

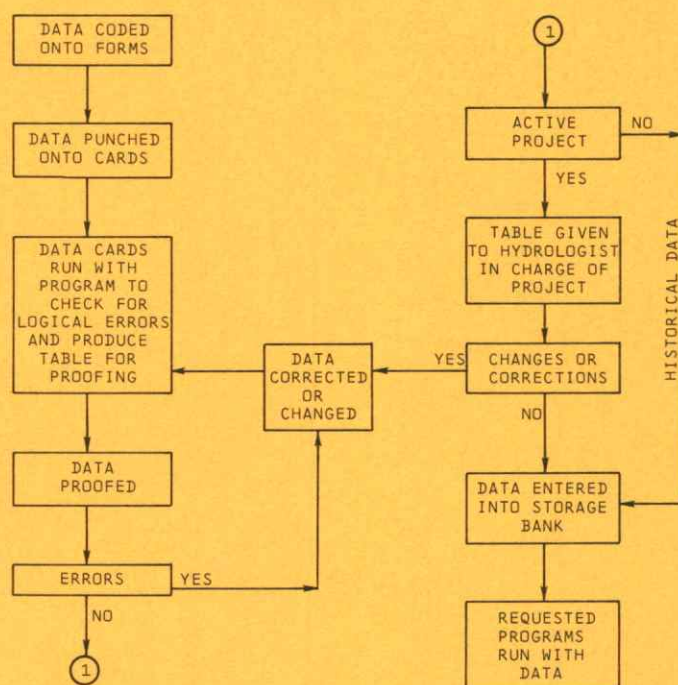
Brief Descriptions of and Examples of Output from Computer Programs Developed for Use with Water Data in Kansas

By

Brent H. Lowell

Charles O. Morgan

Jesse M. McNellis



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BRIEF DESCRIPTIONS OF AND EXAMPLES OF OUTPUT FROM
COMPUTER PROGRAMS DEVELOPED FOR USE WITH WATER DATA IN KANSAS

Brent H. Lowell¹, Charles O. Morgan¹, and Jesse M. McNellis¹

ABSTRACT

Programs written in FORTRAN IV language have been developed in the Kansas District of the U.S. Geological Survey to handle basic water data by use of the digital computer. The programs check, tabulate, graph, map, and statistically analyze data derived from hydrologic and geologic investigations.

INTRODUCTION

This report contains brief descriptions of and output from some of the digital computer programs developed or adapted by personnel of the Kansas District of the Water Resources Division, United States Geological Survey, Lawrence, Kans. It is not meant to give detailed program information, but rather to acquaint the reader briefly with many of the programs that are currently available in Kansas for use with water data. All programs are written in FORTRAN IV programming language (McCracken, 1965) and are operational on the GE 635 computer at The University of Kansas Computation Center, Paul J. Wolfe, Director. The described programs can be used, with minor adaptations, on any computer with a FORTRAN IV compiler.

Operational programs are separated into three general groups: checking and tabulation programs, standard analysis programs, and other programs. Additional programs that are in the development stage include: a program for performing a multitude of operations on water-level records including change maps for selected periods and regression analysis, a program for plotting graphically the suspended- and bed-load sediment data, and a program to treat statistically the parameters considered in hydraulic geometry of channels.

¹Water Resources Division, U.S. Geological Survey

The appendix contains the various coding forms generally used to record data for input to the programs described herein. These coding forms serve as a pictorial description of the various types of data processed by the programs. The programs are not limited to input of a single data format, such as the arrangement shown by the coding forms. By modification of the read statements in the programs, almost any arrangement of equivalent data can be processed.

A glossary of terms follows the References.

DATA-HANDLING PROCEDURE

The data-handling procedure that has evolved in the Kansas District is outlined in figure 1. Quality control of data is obtained by examining the output from computer programs and by proofing the output with source documents rather than proofing the coded forms. If this procedure has been followed, rarely will errors that can be attributed to errors in the data appear in the results from tabulation and analytical programs.

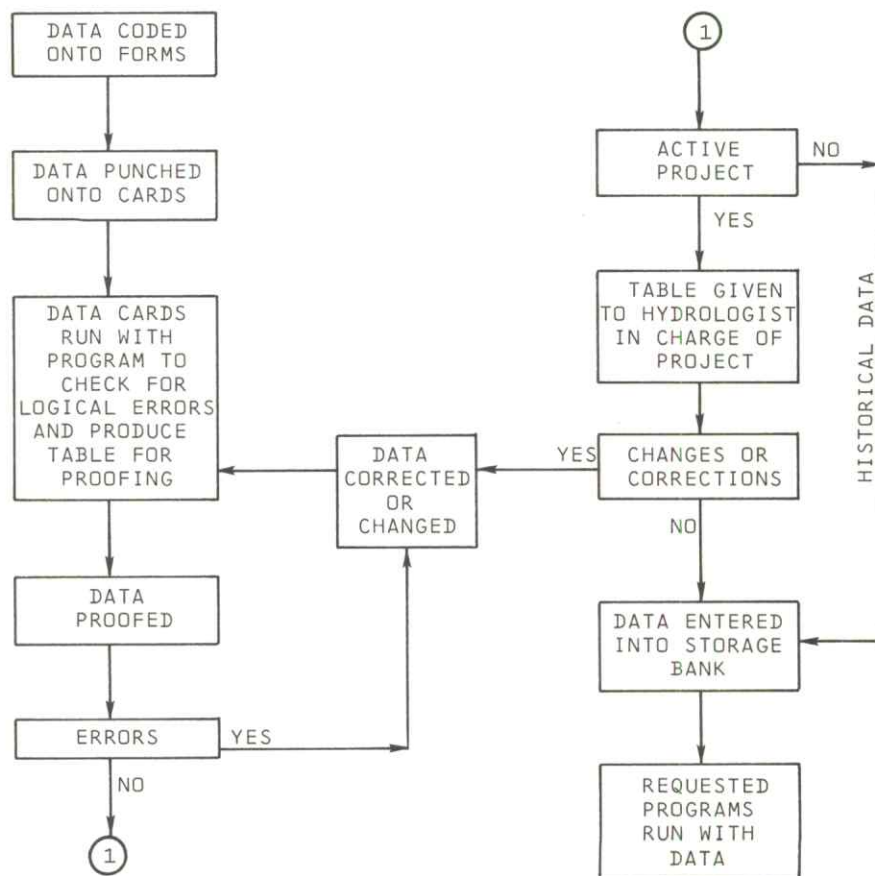


Figure 1.--Flow chart of data-handling procedure for computer applications.

CHECKING AND TABULATION PROGRAMS

Programs in this category are CKDATA, LVLCK, WELDAT, KTAB, LOG2, WLTAB, and SEDTAB. Program results (output) are used to check and proof data and to produce the tables of data that make up the bulk of basic-data reports.

CKDATA

CKDATA is a program that checks well-inventory and ground-water-quality data for logic errors; input are cards punched from the U.S. Geological Survey's ABC and QRS forms (see appendix), respectively (Lang and Leonard, 1967). It checks the data for illegal characters and coding errors and determines if certain values are within specific ranges. After data are run without error in CKDATA, they can be entered into other programs that will process them to completion.

The output is in tabular form (fig. 2) and contains a data group identifier or title ("test data" is used in this report to indicate only a part of the specific data group available) and a heading of numbers from 1-80 that corresponds to the 80 columns on a punch card. Data groups are listed set by set, with any errors detected in a set being noted immediately after the set.

TEST DATA	1	2	3	4	5	6	7	8
	1234567890123456789012345678901234567890123456789012345678901234567890							
	18073720 ON 98594012 315	15W19BD			D. S. SHAW	UU I		A
	18073720 ON 9859401 954	06 X	P 1		83A040			B
	18073720 ON 985940112E	HP C2						
CARD LETTER MISSING, SKIP DATA SET								
	1809381727N 98341512 205	11W20CCC			M. HAGEN	UU I		A
	1809381727N 9834151 444	06 X	N		21B042			B
	1809381727N 983415112E	SQG36						C
ERROR--METHOD DRILLED, COLUMN 32, CARD B								
	1823395132N101445412 25	39W19CCC			A. C. KELLER	Z9I		A
	1823395132N10144541 230	04 X	P 1	32090	16A648			B
	1823395132N1014454113D	VQG04 R		Q SI				C
ERROR IN LONGITUDE								
ERROR--METHOD DRILLED, COLUMN 32, CARD B								
ERROR--ALTITUDE, COLUMNS 42 THROUGH 46, CARD B								
	1825371414N 99454612 325	23W24DD			J. F. FOLKS ESTPSW I			A
	1825371414N 9945461 214	06 X	P 6		18A040			B
	1825371414N 994546112E	VQG04 R						C
ERROR--METHOD DRILLED, COLUMN 32, CARD B								
	1839393846N100155812 35	26W 5CC			JOHN HICKS	S O I		A
	1839394856N10015581 1474	05 X	N		141B852			B
	1839394856N1001558113D	HTP60 R						C
ERROR--METHOD DRILLED, COLUMN 32, CARD B								
	1845384632N 95 52512 155	21E 4BCC			USGS AND KGS	UU		A
	1845384632N 95 5251 1444	1205 X	N		22B556			B
	1845384632N 95 5251 F	N3Y0		N3X5				C
ERROR IN LONGITUDE								
ERROR--METHOD DRILLED, COLUMN 32, CARD B								
	1845385437N 95185312 135	19E21BB			C. E. BANNING	PHW I CO		A
	1845385437N 9518531 994	06 X	J 5		24A552			B
	1845385437N 9518531 F	N3Y6		N3Y3				C
ERROR IN LONGITUDE								
ERROR--METHOD DRILLED, COLUMN 32, CARD B								

Figure 2.--Example table from ABC and QRS data-card checking program showing some diagnostic error messages. This example illustrates only ABC data-card sets.

LVLCK

LVLCK is a program that checks water-level cards punched from forms (see appendix) developed by the U.S. Geological Survey (Lang and Leonard, 1967). As does CKDATA, it checks for illegal characters and coding errors. It also checks whether the water-level measurements are in ascending-date order (oldest measurement first) and determines the highest and lowest water levels and the corresponding dates on which they occurred.

The output (fig. 3) is in tabular form and contains a data group identifier (title) and a heading of numbers from 1-80 that corresponds to the 80 columns on a punch card. If an error is found, the error message is printed after the incorrect data card.

TEST DATA

	1	2	3	4	5	6	7	8				
	1234567890123456789012345678901234567890123456789012345678901234567890											
	184038	139N	9734141	23	2W29BBB	CITY OF WICHITA	M1	143128WPW004	1			
	184038	138N	9734141	2218	200	39-			2			
***ERROR IN COLUMN 10	184038	139N	9734141		23-2W-29BBB.	(M-1) CITY OF WICHITA, DRILLED,			3			
	184038	139N	9734141		WATER-TABLE, PUBLIC-SUPPLY WELL IN SAND AND				4			
	184038	139N	9734141		GRAVEL OF PLEISTOCENE AGE, DIAMETER 18 INCHES, DEP				5			
	184038	139N	9734141		TH 222 FEET, MEASURING POINT, TOP OF CASING, 2.00				6			
	184038	139N	9734141		FEET ABOVE LSD.							
	184038	139N	9734141	41339	1856	5 139	2075	61239	2014	61939	2045	AI101
	184038	139N	9734141	7 339	1987	71039	1987	71739	2022	72439	1972	AQ102
	184038	139N	9734141	73139	1985	8 739	1990	82139	1952	82839	1942	AQ103
	184038	139N	9734141	9 539	1946	91139	1953	91839	1968	92539	1974	AQ104
	184038	139N	9734141	110 239	1979	10 939	1986	101639	1991	102339	1991	AQ105
	184038	139N	9734141	1103039	2001	11 639	2035	111339	2000	112139	2000	AQ106
	184038	139N	9734141	1112739	2005	12 439	2003	121139	2001	121839	2003	AQ107
	184038	139N	9734141	1122739	2005	12940	2015	21240	2015	3 640	1996	AI108
***ERROR IN COLUMN 76	184038	139N	9734141	31840	1995	32540	1996	4 240	1991	41540	1989	AQ109
	184038	139N	9734141	5 640	1969	51340	1928	52740	1882	6 340	1886	AQ110
	184038	139N	9734141	61040	1892	61740	1899	62440	1909	7 140	1921	AQ111
	184038	139N	9734141	7 840	1930	71540	1972	72240	1983	72940	1993	AQ112
	184038	139N	9734141	8 540	2018	81240	2007	81940	2052	82640	2030	AQ113
	184038	139N	9734141	9 340	6498A	9 940	6858A	91640	2369	91840	2314	AQ114
	184038	139N	9734141	92440	2244	93040	2257	10 740	2356	101440	6417A	AQ115
	184038	139N	9734141	1102140	2579	102840	2617	11 440	2427	111140	1579	AQ116
	184038	139N	9734141	1111940	2790	12 240	6927A	12 940	6529A	122340	2674	AQ117
	184038	139N	9734141	11341	7057A	12041	7063A	12841	3284	21041	2530	AQ118
***ERROR IN COLUMN 39	184038	139N	9734141	21741	2524	22541	2773	3 341	6811A	31841	2753	AQ119
***DATE NOT IN ASCENDING ORDER, COLUMNS 48 TO 53	184038	139N	9734141	32441	2500	33141	2570	42141	7002A	42841	7200A	AQ120
	184038	139N	9734141	51241	2614	51941	2540	52641	7159A	6 241	7178A	AQ121
	184038	139N	9734141	61641	3077	7 741	2728	71451	2446	72141	6983A	AQ122
***DATE NOT IN ASCENDING ORDER, COLUMNS 62 TO 67	184038	139N	9734141	72841	7202A	82541	3063	91041	2779	91541	2766	AM123
	184038	139N	9734141	110 841	3203	102441	2421	111141	2738	12 141	2704	AM124
	184038	139N	9734141	1121541	2207	1 542	2347	12642	2588	3 242	7128A	AM125
	184038	139N	9734141	32342	2230	41342	7200A	42842	3158	51842	7174A	AM126
	184038	139N	9734141	6 142	7249A	7 642	2638	72142	3143	81042	2612	AM127
	184038	139L	9734141	82442	2841	83142	30*4	91442	2395	93042	2589	AM
***ERROR IN COLUMN 11												
***ERROR IN COLUMN 45												

HIGHEST WATER LEVEL 15.79 BELOW LSD 11/11/40 LOWEST WATER LEVEL 72.49 BELOW LSD 7/6/42

Figure 3.--Example table from water-level checking program showing some diagnostic error messages.

WELDAT

WELDAT is a program that tabulates information from the well-inventory (ABC) cards. Because all items contained on the ABC cards are read in and set up for output, the arrange-

ment of data in the table is flexible and can be adjusted to suit individual needs. For each different table desired, a new table subroutine must be written to print the new table arrangement.

A sample well-record table (fig. 4) shows one possible table arrangement. Heading information appears at the top of each page and is followed by the table headings that identify the information contained below them. If footnotes are desired to explain various symbols appearing in the table, they are indicated by a number in parentheses within the table heading.

RECORDS OF WELLS AND TEST HOLES IN TEST DATA

WELL (1)	OWNER OR USER	DEPTH OF WELL (FEET) (2)	DIAM. OF WELL (FT OR IN) (3)	C T A YOS PFI E N G (3)	PRINCIPAL WATER-BEARING BED(S)		LIFT AND POWER (5)	USE (6)	WATER LEVEL DEPTH BELOW LSD (FT) (7)	DATE OF MEAS. (8)	ALT. OF LAND SURF. (FT) (8)	C D H A E T M A (8)	REMARKS (9)
					CHARACTER OF MATERIAL (4)	GEOLOGIC SOURCE							
12 22E 23DAA	SUNFLOWER ORD. WORKS	47.	4	N	SD AND GR	ALLUVIUM	N	T			777.7		
12 22E 23DAB	SUNFLOWER ORD. WORKS	50.	4	N	SD AND GR	ALLUVIUM	N	T		42	781.5		
12 22E 23DAC	W. AND H. CALDWELL	46 R 24		S	SD AND GR	ALLUVIUM	T,G	I	25.0	9-57	787.5		330GPM
12 22E 23DAD	SUNFLOWER ORD. WORKS	48.	4	N	SD AND GR	ALLUVIUM	N	T		42	778.6		
12 22E 23DCA	SUNFLOWER ORD. WORKS	53.	4	N	SD AND GR	ALLUVIUM	N	T	16.0	8-42	782.9		
12 22E 23DCD	SUNFLOWER ORD. WORKS	55.	4	N	SD AND GR	ALLUVIUM	N	T	13.1	8-42	780.		
12 22E 24CCC	CITY OF OLATHE	60 R 16		S	SD AND GR	ALLUVIUM	T,E	PS	24 R	6-64	782.8		750GPM R
12 22E 24CCC2	CITY OF OLATHE	56 R 16		S	SD AND GR	ALLUVIUM	T,E	PS	21 R	6-64	780.0		500GPM R
12 22E 25BBC	CITY OF OLATHE	66 R 16		S	SD AND GR	ALLUVIUM	T,E	PS	21 R	6-64	780.7		1000GPM R
12 22E 25BBC2	CITY OF OLATHE	63 R 16		S	SD AND GR	ALLUVIUM	T,E	PS	22 R	6-64	780.9		800GPM R
12 22E 25BCC	K.G.S.	33.	1	G	SD AND GR	ALLUVIUM	N	O	16.2	5-61	780.2		
12 22E 25CBB	R. FRISBIE	65 R 5		G	SD, ST, CL	TERRACE DEPOSITS	D		25.1	11-52	795.0		
12 22E 25CDB	A. C. KRAMSCH	44 R			SD, ST, CL	TERRACE DEPOSITS	D,S		26 R	10-52	795	P	10GPM E
12 22E 26ADD	RURAL WATER DIST. 1	37 R 8		S	SD AND GR	ALLUVIUM	T,E	PS	21 R	2-61	778	C	60GPM R
12 22E 26BAC	SUNFLOWER ORD. WORKS	63.	4	N	SD AND GR	ALLUVIUM	N	T			783.4		
12 22E 26BAD	SUNFLOWER ORD. WORKS	66.	4	N	SD AND GR	ALLUVIUM	N	T			779.		
12 22E 26BDA	W. D. MASTERTSON	18 R 2		G	SD AND GR	ALLUVIUM	CY,H	D		10-52	782.	P	
12 22E 26BDB	B. E. HODGTON	50 R 18		C	SD AND GR	ALLUVIUM	T,LPG	I	18.7	9-57	783		400GPM R
12 22E 28ABC	CITY OF DESOTO	46.	24	S	SD AND GR	ALLUVIUM	T,E	PS	18.5	1-64	783.	P	235GPM R

(1) WELL-NUMBERING SYSTEM DESCRIBED IN TEXT.

(2) MEASURED DEPTHS OF WELLS GIVEN IN FEET AND TENTHS BELOW LAND SURFACE/ R, REPORTED/ E, ESTIMATED.

(3) B, BRICK/ C, CONCRETE/ G, GALVANIZED/ I, IRON, BLACK/ N, NONE/ O, OIL BARREL/ P, PLASTIC/ R, ROCK/ S, STEEL/ T, TILE/ A, ALLUMINUM/ E, CONTACT SPRING/ H, FRACTURE SPRING/ U, SOLUTION SPRING.

(4) SS, SANDSTONE/ LS, LIMESTONE/ SH, SHALE/ DOL, DOLOMITE/ GYP, GYPSUM/ SD, SAND/ GR, GRAVEL/ ST, SILT/ CL, CLAY/ AL, ALLUVIUM/ IG, IGNEOUS/ META, METAMORPHIC.

(5) METHOD OF LIFT--C, CENTRIFUGAL/ CY, CYLINDER/ T, TURBINE/ B, BUCKET/ AL, AIRLIFT/ EC, ENDLESS CHAIN/ SUB, SUBMERSIBLE/ N, NONE. TYPE OF POWER--E, ELECTRIC/ H, HAND/ W, WIND/ G, GASOLINE/ NG, NATURAL GAS/ LPG, LIQUID PETROLEUM GAS/ D, DIESEL/ T, TRACTOR/ IC, INTERNAL COMBUSTION.

(6) D, DOMESTIC/ S, STOCK/ I, IRRIGATION/ ID, INDUSTRIAL/ PS, PUBLIC SUPPLY/ O, OBSERVATION/ N, NONE/ T, TEST/ COM, COMMERCIAL.

(7) MEASURED DEPTHS GIVEN IN FEET AND TENTHS/ R, REPORTED/ E, ESTIMATED/ P, PUMPING/ +, FEET ABOVE LAND SURFACE.

(8) C, COMPLETE/ P, PARTIAL/ L, CHLORIDE/ K, CONDUCTANCE/ A, SERIES OF COMPLETES/ S, SERIES OF PARTIALS/ D, SERIES OF COMPLETES AND PARTIALS/ B, BACTERIOLOGICAL/ E, BACTERIOLOGICAL AND COMPLETE/ R, RADIOCHEMICAL.

(9) YIELD--GPM, GALLONS PER MINUTE/ GPD, GALLONS PER DAY/ R, REPORTED/ E, ESTIMATED DRAWDOWN--IN FEET.

Figure 4.--Example well-record table with standard footnotes.

ANALYSES OF WATER FROM TYPICAL WELLS IN TEST DATA

DISSOLVED CONSTITUENTS AND HARDNESS GIVEN IN MILLIGRAMS PER LITER (A).

WELL NUMBER	(B) DEPTH, FEET	GEOLOGIC SOURCE	DATE OF COLLECTION	TEMP- ERATURE (°C)	DIS- SOLVED SOLIDS (EVAPO- RATED AT 180°C)	SILICA (SI02)	IRON (FE)	MAN- GAN- ESE (MN)	CALCIUM (CA)	MAG- NESIUM (MG)	SODIUM AND PO- TASSIUM (NA+K)	BICAR- BONATE (HCO3)	SULFATE (SO4)	CHLORIDE (CL)	FLUORIDE (F)	NITRATE (NO3)	HARDNESS AS CaCO3			SPECIFIC CONDUCT- ANCE (MI- CROMHOS AT 25°C)
2 40W 12BRC	130	OGALLALA FORMATION	12 5 50	...	559	59	.35	...	64	34	51	205	44	45	1.6	159	299	168	131	.....
2 40W 28BBA	142	OGALLALA FORMATION	7 2 64	...	295	62	.00	...	35	12	40	210	19	9.0	1.6	13	137	137	0	400
2 41W 27BBD	245	OGALLALA FORMATION	6 2 66	17	266	49	.17	...	32	15	36	210	15	4.0	2.0	10	142	142	0	390
2 42W 14CDC	260	OGALLALA FORMATION	6 27 67	13	364	46	.19	...	37	15	62	210	63	17	1.3	19	154	154	0	530
3 37W 36ADB	300	OGALLALA FORMATION	7 6 64	17	366	64	.03	...	40	15	45	224	31	11	1.8	18	162	162	0	460
3 38W 36BAD	COMP	OGALLALA FORMATION	2 3 50	...	298	51	.04	...	32	14	37	209	19	9.0	1.5	13	138	138	0	.....
3 39W 32BDB	224	OGALLALA FORMATION	6 23 64	...	295	49	.00	...	40	16	33	222	24	14	1.5	8.0	166	166	0	420
3 41W 2CCC	182	OGALLALA FORMATION	12 2 50	14	283	49	.10	...	37	19	25	205	20	12	1.3	19	170	168	2	.....
3 41W 31ADB	255	OGALLALA FORMATION	0 30 64	16	271	60	.00	...	36	9.7	34	203	16	6.0	1.4	8.0	130	130	0	370
3 41W 35ACB	103	OGALLALA FORMATION	7 1 64	15	285	58	.00	...	34	13	39	207	19	8.0	2.3	10	138	138	0	390
3 42W 16CDD	250	OGALLALA FORMATION	6 30 64	16	272	64	.00	...	34	11	33	200	16	8.0	1.4	5.8	130	130	0	370
3 42W 28DDA	159	OGALLALA FORMATION	12 2 50	16	244	51	.14	...	32	14	23	185	13	9.0	1.4	9.3	138	138	0	.....
4 37W 4DCB	335	OGALLALA FORMATION	6 2 66	10	302	54	.47	...	37	14	43	217	28	7.0	1.6	11	150	150	0	430
4 37W 10ADC	315	OGALLALA FORMATION	7 7 64	10	...	...	...	...	...	...	...	...	...	...	...	...	136	...	...	415
4 37W 17AAC	342	OGALLALA FORMATION	6 1 66	10	293	49	.13	...	42	14	35	217	25	7.0	1.2	12	162	162	0	430

* = DEGREE SYMBOL

A, ONE MILLIGRAM PER LITER IS EQUIVALENT TO 8.33 POUNDS OF SUBSTANCE PER MILLION GALLONS OF WATER.

B, COMP - COMPOSITE SAMPLE FROM 2 OR MORE WELLS.

C, IN AREAS IN WHICH THE NITRATE CONTENT OF WATER IS KNOWN TO EXCEED 45 MG/L, THE PUBLIC SHOULD BE WARNED OF THE POTENTIAL DANGERS OF USING THE WATER FOR INFANT FEEDING (U.S. PUBLIC HEALTH SERVICE, 1962, P. 7)

Figure 5.--Example water-quality table with standard footnotes.

KTAB

KTAB is a program that tabulates water-quality information contained principally on the ground-water-quality (QRS) cards. The table arrangement is highly flexible and easily can be changed to fit different needs.

A sample water-quality table is shown in figure 5. Heading information appears at the top of each page and is followed by the table headings. The table may contain footnotes.

LOG2

LOG2 is a program that tabulates a lithologic log of a well or measured geologic section in abbreviated form. Data are recorded and coded on forms (see appendix) developed in the Kansas District. Information coded in the blocks is punched and the resulting data cards are processed to obtain the output as shown in figure 6.

WLTAB

WLTAB is a program designed to produce water-level tables from U.S. Geological Survey water-level data cards. The tables are arranged similar to tables found in U.S. Geological Survey water-supply papers.

Depending on the data, the program prints up to three types of tables: (1) recorder-well measurement, (2) irregular

TEST LOG

GEOLOGIC NAME	LITHOLOGIC DESCRIPTION	THICK- NESS	DEPTH
QUATERNARY SYS			
PLEISTOCENE SER			
ALLUVIUM			
LOAM ,	SNDY WITH SILT AND FINE TO MEDM		
SAND	.....	6	6
CLAY ,	GRAY , HARD	9	15
SAND	.....	1	16
SILT	AND CLAY WITH VERY FINE TO MEDM SAND		
STRK	.....	5	21
SAND ,	VERY FINE TO MEDM AND CLAY	5	26
GRAV ,	FINE TO CRSE STRK AND GRAY SILT		
AND CLAY	.....	5	31
SAND ,	VERY FINE TO CRSE WITH CLAY STRK		
AND GRAV	.....	5	36
GRAV	.....	5	41
CLAY ,	SILT , SAND AND FINE TO CRSE		
GRAV	.....	6	47
CRETACEOUS SYS			
U CRETACEOUS SER			
PIERRE SH			
SHLE	.....	1	48
WATER LEVEL =			23

Figure 6.--Example lithologic log.

24-3W-25CCC. (110) CITY OF WICHITA. DRILLED, WATER-TABLE OBSERVATION WELL IN SAND AND GRAVEL OF PLEISTOCENE AGE, DIAMETER 1.25 INCHES, DEPTH 38 FEET. MEASURING POINT, TOP OF PIPE, 4.00 FEET ABOVE LSD.
 ALTITUDE OF LAND SURFACE 1419.50 FEET.
 HIGHEST WATER LEVEL 4.85 BELOW LSD, JULY 31, 1961.
 LOWEST WATER LEVEL 10.59 BELOW LSD, DEC. 30, 1966.
 RECORDS AVAILABLE 1954-66.

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
JULY 27, 1954	8.00	MAR. 1, 1957	10.36	SEP. 1, 1959	7.18	JAN. 31, 1962	6.33
SEP. 30	8.65	APR. 1	10.29	OCT. 1	7.40	MAR. 1	6.26
NOV. 1	8.81	MAY 1	9.98	OCT. 30	6.22	MAR. 29	6.59
DEC. 1	8.92	MAY 31	7.43	DEC. 1	6.71	MAY 1	6.81
DEC. 30	9.03	JULY 1	6.31	DEC. 29	6.97	JUNE 1	6.47
FEB. 1, 1955	9.10	AUG. 1	6.32	FEB. 1, 1960	6.95	JULY 2	5.25
FEB. 28	9.27	AUG. 30	6.80	MAR. 1	6.64	JULY 31	4.86
APR. 1	9.22	OCT. 2	6.69	MAR. 30	5.60	AUG. 30	5.82
MAY 3	9.27	NOV. 1	6.99	MAY 2	5.47	SEP. 28	5.88
MAY 31	9.30	DEC. 5	6.91	JUNE 1	5.48	OCT. 31	5.95
JUNE 30	9.40	JAN. 1, 1958	7.12	JULY 1	5.73	NOV. 29	6.25
AUG. 1	9.50	FEB. 4	7.18	AUG. 1	6.38	DEC. 31	6.48
SEP. 1	9.61	MAR. 5	7.27	SEP. 1	6.59	MAR. 29, 1963	7.13
SEP. 30	9.51	APR. 2	5.51	SEP. 29	6.92	JULY 1	7.97
OCT. 31	8.63	MAY 2	5.56	NOV. 1	7.15	OCT. 2	8.42
DEC. 1	8.73	JUNE 2	6.13	DEC. 1	8.38	JAN. 2, 1964	9.04
JAN. 3, 1956	8.63	JULY 1	6.53	JAN. 1, 1961	7.34	MAR. 31	9.49
JAN. 31	7.98	AUG. 1	5.18	FEB. 1	7.58	JUNE 30	9.62
MAR. 1	9.06	SEP. 2	5.95	MAR. 1	7.65	OCT. 1	10.11
APR. 30	9.13	OCT. 2	4.86	MAR. 30	7.53	DEC. 1	9.36
MAY 1	9.19	OCT. 31	5.34	APR. 28	7.32	DEC. 31	9.45
MAY 31	9.38	DEC. 1	5.70	JUNE 1	5.89	APR. 2, 1965	9.99
JULY 2	9.43	JAN. 1, 1959	5.87	JULY 1	6.02	JULY 1	8.80
AUG. 1	9.56	JAN. 30	5.65	JULY 31	4.85	SEP. 30	8.67
AUG. 31	9.70	MAR. 2	6.05	SEP. 1	5.81	DEC. 29	9.00
OCT. 1	9.82	APR. 1	6.29	SEP. 29	5.88	APR. 1, 1966	9.32
NOV. 1	10.01	MAY 1	6.37	OCT. 30	6.36	JULY 1	9.70
NOV. 30	10.11	JUNE 1	6.05	NOV. 30	6.86	OCT. 1	10.20
DEC. 31	10.20	JUNE 30	6.54	DEC. 29	6.22	DEC. 30	10.59
JAN. 31, 1957	10.28	JULY 31	6.90				

Figure 7.--Example water-level table.

measurement, and (3) less than seven water-level measurements. Only the irregular-measurement table is shown (fig. 7) although each table has a different arrangement. Each table contains a heading giving necessary information about the well. This information is obtained from the heading cards of the data set. In addition, the program picks out the highest and lowest water-level measurements and the dates on which they occurred. A water-level record may contain irregular, then recorder-well, and then irregular measurements, resulting in three tables of the appropriate format.

SEDTAB

SEDTAB is a program that tabulates suspended-sediment information. Input is a sediment card (see appendix) containing concentration, discharge, temperature, number of hours covered

KANSAS RIVER BASIN												
06-8776.00 SMOKY HILL RIVER AT ENTERPRISE, KANSAS.												
SUSPENDED SEDIMENT, WATER YEAR OCTOBER 1966 TO SEPTEMBER 1967--CONTINUED (WHERE NO DAILY CONCENTRATIONS ARE REPORTED, LOADS ARE ESTIMATED)												
DAY	OCTOBER				NOVEMBER				DECEMBER			
	I SUSPENDED SEDIMENT				I SUSPENDED SEDIMENT				I SUSPENDED SEDIMENT			
	MEAN	I		I	MEAN	I		I	MEAN	I		I
	DIS- CHARGE (CFS)	CONCEN- TRATION (MG/L)	TONS PER DAY	I	DIS- CHARGE (CFS)	CONCEN- TRATION (MG/L)	TONS PER DAY	I	DIS- CHARGE (CFS)	CONCEN- TRATION (MG/L)	TONS PER DAY	I
1..	197	86	46	I	140	49	19	I	140	17	6	
2..	194	95	50	I	131	--	16	I	134	--	18	
3..	197	85	45	I	128	43	15	I	119	49	16	
4..	190	92	47	I	134	--	14	I	131	--	16	
5..	178	72	35	I	131	31	11	I	149	30	12	
6..	178	64	31	I	143	--	15	I	152	--	21	
7..	178	68	33	I	137	50	18	I	146	65	26	
8..	178	73	35	I	140	--	19	I	146	--	24	
9..	171	69	32	I	143	52	20	I	149	61	25	
10..	171	66	30	I	140	--	23	I	143	--	19	
11..	164	48	21	I	140	70	26	I	113	47	14	
12..	152	49	20	I	131	--	18	I	107	--	9	
13..	146	49	19	I	137	24	9	I	143	22	8	
14..	140	62	23	I	143	23	9	I	146	--	12	
15..	328	66	58	I	143	22	8	I	146	38	15	
16..	566	62	95	I	146	--	12	I	152	35	14	
17..	730	280	550	I	146	40	16	I	155	32	13	
18..	800	270	580	I	143	40	15	I	155	35	15	
19..	840	280	640	I	140	36	14	I	152	39	16	
20..	638	310	530	I	149	--	16	I	146	45	18	
21..	315	310	260	I	161	52	23	I	146	51	20	
22..	220	290	170	I	152	--	12	I	149	--	16	
23..	186	66	33	I	146	25	10	I	128	33	11	
24..	171	65	30	I	146	30	12	I	95	--	5	
25..	167	66	30	I	152	35	14	I	110	24	7	
26..	164	96	43	I	146	--	24	I	137	--	18	
27..	161	82	36	I	152	88	36	I	122	67	22	
28..	161	82	36	I	146	85	34	I	80	--	6	
29..	152	100	41	I	137	81	30	I	113	89	27	
30..	143	98	38	I	143	--	23	I	137	--	33	
31..	143	100	39	I	--	--	--	I	128	92	32	
TOTAL	8319.00	--	3676	I	4266.00	--	531	I	4169.00	--	514	

Figure 8.--Example daily suspended-sediment table. Monthly totals for mean discharge (cubic feet per second) and load (tons per day) are given for 3 months of record.

by sample, and several other parameters. The program also will accept U.S. Geological Survey standard form 9-1539 as input.

Output from the program includes a daily suspended-sediment table (fig. 8) with the loads computed by the program, a summary table of information, a temperature table, and a frequency distribution of load for the current period of record. In addition, the program will punch a deck of sediment cards according to U.S. Geological Survey specifications for form 9-1539 if the input deck is not already in this form.

STANDARD ANALYSIS PROGRAMS

Standard analysis programs are here defined as procedures or methods for working with data that were performed with some regularity in the district before the availability of digital computers. Programs in this category are LT-LG, STIFF, COLIN, PIPER, IRCLS, and HYDROG.

LT-LG

LT-LG is a program that plots well-inventory and water-quality data in map form, using latitude and longitude coordinates to locate the data points on the maps (Good, 1964). The input to the program is standard ABC and QRS cards. Maps are plotted to any desired scale by Albers' equal-area conic projection. Currently 220 maps can be called from data contained in or calculated from the input data. These data can also be grouped and plotted by aquifers.

Output consists of an optional listing of data (not shown) and any or all the 220 possible maps, including altitude of land surface (fig. 9). If more than one data point falls at the same plot position, an overprint symbol is plotted, and the actual values are printed in the overprint list below the map. The overprint values are located by reading down the overprint list and by reading each line from left to right and the lines from top to bottom on the map. To locate county corners, township corners, section corners, latitude-longitude intersection, or other features, false data points are input.

STIFF

STIFF is a program (Morgan and McNellis, 1969b) that plots Stiff diagrams (Stiff, 1951; Hem, 1959, p. 173-174) of chemical analyses of water. Input data are QRS cards.

TEST DATA

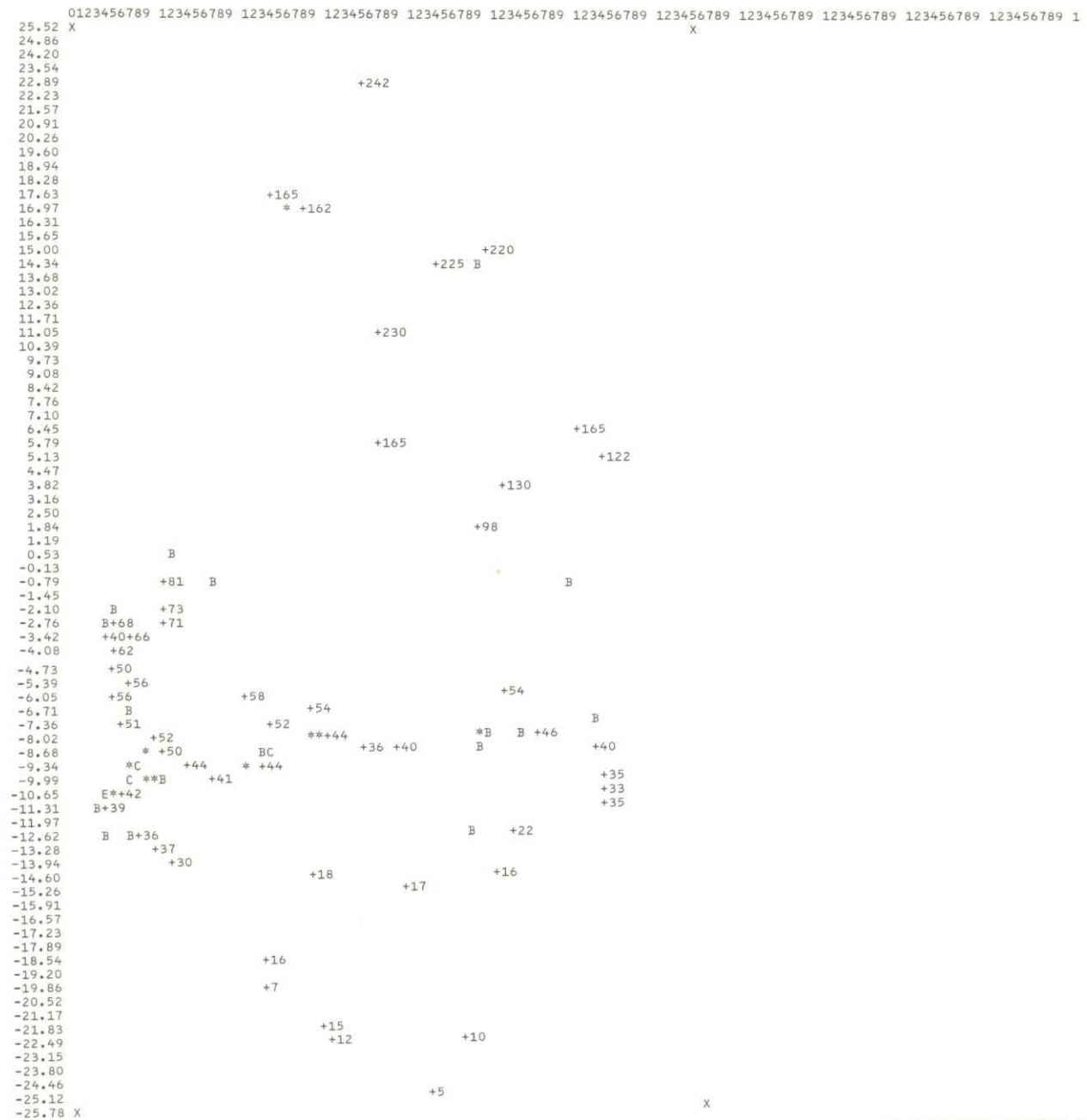
ALTITUDE

SHEET NUMBER 1

SCALE IS 1 TO 250000 OR 3.946 MILES PER INCH

LAT ON VERTICAL SCALE
 LAT TOP OF SCALE = 25.8460
 LAT BOTTOM OF SCALE = -25.8130
 VERTICAL EXAGGERATION = 1.00000
 VERTICAL INCREMENT = 0.657618

LONG ON HORIZONTAL SCALE
 LONG LEFT OF SCALE = 14.9508
 LONG RIGHT OF SCALE = -15.4312
 HORIZONTAL INCREMENT = 0.3946
 RIGHT SIDE OF PLOT IS 7.7 INCHES FROM 0 ON THE LEFT SIDE.



OVERPRINT VALUES

* 165
 B 220
 210
 B 85
 85

EACH DASH = 0.50

For the program to produce a diagram, an analysis must have a cation-anion balance within 5 percent if dissolved solids concentrations are 100 mg/l (milligrams per liter) or less, 3 percent if dissolved solids concentrations are 101-250 mg/l, and 2 percent if dissolved solids concentrations are greater than 250 mg/l. If the analysis does not balance, the well number and date, the constituent values, and the message that the analysis does not balance are printed (not shown).

Also available is an average-by-aquifer Stiff diagram (not shown). For this diagram, all analyses for a particular aquifer are added together and the calculated averages are used to plot the diagram.

COLIN

COLIN is a program that plots Collins diagrams (Collins, 1923, p. 394; Hem, 1959, p. 168-172, 178) of water-quality data. Input data are QRS cards.

Figure 11 is an example Collins bar diagram. Each diagram has a title, a bar (Collins) diagram, a scale and constituents in milliequivalents per liter, and a symbol listing. The symbols and scale are both adjustable. Balance is checked for each analysis as described for the Stiff diagrams.

```

LOCATION = 38N32W11CA      DATE = 11/17/65      WELL DEPTH = 123      GEOLOGIC UNIT(S) = T TS
SCALE = 2.00 ME/L PER INCH

123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789
=====,,$$/
=====,,$$/
=====,,$$/
-----
111111111111111111M2
111111111111111111M2
111111111111111111M2

CA = 3.0439      MG = 0.5017      NA = 0.5220      K = 0.1074
HCO3+CO3 = 3.6550      SO4 = 0.2082      CL = 0.2002      NO3+F = 0.0436

= = CALCIUM      , = MAGNESIUM
$ = SODIUM      / = POTASSIUM
1 = HCO3+CO3     M = SULFATE
2 = CHLORIDE     W = NO3+F

```

Figure 11.--Example Collins bar diagram.

PIPER

PIPER is a program (McNellis and Morgan, 1969) that plots modified Piper diagrams (Piper, 1953; Hem, 1959, p. 182-184, 233) of water-quality data. QRS cards are the basic input data.

The output consists of two tables and the possibility of seven diagrams. The first table (fig. 12) lists pertinent information about samples that have complete chemical

PIPER DIAGRAMS--TEST DATA

LIST OF COMPLETE CHEMICAL ANALYSES OF WATER AND THEIR IDENTIFICATION NUMBERS

IDEN. NUMBER	WELL NUMBER	DATE SAMPLED	WELL DEPTH	GEOLOGIC UNIT(S)
1.	16 16W 32CCB	5 12 60	266	DAKOTA FM
2.	16 17W 16DCD	5 12 60	370	DAKOTA FM
3.	16 17W 22AAA	10 6 60	320	DAKOTA FM
4.	16 18W 6DAC1	5 13 60	230	DAKOTA FM
DOES NOT BAL.	16 18W 6DAC2	5 13 60	R	
5.	16 18W 10CB	10 29 49	168	DAKOTA FM
6.	16 18W 27CDD	5 12 60	209	DAKOTA FM
7.	16 19W 17BAB	5 13 60	400	DAKOTA FM
8.	16 20W 5BBD	5 13 60	530	DAKOTA FM
9.	16 20W 21DDC1	5 13 60	55	PLEISTOCENE SER
10.	17 16W 20AAA	10 13 60	315	DAKOTA FM
11.	17 16W 24CCC	6 1 45	30	
12.	17 17W 28DCD	5 12 60	230	DAKOTA FM
13.	17 18W 20DAA	10 12 60	300	DAKOTA FM
14.	17 18W 28AAD	5 12 60	335	DAKOTA FM
15.	17 18W 33ACD	8 26 57	300	DAKOTA FM
16.	17 18W 33DBC	9 12 58	300	DAKOTA FM
17.	17 18W 34BBD	5 8 61	302	DAKOTA FM
18.	17 19W 27DDC	5 16 60	320	DAKOTA FM
19.	17 20W 5BCB	9 9 46		DAKOTA FM
20.	17 20W 7 CAD2	4 24 61	53	PLEISTOCENE SER
21.	17 20W 29CDD	5 13 60	285	DAKOTA FM
22.	17 20W 36ABB	10 12 60	325	DAKOTA FM
23.	18 16W 16BBB4	8 5 60	87	PLEISTOCENE SER
24.	18 16W 19BBA	8 19 60	55	PLEISTOCENE SER
25.	18 16W 23AAA1	5 25 61	75	PLEISTOCENE SER
26.	18 16W 23AAA1	11 5 58	75	PLEISTOCENE SER
27.	18 16W 23ADD	8 24 60	R	
28.	18 16W 28CDC	5 17 60	168	DAKOTA FM
29.	18 17W 11CDA	8 17 60	86	PLEISTOCENE SER
30.	18 17W 14CDC	8 19 60	71	PLEISTOCENE SER
31.	18 17W 18CCC1	10 7 60	224	DAKOTA FM
32.	18 17W 22DAD	3 4 56		PLEISTOCENE SER
33.	18 17W 22DAD	1 14 60		PLEISTOCENE SER
34.	18 17W 27ABA	8 24 60	60	PLEISTOCENE SER
35.	18 17W 28BCC1	8 11 60	64	PLEISTOCENE SER
36.	18 17W 34BCA	10 11 60	175	DAKOTA FM
37.	18 18W 9AAB	10 12 60	265	DAKOTA FM
38.	18 18W 25BCB	8 22 60	67	PLEISTOCENE SER
39.	18 18W 26DDA	10 12 60	187	DAKOTA FM
40.	18 18W 28AAC	1 31 61	83	PLEISTOCENE SER
41.	18 18W 28AAC	6 20 61	83	PLEISTOCENE SER
42.	18 18W 28AAC	7 61	83	PLEISTOCENE SER
43.	18 18W 30DDC	8 11 60	70	PLEISTOCENE SER
44.	18 18W 31DDA	10 11 60	150	DAKOTA FM
45.	18 18W 34BBB	8 22 60	61	PLEISTOCENE SER
46.	18 18W 36DCA	8 19 60	54	PLEISTOCENE SER
47.	18 19W 21CDB1	8 11 60	60	PLEISTOCENE SER
48.	18 19W 27AAA	8 11 60	64	PLEISTOCENE SER
49.	18 20W 14CCB	8 11 60	45	PLEISTOCENE SER
50.	18 20W 15CCB	8 11 60		PLEISTOCENE SER
51.	18 20W 19ACC	8 11 60	54	PLEISTOCENE SER
52.	18 20W 19CCB	8 22 60	R	
53.	18 20W 20DBC	3 27 62	48	PLEISTOCENE SER
54.	18 20W 20DBC	2 6 61	48	PLEISTOCENE SER
55.	18 20W 36ABB	10 11 60	214	DAKOTA FM
56.	19 16W 23DBB	10 7 60	80	PLEISTOCENE SER
57.	19 17W 28ADD	5 17 60	185	DAKOTA FM
58.	19 18W 3ACA	8 15 60	140	PLEISTOCENE SER
59.	19 18W 27CCB	5 16 60	390	DAKOTA FM
60.	19 19W 24CCB	5 16 60	290	DAKOTA FM
61.	19 20W 4BBB	10 11 60	284	DAKOTA FM
62.	19 20W 17DDC	5 13 60	442	DAKOTA FM
63.	19 20W 26BAA	5 13 60	410	DAKOTA FM

Figure 12.--Example table showing analysis-identification data for a Piper diagram. The IDEN. NUMBER is assigned to each analysis by the program for use in plotting Piper diagrams.

analyses and the identification numbers that represent each analysis on subsequent diagrams (1), (4), and (6). The second table (not shown) lists geologic units and the identification numbers that represent each geologic unit on subsequent diagrams (2), (3), (5), and (7).

Seven Piper diagrams can be printed:

- (1) Square diagram (fig. 13) of percentage reacting values (cations versus anions) wherein the numbers plotted identify analyses.
- (2) Square diagram as (1) above, except the numbers plotted identify geologic units.
- (3) Square diagram as (2) above, except the numbers are plotted at the position of the average for all data from each geologic unit.
- (4) Trilinear diagram of percentage reacting values of cations wherein the numbers plotted identify analyses.
- (5) Trilinear diagram (fig. 14) as (4) above, except numbers plotted identify geologic units.
- (6) Trilinear diagram of percentage reacting values of anions wherein the numbers plotted identify analyses.
- (7) Trilinear diagram as (6) above, except numbers plotted identify geologic units.

Balance of cations and anions is checked for each analysis as described for the Stiff diagram.

IRCLS

IRCLS is a program that plots modified irrigation-classification diagrams (U.S. Salinity Laboratory Staff, 1954, p. 80; Hem, 1959, p. 251). The sodium-adsorption ratio (SAR) on the vertical arithmetic scale is plotted against conductivity on the horizontal log scale. Input data are QRS cards.

Output from this program consists of two tables and two diagrams. The first table (not shown) lists the analyses that are complete (conductivity and SAR or Ca, Mg, and Na values to calculate SAR) and the assigned identification numbers that will be used on the first diagram (fig. 15). The second table (not shown) contains an identification number for each geologic unit for plotting on the second diagram. Each diagram has data points, overprint values, and a list of those values that are off the scale of the diagram.

PIPER DIAGRAMS--TEST DATA

PIPER DIAGRAM OF CATIONS PLOTTED VERSUS ANIONS. CA + MG (0-100) AT TOP, NA + K (100-0) AT BOTTOM, HCO₃ + CO₃ (0-100) ON LEFT, CL + SO₄ + NO₃ (100-0) ON RIGHT.

SCALE-1 INCH = 10 PERCENT

NUMBERS PLOTTED IDENTIFY ANALYSES.

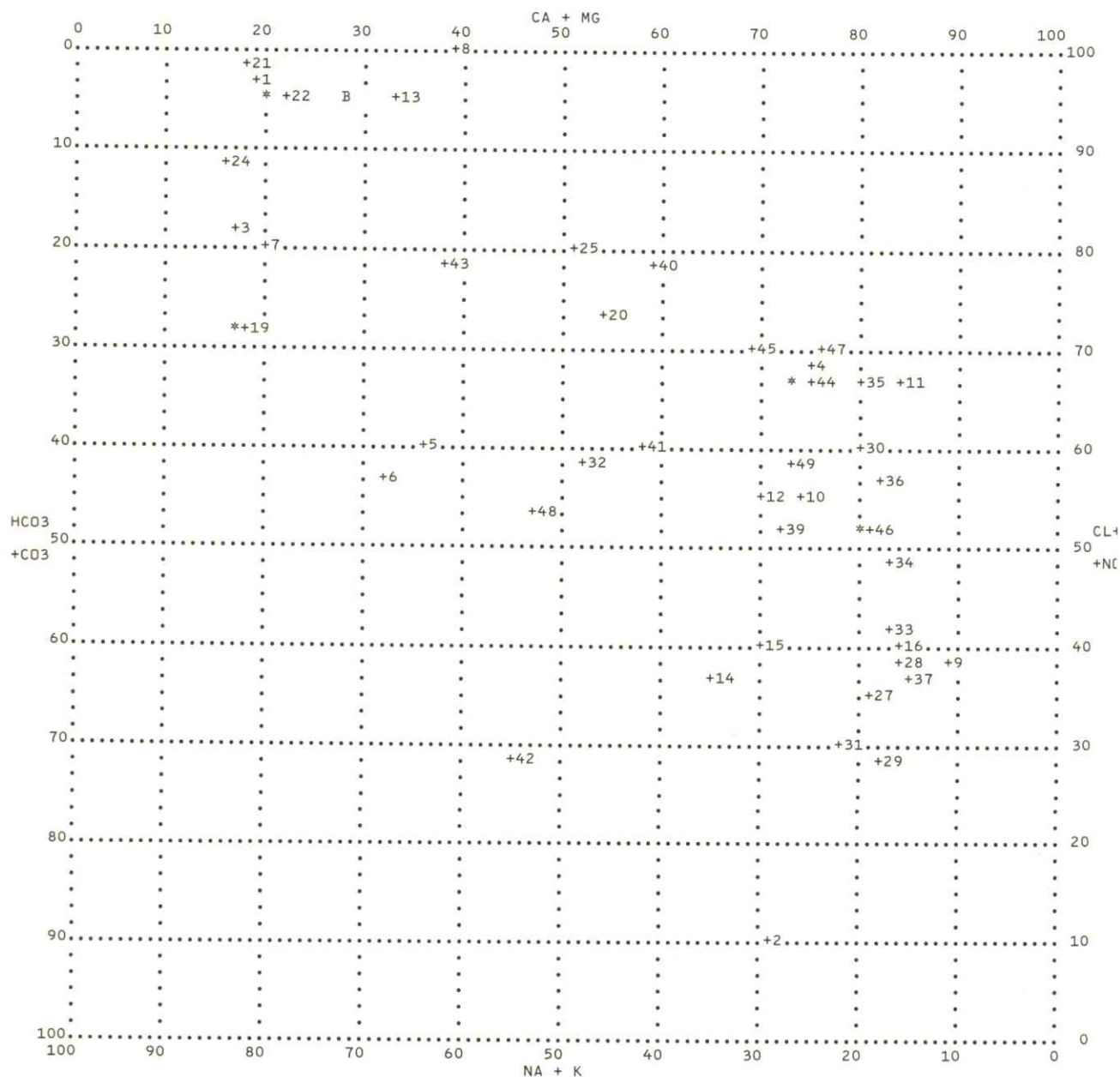


Figure 13.--Example square Piper diagram with analysis-identification numbers assigned by the program and listed in figure 12. Asterisks and letters are overprints (see program LT-LG for discussion).

PIPER DIAGRAMS--TEST DATA

TRILINEAR PLOT OF CATIONS. MG ON LEFT, NA + K ON RIGHT, CA ON BOTTOM.

SCALE-1 INCH = 10 PERCENT.

NUMBERS PLOTTED IDENTIFY GEOLOGIC UNITS

0123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789

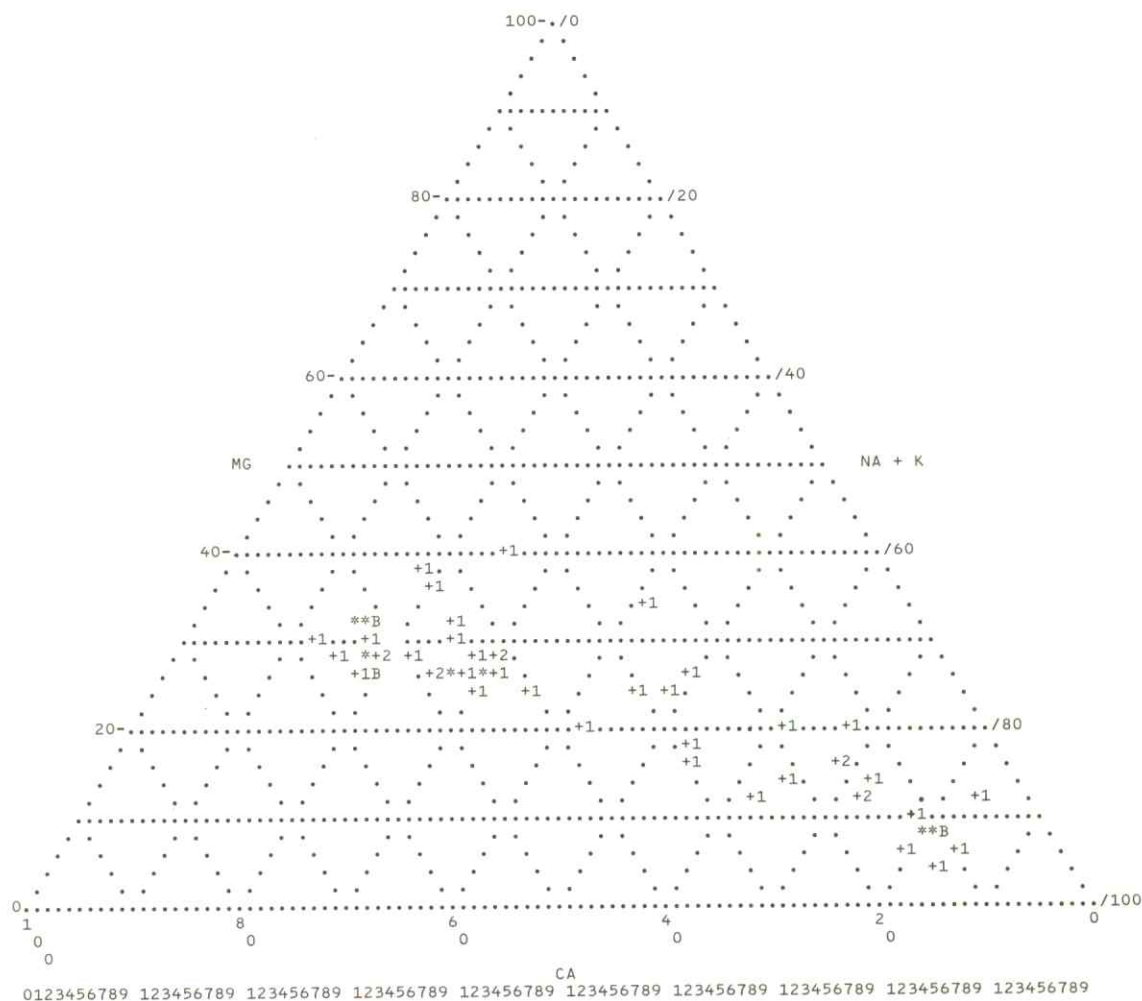


Figure 14.--Example trilinear Piper diagram of cations. Numbers plotted within the diagram identify the geologic source. Asterisks and letters are overprints (see program LT-LG for discussion). The overprint list is not shown.

Figure 15.--Example irrigation-classification diagram with analysis-identification numbers.→ Asterisks and letters indicate overprints (see program LT-LG for discussion). The overprint list and the list of values that are off the scale are not shown. The solid lines were added by hand.

The vertical grid is completed by connecting conductivity value points at the top and bottom of the diagram, and the diagonal grid is completed by connecting the three asterisks on the left margin of the graph with those on the right from top to bottom.

HYDROG

HYDROG is a program that plots hydrographs of water levels in wells. Input data are U.S. Geological Survey water-level cards (Lang and Leonard, 1967).

Output from the program consists of a table explaining the symbols plotted on the hydrograph, a heading describing the well, and a hydrograph (fig. 16). The time scale is vertical and the depth scale is horizontal. Time scales presently available are 1 day, 2.5 days, 5 days, 10 days, and 1 month per line. The depth-to-water-level scales are completely flexible. If the depth scale is exceeded, the hydrograph will go off scale on the right side of the diagram and come back on the diagram on the left side. Off-scale plotting is designated by a change in the plot symbol and by a number in the left margin of the graph. The number in the left margin will indicate the number of times the graph is off scale from the given scale. If the altitude of the well is known, the final scale at the base of the hydrograph will be "altitude in feet" above mean sea level (msl) rather than "water level in feet below or above land surface," as it is at the top of the graph.

OTHER PROGRAMS

Other programs include techniques not considered standard within the district prior to computer usage, techniques under development for analysis of U.S. Geological Survey data, and programs not directly using U.S. Geological Survey data. Programs in this category are MIX, MXMT, RAR, ROPES, CVTVAL, FADER, BRIDGE, SPSL, KANS, GUMBEL, LPK, Q50CAL, and SURCK.

MIX

MIX is a program that combines from two to five water analyses in one to nine specified hypothetical mixes. The input consists of two to five sets of QRS cards.

Output from the program includes a table showing the percentage of each analysis used in nine mixes (not shown), Stiff diagrams of each individual input analysis (not shown), and Stiff diagrams illustrating each of the hypothetical mixes (figure 17 shows one mix). Each Stiff diagram of a mixed sample contains a heading giving the geologic units from which the

parent waters were obtained and the percentages of each water represented, the diagram including scale factor and principal water type, and constituent values used to plot the diagram. For further explanation of the Stiff diagram, refer to description of STIFF program.

PLOTTED SYMBOLS ON HYDROGRAPHS

- A = WELL BEING PUMPED (N = OFF-SCALE PLOT)
- B = WELL PUMPED RECENTLY (O = OFF-SCALE PLOT)
- C = NEARBY WELL BEING PUMPED (P = OFF-SCALE PLOT)
- D = NEARBY WELL PUMPED RECENTLY (Q = OFF-SCALE PLOT)
- E = ESTIMATED (R = OFF-SCALE PLOT)
- F = DRY, PLOTTED VALUE IS WELL DEPTH (S = OFF-SCALE PLOT)
- G = MEASUREMENT BY ANOTHER AGENCY (T = OFF-SCALE PLOT)
- H = TAPE MEASUREMENT(RECORDER) (U = OFF-SCALE PLOT)
- I = AFFECTED BY ATMOSPHERIC PRESSURE (V = OFF-SCALE PLOT)
- J = OTHER (W = OFF-SCALE PLOT)
- + = UNDISTURBED WATER LEVEL (- = OFF-SCALE PLOT)

2,3,4,ETC. = NUMBER OF NEARLY EQUAL WATER LEVELS AT APPROXIMATELY THE SAME TIME
TEST DATA

26-25W-34BBB. (8) F. H. DIEHL. DRILLED, WATER-TABLE IRRIGATION WELL IN ALLUVIUM, DIAMETER 20 INCHES, DEPTH 24 FEET, MEASURING POINT, TOP OF CASING, 0.80 FOOT ABOVE LSD. G = MEASURED BY K.S.B.A.
J = AFFECTED BY FLOOD WATERS

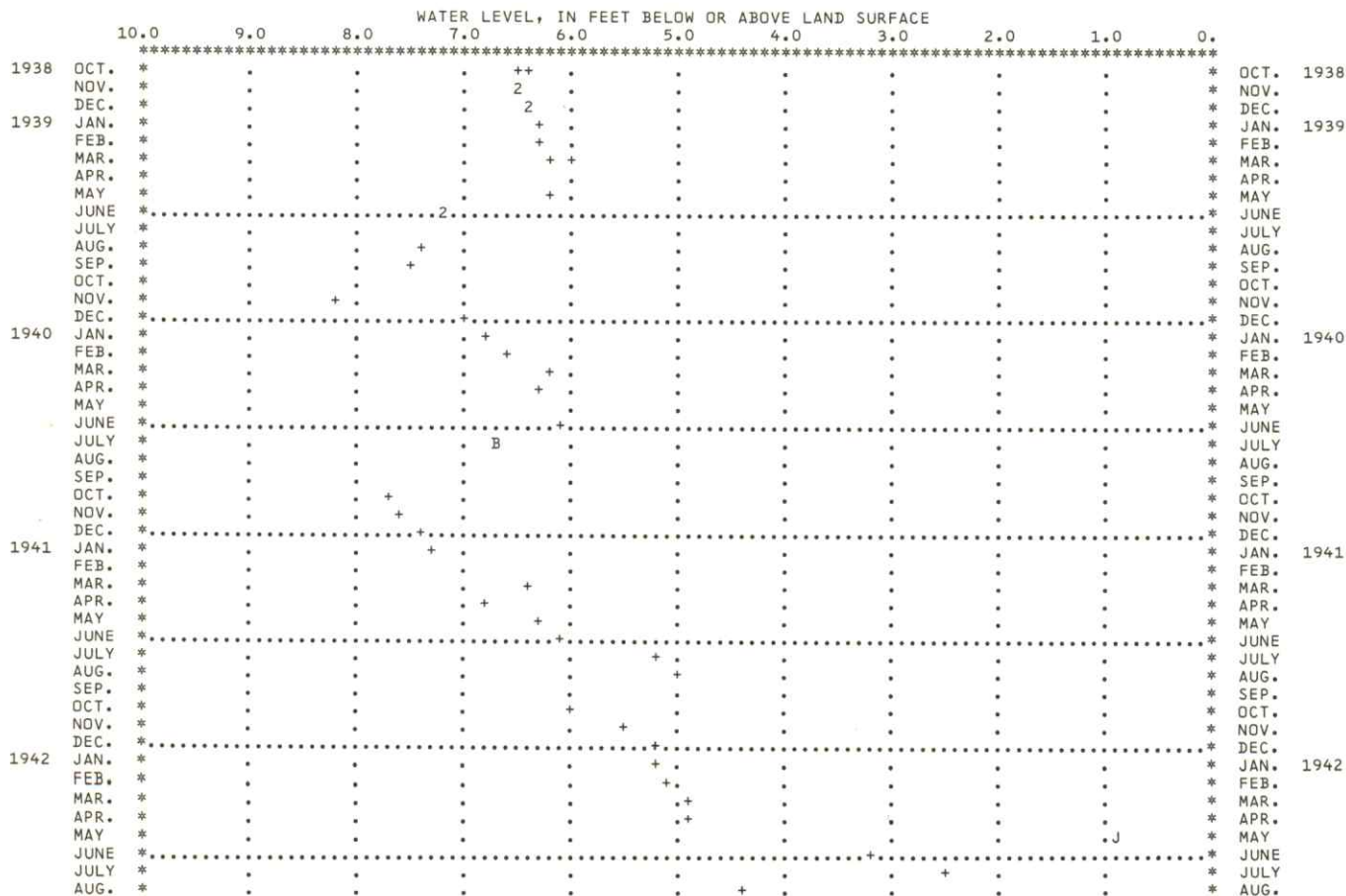
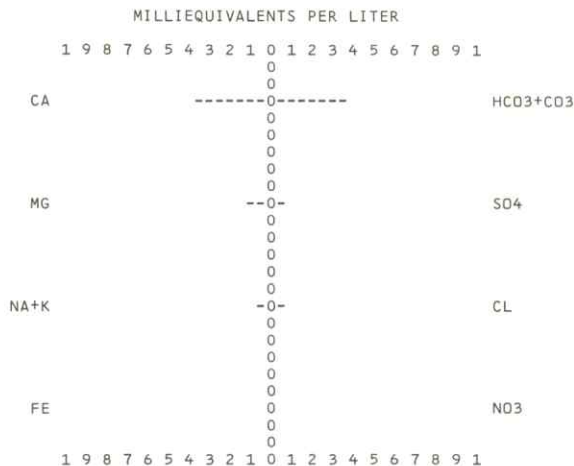


Figure 16.--Example monthly hydrograph and symbol-identification table.

GEOLOGIC UNIT(S)	TPUG	ANALYSIS	1=	50	PERCENT OF MIXTURE
GEOLOGIC UNIT(S)	TOBR	ANALYSIS	2=	50	PERCENT OF MIXTURE
TOTAL SCALE=	5	MILLIEQUIVALENTS PER LITER		EACH DASH=	0.25



WATER TYPE---CALCIUM BICARBONATE

CONSTITUENTS IN MILLIEQUIVALENTS PER LITER

CA=	1.7714	MG=	0.4976	NA=	0.1718	K=	0.0000	FE=	0.0967
HCO3=	1.9832	CO3=	0.0000	SO4=	0.2290	CL=	0.1903	NO3=	0.0694

Figure 17.--Example Stiff diagram showing a hypothetical mixed sample.

THIS CHART SHOWS WHAT PERCENTAGES OF ANALYSIS 1 AND ANALYSIS 2 ARE REQUIRED TO MAKE A MIXTURE SIMILAR TO A KNOWN ONE. THE CALCULATED MIXTURE VALUE IS PRINTED DIRECTLY BELOW THE KNOWN FOR VISUAL COMPARISON								
	MN	FE	AL	PO4	NO3	F	CL	SO4
ANALYSIS 1	-1.00	0.19	-1.00	-1.00	0.01	-1.00	0.16	0.02
ANALYSIS 2	-1.00	0.	-1.00	-1.00	0.13	-1.00	0.23	0.44
ASSUMED MIX	-1.00	0.06	-1.00	-1.00	0.09	-1.00	0.20	0.31
CALCULATED	-1.00	0.06	-1.00	-1.00	0.09	-1.00	0.20	0.31
PERCENT 1	-1.00	30.00	-1.00	-1.00	30.00	-1.00	30.00	30.00
PERCENT 2	-1.00	70.00	-1.00	-1.00	70.00	-1.00	70.00	70.00
DEVIATION	-1.00	0.	-1.00	-1.00	0.	-1.00	0.	0.
ANAL ERROR	-1.00	0.93	-1.00	-1.00	0.68	-1.00	2.00	2.50
	CO3	HCO3	K	NA	MG	CA		
ANALYSIS 1	-1.00	0.97	-1.00	0.15	0.09	0.85		
ANALYSIS 2	0.	3.00	-1.00	0.20	0.90	2.69		
ASSUMED MIX	-1.00	2.39	-1.00	0.18	0.66	2.14		
CALCULATED	-1.00	2.39	-1.00	0.18	0.66	2.14		
PERCENT 1	-1.00	30.00	-1.00	30.00	30.00	30.00		
PERCENT 2	-1.00	70.00	-1.00	70.00	70.00	70.00		
DEVIATION	-1.00	0.	-1.00	0.	0.	0.		
ANAL ERROR	-1.00	0.40	-1.00	4.55	5.05	1.35		

Figure 18.--Example table showing percentages of two parent waters needed to duplicate an assumed-mixed water. Constituents are in milliequivalents per liter. Negative values indicate missing data.

MXMT

MXMT is a program that calculates to the nearest 1 percent the ion distribution of an assumed-mixed water thought to result from a mixture of up to three parent waters. Input consists of the assumed-mixed water analysis and the parent water analyses.

The program is designed to handle any format of water-quality data cards, to select for comparison any of the parameters from the data cards, to select for determination the mean percentage for any of the parameters, and to output the results in any desired order. Multiple sets of assumed-mixed waters may be compared with a single group of parent waters. When three parent waters are examined, a predetermined percentage of one of the parent waters can be used, if desired.

Examples of output from the program consist of two tables and two diagrams. Figure 18 lists by constituent the input data for two parent waters and an assumed-mixed water, the calculated mix, and the percentages required from each parent water to attain the calculated mix. Figure 19 is a diagram illustrating the percentages of the parent waters in figure 18.

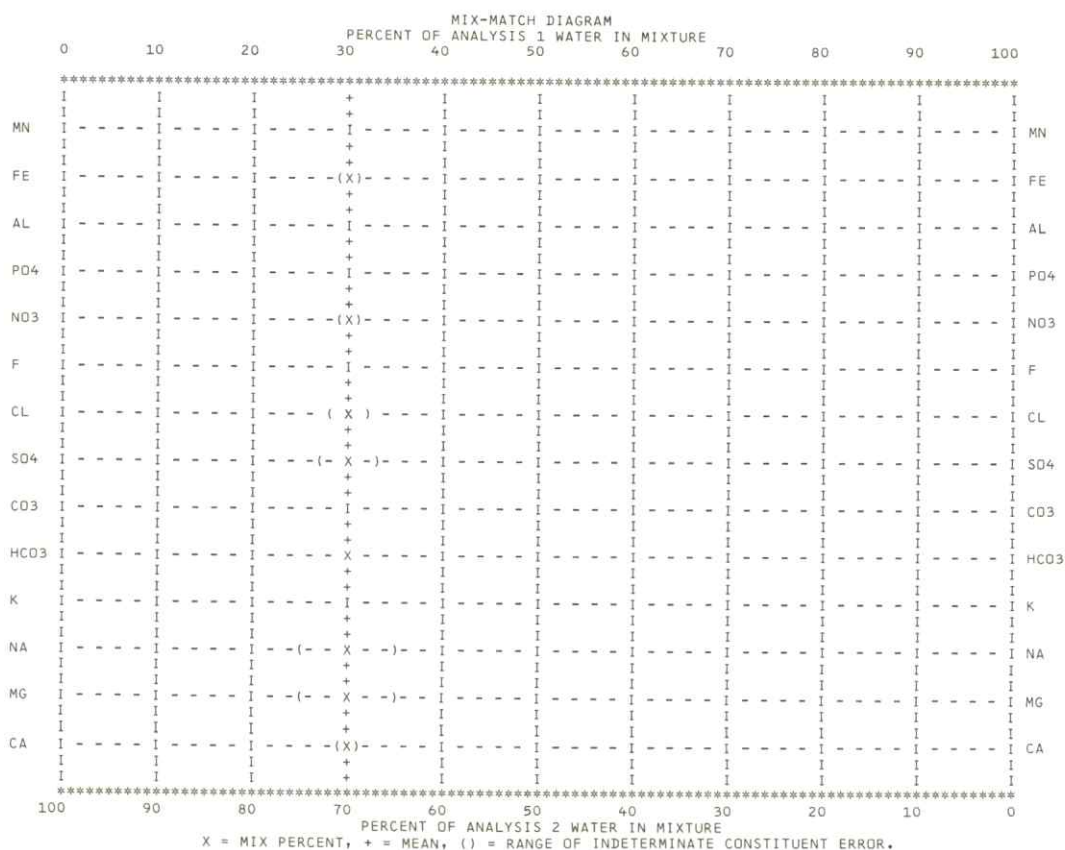


Figure 19.--Example diagram showing percentages of two parent waters needed to duplicate an assumed-mixed water.

Figures 20 and 21 are the table and diagram, respectively, for three parent waters and an assumed-mixed water.

THIS CHART SHOWS WHAT PERCENTAGES OF ANALYSIS 1, ANALYSIS 2, AND ANALYSIS 3 WATERS ARE REQUIRED TO MAKE A MIXTURE SIMILAR TO A KNOWN ONE. THE CALCULATED MIXTURE VALUE IS PRINTED DIRECTLY BELOW THE KNOWN FOR VISUAL COMPARISON

	CA	MG	NA	K	HCO3	CO3	SO4	CL
ANALYSIS 1	2.59	0.69	0.35	0.10	3.25	0.	0.06	0.16
ANALYSIS 2	2.20	0.61	1.39	-1.00	3.80	0.	0.21	0.17
ANALYSIS 3	2.84	0.74	0.27	0.09	3.00	-1.00	0.31	0.27
ASSUMED MIX	2.56	0.68	0.59	-1.00	3.32	-1.00	0.16	0.19
CALCULATED	2.56	0.68	0.59	-1.00	3.32	-1.00	0.16	0.19
PERCENT 1	40.00	40.00	40.00	-1.00	40.00	-1.00	40.00	40.00
PERCENT 2	29.00	29.00	26.00	-1.00	28.00	-1.00	49.00	36.00
PERCENT 3	31.00	31.00	34.00	-1.00	32.00	-1.00	11.00	24.00
DEVIATION	0.	0.	0.	-1.00	0.	-1.00	0.	0.
ANAL ERROR	3.85	3.12	1.93	-1.00	1.02	-1.00	4.17	1.25

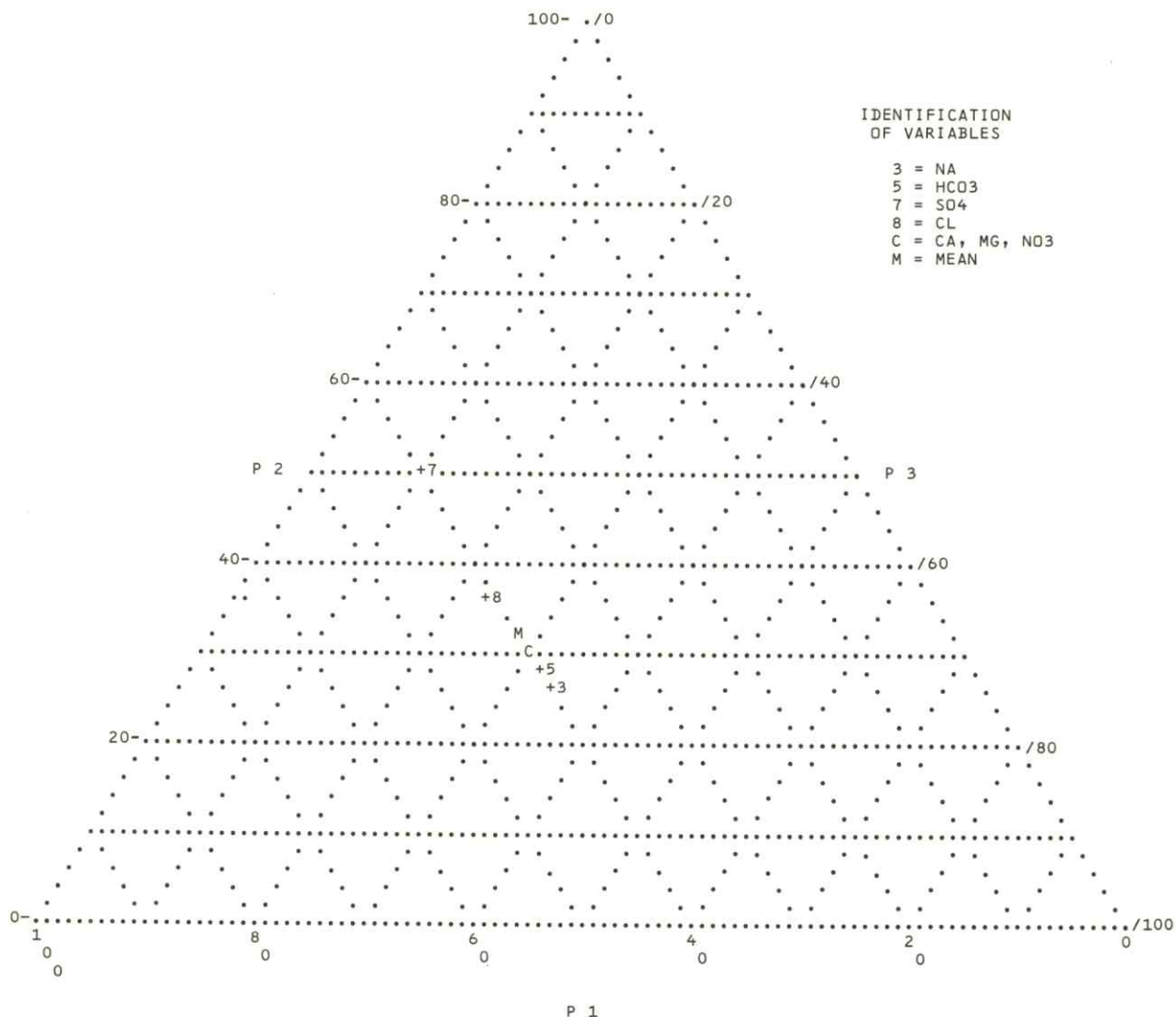
	F	NO3	PO4	AL	FE	MN
ANALYSIS 1	-1.00	0.12	-1.00	-1.00	0.04	-1.00
ANALYSIS 2	-1.00	0.00	-1.00	-1.00	-1.00	-1.00
ANALYSIS 3	-1.00	0.23	-1.00	-1.00	0.12	-1.00
ASSUMED MIX	-1.00	0.12	-1.00	-1.00	-1.00	-1.00
CALCULATED	-1.00	0.12	-1.00	-1.00	-1.00	-1.00
PERCENT 1	-1.00	40.00	-1.00	-1.00	-1.00	-1.00
PERCENT 2	-1.00	29.00	-1.00	-1.00	-1.00	-1.00
PERCENT 3	-1.00	31.00	-1.00	-1.00	-1.00	-1.00
DEVIATION	-1.00	0.	-1.00	-1.00	-1.00	-1.00
ANAL ERROR	-1.00	3.62	-1.00	-1.00	-1.00	-1.00

Figure 20.--Example table showing percentages of three parent waters needed to duplicate an assumed-mixed water. Constituents are in milliequivalents per liter. Negative values indicate missing data.

RAR

RAR is a program that sorts water-quality data by geologic unit and calculates and tabulates milligrams per liter, milliequivalents per liter, and requested ratios. A maximum of 50 ratios can be calculated on a single run through the computer. However, if more ratios are needed, the program can be run as many times as necessary to obtain them. The input to the program is QRS data cards.

Output from the program consists of a mg/l (milligrams per liter) table (fig. 22), a me/l (milliequivalents per liter) table (fig. 23), a listing identifying the ratio numbers (fig. 24), and a ratio table (fig. 25). The tables are subdivided by geologic unit; each analysis within that unit is identified. Within the geologic unit subdivisions the maximum, minimum, mean, standard deviation, and number of samples considered are summarized. Negative values in the tables indicate missing data.



IDENTIFICATION
OF VARIABLES

3 = NA
5 = HCO₃
7 = SO₄
8 = CL
C = CA, MG, NO₃
M = MEAN

Figure 21.--Example trilinear diagram showing percentages of three parent waters (P1, P2, P3) needed to duplicate an assumed-mixed water. The "C" is an overprint (see program LT-LG for discussion).

TEST DATA			MG/L TABLE														
LOCATION	DEPTH	DATE	TEMP.	D.	SOL.	SI02	AL	FE	MN	CA	MG	NA	K	HCO3	CO3	SO4	CL
AQUIFER(S) T T S																	
35N32W 3AC	-2	11 17 65	57.		269.	73.0	-2.0	0.02	0.12	41.0	4.5	23.0	9.6	194.	0.	20.0	0.8
36N30W24CD	-2	11 18 65	53.		298.	60.0	-2.0	0.03	0.09	61.0	9.2	7.3	8.2	214.	0.	9.2	8.7
36N33W10AB	-2	11 17 65	49.		182.	59.0	-2.0	0.02	0.10	24.0	2.9	16.0	6.8	126.	0.	6.2	1.2
36N32W 1CD	-2	11 17 65	58.		324.	68.0	-2.0	0.01	0.14	30.0	3.9	59.0	11.0	248.	0.	28.0	1.7
37N30W32BB	-2	11 18 65	52.		261.	60.0	-2.0	0.	0.12	50.0	7.3	10.0	8.4	207.	0.	12.0	2.3
35N28W10CC	-2	11 18 65	60.		286.	60.0	-2.0	0.06	0.10	63.0	6.3	6.0	9.0	224.	0.	10.0	3.1
37N26W 9BB	-2	11 18 65	53.		288.	63.0	-2.0	0.01	0.08	60.0	4.5	14.0	14.0	241.	0.	9.0	3.4
38N30W27DD	-2	11 17 65	52.		311.	67.0	-2.0	0.17	0.81	63.0	6.3	23.0	9.0	287.	0.	3.5	2.0
38N32W11CA	-2	11 17 65	52.		298.	64.0	-2.0	0.02	0.12	61.0	6.1	12.0	4.2	223.	0.	10.0	7.1
MAXIMUM			60.		324.	73.0	-2.0	0.17	0.81	63.0	9.2	59.0	14.0	287.	0.	28.0	8.7
MEAN			54.		280.	63.8	-2.0	0.04	0.19	50.3	5.7	18.9	8.9	218.	0.	12.0	3.4
MINIMUM			49.		182.	59.0	-2.0	0.	0.08	24.0	2.9	6.0	4.2	126.	0.	3.5	0.8
SAMPLE STANDARD DEV.			4.		41.	4.7	-2.0	0.05	0.23	15.1	1.9	16.2	2.7	44.	-2.	7.5	2.7
VALUES			9		9	9	-2	9	9	9	9	9	9	9	9	9	9

Figure 22.--Example milligrams-per-liter table, sorted by aquifer.

LOCATION	DEPTH	DATE	AL	FE	MN	CA	MG	NA	K	HCO3	CO3
AQUIFER(S) T TS											
35N32W 3AC	-2	11 17 65	-2.0000	0.0007	0.0044	2.0459	0.3701	1.0005	0.2456	3.1797	0.
36N30W24CD	-2	11 18 65	-2.0000	0.0011	0.0033	3.0439	0.7566	0.3175	0.2098	3.5075	0.
36N33W10AB	-2	11 17 65	-2.0000	0.0007	0.0036	1.1976	0.2385	0.6960	0.1739	2.0651	0.
36N32W 1CD	-2	11 17 65	-2.0000	0.0004	0.0051	1.4970	0.3207	2.5665	0.2814	4.0647	0.
37N30W32BB	-2	11 18 65	-2.0000	0.	0.0044	2.4950	0.6004	0.4350	0.2149	3.3927	0.
35N28W10CC	-2	11 18 65	-2.0000	0.0021	0.0036	3.1437	0.5181	0.2610	0.2302	3.6714	0.
37N26W 9BB	-2	11 18 65	-2.0000	0.0004	0.0029	2.9940	0.3701	0.6090	0.3581	3.9500	0.
38N30W27DD	-2	11 17 65	-2.0000	0.0061	0.0295	3.1437	0.5181	1.0005	0.2302	4.7039	0.
38N32W11CA	-2	11 17 65	-2.0000	0.0007	0.0044	3.0439	0.5017	0.5220	0.1074	3.6550	0.
MAXIMUM			-2.0000	0.0061	0.0295	3.1437	0.7566	2.5665	0.3581	4.7039	0.
MEAN			-2.0000	0.0014	0.0068	2.5116	0.4660	0.8231	0.2279	3.5767	0.
MINIMUM			-2.0000	0.	0.0029	1.1976	0.2385	0.2610	0.1074	2.0651	0.
SAMPLE STANDARD DEV.			-2.0000	0.0019	0.0085	0.7559	0.1583	0.7051	0.0690	0.7198	-2.0000
VALUES			-2	9	9	9	9	9	9	9	9

Figure 23.--Example milliequivalents-per-liter table, sorted by aquifer.

TEST DATA		RATIO IDENTIFICATION LIST			
NUMBER IN TABLE		NUMERATOR	DENOMINATOR	MODE	
1	ALK.		/SO4	MG/L	
2	HD.		/D.S.	MG/L	
3	NA		/CL	MG/L	
4	CL		/COND.	MG/L	
5	HD.		/COND.	MG/L	
6	SO4		/COND.	MG/L	
7	SiO2		/D.S.	MG/L	
8	CL		/D.S.	MG/L	
9	COND.		/D.S.	MG/L	
10	FE		/PH	MG/L	
11	D.S.		/COND.	MG/L	
12	DEPTH		/D.S.	MG/L	
13	CA		/MG	ME/L	
14	CL		/HCO3	ME/L	
15	HCO3		/SO4	ME/L	
16	CA MG		/NA	ME/L	
17	CA MG		/NA K	ME/L	
18	NA		/NA K CA MG	ME/L	
19	HCO3		/HCO3 SO4 CL NO3 F	ME/L	
20	CA HCO3		/CA SO4	ME/L	
21	CA		/NA MG	ME/L	
22	NA		/CL	ME/L	
23	SO4		/SO4 HCO3 CL NO3 F	ME/L	
24	CL		/SO4	ME/L	
25	NA		/MG	ME/L	

Figure 24.--Example ratio-identification table.
Only a partial list is shown.

TEST DATA			RATIO TABLE								
LOCATION	DEPTH	DATE	1	2	3	4	5	6	7	8	9
AQUIFER(S) T TS											
35N32W 3AC	-2	11 17 65	7.9500	0.4498	28.7500	0.0023	0.3497	0.0578	0.2714	0.0030	1.2862
36N30W24CD	-2	11 18 65	19.0217	0.6879	0.8391	0.0209	0.4928	0.0221	0.2013	0.0292	1.3960
36N33W10AB	-2	11 17 65	16.6129	0.3956	13.3333	0.0053	0.3172	0.0273	0.3242	0.0066	1.2473
36N32W 1CD	-2	11 17 65	7.2500	0.2809	34.7059	0.0039	0.2082	0.0641	0.2099	0.0052	1.3488
37N30W32BB	-2	11 18 65	14.1667	0.5939	4.3478	0.0062	0.4201	0.0325	0.2299	0.0088	1.4138
35N28W10CC	-2	11 18 65	18.4000	0.6399	1.9355	0.0079	0.4668	0.0255	0.2098	0.0108	1.3706
37N26W 9BB	-2	11 18 65	22.0000	0.5833	4.1176	0.0084	0.4128	0.0221	0.2187	0.0118	1.4132
38N30W27DD	-2	11 17 65	67.1429	0.5884	11.5000	0.0045	0.4159	0.0080	0.2154	0.0064	1.4148
38N32W11CA	-2	11 17 65	18.1000	0.5940	1.6901	0.0182	0.4538	0.0256	0.2148	0.0238	1.3087
MAXIMUM			67.1429	0.6879	34.7059	0.0209	0.4928	0.0641	0.3242	0.0292	1.4148
MEAN			21.1827	0.5348	11.2466	0.0086	0.3930	0.0317	0.2328	0.0117	1.3555
MINIMUM			7.2500	0.2809	0.8391	0.0023	0.2082	0.0080	0.2013	0.0030	1.2473
SAMPLE STANDARD DEV.			17.9383	0.1312	12.4794	0.0065	0.0884	0.0179	0.0399	0.0089	0.0621
VALUES			9	9	9	9	9	9	9	9	9

Figure 25.--Example ratio table, sorted by aquifer. The numbers at the top of the table are the ratio numbers given in figure 24. Only a partial list of ratios is shown.

ROPES

ROPES is a program that plots individual ionic constituents of requested ground-water-quality data (QRS cards) or surface-water-quality data (blank, 1,2,3 cards) from an area or stream-sample site at a requested log scale. A specific date or range in sampling date, depth or range in depth, discharge or range in discharge, concentration or range in concentration of specific constituents, geologic unit or units, and milligrams per liter or milliequivalents per liter may be specified, sorted for, and plotted. A maximum of 16 parameters can be plotted on a single diagram from the 48 different parameters available.

Output consists of a series of tables (figs. 26 and 27) that give an identification number to each piece of data; a list of parameters to be plotted along with maximum, minimum,

TEST DATA				
NUM.	WELL NUMBER	WELL DEPTH	DATE SAMPLED	GEOLOGIC UNIT(S)
1.	2001E13CCC	58.0	6. 15. 66.	Q OA
2.	2101W19DCC	50.0	6. 16. 66.	Q OA
3.	2103W03CCA1	33.0	9. 15. 66.	T OT
4.	2101E31CCC	35.0	6. 16. 66.	Q OA
5.	2102E10BAC1	81.0	7. 20. 65.	Q OA
6.	2102E34BDB	60.0	6. 15. 66.	Q OA
7.	2201W19BBB	2506.0	9. 15. 66.	Q OA
8.	2201W27ADC	23.0	6. 15. 66.	Q OA
9.	2201E33AAA	38.0	6. 15. 66.	Q OA
10.	2202E09CSC1	28.0	6. 15. 66.	Q OA
11.	2303W12DDA1	75.0	9. 15. 66.	01BR
12.	2303W32ADA1	80.0	9. 15. 66.	01SH
13.	2402W21CCB1	220.0	9. 14. 66.	01SH
14.	2501W01CCD1	165.0	9. 14. 66.	01SH
15.	2501E15ABB	-1000.0	6. 15. 66.	Q OA
16.	2502E03CDD	21.0	6. 14. 66.	Q OA
17.	2602W11AAB1	135.0	9. 14. 66.	01PW
18.	2602E26AAA	105.0	7. 26. 65.	Q OA
19.	2701W01CAD1	65.0	9. 13. 66.	01CO
20.	2701E10BAA1	107.0	9. 13. 66.	01PW
21.	2802W07AAA1	150.0	9. 14. 66.	01CO
22.	2802W03AAA1	150.0	9. 13. 66.	01PW
23.	2802E36DAA	36.0	6. 14. 66.	Q OA
24.	2901E13CCC1	90.0	9. 13. 66.	01CO
25.	2901E31DCB1	-1000.0	9. 13. 66.	01CO
26.	3002W36CDB	179.0	9. 14. 66.	01CO

Figure 26.--Example table showing identification numbers (NUM) assigned to each analysis by the program for use in plotting Ropes diagrams. Negative values indicate missing data.

TEST DATA

GROUND-WATER DATA

NUM.	GEOLOGIC UNIT(S)		Q	QA							
	DATE		K		NA	MG	CA	HCO3	SO4	CL	NO3
1.	6.	15.	66.	0.0639	0.9570	0.9869	2.5449	4.4581	0.0125	0.1297	0.0065
2.	6.	6.	66.	0.0409	0.3349	0.9869	1.8962	2.9174	0.2290	0.1664	0.0065
4.	6.	16.	66.	0.0307	0.4176	0.8224	1.7465	2.8191	0.2498	0.0479	0.0000
5.	7.	20.	65.	0.0460	0.6525	1.5626	4.0419	6.1626	0.0333	0.0620	0.0016
6.	6.	15.	66.	0.0435	0.5220	1.0691	2.5449	4.2614	0.0000	0.0282	0.0000
7.	9.	15.	66.	0.0333	0.2914	3.2896	5.0399	7.8016	0.2498	0.5640	0.0177
8.	6.	15.	66.	0.5372	1.1310	0.9869	1.8463	1.9996	0.9161	0.8460	0.7258
9.	6.	15.	66.	0.0665	0.1609	0.5839	1.9960	2.5568	0.2707	0.0310	0.0000
10.	6.	15.	66.	0.0639	0.9135	1.8915	5.0898	7.3755	0.5621	0.2312	0.0000
15.	6.	15.	66.	0.0972	0.5655	0.9869	1.6467	2.4585	0.5413	0.2707	0.0194
16.	6.	14.	66.	0.0588	1.1745	0.8224	2.3453	2.2946	0.8953	0.7896	0.4194
18.	7.	26.	65.	0.0358	0.3001	1.2336	2.9940	4.4089	0.0375	0.0705	0.0000
23.	6.	14.	66.	0.0358	0.6090	0.3948	0.5988	0.4917	0.3748	0.3948	0.2903
MAX.				0.5372	1.1745	3.2896	5.0898	7.8016	0.9161	0.8460	0.7258
MEAN				0.0887	0.6177	1.2013	2.6409	3.8466	0.3363	0.2794	0.1144
MIN.				0.0307	0.1609	0.3948	0.5988	0.4917	0.0000	0.0282	0.0000
S.D.				0.1360	0.3323	0.7354	1.3387	2.1777	0.3126	0.2861	0.2269
NUM.				13.	13.	13.	13.	13.	13.	13.	13.

NUM.	DATE	DPTH/10
1.	6. 15. 66.	5.8000
2.	6. 16. 66.	5.0000
4.	6. 16. 66.	3.5000
5.	7. 20. 65.	8.1000
6.	6. 15. 66.	6.0000
7.	9. 15. 66.	250.6000
8.	6. 15. 66.	2.3000
9.	6. 15. 66.	3.8000
10.	6. 15. 66.	2.8000
15.	6. 15. 66.	-1000.0000
16.	6. 14. 66.	2.1000
18.	7. 26. 65.	10.5000
23.	6. 14. 66.	3.6000
MAX.		250.6000
MEAN		25.3417
MIN.		2.1000
S.D.		70.9812
NUM.		12.

Figure 27.--Example table showing constituents, in milligrams per liter, sorted by aquifer. The identification numbers, NUM, are from figure 26. Negative values indicate missing data.

mean, standard deviation, and number of samples considered; and for some plots, a table identifying the values plotted. In addition to the tables, a series of diagrams can be requested. One specific diagram (fig. 28) is illustrated with constituent values from figure 27.

As may be inferred from the above, output from the program is highly variable and many more examples of output could have been included. For detailed information about this program, see the report by Ropes, Morgan, and McNellis (1969).

CVTVAL

CVTVAL is a program that converts any one value to another as long as the values are related by a linear conversion factor (miles to kilometers, etc.). Input to the program

ROPES DIAGRAM

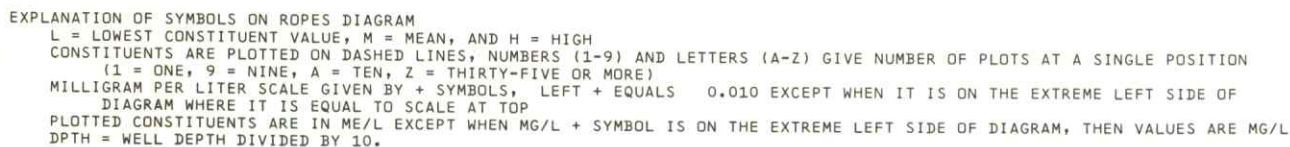


Figure 28.--Example Ropes diagram showing constituent values plotted on semilog scale. The explanation of symbols, shown here, is printed on a separate page following each graph.

consists of a title, the necessary conversion factors, the incremental value, and the range for which results are desired. Output is printed in tabular form. Output for converting miles to kilometers is illustrated (fig. 29).

CONVERSION FROM MILES TO KILOMETERS FROM 0.1 TO 100. MILES IN 0.1-MILE INCREMENTS

MILES	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	MILES
0.00 -	0.00	0.16	0.32	0.48	0.64	0.80	0.97	1.13	1.29	1.45 -	0.00
1.00 -	1.61	1.77	1.93	2.09	2.25	2.41	2.57	2.74	2.90	3.06 -	1.00
2.00 -	3.22	3.38	3.54	3.70	3.86	4.02	4.18	4.35	4.51	4.67 -	2.00
3.00 -	4.83	4.99	5.15	5.31	5.47	5.63	5.79	5.95	6.12	6.28 -	3.00
4.00 -	6.44	6.60	6.76	6.92	7.08	7.24	7.40	7.56	7.72	7.89 -	4.00
5.00 -	8.05	8.21	8.37	8.53	8.69	8.85	9.01	9.17	9.33	9.50 -	5.00
6.00 -	9.66	9.82	9.98	10.14	10.30	10.46	10.62	10.78	10.94	11.10 -	6.00
7.00 -	11.27	11.43	11.59	11.75	11.91	12.07	12.23	12.39	12.55	12.71 -	7.00
8.00 -	12.87	13.04	13.20	13.36	13.52	13.68	13.84	14.00	14.16	14.32 -	8.00
9.00 -	14.48	14.65	14.81	14.97	15.13	15.29	15.45	15.61	15.77	15.93 -	9.00
10.00 -	16.09	16.25	16.42	16.58	16.74	16.90	17.06	17.22	17.38	17.54 -	10.00
11.00 -	17.70	17.86	18.02	18.19	18.35	18.51	18.67	18.83	18.99	19.15 -	11.00
12.00 -	19.31	19.47	19.63	19.79	19.96	20.12	20.28	20.44	20.60	20.76 -	12.00
13.00 -	20.92	21.08	21.24	21.40	21.57	21.73	21.89	22.05	22.21	22.37 -	13.00
14.00 -	22.53	22.69	22.85	23.01	23.17	23.34	23.50	23.66	23.82	23.98 -	14.00
15.00 -	24.14	24.30	24.46	24.62	24.78	24.94	25.11	25.27	25.43	25.59 -	15.00
16.00 -	25.75	25.91	26.07	26.23	26.39	26.55	26.72	26.88	27.04	27.20 -	16.00
17.00 -	27.36	27.52	27.68	27.84	28.00	28.16	28.32	28.49	28.65	28.81 -	17.00
18.00 -	28.97	29.13	29.29	29.45	29.61	29.77	29.93	30.09	30.26	30.42 -	18.00
19.00 -	30.58	30.74	30.90	31.06	31.22	31.38	31.54	31.70	31.87	32.03 -	19.00

Figure 29.--Example table showing relationship of miles to kilometers.

FADER

FADER is a program that calculates drawdowns within a theoretical well field (Fader, 1967). Input to the program consists of an assumed transmissivity, storage coefficient, pumping rate, well spacing, and duration of time wells are to be pumped. Output showing various parameters specified or calculated is in table form (fig. 30). Calculations may be made for nodes located either at the pumped wells or half the distance between the pumped wells.

BRIDGE

BRIDGE is a program that determines the basic hydraulic characteristics of any stream cross section, including open channel, bridge, and culvert. The methods are derived basically from a Department of Interior administrative report, with slight modification to fit the computer.

Data read into the program include: (1) cross-section data points (enough to make calculations) including station and elevation, (2) stations at which break points are desired and their corresponding Manning's n values, (3) increment used to increase water-surface elevations, and (4) highest and lowest water-surface elevations between which evaluation is made.

COMPUTATIONS OF DRAWDOWN AT A WELL IN THE INTERIOR OF A
THEORETICAL WELL FIELD.

T= 50000. S= 0.1500000 Q= 356. TM = 10 YEARS

DISTANCE R (FEET)	U	W(U)	DRAWDOWN PER WELL (FEET)	NO OF WELLS CAUSING DRAWDOWN	TOTAL DRAWDOWN CAUSED BY WELLS AT R (FEET)
1	153699E-08	19.7162	16.0875	1	16.0875
5280	428487E-01	2.61526	2.13392	4	8.53570
7390	839380E-01	1.98267	1.61776	4	6.47105
10560	0.171395	1.35089	1.10226	4	4.40905
11700	0.210398	1.18137	0.963939	8	7.71151
14800	0.336661	0.821781	0.670533	4	2.68213
15800	0.383693	0.730510	0.596061	4	2.38424
16700	0.428650	0.656660	0.535803	8	4.28642
19100	0.560708	0.492298	0.401692	8	3.21353
21120	0.685580	0.384180	0.313473	4	1.25389
21700	0.723751	0.357393	0.291615	8	2.33292
22300	0.764328	0.331465	0.270460	4	1.08184
23600	0.856040	0.281002	0.229284	8	1.83427
26400	1.07122	0.194945	0.159066	12	1.90879
26900	1.11218	0.182348	0.148787	8	1.19030
28510	1.24929	0.146575	0.119598	8	0.956786
29880	1.37224	0.121226	989150E-01	4	0.395660
30780	1.45615	0.106787	871329E-01	8	0.697063
31700	1.54450	936380E-01	764042E-01	4	0.305617
32100	1.58373	883890E-01	721212E-01	8	0.576969
33370	1.71152	734275E-01	599133E-01	8	0.479307
33840	1.76007	684959E-01	558894E-01	8	0.447115
35270	1.91197	552703E-01	450979E-01	8	0.360783
36960	2.09959	426381E-01	347907E-01	4	0.139163
37380	2.14758	399347E-01	325848E-01	8	0.260678
38120	2.23345	355465E-01	290043E-01	8	0.232034
38440	2.27110	337882E-01	275695E-01	8	0.220556
40230	2.48754	253273E-01	206658E-01	8	0.165327
41300	2.62162	212413E-01	173319E-01	8	0.138655
42300	2.75011	179760E-01	146675E-01	4	586702E-01
42600	2.78926	170899E-01	139446E-01	16	0.223113
43600	2.92175	144171E-01	117636E-01	8	941091E-01
45100	3.12625	111192E-01	907270E-02	20	0.181454
47500	3.47075	722706E-02	589694E-02	12	707632E-01
53000	4.31739	257831E-02	210378E-02	8	168302E-01

TOTAL = 71.4038

Figure 30.--Example table showing drawdowns within a theoretical well field. When the accuracy of a parameter exceeds six significant figures, the parameter number is followed by E and a number that indicates the placement of the decimal to the left of the first digit. For example, 586702E-01 is .0586702 and 257831E-02 is .00257831.

TRANSE STA 0

W.S. ELE.	AREA	CONVEYANCE	ALPHA	PIER AREA	AREA3	KQ	KB	KA	M	E	J	BSUBT
5.190	0.0	0.	1.0000	0.	0.0						0.	0.08
5.200	0.0	0.	1.0000	0.	0.0						0.	0.15
5.210	0.0	0.	1.0000	0.	0.0						0.	0.23
5.220	0.0	0.	1.0000	0.	0.0						0.	0.31
5.230	0.0	0.	1.0000	0.	0.0						0.	0.38
5.240	0.0	0.	1.0000	0.	0.0						0.	0.46
5.250	0.0	0.	1.0000	0.	0.0						0.	0.54
5.260	0.0	0.	1.0000	0.	0.0						0.	0.62
5.270	0.0	0.	1.0000	0.	0.0						0.	0.69
5.280	0.0	0.	1.0000	0.	0.0						0.	0.77
5.290	0.0	0.	1.0000	0.	0.0						0.	0.85
5.300	0.1	0.	1.0000	0.	0.1						0.	0.92
5.310	0.1	1.	1.0000	0.	0.1						0.	1.00
5.320	0.1	1.	1.0000	0.	0.1						0.	1.03
5.330	0.1	1.	1.0000	0.	0.1						0.	1.06
5.340	0.1	1.	1.0000	0.	0.1						0.	1.09
5.350	0.1	1.	1.0000	0.	0.1						0.	1.12
5.360	0.1	1.	1.0000	0.	0.1						0.	1.15
5.370	0.1	2.	1.0000	0.	0.1						0.	1.18
5.380	0.1	2.	1.0000	0.	0.1						0.	1.21
5.390	0.2	2.	1.0000	0.	0.2						0.	1.24
5.400	0.2	2.	1.0000	0.	0.2						0.	1.26
5.410	0.2	3.	1.0000	0.	0.2						0.	1.29
5.420	0.2	3.	1.0000	0.	0.2						0.	1.32
5.430	0.2	3.	1.0000	0.	0.2						0.	1.35
5.440	0.2	3.	1.0000	0.	0.2						0.	1.38
5.450	0.2	4.	1.0000	0.	0.2						0.	1.41
5.460	0.2	4.	1.0000	0.	0.2						0.	1.44
5.470	0.3	4.	1.0000	0.	0.3						0.	1.47
5.480	0.3	5.	1.0000	0.	0.3						0.	1.50
5.490	0.3	5.	1.0000	0.	0.3						0.	1.53
5.500	0.3	5.	1.0000	0.	0.3						0.	1.56
5.510	0.3	6.	1.0000	0.	0.3						0.	1.59
5.520	0.3	6.	1.0000	0.	0.3						0.	1.62
5.530	0.4	7.	1.0000	0.	0.4						0.	1.65
5.540	0.4	7.	1.0000	0.	0.4						0.	1.68
5.550	0.4	7.	1.0000	0.	0.4						0.	1.71
5.560	0.4	8.	1.0000	0.	0.4						0.	1.74
5.570	0.4	8.	1.0000	0.	0.4						0.	1.76
5.580	0.4	9.	1.0000	0.	0.4						0.	1.79
5.590	0.5	9.	1.0000	0.	0.5						0.	1.82
5.600	0.5	10.	1.0000	0.	0.5						0.	1.85
5.610	0.5	10.	1.0000	0.	0.5						0.	1.88
5.620	0.5	11.	1.0000	0.	0.5						0.	1.91
5.630	0.5	12.	1.0000	0.	0.5						0.	1.94
5.640	0.6	12.	1.0000	0.	0.6						0.	1.97
5.650	0.6	13.	1.0000	0.	0.6						0.	2.00
5.660	0.6	13.	1.0000	0.	0.6						0.	2.06
5.670	0.6	14.	1.0000	0.	0.6						0.	2.11
5.680	0.6	14.	1.0000	0.	0.6						0.	2.17
5.690	0.7	15.	1.0000	0.	0.7						0.	2.22

Figure 31.--Example table showing a computation of bridge section properties.

The output includes a table (fig. 31) and a diagram (fig. 32). The table has different parameters depending on the type of section being determined. The types of cross sections and computed properties are: (1) open channel section--conveyances (K_a , K_b , and K_q), channel-contraction ratio (m), and eccentricity ratio (e); (2) bridge section--pier area, total area ($area_3$), ratio of the pier area to total area (j), and contraction width (B_t); and (3) culvert section--contraction width. All sections will include area, conveyance, and velocity head adjustment factor (α) for every water-surface elevation evaluated.

SCALE FACTOR ON X IS 1.00E 01 SCALE FACTOR ON Y IS 1.00E 01

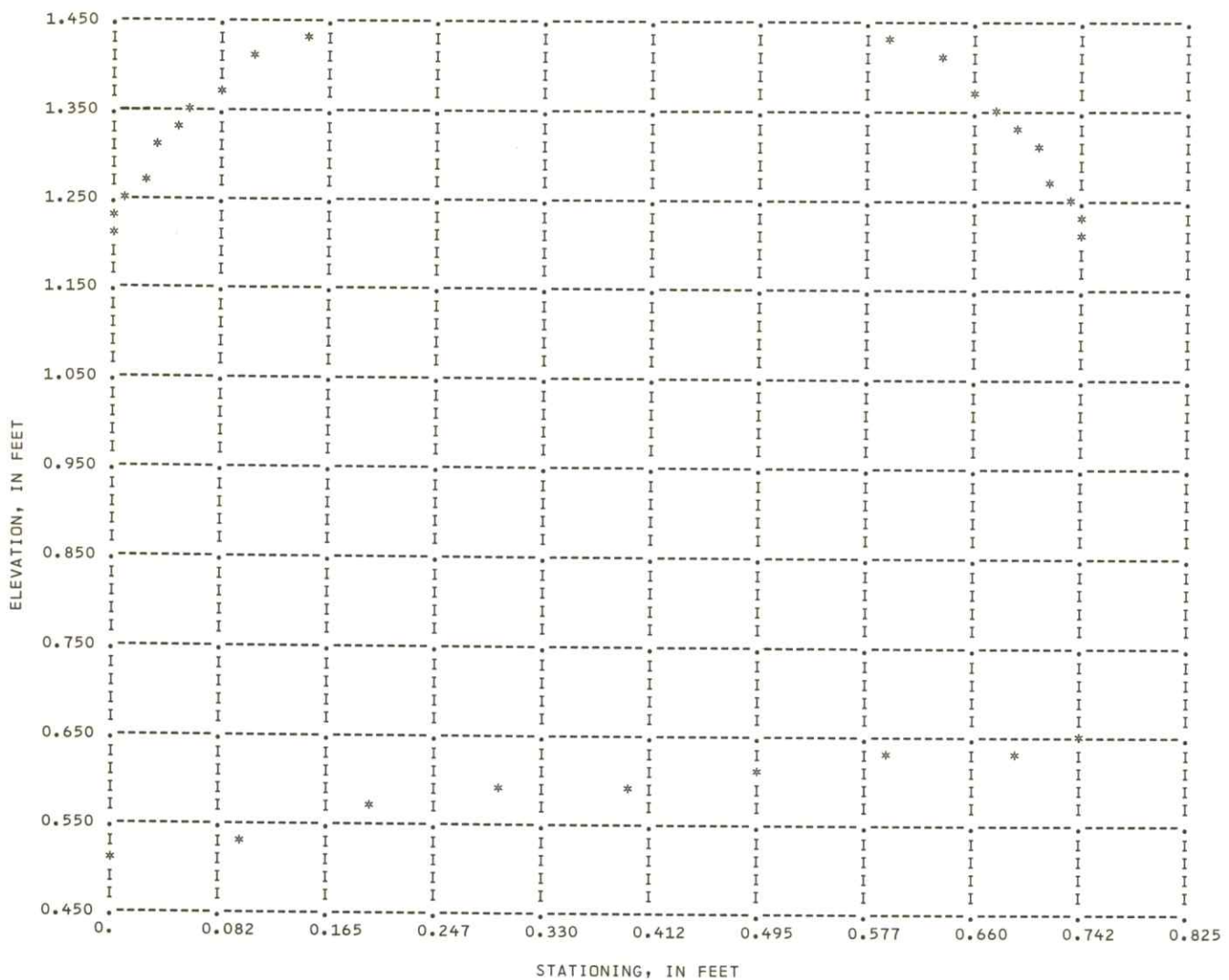


Figure 32.--Example graph of a culvert section. Datum is arbitrary.

SPSL

SPSL is a program that tabulates and reduces for analysis voluminous data collected during surface-water seepage-salinity surveys of low streamflow. Input consists of station locations on the main channel and tributaries, discharge measurements, and chemical analyses. Output is in tabular form as shown by figure 33. The various tables produced by the program are listed in figure 34.

NET SEEPAGE, IN TONS/DAY, IN EACH REACH

DATE	DISCHARGE (CFS)	SIO2	CA	MG	NA	K	HCO3	CO3	SO4	CL	F	NO3	P04	B
STATION 23.4R														
10 18 62	0.07	-0.02	0.02	0.06	0.01	-0.02	0.08	0.	0.16	0.02	0.00	0.00	-0.00	-0.00
10 24 63	-2.24	0.12	0.44	0.07	0.12	0.11	2.00	0.	0.08	0.08	0.00	0.01	0.01	0.00
5 13 64	2.62	0.14	0.74	0.14	0.22	0.13	2.95	0.	0.26	0.24	0.00	0.02	0.02	0.00
10 14 65	0.15	0.00	0.04	0.01	0.01	0.01	0.13	-0.01	0.05	0.01	0.00	0.00	0.00	0.
10 13 66	0.37	0.03	0.12	0.04	0.03	0.02	0.43	0.	0.12	0.03	0.00	0.01	0.00	0.00
10 19 67	0.61	0.03	0.08	0.08	0.05	0.03	0.48	0.	0.15	0.03	-0.00	0.00	0.00	0.00
STATION 27.0R														
10 18 62	-0.22	0.01	0.00	0.05	0.01	0.02	0.27	0.	0.02	0.04	0.00	0.00	0.00	0.00
10 24 63	-0.20	0.00	0.14	0.07	0.08	0.01	0.22	0.	0.05	0.08	0.00	0.00	0.00	0.00
5 13 64	-1.65	0.08	0.47	0.06	0.13	0.08	1.80	0.	0.16	0.13	0.00	0.01	0.01	0.00
10 14 65	0.09	0.01	0.01	0.00	0.00	0.00	0.04	0.	0.01	0.00	0.00	0.00	0.00	0.
10 13 66	0.09	0.01	0.03	0.01	0.00	0.00	0.10	0.	0.05	0.02	-0.00	0.00	-0.00	0.00
10 19 67	-0.22	0.01	0.12	0.03	0.01	0.01	0.30	0.	0.02	0.00	0.00	0.02	0.00	0.00
STATION 29.7R														
10 18 62	-0.22	0.01	0.00	0.05	0.01	0.02	0.27	0.	0.02	0.04	0.00	0.00	0.00	0.00
10 24 63	0.56	-0.04	0.19	-0.07	0.09	0.03	0.42	0.	0.08	0.12	0.00	0.00	0.00	0.00
5 13 64	0.49	0.02	0.16	0.01	0.04	0.02	0.54	0.	0.07	0.05	0.00	0.00	0.00	0.00
10 14 65	-0.12	0.01	0.01	0.00	0.00	0.01	0.05	0.	0.01	0.00	0.00	0.00	0.00	0.
10 13 66	-0.33	0.02	0.07	0.03	0.00	0.01	0.33	0.	0.02	0.01	0.00	0.01	0.00	0.00
10 19 67	0.86	0.03	0.31	-0.05	0.03	0.04	0.83	0.	0.12	0.02	0.00	-0.01	0.00	0.00

Figure 33.--Example table from seepage-salinity program. The station number is the location of a station on a tributary (T) or river (R), in river miles upstream from the mouth. Positive values represent gains by the stream; negative values represent losses.

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EXPLANATION OF OUTPUT
  DATA ARE OUTPUT ONTO UNIT L2.  INFORMATION IS ARRANGED BY
  TABLE 2 THROUGH N, FOLLOWED BY TABLE 1.  WITHIN EACH TABLE THE
  DATA ARE GROUPED BY DATE, WITH STATIONS SEQUENCED IN A DOWN-
  STREAM ORDER.
  ***THE SORT ROUTINE GROUPS EACH STATION (BY TABLE CATAGORY)
  INTO SEQUENTIAL DATES.
THE FOLLOWING DATA ARE OUTPUT ONTO UNIT L2*****
-----
CONCENTRATIONS, IN MG/L, AT EACH STATION
-----
CONCENTRATIONS, IN ME/L, AT EACH STATION
-----
CHEMICAL DISCHARGE, IN KE/DAY, AT EACH STATION
-----
CHEMICAL DISCHARGE, IN TONS/DAY, AT EACH STATION
-----
WATER AND CHEMICAL DISCHARGE AT EACH STATION AS PERCENTAGE OF
THAT AT REFERENCE STATION
-----
PERCENTAGE COMPOSITION AT EACH STATION
-----
NET GAINS OR LOSSES, IN KE/DAY, IN EACH REACH
-----
CONCENTRATIONS, IN ME/L, IN NET GAINS OR LOSSES IN EACH REACH
-----
PERCENTAGE COMPOSITION OF NET GAINS OR LOSSES IN EACH REACH
-----
NET GAINS OR LOSSES, IN TONS/DAY, IN EACH REACH
-----
NET GAINS OR LOSSES AS PERCENTAGE OF WATER AND CHEMICAL DISCHARGE
AT REFERENCE STATION
-----
CONCENTRATIONS, IN MG/L, OF NET GAINS OR LOSSES IN EACH REACH
-----
NET SEEPAGE, IN KE/DAY, IN EACH REACH
-----
PERCENTAGE COMPOSITION OF NET SEEPAGE IN EACH REACH
-----
CONCENTRATIONS, IN ME/L, IN NET SEEPAGE IN EACH REACH
-----
CONCENTRATIONS, IN MG/L, IN NET SEEPAGE IN EACH REACH
-----
NET SEEPAGE, IN TONS/DAY, IN EACH REACH
-----
NET SEEPAGE IN EACH REACH AS PERCENTAGE OF WATER AND CHEMICAL
AT REFERENCE STATION
-----
CUMULATIVE NET SEEPAGE, IN KE/DAY
-----
CUMULATIVE NET SEEPAGE, IN TONS/DAY
-----
PERCENTAGE COMPOSITION OF CUMULATIVE NET SEEPAGE
-----
CONCENTRATIONS, IN ME/L, IN CUMULATIVE NET SEEPAGE
-----
CONCENTRATIONS, IN MG/L, IN CUMULATIVE NET SEEPAGE
-----
CUMULATIVE NET SEEPAGE AS PERCENTAGE OF WATER AND CHEMICAL
DISCHARGE AT REFERENCE STATION
*****

```

Figure 34.--Example table showing the 24 types of tables available from the seepage-salinity program.

KANS

KANS is a program that converts General Land Office locations (township and range system) in Kansas to latitude and longitude coordinates (Morgan and McNellis, 1969a). Converted coordinates are accurate to within 10 seconds and usually within 5 seconds of a measured latitude-longitude location; the accuracy depends upon the quality of the base map, the precision of the measured control values, and the regularity of the General Land Office grid. Adapted versions of the program are used in Nebraska and North Dakota. Figure 35 illustrates the output of the program.

COUNTY	LAND OFFICE LOC.	LATITUDE DIR.	LONGITUDE	SEQ.	AC.	NUMBER
ELLIS	14 20W 32AAA	38 47 54 N	99 33 43	1	2	27
ELLIS	14 20W 32ADD	38 47 34 N	99 33 43	1	2	28
ELLIS	14 20W 32BBC	38 47 48 N	99 34 41	1	2	29
ELLIS	14 20W 32DDA	38 47 15 N	99 33 43	1	2	30
ELLIS	14 20W 32DDD	38 47 8 N	99 33 43	1	2	31
ELLIS	14 20W 33CBB	38 47 28 N	99 33 35	1	2	32
ELLIS	14 20W 34BBB	38 47 54 N	99 32 27	1	2	33
ELLIS	14 20W 34BBC	38 47 47 N	99 32 27	1	2	34
ELLIS	14 20W 34BCC	38 47 34 N	99 32 27	1	2	35
ELLIS	14 20W 35BBB	38 47 53 N	99 31 20	1	2	36
ELLIS	14 20W 35BCC1	38 47 34 N	99 31 20	1	2	37
ELLIS	14 20W 35BCC2	38 47 34 N	99 31 20	2	2	38
ELLIS	14 20W 35CC	38 47 11 N	99 31 16	1	2	39
ELLIS	14 20W 36AAA	38 47 53 N	99 29 14	1	2	40
ELLIS	14 20W 36ABB	38 47 53 N	99 29 39	1	2	41
ELLIS	14 20W 36BBB	38 47 53 N	99 30 13	1	2	42

Figure 35.--Example table showing calculated latitude and longitude values from township and ranges values. SEQ is the sequence number for the location. AC designates the accuracy of the final latitude-longitude calculation.

GUMBEL

GUMBEL is a program that uses the Gumbel (1941) method for computing and plotting flood recurrence intervals and discharges. The mean, standard deviation, coefficient of variation, skew coefficient, and first-order serial correlation coefficients also are computed and printed. Output is tabular and graphic (figs. 36 and 37).

LPK

LPK is a program that fits a log Pearson type III distribution to one or more groups of extreme-event data. The standard error of estimate is calculated in log units and in percentage for the predicted value at each recurrence probability. Input data may include events having a magnitude of zero or of less than some specified magnitude. These are handled by first using only the non-zero (or larger than specified magnitude) values in the computation, and then adjusting the probabilities according to the conditional probability relation. Output is tabular (fig. 38) and graphic (fig. 39).

STATION NO. IS 6- 8603.0 AND TWN-RNG ARE 13-30W FOR SB HACKBERRY C NR ORION KANS

INPUT DISCHARGES AND CODES ARE 630. 1 260. 1 140. 1 2300. 1 200. 1 90. 1 95. 1 1000. 1 770. 1 420. 1

4400. 2
DISCHARGES AND CODES USED ARE 630. 1 260. 1 140. 1 2300. 1 200. 1 90. 1 95. 1 1000. 1 770. 1 420. 1

4400. 2

STATISTICS OF FLOOD DISCHARGES

UNITS OF FLOOD DISCHARGE	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION	SKEW COEFFICIENT	FIRST ORDER SERIAL CORRELATION COEFFICIENT
CFS	936.818	1315.546	1.404	2.227	-0.198
LOGS OF CFS	2.646	0.553	0.209	0.441	-0.007
RECURRENCE INTERVAL, YEARS	1.20	2.33	5.00	10.00	20.00
DISCHARGE, LOG CFS	2.1456	2.6468	3.0443	3.3681	3.6786
					4.0806

ORIGINAL SEQUENCE ORDERED

2.7993	3.6435
2.4150	3.3617
2.1461	3.0000
3.3617	2.8865
2.3010	2.7993
1.9542	2.6232
1.9777	2.4150
3.0000	2.3010
2.8865	2.1461
2.6232	1.9777
3.6435	1.9542

LOG Q LINEAR PLOTTING POSITION

3.6435	2.4417
3.3617	1.7020
3.0000	1.2459
2.8865	0.9027
2.7993	0.6180
2.6232	0.3665
2.4150	0.1330
2.3010	-0.0940
2.1461	-0.3266
1.9777	-0.5832
1.9542	-0.9102

Figure 36.--Example table showing flood recurrence intervals and discharges (Gumbel method).

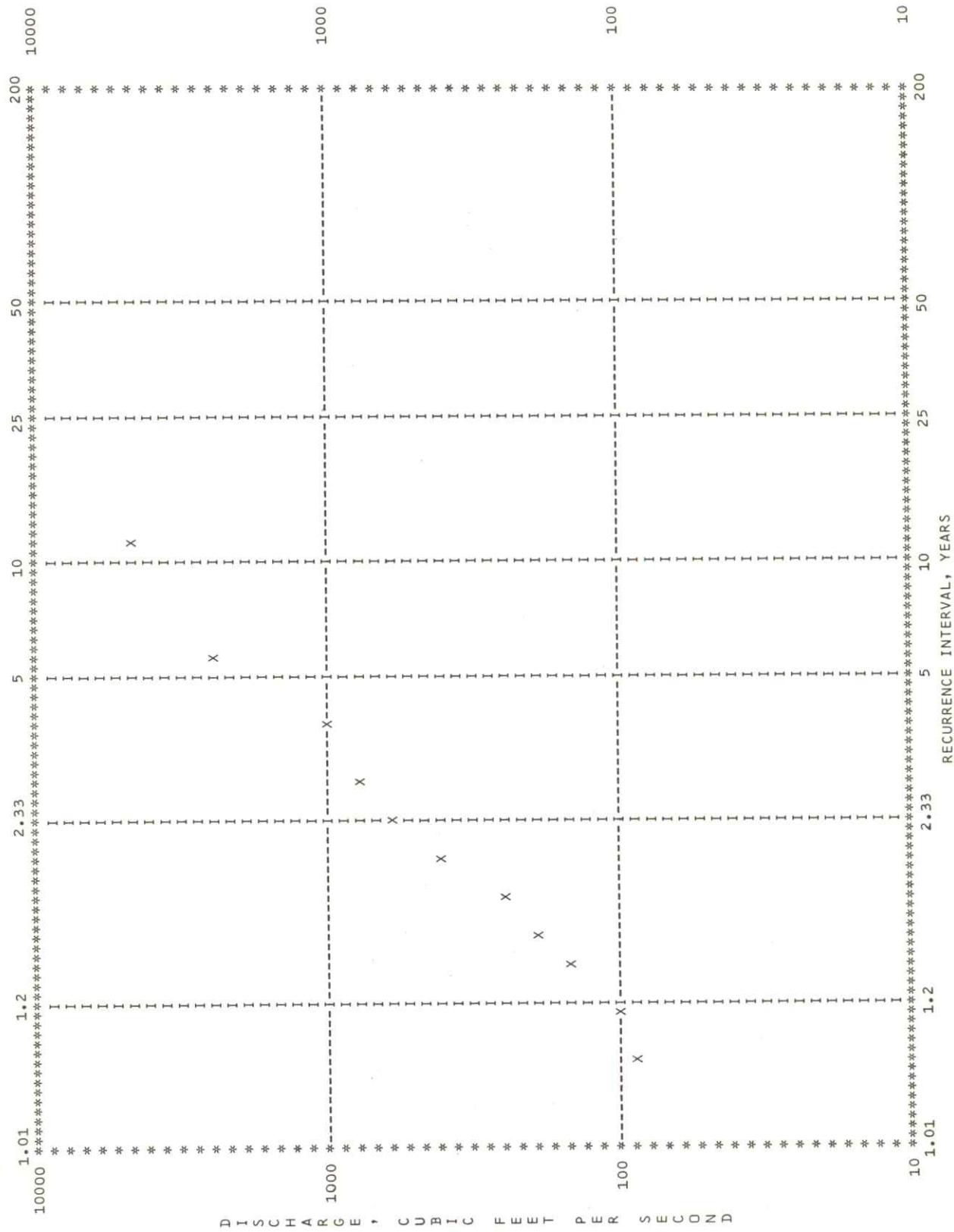


Figure 37.--Example graph showing flood recurrence intervals and discharges (Gumbel method).

TEST DATA 1922-24, 1930-64 7-DAY LOWS

STATION 6-9175. 0

1 N = 38

FLOW BELOW WHICH FLOWS ARE NOT USED IN COMPUTATION

LOW FLOW DATA

NUMBER OF VALUES ABOVE ZERO OR TOP = 35

0. OR 0.

INPUT DATA

1.000	1.000	5.000	1.000	1.000	0.400	2.000	0.	2.000	0.
1.000	1.000	1.000	1.000	1.000	0.700	0.	1.000	0.900	1.000
0.800	1.000	1.700	2.200	2.200	0.800	0.500	0.700	1.200	0.200
0.400	0.800	1.500	1.000	1.000	1.900	0.400	1.000		

MEAN LOGS = 0.018

STANDARD DEVIATION LOGS = 0.345

SKEDNESS LOGS = 1.703

STANDARD ERROR OF SKEDNESS LOGS = 0.398

RECCURENCE		RECCURENCE		MAGNITUDES		LOG UNITS		+ PERCENT		- PERCENT		AVG. PERCENT	
PROB	INTERVAL	INTERVAL	INTERVAL	MAGNITUDES	MAGNITUDES	LOG UNITS	LOG UNITS	+ PERCENT	+ PERCENT	- PERCENT	- PERCENT	AVG. PERCENT	AVG. PERCENT
0.9950	1.005	1.005	1.005	25.400	25.400	0.121	0.121	32.2	24.4	22.8	28.3	28.3	28.3
0.9900	1.010	1.010	1.010	15.500	15.500	0.112	0.112	29.5	22.8	21.1	26.2	26.2	26.2
0.9800	1.020	1.020	1.020	9.250	9.250	0.103	0.103	26.7	21.1	19.3	23.9	23.9	23.9
0.9600	1.042	1.042	1.042	5.570	5.570	0.093	0.093	23.8	19.3	18.6	21.5	21.5	21.5
0.9500	1.053	1.053	1.053	4.790	4.790	0.090	0.090	22.9	18.6	16.6	20.8	20.8	20.8
0.9000	1.111	1.111	1.111	2.850	2.850	0.079	0.079	19.9	16.6	14.5	18.2	18.2	18.2
0.8000	1.250	1.250	1.250	1.670	1.670	0.068	0.068	16.9	14.5	12.6	15.7	15.7	15.7
0.5000	2.000	2.000	2.000	0.787	0.787	0.058	0.058	14.4	12.6	10.5	13.5	13.5	13.5
0.2000	5.000	5.000	5.000	0.503	0.503	0.068	0.068	16.9	14.5	12.6	15.7	15.7	15.7
0.1000	10.000	10.000	10.000	0.432	0.432	0.079	0.079	19.9	16.6	14.5	18.2	18.2	18.2
0.0500	20.000	20.000	20.000	0.001	0.001								
0.0400	25.000	25.000	25.000	0.001	0.001								
0.0200	50.000	50.000	50.000	0.001	0.001								
0.0100	100.000	100.000	100.000	0.001	0.001								
0.0050	200.000	200.000	200.000	0.001	0.001								

Figure 38.--Example table showing extreme event (low flow) recurrence intervals and discharges (Pearson type III method). N is the number of values in the input data.

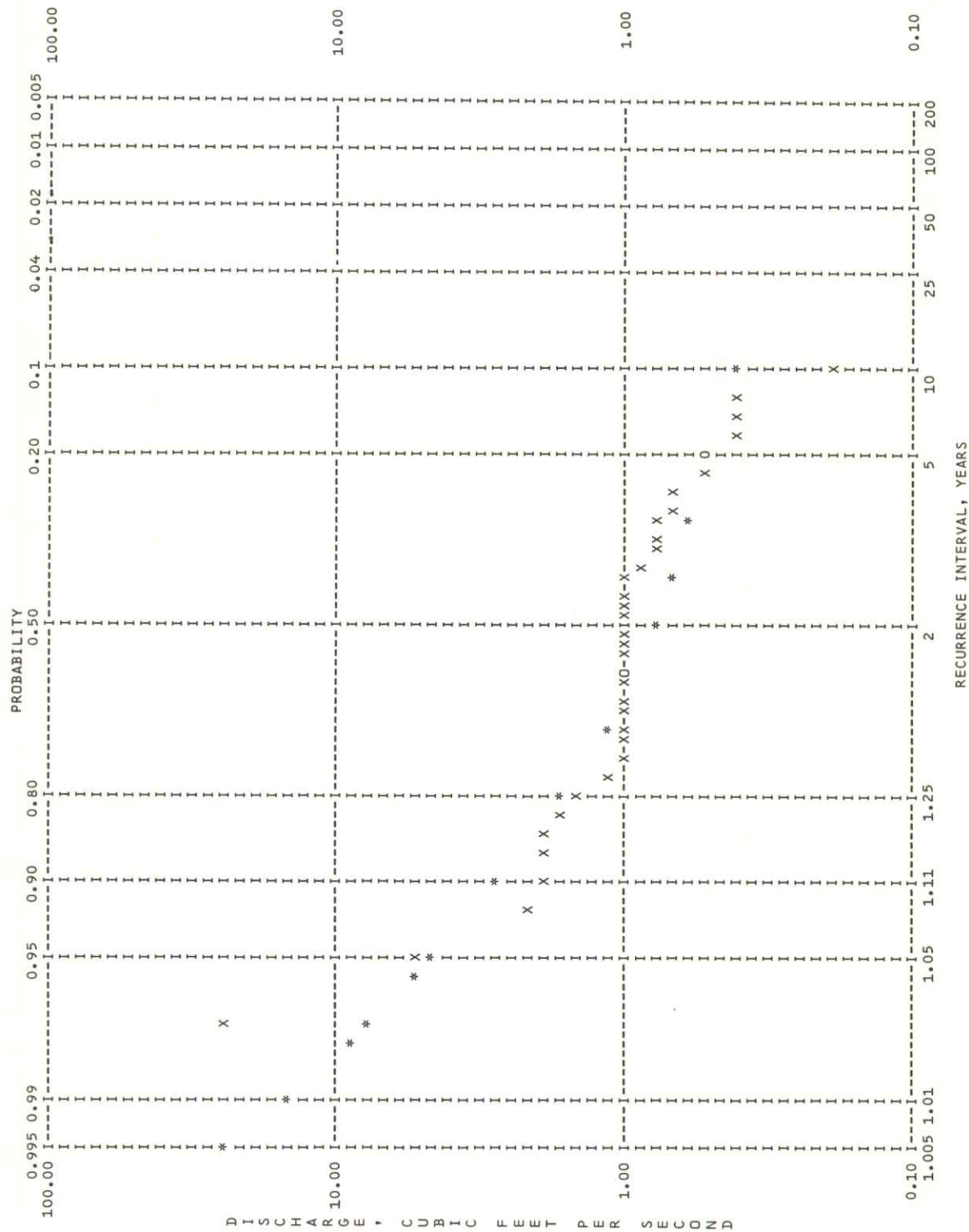


Figure 39.--Example graph showing extreme event (low flow) recurrence intervals and discharges (Pearson type III method). The symbols are: X, input flow data; *, predicted flow data; and 0, overprint value for predicted and input data.

Q50CAL

Q50CAL is a program that calculates the magnitudes of 2.33- and 50-year floods for Kansas streams. Methodology for the calculation comes from two reports (Ellis and Edelen, 1960; Irza, 1966). The program is part of a study to compute stage-drainage area-frequency relations for flood mapping in Kansas. The output is tabular (fig. 40).

INDEX	IDENT NO.	STATION NAME	REGION	LOCALE	D. AREA IN	D. AC.	D. AREA OUT	CHAN COMP	SLOPE	WET DAYS	Q2.33 CFS	Q50 CFS
1	6-8896.00	S. B. SHUNGANUNGA C. NR. PAULINE	B	1	384	2	3.84	CLAY	28.9	7.9	569.	3020.
1	6-8903.00	SPRING C. NR. WETMORE	B	1	210	1	21.0	CLAY	19.6	6.7	1140.	6050.
1	6-8906.00	ROCK C. AT MERIDEN	B	1	220	1	22.0	CLAY	16.3	7.7	1420.	7550.
1	6-8907.00	SLOUGH C. TRIB. NR. OSKALOOSA	B	1	83	2	0.83	CLAY	57.2	8.0	266.	1410.
1	6-8908.00	SLOUGH C. NR. OSKALOOSA	B	1	310	1	31.0	CLAY	17.3	8.0	1960.	10400.
1	6-9123.00	DRAGOON C. TRIB. NR. LYNDON	B	2	376	2	3.76	CLAY	62.7	8.9	908.	4810.
1	6-9136.00	ROCK C. NR. OTTAWA	B	2	102	1	10.2	CLAY	18.1	10.0	1430.	7560.
1	6-9137.00	MIDDLE C. NR. PRINCETON	B	2	520	1	52.0	SAND	12.1	1.0	55.	294.
1	6-9167.00	MIDDLE C. NR. KINCAID	B	2	202	2	2.02	CLAY	49.8	11.2	845.	4480.
1	6-9171.00	MARMATON R. TRIB. NR. BRONSON	B	2	88	2	0.88	CLAY	45.8	11.3	480.	2550.
1	6-9174.00	MARMATON R. TRIB. NR. FORT SCOTT	B	2	280	2	2.80	CLAY	45.5	12.0	1150.	6110.
1	7-1386.00	WHITE WOMAN C. TRIB. NR. SELKIRK	A	5	759	2	7.59	CLAY	20.5	4.3	263.	2320.
1	7-1388.00	LION C. TRIB. NR. MODOC	A	5	119	2	1.19	CLAY	27.8	4.0	75.	658.
1	7-1389.00	LION C. NR. MODOC	A	5	186	1	18.6	CLAY	12.8	4.0	356.	3140.
1	7-1397.00	ARKANSAS R. TRIB. NR. DODGE CITY	B	4	866	2	8.66	SAND	15.0	5.5	404.	2140.
1	7-1403.00	WHITE WOMAN C. NR. BELLEFONT	B	4	140	1	14.0	SAND	10.9	5.5	499.	2640.
1	7-1406.00	PAWNEE R. TRIB. NR. KALVESTA	B	4	689	2	6.89	SAND	14.3	5.0	287.	1520.
1	7-1414.00	S. F. WALNUT C. TRIB. NR. DIGHTON	B	4	81	2	0.81	SAND	23.0	5.0	82.	432.
1	7-1416.00	LONG BRANCH C. NR. NESS CITY	B	4	280	1	28.0	SAND	9.3	5.0	629.	3330.
1	7-1418.00	OTTER C. NR. RUSH CENTER	B	4	170	1	17.0	CLAY	16.4	5.5	652.	3460.

Figure 40.--Example table showing magnitudes of 2.33- and 50-year floods.

SURCK

SURCK is a program that checks low-flow partial-record station cards (see appendix) that are being used experimentally in the Kansas District. It checks for illegal characters, for coding errors, and whether the discharge measurements are in ascending date order (oldest measurement first).

The output (fig. 41) is in tabular form and contains a data group identifier (title) and a heading of numbers from 1-80 that corresponds to the 80 columns on a punch card. If errors are found, error messages are printed after the checking of each data card.

SURFACE WATER LOW-FLOW PARTIAL-RECORD STATIONS RECORDS

	1	2	3	4	5	6	7	8
	123456789012345678901234567890123456789012345678901234567890							
18 226-815800 319E20WOLF RIVER AT LEONA, KANSAS,								1
18 226-815800 319E30				135		1600	317E12	2
*** ERROR IN IDENT, COLUMN 19								
18 226-815800 319E20 960-								3
18 226-815800 319E20			6-8158.00	WOLF RIVER AT LEONA, KANSAS, WOLF				4
18 226-815800 319E20RIVER BASIN, ON WEST LINE SEC. 20, T.3S., R.19E.								5
18 226-815800 319E20AT BRIDGE ON COUNTY HIGHWAY, .5 MILE SOUTH OF LEON								6
18 226-815800 319E20A.								
18 226-815800 319E2011119593980 2512 29603990 2511149601300 25 4 39626760 25 101								
*** DATE NOT IN ASCENDING ORDER, COLUMNS 49 TO 55								
18 226-815700 319E2011129622190 25 2269633090 2511189635250 15 3 99641360 25 102								
*** ERROR IN IDENT, COLUMN 11								
18 226-815800 319E2010269644680 1511 89652840 25 3219661760 25 8 99669510 15 103								
18 226-815800 319E2010249664060 1512159669000 15 3209671140 25								

Figure 41.--Example table from streamflow-record error-checking program.

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GLOSSARY

- Break point - the point at which another increment of area, wetted perimeter, and conveyance is calculated.
- Bridge section - flow section under a bridge, measured perpendicular to the direction of flow.
- Channel-contraction ratio (M) - degree of contraction imposed by a constriction on the normal stream channel.
- Coefficient of variation - the ratio of the standard deviation to the mean.
- Conditional probability - the probability of an event, given that some other event has occurred. As used in LPK, it is the probability of an extreme event, given that it is one of the set that is larger than zero or other specified magnitude.
- Contraction width (b_t) - width of water surface at a contracted flow section.
- Conveyance - a measure of the carrying capacity of the channel. (See also K_a , K_b , and K_q .)
- Culvert section - flow section in a culvert, measured perpendicular to the direction of flow.
- Eccentricity ratio (e) - ratio of the conveyances K_a/K_b .
- First order serial correlation coefficient - a statistical expression of the closeness of relationship between succeeding events in a series.
- Flood, 2.33-year - a flood that is expected to be equaled or exceeded once in 2.33 years, on the average.
- Flood, 50-year - a flood that is expected to be equaled or exceeded once in 50 years, on the average.
- K_a and K_b - conveyances of the parts of the approach section. K_a is always the smaller of the two.
- K_e /day - kiloequivalents per day.
- K_q - conveyance of the part of the approach section carrying the discharge that passes through the opening without contraction.
- Log Pearson type III distribution - one of a series of probability distributions derived by Pearson. It is specified by three parameters--the mean, the standard deviation, and the skewness coefficient--which are calculated from the logarithms of the data.
- Open-channel section - flow section in an open channel measured perpendicular to the direction of flow.

Pier area - submerged cross-sectional area of piers or piles.

Seepage-salinity survey - a study designed to evaluate variations and fluctuations in the quantity and chemical quality of low streamflow, tributary inflow, and seepage in a reach of a stream.

Skew coefficient - a measure of the asymmetry of a probability distribution.

Sodium-adsorption ratio - a ratio for soil extracts and irrigation waters used to express the relative activity of sodium ions in exchange reactions with soil.

Storage coefficient - the volume of water released from storage in each vertical column of the aquifer having a base of 1 foot square when the water table or other piezometric surface declines 1 foot.

Total area - area of bridge section, including pier area.

Transmissivity - the rate of flow of water, in gallons per day, at the prevailing water temperature, through each vertical strip of the aquifer 1 foot wide having a height equal to the thickness of the aquifer and under a unit hydraulic gradient.

Velocity head adjustment factor - a coefficient which corrects for uneven velocity distribution in a section.

APPENDIX

Coding forms used for preparation of data prior to usage by programs.

Well schedule form ABC (front)

FORM 9-1642B
(DEC. 68)

Well No. _____

WELL SCHEDULE

U. S. DEPT. OF THE INTERIOR

GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

MASTER CARD

Record by _____ Source of data _____ Date _____ Map _____

State _____ County _____ (or town) _____

Latitude: _____ N _____ S _____ Longitude: _____ 12 degrees _____ 13 min _____ 14 sec _____ Sequential number: _____

Lat-long accuracy: _____ T. _____ S. _____ R. _____ W. _____ Sec. _____, _____, _____, _____ B & M

Local well number: _____ Other number: _____

Local use: _____ Owner or name: _____

Owner or name: _____ Address: _____

Ownership: County, Fed Gov't, City, Corp or Co, Private, State Agency, Water Dist _____

Use of water: (A) Air cond, Bottling, Comm, Dewater, Power, Fire, Dom, Irr, Med, Ind, P S, Rec, (S) Stock, Instit, Unused, Repressure, Recharge, Desal-P S, Desal-other, Other _____

Use of well: (A) Anode, Drain, Seismic, Heat Res, Obs, Oil-gas, Recharge, Test, Unused, Withdraw, Waste, Destroyed _____

DATA AVAILABLE: Well data _____ Freq. W/L meas.: _____ Field aquifer char. _____

Hyd. lab. data: _____

Qual. water data; type: _____

Freq. sampling: _____ Pumpage inventory: _____ yes _____ no, period: _____

Aperture cards: _____ yes _____

Log data: _____

WELL-DESCRIPTION CARD

SAME AS ON MASTER CARD Depth well: _____ ft _____ Meas. _____

Depth cased: _____ ft _____ Casing type: _____; Diam. _____ in _____

Finish: (C) porous concrete, (F) gravel w. (H) gravel w. (G) horiz. open (P) perf., (S) screen, (T) sd. pt., (W) shored, (X) open hole, (Z) other _____

Method: (A) air, (B) bored, (C) cable, (D) dug, (H) hyd, (J) jetted, (P) air, (R) reverse, (T) trenching, (V) driven, (W) drive, (Z) wash, other _____

Date _____ Pump intake setting: _____ ft _____

Driller: _____ name _____ address _____

Lift (type): (A) air, (B) bucket, (C) cent, (J) jet, (L) multiple, (M) multiple, (N) none, (P) piston, (R) rot, (S) submerg, (T) turb, other _____ Deep _____ Shallow _____

Power (type): nat, diesel, elec, gas, gasoline, hand, gas, wind; H.P. _____ Trans. or meter no. _____

Descrip. MP _____ ft above _____ below LSD, Alt. MP _____

Alt. LSD: _____ Accuracy: _____ (source) _____

Water Level _____ ft above _____ below MP; Ft below LSD _____ Accuracy: _____

Date _____ Yield: _____ gpm _____ Method determined _____

Drawdown: _____ ft _____ Accuracy: _____ Pumping period _____ hrs _____

QUALITY OF WATER DATA: Iron _____ ppm _____ Sulfate _____ ppm _____ Chloride _____ ppm _____ Hard. _____ ppm _____

Sp. Conduct _____ K x 10 _____ Temp. _____ °F _____ Date sampled _____

Taste, color, etc. _____

Well No. _____

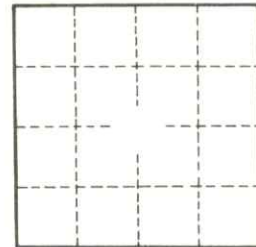
Well schedule form ABC (back)

Well No. _____

Latitude-longitude N
S
d m s d m s

HYDROGEOLOGIC CARD

SAME AS ON MASTER CARD		Physiographic Province: _____	Section: _____
19	20	21	22
Drainage Basin: _____		Subbasin: _____	
(D) (C) (E) (F) (H) (K) (L) depression, stream channel, dunes, flat, hilltop, sink, swamp, offshore, pediment, hillside, terrace, undulating, valley flat			
MAJOR AQUIFER: _____		28	29
system _____ series _____		aquifer, formation, group _____	
Lithology: _____		Origin: _____	Aquifer Thickness: _____ ft
33	34	35	36
Length of well open to: _____ ft		Depth to top of: _____ ft	
MINOR AQUIFER: _____		44	45
system _____ series _____		aquifer, formation, group _____	
Lithology: _____		Origin: _____	Aquifer Thickness: _____ ft
51	52	53	54
Length of well open to: _____ ft		Depth to top of: _____ ft	
Intervals Screened: _____			
Depth to consolidated rock: _____ ft		60	61
Depth to basement: _____ ft		65	66
Surficial material: _____		Infiltration characteristics: _____	
Coefficient Trans: _____ gpd/ft		70	71
Coefficient Perm: _____ gpd/ft ²		Coefficient Storage: _____	
Spec cap: _____ gpm/ft		76	77
Number of geologic cards: _____		79	



Well No. _____

Water level form--cards 101-999

Geological Survey

Experimental form: WLD-2

UNITED STATES DEPARTMENT OF THE INTERIOR

Water-Level Data

Card 101-999 a
Duplicate each card 1-19 (card 1)

Water level					
M	D	Y	+		Sts
					.
20					26 b
					30

[illegible][illegible][illegible]

Water level					Sts
M	D	Y	+		
1	1	1			

	M	D	Y	+	Water level	Sts
72	|	|	|	|		
68 b	|	|	|	|		.
75	|	|	|	|		

[illegible]

	M	D	Y	+	Water level	
72						Sts
68 b						
75						

a Number cards in sequence starting with 101.
b Water levels above land surface, punch a plus (+). Levels below, leave column blank.
c Leave card number on last card blank.

[illegible]

Type		76
Frequency		77

Water level				
M	D	Y	+	Sts
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9
10	10	10	10	10
11	11	11	11	11
12	12	12	12	12
13	13	13	13	13
14	14	14	14	14
15	15	15	15	15
16	16	16	16	16
17	17	17	17	17
18	18	18	18	18
19	19	19	19	19
20	20	20	20	20
21	21	21	21	21
22	22	22	22	22
23	23	23	23	23
24	24	24	24	24
25	25	25	25	25
26	26	26	26	26
27	27	27	27	27
28	28	28	28	28
29	29	29	29	29
30	30	30	30	30
31	31	31	31	31
32	32	32	32	32
33	33	33	33	33
34	34	34	34	34
35	35	35	35	35
36	36	36	36	36
37	37	37	37	37
38	38	38	38	38
39	39	39	39	39
40	40	40	40	40
41	41	41	41	41
42	42	42	42	42
43	43	43	43	43
44	44	44	44	44
45	45	45	45	45
46	46	46	46	46
47	47	47	47	47
48	48	48	48	48
49	49	49	49	49
50	50	50	50	50

Type	Frequency
☐	76
☐	77

	M	D	Y	+	Water level	Srs
34	|	|	|	|	40 b	|
47	|	|	|	|		|

Type	Frequency
☐	76
☐	77

Water level				
M	D	Y	+	Sts
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9
10	10	10	10	10
11	11	11	11	11
12	12	12	12	12
13	13	13	13	13
14	14	14	14	14
15	15	15	15	15
16	16	16	16	16
17	17	17	17	17
18	18	18	18	18
19	19	19	19	19
20	20	20	20	20
21	21	21	21	21
22	22	22	22	22
23	23	23	23	23
24	24	24	24	24
25	25	25	25	25
26	26	26	26	26
27	27	27	27	27
28	28	28	28	28
29	29	29	29	29
30	30	30	30	30
31	31	31	31	31
32	32	32	32	32
33	33	33	33	33
34	34	34	34	34
35	35	35	35	35
36	36	36	36	36
37	37	37	37	37
38	38	38	38	38
39	39	39	39	39
40	40	40	40	40
41	41	41	41	41
42	42	42	42	42
43	43	43	43	43
44	44	44	44	44
45	45	45	45	45
46	46	46	46	46
47	47	47	47	47

Type	Frequency
☐	76
☐	77

[illegible]

Card No. c

--	--	--	--

78 80

	Water level					
	M	D	Y	+	Sts	
8						
54 b						*
61						

Card No. c

Water level				
M	D	Y	+	Sts
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
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95				
96				
97				
98				
99				
100				

Card No. c

[illegible]

Observer	_____
Date	_____
Punched by	_____
Date	_____
Verified by	_____
Date	_____

Header Card

State County Recorded By

Location 1/4 1/4 1/4, Section T S R E-W Well Number

T	R	E-W	Sec.	1/4	1/4	1/4	No.			
4	5	6	7	8	9	10	11	12	13	14

Owner Address

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

 Date Recorded

Driller Address

38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

 Date Drilled

Method Drilled 65 Type Log 66

Other Type Logs Available 67 Altitude, Datum

68	69	70	71	72
----	----	----	----	----

 Accuracy 73

Depth To Top Of First Recorded Unit Below Datum Feet

74	75	76	77
----	----	----	----

 Number Of Data Cards

78	79	80
----	----	----

Log Data Cards

15	16	17	18	19	20	21	22	23	24	25	26
27	28	29	30	31	32	33	34	35	36	37	38
39	40	41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60	61	62
63	64	65	66	67	68	69	70	71	72	73	74
75	76	77	78	79	80	75	76	77	78	79	80
Card Number						Card Number					

Kansas sediment coding form

State			County				National Identification Number				Local Location		T		R		E-W Sect.		Lat.		N, S	
	1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	26	27
Long.			Station Name																			
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	70
Drainage Area			Drainage Area Acc.																			
	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92

[illegible]

Card 1

Card 2

Card 3

^a Record last 3 digits of year with a comma (,) or a dash (-). The comma (,) indicates a break in measurement sequence; the dash (-) indicates a continuing record.

Low-flow partial-record station form--card type 4

Card 4

1) Duplicate 1-20 (same as preceding cards) on all heading cards. 2) Start card 1 of heading in column 26. Subsequent cards start in column 21. 3) Number cards (79-80) in sequence beginning with card 3. 4) Punch exactly as written with no breaks between each group of cards. 5) Leave columns 79-80 blank on last heading card.

Line 1																				26	30	40	50	60	70		
Line 2																				21	30	40	50	60	70		
Line 3																				21	30	40	50	60	70		
Line 4																				21	30	40	50	60	70		
Line 5																				21	30	40	50	60	70		
Line 6																				21	30	40	50	60	70		
Line 7																				21	30	40	50	60	70		
Line 8																				21	30	40	50	60	70		
Line 9																				21	30	40	50	60	70		
Line 10																				21	30	40	50	60	70		

Card 5

1) Duplicate 1-20 (same as preceding cards). Number cards starting at 101. Leave card number on last card blank.

Mon	Day	Year	Value	Expon.	Status	Mon	Day	Year	Value	Expon.	Status
21 22	23 24	25 27	28 31	32 33	34	35 36	37 38	39 41	42 45	46 47	48
Mon	Day	Year	Value	Expon.	Status	Mon	Day	Year	Value	Expon.	Status
49 50	51 52	53 55	56 59	60 61	62	63 64	65 66	67 69	70 73	74 75	76 77 80

Mon	Day	Year	Value	Expon.	Status	Mon	Day	Year	Value	Expon.	Status
21 22	23 24	25 27	28 31	32 33	34	35 36	37 38	39 41	42 45	46 47	48
Mon	Day	Year	Value	Expon.	Status	Mon	Day	Year	Value	Expon.	Status
49 50	51 52	53 55	56 59	60 61	62	63 64	65 66	67 69	70 73	74 75	76 77 80

Mon	Day	Year	Value	Expon.	Status	Mon	Day	Year	Value	Expon.	Status
21 22	23 24	25 27	28 31	32 33	34	35 36	37 38	39 41	42 45	46 47	48
Mon	Day	Year	Value	Expon.	Status	Mon	Day	Year	Value	Expon.	Status
49 50	51 52	53 55	56 59	60 61	62	63 64	65 66	67 69	70 73	74 75	76 77 80

Mon	Day	Year	Value	Expon.	Status	Mon	Day	Year	Value	Expon.	Status
21 22	23 24	25 27	28 31	32 33	34	35 36	37 38	39 41	42 45	46 47	48
Mon	Day	Year	Value	Expon.	Status	Mon	Day	Year	Value	Expon.	Status
49 50	51 52	53 55	56 59	60 61	62	63 64	65 66	67 69	70 73	74 75	76 77 80

Mon	Day	Year	Value	Expon.	Status	Mon	Day	Year	Value	Expon.	Status
21 22	23 24	25 27	28 31	32 33	34	35 36	37 38	39 41	42 45	46 47	48
Mon	Day	Year	Value	Expon.	Status	Mon	Day	Year	Value	Expon.	Status
49 50	51 52	53 55	56 59	60 61	62	63 64	65 66	67 69	70 73	74 75	76 77 80

