	18 18W 348BB	8 22 60	59	PLEISTOCENE SER	FLUVIAL DEP	73.77	50.99	64.75	9.02	12.99	34.64
52.	18 18W 360CA	8 19 60	54	PLEISTOCENE SER	EOLIAN-FLUV DEP	91.97	73.51	81.46	10.51	7.40	12.86
53.	18 19W 21CDB	8 11 60	58	PLEISTOCENE SER	FLUVIAL DEP	84.43	67.61	73.27	11.16	8.11	23.43
54.	18 19W 22CBB	7 21 65	54	PLEISTOCENE SER	FLUVIAL DEP	87.76	65.65	73.19	14.57	6.50	27.76
55.	18 19W 27AAA	8 11 60	64	PLEISTOCENE SER	FLUVIAL DEP	84.45	53.70	75.26	9.19	11.19	32.79
56.	18 20W 14CCP	8 11 60	44	PLEISTOCENE SER	FLUVIAL DEP	89.15	71.09	77.28	11.87	8.25	18.26
57.	18 20W 15CCB	8 11 60	63	PLEISTOCENE SER	FLUVIAL DEP	88.55	67.10	75.55	12.99	8.45	22.39
58.	18 20W 19ACC	8 11 60	54	PLEISTOCENE SER	FLUVIAL DEP	84.73	73.23	71.32	13.40	5.01	20.89
59.	18 20W 19CCB	8 22 60	R			77.61	65.02	63.50	14.11	9.01	25.09
60.	18 20W 20ACC	7 21 65	52	PLEISTOCENE SER	FLUVIAL DEP	78.65	37.90	64.80	13.84	8.01	53.45
61.	18 20W 20DCA	2 6 61	48	PLEISTOCENE SER	FLUVIAL DEP	90.67	74.68	81.86	8.82	4.29	20.11
62.	18 20W 20DCA	3 27 62	48	PLEISTOCENE SER	FLUVIAL DEP	93.69	76.20	79.02	14.67	4.79	17.90
63.	18 20W 36ABB	10 11 60	214	DAKOTA FM	5.08	29.28	3.16	1.92	47.49	23.20	
64.	19 16W 230DB	10 7 60	80	PLEISTOCENE SER	DAKOTA FM	87.45	46.70	75.59	11.86	30.43	15.99
65.	19 17W 27ADD	5 17 60	185	DAKOTA FM	55.83	82.86	31.77	24.06	9.82	6.89	
66.	19 18W 3ACA	8 15 60	140	EOLIAN-FLUV DEP	DAKOTA FM	88.59	63.91	77.29	11.30	14.38	20.44
67.	19 18W 27CCB	5 16 60	390	DAKOTA FM	25.48	60.88	12.30	13.18	31.64	7.27	
68.	19 19W 24CCB	5 16 60	290	DAKOTA FM	16.82	46.38	9.49	7.33	26.81	26.61	
69.	19 20W 49RB	10 11 60	284	DAKOTA FM	6.38	37.98	3.46	2.91	32.60	29.39	
70.	19 20W 17DDC	5 13 60	360	DAKOTA FM	4.86	38.70	1.74	3.12	38.26	22.89	
71.	19 20W 26BAA	5 13 60	410	DAKOTA FM	7.71	42.57	2.64	5.07	27.40	29.83	

SELECTED REFERENCES

- Back, William, 1961, Techniques of mapping hydrochemical facies: U.S. Geological Survey Prof. Paper 424-D, p. D380-D382.
- Dingman, R. J., and Ferguson, H. R., 1956, The water resources of Baltimore and Harford Counties [Maryland]: Maryland Dept. of Geology, Mines and Water Resources Bull. 17, 233 p.
- Good, D. I., 1964, FORTRAN II Trend-surface program for the IBM 1620: Kansas Geol. Survey Spec. Distrib. Pub. 14, 54 p.
- Hem, J. D., 1959, Study and interpretation of the chemical characteristics of natural water: U.S. Geol. Survey Water-Supply Paper 1473, 269 p.
- Lang, S. M., and Leonard, A. R., 1967, Instructions for using the punch card system for storage and retrieval of ground-water data: Techniques of Water-Resources Investigations of the U.S. Geol. Survey, book 7, sec. A, U.S. Geological Survey open-file report, 92 p.
- Langelier, W. F., and Ludwig, H. F., 1942, Graphical methods for indicating the mineral character of natural waters: Am. Water Works Assoc. Jour., v. 34, p. 335-352.
- Morgan, C. O., and Winner, M. D., Jr., 1962, Hydrochemical facies in the "400-foot" and "600-foot" sands of the Baton Rouge area, Louisiana: U.S. Geol. Survey Prof. Paper 450-B, p. B120-B123.
- Morgan, C. O., and McNellis, J. M., 1969, Stiff diagrams of water-quality data programmed for the digital computer: Kansas Geol. Survey Spec. Distrib. Pub. 43, 27 p.
- Piper, A. M., 1953, A graphic procedure in the geochemical interpretation of water analyses: U.S. Geol. Survey Ground-Water Note 12, 14 p.

APPENDIXES

Appendix I.--Listing of FORTRAN IV statements in PIPER program.

C	PIPER00	PROGRAM TO PRINT PIPER DIAGRAMS	PIP 10
C		-----	PIP 20
C	PIPER---	PROGRAM TO WRITE PIPER DIAGRAMS (PIPER, A.M., 1953, A	PIP 30
C		GRAPHIC PROCEDURE IN THE GEOCHEMICAL INTERPRETATION OF	PIP 40
C		WATER ANALYSES. U.S.GEOL. SURVEY GROUND-WATER NOTE 12.	PIP 50
C		14P. AND HEM, J.D., 1959, STUDY AND INTERPRETATION OF	PIP 60
C		THE CHEMICAL CHARACTERISTICS OF NATURAL WATER. U.S.GEOL.	PIP 70
C		SURVEY, WATER-SUPPLY PAPER 1473, P.182-184,233.)	PIP 80
C		-----	PIP 90
C	PROGRAMMERS--	JESSE M. MCNELLIS AND CHARLES O. MORGAN	PIP 100
C		KANSAS DISTRICT, WRD, USGS, LAWRENCE, KANSAS	PIP 110
C		DATE--AUGUST 1965	PIP 120
C		LANGUAGE--FORTRAN IV	PIP 130
C		-----	PIP 140
C	PROGRAM PIPER	REQUIRES 7 SUBROUTINES PLOT5, PLOT4, RANGE, SETTR1,	PIP 150
C		SETTR2, BLOCK DATA, AND ORDER3.	PIP 160
C		SUBROUTINES PLOT5, PLOT4, RANGE, AND ORDER3 WERE	PIP 170
C		PROGRAMMED BY D.I. GOOD-SEE GOOD,D.I., 1964, FORTRAN II TREND	PIP 180
C		SURFACE PROGRAM FOR IBM 1620. KANSAS GEOL. SURVEY SPEC.	PIP 190
C		DISTRIB. PUB. 14, 54P.	PIP 200
C		-----	PIP 210
C	INPUT DATA	ARE KANSAS WATER-QUALITY CARDS, OUTPUT IS 2 TABLES AND	PIP 220
C		7 PIPER DIAGRAMS	PIP 230
C		-----	PIP 240
C		-----	PIP 250
C	EXPLANATION	OF OUTPUT	PIP 260
C		-----	PIP 270
C		TWO TABLES ARE PRINTED	PIP 280
C		ONE LISTS COMPLETE CHEMICAL ANALYSES AND THE NUMBER	PIP 290
C		THAT REPRESENTS EACH ANALYSIS ON PLOTS 1, 4,	PIP 300
C		AND 6.	PIP 310
C		THE OTHER LISTS GEOLOGIC UNITS AND THE NUMBER THAT	PIP 320
C		REPRESENTS EACH GEOLOGIC UNIT ON PLOTS 2, 3, 5, AND	PIP 330
C		7.	PIP 340
C		SEVEN PIPER PLOTS CAN BE PRINTED	PIP 350
C		1 = PLOT OF PERCENTAGE REACTING VALUES (CATIONS	PIP 360
C		VERSUS ANIONS) NUMBERS PLOTTED IDENTIFY ANALYSES.	PIP 370
C		2 = PLOT AS ABOVE, NUMBERS PLOTTED IDENTIFY GEOLOGIC	PIP 380
C		UNITS.	PIP 390
C		3 = PLOT AS ABOVE, AVERAGE BY AQUIFER.	PIP 400
C		4 = TRILINEAR PLOT OF PERCENTAGE REACTING VALUES OF	PIP 410
C		CATIONS, NUMBERS PLOTTED IDENTIFY ANALYSES.	PIP 420
C		5 = TRILINEAR PLOT AS ABOVE, NUMBERS IDENTIFY	PIP 430
C		GEOLOGIC UNITS.	PIP 440
C		6 = TRILINEAR PLOT OF PERCENTAGE REACTING VALUES OF	PIP 450
C		ANIONS, NUMBERS IDENTIFY ANALYSES.	PIP 460
C		7 = TRILINEAR PLOT AS ABOVE, NUMBERS IDENTIFY	PIP 470
C		GEOLOGIC UNITS.	PIP 480
C	ANALYSES	ARE CHECKED FOR COMPLETENESS AS ONLY COMPLETE ONES ARE	PIP 490
C		USED ON THE PLOTS	PIP 500
C	COMPLETE	ANALYSES ARE CHECKED FOR A BALANCE OF THE CATIONS AND	PIP 510
C		ANIONS (5 PERCENT IF DISSOLVED SOLIDS ARE 100 MG/L OR LESS,	PIP 520
C		3 PERCENT IF DISSOLVED SOLIDS ARE FROM 101 THROUGH 250 MG/L,	PIP 530
C		AND 2 PERCENT IF DISSOLVED SOLIDS GREATER THAN 250 MG/L)	PIP 540
C		-----	PIP 550
C	EXPLANATION	OF INPUT CONTROL CARDS	PIP 560
C		-----	PIP 570
C		CARDS THAT REMAIN UNCHANGED	PIP 580
C		-----	PIP 590

C	150 CARDS - AQUNT	PIP 600
C	PUNCHED IN A 4(3A6,2X) FORMAT	PIP 610
C	AQUNT = GEOLOGIC UNITS FOR KANSAS	PIP 620
C	1 CARD - HINC, VINC--	PIP 630
C	PUNCHED IN A 2F10.0 FORMAT	PIP 640
C	HINC = HORIZONTAL INCREMENT OF PLOT	PIP 650
C	VINC = VERTICAL INCREMENT OF PLOT	PIP 660
C	-----	PIP 670
C	CARD THAT IS ARRANGED FOR EACH DATA GROUP	PIP 680
C	-----	PIP 690
C	1 CARD - TITLE, IPLOT	PIP 700
C	PUNCHED IN A 6A6, 4X, 7A1 FORMAT	PIP 710
C	TITLE = TITLE OF PROJECT (E.G. RUSH	PIP 720
C	COUNTY, KANSAS). LEFT-HAND	PIP 730
C	JUSTIFIED IN COLUMNS 1 THROUGH 36.	PIP 740
C	IPLOT = PIPER PLOTS TO BE PRINTED, PUNCH 1	PIP 750
C	IN THE FOLLOWING COLUMNS FOR	PIP 760
C	PLOT NEEDED.	PIP 770
C	COLUMN 41 - SQUARE PLOT OF	PIP 780
C	PERCENTAGE	PIP 790
C	REACTING VALUES	PIP 800
C	OF CATIONS VERSUS	PIP 810
C	ANIONS- ANALYSIS	PIP 820
C	NUMBER	PIP 830
C	COLUMN 42 - AS ABOVE-GEOLOGIC	PIP 840
C	UNIT NUMBER.	PIP 850
C	COLUMN 43 - AS ABOVE-AVERAGE	PIP 860
C	BY GEOLOGIC UNIT	PIP 870
C	COLUMN 44 - TRILINEAR PLOT OF	PIP 880
C	CATIONS. ANALYSIS	PIP 890
C	NUMBER	PIP 900
C	COLUMN 45 - AS ABOVE-GEOLOGIC	PIP 910
C	UNIT NUMBER	PIP 920
C	COLUMN 46 - TRILINEAR PLOT OF	PIP 930
C	ANIONS. ANALYSIS	PIP 940
C	NUMBER	PIP 950
C	COLUMN 47 - AS ABOVE-GEOLOGIC	PIP 960
C	UNIT NUMBER	PIP 970
C	-----	PIP 980
C	A CARD WITH A Z PUNCHED IN THE FIRST COLUMN MUST FOLLOW EACH	PIP 990
C	DATA GROUP.	PIP1000
C	-----	PIP1010
C	-----	PIP1020
C	DIMENSION NOAQ(200), RX(1000), CX(1000), CY(1000), AX(1000), AY(1000), IPLOT(10), TITLE(6), AQUNT(1800)	PIP1030
C	COMMON /MLN/ MAP(122)	PIP1040
C	COMMON /DECODE/ NA(37)	PIP1050
C	COMMON /DTA/ JARBO(52),JREF(12)	PIP1060
C	COMMON /INDT/ PCAN(1000),PCCA(1000),PX(1000),IER(500),ITAB(500),KT	PIP1070
C	LAB(500)	PIP1080
C	REAL LPI	PIP1090
C	WRITE (6,1)	PIP1100
C	1 FORMAT (1H1)	PIP1110
C	-----	PIP1120
C	-----	PIP1130
C	SET UP NA AND JREF ARRAYS	PIP1140
C	-----	PIP1150
C	-----	PIP1160
C	JREF(1)=JARBO(39)	PIP1170
C	-----	PIP1180
C	-----	PIP1190

	JREF(2)=JARBO(40)	PIP1200
	DO 2 I=1,10	PIP1210
	2 JREF(I+2)=JARBO(I+27)	PIP1220
	DO 3 I=11,36	PIP1230
	3 NA(I)=JARBO(I-10)	PIP1240
	DO 4 I=1,10	PIP1250
	4 NA(I)=JARBO(I+27)	PIP1260
	NA(37)=JARBO(52)	PIP1270
C	-----	PIP1280
C		PIP1290
C	READ GEOLOGIC UNIT ARRAY-AQUNT	PIP1300
C	-----	PIP1310
C	READ (5,5) (AQUNT(I),I=1,1800)	PIP1320
	5 FORMAT (4(3A6,2X))	PIP1330
C	-----	PIP1340
C		PIP1350
C	CPI-COLUMNS PER INCH	PIP1360
C		PIP1370
C	LPI-LINES PER INCH	PIP1380
C		PIP1390
C	MXHP-WIDTH OF OUTPUT IN COLUMNS	PIP1400
C		PIP1410
C	HINC-HORIZONTAL INCREMENT	PIP1420
C		PIP1430
C	VINC-VERTICAL INCREMENT	PIP1440
C		PIP1450
C	-----	PIP1460
C		PIP1470
	CPI=10.	PIP1480
	LPI=6.	PIP1490
	MXHP=132	PIP1500
	READ (5,6) HINC,VINC	PIP1510
	6 FORMAT (2F10.0)	PIP1520
	7 DO 8 I=1,200	PIP1530
	8 NOAQ(I)=0	PIP1540
	IK=0	PIP1550
C	-----	PIP1560
C		PIP1570
C	READ TITLE AND PIPER DIAGRAMS TO BE PLOTTED	PIP1580
C	-----	PIP1590
C	READ (5,9) (TITLE(I),I=1,6),(I PLOT(I),I=1,10)	PIP1600
	9 FORMAT (6A6,4X,10I1)	PIP1610
C	-----	PIP1620
C		PIP1630
C	ZERO CORE	PIP1640
C	-----	PIP1650
C		PIP1660
C	-----	PIP1670
	DO 10 J=1,1000	PIP1680
	PCAN(J)=0.0	PIP1690
	PCCA(J)=0.0	PIP1700
10	PX(J)=0.0	PIP1710
C	-----	PIP1720
C		PIP1730
C	WRITE TITLE	PIP1740
C	-----	PIP1750
C		PIP1760
	WRITE (6,11) (TITLE(I),I=1,6)	PIP1770
11	FORMAT (1X,6A6)	PIP1780
	WRITE (6,12)	PIP1790

```

12 FORMAT (//)
WRITE (6,13)
13 FORMAT (4X,78HLIST OF COMPLETE CHEMICAL ANALYSES OF WATER AND THE I
IR IDENTIFICATION NUMBERS //)
-----
WRITE HEADING FOR IDENTIFICATION LIST OF WATER SAMPLES
-----
WRITE (6,14)
14 FORMAT (64H IDEN. NUMBER WELL NUMBER DATE DEPTH GEOLOGIC
1UNIT(S) ,21X,45HCA-MG HCO3 CA MG CL SO4 /)
JX=0
-----
READ QUALITY OF WATER DATA
-----
15 READ (5,16) IKC,LST,LCO1,LCO2,LTP,LRG,LWE,LSC,L11,L12,L13,L14,KMO,
IKDA,KYR,KWD,KTY,SIO,AL,FE,AMN,CA,AMG,ANA,AK,HCO,CO,SO,CL,ICN1
16 FORMAT (4A1,2A2,A1,A2,4A1,3A2,A4,A1,2F3.0,F5.0,F3.0,F6.0,F5.0,F6.0
1,F3.0,F4.0,F2.0,F5.0,F7.0,1X,I1)
IF (IKC.EQ.NA(36)) GO TO 32
READ (5,17) LF1,LF2,FL,ANO,PO,BO,DS,HD,ANC,ALK,FCO,SAR,RSC,AK10,PH
1,ICOL,IEMP,ITY,ISOUR,ICN2
17 FORMAT (15X,2I3,F3.0,F5.0,2F3.0,F6.0,F5.0,2F4.0,3F3.0,F6.0,F3.0,I2
1,I3,I1,A1,I1)
-----
CHECK FOR COMPLETE ANALYSIS
-----
IF (CA.GT.0..AND.AMG.GT.0..AND.ANA.GT.0..AND.HCO.GT.0..AND.SO.GT.0
1..AND.CL.GT.0.) GO TO 18
GO TO 15
-----
DECODE GEOLOGIC UNIT
-----
18 IF (LF1.LE.0) LF1=599
LFM1=(LF1*3)-2
LFM2=LFM1+2
IF (LF2.LE.0) LF2=599
LFM3=(LF2*3)-2
LFM4=LFM3+2
-----
DECIMALIZE CHEMICAL CONSTITUENTS AND CALCULATE ME/L
-----
IF (KTY.EQ.NA(12)) AMG=AMG*10.
IF (KTY.EQ.NA(12)) SO=SO*10.
IF (KTY.EQ.NA(12)) ANA=ANA*10.
SIO=SIO*0.1
AL=AL*0.1
BAL=AL*.11119
FE=FE*0.01
BFE=FE*.05372
AMN=AMN*0.01

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PIP1800
PIP1810
PIP1820
PIP1830
PIP1840
PIP1850
PIP1860
PIP1870
PIP1880
PIP1890
PIP1900
PIP1910
PIP1920
PIP1930
PIP1940
PIP1950
PIP1960
PIP1970
PIP1980
PIP1990
PIP2000
PIP2010
PIP2020
PIP2030
PIP2040
PIP2050
PIP2060
PIP2070
PIP2080
PIP2090
PIP2100
PIP2110
PIP2120
PIP2130
PIP2140
PIP2150
PIP2160
PIP2170
PIP2180
PIP2190
PIP2200
PIP2210
PIP2220
PIP2230
PIP2240
PIP2250
PIP2260
PIP2270
PIP2280
PIP2290
PIP2300
PIP2310
PIP2320
PIP2330
PIP2340
PIP2350
PIP2360
PIP2370
PIP2380
PIP2390

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	BMN=AMN*.03640	PIP2400
	CA=CA*0.1	PIP2410
	BCA=CA*.04990	PIP2420
	AMG=AMG*0.1	PIP2430
	BMG=AMG*.08224	PIP2440
	ANA=ANA*0.1	PIP2450
	BNA=ANA*.04350	PIP2460
	AK=AK*0.1	PIP2470
	BK=AK*.02558	PIP2480
	BHCO=HCO*.01639	PIP2490
	BCO=C0*.03333	PIP2500
	SO=SO*0.1	PIP2510
	BSO=SO*.02082	PIP2520
	CL=CL*0.1	PIP2530
	BCL=CL*.02820	PIP2540
	FL=FL*0.1	PIP2550
	BFL=FL*.05263	PIP2560
	ANO=ANO*0.1	PIP2570
	BNO=ANO*.01613	PIP2580
	PO=PO*0.1	PIP2590
	BPO=PO*.03159	PIP2600
	BO=BO*0.01	PIP2610
	PH=PH*0.01	PIP2620
	-----	PIP2630
C		PIP2640
C	CHECK CATION-ANION BALANCE OF ANALYSIS	PIP2650
C		PIP2660
C	-----	PIP2670
	CATION=BK+BMN+BCA+BMG+BNA	PIP2680
	ANION=BHCO+BCO+BSO+BCL+BFL+BNO	PIP2690
	IF (DS.GT.100.) GO TO 19	PIP2700
	AN1=.475	PIP2710
	AN2=.525	PIP2720
	GO TO 21	PIP2730
19	IF (DS.GT.250.) GO TO 20	PIP2740
	AN1=.485	PIP2750
	AN2=.515	PIP2760
	GO TO 21	PIP2770
20	AN1=.49	PIP2780
	AN2=.51	PIP2790
21	IF ((ANION/(ANION+CATION)).GE.AN1.AND.(ANION/(ANION+CATION)).LE.AN	PIP2800
	12) GO TO 23	PIP2810
	CATION=CATION+BFE	PIP2820
	IF ((ANION/(ANION+CATION)).GE.AN1.AND.(ANION/(ANION+CATION)).LE.AN	PIP2830
	12) GO TO 23	PIP2840
	-----	PIP2850
C		PIP2860
C	IF ANALYSIS DOES NOT BALANCE, WRITE ERROR MESSAGE	PIP2870
C		PIP2880
C	-----	PIP2890
	WRITE (6,22) LTP,LRG,LWE,LSC,L11,L12,L13,L14,KMO,KDA,KYR,KWD,(AQUN	PIP2900
	1T(I),I=LFM1,LFM2),(AQUNT(I),I=LFM3,LFM4)	PIP2910
22	FORMAT (1X,15HDOES NOT BAL. ,A2,1X,A2,A1,1X,A2,4A1,4X,A2,1X,A2,1X	PIP2920
	1,A2,7X,A4,7X,3A6,3X,3A6)	PIP2930
	GO TO 15	PIP2940
23	JX=JX+1	PIP2950
	-----	PIP2960
C		PIP2970
C	DETERMINE PERCENTAGE CATIONS	PIP2980
C		PIP2990

C	-----	PIP3000
	CAT1=BCA+BMG	PIP3010
	CAT2=BNA+BK	PIP3020
	PCAN(JX)=CAT1/(CAT1+CAT2)*100.	PIP3030
C	-----	PIP3040
C		PIP3050
C	DETERMINE PERCENTAGE ANIONS	PIP3060
C	-----	PIP3070
		PIP3080
	ANI1=BSO+BCL+BND	PIP3090
	ANI2=BHCO+BCO	PIP3100
	PCCA(JX)=ANI2/(ANI1+ANI2)*100.	PIP3110
	PMG=BMG/(BMG+BCA+BNA+BK)	PIP3120
	PCA=BCA/(BMG+BCA+BNA+BK)	PIP3130
	PSO4=BSO/(BSO+BHCO+BCO+BCL)	PIP3140
	PCL=BCL/(BSO+BHCO+BCO+BCL)	PIP3150
	XCA=PCA*100.	PIP3160
	XMG=PMG*100.	PIP3170
	XCL=PCL*100.	PIP3180
	XSO=PSO4*100.	PIP3190
	CY(JX)=PMG*.86603*100.	PIP3200
	CX(JX)=(1.0-PCA)-(.5000*PMG))*100.	PIP3210
	AY(JX)=PSO4*.86603*100.	PIP3220
	AX(JX)=(PCL+ (.5000*PSO4))*100.	PIP3230
	-----	PIP3240
C		PIP3250
C	ASSIGN IDENTIFICATION NUMBER TO ANALYSIS	PIP3260
C	-----	PIP3270
C		PIP3280
	PX(JX)=JX	PIP3290
	-----	PIP3300
C		PIP3310
C	WRITE IDENTIFICATION NUMBER, WELL NUMBER, SAMPLING DATE OF	PIP3320
C	ANALYSIS, GEOLOGIC UNIT NAME(S), PERCENTAGE CATIONS, AND	PIP3330
C	PERCENTAGE ANIONS	PIP3340
C	-----	PIP3350
		PIP3360
	WRITE (6,24) PX(JX),LTP,LRG,LWE,LSC,L11,L12,L13,L14,KMO,KDA,KYR,KW	PIP3370
	ID,(AQUNT(I),I=LFM1,LFM2),(AQUNT(I),I=LFM3,LFM4),PCAN(JX),PCCA(JX),	PIP3380
	2XCA,XMG,XCL,XSO	PIP3390
24	FORMAT (2X,F7.0,6X,A2,1X,A2,A1,1X,A2,4A1,2X,A2,1X,A2,1X,A2,1X,A4,3	PIP3400
	1X,3A6,1X,3A6,6F7.2)	PIP3410
	DO 25 I=1,200	PIP3420
	IF (LF1.EQ.NOAQ(I)) GO TO 26	PIP3430
25	CONTINUE	PIP3440
	IK=IK+1	PIP3450
	NOAQ(IK)=LF1	PIP3460
	DK=IK	PIP3470
	GO TO 27	PIP3480
26	DK=I	PIP3490
27	RX(JX)=DK	PIP3500
	IF (LF2.EQ.599) GO TO 31	PIP3510
	DO 28 I=1,200	PIP3520
	IF (LF2.EQ.NOAQ(I)) GO TO 29	PIP3530
28	CONTINUE	PIP3540
	IK=IK+1	PIP3550
	NOAQ(IK)=LF2	PIP3560
	DK=IK	PIP3570
	GO TO 30	PIP3580
29	DK=I	PIP3590

30	RX(JX)=(RX(JX)*100.)+DK	PIP3600
31	GO TO 15	PIP3610
32	IF (JX.GE.1000) NDG1=4	PIP3620
	IF (JX.LE.999) NDG1=3	PIP3630
	IF (JX.LE.99) NDG1=2	PIP3640
	IF (JX.LE.9) NDG1=1	PIP3650
	VDGT=0.	PIP3660
	DO 33 I=1,JX	PIP3670
33	VDGT=AMAX1(VDGT,RX(I))	PIP3680
	NDGT=VDGT	PIP3690
	IF (NDGT.GE.1000) NDG2=4	PIP3700
	IF (NDGT.LE.999) NDG2=3	PIP3710
	IF (NDGT.LE.99) NDG2=2	PIP3720
	IF (NDGT.LE.9) NDG2=1	PIP3730
	IF (IK.GE.100) NDG3=3	PIP3740
	IF (IK.LE.99) NDG3=2	PIP3750
	IF (IK.LE.9) NDG3=1	PIP3760
	REWIND 1	PIP3770
	DO 34 I=1,JX	PIP3780
	WRITE (1) RX(I),PCAN(I),PCCA(I)	PIP3790
34	CONTINUE	PIP3800
	IX=JX	PIP3810
	IF (IPLOT(1).NE.1) GO TO 38	PIP3820
	-----	PIP3830
	CALL SUBROUTINE PLOT5, A PLOTTING ROUTINE PROGRAMMED BY DON GOOD	PIP3840
	-----	PIP3850
	NDG=NDG1	PIP3860
	WRITE (6,35) (TITLE(I),I=1,6)	PIP3870
	WRITE (6,35) (TITLE(I),I=1,6)	PIP3880
35	FORMAT (1H1,6A6,//)	PIP3890
	WRITE (6,36)	PIP3900
36	FORMAT (5X,99HP PER DIAGRAM OF CATIONS PLOTTED VERSUS ANIONS. CA	PIP3910
	1+ MG (0-100) AT TOP, NA + K (100-0) AT BOTTOM, /5X,62HHCO3 + CO3 (PIP3920
	20-100) ON LEFT, CL + SO4 + NO3 (100-0) ON RIGHT. //5X,26HSCALE-1	PIP3930
	3 INCH = 10 PERCENT.//)	PIP3940
	WRITE (6,37)	PIP3950
37	FORMAT (5X,35HNUMBERS PLOTTED IDENTIFY ANALYSES.)	PIP3960
	CALL PLOT5 (IX,0.,115.,HINC,-.833333,100.,VINC,NDG,CPI,LPI,MXHP,1)	PIP3970
38	WRITE (6,35) (TITLE(I),I=1,6)	PIP3980
	WRITE (6,39)	PIP3990
39	FORMAT (5X,52HGEOLOGIC UNIT IDENTIFICATION NUMBERS FOR PIPER PLOT	PIP4000
	1//)	PIP4010
	DO 41 I=1,IK	PIP4020
	LFM1=(NOAQ(I)*3)-2	PIP4030
	LFM2=LFM1+2	PIP4040
	WRITE (6,40) I,(AQUNT(N),N=LFM1,LFM2)	PIP4050
40	FORMAT (1X,15,3H = ,3A6)	PIP4060
41	CONTINUE	PIP4070
	IF (IPLOT(2).NE.1) GO TO 44	PIP4080
	REWIND 1	PIP4090
	DO 42 I=1,JX	PIP4100
	READ (1) RX(I),PCAN(I),PCCA(I)	PIP4110
42	PX(I)=RX(I)	PIP4120
	NDG=NDG2	PIP4130
	WRITE (6,35) (TITLE(I),I=1,6)	PIP4140
	WRITE (6,36)	PIP4150
	WRITE (6,43)	PIP4160
43	FORMAT (5X,44HNUMBERS PLOTTED IDENTIFY GEOLOGIC UNITS)	PIP4170
	CALL PLOT5 (IX,0.,115.,HINC,-.833333,100.,VINC,NDG,CPI,LPI,MXHP,2)	PIP4180
		PIP4190

44	IF (IPLOT(3).NE.1) GO TO 52	PIP4200
	REWIND 1	PIP4210
	DO 45 I=1,JX	PIP4220
	READ (1) RX(I),PCAN(I),PCCA(I)	PIP4230
45	CONTINUE	PIP4240
	DO 48 I=1,IK	PIP4250
	IAVCNT=0	PIP4260
	WX=0.	PIP4270
	PC=0.	PIP4280
	PA=0.	PIP4290
	DO 47 J=1,JX	PIP4300
	NAQ=RX(J)	PIP4310
	IF (I.EQ.NAQ) GO TO 46	PIP4320
	GO TO 47	PIP4330
46	PC=PCCA(J)+PC	PIP4340
	PA=PCAN(J)+PA	PIP4350
	WX=WX+1.	PIP4360
47	CONTINUE	PIP4370
	IF (WX.LT.1.) GO TO 48	PIP4380
	PX(I)=I	PIP4390
	PCCA(I)=PC/WX	PIP4400
	PCAN(I)=PA/WX	PIP4410
	IAVCNT=IAVCNT+1	PIP4420
48	CONTINUE	PIP4430
	IX=IK	PIP4440
	NDG=NDG3	PIP4450
	WRITE (6,35) (TITLE(I),I=1,6)	PIP4460
	WRITE (6,36)	PIP4470
	WRITE (6,49)	PIP4480
49	FORMAT (5X,65HAVERAGE PLOT BY GEOLOGIC UNIT, NUMBERS IDENTIFY GEOL	PIP4490
	LOGIC UNITS.)	PIP4500
	IF (IAVCNT.GT.0) GO TO 51	PIP4510
	WRITE (6,50)	PIP4520
50	FORMAT (///10X,47H***MULTIPLE AQUIFERS - NO AVERAGE PLOT POSSIBLE/	PIP4530
	11H1)	PIP4540
	GO TO 52	PIP4550
51	CALL PLOT5 (IX,0.,115.,HINC,-.833333,100.,VINC,NDG,CPI,LPI,MXHP,3)	PIP4560
52	IX=JX	PIP4570
	VNC=VINC	PIP4580
	IF (VINC.GT.1.665.AND.VINC.LT.1.668) VNC=1.73206	PIP4590
	IF (IPLOT(4).NE.1) GO TO 55	PIP4600
	DO 53 I=1,JX	PIP4610
	PCCA(I)=CY(I)	PIP4620
	PCAN(I)=CX(I)	PIP4630
53	PX(I)=I	PIP4640
	NDG=NDG1	PIP4650
	WRITE (6,35) (TITLE(I),I=1,6)	PIP4660
	WRITE (6,54)	PIP4670
54	FORMAT (5X,72HTRILINEAR PLOT OF CATIONS. MG ON LEFT, NA + K ON RI	PIP4680
	IGHT, CA ON BOTTOM. ///5X,27HSCALE-1 INCH = 10 PERCENT. ///	PIP4690
	WRITE (6,37)	PIP4700
	CALL PLOT5 (IX,0.,104.,HINC,87.46903,0.,VNC,NDG,CPI,LPI,MXHP,4)	PIP4710
55	IF (IPLOT(5).NE.1) GO TO 57	PIP4720
	DO 56 I=1,JX	PIP4730
	PCCA(I)=CY(I)	PIP4740
	PCAN(I)=CX(I)	PIP4750
56	PX(I)=RX(I)	PIP4760
	NDG=NDG2	PIP4770
	WRITE (6,35) (TITLE(I),I=1,6)	PIP4780
	WRITE (6,54)	PIP4790

	WRITE (6,43)	
	CALL PLOT5 (IX,0.,104.,HINC,87.46903,0.,VNC,NDG,CPI,LPI,MXHP,5)	PIP4800
57	IF (IPLOT(6).NE.1) GO TO 60	PIP4810
	DO 58 I=1,JX	PIP4820
	PCCA(I)=AY(I)	PIP4830
	PCAN(I)=AX(I)	PIP4840
58	PX(I)=I	PIP4850
	NDG=NDG1	PIP4860
	WRITE (6,35) (TITLE(I),I=1,6)	PIP4870
	WRITE (6,59)	PIP4880
		PIP4890
59	FORMAT (5X,75HTRILINEAR PLOT OF ANIONS. HCO3 + CO3 ON LEFT, SO4 ON	PIP4900
	IN RIGHT, CL ON BOTTOM. ///5X,27HSCALE-1 INCH = 10 PERCENT. ///	PIP4910
	WRITE (6,37)	PIP4920
	CALL PLOT5 (IX,0.,104.,HINC,87.46903,0.,VNC,NDG,CPI,LPI,MXHP,6)	PIP4930
60	IF (IPLOT(7).NE.1) GO TO 62	PIP4940
	DO 61 I=1,JX	PIP4950
	PCCA(I)=AY(I)	PIP4960
	PCAN(I)=AX(I)	PIP4970
61	PX(I)=RX(I)	PIP4980
	NDG=NDG2	PIP4990
	WRITE (6,35) (TITLE(I),I=1,6)	PIP5000
	WRITE (6,59)	PIP5010
	WRITE (6,43)	PIP5020
	CALL PLOT5 (IX,0.,104.,HINC,87.46903,0.,VNC,NDG,CPI,LPI,MXHP,7)	PIP5030
62	IX=0	PIP5040
	WRITE (6,1)	PIP5050
	GO TO 7	PIP5060
	END	PIP5070-

C	PLOT5000	SUBROUTINE PLOT5	PT5	10
		SUBROUTINE PLOT5 (N,HL,HR,HINC,VT,VB,VINC,NDG,CPI,LPI,MXHP,IPLT)	PT5	20
		COMMON /INDT/ H(1000),V(1000),Z(1000),IER(500),ITAB(500),KTAB(500)	PT5	30
		COMMON /DTA/ JARBO(52),JREF(12)	PT5	40
		REAL LPI	PT5	50
		IF ((HL.LT.HR).AND.(HINC.LT.0.0)) HINC=-HINC	PT5	60
		IF ((HL.GT.HR).AND.(HINC.GT.0.0)) HINC=-HINC	PT5	70
		IF ((VT.GT.VB).AND.(VINC.GT.0.0)) VINC=-VINC	PT5	80
		IF ((VT.LT.VB).AND.(VINC.LT.0.0)) VINC=-VINC	PT5	90
		NSHT=1	PT5	100
		OHR=HR	PT5	110
		THP=MXHP-10-NDG	PT5	120
		IF (HINC.GT.0.0) GO TO 1	PT5	130
		IF (OHR.LE.HL+HINC*THP) GO TO 3	PT5	140
		GO TO 2	PT5	150
	1	IF (OHR.GE.HL+HINC*THP) GO TO 3	PT5	160
	2	NCOL=(OHR-HL)/HINC	PT5	170
		FNCL=NCOL	PT5	180
		IF (ABS(FNCL*HINC).LT.ABS(OHR-HL)) NCOL=NCOL+1	PT5	190
		NCOL=NCOL+NDG	PT5	200
		GO TO 4	PT5	210
	3	NCOL=MXHP-10	PT5	220
	4	VEYG=ABS((HINC*CPI)/(VINC*LPI))	PT5	230
		FNCL=NCOL-NDG	PT5	240
		HR=HL+FNCL*HINC	PT5	250
		I=0	PT5	260

K=N	PT5 270
5 I=I+1	PT5 280
IF (I.GT.K) GO TO 10	PT5 290
IF (VINC.GT.0.0) GO TO 6	PT5 300
IF (V(I).GT.VT.OR.V(I).LT.VB) GO TO 9	PT5 310
GO TO 7	PT5 320
6 IF (V(I).LT.VT.OR.V(I).GT.VB) GO TO 9	PT5 330
7 IF (HINC.LT.0.0) GO TO 8	PT5 340
IF (H(I).GT.HR.OR.H(I).LT.HL) GO TO 9	PT5 350
GO TO 5	PT5 360
8 IF (H(I).LT.HR.OR.H(I).GT.HL) GO TO 9	PT5 370
GO TO 5	PT5 380
9 DUM=V(I)	PT5 390
V(I)=V(K)	PT5 400
V(K)=DUM	PT5 410
DUM=H(I)	PT5 420
H(I)=H(K)	PT5 430
H(K)=DUM	PT5 440
DUM=Z(I)	PT5 450
Z(I)=Z(K)	PT5 460
Z(K)=DUM	PT5 470
I=I-1	PT5 480
K=K-1	PT5 490
GO TO 5	PT5 500
10 CALL PLOT4 (K,HL,HR,HINC,VT,VB,VINC,NDG,NSHT,NCOL,VEXG,IPLT)	PT5 510
RETURN	PT5 520
END	PT5 530-

C	PLOT4000	SUBROUTINE PLOT4	PT4 10
	SUBROUTINE PLOT4	(N,HL,HR,HINC,VT,VB,VINC,NDG,NSHT,NCOL,VEXG,IPLT)	PT4 20
	COMMON /INDT/	X(1000),Y(1000),Z(1000),IER(500),ITAB(500),KTAB(500)	PT4 30
	COMMON /DTA/	JARBO(52),JREF(12)	PT4 40
	COMMON /MLN/	MAP(122)	PT4 50
	DIMENSION	IZD(9)	PT4 60
C	PROGRAM -	SUBROUTINE PLOT4	PT4 70
C	LANGUAGE -	FORTRAN IV	PT4 80
C	NECESSARY SUBROUTINES -	RANGE, ORDER3.	PT4 90
C	COMPUTER -	IBM 1620 60K CORE	PT4 100
C	PROGRAMMER -	DONALD I GOOD	PT4 110
C	DATE COMPLETED -	APRIL 1964	PT4 120
C	REVISED SEPT 1964	OWEN T SPITZ	PT4 130
C			PT4 140
C			PT4 150
C	DETERMINE NUMBER OF CHARACTERS, NCC, IN PLOTTING ARRAY		PT4 160
	WRITE (6,1)		PT4 170
1	FORMAT (1H1)		PT4 180
	VCXX=ABS(VINC)		PT4 200
	IF (IPLT.GT.3.AND.(VCXX.GT.1.7320.AND.VCXX.LT.1.73210))	CALL SETTR	PT4 210
11	(PLIM,1,0,0,0,0,0,0,IPLT)		PT4 220
	IF (IPLT.LE.3.AND.(VINC.GT.1.665.AND.VINC.LT.1.668))	CALL SETTR2	(PT4 230
1	PLIM,1,0,0,0,0,0,0)		PT4 240
	NZ=500		PT4 250
	NCD=NCOL		PT4 260
	NCC=NCD-(NDG+1)		PT4 270
	FNC=NCC		PT4 280

C	M1=NDG+1	PT4 290
C	CALCULATE PLOTTING DIMENSIONS	PT4 300
C		PT4 310
C	-----	PT4 320
C	CHECK ARGUMENTS FOR VALIDITY	PT4 330
C	-----	PT4 340
	NKR=0	PT4 350
	CALL RANGE (0,1000,N,NAR)	PT4 360
	KAR=1	PT4 370
	IF (NAR) 2,2,4	PT4 380
C		PT4 390
	2 CALL RANGE (1,9,NDG,NAR)	PT4 400
	KAR=2	PT4 410
	IF (NAR) 3,3,4	PT4 420
C		PT4 430
	3 CALL RANGE (M1,132,NCOL,NAR)	PT4 440
	KAR=3	PT4 450
	IF (NAR) 6,6,4	PT4 460
C		PT4 470
	4 WRITE (6,5) KAR	PT4 480
	5 FORMAT (1X,22H SUBROUTINE PLOT4 ERRORI2)	PT4 490
	NKR=1	PT4 500
	GO TO (2,3,68), KAR	PT4 510
	6 IF (NKR) 7,7,68	PT4 520
C		PT4 530
C	ZERO CARRIAGE CONTROL ARRAY FOR OVERPRINT VALUES	PT4 540
C		PT4 550
	7 DO 8 I=1,NZ,1	PT4 560
	KTAB(I)=JARBO(52)	PT4 570
	8 ITAB(I)=JARBO(52)	PT4 580
	IF (VINC.GT.0.0) GO TO 9	PT4 590
	KYD=1	PT4 600
	YMAX=VT	PT4 610
	YMIN=VB	PT4 620
	M3=0	PT4 630
	GO TO 10	PT4 640
	9 YMAX=VB	PT4 650
	YMIN=VT	PT4 660
	M3=1	PT4 670
	KYD=0	PT4 680
	10 KXD=0	PT4 690
	IF (HINC.GT.0.0) KXD=1	PT4 700
	IF (N.EQ.0) GO TO 11	PT4 710
	CALL ORDER3 (Y,X,Z,1,N,KYD,LK)	PT4 720
	IF (LK.EQ.1) GO TO 68	PT4 730
C		PT4 740
C		PT4 750
		PT4 760
	11 PLIM=VT	PT4 770
	KER=0	PT4 780
	NL=0	PT4 790
C		PT4 800
C	CALCULATE UPPER (TOWARD TOP OF PAGE) BOUND OF VERTICAL PLOTTING	PT4 810
C	INTERVAL	PT4 820
C		PT4 830
	12 VERT=PLIM	PT4 840
C		PT4 850
C	INCREMENT OVERPRINT INDEX. BLANK PLOTTING ARRAY	PT4 860
C		PT4 870
	KERF=KER+1	PT4 880
		PT4 890

	DO 13 I=1,NCD,1	PT4 900
	13 MAP(I)=JARBO(52)	PT4 910
C		PT4 920
C	CALCULATE LOWER (TOWARD BOTTOM OF PAGE) BOUND OF VERTICAL PLOTTING	PT4 930
C	INTERVAL	PT4 940
	PLIM=VERT+VINC	PT4 950
	PLIX=VERT+.5*VINC	PT4 960
	IF (IPLT.GT.3.AND.(VCXX.GT.1.73200.AND.VCXX.LT.1.73210)) CALL SETTPT4	PT4 970
	1R1 (PLIX,2,LX,LA,LY,LB,LZ,LC,IPLT)	PT4 980
	IF (IPLT.LE.3.AND.(VINC.GT.1.665.AND.VINC.LT.1.668)) CALL SETTR2	PT4 990
	1PLIX,2,LX,LA,LY,LB,LZ,LC)	PT41000
	IF (N.EQ.0) GO TO 56	PT41010
C		PT41020
C	DETERMINE INDEX OF NEXT DATA POINT, NF	PT41030
C		PT41040
	NF=NL+1	PT41050
	I=NL	PT41060
C		PT41070
C	SET UP VALUES FOR VERTICAL INTERVAL	PT41080
C		PT41090
	IF (M3) 18,14,18	PT41100
C		PT41110
C	COUNT NO. OF DATA POINTS IN VERTICAL PLOTTING INTERVAL	PT41120
C		PT41130
	14 I=I+1	PT41140
	IF (I-N) 15,15,16	PT41150
	15 IF (Y(I)-PLIM) 16,14,14	PT41160
C		PT41170
C	DETERMINE INDEX OF LAST DATA POINT IN VERTICAL PLOTTING INTERVAL,	PT41180
C	NL. ORDER DATA POINTS IN VERTICAL PLOTTING INTERVAL	PT41190
C		PT41200
	16 NL=I-1	PT41210
	IF (NL-NF) 56,22,17	PT41220
	17 CALL ORDER3 (X,Y,Z,NF,NL,KXD,LK)	PT41230
	IF (LK) 22,22,68	PT41240
C		PT41250
C	COUNT NO. OF DATA POINTS IN VERTICAL PLOTTING INTERVAL	PT41260
C		PT41270
	18 I=I+1	PT41280
	IF (I-N) 19,19,20	PT41290
	19 IF (Y(I)-PLIM) 18,18,20	PT41300
C		PT41310
C	DETERMINE INDEX OF LAST DATA POINT IN VERTICAL PLOTTING INTERVAL,	PT41320
C	NL. ORDER DATA POINTS IN VERTICAL PLOTTING INTERVAL	PT41330
C		PT41340
	20 NL=I-1	PT41350
	IF (NL-NF) 56,22,21	PT41360
	21 CALL ORDER3 (X,Y,Z,NF,NL,KXD,LK)	PT41370
	IF (LK) 22,22,68	PT41380
C		PT41390
C	PLACE Z-VALUES FOR VERTICAL INTERVAL IN PLOTTING ARRAY FROM	PT41400
C	RIGHT TO LEFT	PT41410
C		PT41420
	22 I=NF-1	PT41430
	23 I=I+1	PT41440
C		PT41450
C	DETERMINE POSITION, IDX, IN PLOTTING ARRAY TO PLACE SIGN OF	PT41460
C	PLOTTED VALUE	PT41470
C		PT41480
	IDX=(X(I)-HL)/HINC+1.0	PT41490

C		PT41500
C		PT41510
C	DETERMINE IF PLOTTED VALUE LIES IN HORIZONTAL PLOTTING RANGE	PT41520
C		PT41530
	IF (IDX) 55,55,24	PT41540
24	IF (IDX-NCC-1) 25,25,55	PT41550
C		PT41560
C	DETERMINE IF THIS POSITION IN THE PLOTTING ARRAY IS ALREADY	PT41570
C	OCCUPIED	PT41580
C		PT41590
25	IF (MAP(IDX).EQ.JARBO(52).OR.MAP(IDX).EQ.JARBO(27)) GO TO 26	PT41600
	GO TO 45	PT41610
C		PT41620
C	BREAK PLOTTED VALUE INTO 4 SEPARATE DIGITS AND CODE THESE DIGITS	PT41630
C	IN THE DOUBLE DIGIT CODE	PT41640
C		PT41650
26	LAZ=ABS(Z(I))	PT41660
	DVD=LAZ	PT41670
	DSR=1.	PT41680
	DO 27 J=1,NDG,1	PT41690
27	DSR=DSR*10.	PT41700
	J=1	PT41710
C		PT41720
28	J=J+1	PT41730
	DSR=DSR*0.1	PT41740
	K=DVD/DSR	PT41750
	IZD(J)=JREF(K+3)	PT41760
	IF (NDG.EQ.1) GO TO 31	PT41770
	FK=K	PT41780
	REM=DVD-FK*DSR	PT41790
	IF (J-NDG) 29,30,30	PT41800
29	DVD=REM	PT41810
	GO TO 28	PT41820
30	K=REM	PT41830
	IZD(NDG+1)=JREF(K+3)	PT41840
C		PT41850
C	DETERMINE LEFT-MOST NON-ZERO DIGIT OF PLOTTED VALUE (EXCEPT ZERO)	PT41860
C		PT41870
31	J=1	PT41880
32	J=J+1	PT41890
	IF (J-(NDG+1)) 33,34,34	PT41900
33	IF (IZD(J).NE.JARBO(28)) GO TO 34	PT41910
	IZD(J)=JARBO(52)	PT41920
	GO TO 32	PT41930
34	K=J-1	PT41940
C		PT41950
C	PLACE SIGN OF PLOTTED VALUE	PT41960
C		PT41970
	IF (Z(I)) 35,36,36	PT41980
35	IZD(K)=JREF(2)	PT41990
	GO TO 37	PT42000
36	IZD(K)=JREF(1)	PT42010
C		PT42020
C	PLACE DIGITIZED VALUE IN PLOTTING ARRAY	PT42030
C		PT42040
37	IMP=IDX-1	PT42050
	J=K-1	PT42060
38	J=J+1	PT42070
	IF (J-NDG-1) 39,39,55	PT42080
39	IMP=IMP+1	PT42090

	IF (MAP(IMP).EQ.JARBO(52).OR.MAP(IMP).EQ.JARBO(27)) GO TO 40	PT42100
	GO TO 41	PT42110
40	MAP(IMP)=IZD(J)	PT42120
	GO TO 38	PT42130
C		PT42140
C	ERROR ROUTINE FOR OVERLAP PLOTTING	PT42150
C		PT42160
41	MAP(IDX)=JARBO(38)	PT42170
	L=IDX+1	PT42180
	IMP=IMP-1	PT42190
	J=IDX	PT42200
42	J=J+1	PT42210
	IF (J-IMP) 43,43,44	PT42220
43	MAP(J)=JARBO(52)	PT42230
	GO TO 42	PT42240
C		PT42250
44	KER=KER+1	PT42260
	IER(KER)=Z(I)	PT42270
	ITAB(KER)=JARBO(38)	PT42280
	GO TO 55	PT42290
C		PT42300
C	ERROR ROUTINES FOR MULTIPLE PLOTTING	PT42310
C		PT42320
C	CHECK FOR ASTERISK	PT42330
45	IF (MAP(IDX).EQ.JARBO(38)) GO TO 50	PT42340
	DO 46 ICU=1,12	PT42350
	IF (MAP(IDX).NE.JREF(ICU)) GO TO 46	PT42360
	IF (ICU-3) 47,51,51	PT42370
46	CONTINUE	PT42380
	IF (MAP(IDX).EQ.JARBO(52).OR.MAP(IDX).EQ.JARBO(27)) GO TO 47	PT42390
	GO TO 51	PT42400
C		PT42410
C	IF 2 VALUES ARE TO OCCUPY MAP(IDX)	PT42420
C		PT42430
47	KER=KER+2	PT42440
	IER(KER-1)=Z(I-1)	PT42450
	IER(KER)=Z(I)	PT42460
	JAR=2	PT42470
	ITAB(KER)=JARBO(JAR)	PT42480
	JAM=2	PT42490
	MAP(IDX)=JARBO(JAM)	PT42500
	IMP=IDX	PT42510
48	IMP=IMP+1	PT42520
	IF (IMP.GT.NCD) GO TO 55	PT42530
	IF (MAP(IMP).EQ.JARBO(52).OR.MAP(IMP).EQ.JREF(1).OR.MAP(IMP).EQ.JR	PT42540
	IEF(2).OR.MAP(IMP).EQ.JARBO(38).OR.MAP(IMP).EQ.JARBO(27)) GO TO 55	PT42550
	DO 49 IFND=1,10	PT42560
	IF (MAP(IMP).EQ.JARBO(IFND)) GO TO 55	PT42570
49	CONTINUE	PT42580
	MAP(IMP)=JARBO(52)	PT42590
	GO TO 48	PT42600
C		PT42610
C	IF MAP(IDX) IS OCCUPIED BY AN *	PT42620
C		PT42630
50	KER=KER+1	PT42640
	IER(KER)=Z(I)	PT42650
	ITAB(KER-1)=JARBO(52)	PT42660
	JAR=2	PT42670
	ITAB(KER)=JARBO(JAR)	PT42680
	JAM=2	PT42690

	MAP(IDX)=JARBO(JAM)	PT42700
	GO TO 55	PT42710
C		PT42720
C	IF 3-9 VALUES ARE TO OCCUPY MAP(IDX)	PT42730
C		PT42740
	51 DO 52 ICU=2,9	PT42750
	IF (MAP(IDX).EQ.JARBO(ICU)) GO TO 53	PT42760
	52 CONTINUE	PT42770
	GO TO 54	PT42780
	53 JAR=ICU	PT42790
	JAM=ICU	PT42800
	JAM=JAM+1	PT42810
	MAP(IDX)=JARBO(JAM)	PT42820
	KER=KER+1	PT42830
	JAR=JAR+1	PT42840
	ITAB(KER)=JARBO(JAR)	PT42850
	ITAB(KER-1)=JARBO(52)	PT42860
	IER(KER)=Z(I)	PT42870
	GO TO 55	PT42880
C		PT42890
C	IF MORE THAN 9 VALUES ARE TO OCCUPY MAP(IDX)	PT42900
C		PT42910
	54 MAP(IDX)=JARBO(1)	PT42920
	KER=KER+1	PT42930
	IER(KER)=Z(I)	PT42940
	ITAB(KER-1)=JARBO(52)	PT42950
	ITAB(KER)=JARBO(1)	PT42960
C		PT42970
C	DETERMINE IF FINAL VALUE FOR THIS VERTICAL PLOTTING INTERVAL	PT42980
C	IS PROCESSED	PT42990
C		PT43000
	55 IF (KER.GT.NZ) GO TO 69	PT43010
	IF (I-NL) 23,56,56	PT43020
C		PT43030
C	WRITE PLOTTING ARRAY	PT43040
C		PT43050
	56 CV=VERT+0.5*VINC	PT43060
	WRITE (6,57) LX,LY,LZ,LA,LB,LC,(MAP(I),I=1,NCD,1)	PT43070
	57 FORMAT (4X,128A1)	PT43080
C		PT43090
C	INVERT LIST OF OVERPRINT AND CARRIAGE CONTROL VALUES IN LAST	PT43100
C	VERTICAL PLOTTING INTERVAL	PT43110
C		PT43120
	IF (KER-KERF) 61,58,59	PT43130
	58 KTAB(KER)=JARBO(28)	PT43140
	GO TO 61	PT43150
	59 KTAB(KERF)=JARBO(28)	PT43160
	KF=(KER-KERF+1)/2+KERF-1	PT43170
	J=KER+KERF	PT43180
	DO 60 I=KERF,KF,1	PT43190
	IED=IER(I)	PT43200
	ITB=ITAB(I)	PT43210
	K=J-I	PT43220
	IER(I)=IER(K)	PT43230
	ITAB(I)=ITAB(K)	PT43240
	IER(K)=IED	PT43250
	60 ITAB(K)=ITB	PT43260
C		PT43280
C	DETERMINE IF LAST VERTICAL PLOTTING INTERVAL IS PLOTTED	PT43290
	61 IF (M3) 63,62,63	PT43300

	62 IF (PLIM-YMIN) 64,12,12	PT43310
	63 IF (PLIM-YMAX) 12,12,64	PT43320
	64 IF (IPLT.GT.3.AND.(VCXX.GT.1.73200.AND.VCXX.LT.1.73210)) CALL SETTPT43330	PT43330
	IR1 (PLIX,3,LX,LA,LY,LB,LZ,LC,IPLT)	PT43340
	IF (IPLT.LE.3.AND.(VINC.GT.1.665.AND.VINC.LT.1.668)) CALL SETTR2 (PT43350	PT43350
C	1PLIX,3,LX,LA,LY,LB,LZ,LC)	PT43360
C		PT43370
C	WRITE FINAL SCALE	PT43380
C		PT43390
C	WRITE OVERPRINT VALUES	PT43400
C		PT43410
	IF (KER) 68,68,65	PT43420
	65 WRITE (6,66)	PT43430
	66 FORMAT (1H016HOVERPRINT VALUES)	PT43440
	WRITE (6,67) (KTAB(I),ITAB(I),IER(I),I=1,KER)	PT43450
	67 FORMAT (2A1,I6)	PT43460
	68 RETURN	PT43470
	69 WRITE (6,70)	PT43480
	70 FORMAT (1H0,36HOVERPRINT VALUES HAVE EXCEEDED ARRAY,/1H0,29HPLOT OPT43500	PT43500
	IF THIS MAP DISCONTINUED)	PT43510
	RETURN	PT43520
	END	PT43530-

C	RANGE000 SUBROUTINE RANGE	RNG 10
	SUBROUTINE RANGE (LL,LU,N,NER)	RNG 20
C		RNG 30
C	INTERVAL (LL,LU)	RNG 40
C	RANGE DETERMINES WHETHER OR NOT N FALLS IN THE CLOSED	RNG 50
C		RNG 60
	NER=0	RNG 70
	IF (LL-N) 1,3,2	RNG 80
1	IF (LU-N) 2,3,3	RNG 90
2	NER=1	RNG 100
3	RETURN	RNG 110
	END	RNG 120-

C	ORDER300 SUBROUTINE ORDER3	OR3 10
C	PROGRAM - SUBROUTINE ORDER3	OR3 20
C	LANGUAGE - FORTRAN IV	OR3 30
C	NECESSARY SUBROUTINES - RANGE	OR3 40
C	COMPUTER - IBM 1620 60K CORE	OR3 50
C	PROGRAMMER - DONALD I GOOD	OR3 60
C	DATE COMPLETED - APRIL 1964	OR3 70
C		OR3 80
C		OR3 90
	SUBROUTINE ORDER3 (A,B,C,NF,NL,KD,KR)	OR3 100
	DIMENSION A(1000), B(1000), C(1000)	OR3 110
C		OR3 120
C	INITIALIZATION STEPS	OR3 130
C		OR3 140

	KR=0	OR3 150
	ND=NL-NF	OR3 160
C	-----	OR3 170
C	CHECK ARGUMENTS FOR VALIDITY	OR3 180
C	-----	OR3 190
	CALL RANGE (1,1000,NF,NKR)	OR3 200
	KAW=1	OR3 210
	IF (NKR) 1,1,5	OR3 220
C		OR3 230
	1 CALL RANGE (0,1000,NL,NKR)	OR3 240
	KAW=2	OR3 250
	IF (NKR) 2,2,5	OR3 260
C		OR3 270
	2 CALL RANGE (0,1,KD,NKR)	OR3 280
	KAW=3	OR3 290
	IF (NKR) 3,3,5	OR3 300
C		OR3 310
	3 IF (ND) 4,7,7	OR3 320
	4 KAW=4	OR3 330
C		OR3 340
	5 WRITE (6,6) KAW	OR3 350
	6 FORMAT (1X,23HSUBROUTINE ORDER3 ERRORI2)	OR3 360
	KR=1	OR3 370
	GO TO (1,2,3,15), KAW	OR3 380
	7 IF (KR) 8,8,15	OR3 390
C		OR3 400
C	CALCULATE ORDERING PARAMETERS	OR3 410
C		OR3 420
	8 IF (ND) 15,15,9	OR3 430
	9 NP=NF+1	OR3 440
	NE=NL+1	OR3 450
C	-----	OR3 460
C	ORDER ARRAYS IN ASCENDING ORDER ON A	OR3 470
C	-----	OR3 480
	DO 12 K=1,ND,1	OR3 490
C		OR3 500
	NE=NE-1	OR3 510
	AMAX=A(NF)	OR3 520
	J=NF	OR3 530
	DO 11 I=NP,NE,1	OR3 540
	IF (AMAX-A(I)) 10,11,11	OR3 550
	10 AMAX=A(I)	OR3 560
	J=I	OR3 570
	11 CONTINUE	OR3 580
C		OR3 590
	BAMAX=B(J)	OR3 600
	CAMAX=C(J)	OR3 610
	A(J)=A(NE)	OR3 620
	B(J)=B(NE)	OR3 630
	C(J)=C(NE)	OR3 640
C		OR3 650
	A(NE)=AMAX	OR3 660
	B(NE)=BAMAX	OR3 670
	C(NE)=CAMAX	OR3 680
C		OR3 690
	12 CONTINUE	OR3 700
C		OR3 710
C	INVERT ARRAYS IF DESCENDING ORDER IS DESIRED	OR3 720
C		OR3 730
	IF (KD) 15,15,13	OR3 740

13	NS2=(NL-NF+1)/2+NF-1	OR3	750
	NT=NL+NF	OR3	760
	DO 14 I=NF,NS2,1	OR3	770
	AMAX=A(I)	OR3	780
	BAMAX=B(I)	OR3	790
	CAMAX=C(I)	OR3	800
	K=NT-I	OR3	810
	A(I)=A(K)	OR3	820
	B(I)=B(K)	OR3	830
	C(I)=C(K)	OR3	840
	A(K)=AMAX	OR3	850
	B(K)=BAMAX	OR3	860
14	C(K)=CAMAX	OR3	870
15	RETURN	OR3	880
	END	OR3	890-

C	SETTRI00	ST1	10
C	SETTRI - SETS UP TRIANGULAR OVERLAY	ST1	20
	SUBROUTINE SETTRI (PLIM,KXX,LX,LA,LY,LB,LZ,LC,IPLT)	ST1	30
	COMMON /MLN/ MAP(122)	ST1	40
	DATA MP0,MP1,MP2,MP4,MP6,MP8,MP,MD,MSL/1H0,1H1,1H2,1H4,1H6,1H8,1HP	ST1	50
	1,1H-,1H//	ST1	60
	DATA MM,MH,MC,MO,MS,MG,MA,MK,MN,MPL/1HM,1HH,1HC,1HO,1HS,1HG,1HA,1HST	ST1	70
	1K,1HN,1H+//	ST1	80
	DATA MP3/1H3/	ST1	90
	DATA MHAR,MBL/1H.,1H /	ST1	100
	GO TO (1,2,48), KXX	ST1	110
C	SET UP VARIABLES FOR TRILINEAR PLOT	ST1	120
1	L=52	ST1	130
	K=50	ST1	140
	KX=0	ST1	150
C	ALINE--EQUAL TO Y COORDINATE POSITION OF 10 PERCENT LINES	ST1	160
C	INCREMENTED BY -8.6603)	ST1	170
	ALINE=77.9427	ST1	180
C	VKIN--VARIABLE USED IN DETERMINING 10 PERCENT LINES	ST1	190
	VKIN=.86603	ST1	200
	M1=46	ST1	210
	M2=41	ST1	220
	M3=36	ST1	230
	M4=31	ST1	240
	M5=26	ST1	250
	M6=21	ST1	260
	M7=16	ST1	270
	M8=11	ST1	280
	M9=6	ST1	290
	M10=1	ST1	300
	N1=56	ST1	310
	N2=61	ST1	320
	N3=66	ST1	330
	N4=71	ST1	340
	N5=76	ST1	350
	N6=81	ST1	360
	N7=86	ST1	370
	N8=91	ST1	380
	N9=96	ST1	390

	N10=101	ST1 400
	RETURN	ST1 410
C	SET SYMBOLS INTO MAP ARRAY	ST1 420
2	L=L-1	ST1 430
	K=K+1	ST1 440
	LX=MBL	ST1 450
	LY=MBL	ST1 460
	LZ=MBL	ST1 470
	LA=MBL	ST1 480
	LB=MBL	ST1 490
	LC=MBL	ST1 500
	MAP(L)=MHAR	ST1 510
	MAP(K)=MHAR	ST1 520
	IF (ALINE.LT.(PLIM+VKIN).AND.ALINE.GT.(PLIM-VKIN)) GO TO 4	ST1 530
	IF (KX.GT.0) GO TO 20	ST1 540
	IF (PLIM.LT.86.) RETURN	ST1 550
C	SET IN LEGENDS AT UPPER POINT OF DIAGRAM	ST1 560
	IF (IPLT.GE.6) GO TO 3	ST1 570
	MAP(47)=MP1	ST1 580
	MAP(48)=MPO	ST1 590
	MAP(49)=MPO	ST1 600
	MAP(50)=MD	ST1 610
	MAP(52)=MSL	ST1 620
	MAP(53)=MPO	ST1 630
	RETURN	ST1 640
3	MAP(50)=MPO	ST1 650
	MAP(52)=MD	ST1 660
	MAP(53)=MP1	ST1 670
	MAP(54)=MPO	ST1 680
	MAP(55)=MPO	ST1 690
	RETURN	ST1 700
4	IF (ALINE.LT.45..AND.ALINE.GT.42.) GO TO 5	ST1 710
	GO TO 7	ST1 720
C	SET IN LEGENDS IDENTIFYING POSITIONS OF PARENT WATERS 2 AND 3 ON	ST1 730
C	DIAGRAM	ST1 740
5	IF (IPLT.GE.6) GO TO 6	ST1 750
	MAP(21)=MM	ST1 760
	MAP(22)=MG	ST1 770
	MAP(80)=MN	ST1 780
	MAP(81)=MA	ST1 790
	MAP(83)=MPL	ST1 800
	MAP(85)=MK	ST1 810
	GO TO 7	ST1 820
6	MAP(13)=MH	ST1 830
	MAP(14)=MC	ST1 840
	MAP(15)=MO	ST1 850
	MAP(16)=MP3	ST1 860
	MAP(18)=MPL	ST1 870
	MAP(20)=MC	ST1 880
	MAP(21)=MO	ST1 890
	MAP(22)=MP3	ST1 900
	MAP(81)=MS	ST1 910
	MAP(82)=MO	ST1 920
	MAP(83)=MP4	ST1 930
C	INCREMENT ALINE TO Y VALUE OF NEXT 10 PERCENT LINE	ST1 940
7	ALINE=ALINE-8.6603	ST1 950
C	SET IN 10 PERCENT LINE FROM PRESENT LEFT TO RIGHT EDGE OF PLOT	ST1 960
	DO 8 IX=L,K	ST1 970
	MAP(IX)=MHAR	ST1 980
8	CONTINUE	ST1 990

	KX=KX+1	ST11000
C	SET IN LEGENDS FOR PERCENTAGE LINES	ST11010
	IF (IPLT.GE.6) GO TO 14	ST11020
	GO TO (37,9,37,10,37,11,37,12,37,13), KX	ST11030
9	MAP(40)=MD	ST11040
	MAP(39)=MP0	ST11050
	MAP(38)=MP8	ST11060
	MAP(62)=MSL	ST11070
	MAP(63)=MP2	ST11080
	MAP(64)=MP0	ST11090
	GO TO 37	ST11100
10	MAP(30)=MD	ST11110
	MAP(29)=MP0	ST11120
	MAP(28)=MP6	ST11130
	MAP(72)=MSL	ST11140
	MAP(73)=MP4	ST11150
	MAP(74)=MP0	ST11160
	GO TO 37	ST11170
11	MAP(20)=MD	ST11180
	MAP(19)=MP0	ST11190
	MAP(18)=MP4	ST11200
	MAP(82)=MSL	ST11210
	MAP(83)=MP6	ST11220
	MAP(84)=MP0	ST11230
	GO TO 37	ST11240
12	MAP(10)=MD	ST11250
	MAP(9)=MP0	ST11260
	MAP(8)=MP2	ST11270
	MAP(92)=MSL	ST11280
	MAP(93)=MP8	ST11290
	MAP(94)=MP0	ST11300
	GO TO 37	ST11310
13	MAP(102)=MSL	ST11320
	MAP(103)=MP1	ST11330
	MAP(104)=MP0	ST11340
	MAP(105)=MP0	ST11350
	LC=MP0	ST11360
	GO TO 37	ST11370
C	14 GO TO (37,15,37,16,37,17,37,18,37,19), KX	ST11380
	INITIALIZATION STEPS FOR PLOTTING	PT4 760
15	MAP(40)=MP0	ST11390
	MAP(62)=MD	ST11400
	MAP(63)=MP8	ST11410
	MAP(64)=MP0	ST11420
	GO TO 37	ST11430
16	MAP(30)=MP0	ST11440
	MAP(72)=MD	ST11450
	MAP(73)=MP6	ST11460
	MAP(74)=MP0	ST11470
	GO TO 37	ST11480
17	MAP(20)=MP0	ST11490
	MAP(82)=MD	ST11500
	MAP(83)=MP4	ST11510
	MAP(84)=MP0	ST11520
	GO TO 37	ST11530
18	MAP(10)=MP0	ST11540
	MAP(92)=MD	ST11550
	MAP(93)=MP2	ST11560
	MAP(94)=MP0	ST11570
	GO TO 37	ST11580

19	MAP(102)=MD	ST11590
	MAP(103)=MPO	ST11600
	LC=MPO	ST11610
C	SET IN DOTS FOR 10 PERCENT LINES AND OUTSIDE BOUNDARIES	ST11620
20	GO TO (30,29,28,27,26,25,24,23,22,21), KX	ST11630
21	MAP(M10)=MHAR	ST11640
	MAP(N10)=MHAR	ST11650
22	MAP(M9)=MHAR	ST11660
	MAP(N9)=MHAR	ST11670
23	MAP(M8)=MHAR	ST11680
	MAP(N8)=MHAR	ST11690
24	MAP(M7)=MHAR	ST11700
	MAP(N7)=MHAR	ST11710
25	MAP(M6)=MHAR	ST11720
	MAP(N6)=MHAR	ST11730
26	MAP(M5)=MHAR	ST11740
	MAP(N5)=MHAR	ST11750
27	MAP(M4)=MHAR	ST11760
	MAP(N4)=MHAR	ST11770
28	MAP(M3)=MHAR	ST11780
	MAP(N3)=MHAR	ST11790
29	MAP(M2)=MHAR	ST11800
	MAP(N2)=MHAR	ST11810
30	MAP(M1)=MHAR	ST11820
	MAP(N1)=MHAR	ST11830
	IF (IPLT.LT.6) GO TO 37	ST11840
	IF (PLIM.GT.3.40.AND.PLIM.LT.3.60) LA=MP1	ST11850
	VLCK=ALINE+1.7306	ST11860
	IF (VLCK.LT.(PLIM+VKIN).AND.VLCK.GT.(PLIM-VKIN)) GO TO 31	ST11870
	GO TO 37	ST11880
31	KGP=KX+1	ST11890
	GO TO (37,32,37,33,37,34,37,35,37,36), KGP	ST11900
32	MAP(39)=MP2	ST11910
	GO TO 37	ST11920
33	MAP(29)=MP4	ST11930
	GO TO 37	ST11940
34	MAP(19)=MP6	ST11950
	GO TO 37	ST11960
35	MAP(9)=MP8	ST11970
	GO TO 37	ST11980
36	LB=MPO	ST11990
C	INCREMENT VARIABLES FOR DEFINING DIAGRAM OUTLINE	ST12000
37	GO TO (47,46,45,44,43,42,41,40,39,38), KX	ST12010
38	M10=M10+1	ST12020
	N10=N10-1	ST12030
39	M9=M9+1	ST12040
	N9=N9-1	ST12050
40	M8=M8+1	ST12060
	N8=N8-1	ST12070
41	M7=M7+1	ST12080
	N7=N7-1	ST12090
42	M6=M6+1	ST12100
	N6=N6-1	ST12110
43	M5=M5+1	ST12120
	N5=N5-1	ST12130
44	M4=M4+1	ST12140
	N4=N4-1	ST12150
45	M3=M3+1	ST12160
	N3=N3-1	ST12170
46	M2=M2+1	ST12180

N2=N2-1	ST12190
47 M1=M1+1	ST12200
N1=N1-1	ST12210
RETURN	ST12220
48 IF (IPLT.LE.5) WRITE (6,49)	ST12230
IF (IPLT.GE.6) WRITE (6,50)	ST12240
49 FORMAT (10X,1H1,19X,1H8,19X,1H6,19X,1H4,19X,1H2,19X,1H0/11X,1H0,4(ST12250
119X,1H0)/12X,1H0/60X,2HCA)	ST12260
50 FORMAT (10X,1H0,5(19X,1H0)/29X,1H2,19X,1H4,19X,1H6,19X,1H8,19X,1H0	ST12270
1/108X,1H1/60X,2HCL)	ST12280
RETURN	ST12290
END	ST12300-

C	SETTR200	ST2	10
C	SETTR2 - SETS UP SQUARE OVERLAY	ST2	20
	SUBROUTINE SETTR2 (PLIM,KXX,LX,LA,LY,LB,LZ,LC)	ST2	30
	COMMON /MLN/ MAP(122)	ST2	40
	DATA MPO,MP1,MP2,MP3,MP4,MP5,MP6,MP7,MP8,MP9,MC,ML,MP,MS,MO,MN,MDT	ST2	50
	1,MBL,MH/1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1HC,1HL,1H+,1HS,1H	ST2	60
	20,1HN,1H.,1H,1HH/	ST2	70
	GO TO (1,3,20), KXX	ST2	80
	1 WRITE (6,2)	ST2	90
	2 FORMAT (57X,7HCA + MG/10X,1H0,8X,2H10,8X,2H20,8X,2H30,8X,2H40,8X,2	ST2	100
	1H50,8X,2H60,8X,2H70,8X,2H80,8X,2H90,7X,3H100)	ST2	110
	KX=0	ST2	120
	ALINE=0.	ST2	130
	VKIN=.833333	ST2	140
	RETURN	ST2	150
	3 LZ=MBL	ST2	160
	LY=MBL	ST2	170
	LX=MBL	ST2	180
	LA=MBL	ST2	190
	LB=MBL	ST2	200
	LC=MBL	ST2	210
	IF (ALINE.LT.(PLIM+VKIN).AND.ALINE.GT.(PLIM-VKIN)) GO TO 7	ST2	220
	DO 4 I=1,101,10	ST2	230
	MAP(I)=MDT	ST2	240
	4 CONTINUE	ST2	250
	IF (PLIM.GT.52.) RETURN	ST2	260
	IF (PLIM.LT.48.) RETURN	ST2	270
	IF (PLIM.GT.50.) GO TO 6	ST2	280
	IF (PLIM.LT.50.) GO TO 5	ST2	290
	RETURN	ST2	300
	5 MAP(105)=MC	ST2	310
	MAP(106)=ML	ST2	320
	MAP(107)=MP	ST2	330
	LX=MH	ST2	340
	LY=MC	ST2	350
	LZ=MO	ST2	360
	LA=MP3	ST2	370
	MAP(108)=MS	ST2	380
	MAP(109)=MO	ST2	390
	MAP(110)=MP4	ST2	400
	RETURN	ST2	410
	6 MAP(105)=MP	ST2	420
	MAP(106)=MN	ST2	430

MAP(107)=MO	ST2 440
MAP(108)=MP3	ST2 450
LX=MP	ST2 460
LY=MC	ST2 470
LZ=MO	ST2 480
LA=MP3	ST2 490
RETURN	ST2 500
7 DO 8 I=1,101	ST2 510
MAP(I)=MDT	ST2 520
8 CONTINUE	ST2 530
ALINE=ALINE+10.	ST2 540
MAP(104)=MPO	ST2 550
LC=MPO	ST2 560
KX=KX+1	ST2 570
GO TO (9,10,11,12,13,14,15,16,17,18,19), KX	ST2 580
9 MAP(102)=MP1	ST2 590
MAP(103)=MPO	ST2 600
RETURN	ST2 610
10 MAP(103)=MP9	ST2 620
LB=MP1	ST2 630
RETURN	ST2 640
11 MAP(103)=MP8	ST2 650
LB=MP2	ST2 660
RETURN	ST2 670
12 MAP(103)=MP7	ST2 680
LB=MP3	ST2 690
RETURN	ST2 700
13 MAP(103)=MP6	ST2 710
LB=MP4	ST2 720
RETURN	ST2 730
14 MAP(103)=MP5	ST2 740
LB=MP5	ST2 750
RETURN	ST2 760
15 MAP(103)=MP4	ST2 770
LB=MP6	ST2 780
RETURN	ST2 790
16 MAP(103)=MP3	ST2 800
LB=MP7	ST2 810
RETURN	ST2 820
17 MAP(103)=MP2	ST2 830
LB=MP8	ST2 840
RETURN	ST2 850
18 MAP(103)=MP1	ST2 860
LB=MP9	ST2 870
RETURN	ST2 880
19 MAP(103)=MPO	ST2 890
MAP(104)=MBL	ST2 900
LA=MP1	ST2 910
LB=MPO	ST2 920
RETURN	ST2 930
20 WRITE (6,21)	ST2 940
21 FORMAT (8X,3H100,8X,2H90,8X,2H80,8X,2H70,8X,2H60,8X,2H50,8X,2H40,8	ST2 950
1X,2H30,8X,2H20,8X,2H10,9X,1H0/57X,6HNA + K)	ST2 960
RETURN	ST2 970
END	ST2 980-

C	BLK00000	BLK	10
	BLOCK DATA	BLK	20
	COMMON /WDD/ W1,W2,W3,W4,W5,W6	BLK	30
	COMMON /DTA/ JARBO(52),JREF(12)	BLK	40
	DATA JARBO/1HA,1HB,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ,1HK,1HL,1HM,1HNB	BLK	50
	1,1HO,1HP,1HQ,1HR,1HS,1HT,1HU,1HV,1HW,1HX,1HY,1HZ,1H.,1HO,1H1,1H2,1BL	BLK	60
	2H3,1H4,1H5,1H6,1H7,1H8,1H9,1H*,1H+,1H-,1H ,1H ,1H ,1H ,1H ,1H ,1H	BLK	70
	3,1H ,1H ,1H ,1H ,1H /	BLK	80
	DATA W1,W2,W3,W4,W5,W6/1H ,2H ,3H ,4H ,5H ,6H /	BLK	90
	END	BLK	100-

Appendix II.--Listing of control cards and Rush County quality-of-water data.

AQUNT ARRAY

CENOZOIC ROCKS	NEOGENE SYS	QUATERNARY SYS	PLEISTOCENE SER
U PLEISTOCENE SSER	RECENT ST	EOLIAN-FLUV DEP	EOLIAN DEP
FLUVIAL DEP	WISCONSINAN ST	MANKATOAN SST	BIGNELL FM
CARYAN SST	TERRACE DEP	BRADYAN SST	BRADY SOIL
PEORIA FM	TAZEWELLIAN SST	ICWAN SST	GLACIAL DRIFT
SANGAMONIAN ST	SANGAMON SOIL	ILLINOISAN ST	LOVELAND FM
CRETE FM	REC-ILL ST	SANBORN GP	VANHEM FM
KINGSDOWN FM	L PLEISTOCENE SSER	YARMOUTHIAN ST	YARMOUTH SOIL
KANSAN ST	SAPPA FM	PEARLETTE ASH B	GRAND ISLAND FM
KANSAS TILL	ATCHISON FM	AFTONIAN ST	AFTON SOIL
NEBRASKAN ST	BLANCO FM	FULLERTON FM	HOLDREGE FM
NEBRASKA TILL	DAVID CITY FM	YARMCOUTH-NEBRAS ST	MEADE GP
CROOKED CREEK FM	ATWATER ME	STUMP ARROYO ME	BALLARD FM
ANGELL ME	QUAT OR TERT	PLIO-PLEIST SER	UPLAND CHERT GRAV
TERTIARY SYS	PLIOCENE SER	REXROAD FM	OGALLALA FM
KIMBALL ME	ASH HOLLOW ME	VALENTINE ME	DELMORE FM
LAVERNE FM	CALVERT ASH B	DELLVALE ASH B	FORT WALLACE ASH B
RAWLINS ASH B	REAGER ASH B	REAMSVILLE ASH B	MESOZOIC ROCKS
CRETACEOUS SYS	GULFIAN SER	U CRETACEOUS SER	MONTANA GP
PIERRE SH	BEECHER IS SH ME	MISSLER ME	SALT GRASS SH ME
LAKE CREEK SH ME	WESKAN SH ME	SHARON SP SH ME	COLORADO GP
NIOBRARA CHALK	SMOKY HILL CHK ME	FORT HAYS LS ME	CARLILE SH
CODELL SS ME	BLUE HILL SH ME	FAIRPORT CHALK ME	GREENHORN LS
BRIDGE CREEK LS ME	PFEIFER SH ME	FENCEPOST LS B	JETMORE CHALK ME
HARTLAND SH ME	LINCOLN LS ME	GRANEROS SH	L(?) CRET SER
COCKRUM SS	DAKOTA FM	JANSSEN CLAY ME	TERRA COTTA CL ME
OMADI FM	CRUISE SS ME	HUNTSMAN SH ME	GURLEY SS ME
COMANCHEAN SER	L CRETACEOUS SER	KIOWA SH	CHAMPION SHELL B
CHEYENNE SS	JURASSIC SYS	U JURASSIC SER	MORRISON FM
TRIASSIC SYS	U TRIASSIC SER	DOCKUM GP	X I ME
PALEOZOIC ROCKS	PERMIAN SYS	GUADALUPIAN SER	U PERMIAN SERIES
QUARTERMASTER GP	TALOGA FM	BIG BASIN FM	DAY CREEK DOL
WHITEHORSE FM	KIGER SH ME	HOLOCENE	RELAY CREEK DOL ME
MARLOW SS ME	L PERMIAN SER	LEONARDIAN SER	CIMARRONIAN ST
NIPPEWALLA GP	DOG CREEK FM	BLAINE GYP	HASKEW GYP ME
SHIMER GYP ME	NESCATUNGA GYP ME	MED LODGE GYP ME	FLOWERPOT SH
CEDAR HILLS SS	SALT PLAIN STS	CRISFIELD SS B	HARPER STS
KINGMAN STS ME	CHIKASKIA STS ME	SUMNER GP	STONE CORRAL FM
NINNESCAH SH	RUNNYMEDE STS ME	KAN GLAC-FLUV DEP	WELLINGTON FM
MILAN DOL ME	NICKERSON TILL	HUTCHINSON SALT ME	BUCK CREEK TER DEP
CARLTON LS ME	IOWA POINT TILL	HOLLENBERG LS ME	CEDAR BLUFFS TILL
WOLFCAMPIAN SER	GEARYAN ST	CHASE GP	NOLANS LS
HERINGTON LS ME	PADDOCK SH ME	KRIDER LS ME	ODELL SH
WINFIELD LS	CRESSWELL LS ME	GRANT SH ME	STOVALL LS ME
DOYLE SH	GAGE SH ME	TOWANDA LS ME	HOLMESVILLE SH ME
BARNESTON LS	FORT RILEY LS ME	OKETA SH ME	FLORENCE LS ME
MATFIELD SH	BLUE SPRINGS SH ME	KINNEY LS ME	WYMORE SH ME
WRETFORD LS	SCHROYER LS ME	HAVENSVILLE SH ME	THREEMILE LS ME
COUNCIL GROVE GP	SPEISER SH	FUNSTON LS	BLUE RAPIDS SH
CROUSE LS	EASLY CREEK SH	BADER LS	MIDDLEBURG LS ME
HOOSER SH ME	EISS LS ME	STEARNS SH	BEATTIE LS
MORRILL LS ME	FLORENA SH ME	COTTONWOOD LS ME	ESKRIDGE SH
GRENOLA LS	NEVA LS ME	SALEM POINT SH ME	BURR LS ME
LEGION SH ME	SALLYARDS LS ME	ROCA SH	RED EAGLE LS
HOWE LS ME	BENNETT SH ME	GLENROCK LS ME	JOHNSON SH
FORAKER LS	LONG CREEK LS ME	HUGHES CREEK SH ME	AMERICUS LS ME
ADMIRE GP	JANESVILLE SH	HAMLIN SH ME	OAKS SH ME

HOUCHE CR LS ME	STINE SH ME	FIVE POINT LS ME	WEST BRANCH SH ME
FALLS CITY LS	ONAGA SH	HAWXBY SH ME	ASPINWALL LS ME
TOWLE SH ME	INDIAN CAVE SS B	PENNSYLVANIAN SYS	VIRGILIAN SER
U PENN SER	VIRGILIAN ST	WABAUNSEE GP	RICHARDSON SGP
WOOD SIDING FM	BROWNVILLE LS ME	PONY CREEK SH ME	GRAYHORSE LS ME
PLUMB SH ME	NEBRAS CITY LS ME	CANEYVILLE LS	ROOT SH
FRENCH CREEK SH ME	JIM CREEK LS ME	FRIEDRICH SH ME	STOTLER LS
GRANDHAVEN LS ME	DRY SH ME	DOVER LS ME	PILLSBURY SH
LANGDON SH	ZEANDALE LS	MAPLE HILL LS ME	WAMEGO SH ME
PIERSON POINT SH	TARKIO LS ME	NEMAHA SGP	WILLARD SH
EMPORIA LS	ELMONT LS ME	HARVEYVILLE SH ME	READING LS ME
AUBURN SH	BERN LS	WAKARUSA LS ME	SOLDIER CR SH ME
BURLINGAME LS ME	SACFOX SGP	SCRANTON SH	SILVER LAKE SH ME
RULO LS ME	CEDAR VALE SH ME	ELMO COAL	HAPPY HOLLOW LS ME
WHITE CLOUD SH ME	HOWARD LS	UTOPIA LS ME	WINZELER SH ME
CHURCH LS ME	AARDE SH ME	NODAWAY COAL	BACHELOR CR LS ME
SEVERY SH	SHAWNEE GP	TOPEKA LS	COAL CREEK LS ME
HOLT SH ME	DU BOIS LS ME	TURNER CREEK SH ME	SHELDON LS ME
JONES POINT SH ME	CURZON LS ME	IOWA POINT SH ME	HARTFORD LS ME
CALHOUN SH	DEER CREEK LS	ERVINE CREEK LS ME	LARSH-BURR SH ME
ROCK BLUFF LS ME	OSKALOOSA SH ME	OZAWKIE LS ME	TECUMSEH SH
QUEEN HILL SH ME	BIG SPRINGS LS ME	DONIPHAN SH ME	SPRING BR LS ME
LECOMPTON LS	AVOCA LS ME	KING HILL SH ME	BEIL LS ME
ELGIN SS	KANWAKA SH	STULL SH ME	CLAY CREEK LS ME
JACKSON PARK SH ME	OREAD LS	KEREFORD LS ME	HEUMADER SH ME
PLATTSMOUTH LS ME	HEEBNER SH ME	LEAVENWORTH LS ME	SNYDERVILLE SH ME
TORONTO LS ME	DOUGLAS GP	LAWRENCE FM	WATHENA SH ME
AMAZONIA LS ME	WILLIAMSBURG COAL	GILMAN CANYON FM	IRELAND SS ME
ROBBINS SH ME	HASKELL LS ME	STRANGER FM	VINLAND SH ME
WESTPHALIA LS ME	TONGANOXIE SS ME	U SIBLEY COAL	L SIBLEY COAL
PEDEE GP	IATAN LS ME	WESTON SH ME	MISSOURIAN ST
LANSING GP	STANTON LS	SOUTH BEND LS ME	ROCK LAKE SH ME
STONER LS ME	EUDORA SH ME	CAPTAIN CR LS ME	VILAS SH
PLATTSBURG LS	SPRING HILL LS ME	HICKORY CR SH ME	MERRIAM LS ME
KANSAS CITY GP	ZARAH SGP	BONNER SPRINGS SH	WYANDOTTE LS
FARLEY LS ME	ISLAND CREEK SH ME	ARGENTINE LS ME	QUINDARO SH ME
FRISBIE LS ME	LANE SH	LANE-BONNER SP SH	LANE-VILAS SH
LINN SGP	IOLA LS	RAYTOWN LS ME	MUNCIE CREEK SH ME
PAOLA LS ME	CHANUTE SH	COTTAGE GRO SS ME	THAYER COAL
OUTWASH DEPOSITS	NOXIE SS ME	DRUM LS	CORBIN CITY LS ME
DEWEY LS ME	CEMENT CITY LS ME	CHERRYVALE SH	QUIVIRA SH ME
WESTERVILLE LS ME	WEA SH ME	BLUCK LS ME	FONTANA SH ME
WEA-QUIVIRA SH ME	BRONSON SGP	DENNIS LS	WINTERSET LS ME
STARK SH ME	CANVILLE LS ME	GALESBURG SH	NORTONVILLE CLAY
DODDS CREEK SS ME	SWOPE LS	BETHANY FALS LS ME	HUSHPUCKNEY SH ME
MIDDLE CREEK LS ME	LADORE SH	HERTHA LS	SNIABAR LS ME
MOUND CITY SH ME	CRITZER LS ME	COFFEYVILLE FM	PLEASANTON GP
TACKET FM	KNOBTOWN SS ME	CHECKERBOARD LS	SEMINOLE FM
SOUTH MOUND SH ME	HEPLER SS ME	DESMOINESIAN SER	M PENN SER
DESMOINESIAN ST	MARMATON GP	MEMORIAL SH	HOLDENVILLE SH
LENAPAH LS	IDENBRO LS ME	PERRY FARM SH ME	NORFLEET LS ME
NOWATA SH	NEB GLAC-FLUV DEP	WALT JOHNSON SS ME	UNNAMED
ALTAMONT LS	WORLAND LS ME	LAKE NEUSHO SH ME	AMORET LS ME
TINA LS	BANDERA SH	MULBERRY COAL	UNNAMED
BANDERA QUAR SS ME	UNNAMED	PAWNEE LS	LABERDIE LS ME
MINE CREEK SH ME	MYRICK STAT LS ME	ANNA SH ME	LABETTE SH
WARRENSBURG SS	UNNAMED	ENGLEVALE SS ME	FORT SCOTT LS
HIGGINSVILLE LS ME	LITTLE OSAGE SH ME	HOUX LS B	SUMMIT COAL
BLACKJACK CR LS ME	CHEROKEE GP	CABANISS FM	EXCELLO SH
MULKY COAL	BREEZY HILL LS ME	IRON POST COAL	UNNAMED

UNNAMED	STICE COAL	WHEELER COAL(?)	BEVIER COAL
UNNAMED	VERDIGRIS LS ME	ARDMORE LS ME	CROWEBURG COAL
BROKEN ARROW COAL	UNNAMED	FLEMING COAL	UNNAMED
MINERAL COAL	UNNAMED	SCAMMON COAL	CHELSEA SS ME
PILOT COAL	TIAWAH LS	TEBU COAL	UNNAMED
WIER PITTS COAL	KREBS FM	SEVILLE LS ME	KNIFETON COAL
UNNAMED	BLUEJACKET SS ME	DRYWOOD COAL	UNNAMED
COLUMBUS COAL	ROWE COAL	UNNAMED	NEUTRAL COAL
UNNAMED	LITTLE CABIN SS ME	WARNER SS ME	RIVERTON COAL
UNNAMED	ATOKAN SER	ATOKAN(BENDIAN) ST	ATOKAN ST
CHAT	UNNAMED	MORROWAN SER	L PENN SER
MORROWAN ST	KEARNY FM	PENN BS CON	MISSISSIPPIAN SYS
CHESTERAN SER	U MISS SER	CHESTERAN ST	UNNAMED
MERAMECIAN SER	MERAMECIAN ST	STE. GENEVIEVE LS	ST. LOUIS LS
SPERGEN LS	SALEM LS	WARSAW LS	COWLEY FM
L MISS SER	OSAGIAN SER	OSAGIAN ST	KEOKUK LS
BURLINGTON LS	REEDS SPRING LS	ST. JOE LS	KINDERHOOKIAN SER
KINDERHOOKIAN ST	GILMORE CITY LS	SEDALIA DOL	NORTHVIEW SH
CHOUTEAU LS	COMPTON LS	BOICE SH	DEV OR MISS SYS
CHATTANOOGA SH	DEVONIAN SYS	M DEVONIAN SER	L SIL-M DEV SER
SILURIAN SYS	L SILURIAN SER	HUNTON GP	UNNAMED
UNNAMED	CHIMNEY HILL DOL	ORDOVICIAN SYS	U ORDOVICIAN SER
MAQUOKETA(SYL) SH	M ORDOVICIAN SER	VIOLA (KIMM) LS	SIMPSON GP
PLATTEVILLE FM	ST. PETER SS	UNNAMED	L ORDOVICIAN SER
ARBUCKLE GP	COTTER DOL	JEFFERSON CITY DOL	COTTER-JEFF CY DOL
ROUBIDOUX FM	GASCONADE DOL	VAN BUREN FM	GUNTER SS ME
L ORD-U CAM SER	EMINENCE DOL	CAMBRIAN SYS	U CAMBRIAN SER
BONNETERRE DOL	HONEY CREEK LS	LAMOTTE(REAGAN) SS	LAMOTTE SS
REAGAN SS	PENN-CAM	GRANITE WASH	PRECAMBRIAN ROCKS
PRECAMBRIAN SYS	UNDIFFERENTIATED	NEWMAN TERRACE DEP	ALLUVIUM
HILLS POND PERIODT	NEOGENE-CRET SYS	L(?)CRET-L CRET SER	JUR-TRI SYS
L PERM-U PENN SER	PENN-MISS SYS	MISS-DEV SYS	DEV-SIL SYS
ORD-CAM SYS	COLLUVIUM		NOT DETERMINED

HINC AND VINC

1. 1.66666

TITLE ARRAY AND I PLOT ARRAY

RUSH COUNTY, KANSAS

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DATA GROUP

K831616W32CCB	51260	266C	95	021000	19	13	514	332	0	208	510	11
K831616W32CCB	102	33	34	1444	101	0	272	2650			61132	
K831617W16DCD	51260	370C	50	032000	11	11	459	27700	198		445	11
K831617W16DCD	102	34	04	1269	72	0	227	2170			60132	
K831617W22AAA	10	660	320C	056000	13	96	514	274	0	193	535	11
K831617W22AAA	102	34	16	1413	72	0	224	2680			62432	
K831618W 6DAC	51360	230C	85	002000	14	19	760	307	0	258	875	11
K831618W 6DAC	102	37	28	2092	113	0	252	3870			60132	
K831618W 6DAC2	51360	SEEPC			2010	356	3967	190	0	1389	9575	11
K831618W 6DAC2				17390	64786	322	156	29850			55	32
K831618W10CB	102949	168C18		32	21	12	792	344	0	268	886	11
K831618W10CB	102	50	8	2170	102	0		383079			59	32
K831618W27CDD	51260	209C	80	042000	19	11	680	356	0	266	700	11
K831618W27CDD	102	44	38	1867	92	0	292	3430			57132	
K831619W17BAB	51360	400C	80	039000	83	16	363	398	0	183	243	11
K831619W17BAB	102	56	29	1026	86	0	326	1800			65132	

K831620W 5BRD	51360	530C	85	007000	83	96	480	431	0	221	357	11	
K831620W 5BRD	102	52	38	1305	60	0	354		2320		64132		
K831620W21DDC	51360	54C46		001000	89	20	20	290	0	37	39	11	
K831620W21DDC	004007	05	18	412	304	66	238		700		58132		
K831716W20AAA	101360	315C	60	054000	74	13	390	442	0	88	288	11	
K831716W20AAA	102	44	21	1005	24	0	362		1870		132		
K831716W24CCC	6 145	30C		017	135	13	28	395		41	31	11	
K831716W24CCC	007088	19	44	489	390	66	324				32		
K831717W28DCD	51260	230C	70	016000	18	22	636	321	0	244	700	11	
K831717W28DCD	102	36	49	1794	136	0	263		3320		60132		
K831718W20DAA	101260	300C	80	009007	10	51	503	273	0	191	500	11	
K831718W20DAA	102	38	19	1357	46	0	224		2370		132		
K831718W28AAD	51260	335C	80	030000	38	29	1328	249	0	291	1830	11	
K831718W28AAD	102	32	71	3657	214	10	204		6740		62132		
K831718W33ACD	82657	300C	75	016000	13	57	472	285	0	218	435	11	
K831718W33ACD	102	35	04	1295	56	0	234		237978		432		
K831718W33DBC	91258	300C	75	026000	10	76	474	276	0	220	440	11	
K831718W33DBC	102	37	10	1300	56	0	226		242273		532		
K831718W34BRD	5 861	302C	90	12 005	31	94	448	307	0	214	430	11	
K831718W34BRD	102	32	09	1296	116	0	252		240078		432		
K831719W27DDC	51660	320C	60	008000	101	46	554	432	0	451	576	11	
K831719W27DDC	102	41	04	1951	441	87	354		3370		62132		
K831720W 5BCB	9 946	315C13		16	15	94	293	264	0	216	186	11	
K831720W 5BCB	102	28	15	850	76	0	216		76		32		
K831720W 7CAD	42461	53C26		002000	101	22	51	276	0	139	55	11	
K831720W 7CAD	004007	07	28	534	342	116	226		91075		432		
K831720W29CDD	51360	285C10		010000	49	36	335	298	0	360	261	11	
K831720W29CDD	102	28	38	1204	270	26	244		1900		63132		
K831720W36ABB	101260	325C	60	27 000	91	33	324	268	0	163	242	11	
K831720W36ABB	102	32	13	884	36	0	220		1640		132		
K831816W14BCC	72165	73C28		01 12	267	22	61	87	337	0	63	359	11
K831816W14BCC	004009	1	62	16 1037	756	480	276		185075		132		
K831816W16BBB2	8 560	86C47		018000	94	91	19	305	0	30	19	11	
K831816W16BBB2	004009	02	58	374	272	22	250		590		59132		
K831816W18ACB	72165	85C26		35 46	120	12	53	73	410	0	94	28	11
K831816W18ACB	004009	3	6	19 543	349	13	336		84077		132		
K831816W19BBA	81960	55C34		027055	165	19	84	458	0	187	57	11	
K831816W19BBA	004009	07	71	789	490	114	376		1270		55132		
K831816W23AAA	11 558	75C27		003002	108	10	27	32400	39		44	11	
K831816W23AAA	004009	02	18	416	310	44	266		74473		432		
K831816W23AAA	52561	75C31		001000	114	11	28	346	0	48	38	11	
K831816W23AAA	004009	02	29	444	330	46	284		76076		132		
K831816W23ADD	82460	RC28		32 062	95	10	45	295	0	80	31	11	
K831816W23ADD		05	62	441	278	36	242		730		72	32	
K831816W28CDC	51760	168C	80	036000	91	15	274	554	0	142	46	11	
K831816W28CDC	102	45	13	773	84	0	454		1310		58132		
K831817W11CDA	81760	86C50		027000	102	11	24	271	0	17	76	11	
K831817W11CDA	004009	04	58	420	300	78	222		690		55132		
K831817W14CDC	81960	70C36		18 070	105	12	46	337	0	93	24	11	
K831817W14CDC	004009	3	49	487	312	36	276		790		54132		
K831817W14CDC	72165	70C24		55 46	136	89	46	69	410	0	111	27	11
K831817W14CDC	004009	3	14	16 564	376	40	336		87075		132		
K831817W18CCC	10 760	224C	90	046000	21	10	457	336	0	143	465	11	
K831817W18CCC	102	30	04	1274	94	0	276		2360		132		

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Appendix III.--Program abstract.

KANSAS GEOLOGICAL SURVEY COMPUTER PROGRAM
THE UNIVERSITY OF KANSAS, LAWRENCE

PROGRAM ABSTRACT

Title (If subroutine state in title):

Modified Piper Diagrams by the Digital Computer

Date: August 1965

Author, organization: Jesse M. McNellis and Charles O. Morgan

U.S. Geological Survey, Water Resources Division

Direct inquiries to: Jesse M. McNellis or Charles O. Morgan

Name: _____ Address: U.S.G.S., WRD

Box 768, Lawrence, Kansas, 66044

Purpose/description: To produce modified Piper diagrams for use in the interpretation of
water-quality data.

Mathematical method: See program listing.

Restrictions, range: 1000 analyses that include the major anions and cations.

Computer manufacturer: GE, IBM Model: GE 635, IBM 7040, IBM 360/65

Programming language: FORTRAN IV

Memory required: 36 K Approximate running time: _____

Special peripheral equipment required: Scratch unit 01

Remarks (special compilers or operating systems, required word lengths, number of successful runs, other machine versions, additional information useful for operation or modification of program) _____

