Comprehensive Information Retrieval and Model Input Sequence (CIRMIS)

D. R. Friedrichs

April 1977

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MODEL INPUT SEQUENCE (CIRMIS)

by
D. R. Friedrichs

April 1977

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COMPREHENSIVE INFORMATION RETRIEVAL AND MODEL INPUT SEQUENCE (CIRMIS)

D. R. FRIEDRICH

INTRODUCTION

In the past, solutions to problems in water resources and pollution control were very time-consuming because of the slow response of data processing techniques. Better methods were required for obtaining data, error checking, storing data, and for implementing and producing results that would expedite these solution times. The Comprehensive Information Retrieval and Model Input Sequence (CIRMIS) was developed to provide the research scientist with man-machine interactive capabilities in a real-time environment, thereby producing results more quickly and efficiently.

The CIRMIS system was originally developed to increase data storage and retrieval capabilities and ground-water model control for the Hanford site. The overall configuration, however, was designed to be flexible for use in other areas.

Expansion of this system has continued for several years, and CIRMIS has proven to be an invaluable tool by furnishing rapid access to data as well as rapid input of boundary maps or isopleth surfaces and interactive control of ground-water models.

The CIRMIS system provides the user with three major functions: 1) retrieval of well based data, 2) special application for manipulating surface data or background maps and 3) the manipulation and control of ground-water models. These programs comprise only a portion of the entire CIRMIS system. A complete description of the CIRMIS system is given in the following text.

CIRMIS HARDWARE CONFIGURATION

The Water and Land Resources Computer Facility consists of two major systems (Figure 1). The basis of the main system is a PDP-11/45 processor with 124K core storage; three 20-million word mass storage units; several on-line terminals and output devices; and multi-user capabilities. The secondary system, a PDP-9 computer is used as the main controller for the CIRMIS system. The PDP-9 has 16K core storage; a 1-million word high-speed disc storage unit; advanced input/output; and hands-on interactive capabilities. The two computer systems are connected via a 9600-baud data link.

The interactive PDP-9 computer provides visual man-machine interactive capabilities through the use of a display with light pen keyboard and function keys (Figure 2) and a coordinate digitizer with a cursor and 16 function keyboard (Figure 3). The impression is given that the PDP-9 computer is the only one in operation even though the bulk of the computing is accomplished at the 11/45. As the user operates certain models, or makes various data requests, a constant, almost transparent communication occurs between the two computers.

The CIRMIS system involves both computers. Major operating programs are stored on one disc unit at the 11/45 and both permanent and temporary data are stored on another disc. A smaller disc at the PDP-9 is used for temporary data storage and storage of the interactive graphic programs which control CIRMIS operations.

The CIRMIS system can also service requests from terminals other than the direct-connected interactive computer connected via data link. The Atlantic Richfield Hanford Company (ARHCO) has a dedicated telephone line to the 11/45 which services a Tektronix 4014 graphic terminal (Figure 4) located 20 miles from the computer facility. This terminal has a 19 in. diagonal screen with a keyboard and pseudo-tracking cross capabilities similar to the UNIVAC 1558 scope at the interactive computer. However, the 4014 is a memory scope whereas the 1558 is a refresh scope.

FIGURE 1. Computer Hardware Configuration

FIGURE 2. UNIVAC 1558 Display Console

FIGURE 3. Coordinate Digitizer

The 4014 terminal acts much like the interactive computer, but since it has no core memory it is dependent upon the 11/45 for drawing displays on the scope. This is considerably slower, and combining a lack of a coordinate digitizer, the 4014 is not able to use the CIRMIS system to its full extent.

The 11/45 also has dial-up telephone capabilities. A portable ADDS terminal (Figure 5) with a 5-in. CRT and keyboard may be used similarly to the 4014 terminal. Although the ADDS has fewer capabilities, it may be used anywhere there is a phone. The user dials the number at the computer, attaches the telephone receiver to the data modem at the side of the ADDS and then activates the CIRMIS system.

CIRMIS SOFTWARE CONFIGURATION

The monitor programs for each computer are designed to provide the bulk of the data requests and error diagnosis for the CIRMIS system. Some of the special applications programs and models do interact between computers and bypass the monitors after the initial data requests and control parameters have been issued. Figure 6 shows a schematic of the entire CIRMIS programming network and the manner in which the programs interact. While the schematic is greatly simplified, the basic interactions are shown. Figures 7 and 8 show the basic program interactions at the 11/45 and PDP-9, respectively.

CIRMIS PROGRAMMING STANDARDS AND PROCEDURES

During development of the CIRMIS system, a method was established to regulate the rapidly increasing number of programs required by the system. Basic FORTRAN programming standards and procedures have been adopted and others are in the process of being applied.

FIGURE 4. Tektronix 4014 Display

FIGURE 5. ADDS Portable Terminal

FLOW CHART FOR CIRMIS

FIGURE 6. Overall CIRMIS Software Configuration

WELL BASED DATA ACQUISITION AND RETRIEVAL - PDP 11/45

MODEL INPUT-OUTPUT SEQUENCE - PDP 11/45

NOTE: THESE MODELS HAVE ALL OUTPUT CAPABILITIES

FIGURE 7. 11/45 Software Sequences

WELL BASED DATA RETRIEVAL - PDP 9

SPECIAL APPLICATIONS - PDP 9

MODEL INPUT SEQUENCING - PDP 9

FIGURE 8. PDP-9 Software Sequences

PROGRAM HEADER BLOCKS

All main programs and subroutines will include header blocks which contain all of the information pertinent to a particular program. This information includes: 1) program name, 2) program identification (ID), 3) program description, 4) data files used, 5) loading sequence 6) author(s) and 7) dates. File [106,215] HEADR.FTN contains a skeleton of the header block which can be read in at the front of each program and the blanks filled in with the proper information. In this way all programs are consistent with one another and the pertinent information is readily available. Figure 9 shows an example of the header block where the information added by the user has been underlined.

```

***** EXAMPLE OF A PROGRAM HEADER*****

C ***** (106,215)PROGRAM.FTN *****
C
C PROGRAM ID: SNV-11-MEL-104 (FUNCTION=HALMINE-CATEGORY=DATA TYPE=I/O DEV)
C
C PROGRAM DESCRIPTION:
C THIS IS AN EXAMPLE OF THE USE OF THE HEADER FILE
C
C DATA FILES:
C


| NAME                   | LOG      | TYPE       | ACCESS     |
|------------------------|----------|------------|------------|
| <u>(10,0)DATA,RAN</u>  | <u>2</u> | <u>RAN</u> | <u>R/W</u> |
| <u>(20,3)FILE,SON</u>  | <u>3</u> | <u>SCB</u> | <u>W</u>   |
| <u>(21,3)GUMPY,FOW</u> | <u>5</u> | <u>FOR</u> | <u>R</u>   |


C
C LOADING SEQUENCE: (OMITTED FOR SUBROUTINES)
C POP11/85
C CRATA, SC+TRADLU
C POP9
C SA VRT, LV
C SGLOAU
C DE DSWELL, (NRI, WITIN(ALT))
C
C BATTLE MEMORIAL INSTITUTE
C PACIFIC NORTHWEST LABORATORIES
C WATER & LAND RESOURCES DEPT.
C
C AUTHOR(S): JOE ALON & WILLIE HARETT
C
C DATE: INITIAL VERSION JAN 1974
C CURRENT VERSION JUL 1974
C
C
C

```

FIGURE 9. Program Header Block

PROGRAM IDENTIFICATION CODES (ID)

The program ID is an alphanumeric string which describes the function and position of a program within the CIRMIS network. The code consists of a three- to five-segment string with each segment separated by hyphens. This ID is located near the top of the header block for rapid reference. The five segments of the ID are--Function-Machine-Category-Data Type-I/O Dev--and are defined as follows:

1. Functional Category - This defines a program's basic function type

GEN - Generator/Updater Program

MON - Link Monitor Routine

SEL - Data and/or Device Selector/Inserter

SRV - Service Routines (Available for on-line Interaction)

UTL - Special Utility Routine

2. Machine Code - Defines the computer on which a program will run

11 - WLR PDP-11/45 Computer

9 - WLR PDP-9 Computer

3. Data Access Category - Defines the data access controller routine

WEL - Well Based Data

COR - Crib Discharge Records

MIS - Model Input Sequence

SPA - Special Applications

4. Data Type or Model Type Code - (if applicable)

If the access category is (WEL) the following codes may apply:

0 (HYD) - Hydrograph Data

1 (CTM) - Contamination Data

2 (WDC) - Well Structures Information

3 (WLG) - Well Log Records

4 (SVE) - Sieve Analyses

5 (PMP) - Pump Test Results

6 (PHY) - Physical Properties of Soils

7 (CHM) - Chemical Properties of Soils

If the access category is (MIS) the following codes may apply:

- 0 (TIR) - Iterative Sequence Model
 - 1 (VTI) - Variable Thickness Transient Model
 - 2 (PST) - Partially-Saturated Transient Model
 - 3 (MMT) - Micro-Macro Transport Model
 - 4 (BCT) - Boundary Calculation Type Program
5. I/O Device Code - (if applicable)
- 0 (SCP) - Univac Display
 - 1 (CAL) - Calcomp Plotter
 - 2 (LPR) - Line Printer
 - 3 (GLD) - Gould Printer/Plotter
 - 4 (TEK) - Tektronix Scope
 - 5 (ADS) - Adds Terminal

DATA FILE TYPE CODES

The data file type codes shown under the title DATA FILES in the header block are used to describe the type of data in a particular file. The data type is used as the extension in the normal 11/45 file naming convention. By standardizing the data type the type of access can easily be determined and the programmer knows immediately how the data are to be read or written. There are three basic data file type codes:

- RAN - Random Access Binary Structure
- SQB - Sequential Binary Structure
- FOR - Formatted ASCII

PROGRAM NAMING CONVENTIONS

Most programs in the CIRMIS system can be named using a combination of the three-letter mnemonics shown under the explanation of Program ID codes. The six-letter program names are determined by combining the three-letter mnemonic for a specific data type with the three-letter mnemonic of a function type or an I/O device type. For example:

- The program that retrieves hydrograph data and creates a Calcomp plot would be designated as

[HYD] + [CAL] = HYDCAL

- The program that displays well contaminant data on the UNIVAC scope would be

[CTM] + [SCP] = CTMSCP

- The routine that generates the well log data file would be

[WLG] + [GEN] = WLGGEN

FORTRAN COMMENTING CONVENTIONS

The FORTRAN programs comprising the CIRMIS system are generally very well commented as a future aid to programmers. Several commenting standards, which indicate levels of priority, are typically used in these programs. These are shown in Figure 10.

FIGURE 10. FORTRAN Commenting Conventions

FORTRAN PROGRAM NUMBERING CONVENTIONS

The programs within the CIRMIS system all use a set numbering convention. This numbering convention was adopted to standardize all of the programs and make them easy to read; allow later program additions to be made without destroying the readability; and allow the rapid location of any statement or format number within the program. Figure 11 shows two program examples using the numbering convention.

<u>PROGRAM NUMBERING CONVENTIONS</u>		
<u>NUMBERS</u>	<u>USE</u>	
11-99	FIRST ORDER PROGRAM SEQUENCING.	
1100-9999	FIRST HIGHER ORDER PROGRAM SEQUENCING.	
11000-99999	SECOND HIGHER ORDER PROGRAM SEQUENCING.	
100-999	FORMAT NUMBERING.	
<u>EXT</u>	LUN 1 = 100-199 LUN 2 = 200-299 ETC.	
<u>NOTE:</u>	GENERALLY THE SECOND 2 DIGITS IN A FORMAT LABEL CAN CORRELATE WITH THE PREVIOUS FIRST ORDER PROGRAM SEQUENCE NO.	
<u>EXT</u>	34	UN 35 J01,0 WRITE(2,234) J
	234	FORMAT(16)
	35	CONTINUE
<u>PROGRAM EXAMPLE 1 :</u>		
		<u>TYPE</u>
11	READ(0,011) NPT	FIRST ORDER
011	FORMAT(16)	FORMAT
	DO 12 J=1,NPT	
	WRITE(3,311) J	
311	FORMAT(12)	FORMAT
	DO 1150 K=1,0	
	VALUE=J**2	
1150	CONTINUE	FIRST HIGHER ORDER
12	CONTINUE	FIRST ORDER
	GO TO 11	
	STOP	
	END	
<u>EXAMPLE 2:</u>		
		<u>TYPE</u>
20	IF(IX,LT,0) GO TO 40	FIRST ORDER
	NX=FLOAT(IX)*HSFAC	
2050	P=NX	FIRST HIGHER ORDER
20501	P=P+1.	SECOND HIGHER ORDER
2051	P=P**2	FIRST HIGHER ORDER
	WRITE(3,320) P,NX	
320	FORMAT(2F10.0)	FORMAT
	IF(IX,EQ,1) GO TO 20501	
	GO TO 20	
25	Q=ABS(IX)*2.	FIRST ORDER
	IF(Q,GT,100.) GO TO 26	
2500	GO TO 20	FIRST HIGHER ORDER
26	STOP	FIRST ORDER
	END	

FIGURE 11. FORTRAN Numbering Conventions

CIRMIS WELL BASED DATA

Well based data can involve several different types and can be quite voluminous especially if collected over several years. This section details the initial setup procedures, file structures, data types and output capabilities for the well based data portion of the CIRMIS system. This portion must be structured so the data can be stored to allow rapid access with as little wasted storage as possible. In addition the procedure adopted for the CIRMIS system provides capabilities for modifying or adding data to existing data types or inserting new data types into the system without major modification. Updating requires no modification, while adding new data types only requires programs to store and retrieve the new data and minor modification to the existing system to acknowledge the new data entry.

WELL HEADER FILE

The well header file is the most important element of the well based data portion because without the header file none of programs can be operated. The header file contains all of the primary information for each well including pointers and addresses to the files containing various data types. Until additional programs are developed the header file must be regenerated each time new wells are added to the system. This regeneration is mandatory because addition of wells may reposition the existing wells in the header file.

The CIRMIS well based data is accessed by individual well using a technique unique to each project because of differences in designating well locations from project to project. The technique previously used for selecting an individual well used sequential table lookup procedures. This meant that a list of all of the wells in the particular modeled region was searched sequentially until a match of the selected well was found. When this was completed a unique disc address for the selected well could then be accessed in the header file to retrieve all of the pointers to the pertinent data

for the selected well. This was a slow procedure especially when the selected well was located at the end of the sequential list.

To overcome this problem a method was devised to use the actual well designation itself to form an individual disc address. In this manner each well could be accessed directly without the extensive sequential search. This method employs a combination of bit extraction and hashing which is becoming more widely used in computer data base management systems. More disc space is required to store the well header information, but the rapid access of these data once stored outweighs this disadvantage.

The well header contains a 256-integer word block for each well. The last integer word (256) in the block contains either a minus one (-1), or in the case of a duplicate entry, a disc address pointing to a block in an assigned free buffer area where the duplicate can be located.

Each project then requires a unique set of programs to establish a hashing technique that will satisfy certain criteria. These criteria are:

1. keep total number of disc blocks to a minimum
2. keep total number of duplicate addresses to a minimum.

It is possible to obtain the same disc address for more than one well after hashing. This is not a problem, however, because the hashing program sets up initial free buffer areas where wells that have duplicate disc addresses can be stored.

For the Hanford wells, separate storage areas were set aside in a 4000 word block well header file for each of seven categories defined by the well prefix (i.e., 199, 299E, 299W, 399, 699, 1199 and 3099). This simplified the initial hashing procedure since each category was assigned a set of extracted bits and multiplication factor and disc storage area within the 4000 word block. Table 1 shows the location and sizes of blocks for each category after all seven categories of wells had been successfully hashed.

TABLE 1. Assigned Storage of Hanford Wells in WELLHDR File

Well Prefix	Total Wells in File	Highest Disc Addr. After Hashing...	No. of Duplicates	Duplicate Storage Areas			Assigned Disc Storage	Disc Area
				Block Range	Sectors Per Block	Total Free		
199	102	178	18	0 + 22	23	23	200	0 + 199
299E	512	981	110	114 + 200 202 + 300	87 99	196	1000	200 + 1199
299W	696	1128	94	19 + 80 709 + 755	62 47	109	1300	1200 + 2499
399	37	49	5	50 + 74	25	25	75	2500 + 2574
699	667	1120	185	989 + 1072 1076 + 1112 1121 + 1199	84 37 129	350	1250	2575 + 3824
1199	105	141	37	44 + 89	46	46	150	3825 + 3974
3099	9	12	0	-	-	-	25	3975 + 3999
	2128		449					

The initial hashing program (BITEXT) is run several times for each well category with different input parameters (Table 2), such as which bits to extract from the well designation and a multiplication factor. The program then uses these parameters to calculate a disc address for each well and when completed outputs a summary similar to that shown in Figure 12. When the user is satisfied that the largest calculated disc address and number of duplicates are at a minimum, the final set of parameters are used in another program (HORGEN) to calculate the File Q well header file. These same parameters are used in an 11/45 monitor subroutine (HASHER) to retrieve the header block for each well. Appendix A shows the final parameters for each well category.

The BITEXT program combines the specified bits from words 3 and 4 of the well designation to form a new word (WORD1), then multiplies this by the multiplication factor and adds the word (WORD2) derived from combining the specified bits from words 5 and 6 of the well designation.

The 11/45 computer has a sixteen bit integer word. Each sixteen bit word contains two bytes of eight bits. Alphanumeric characters can be

TABLE 2. BITEXT Input File Description for 699 Wells

<u>Data</u>	<u>Card No.</u>	<u>Format</u>	<u>Name</u>	<u>Description</u>
699.	1	A4,A1	TEST2,AA	Well Prefix (i.e.: 199,299E,299W,399,499,1199,3099)
10.0,	2	F10.0	FACT	Multiplication Factor
0,	3A	I2	NBIT(1)	Number of Bits to be Extracted from Word 1
7,	4A	I2	NBIT(2)	Number of Bits to be Extracted from Word 4
11,10,9,8,2,1,0,	4B	I6I2	IBIT(2,3)	Location of Bits to be Extracted from Word 4
3,	5A	I2	NBIT(3)	Number of Bits to be Extracted from Word 5
2,1,0,	5B	I6I2	IBIT(3,4)	Location of Bits to be Extracted from Word 5
6,	6A	I2	NBIT(4)	Number of Bits to be Extracted from Word 6
10,9,8,2,1,0,	6B	I6I2	IBIT(4,5)	Location of Bits to be Extracted from Word 6

***** BITEXT TIME= 10142:15 DATE= 17-FEB-77 *****

THIS PROGRAM ALLOWS THE USER TO SPECIFY BITS FOR BIT EXTRACTION FROM THE LAST 4 WORDS IN A 6 WORD WELL DESIGNATION

HANFORD WELL PREFIX 699

MULTIPLYING FACTOR= 10,000

BITS EXTRACTED FROM WORD 3 = 0

BITS EXTRACTED FROM WORD 4 = 7

BIT LOCATIONS USED (0 - 15) 11,10, 9, 8, 2, 1, 0,

BITS EXTRACTED FROM WORD 5 = 3

BIT LOCATIONS USED (0 - 15) 2, 1, 0,

BITS EXTRACTED FROM WORD 6 = 6

BIT LOCATIONS USED (0 - 15) 10, 9, 8, 2, 1, 0,

699 858 E7	WORD1=	44	WORD2=	47	OISC, ADR, =	447
699 855 E6	WORD1=	45	WORD2=	46	OISC, ADR, =	446
699 854 E6	WORD1=	44	WORD2=	46	OISC, ADR, =	446
699 854 E5	WORD1=	44	WORD2=	45	OISC, ADR, =	445
699 853 E2	WORD1=	43	WORD2=	42	OISC, ADR, =	472
699 852 E3A	WORD1=	42	WORD2=	345	OISC, ADR, =	765 ←
699 852 E3B	WORD1=	42	WORD2=	346	OISC, ADR, =	766
699 852 E3C	WORD1=	42	WORD2=	347	OISC, ADR, =	767
699 852 E2A	WORD1=	42	WORD2=	337	OISC, ADR, =	757
699 852 E2B	WORD1=	42	WORD2=	336	OISC, ADR, =	756
699 851 2	WORD1=	41	WORD2=	2	OISC, ADR, =	412

FIGURE 12. BITEXT Output Listing for 699 Wells

defined using an eight bit ASCII code and can be stored one character per byte.
An 11/45 computer word is defined as:

(One 16 bit Integer Word)

The final hashing parameters for well category 699 are shown in Figure 12. As an example, well 699-S52-E3A will be used to demonstrate the hashing technique.

Designation: 699 S52 E3A
 | | | | |
 Word Number: 1 2 3 4 5 6

Since only words 3, 4, 5 and 6 are used from the well designation, a breakdown of these four words is given:

	<u>Character</u>	<u>ASCII Code (In Octal)</u>
Word 3	{ Space	240
	{ 5	323
Word 4	{ 5	265
	{ 2	262
Word 5	{ Space	240
	{ E	305
Word 6	{ 3	263
	{ A	301

Figure 13 shows the bits extracted from word 4 of the well designation to form the first word (WORD1) of the hashing algorithm (word 3 is not used in the 699 well category).

FIGURE 13. Formation of First Algorithm Word

Figure 14 shows the bits extracted from words 5 and 6 of the well designation to form the second word (WORD2) used by the hashing algorithm.

FIGURE 14. Formation of Second Algorithm Word

The relative disc address is then calculated using these newly created words in the following algorithm.

$$\text{Relative disc adr.} = \text{WORD1} \times \text{FACTM} + \text{WORD2} \quad (1)$$

where:

FACTM = multiplication factor = 10 (from Figure 12)

WORD1 = 0,101,010 = $52_8 = 42_{10}$ (from Figure 13)

WORD2 = 101,011,001 = $531_8 = 345_{10}$ (from Figure 14)

Substituting these values into Equation 1 gives

$$\text{Relative disc adr.} = 42 \times 10 + 345 = 765 \text{ (See Figure 12)}$$

Since the starting disc address within the WELLHDR file for the 699 wells is 2500 (See Table 1) the absolute disc address for well 699-552-E3A is:

$$\begin{aligned} \text{Absolute disc adr.} &= \text{Relative disc adr.} + \text{starting disc adr.} \\ &= 765 + 2500 = 3265 \end{aligned}$$

The same procedure is used for all of the well categories. Once parameters have been found that meet the minimum disc blocks and minimum duplicate criteria as previously discussed, the parameters are applied to actually build the WELLHDR header file using the HDRGEN program.

In Figure 15, nine wells show the storing technique. These wells are read by the HDRGEN program in order from 1 to 9. Upon being hashed, wells 1, 5 and 8 have duplicate disc addresses (52). Wells 3 and 7 also have duplicate disc addresses (105), while the remainder, numbers 2, 4, 6 and 9, have no duplicate addresses.

FIGURE 15. Example of HDRGEN Storing Technique

Usually after determining the optimum parameters using BITEXT, several areas within the assigned block for a particular well category have no wells stored in them. The user can select the largest of these blocks as free storage areas and designate these in the HDRGEN program for the storage of duplicate wells. Subsequently the HDRGEN program will begin filling the free storage areas with duplicates. Table 1 shows the duplicate storage areas assigned to each of the Hanford well categories.

WELL DATA DESCRIPTION AND STORAGE

The CIRMIS well based data category presently has the capability of handling up to eight different data types and up to five different output devices for each of these data types as listed below:

Data Type

- 1) water level histories
- 2) contamination histories
- 3) well structures documentation
- 4) well log records
- 5) soil sieve analysis
- 6) pump test results
- 7) physical properties of soils
- 8) chemical properties of soils

Output Devices

- 1) Univac graphic display
- 2) Calcomp plotter
- 3) line printer
- 4) Gould electrostatic printer/plotter
- 5) Tektronix display

Since each project may have different data types, different structure or output requirements, the data base programs may need some modification or new programs. If, however, the data for a new project can be made to conform to the existing structure, the data can be stored and accessed with no modification.

The data are stored on a random access disc. All of the wells have one block of information stored in a header file and each specific data type is stored in a separate file. For example, all of the hydrograph data for all of the wells with data will be stored in a random access disc file called FRMTHYD. Table 3 shows a directory listing of a typical CIRMIS File Q disc.

TABLE 3. CIRMIS File Q Directory Listing

FILE=Q DIRECTORY OF QP1:
DATE: 15-FEB-77
TIME: 09:57:23

ENTRY NO. -----	FILE NAME -----	START BLOCK -----	SIZE -----
1	WELLHDR	2.	4000.
2	FRMTHYD	4002.	4000.
3	UPDATEHDR	8002.	1.
4	FRMTVTT	8003.	400.
5	EXMACODE	8403.	32.
6	FRMTCTM	8435.	31000.
7	FRMTIMP	39435.	4000.
8	FRMTWLG	43435.	8000.
9	HDATA	51435.	10000.
10	GRAUX	61435.	350.
11	GRAUY	61785.	350.

TOTAL FILE ENTRIES = 11
DELETED FILES = 0
NEXT AVAILABLE BLOCK = 62135.
TOTAL FREE SPACE = 17865.
AVAILABLE FREE SPACE = 17865.

where:

WELLHDR - contains header blocks for each well
FRMTHYD - contains historical hydrograph data
FRMTWDC - contains well structures data
FRMTVTT - contains VTT overlay information
FRMTWLG - contains drillers log information
FRMTCTM - contains historical contaminant data

It should be emphasized that the well header file "WELLHDR" contains a one-sector entry for each well, while the remaining data files only contain information for those wells where data exist.

The well header file is essentially a directory. It has one 256 integer word sector for every well. These sectors contain labels, pointers, disc address and bit maps indicating whether or not data exist in the outer files. A complete description of the header block format for each well is shown in the WELLHDR file in Appendix B.

Using the standard 11/45 bit configuration the bit maps (IDBIT & ICBIT) are described as:

IDBIT - Data type availability (1 integer word--word 19 in the WELLHDR file)
There are presently up to 11 data types available for each well. The bit locations for each data type are shown in Table 4.

TABLE 4. Data Type Bit Locations (IDBIT)

<u>Bit No.</u>	<u>Data Type</u>
0	historical hydrograph data
1	historical contaminant data
2	well documentation
3	well log records
4	sieve analysis
5	pump test data
6	physical properties of soils
7	chemical properties of soils
8	hydrograph/VTT overlays
9	historical piezometer data
10	historical temperature data

ICBIT's - Contaminant type availability (words 20 and 21 in the WELLHDR file. These two words are examined only if bit 1 of IDBIT is set to 1. Currently up to 26 possible contaminant types are available for each well. The bit locations for each contaminant are shown in Table 5.

TABLE 5. Contaminant Type Bit Locations (ICBIT's)

<u>ICBIT(1)</u>			Contaminant Code	
<u>Bit</u>	<u>Contaminant Type</u>	<u>Units</u>	<u>EMA</u>	<u>CIRMIS</u>
0	Total Alpha	pCi/l	112	1
1	Total Beta	pCi/l	111	2
2	Tritium	pCi/l	108	3
3	Nitrate	mg/l	115	4
4	Strontium-90	pCi/l	121	5
5	Cesium-137	pCi/l	24	6
6	Cobalt-60	pCi/l	10	7
7	Uranium-238	ng/l	104	8
8	Plutonium-239	pCi/l	103	9
9	Ruthenium-106	pCi/l	34	10
10	Chromium	mg/l	114	11
11	Fluoride	mg/l	26	12
12	Magnesium	mg/l	54	13
13	Iron	mg/l	55	14
14	Phosphate	mg/l	56	15
15	Chloride	mg/l	57	16
<u>ICBIT(2)</u>			Contaminant Code	
<u>Bit</u>	<u>Contaminant Type</u>	<u>Units</u>	<u>EMA</u>	<u>CIRMIS</u>
0	Copper	mg/l	58	17
1	Hardness	mg/l	62	18
2	Solids	mg/l	63	19
3	Manganese	mg/l	64	20
4	Organic Carbon	mg/l	198	21
5	PH	mg/l	199	22
6	Sulphate	mg/l	200	23
7	Sodium	mg/l	201	24
8	Calcium	mg/l	202	25
9	Total Gamma	pCi/l	998	26
10-15	Blank			

IPBIT - Piezometer data availability (1 word--word 29 in the WELLHDR file).

This word is examined only if bit 9 of IDBIT is set to 1. There are up to 6 possible piezometer designations, (O,P,Q,R,S&T) the bit locations of which are shown below:

Initially every bit in the BIT maps (IDBIT & ICBIT) is set to zero (0) for each well. If a new data type is entered into the data base for a given well, the appropriate bit is set to one (1) in the IDBIT. If the data type is a contaminant the appropriate contaminant bit is also set to 1 in the ICBIT. The data setup programs then store the appropriate information for the new data type (such as disc address, number of entries etc.) into the well header as designated under the specific data type in Appendix B. The data is then stored into the appropriate File Q data file.

An example of the way these bit maps are used is shown below. If a bit is set to one (1) information for the correlating data type has been stored on the File Q data disc; if a bit is zero (0) no information has been stored.

Example IDBIT:

The IDBIT shown above indicates three types of data are available:

Bit No.	Data Type
0	historical hydrograph data
1	historical contaminant data
3	well log records

In this example no data are available for any other data types.

Since bit 1 has been set to one (1) a check of the two ICBIT words will show which contaminant data are available.

Example ICBIT(1):

ICBIT(1) shown above indicates three types of contaminant data are available.

<u>Bit No.</u>	<u>Contaminant Type</u>
1	total alpha
4	strontium-90
6	cobalt-60

Example ICBIT(2)

In ICBIT(2) shown above all of the bits are set to zero (0); therefore, no contaminant data are available for contaminant types 17 through 26.

DATA ENTRY

Once the hashing technique has been developed and all of the project well header information has been stored onto the File Q disc, the separate program for each data type may be run. File Q data generator programs are written to retrieve a particular data type with unique formatting characteristics and store it on the File Q disc for later rapid access. These generator programs may be rerun whenever the raw data in any particular data type have been modified, without regenerating the well header or rerunning the

other data generator programs. After all of the desired data for all available data types have been stored on the File Q disc, the well based portion of CIRMIS can be used to access the data.

WELL DATA OUTPUT

User's manuals for operating the CIRMIS system are available and these procedures will not be discussed; however, Figures 16 through 22 show some of the output capabilities available. Since CIRMIS is predominantly graphic-oriented, most of the output is in graphic form.

All of the data types may be output to the Calcomp plotter as shown in Figures 16 through 18 or to the Gould printer in almost identical form. The Calcomp plotter is used when high quality report-type graphics are required, and the Gould is used for rapid output where speed and not extreme clarity is needed. The Gould can also be used to produce shading or texture (Figure 19). The type of shading shown in Figure 19 would be impractical on the Calcomp because of the lengthy plotting time. Figures 20 and 21 illustrate various data types as they appear on the interactive CRT. Figure 22 shows one of the various line printer listings produced by CIRMIS. Detailed operation of the well based data of CIRMIS is described in the CIRMIS User's Manual.⁽¹⁾

WATER LEVEL HISTORY

WELL DESIGNATION - 699 39 79

CASING ELEVATION - 673.52

FIGURE 16. Calcomp Plot of Water Level History for Well 699--39--79

CONCENTRATION HISTORY --- TOTAL BETA
WELL DESIGNATION - 699 39 79

FIGURE 17. Calcomp Plot of Contaminant History for Well 699--39--79

WELL NO. 399 1 2 16-FEB-77 15:06:02

DATE: 1977
 SYSTEM: WELLS
 OPERATOR: WEL
 OWNER:

FIGURE 18. Calcomp Plot of Well Log Data for Well 399---1---2

WELL NO. 399

1

2

20-100-75

100-100

200 15 2
ROW

FIGURE 19. Gould Plot of Well Log Data for Well 399---1---2

FIGURE 20. Scope Display of Water Level History for Well 699--39--79

FIGURE 21. Scope Display of Contaminant History for Well 699--39--79

WELL NO. 399 1 2 TOTAL DEPTH= 101.00

DATE: 733050
DRILLER: ROW
FORMAN:

RECENT EOLIAN DEPOSITS

DEPTH	MATERIALS PENETRATED
5.	SILTY SAND

GLACIOFLUVIAL SEDIMENTS

DEPTH	MATERIALS PENETRATED
15.	BOULDERS, SAND AND SILT
30.	BLACK SAND AND FINE GRAVEL
38.	MOSTLY GRAVEL, SOME SAND
40.	GRAVEL, SAND AND CLAY
50.	GRAVEL
66.	COARSE SAND AND GRAVEL
75.	GRAVEL, SAND AND SOME SILT

RINGOLD FORMATION

DEPTH	MATERIALS PENETRATED
80.	GRAVELLY SAND AND VOLCANIC MUD
85.	BLACK SAND AND GRAVEL, CAVES
99.	FINE SAND, SOME GRAVEL AND SOME VOLCANIC MUD
101.	GRAVEL AND SAND

FIGURE 22. Line Printer Listing of Well Log Data for Well 399---1---2

SPECIAL APPLICATIONS AND MANIPULATIONS PROGRAMS

The Special Applications and Manipulations Programs are used to generate surfaces and background maps. These surfaces and maps are critical in the operation of ground-water models and CIRMIS provides an interactive visual method of rapidly generating, modifying, and storing these data.

The special applications programs depend heavily on a coordinate digitizer for the rapid input of data and an interactive graphics display for instantaneous viewing of these data in various forms (contours, cross sections, listings, etc.) and/or rapidly correcting or modifying these data. After a surface data file or background map file has been digitized and corrected using the interactive computer system, the file is transferred to the large computer system for permanent storage on disc. These files can then be retrieved by the CIRMIS system or by the MODELS.

Unlike the well based data category of CIRMIS which usually requires modifications to the programs because data types differ from project to project, the special applications category has provisions to access any number of projects without any program modification. Since project data are similar, all that is required is a directory of the existing projects which can be accessed by CIRMIS and a means of entering new projects into the directory. Appendix C is a listing of the existing projects already stored in the CIRMIS data base.

The Special Applications and Manipulations category provides a number of programs which are designed to: 1) rapidly generate, manipulate and view surface data or background maps; 2) use surface data in various calculational programs; and 3) provide the user with various special utility routines.

A brief description of the major programs are described below:

<u>Program Name</u>	<u>Description</u>
Surface Generator	- Used to digitize hand-drawn contours to generate a surface matrix.
Matrix Editor	- Used to inspect cross sections of the surface matrix and change or input individual nodal values.
Surface Contouring	- Provides a graphic display of individual contours of the surface matrix.
Travel Time	- Calculates and displays stream lines and travel times using an input set of surface conditions.
Pathline	- Calculates and displays pathlines and travel times using variable potential surfaces.
Utility Programs	- Special utility programs.

PROJECTS AND DATA FILES

Currently, the CIRMIS system has the capability of handling an unlimited number of projects. Each project, however, can only accommodate up to 22 surface files and up to 10 background maps, which up to this time has proven sufficient. If necessary the number of surface files and/or background maps can be increased with appropriate program modifications. Two random access files are used as a master file directory of these projects and their associated data files: 1) PROJNUM.RAN simply contains one value which indicates the latest number of accessible projects and 2) PROJSURF.RAN contains all of the required information for each individual project. PROJSURF.RAN has a 512 integer word block for each available project. The information contained in these blocks is described in Table 6.

The CIRMIS system also has capabilities for inserting new projects or new surface and/or background maps into existing projects. Insertions or deletions can also be made independent of the CIRMIS system. All of these procedures are described in detail in the CIRMIS User's Manual.⁽¹⁾

TABLE 6. PROJSURF.RAN File Structure for One Project

Buffer Location	Name	Description	Data Type	Number of Words
NBUF(1) } ↓ NBUF(10) }	PROJ(5)	Project Name	Real	10
NBUF(11)	NODESX	No. of Nodes in x Direction	Integer	1
NBUF(12)	NODESY	No. of Nodes in y Direction	Integer	1
NBUF(13) } NBUF(14) }	XINC	x Increment	Real	2
NBUF(15) } NBUF(16) }	YINC	y Increment	Real	2
NBUF(17)	NFILE	No. of Surface Files	Integer	1
NBUF(18)	NMAP	No. of Map Files	Integer	1
NBUF(19) } ↓ BNUF(293) }	FNAME(25,22)	Surface File Names	Byte	275
BNUF(294) } ↓ NBUF(337) }	ZMIN(22)	Minimum Data Values Associated with Each Surface File	Real	44
NBUF(338) } ↓ NBUF(381) }	XMAX(22)	Maximum Data Values Associated with Each Surface File	Real	44
NBUF(382) } ↓ NBUF(506) }	PMP(25,10)	Background Map Names	Byte	125
NBUF(507) } ↓ NBUF(512) }	IDM(6)	Free Space	Integer	6

Total Number of Integer Words = 512

When a project for a particular model is requested by the user through CIRMIS, these random access files are retrieved and searched to obtain a matching project name and associated parameters. After finding the proper project in the file another search is made of the selected file to match the requested surface and background map files. When CIRMIS determines that the project and associated files exist in the master header file, the user is allowed to continue with the sequence that has been initiated. Initiation of the sequence is described in the CIRMIS User's Manual.⁽¹⁾

Each project is defined by a set number of defining parameters: 1) the project name, 2) the number of nodes in the x and y directions and 3) the x and y increment between nodes (feet, meters, etc.). When requesting a project with CIRMIS, the parameters input by the user must match exactly with those shown in the master directory for the requested project. If they do not match CIRMIS will inform the user that the project does not exist. This also applies to surface and background map file names. If a match does not exist CIRMIS will inform the user unless a specific request was made to send a new surface or map file to the 11/45. At that time the new surface or map will be inserted into the directory under the specified project.

Surface files are stored on an RSX11D structured disc in binary format. The surface files are stored line by line from 1 to NODESY and each line contains NODESX values. Background map files are generated and temporarily stored at the interactive computer in a formatted structure. This is described in detail in the Map Generator portion of the User's Manual. When a map file is transferred to the 11/45, it is converted and stored on an RSX11D structured disc in binary format.

Some of the Special Applications Programs along with some of the programs used in the Model Input Sequence require multiple surface-type data files. For example the travel time program requires three different types of surface data: 1) potential, 2) hydraulic conductivity, and 3) storage coefficient. To conserve computer core requirements these data are restructured into

blocked form and stored on a random access File Q disc. This then allows the operating program to access all of the information in a small block, thereby eliminating the need for all of the data for an entire matrix to be core resident. This considerably reduces program size. The method selected for restructuring divides the matrices into 11 x 11 blocks as shown in Figure 23. Where adjacent blocks join, duplicate node entries are made in the data files. Duplicate node entries reduce the number of accesses required when interpolating the data using four surrounding nodes.

The storage file is structured to accommodate five types of surface data, the three previously mentioned for the travel time program plus two additional used by the flow tube program (rate of change and aquifer thickness). The Pathline program uses the same surface type data as the travel time program and may also use several additional potential surfaces if operating in a transient system.

To further facilitate the rapid access of these data they are stored in an interleaved fashion, so that any number of the five data types for a particular 11 x 11 block can be recalled with one disc access.

The program, "HDATA", performs this data manipulation and sets up a file called HDATA on a File Q random access disc. This file has one 256 integer word header block at the beginning (block 0) followed by the blocked data. An example HDATA file using four blocks is shown in Figure 24. The header block is described in Table 7.

Figure 25 is a representative display on the interactive scope. This figure shows a Hanford background map along with various options used by the particular program.

FIGURE 23. Example of 11 x 11 Matrix Blocking Method

Disc
ADR.

0	Header File		
1	Hydraulic Conductivity	I = 1	J = 1
2	Storage Coefficient		
3	Rate of Change		
4	Aquifer Thickness		
5	Hydraulic Conductivity	I = 2	J = 1
6	Storage Coefficient		
7	Rate of Change		
8	Aquifer Thickness		
9	Hydraulic Conductivity	I = 1	J = 2
10	Storage Coefficient		
11	Rate of Change		
12	Aquifer Thickness		
13	Hydraulic Conductivity	I = 2	J = 2
14	Storage Coefficient		
15	Rate of Change		
16	Aquifer Thickness		
17	Potential Surface (Time Plane 1)	I = 1	J = 1
18	Potential Surface (Time Plane 1)	I = 2	
19	Potential Surface (Time Plane 1)	I = 1	J = 2
20	Potential Surface (Time Plane 1)	I = 2	
21	Potential Surface (Time Plane 2)	I = 1	J = 1
22	Potential Surface (Time Plane 2)	I = 2	
23	Potential Surface (Time Plane 2)	I = 1	J = 2
24	Potential Surface (Time Plane 2)	I = 2	
	.		
	.		
	.		
	.		
	Potential Surface (Time Plane N)	I = 1	J = 1
	Potential Surface (Time Plane N)	I = 2	
	Potential Surface (Time Plane N)	I = 1	J = 2
	Potential Surface (Time Plane N)	I = 2	

FIGURE 24. Example of Surface Type Data Storage

TABLE 7. "HDATA" File Q Header Block Format (Block 0)

Buffer Location	Name	Description	Date Type
IBUF(1)	BMO	Beginning Month (1 to 12)	Integer ↓
(2)	BYR	Beginning Year (19)	
(3)	EMO	Ending Month	
(4)	EYR	Ending Year	
(5)	NS RF	Program Controller, where: NSURF=0; Do Nothing NSURF=3; Travel Program NSURF=5; Flowtube Program NSURF>5; Pathline Program	
IBUF(6)	NXX	Nodes in x Direction	Integer ↓
IBUF(7)	NY Y	Nodes in y Direction	
IBUF(8) } IBUF(9) }	XINC	x Increment (Node Spacing)	Real
IBUF(10) } IBUF(11) }	YINC	y Increment (Node Spacing)	Real
IBUF(12) } (13) } (14) } (15) } (16) }	NOFIL(1)* (2) (3) (4) (5)	Potential Surface(s) Hydraulic Conductivity Storage Coefficient Aquifer Bottom Rate of Change	Integer ↓
IBUF(17)	FPOT(25) FHYC(25)	Name of Potential File Name of Hydraulic Conductivity File	Byte ↓
	FSIG(25)	Name of Storage Coefficient File	
	FBOT(25)	Name of Aquifer Bottom File	
	FDHDT(25)	Name of Rate of Change File	
IBUF(256)	FIL(355)	Filler (Unused)	

*NOTE: If NOFIL(N) = 0; set up file
NOFIL(N) = 1; file already set up.

FIGURE 25. Representative Display of Hanford Background Map and Options Used With the Surface Generator Program

MODEL INPUT SEQUENCE

The Model Input Sequence allows the user to interactively input and check the parameters required by various ground-water models. The interactive capabilities, in conjunction with the immediate visual display of parameters, eliminates the data input errors that had previously been encountered with other techniques.

Only one active program, Flowtube, is being applied at present; however, additional programs can readily be inserted into the sequence with relatively few modifications. These need not be limited to ground-water models since the Model Input Sequence is basically a model controller. The capabilities are available for models which require project specifications and surface type data input. These input parameters are identical to those discussed in detail in the Special Applications and Manipulations Section. The additional parameters required by ground water and other models are designed into the Model Input Sequence as they are needed. The models are generally operated on the 11/45 computer with control and monitoring performed at the interactive computer because the 11/45 has greater computing capabilities and greater data storage capacity, and the interactive computer system is freed to provide more sophisticated model control.

REFERENCE

1. D. R. Friedrichs, Comprehensive Information Retrieval and Model Input Sequence (CIRMIS), User's Manual. BNWL-2236, Battelle Pacific Northwest Laboratories, Richland, WA, April 1977.

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APPENDIX A

Final Parameters Used by CIRMIS for Hanford Wells

***** "HITEXT" TIME= 06:55:16 DATE= 17-FEB-77 *****

THIS PROGRAM ALLOWS THE USER TO SPECIFY BITS FOR HIT EXTRACTION FROM
THE LAST 4 WORDS IN A 6 WORD WELL DESIGNATION

HANFORD WELL PREFIX 199

MULTIPLYING FACTOR= 2.0000

BITS EXTRACTED FROM WORD 3 = 0

BITS EXTRACTED FROM WORD 4 = 7

HIT LOCATIONS USED (0 = 15) 11, 10, 9, 3, 2, 1, 0,

BITS EXTRACTED FROM WORD 5 = 0

BITS EXTRACTED FROM WORD 6 = 6

HIT LOCATIONS USED (0 = 15) 11, 9, 8, 6, 5, 2, 1, 0,

199	H3	1	WORD1=	19	WORD2=	1	DISC. ADR. =	39
199	H3	2	WORD1=	19	WORD2=	2	DISC. ADR. =	40
199	H4	1	WORD1=	20	WORD2=	1	DISC. ADR. =	41
199	H4	2	WORD1=	20	WORD2=	2	DISC. ADR. =	42
199	H4	3	WORD1=	20	WORD2=	3	DISC. ADR. =	43
199	H4	4	WORD1=	20	WORD2=	4	DISC. ADR. =	44
199	H5	1	WORD1=	21	WORD2=	1	DISC. ADR. =	43
199	H8	1	WORD1=	24	WORD2=	1	DISC. ADR. =	49
199	H8	2	WORD1=	24	WORD2=	2	DISC. ADR. =	50

FIGURE A-1. Final Parameters Used with Hanford Well Prefix 199
(Also partial well listing)

***** "BITEX" TIME= 06153108 DATE= 17-FEB-77 *****

THIS PROGRAM ALLOWS THE USER TO SPECIFY BITS FOR BIT EXTRACTION FROM
THE LAST 4 WORDS IN A 6 WORD WELL DESIGNATION

HANFORD WELL PREFIX 299E

MULTIPLYING FACTOR= 100,000

BITS EXTRACTED FROM WORD 3 = 0

BITS EXTRACTED FROM WORD 4 = 3

BIT LOCATIONS USED (0 = 15) 2, 1, 0,

BITS EXTRACTED FROM WORD 5 = 2

BIT LOCATIONS USED (0 = 15) 1, 0,

BITS EXTRACTED FROM WORD 6 = 8

BIT LOCATIONS USED (0 = 15) 11, 10, 9, 8, 3, 2, 1, 0,

299 E13	1	WORD1=	3	WORD2=	1	DISC. ADR. =	301
299 E13	2	WORD1=	3	WORD2=	2	DISC. ADR. =	302
299 E13	3	WORD1=	3	WORD2=	3	DISC. ADR. =	303
299 E13	4	WORD1=	3	WORD2=	4	DISC. ADR. =	304
299 E13	5	WORD1=	3	WORD2=	5	DISC. ADR. =	305
299 E13	6	WORD1=	3	WORD2=	6	DISC. ADR. =	306
299 E13	7	WORD1=	3	WORD2=	7	DISC. ADR. =	307
299 E13	8	WORD1=	3	WORD2=	8	DISC. ADR. =	308

FIGURE A-2. Final Parameters Used with Hanford Well Prefix 299E
(Also partial well listing)

***** "HITRAT" Time= 06:55:44 DATE= 17-FEB-77 *****

THIS PROGRAM ALLOWS THE USER TO SPECIFY BITS FOR BIT EXTRACTION FROM
THE LAST 4 WORDS IN A 6 WORD WELL DESIGNATION

HANFORD WELL PREFIX 299W

MULTIPLYING FACTOR= 100,000

BITS EXTRACTED FROM WORD 3 = 4

BITS EXTRACTED FROM WORD 4 = 4

BIT LOCATIONS USED (N = 15) 5, 2, 1, 0,

BITS EXTRACTED FROM WORD 5 = 1

BIT LOCATIONS USED (N = 15) 0,

BITS EXTRACTED FROM WORD 6 = 8

BIT LOCATIONS USED (N = 15) 11,10, 9, 8, 3, 2, 1, 0,

299	WB	1	WORD1=	6	WORD2=	1	DISC.	ADR.	=	601
299	W10	1	WORD1=	0	WORD2=	1	DISC.	ADR.	=	1
299	W10	2	WORD1=	0	WORD2=	2	DISC.	ADR.	=	2
299	W10	3	WORD1=	0	WORD2=	3	DISC.	ADR.	=	3
299	W10	4	WORD1=	0	WORD2=	4	DISC.	ADR.	=	4
299	W10	5	WORD1=	0	WORD2=	5	DISC.	ADR.	=	5
299	W10	6	WORD1=	0	WORD2=	6	DISC.	ADR.	=	6
299	W10	7	WORD1=	0	WORD2=	7	DISC.	ADR.	=	7

FIGURE A-3. Final Parameters Used with Hanford Well Prefix 299W
(Also partial well listing)

***** "BITEXT" TIME= 06156148 DATE= 17-FEB-77 *****

THIS PROGRAM ALLOWS THE USER TO SPECIFY BITS FOR BIT EXTRACTION FROM
THE LAST 4 WORDS IN A 6 WORD WELL DESIGNATION

HANFORD WELL PREFIX 399

MULTIPLYING FACTOR= 8.000

BITS EXTRACTED FROM WORD 3 = 0

BITS EXTRACTED FROM WORD 4 = 3
BIT LOCATIONS USED (N = 15) 2, 1, 0,

BITS EXTRACTED FROM WORD 5 = 0

BITS EXTRACTED FROM WORD 6 = 3
BIT LOCATIONS USED (N = 15) 2, 1, 0,

399	1	1	WORD1=	1	WORD2=	1	DISC. ADR. =	9
399	1	2	WORD1=	1	WORD2=	2	DISC. ADR. =	10
399	1	3	WORD1=	1	WORD2=	3	DISC. ADR. =	11
399	1	4	WORD1=	1	WORD2=	4	DISC. ADR. =	12
399	1	5	WORD1=	1	WORD2=	5	DISC. ADR. =	13
399	1	6	WORD1=	1	WORD2=	6	DISC. ADR. =	14
399	2	1	WORD1=	2	WORD2=	1	DISC. ADR. =	17
399	2	2	WORD1=	2	WORD2=	2	DISC. ADR. =	18
399	2	3	WORD1=	2	WORD2=	3	DISC. ADR. =	19

FIGURE A-4. Final Parameters Used with Hanford Well Prefix 399
(Also partial well listing)

***** "HITFX1" TIME= 06156:19 DATE= 17-FEB-77 *****

THIS PROGRAM ALLOWS THE USER TO SPECIFY BITS FOR BIT EXTRACTION FROM
THE LAST 4 WORDS IN A 6 WORD WELL DESIGNATION

HANFORD WELL PREFIX 699

MULTIPLYING FACTOR= 10,000

BITS EXTRACTED FROM WORD 3 = 0

BITS EXTRACTED FROM WORD 4 = 7

BIT LOCATIONS USED (4 = 15) 11, 10, 9, 8, 2, 1, 0,

BITS EXTRACTED FROM WORD 5 = 3

BIT LOCATIONS USED (0 = 15) 2, 1, 0,

BITS EXTRACTED FROM WORD 6 = 6

BIT LOCATIONS USED (0 = 15) 10, 9, 8, 2, 1, 0,

699 S56 E7	WORD1=	40	WORD2=	47	DISC. ADR. =	447
699 S55 E6	WORD1=	45	WORD2=	46	DISC. ADR. =	496
699 S54 E6	WORD1=	44	WORD2=	46	DISC. ADR. =	486
699 S50 E5	WORD1=	44	WORD2=	45	DISC. ADR. =	485
699 S53 E2	WORD1=	43	WORD2=	42	DISC. ADR. =	472
699 S52 E3A	WORD1=	42	WORD2=	345	DISC. ADR. =	765
699 S52 E3B	WORD1=	42	WORD2=	346	DISC. ADR. =	766
699 S52 E3C	WORD1=	42	WORD2=	347	DISC. ADR. =	767

FIGURE A-5. Final Parameters Used with Hanford Well Prefix 699
(Also partial well listing)

***** "BITEXT" TIME= 06:57:26 DATE= 17-FEB-77 *****

THIS PROGRAM ALLOWS THE USER TO SPECIFY BITS FOR BIT EXTRACTION FROM
THE LAST 4 WORDS IN A 6 WORD WELL DESIGNATION

HANFORD WELL PREFIX 1199

MULTIPLYING FACTOR= 1.000

BITS EXTRACTED FROM WORD 3 = 0

BITS EXTRACTED FROM WORD 4 = 5

BIT LOCATIONS USED (M = 15) 9, 8, 2, 1, 0,

BITS EXTRACTED FROM WORD 5 = 1

BIT LOCATIONS USED (M = 15) 0,

BITS EXTRACTED FROM WORD 6 = 6

BIT LOCATIONS USED (M = 15) 10, 9, 8, 2, 1, 0,

1199	12	13	WORD1=	10	WORD2=	11	DISC. ADR. =	21
1199	14	13	WORD1=	12	WORD2=	11	DISC. ADR. =	23
1199	14	14	WORD1=	12	WORD2=	12	DISC. ADR. =	24
1199	15	13A	WORD1=	13	WORD2=	89	DISC. ADR. =	102
1199	15	15A	WORD1=	13	WORD2=	90	DISC. ADR. =	103
1199	15	15C	WORD1=	13	WORD2=	91	DISC. ADR. =	104
1199	15	13D	WORD1=	13	WORD2=	92	DISC. ADR. =	105
1199	15	14A	WORD1=	13	WORD2=	97	DISC. ADR. =	110

FIGURE A-6. Final Parameters Used with Hanford Well Prefix 1199
(Also partial well listing)

THIS PROGRAM ALLOWS THE USER TO SPECIFY BITS FOR BIT EXTRACTION FROM
THE LAST 4 WORDS IN A 6 WORD WELL DESIGNATION

HANFORD WELL PREFIX 3099

MULTIPLYING FACTOR# 2.00M

BITS EXTRACTED FROM WORD 3 = 0

BITS EXTRACTED FROM WORD 4 = 1
BIT LOCATIONS USED (N = 15) 1,

BITS EXTRACTED FROM WORD 5 = 0

BITS EXTRACTED FROM WORD 6 = 4
BIT LOCATIONS USED (N = 15) 11, 5, 1, 0,

3099	41	14	WORD1#	0	WORD2#	0	DISC. ADR. #	0
3099	41	17	WORD1#	0	WORD2#	3	DISC. ADR. #	3
3099	42	16	WORD1#	1	WORD2#	2	DISC. ADR. #	4
3099	42	18	WORD1#	1	WORD2#	4	DISC. ADR. #	6
3099	45	16	WORD1#	0	WORD2#	2	DISC. ADR. #	2
3099	45	18A	WORD1#	0	WORD2#	9	DISC. ADR. #	9
3099	45	18D	WORD1#	0	WORD2#	10	DISC. ADR. #	10
3099	47	18A	WORD1#	1	WORD2#	9	DISC. ADR. #	11
3099	47	18D	WORD1#	1	WORD2#	10	DISC. ADR. #	12

FIGURE A-7. Final Parameters Used with Hanford Well Prefix 3099
(Also partial well listing)

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APPENDIX B

CIRMIS File-Q Master Well Header Director (WELLHDR)

"WELLHDR" File Q

This is a directory listing of the entries entered into the master index file for the Hanford Wells data.

<u>Location</u>	<u>Name</u>	<u>Description</u>	<u>Program</u>
IBUF (1)			
" (2)			
" (3)	WELDES (3)	Well designation	
" (4)			
" (5)			
" (6)			
IBUF (7)	C(4) YH XH	Actual Plant Coordinates	General Information
" (8)			
" (9)			
" (10)			
" (11)			
" (12)			
IBUF (13)	XCOORD YCOORD	Map coordinates for 68 x 87 node 2000 ft. grid	
" (14)			
" (15)			
" (16)			
IBUF (17)	CASEL	Casing elevation	
" (18)			
IBUF (19)	IDBIT	Bit map of all available data	
" (20)	ICBIT(1)	Bit map of contaminant 1-16 data	
" (21)	ICBIT(2)	Bit map of contaminant 17-26 data	
" (22)	FREE		
" (28)			
" (29)	IPBIT	Bit map of piezometric data	

IBUF (30)	IDK	File Q Disc of Initial Allocation	
" (31)	NPTS	No. of data entries in Initial Allocation	
" (32)	IDKEX	File Q Disc ADR of Extended Allocation	Well Hydrograph
" (33)	NPTX	No. of data entries in extended allocation	
" (34)	INIDK	No. of disc sectors in initial allocation	
IBUF (35)	IDKNT	File Q Disc ADR	
" (36)	NSTRT	Starting word	Well Documentation
" (37)	NWORD	No. of words	
" (38)	FREE		
" (39)	"		
IBUF (40)	IBLK	File Q Disc ADR	Well Log Records
" (41)	NSTRT	Starting Word	
" (42)	NWRD	No. of Words	
" (43)	FREE		
" (44)	"		
IBUF (45)	IDKNT	File Q Disc ADR	Physical Records
" (46)	NCOUNT	No. of Words	
" (47)	FREE		
" (48)	"		
" (49)	"		
IBUF (50)	IDKIN	File Q Disc ADR of Initial Allocation	
" (51)	NPTSIN	No. of Data Entries in Initial Allocation	Temperature Records

IBUF (52)	IDKEX	File Q Disc ADR of Extended Allocation	
" (53)	NPTSEX	No. of Data Entries in Extended Allocation	
" (54)	INALOC	No. of Disc Sector in Initial Allocation	
<hr/>			
IBUF (55)	IDK	File Q Disc ADR	VTT Simulation Data
" (56)	NPTS	No. of VTT Entries	
" (57)	FREE		
" (58)	"		
" (59)	"		
<hr/>			
IBUF (60)	NPTS (1)	No. of Total ALPHA entries	Contamination Records
" (61)	DKSAV (1)	File Q Disc ADR of Initial Allocation	
" (62)	DKSEX (1)	File Q Disc ADR of Extended Allocation	
" (63)	NPSEX (1)	No. of Total ALPHA Entries in Extended Allocation	
" (64)	INDKA (1)	No. of Disc Sectors in Initial Allocation	
" (185)	NPTS (26)	No. of GAMMA entries	
" (186)	DKSAV (26)	File Q Disc ADR of Initial Allocation	
" (187)	DKSEX (26)	File Q Disc ADR of Extended Allocation	
" (188)	NPSEX (26)	No. of Gamma Entries in Extended Allocation	
" (189)	INDKA (26)	No. of Disc Sectors in Initial Allocation	

IBUF (190)	NPTS (1)	No. of O-Tube Entries	
" (191)	DKSAV (1)	File Q Disc ADR of Initial Allocation	
" (192)	DKSEX (1)	File Q Disc ADR of Extended Allocation	
" (193)	NPSEX (1)	No. of O-Tube Entries in Extended Allocation	Piezometer Data
" (194)	INDKA (1)	No. of Disc Sectors in Initial Allocation	
" (225)	NPTS (6)	No of T-Tube Entries	
" (226)	DKSAV (6)	File Q Disc ADR of Initial Allocation	
" (227)	DKSEX (6)	File Q Disc ADR of Extended Allocation	
" (228)	NPSEX (6)	No of T-Tube Entries in Extended Allocation	
" (229)	INDKA (6)	No. of Disc Sectors in Initial Allocation	
IBUF (230)	FOR (6)	Forman's name	
" (241)			
" (242)	DLR (6)	Driller's name	
" (253)			
" (254)	FREE		
" (255)			
IBUF (256)		Next Address pointer for wells of like disc address	

APPENDIX C
CIRMIS Project Directory

NO. OF PROJECTS = 13

PROJECT NAME: HANFORD

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
135	173	1000,000	1000,000	15	2

SURFACE DISC FILES

	ZMIN	ZMAX
OP1:[167,215]HAN473.PT1	300.00	500.00
OP1:[167,215]HAN475.PT1	300.00	500.00
OP1:[167,215]HAN474.HCI	0.00	200000.00
OP1:[167,215]HAN473.ACL	100.00	500.00
OP1:[167,215]HAN473.DHI	0.00	0.00
OP1:[167,215]HAN475.HCI	0.00	200000.00
OP1:[167,215]HAN473.SCI	0.00	100.00
OP1:[167,215]HAN474.SCI	0.00	100.00
OP1:[167,215]HAN476.TX1	0.00	400000.00
OP1:[167,215]HAN475.HCI	0.00	200000.00
OP1:[167,215]HAN475.HCI	0.00	200000.00
OP1:[167,215]HAN473.SCI	0.00	100.00
OP0:[167,215]HAN475.HCI	0.00	200000.00
OP1:[167,215]HAN475.PT1	300.00	500.00
OP0:[167,215]HAN474.HCI	0.00	200000.00

MAP DISC FILES

OP1:[167,215]HANFORD.MAP
OP1:[167,215]HANFORD.MAP

PROJECT NAME: TAIHUT

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
06	35	500,000	500,000	6	1

SURFACE DISC FILES

	ZMIN	ZMAX
OP1:[167,215]TAH475.PT1	100.00	200.00
OP1:[167,215]TAH475.ACL	100.00	200.00
OP1:[167,215]TAH475.ACL	100.00	200.00
OP1:[167,215]TAH475.TX1	0.00	500000.00
OP1:[167,215]TAH475.HCI	0.00	200000.00
OP1:[167,215]TAH475.SCI	0.00	100.00

MAP DISC FILES

OP1:[167,215]TAH475.MAP

PROJECT NAME: HANFORD 2

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
68	87	2000.000	2200.000	11	2

SURFACE DISC FILES

	ZMIN	ZMAX
DP1:[6,4]HANPT128A,AQ1	100.00	500.00
DP1:[6,4]AQUPT128A,AQ1	100.00	500.00
DP1:[6,4]HANPER,AQ1	0.00	260000.00
DP1:[6,4]HANPOR,AQ1	0.00	10.00
DP1:[167,215]HANPER,AQ1	0.00	260000.00
DP1:[167,215]HANPOR,AQ1	0.00	10.00
[167,215]HANPT128A,AQ1	100.00	500.00
[167,215]AQUPT128A,AQ1	100.00	500.00
DP1:[205,200]VITSN2,PT1	0.00	600.00
DP1:[205,200]HAN7255,AB1	0.00	500.00
DP1:[205,200]HAN16R,XY1	0.00	260000.00

MAP DISC FILES

DP1:[167,215]HANFORD,MAP
DP1:[167,215]HANFORD,MAP

PROJECT NAME: PATHLINE

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
41	41	500.000	500.000	6	2

SURFACE DISC FILES

	ZMIN	ZMAX
MT1:TST125,PT1	-100.00	100.00
DP1:[167,215]TST125,PT1	-100.00	100.00
DP1:[167,215]TST125,XY1	0.00	200.00
DP1:[167,215]TST125,SG1	0.00	1.00
DP0:[171,215]TST125,AC1	0.00	200.00
DP0:[171,215]TST125,SC1	0.00	1.00

MAP DISC FILES

DP1:[167,215]PATHTST,MAP
DP0:[171,215]PATHTST,MAP

PROJECT NAME: KVMAN

NODESX	NODESY	XINL	YINL	NO. SURFACES	NO. MAPS
121	59	100.000	100.000	1	1

SURFACE DISC FILES	ZMIN	ZMAX
DP1:(157,215)KVMAN.P1	4200.00	4700.00

MAP DISC FILES
DP1:(157,215)KVMAN.MAP

PROJECT NAME: TOLUA 300A

NODESX	NODESY	XINL	YINL	NO. SURFACES	NO. MAPS
25	33	250.000	250.000	4	1

SURFACE DISC FILES	ZMIN	ZMAX
DP1:(30,106)N3A375.P01	0.00	260000.00
DP1:(30,106)N3A375.P01	0.00	10.00
DP1:(30,106)N3A375.P11	300.00	500.00
DP1:(30,106)N3A375.P11	300.00	500.00

MAP DISC FILES
DP1:(205,200)N3A375.M00

PROJECT NAME: PATHLINE 2

NODESX	NODESY	XINL	YINL	NO. SURFACES	NO. MAPS
61	61	250.000	250.000	5	1

SURFACE DISC FILES	ZMIN	ZMAX
DP1:(157,215)TST125.P12	-100.00	100.00
DP1:(157,215)TST225.P12	-100.00	100.00
DP1:(157,215)TST325.P12	-100.00	100.00
DP1:(157,215)TST125.M02	0.00	200.00
DP1:(157,215)TST125.S02	0.00	1.00

MAP DISC FILES
DP1:(157,215)PATHYST.MAP

PROJECT NAME: CLARK COUNTY

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
43	52	2540.000	2540.000	15	3

SURFACE DISC FILES	ZMIN	ZMAX
DP1:(201,22)CC0576,AT1	0.00	2000.00
DP1:(201,22)CC0576,AT2	-110.00	1100.00
DP1:(201,22)CC0576,AB1	-110.00	1100.00
DP1:(201,22)CC0576,AB2	-300.00	1000.00
DP1:(201,22)CC0576,PT1	0.00	500.00
DP1:(201,22)CC0576,PT2	0.00	600.00
DP1:(201,22)POT1976,A11	-300.00	700.00
DP1:(201,22)POT1976,A12	-300.00	700.00
DP1:(201,22)POT1980,A11	-300.00	700.00
DP1:(201,22)POT1980,A12	-300.00	700.00
DP1:(201,22)POT1990,A11	-300.00	700.00
DP1:(201,22)POT1990,A12	-300.00	700.00
DP1:(201,22)POT2000,A11	-300.00	700.00
DP1:(201,22)POT2000,A12	-300.00	700.00
DP0:(201,22)POT1976,A12	-300.00	700.00

MAP DISC FILES

DP1:(201,22)CLARK.MAP

DP1:(201,22)CLARK.MAP

DP0:(201,21)CLARK.MAP

PROJECT NAME: PATLINE 3

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
01	21	2300.000	2300.000	5	1

SURFACE DISC FILES	ZMIN	ZMAX
DP1:(167,21)TST125,SC3	0.00	1.00
MT1:TST125,PT1	-100.00	100.00
DP1:(167,21)TST125,MC3	0.00	600.00
MT0:TST125,PT1	-100.00	100.00
DP0:(167,21)TST1554,PT1	-100.00	100.00

MAP DISC FILES

DP2:(167,21)PATLINE3.MAP

PROJECT NAME: PATHLINE 5

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
101	81	500.000	500.000	3	1

SURFACE DISC FILES		ZMIN	ZMAX
DP2: [171,215]TS1588.PTS		-1.00.00	100.00
DP2: [171,215]TS1125.HCS		1.00	600.00
DP2: [171,215]TS1125.SCS		0.00	1.00

MAP DISC FILES
DP2: [107,215]PATH53.MAP

PROJECT NAME: HANFORD JUNE 76

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
135	173	1000.000	1000.000	3	1

SURFACE DISC FILES		ZMIN	ZMAX
DP: [107,215]HAN474.PTL		300.00	500.00
DP: [107,215]HAN174.HCI		0.00	200000.00
DP: [107,215]HAN174.SCI		0.00	10.00

MAP DISC FILES
DP: [107,215]HANFORD.MAP

PROJECT NAME: PATHLINE 50

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
41	21	2000.000	2000.000	3	1

SURFACE DISC FILES		ZMIN	ZMAX
DP: [171,215]TS1558.PTL		-1.00.00	1.00.00
DP: [171,215]TS1125.HCS		0.00	600.00
DP: [171,215]TS1125.SCS		0.00	1.00

MAP DISC FILES
DP: [171,215]PATH53.MAP

PROJECT NAME: PATHLINE 5d

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
1d1	81	500.000	500.000	3	1

SURFACE DISC FILES	ZMIN	ZMAX
DP:[171,215]TS1554.PTS	-1.00,00	100.00
DP:[171,215]TST125.HCS	0.00	500.00
DP:[171,215]TST125.SCS	0.00	1.00

MAP DISC FILES
DP:[171,215]PAT-TS3.MAP

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