PNL-3161-1
UC-70

Assessment of Effectiveness of
Geologic Isolation Systems

CIRMIS Data System

Volume 1. Initialization, Operation and Documentation

D. R. Friedrichs

January 1980

Prepared for the
Office of Nuclear Waste Isolation
under its Contract with the
U.S. Department of Energy

Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute

Battelle

PNL-3161-1

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PACIFIC NORTHWEST LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
Under Contract EY-76-C-06-1830

Printed in the United States of America
Available from
National Technical Information Service
United States Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151

Price: Printed Copy $____*; Microfiche $3.00

*Pages	NTIS Selling Price
001-025	$4.00
026-050	$4.50
051-075	$5.25
076-100	$6.00
101-125	$6.50
126-150	$7.25
151-175	$8.00
176-200	$9.00
201-225	$9.25
226-250	$9.50
251-275	$10.75
276-300	$11.00

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FOREWORD

The Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) Program is developing and applying the methodology for assessing the far-field, long-term post-closure safety of deep geologic nuclear waste repositories. AEGIS is being performed by Pacific Northwest Laboratory (PNL) under contract with the Office of Nuclear Waste Isolation (ONWI) for the Department of Energy (DOE). One task within AEGIS is the development of methodology for analysis of the consequences (water pathway) from loss of repository containment as defined by various release scenarios.

Analysis of the long-term, far-field consequences of release scenarios requires the application of numerical codes which simulate the hydrologic systems, model the transport of released radionuclides through the hydrologic systems to the biosphere, and, where applicable, assess the radiological dose to humans.

Essentially three modeling technologies are involved in assessing the water pathway release consequence. These models are: 1) hydrologic models that define the groundwater flow field and provide water flow paths and travel times, 2) transport models that describe the movement and concentrations of the radionuclides in the flow field, and 3) dose models that determine the resultant radiation doses to individuals and/or populations. Figure i is a schematic flow diagram for the release consequence analysis.

The various input parameters required in the analysis are compiled in data systems. The data are organized and prepared by various input subroutines for use by the hydrologic and transport codes. The hydrologic models simulate the groundwater flow systems and provide water flow directions, rates, and velocities as inputs to the transport models. Outputs from the

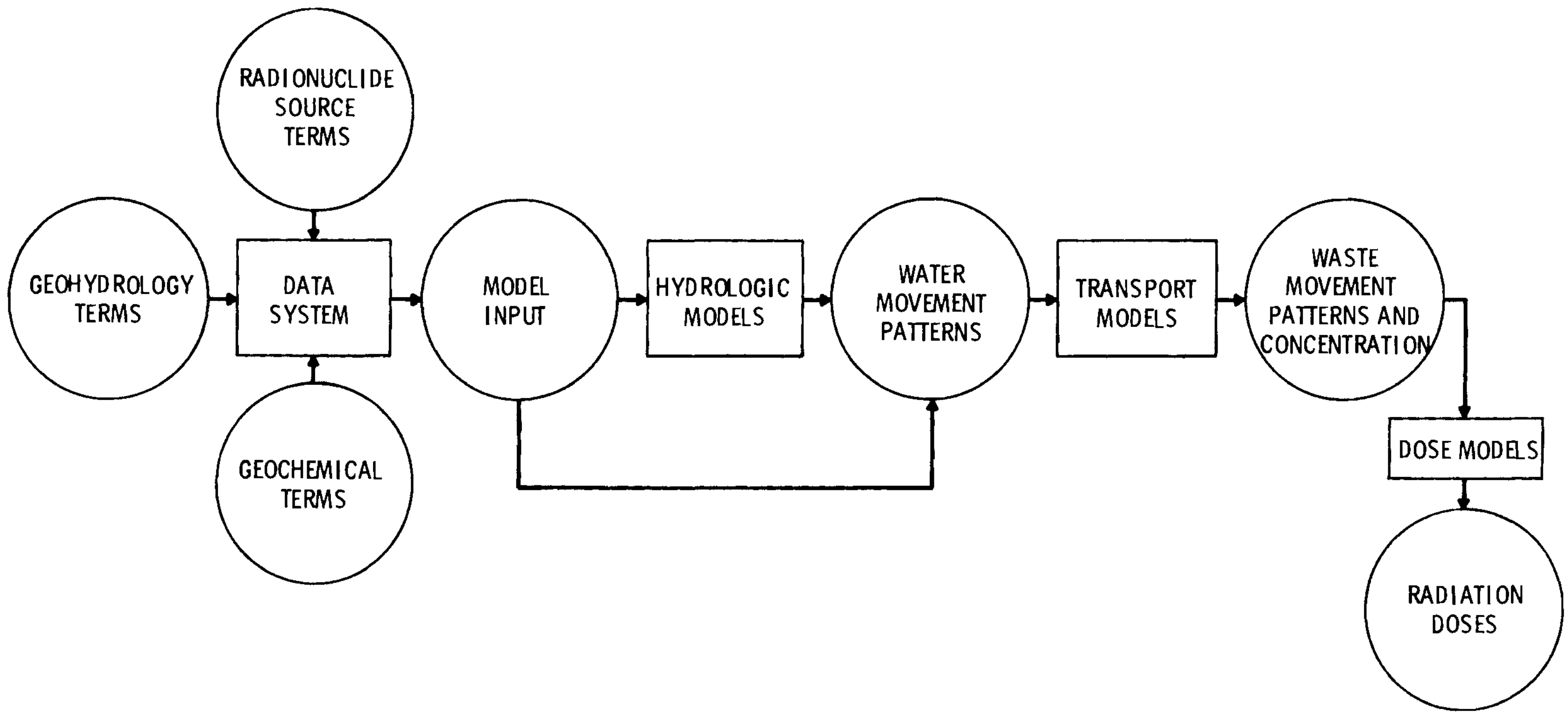


FIGURE i. Schematic Diagram of Consequence Analysis transport models are basically graphs of radionuclide concentration in the groundwater plotted against time. After dilution in the receiving surface-water body (e.g., lake, river, bay), these data are the input source terms for the dose models, if dose assessments are required. The dose models calculate radiation dose to individuals and populations.

Hydrologic and transport models are available at several levels of complexity or sophistication. Model selection and use are determined by the quantity and quality of input data. Model development under AEGIS and related programs provides three levels of hydrologic models, two levels of transport models, and one level of dose models (with several separate models). The models and data systems are documented as follows:

- HYDROLOGIC MODELS:

PNL-3162	PATHS Groundwater Hydrologic Model - first level (simplest) idealized hybrid analytical/ numerical model for two-dimensional, saturated groundwater flow and single component transport; homogeneous geology.
PNL-3160	VTT (Variable Thickness Transient) Groundwater Hydrologic Model - second level (intermediate complexity) two-dimensional saturated groundwater flow, Boussinesq approximation, finite difference approach; two-dimensional (quasi three-dimensional) multiaquifer capability; heterogeneous geology.
PNL-2939	FE3DGW (Finite Element, Three-Dimensional Groundwater) Hydrologic Model - third level (high complexity) three-dimensional, finite element approach (Galerkin formulation) for saturated groundwater flow; heterogeneous geology.

- <u>TRANSPORT MODELS</u>:

PNL-2970	GETOUT Transport Model - first level one-dimensional analytical solution considering radioactive chain decay with capability for only simple release and hydrologic functions; single speciation, constant flow rate, dispersion and sorption, three-member straight decay chains.
PNL-3179	MMT (Multicomponent Mass Transport) Model - second level, one-dimensional numerical, discrete parcel random walk (DPRW) algorithm; chain decay, single speciation, equilibrium sorption, time-variant leach rate and dispersion, n-member straight or branched decay chains.

- <u>DOSE MODELS</u>:

PNL-3180	ARRRG - drinking water, external exposure to aquatic food, water and shorelines, and FOOD - terrestrial food.
PNL-3209	PABLM - Combination of ARRRG and FOOD with additional features related to chronic releases.
BNWL-B-264	KRONIC - chronic external dose from air pathways.
BNWL-B-351	SUBDOSA - acute external dose from air pathways.
BNWL-B-389	DACRIN - chronic or acute inhalation dose from air pathways.

- DATA SYSTEMS:

PNL-3139 SIRS (Sorption Information Retrieval System) - storage and retrieval system for experimental data on sorption/desorption analyses for a wide variety of radionuclides, groundwater compositions, and rocks and minerals.

PNL-3161 CIRMIS (Comprehensive Information Retrieval and Model Input Sequence) Data System - storage and retrieval system for model input and output data, including graphical interpretation and display.

This is the first of four volumes of the description of the CIRMIS Data System.

Return of the form on the last page of this report is required in order to remain on the distribution list for future revisions of the model.

ACKNOWLEDGMENT

This research was supported by the Waste Isolation Safety Assessment Program (WISAP) conducted by Pacific Northwest Laboratory. The program was sponsored by the Office of Nuclear Waste Isolation, managed by Battelle Memorial Institute for the Department of Energy under Contract EY-76-C-06-1830. On 1 October 1979, WISAP became the Assessment of Effectiveness of Geologic Isolation Systems (AEGIS) Program and the Waste/Rock Interactions Technology (WRIT) Program. This report was issued by AEGIS.

CONTENTS

FIGURES

TABLES

CHAPTER 1. INTRODUCTION

The data system has been separated into four separate volumes. These volumes are designed to facilitate both a basic understanding and detailed use of the data system. The first volume describes the hardware and software configuration, data base initialization, and operation of the system; the second volume contains program listings and output; the third volume contains a detailed description of the methods used to insert, change, or delete data from the data base; and the fourth volume contains detailed description of the input of drillers logs and various uses of these drillers logs.

An adaptation and extension of the Comprehensive Information Retrieval and Model Input Sequence (CIRMIS) (Friedrichs 1977a) was selected as the primary data base system for the release consequence analysis hydrologic and transport models being developed under the Waste Isolation Safety Assessment Program (WISAP). CIRMIS was originally developed to increase efficiency in data manipulation for ground-water modeling at the Department of Energy (DOE) Hanford Site. However, configuration of the system was designed to be flexible for use with other models and other areas.

In the past, modeling of complex hydrologic systems was time consuming and tedious because of the cumbersome data handling techniques. Better methods were required for formatting dta, error checking, storing data, and for implementing and producing results that would expedite system simulation. 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. 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 of isopleth surfaces and interactive control of ground-water models. Data are accessible from video displays for rapid visual examination and may also be output to various hard copy devices such as a line printer, electrostatic printer/plotter and Calcomp plotter.

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 are the major functions of CIRMIS but comprise only a portion of the entire CIRMIS system.

CHAPTER 2. CIRMIS HARDWARE AND SOFTWARE

CIRMIS HARDWARE CONFIGURATIONS

The Water and Land Resources Computer Facility at PNL consists of two major systems (Figure 2.1). The basis of the main system is a PDP-11/45 processor with 128K core storage, three 20-million word mass storage units, several on-line terminals and output devices, and multiuser capabilities. The secondary system, a PDP-11/55 computer, is used as the main controller for the CIRMIS system. The PDP-11/45 has 64K core storage, three 4000 word disc storage units, advanced input/output, and hands-on interactive capabilities. The two computer systems are connected via a 56K-baud data link. The CIRMIS system involves both computers.

The interactive PDP-11/45 computer provides visual man-machine interactive capabilities through the use of a VS-60 display with light pen keyboard, joystick, function keys (Figure 2.2), coordinate digitizer with a cursor, and full 50 keyboard (Figure 2.3).

Major operating programs for the 11/45 computer are stored on one 80 megabyte disc unit along with the entire CIRMIS data base. The data on this disc can be accessed simultaneously from both computers. The CIRMIS system can also service requests from terminals other than the direct-connected interactive 11/45 computer. Rockwell International has a dedicated telephone line to the 11/45 which services a Tektronix 4014 graphic terminal (Figure 2.4) 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 VS-60 scope at the PDP-11/55 computer. However, the 4014 is a memory scope, whereas the VS-60 is a refresh scope. The 4014 terminal acts much like the interactive computer, but since it has no core

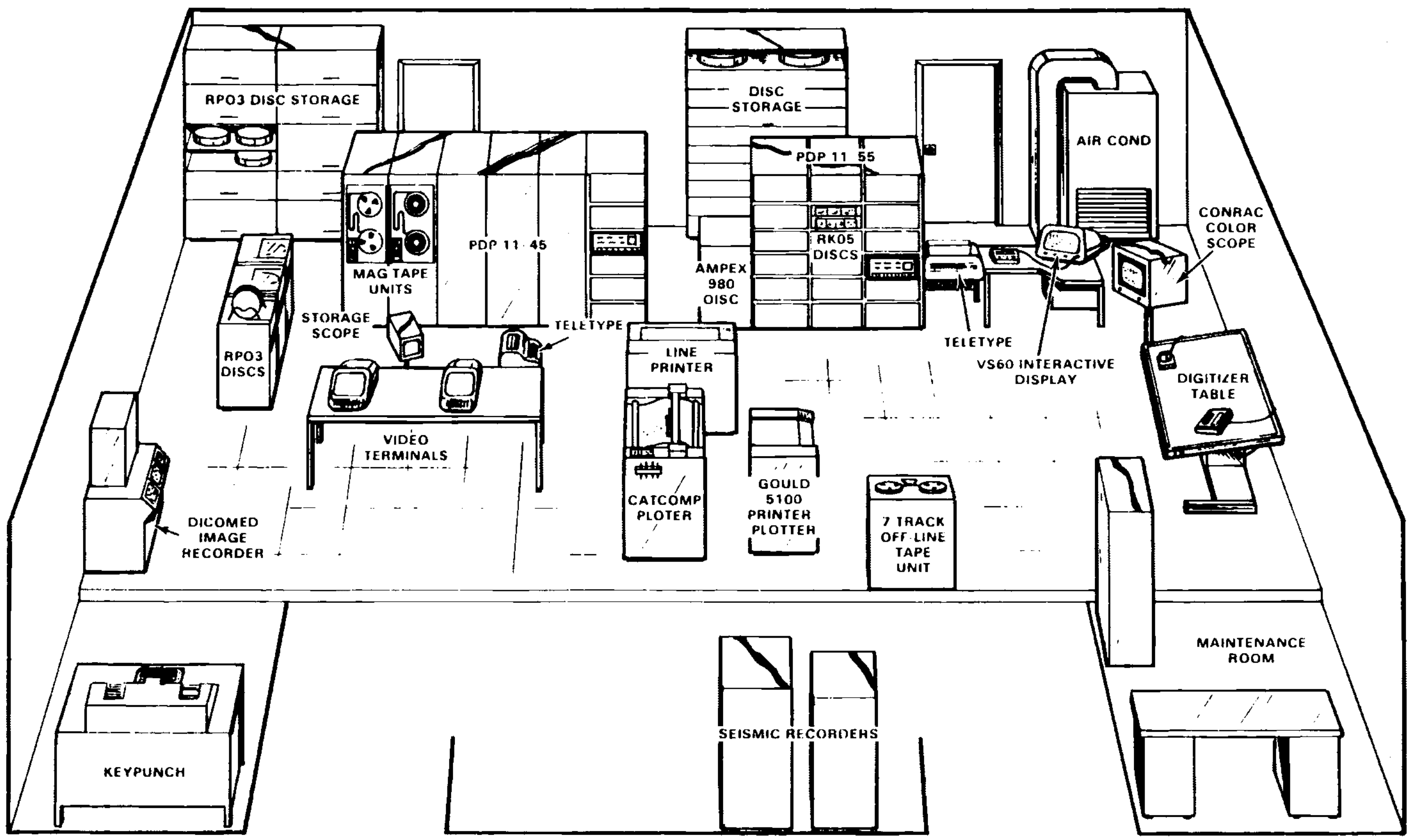


FIGURE 2.1. Computer Hardware Configuration

FIGURE 2.2. 11/55 Computer with VS-60 Display

FIGURE 2.3. Coordinate Digitizer Table

FIGURE 2.4. Tektronix 4014 Display

memory, it is dependent unon the 11/45 for drawing displays on the scope, which is somewhat slower because of the delay time of the telephone link.

The 11/45 also has dial-up telephone capabilities. A portable ADDS terminal (Figure 2.5) 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 most 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 2.6 shows a schematic of the entire CIRMIS programming network and how the programs interact. While the schematic is greatly simplified, the basic interactions are shown. Figures 2.7 and 2.8 show the basic program interactions at the 11/45 and PDP-11/55, respectively.

FIGURE 2.5. ADDS Portable Terminal

FLOW CHART FOR CIRMIS

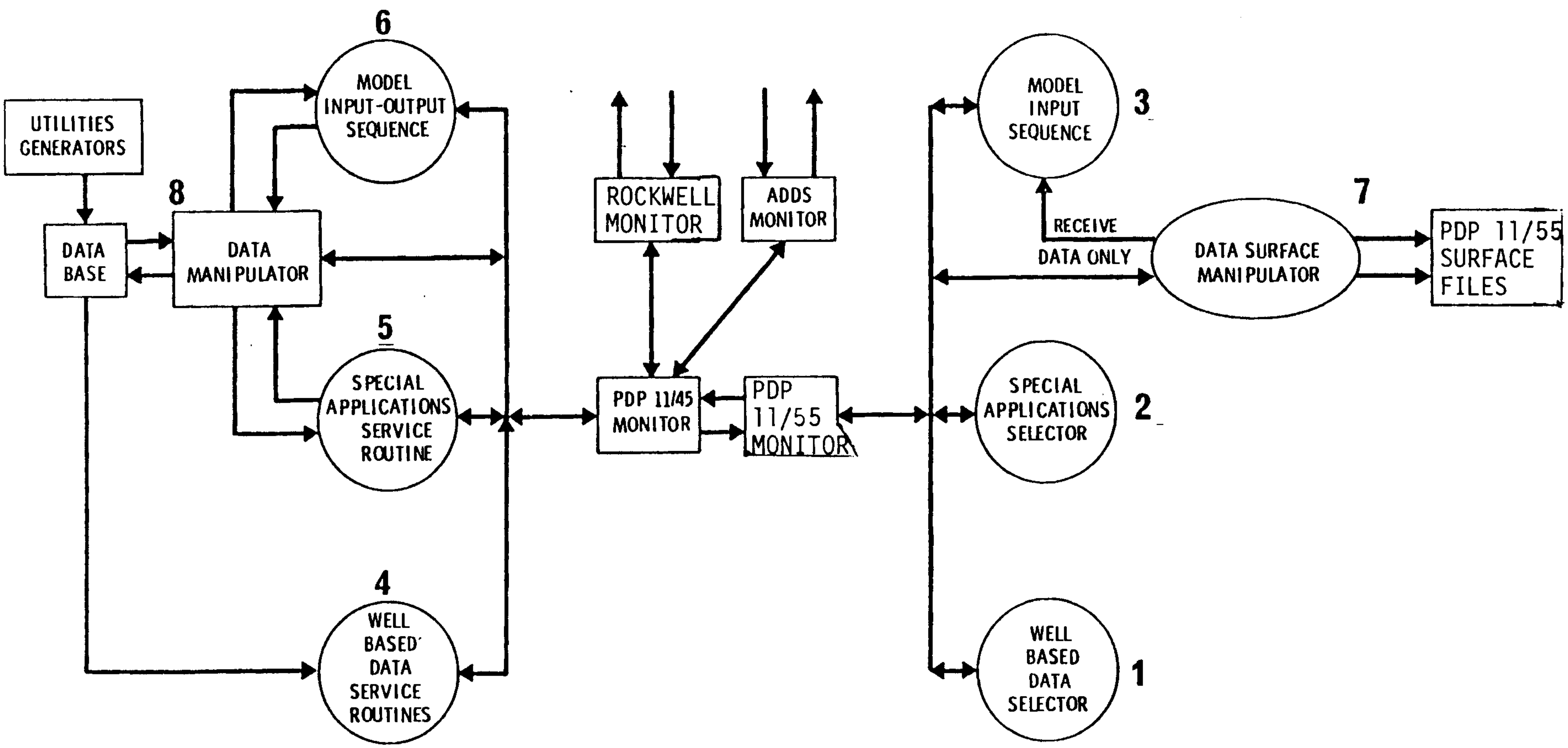
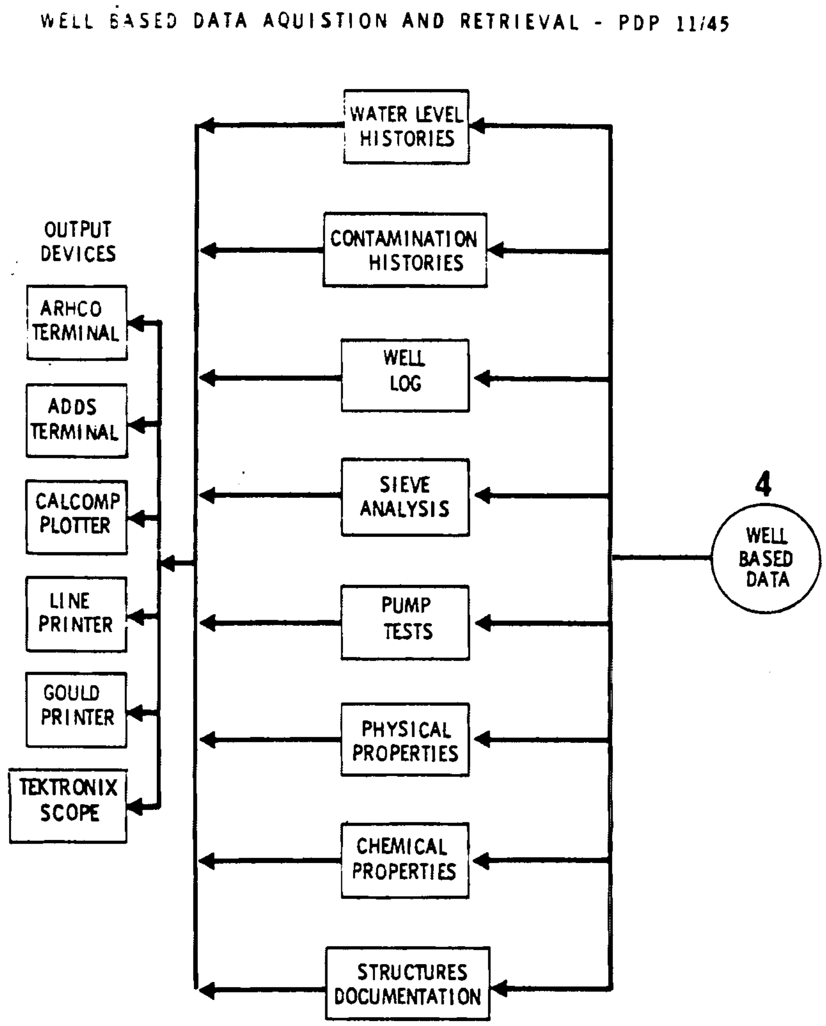


FIGURE 2.6. Overall CIRMIS Software Configuration



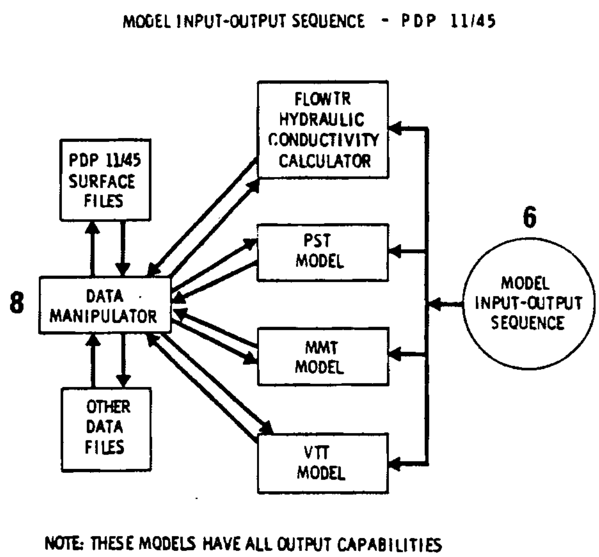


FIGURE 2.7. 11/45 Software Sequences

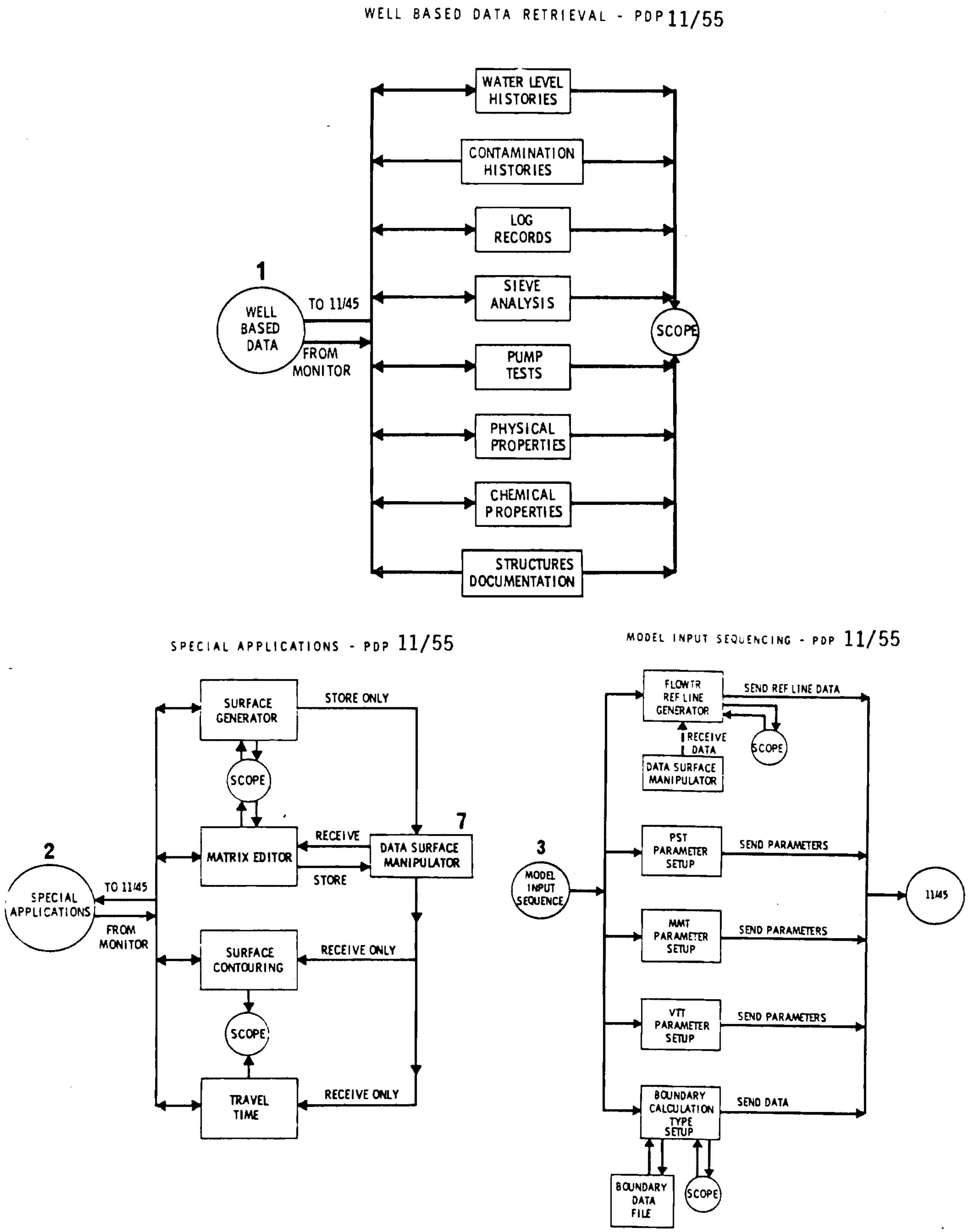


FIGURE 2.8. PDP 11/55 Software Sequences

CHAPTER 3. 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.

PROGRAM HEADER BLOCKS

All main programs and subroutines include header blocks that 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 that 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 3.1 shows an example of the header block where the information added by the user has been underlined.

PROGRAM IDENTIFICATION CODES (ID)

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

```
C ***************  11Ø6,2151 PROGRAM,FIN  ***************
C
C
C PROGRAM ID:  SERV-11-WEL-1-2 (FUNCTION-MACHINE-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                   LUN        TYPE       ACCESS
C     [1Ø,4]DATA,RAN          2         RAN         R/W
      [22,33]FILE2,SQB        3         SQB         W
C     [21,33]DUMMY,FOR        5         FOR         R
C
C LOADING SEQUENCE: (OMITTED FOR SUBROUTINES)
C  PDP11/45
C        MCR TKX =CNTTKBBLD
C  PDP9
C        $A DKD 1Ø
C        $GLOAD
C        >2 DSWELL,INBT,WITHIN(ALT)
C
C
C BATTELLE MEMORIAL INSTITUTE
C PACIFIC NORTHWEST LABORATORY
C WATER & LAND RESOURCES DEPT.
C
C AUTHOR(S):  JOE BLOW & WILLIE MAKEIT
C
C DATE:     INITIAL VERSION    JAN 1974
C           CURRENT VERSION    JUL 1974
C
C
C
```

FIGURE 3.1. Program Header Block

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

   55 - WLR PDP-11/55 Computer

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

   WEL - Well Based Data

   CDR - 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:

   Ø (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

   1Ø (TMP) - Temperature Data

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

   Ø (TIS) - Transmissivity Iterative Sequence Model

   1 (VTT) - 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)

   Ø (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 listed under the DATA FILES title 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

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 an aid to programmers. Several commenting standards, which indicate levels of priority, are typically used in these programs. These are shown in Figure 3.2.

FORTRAN COMMENTING CONVENTIONS:

PRIMARY LEVEL:

```
C
C   *** THIS IS A COMMENT LINE ***
C

C
C   *** THIS IS A LONG COMMENT WHICH EXTENDS OVER MORE THAN ONE
C       LINE AT A GIVEN LOCATION IN A PROGRAM ***
C
```

SECONDARY LEVELS:

```
C---THIS IS THE FIRST LEVEL OF COMMENT TO BE USED BENEATH THE
C   PRIMARY LEVEL

C----THIS IS THE NEXT LEVEL

C-----AND SO FORTH
```

FIGURE 3.2. 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 3.3. shows two program examples using the numbering convention.

PROGRAM NUMBERING CONVENTIONS

```
    NUMBERS         USE

    11-99           FIRST ORDER PROGRAM SEQUENCING
    11ØØ-9999       FIRST HIGHER ORDER PROGRAM SEQUENCING
    11ØØØ-99999     SECOND HIGHER ORDER PROGRAM SEQUENCING
    1ØØ-999         FORMAT NUMBERING
         Ex:   LUN 1 - 1ØØ-199
               LUN 2 = 2ØØ-299
               ETC.
NOTE:  GENERALLY THE SECOND 2 DIGITS IN A FORMAT LABEL CAN COR-
       RELATE WITH THE PREVIOUS FIRST ORDER PROGRAM SEQUENCE NO.
         Ex:   34   DO 35 J=1,4
                    WRITE(2,234) J
               234  FORMAT (16)
               35   CONTINUE
```

```
PROGRAM EXAMPLE 1:                          TYPE

11        READ(6,611) NPT                   FIRST ORDER
611       FORMAT(16)                        FORMAT
          DO 12 J=1,NPT
          WRITE (3,311) J
311       FORMAT(12)                        FORMAT
          DO 115Ø K=1,4
          VAL=K*J**2
115Ø      CONTINUE                          FIRST HIGHER ORDER
12        CONTINUE                          FIRST ORDER
          GO TO 11
          STOP
          END
```

```
PROGRAM EXAMPLE 2:                          TYPE

2Ø        IF(IX.LT.Ø) GO TO 25              FIRST ORDER
          NX=FLOAT(IX)*OSFAC
2Ø5Ø      P=NX                              FIRST HIGHER ORDER
2Ø5Ø1     PK=P+1                            SECOND HIGHER ORDER
2Ø51      PK=P**2                           FIRST HIGHER ORDER
          WRITE(3,32Ø) P,PK
32Ø       FORMAT(2F 1Ø,Ø)                   FORMAT
          IF(IX,EQ.1) GO TO 2Ø5Ø1
          GO TO 2Ø
25        Q=ABS(TX)*2                       FIRST ORDER
          IF(Q,GT,1ØØ,) GO TO 26
25ØØ      GO TO 2Ø                          FIRST HIGHER ORDER
26        STOP                              FIRST ORDER
          END
```

FIGURE 3.3. FORTRAN Numbering Conventions

CHAPTER 4. CIRMIS LOADING PROCEDURES

Three separate monitoring programs make the CIRMIS system quite versatile. The use of these monitors depends upon the requirements of the user and upon computer equipment availability. Two monitoring programs are used separately with the 11/45 computer; MNTR13 and MNTR45. The third monitor program, CIRMIS, is used with the 11/55 computer. The function and loading of these monitors and associated CIRMIS routines and the initialization of the computer equipment are described in the following text.

COMPLETE 11/45 AND 11/55 CIRMIS INTERACTIVE OPERATIONS

If the user requires complete 11/45 CIRMIS interactive operations, both the MNTR45 and CIRMIS monitors provide full graphic data retrieval, display, hard copy output and digitizer capabilities. The 11/45 computer, the 11/55 computer and the shared RPO4 DIVA disc unit must be operational.

The CIRMIS system for both the 11/45 and 11/55 computers is activated at the 11/55 teletype console. The complete sequence is shown below:

1. Place the CIRMIS split volume RPO4 disc pack on the DIVA disc drive DBØ: and depress START button
2. Place the CIRMIS formatted RKO3 disc pack in the 11/55 disc drive and depress the RUN switch.
3. Use the following instructions to initialize the 11/55 portion of the CIRMIS system:

```
>SET /UIC=[351,101]
>ASN DK2:=DI'
>DMOU DK2:
>MOU DK2:
>@DI:CIRMISINS.CMD (note: see Table 4.1)
```

4. Take write lock off DBØ: and clear TTO: on the 11/45. Initialize the 11/45 portion of the CIRMIS system:

```
PLE WLR45_/PW:CIRMIS = DI:DECNET.CMD/CM
```

The DECNET.CMD file is shown in Table 4.2, the 11/45 teletype trailer prompted by this command is shown in Table 4.3.

5. After all of the instructions shown in Table 4.3 have been issued, place DBØ: on READ ONLY.

TABLE 4.1. Listing of 11/55 CIRMISINS.CMD Command File

```
DMO DK1:
FLQ DK1:/ND
DMOU DBØ:
INS DI:CIRMIS
INS DI:HYDSCP
INS DI:CTMSCP
INS DI:WLGSCP
INS DI:DSPSEL
INS DI:MAPLOC
INS DI:WELSEL
INS DI:MAPDRW
INS DI:SURFGN
INS DI:TRAVEL
INS DI:CONTUR
```

TABLE 4.2. Listing of 11/55 DECNET.CMD Command File Used to Initialize 11/45 Portion of CIRMIS

```
HEL  [1,4]
DMOU DBØ:
INS  [11,1] CVS
CVS DBØ: = 3ØØØØ
MOU DBØ:SPLITV/CHA=[DCF,ATCH]
INS @DBØ:[351,1ØØ]CIRMISINS
```

TABLE 4.3. 11/45 Teletype Trailer After PLE Command has been Issued at the 11/55

```
AT. >HEL [1,4]
AT. >DMOU DBØ:
AT. >INS [11,1] CVS

AT. >CVS DBØ: = 3ØØØØ.

AT. >MOU DBØ:SPLITV/CHA=[DCF,ATCH]
MOUNT-**VOLUME INFORMATION
        DEVICE = DBØ
        CLASS  = FILE 11
        LABEL  = SPLITV
        UIC    = [1,1]
        ACCESS = [RWED,RWED,RWED,RWED]

AT.>INS @DBØ:[351,1Ø0]CIRMISINS
```

6. Turn on the display and digitizer. Make the following digitizer console switch settings.

Switch	Position
X-Y DATA	XY
MIRROR	Both OFF
MM-IN	IN
INC-ABS	ABS
Output 1 - Output 2	Output 2
Common Scale	1

7. Type the following instruction on the 11/55 Teletype to start the CIRMIS system:

RUN CIRMIS

The CIRMIS system should now be operational and the display pictured in Figure 4.1 should appear on the CRT.

CIRMIS Operations Using Only the 11/55 Computer

The CIRMIS monitor on the 11/55 computer can stand alone and does not require the use of the 11/45 computer. This method is used when the user requires visual display of well based data without hard copy output or when only surfaces or maps are to be digitized for use with the groundwater models.

The RPO4 disc unit must be operational if well based data are to be retrieved, however; the disc need not be operational if surfaces or maps are being generated.

To activate CIRMIS operations on the 11/55 computer, follow steps 1*, 2, 3, 5, and 6 described under Complete 11/45 and 11/55 CIRMIS Interactive Operations. Step number 4 is omitted.

* Note: Optional if surfaces or maps are to be digitized.

COMPREHENSIVE INFORMATION RETRIEVAL
AND MODEL INPUT SEQUENCE
(CIRMIS)

SELECT A FUNCTIONAL CATEGORY:

WELL BASED DATA RETRIEVAL

SPECIAL APPLICATIONS AND MANIPULATIONS

MODEL INPUT SEQUENCING ROUTINES

EXIT CIRMIS

FIGURE 4.1. 11/55 CIRMIS Monitor Control Display

CIRMIS Operations Using Only the 11/45 Computer

The MNTR13 monitor is used on the 11/45 computer and requires no interaction with the 11/55 computer. The 11/45 computer and any one of three disc units are used (the RPO4 or one of the two RPO3 disc units).

The MNTR13 monitor controls hardcopy output of individual data types in the CIRMIS data base through user keyboard input or rapid output to multiple hard copy devices for any number of data types. Either keyboard control or a command data file may be used. The second option reduces the amounts of machine and operator time needed to acquire a large quantity of data plots or listings. Interactive graphic control and digitizer capabilities are not available with this monitor.

The CIRMIS system is activated at one of the three terminals on the 11/45 computer and is shown below.

1A. IF DBØ: is used, place the CIRMIS split volume RPO4 disc pack on the DIVA disc drive and depress the START button, then issue the following commands on the terminal keyboard.

```
MCR HEL [1,4]
MCR MOU DBØ:SPLITV/CHA =  [DCF, ATCH]
MCR INS @[351,1ØØ]CIRMISINS.CMD
```

The MNTR13 monitor and all of the CIRMIS service routines are now loaded.

1B. IF DP1: or DP2: are used, the CIRMIS retrieval system is a little more hampered because the monitor, and service routines task images must be transferred to the DPØ: system disc. Usually the number of free blocks on the system disc are very few, so only the monitor task image and those service routine task images that are to be used should be transferred.

Because the procedures are identical, N will be used for the unit number in the nomenclature DP1: or DP2:(DPN:); however, the user will use the actual numerical value of the disc unit number.

Because the DPN: discs are half as large as the DB disc, they cannot be made split volume and still contain the entire CIRMIS data base and the program task images simultaneously. Therefore, the data files were put on a File-Q disc and the programs on a separate Files-11 disc.

The following sequence must be followed:

- Place the CIRMIS FILES-11 RPO3 disc pack on DPN:, place START/STOP switch in the START position, then issue the following commands on the terminal keyboard:

```
MCR>HEL [351,1ØØ]
MCR>DMOU DPN:
MCR>MOU DPN:CIRMIS
MCR>PIP
PIP>DPØ: = DPN:MNTR13.TSK
PIP>DPØ: = DPN:FLNAME.TSK
 .  .    .    .   .
 .  .    .    .   .
```

The last command is repeated for each desired service routine that will be used. The names (FLNAME) of all service routines contain six characters. The first three characters indicate the data type and are defined as:

HYD - - - Historic hydrograph
CTM - - - Historic contamination
WST - - - Well structures
WLG - - - Well log records
TMP - - - Historic temperature

The last three characters in FLNAME indicate the I/O device and are defined as:

LPR - - - Line printer
CAL - - - Calcomp plotter
GLD - - - Gould printer/plotter
TEK - - - Tektronix scope

The name of the service routine to output historic hydrograph data on the line printer would therefore be HYDLPR.TSK.

- Install the tasks

```
MCR>HEL [1,4]
MCR>INS
INS>DPO:[351,1ØØ]MNTR13
INS>DPO:[351,1ØØ]FLNAME
 .   .     .      .
 .   .     .      .
```

The last command is repeated for each desired service routine where FLNAME matches those transferred to DPØ:

- Replace the CIRMIS FILES-11 disc pack with the CIRMIS FILE-Q disc pack, then issue the following commands:

```
MCR>DMOU DPN:
MCR>MOU DPN:/CHA = [FOR,ATCH]
```

After one of the two procedures above (1A or 1B) has been executed, the following instruction is used to initiate the CIRMIS system on one of the terminals at the 11/45 computer

```
MCR>RUN MNTR13 (Alt Mode)
```

The monitor will now start and prompter messages will be output to the users terminal, at which time the user is to enter the specific information requested by the program.

If the user requires output for only a small number of data types, the sequence shown on the teletype trailer depicted in Figure 4.2 is used. The first example shown in Figure 4.2 outputs a line printer listing of hydrograph data for Well 6 6Ø 6Ø, the second example outputs a calcomp plot of temperature data for Well 3 3 9.

```
                      CIRMIS MONITOR CONTROL PROGRAM

ENTER FILE-Q DISC UNIT (I.E. DP1,DP2,DBØ)          DBØ:

IS THERE A SPECIAL COMMAND FILE?  (Y OR N)        >N

ENTER DESIRED DATA TYPE CODE.
     (Ø=HYD, 1=CTM, 2=WST, 3=WLG, 1Ø=TMP)          >Ø

ENTER DESIRED OUTPUT CODE.
     (1=CAL, 2=LP, 3=GLD, 4=TEK)                   >2

ENTER WELL DESIGNATION (12A1)                      >6    6Ø    6Ø
SUCCESSFUL ACCESS

DO YOU WANT ANOTHER?  (Y OR N)                     >Y

ENTER DESIRED DATA TYPE CODE.
     (Ø=HYD, 1=CTM, 2=WST, 3=WLG, 1Ø=TMP)          >1

ENTER DESIRED CONTAMINANT CODE (1-26)              >4

ENTER DESIRED OUTPUT CODE.
     (1=CAL, 2=LP, 3=GLD, 4=TEK)                   >1

ENTER WELL DESIGNATION (12A1)                      >3     3     9
SUCCESSFUL ACCESS

DO YOU WANT ANOTHER?  (Y OR N)                     >N

MNTR13 STOP
```

FIGURE 4.2. Teletype Trailer Showing Use of MNTR13 for Individual Data Types

If the user requires output for a large number of data types, the sequence shown on the teletype trailer depicted in Figure 4.3 is used.

```
                    CIRMIS MONITOR CONTROL PROGRAM

ENTER FILE-Q DISC UNIT
(I.E. DP1,DP2,DBØ)                   >DBØ:

IS THERE A SPECIAL COMMAND FILE?
(Y OR N)                             >Y

ENTER COMMAND FILE
NAME (7A4)                           >DPØ: 351,1ØØ  TEST.CMD

MNTR13 STOP
```

FIGURE 4.3. Teletype Trailer Showing Use of a Special Command File as Input to MNTR13

Figure 4.4 shows an example input command file for the second option. Figure 4.5 shows the function and format for each line of the command file.

Line 1 in Figure 4.4 shows 3 wells to be evaluated. Line 2 shows the designation of the First Well (6 2 33A); line 3 shows the data type to be historical contaminant (ID = 1); the output device to be the Gould Plotter (IO = 3) and the year range is from 1973 through 1978 (Ø73Ø78); line 4 shows that all available contaminants are to be processed.

Line 5 in Figure 4.4 shows the designation of the second well (6 14 E6P). Line 6 shows the same ID, IO and year range as the first well (since all of the contaminants are not to be output the number of contaminants (3) is entered at the end of the line), and line 7 shows only contaminants 1, 2 and 5 to be processed.

Card Image		Line Number
3		1
6 2 33A		2
1 3 73 78	or 1,3,73,78	3
ALL		4
6 14 E6P		5
1 3 73 78 3	or 1,3,73,78,3	6
1 2 5	or 1,2,5	7
2E 13 1		8
Ø 1	or Ø,1	9

FIGURE 4.4. Example Input Command File (DPO:[351,100] TEST.CMD) Used with Figure 4.3

```
LINE 1:  NUMBER OF WELLS
           (I4)
LINE 2:  WELL DESIGNATION
           (12A1)
LINE 3:  ID TYPE, I/O TYPE, YEAR RANGE, NUMBER OF CONTAMINATE
           CODES
           (IF ID TYPE .EQ. 1)
           (5I3)
LINE 4:  CONTAMINATE CODES (1-N) OR "ALL," IF (IDTYP .EQ. 1)
           (32I2) OR (A3)

LINES 2-4 REPEATED NWELLS TIMES, IF (IDTYP.EQ.1)
LINE 2    REPEATED NWELLS TIMES, IF (IDTYP.NE.1)
```

FIGURE 4.5. Format and Function of Each Line in the Special Command File

Line 8 shows the designation of the third well (2E 13 1); line 9 shows the data type to be historical hydrograph (ID = Ø); the output device to be the calcomp plotter (IO = 1) and the year range is all available measurements. (If the year ranges are Ø or blank, all measurements will be output.)

The data type codes (ID) are shown in Table 4.4, the output device codes are shown in Table 4.5, and the contaminant codes are shown in Table 4.6.

TABLE 4.4. CIRMIS Data Type

ID NUMBER	CALCOMP DATA TYPE	PEN USED
ID = Ø	WELL HYDROGRAPHS	1
ID = 1	WELL CONTAMINANT HISTORIES	1
ID = 2	WELL STRUCTURES	2
ID = 3	WELL LOG RECORDS	2
ID = 4	SIEVE ANALYSES	1
ID = 5	PUMP TEST DATA	1
ID = 6	PHYSICAL PROPERTIES OF SOILS	1
ID = 7	CHEMICAL PROPERTIES OF SOILS	1
ID = 8	HYDROGRAPH/VTT OVERLAY	1
ID = 9	FREE	
ID = 1Ø	WELL TEMPERATURES	1

TABLE 4.5. CIRMIS Output Options

IO NUMBER	OUTPUT DEVICE
IO = 1	CALCOMP PLOTTER
IO = 2	LINE PRINTER
IO = 3	GOULD PRINTER/PLOTTER
IO = 4	TEKTRONIX SCOPE

TABLE 4.6. CIRMIS Contaminant Codes

CODE	CONTAMINANT	CODE	CONTAMINANT
1	TOTAL ALPHA	17	COPPER
2	TOTAL BETA	18	HARDNESS
3	TRITIUM	19	SOLIDS
4	NITRATE	2Ø	MANGANESE
5	STRONTIUM-90	21	TOTAL ORGANIC CARBON
6	CESIUM-137	22	PH
7	COBALT-60	23	SULFATE
8	URANIUM	24	SODIUM
9	PLUTONIUM-239	25	CALCIUM
1Ø	RUTHENIUM-106	26	TOTAL GAMMA
11	CHROMIUM	27	BICARBONATE ION
12	FLUORIDE	28	CARBONATE ION
13	MAGNESIUM	29	TOTAL POTASSIUM
14	IRON	3Ø	SPECIFIC CONDUCTIVITY
15	PHOSPHATE	31	BORON
16	CHLORIDE	32	LOW ALPHA

CHAPTER 5. SEQUENCE FOR INITIALIZING CIRMIS DATA BASE FOR NEW PROJECTS

Each time a new project is analyzed and a new data base is generated, some program changes usually have to be made to the CIRMIS system. This is because coordinate systems may differ from project to project, and time may be saved in the retrieval of the data by modifying the storage and retrieval routines for use with well designations unique to the studied area. The following terminology is used in this sdection:

1 character	=	1 byte
1 byte	=	8 bits
1 integer word	=	2 bytes
1 real word	=	2 integer words
1 disc sector	=	256 integer words

The CIRMIS system is presently set up to contain up to 6,000 individual wells and their associated data. This may be altered at the time the data base is initialized, however by doing so, several programs in the CIRMIS system must be changed. Two random access files are required: (1) WELLNAM contains the names (12 characters or bytes) of the wells packed 42 names per disc sector, (2) WELLHDR contains the header blocks associated with each well. Each header block is one disc sector and is described under CIRMIS Programming Standards and Operating Procedures.

Four things must be done before entering the raw data types (e.g., drillers logs, historic hydrograph), into the data base. These are (1) build a formatted data file containing well names, coordinates, and case elevations; (2) digitize or calculate the model coordinates; (3) change the well header generator program and the retrieval program to calculate disc addresses according to the user's needs; and (4) rebuild the task images for all programs that use the new retrieval method.

These are relatively simple operations and will now be described in detail.

BUILDING A FORMATTED DATA FILE

The first step in setting up a CIRMIS data base for a new project is to collect all known well names and their associated coordinates and casing elevations.

Normally the well name, real coordinates, and casing elevation are known from regional documentation; these are entered on 80-80 sheets, keypunched, and entered into the computer under the name WELHDR.FOR. In most cases the real coordinates (which may be in the form of township, range, etc., or latitude, longitude, or even in some local coordinate system) and the ground-water model coordinates (which are always measured from the bottom, left corner of the area that is to be modeled) are not the same. If the model coordinates are known, they can also be entered on the 80-80 sheets. The format for this data file is:

Well Name	Real Coordinates (X Y)	Model Coordinates (X Y)	Casing Elevation
1X, 12A1	19A1	2F10.1	F8.2

The wells are sorted or entered into the formatted file so that some order exists. The data base well header generator program WHDRGEN will read the wells in sequential order, store the well designations in a random access file, WELLNAM, and then store each well's parameters in another random access file, WELLHDR, which will contain a 256 integer word disc sector for each well.

DETERMINING MODEL COORDINATES

Two models can be used to determine model coordinates: 1) direct calculation or conversion of the real coordinates, or 2) digitizing the locations of the wells placed upon a regional map.

If the model coordinates are calculated from the real coordinates (which may be simply translating or rotating of the axes) the section (TO CONVERT-TO-MAP-COORDINATES) in the well header generator program WHDRGEN is replaced with appropriate computer code to provide the desired conversion. The formatted data file (WELHDR.FOR) is rewritten for later reference by WHDRGEN after the model coordinates have been calculated.

The second method uses the PDP 11/55 computer and coordinate digitizer. A program, WELDIG, digitizes wells on a regional background map to provide model coordinates. When all of the wells have been digitized, the well names and model coordinates are written to a formatted data file called WELCORD.DAT. Another utility program, COMBINE is used to take the model coordinates from this data file and insert them into the formatted well header data file WELHDR.FOR. If this method to determine model coordinates is used, the section (TO CONVERT-TO-MAP-COORDINATES) in the WHDRGEN program bypassed because the model coordinates are already available.

METHODS FOR STORING AND RETRIEVING WELL DATA

A standard has been set up for the CIRMIS system that requires all well names to contain twelve alphanumeric characters (12 bytes), some of these characters can be blank but 12 locations must be assigned. If this convention were not adhered to modifications would have to be made in a considerable number of CIRMIS routines.

Two methods have been used with the CIRMIS system to provide storage and retrieval capabilities; however, the use of these methods are up to the user.

The first method is simply a sequential storage of the well names, 12 bytes per name and 42 names per disc sector in the well name file WELLNAM. Eight bytes are not used and are left at the end of each sector. All random access disc files begin with a disc address of zero (Ø); therefore, the first 42 well names would be stored in disc sector Ø, the second 42 well names are stored in disc sector 1, and so forth. As the name of each well is stored in the WELLNAM file, the well name, coordinates, and casing elevation are stored sequentially (one 256 word disc sector per well) in the random access disc file WELLHDR.

Figure 5.1 shows the storage configuration for both WELLNAM and WELLHDR. This figure also shows examples of wells (1 and 87) stored in the WELLNAM file and their header blocks stored in WELLHDR.

The method of retrieval uses the following equation:

$$\text{WHSCTR} = \text{WNSCTR} * 42 + \text{LOC} - 1$$

where:

LOC = Numerical location in sector (1 to 42)

WNSCTR = WELLNAM sector address (Ø to 142)

WHSCTR = WELLHDR sector address (Ø to 5999)

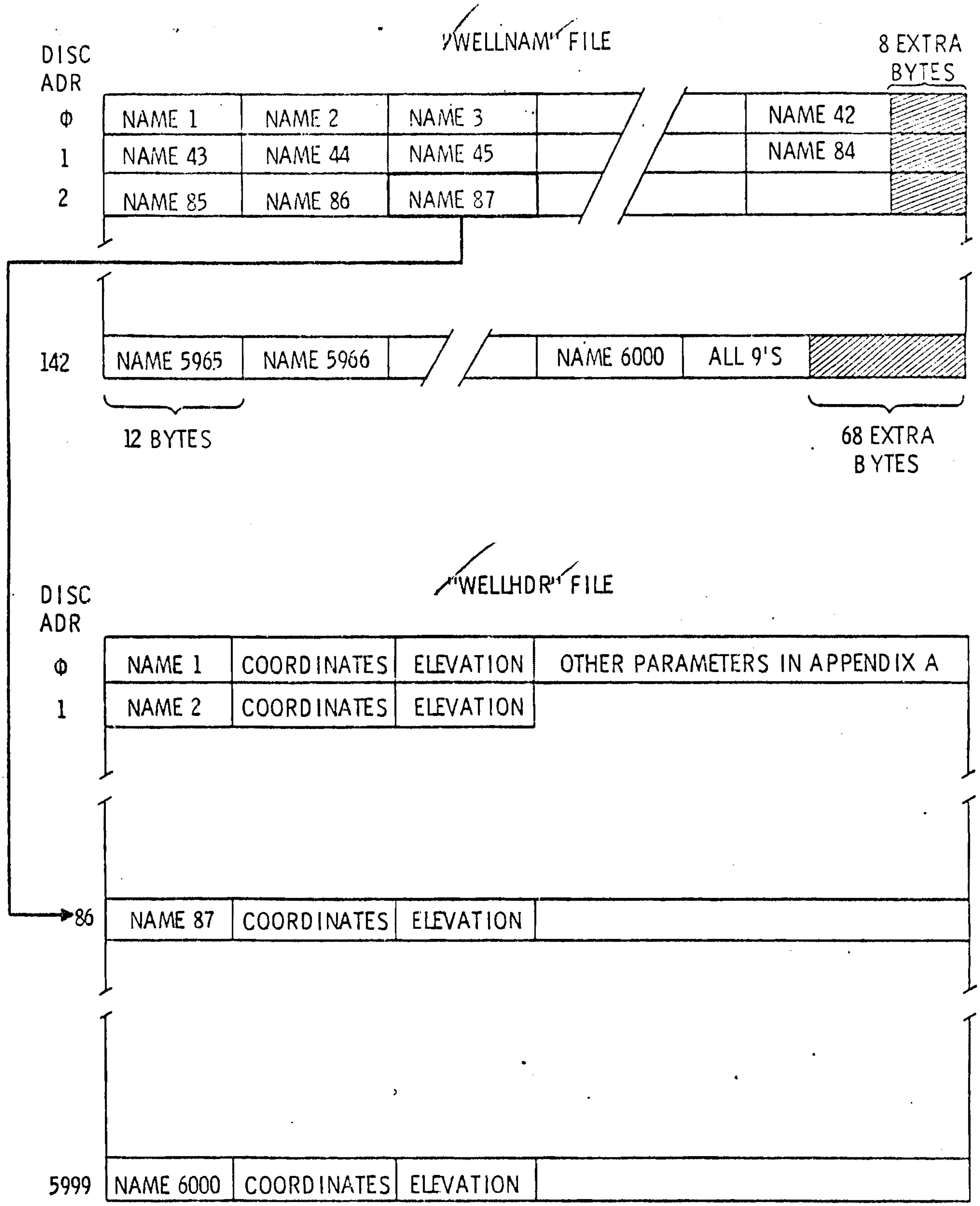

"WELLNAM" FILE
DISC ADR
8 EXTRA BYTES
Φ
NAME 1
NAME 2
NAME 3
NAME 42
1
NAME 43
NAME 44
NAME 45
NAME 84
2
NAME 85
NAME 86
NAME 87
142
NAME 5965
NAME 5966
NAME 6000
ALL 9'S
12 BYTES
68 EXTRA BYTES
"WELLHDR" FILE
DISC ADR
Φ
NAME 1
COORDINATES
ELEVATION
OTHER PARAMETERS IN APPENDIX A
1
NAME 2
COORDINATES
ELEVATION
86
NAME 87
COORDINATES
ELEVATION
5999
NAME 6000
COORDINATES
ELEVATION

FIGURE 5.1.

For example the first well would have a WELLHDR disc sector address of Ø (WHSCTR = Ø*42 + 1 - 1), the 87th well would have a WELLHDR disc sector address of 86 (WHSCTR = 2*42 + 3 - 1).

This sequential method of storage uses the same number of disc sectors in the WELLHDR file as there are wells to be stored. If there were 87 wells to be stored in the data base, only 3 sectors (IFIX (87/42 + 1)) would be used in the WELLNAM file and 87 sectors used in the WELLHDR file. If 6000 wells (maximum allowable) were stored in the data base (Figure 5.1) then 143 sectors (IFIX (6000/42 + 1)) would be used in the WELLNAM file and 6000 sectors used in the WELLHDR file.

The second method can be used if some unique patterns are detected in the assigned well designations. The Programmer may take advantage of this and alter the storage and retrieval procedures to make a more rapid search sequence. For example, the wells for the Waste Isolation Pilot Program site use the first character in the well designations since a unique pattern can be seen in this single character (this will be discussed later). The Hanford wells, on the other hand, show unique patterns in the first two characters of the well designation (this will also be discussed later). Once a pattern has been determined, and the categories selected, the user assigns starting disc sectors (42 well names per sector) in the WELLNAM file for each category. The number of wells in each category is determined by examining the formatted data file WELHDR.FOR and this number is used to determine the number of required sectors.

The Hanford system has seven unique categories assigned to well designations. The well designation prefixes were originally 199, 299E, 299W, 399, 699, 1199, and 3099, however, these prefixes were shortened to 1, 2E, 2W, 3, 6, 11 and 30 prior to entering into the WELHDR.FOR data file. Table 5.1 shows the storage configuration selected for the Hanford wells.

TABLE 5.1. Hanford Storage Allocation

Well Prefix	Sector Range	No. of Sectors	Wells Stored	Max. No. of Wells
1	0 → 4	5	105	210
2E	5 → 29	25	555	1,050
2W	30 → 59	30	801	1,260
3	60 → 64	5	37	210
6	65 → 94	30	781	1,260
11	95 → 99	5	105	210
30	100	1	9	42
	Totals	101	2,393	4,242

More sectors were assigned to each category than were required to hold the names to be stored so that additional wells could be added at a later date. For example, the number of wells with a prefix of 2W (see Table 5.2) are 801 which would take 20 sectors (IFIX (801/42) + 1), but 30 sectors (60-30) were assigned to take care of future expansion.

The starting disc sectors for each category are shown as the first number under the title Sector Range (example: starting disc sector for 2E is 5).

These starting disc sectors are then entered into the generator program WHDRGEN to calculate the disc sector address in WELLNAM where the well name is to be stored. The starting disc sectors are also entered into the retrieving program RTVHDR. RTVHDR does a sequential search of the names in the WELLNAM file until a match is found for a requested well. The retrieval routine accesses one disc sector at a time and searches the 42 names for a match. If a match is not found, the next sector is accessed and searched until all sectors and names have been checked. If a match in well names has occurred, the disc sector address for WELLHDR is calculated and the parameters retrieved according to the following equation:

WHSCTR = (WNSTRT + NSEC - 1)*42 + LOC - 1

where:

WHSCTR = WELLHDR sector address (0 to 5999)
WNSTRT = category starting sector address in WELLNAM
NSEC = number of sectors read (0 N)
LOC = numerical location of name in sector (1 to 42)

Figure 5.2 shows the storage configuration for both random access file WELLNAM and WELLHDR. An example Well 2E 13 1 is used to calculate the WELLHDR disc sector address. Table 5.2 shows starting sector address (WNSTRT = 5), it is the first sector in the 299E category (NSEC = 1) and it is the first well of the 42 wells stored in this sector (LOC = 1). Using the above equation the WELLHDR sector address can be calculated.

WHSCTR = (5 = 1 - 1)*42 + 1 - 1 = 210 (see Figure 5.2)

TABLE 5.2. WIPP Site Storage Configuration

Well Prefix		Sector Range	No. of Sectors	Wells Stored	Max. No. of Wells
A	C	0 → 4	5	10	210
D	F	5 → 9	5	46	210
G	I	10 → 14	5	31	210
J	L	15 → 19	5	5	210
M	O	20 → 24	5	1	210
P	R	25 → 29	5	26	210
S	U	30 → 34	5	0	210
V	W	35 → 44	10	42	420
X	Z	45 → 49	5	0	210
0	3	50 → 54	5	1	210
4	6	55 → 59	5	1	210
7	9	60 → 64	5	0	210
		Totals	65	163	2730

The WIPP site has twelve unique categories assigned to well designations, shown in Table 5.2. Figure 5.3 shows a partial listing of the WIPP site formatted data file WELHDR.FOR. The real coordinates were not known, so the well locations were digitized using WELDIG and entered into the data file using COMBINE.

Figure 5.4 shows the WIPP site storage configuration for both WELLNAM and WELLHDR.

REBUILD TASK IMAGES

Once the formatted data file (WELHDR.FOR) has been constructed, and the generator program (WHDRGEN) and the retrieval subroutine (RTVHDR) have been modified for the new well designations, the generator program, the monitor programs (MNTR13 and MNTR45) on the 11/45 computer, and the well select programs (WELSEL and DSPSEL) on the 11/55 computer must be rebuilt. When this has been done, the generator program (WHDRGEN) can be run to initialize the data base. The data types (e.g., hydrograph, contaminant, well logs) may now be entered into the data base using the appropriate generator programs.

A flow diagram of the sequences to follow when initializing the CIRMIS data base for new projects is shown in Figure 5.5.

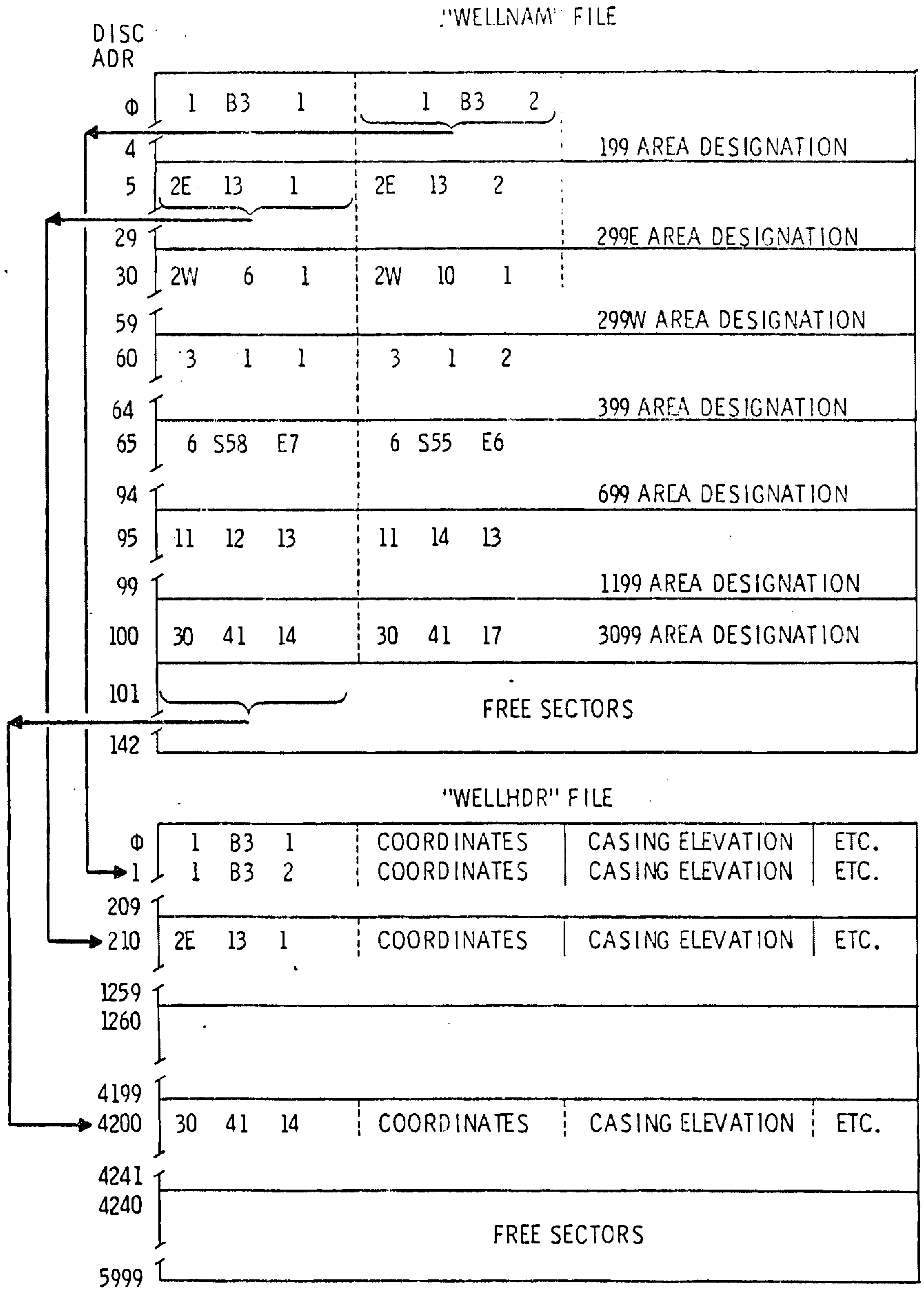


FIGURE 5.2. Hanford Random Access Header Files

Designation	Real Coordinates	Map Coordinates	Elevation	
1-SAND-18			3588.00	
49ER RIDGE			3512.00	
AA-2	112792.7	86251.9	3453.00	23-31-02
AEC-7	122004.4	122326.2	3662.00	21-32-31
AEC-8	110129.8	112656.0	3542.00	22-31-11
BAS-1	123452.5	98279.4	3620.00	22-32-19
BAVERDORF-1			3482.00	
B-1	83959.1	85125.6	3290.00	23-30-01
CB-1	95729.1	84932.5	3320.00	23-31-05
CM-1	88013.8	116831.4	3376.00	22-31-06
COTTON BABY			3450.00	
C-1	83975.2	114763.8	3357.00	22-30-01
D-TS5	83532.7	73653.3	3210.00	23-30-13
D-1	80596.2	81811.0	3241.00	23-30-02
D-18	76034.7	81561.6	3190.00	23-30-10
D-19	74586.5	76300.1	3149.00	23-30-15
D-31	76533.5	86879.5	3244.00	23-30-02
D-36	76300.1	92213.4	0.00	22-30-34
D-48	79486.0	103106.4	3337.00	22-30-14
D-82	73701.6	111714.7	3149.00	22-30-10
D-96	75262.3	118239.3	3189.00	22-30-03
D-104	85544.0	100435.4	3388.00	22-30-24
D-120	83178.7	106799.1	3338.00	22-30-13
D-121	77603.5	109526.4	3202.00	22-30-11
D-123	107957.6	89622.8	3432.00	22-31-34
D-160	83114.3	89655.0	0.00	22-30-36
D-176	73798.1	86959.9	3197.00	23-30-03
D-177	73782.0	84433.7	3151.00	23-30-03
D-179	79156.2	84369.4	3244.00	23-30-02
D-180			3210.00	22-30-34

FIGURE 5.3. Partial Listing of WIPP Site Formatted Data File WELHDR.FOR

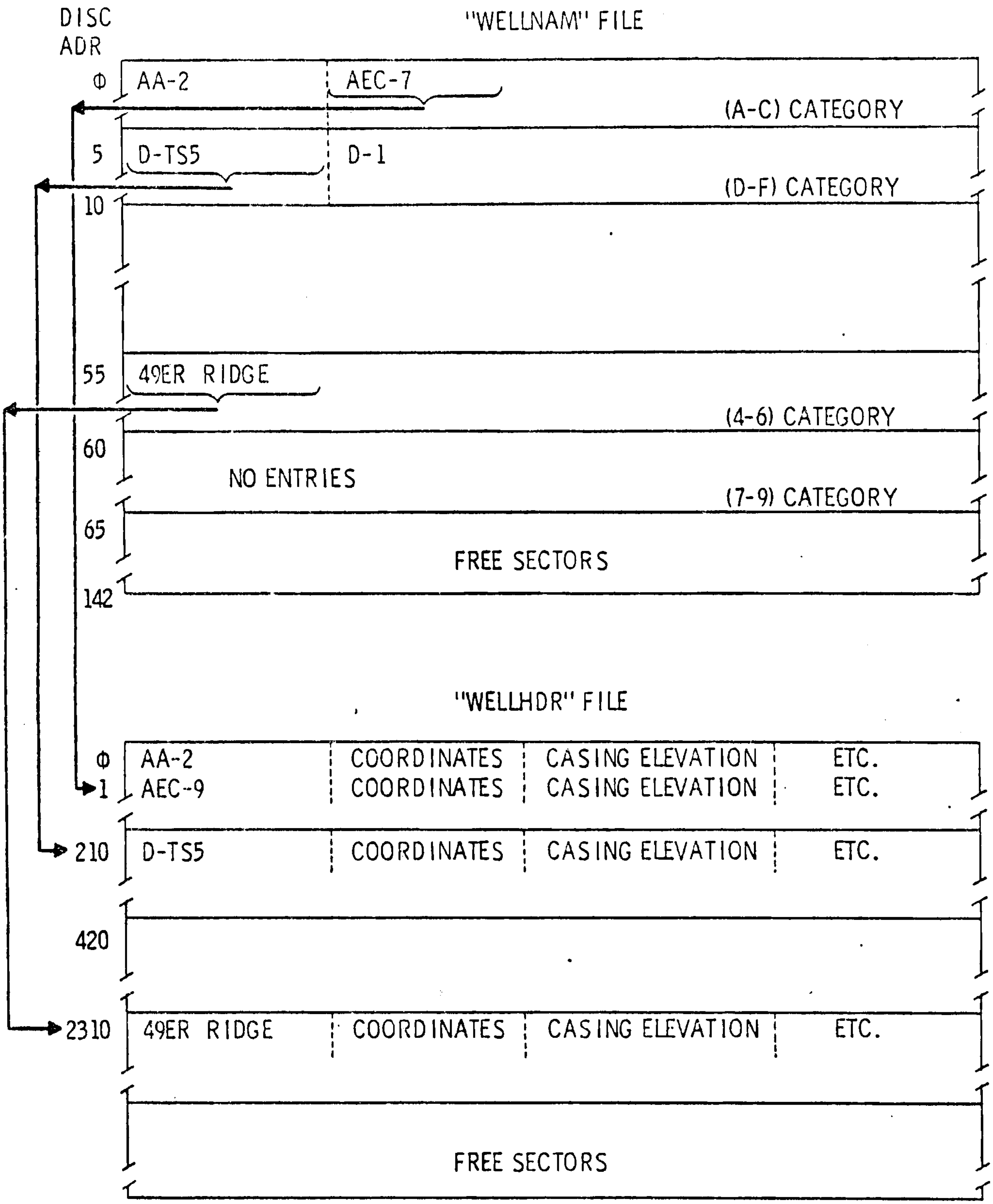


FIGURE 5.4. WIPP Site Random Access Header Files

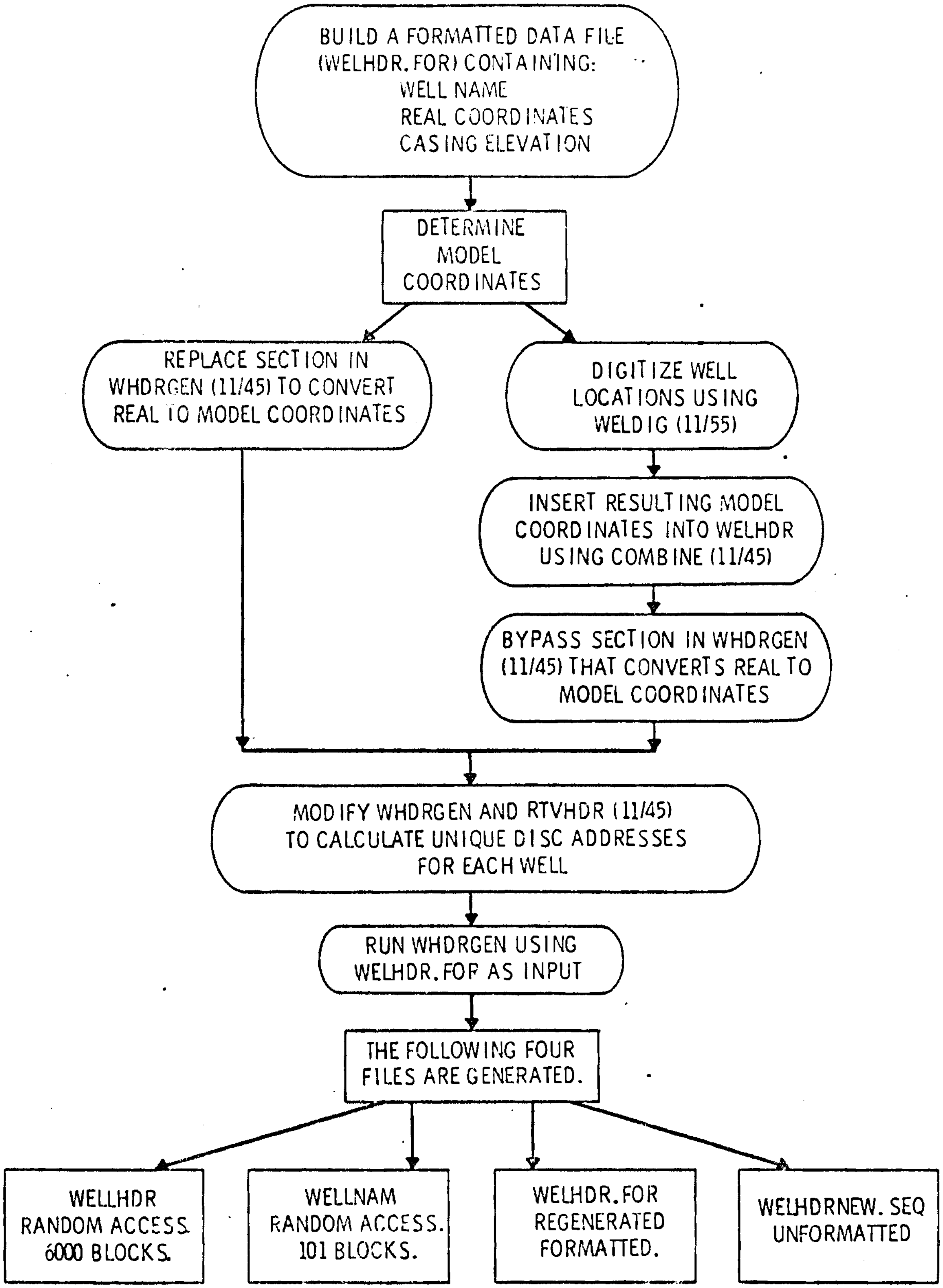


FIGURE 5.5. Flow Diagram of Sequences to Follow When Initializing the CIRMIS Data Base

CHAPTER 6. USERS' MANUAL

6.1. WELL-BASED DATA RETRIEVAL SYSTEM

This section describes the procedures involved in the retrieval of well-based data. Capabilities are available to graphically display various types of information relating to wells and/or obtain hard copy plots and line printer listings of these data.

All of these functions are controlled by the PDP-9 computer through graphic user interaction with a PDP-11/45 computer. The well-based data is stored on a disc mass storage unit which is a peripheral to the PDP-11/45 computer.

INITIAL STARTUP PROCEDURES

To operate the programs in this section, the steps outlined in the ICRMIS loading procedures section must be followed. Once these procedures have been completed, the display in Figure 6.1 will appear.

The programs in this section are defined as WELL BASED DATA RETRIEVAL shown under the heading SELECT A FUNCTIONAL CATEGORY.

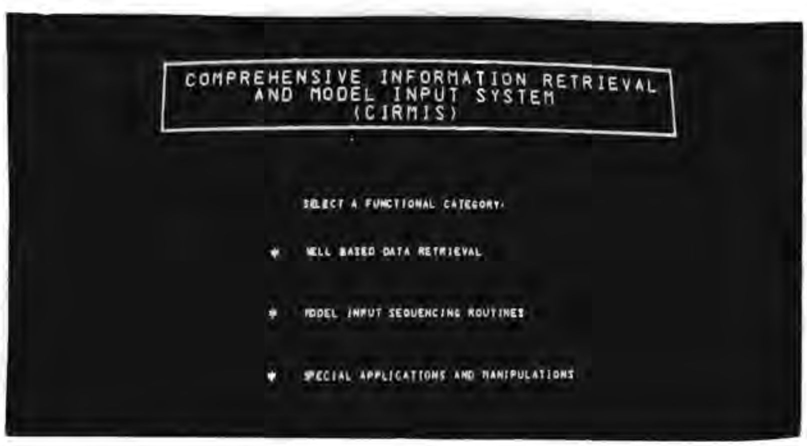


FIGURE 6.1. CIRMIS Monitor Control Page

MONTR9 monitors the PDP-11/45 and provides the user with information as to data availability, program availability, program status, and various other error messages (Figures 6.2A through 6.2C).

Monitor Operation

- The user selects the option WELL BASED DATA RETRIEVAL as shown in Figure 6.1. The present display page is replaced with that shown in Figure 6.3.
- The user selects the first option shown under the title CHOOSE A METHOD OF WELL SELECTION. (The second and third options have been developed to some extent but have not been completed.) The present display page is replaced with that shown in Figure 6.4.
- The user may now enter a well designation on the scope console keyboard (example: 699 20 20).
- Upon getting acknowledgment that the selected well exists, the user may select the CONTINUE option. The present display is replaced with that shown in Figure 6.5.
- Figure 6.5 shows the data type and output devices presently available for the selected well. The user then selects a data type and output device from a box within the matrix. For all data types except contamination histories, the user selects RETRIEVE DATA and the data will be output to the selected device. For contamination data the RETRIEVE DATA option shown in Figure 6.5 is replaced with CONTINUE as shown in Figure 6.5A.
- If contamination history data was selected and upon hitting CONTINUE, the present display will be replaced with that shown in Figures 6.1 through 6.6 where available contaminant data will appear with a preceding star. Upon hitting RETRIEVE DATA with the light pen, the data will be output to the selected device.

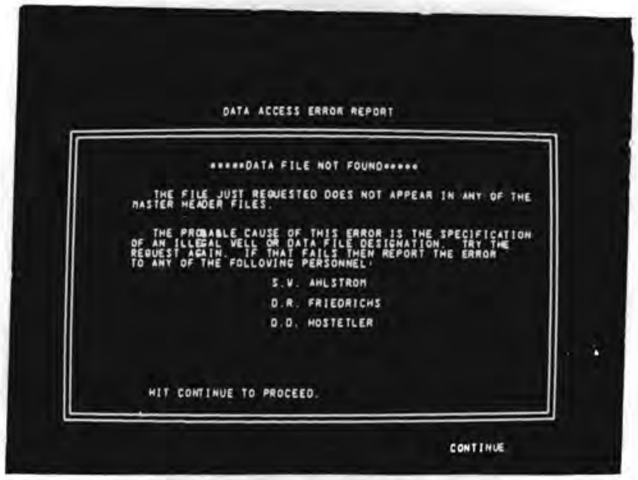


FIGURE 6.2A.

FIGURE 6.2B.

FIGURE 6.2C.

Error Report Messages

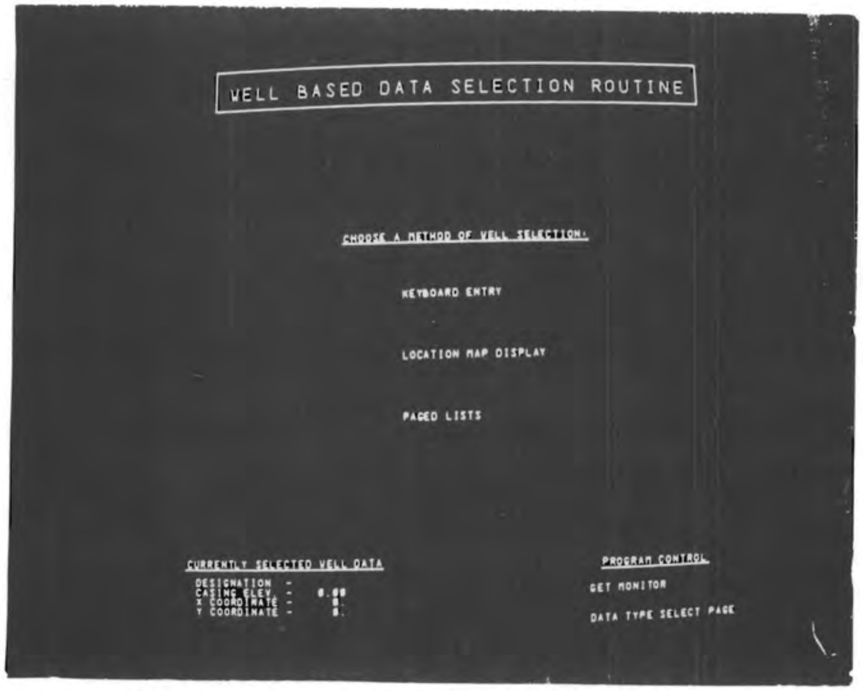


FIGURE 6.3. Well Selection Modes

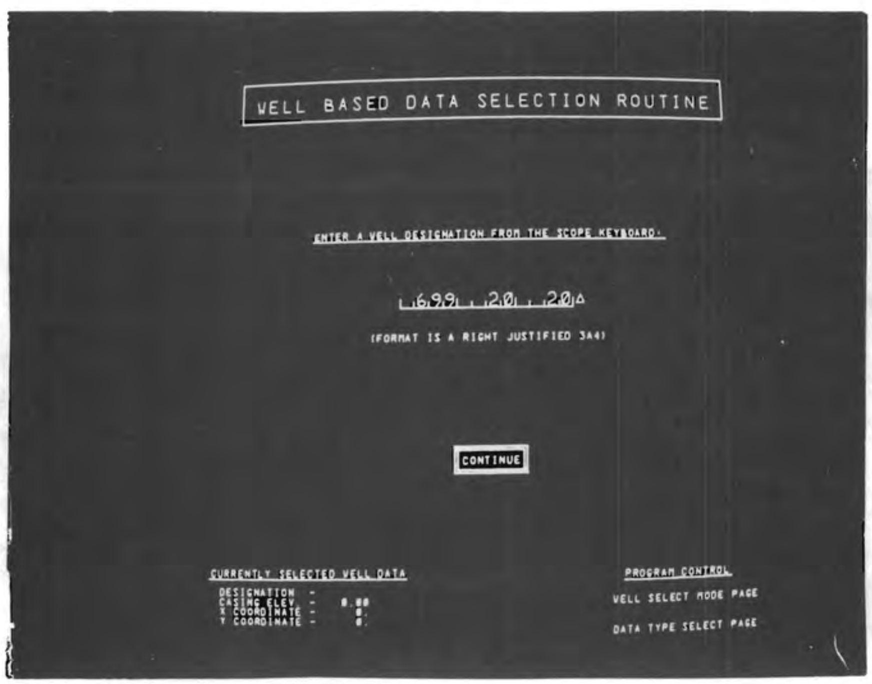


FIGURE 6.4. Individual Well Selection Using Keyboard Mode

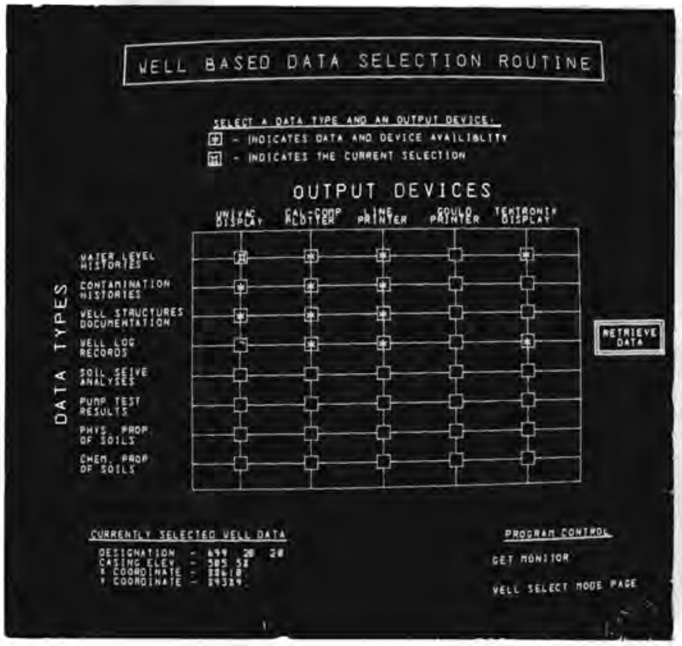


FIGURE 6.5.

Data Type and Output Device Page

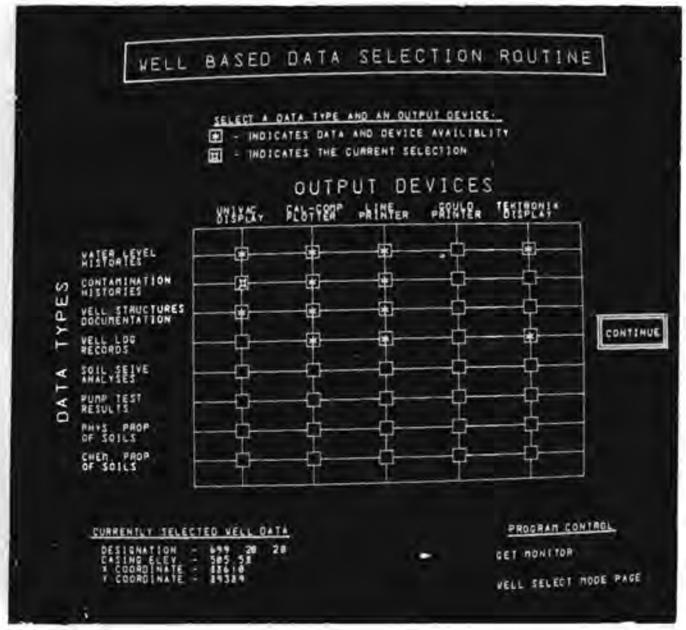


FIGURE 6.5A.

Data Type and Output Device Page for Contaminant Data

FIGURE 6.6. Contaminant Data Selection Page

DATA TYPES

The following is a description of program control operations for specified data types while displayed on the UNIVAC 1558 scope:

HYDSCP - Well Hydrograph (Figues 6.1 through 6.7)

The options to the right of the graph are light pen interactive and are described as:

- ELEV. SCALE - the user may change the elevation scale by selecting this option and entering the desired elevation range on the keyboard as shown in the displayed example
- TIME SCALE - the user may change the time scale by selecting this option and entering the desired time range in years on the keyboard as shown in the displayed example
- CALCOMP - the user may obtain a hardcopy Calcomp plot of the present hydrograph by selecting this option
- GOULD - not operational (waiting for Gould software)
- MONITOR - the user may return to the PDP-9 monitor (see Figure 6.1)
- WELL SELECT - the user may return to select a different data type or output device for the presently (selected well (Figure 6.5)
- VTT OVERLAY - the user may select this option to retrieve and display data obtained from the VTT program as an overlay with the hydrograph

CTMSCP - Contaminaition History (Figures 6.1 through 6.8)

The options to the right of the graph are light pen interactive and many of the options are similar to those described in HYDSCP. They include:

- CONC. SCALE - the concentration scale may be changed by selecting this option and entering the exponent of the desired range (i.e., +2;+4
- TIME SCALE - same as HYDSCP
- CALCOMP - same as HYDSCP
- TEKTRONIX - the present display may be transferred to the Tektronix memory scope
- MONITOR - same as HYDSCP
- WELL SELECT - same as HYDSCP
- JOIN PTS - the displayed concentration values may be joined for better visibility using this option* (Figures 6.1 through 6.8A)
- LEAST SQ. - not operational

*Note: This program also has the option of deleting or reinserting light pen selected points from the connected graph.

WDCSCP - Well Structure Documentation (Figures 6.1 through 6.9)

WDCSCP provides visual display of a well structure. The options to the right of the displayed well structure cross section are light pen interactive and are described as:

- GET MONITOR - same as HYDSCP
- WELL SELECTION - same as HYDSCP
- CALCOMP-PLOT - same as HYDSCP
- ALL - this option displays all of the information described in the following options if the information is available
- CASING - displays casing data
- PERFORATION - displays casing perforation data
- SCREEN - displays screen data
- PIEZOMETERS - displays all available piezometer data

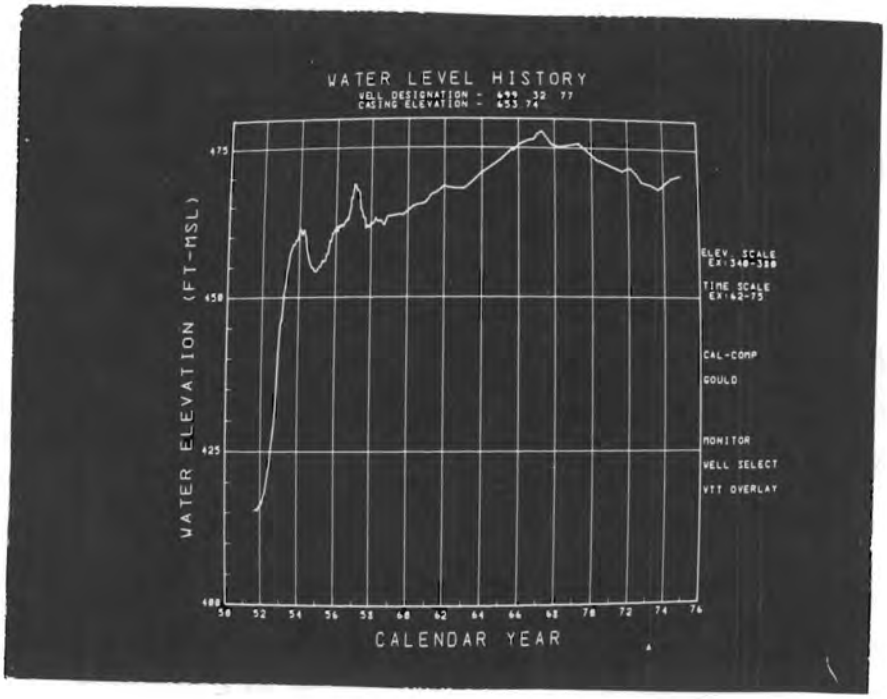


FIGURE 6.7.

Water Level History Display

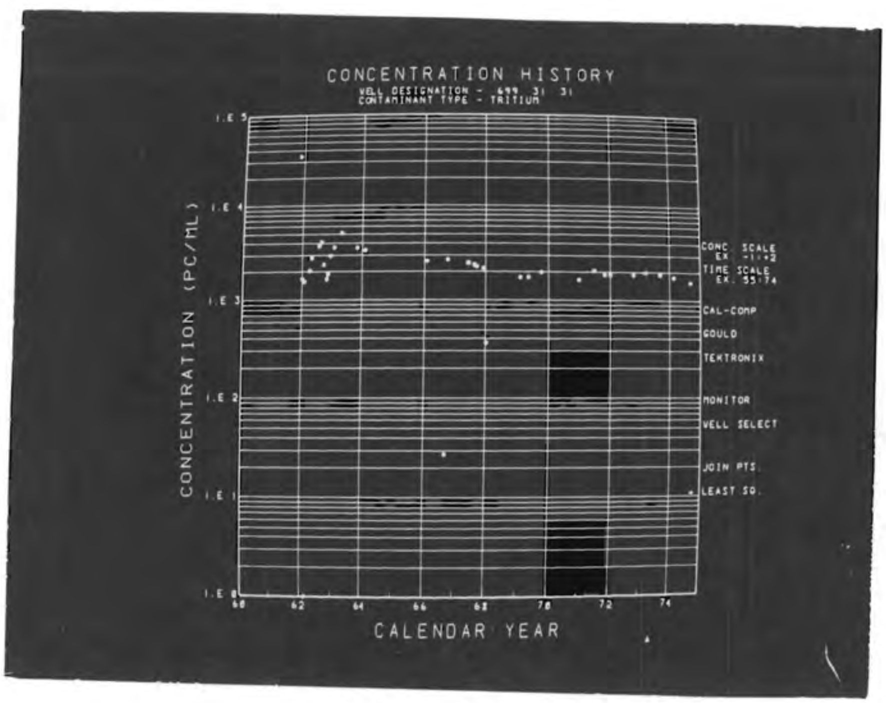


FIGURE 6.8.

Contaminant History Display

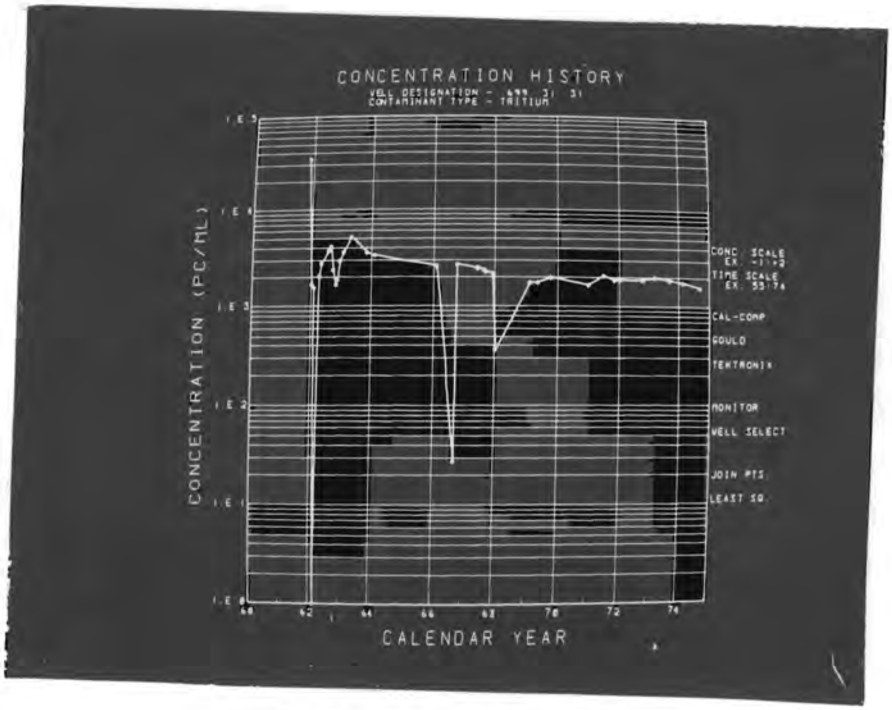


FIGURE 6.8A.

Contaminant History With Joined Data Points

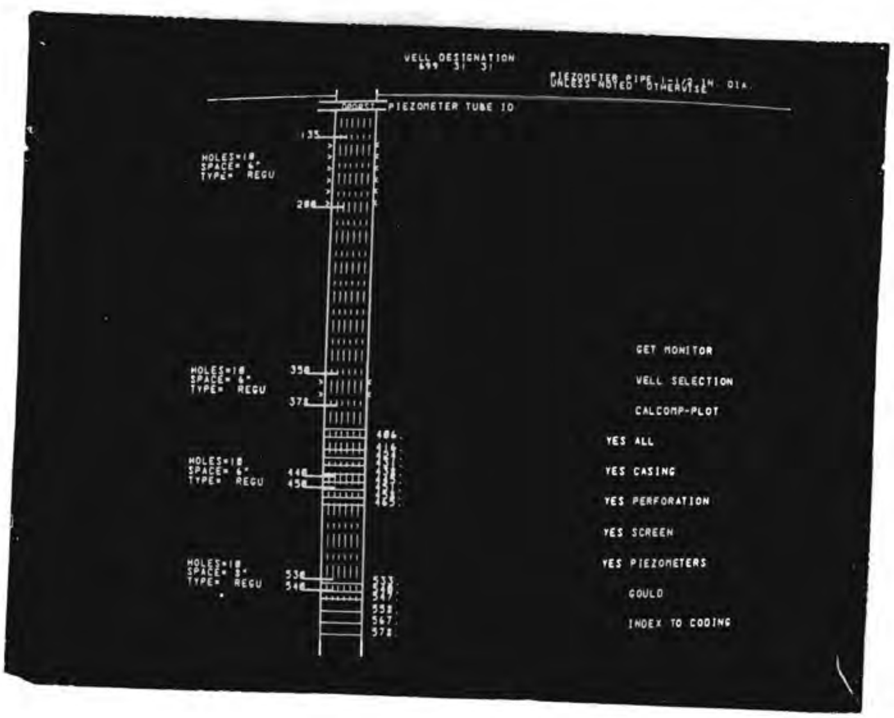


FIGURE 6.9.

Well Structure Display

OUTPUT DEVICES

The CIRMIS system has five output devices available to the user. These are shown under the title OUTPUT DEVICES in Figures 6.5 and 6.5A and are activated with the light pen in the same manner as for output to the interactive scope.

The previous section discussed mainly the interactive scope for output, and Figures 6.7 through 6.9 are displays of various data on this device. The other output devices (except for the Tektronix display) are used for hardcopy output.

The Calcomp plotter is used for high resolution report quality plots. The Calcomp has a 33-inch bed with three selected pens. Figures 6.10 through 6.12 are plots produced on the Calcomp.

The Gould is a rapid output electrostatic plotter. This plotter has a 22-inch bed and is used for producing quick plots; however, the quality is not as good as the Calcomp. Figures 6.13 through 6.15 are plots produced on the Gould.

The line printer is used to produce tabular output for the requested data type. Figures 6.16 through 6.18 are examples of line printer listings for various data types.

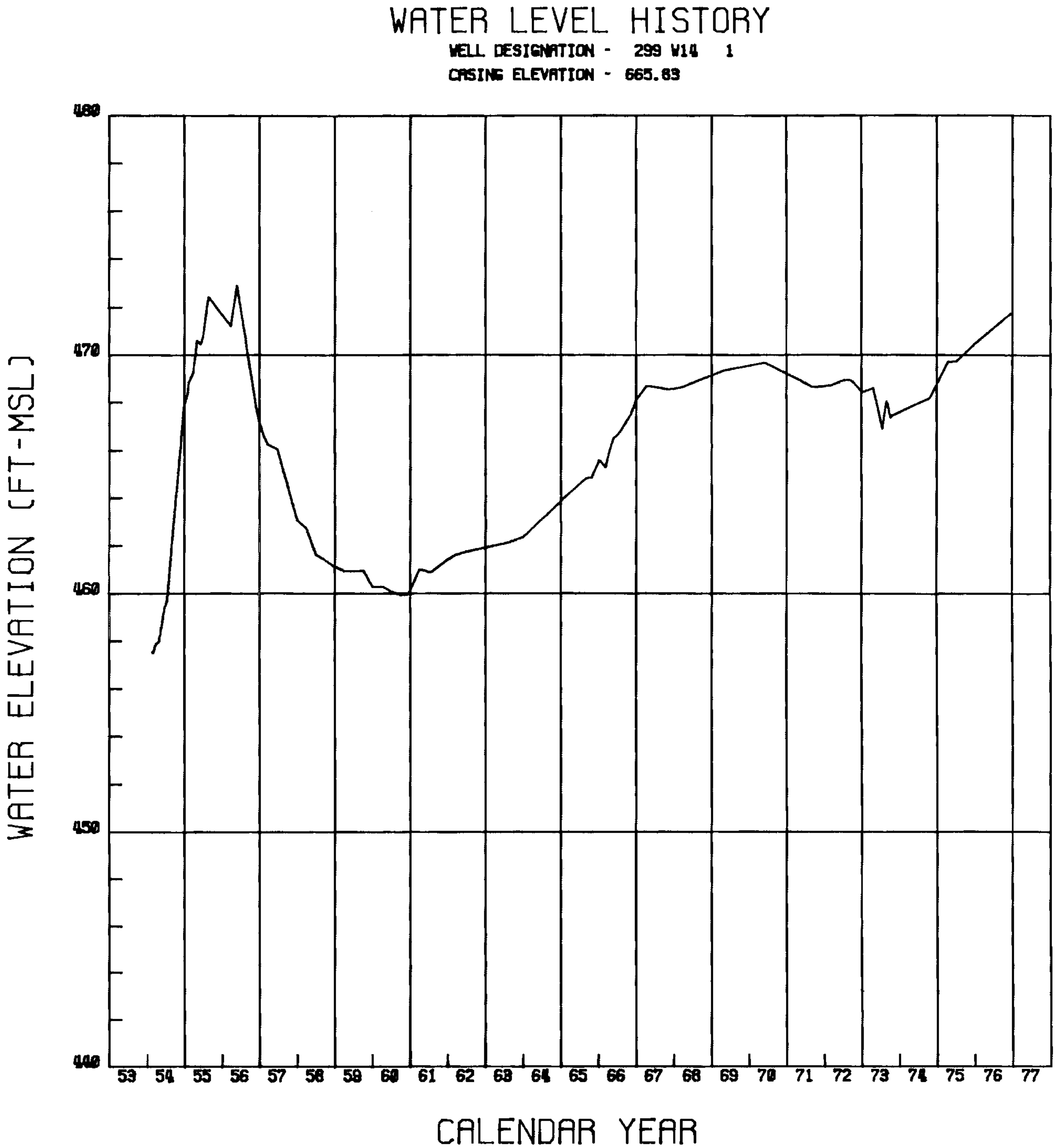


FIGURE 6.10. Calcomp Plot of Water Level History

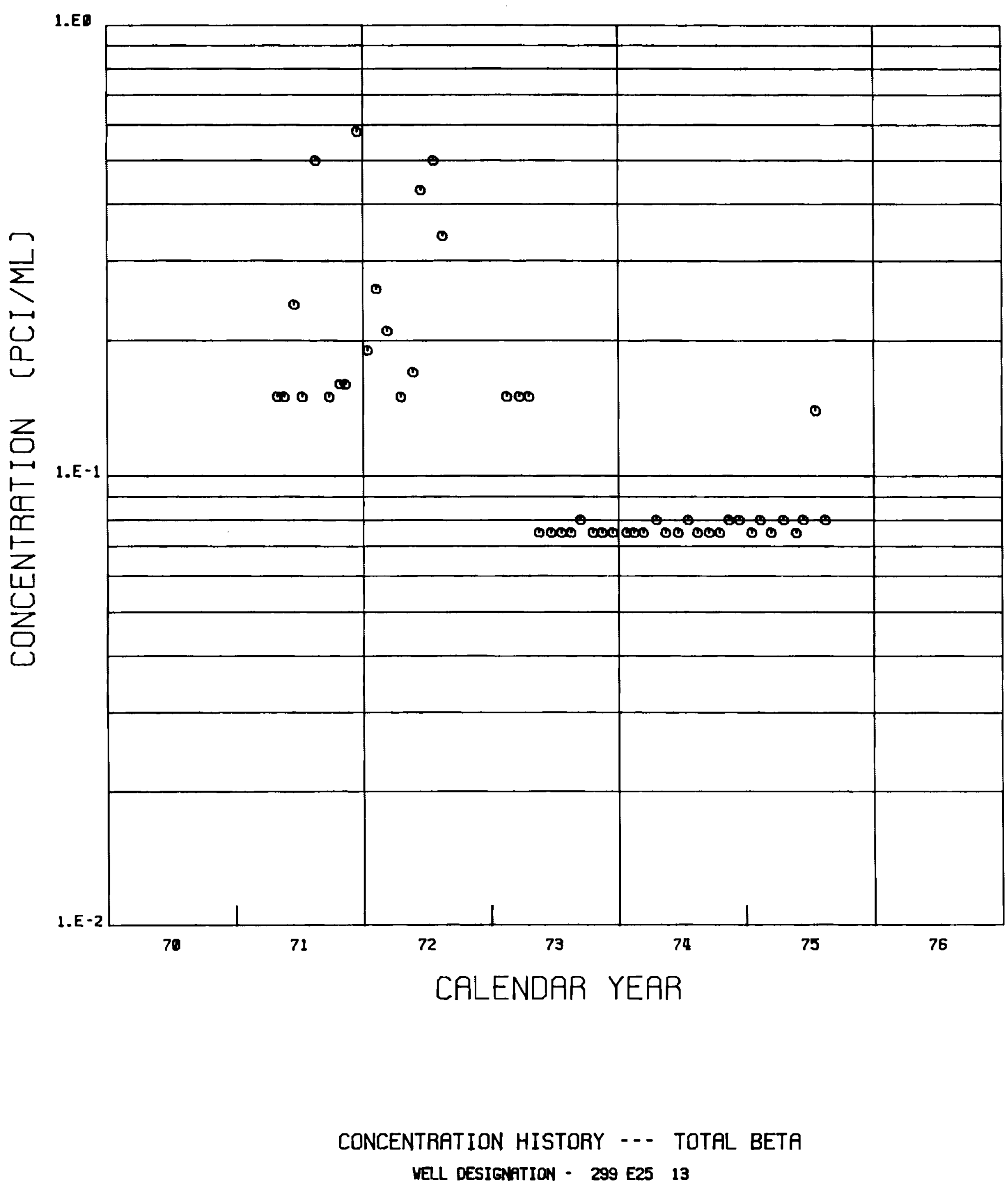


FIGURE 6.11. Calcomp Plot of Contaminant History

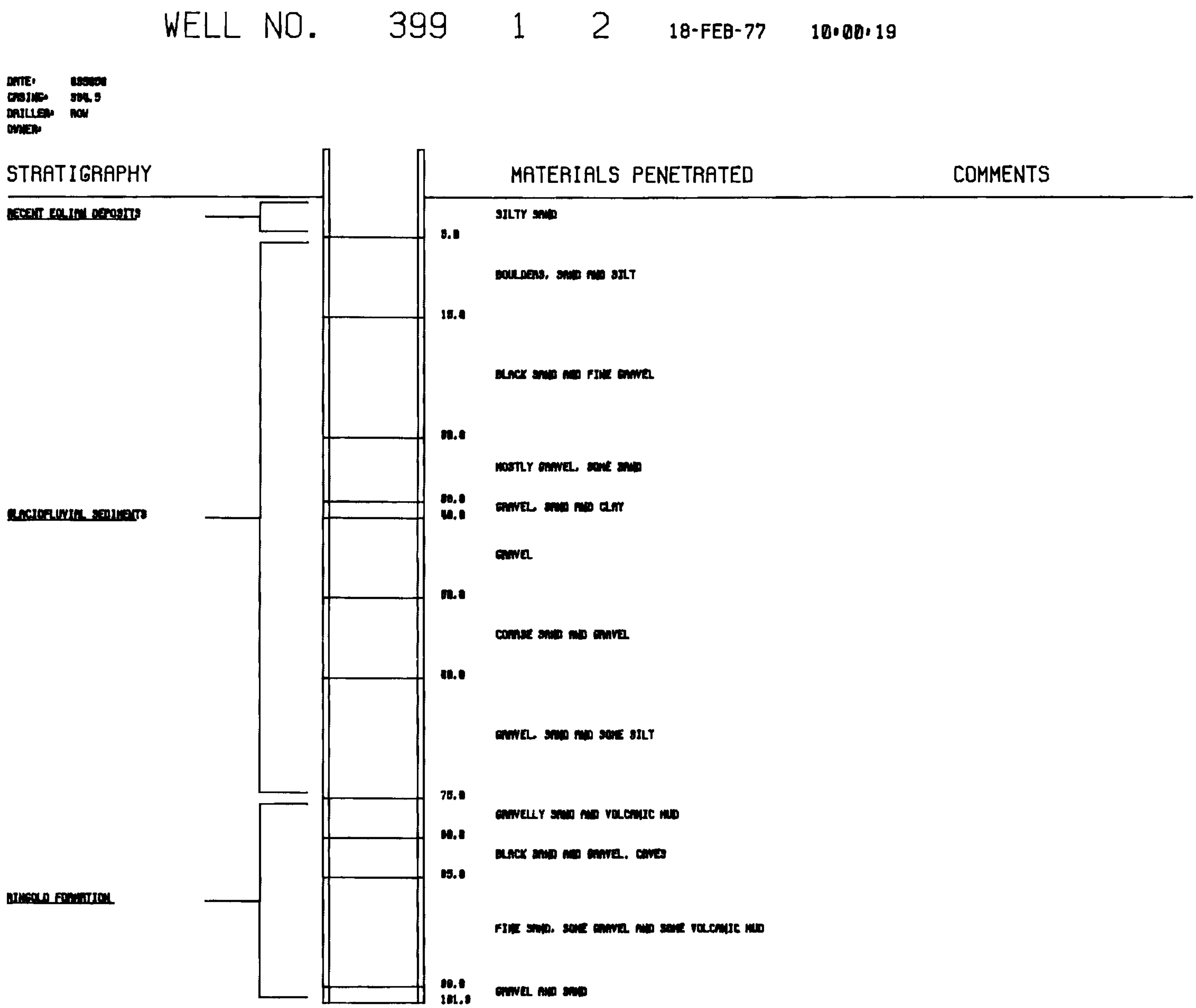


FIGURE 6.12. Calcomp Plot of Well Log Data

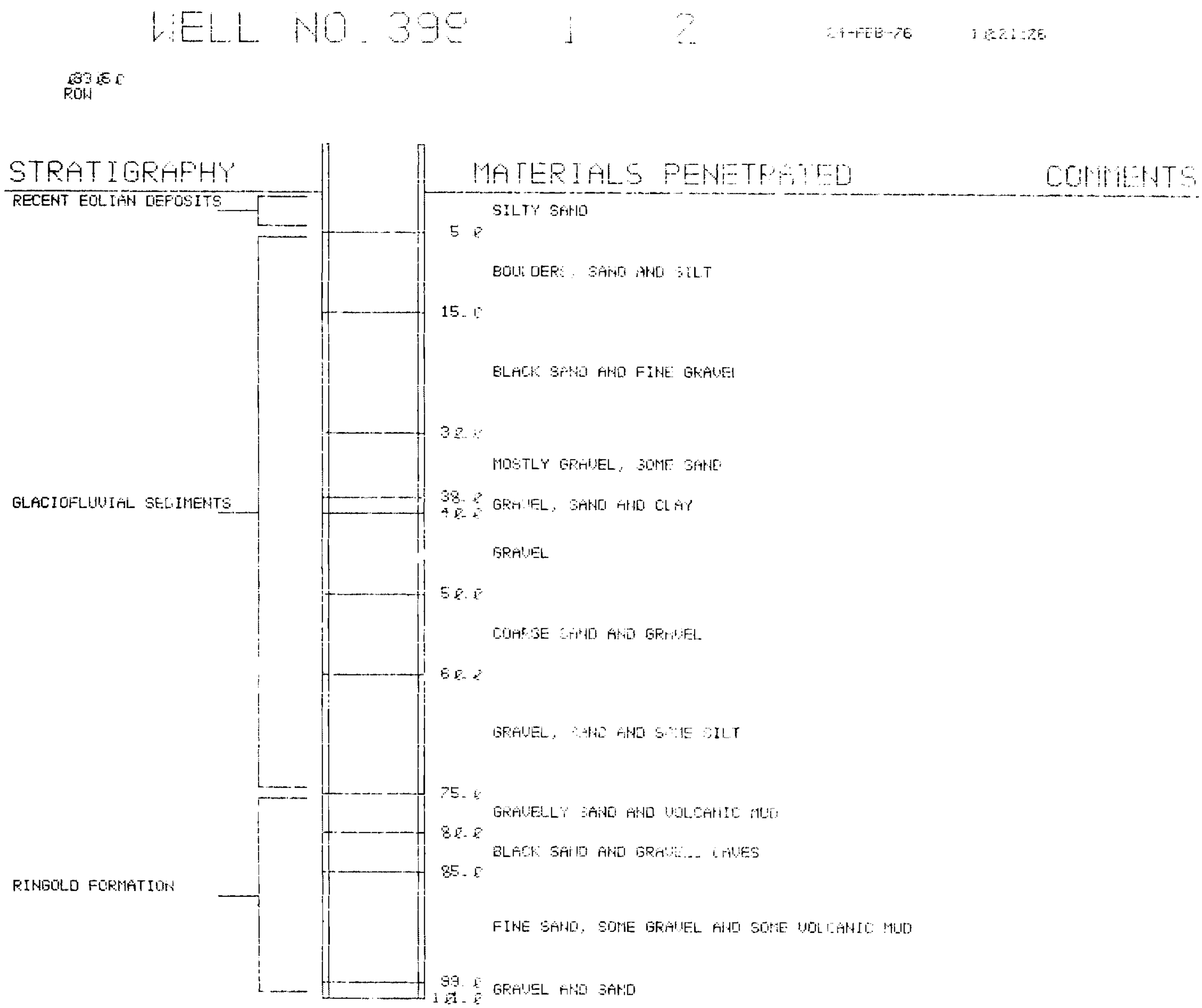


FIGURE 6.13. Gould Plot of Well Log Data (without shading)

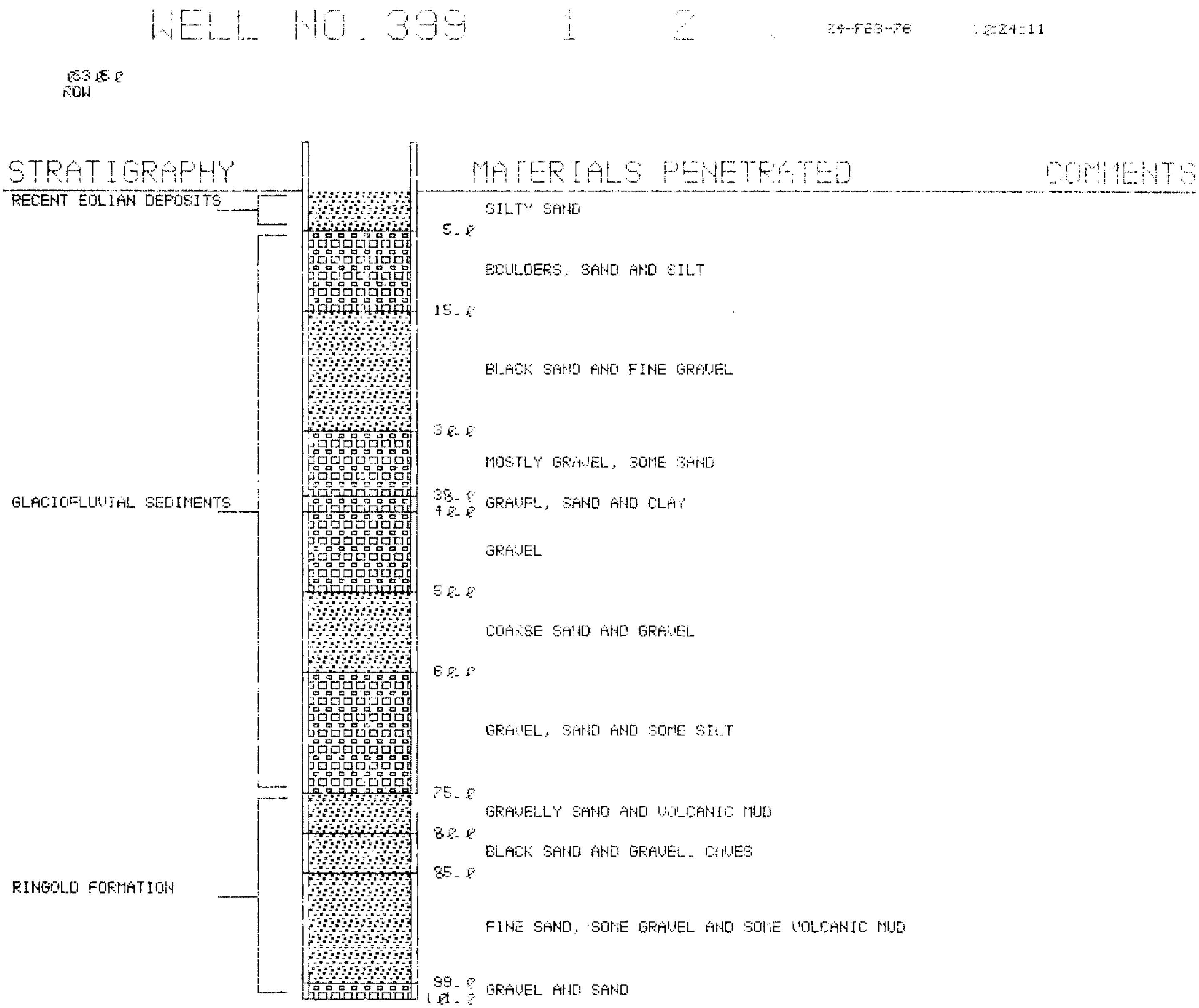


FIGURE 6.14. Gould Plot of Well Log Data (with shading)

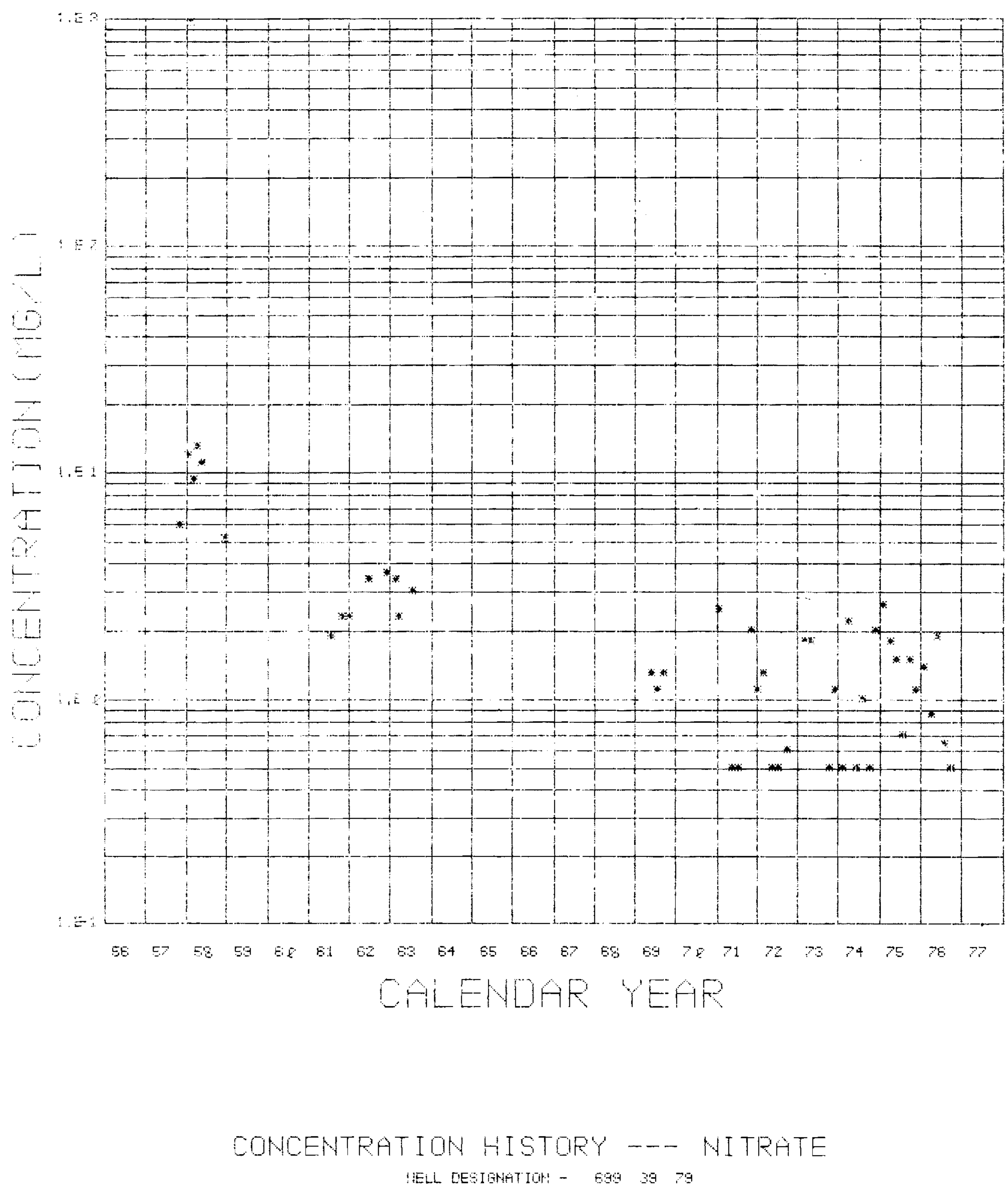


FIGURE 6.15. Gould Plot of Contaminant History

HYDROGRAPH DATA - WELL NO. 699 39 79

MEASURMENTS TO DATE = 199
CASING ELEVATION = 673.52

18-NOV-48	420.63	30-DEC-48	421.14	27-JAN-49	421.28	24-FEB-49	421.64	31-MAR-49	421.89
28-APR-49	422.44	26-MAY-49	422.73	30-JUN-49	422.52	28-JUL-49	422.75	25-AUG-49	422.96
25-SEP-49	423.33	27-OCT-49	423.47	25-NOV-49	424.15	29-DEC-49	424.67	26-JAN-50	424.24
23-FEB-50	425.17	30-MAR-50	425.16	27-APR-50	425.69	25-MAY-50	425.55	29-JUN-50	426.02
27-JUL-50	426.46	31-AUG-50	426.55	28-SEP-50	426.84	26-OCT-50	427.62	24-NOV-50	427.62
28-DEC-50	428.44	25-JAN-51	428.92	27-FEB-51	429.30	27-MAR-51	429.44	24-APR-51	430.20
29-MAY-51	430.25	26-JUN-51	430.97	31-JUL-51	431.28	28-AUG-51	432.01	25-SEP-51	432.45
30-OCT-51	432.64	27-NOV-51	433.74	26-DEC-51	434.10	29-JAN-52	434.82	26-FEB-52	435.41
26-MAR-52	435.53	29-APR-52	436.26	27-MAY-52	436.60	24-JUN-52	437.06	29-JUL-52	437.62
26-AUG-52	437.87	30-SEP-52	438.47	28-OCT-52	439.17	25-NOV-52	439.86	30-DEC-52	441.23
27-JAN-53	441.56	24-FEB-53	442.70	24-MAR-53	443.92	28-APR-53	444.82	26-MAY-53	445.57
30-JUN-53	446.56	28-JUL-53	447.42	25-AUG-53	448.28	29-SEP-53	449.22	27-OCT-53	450.45
24-NOV-53	451.37	29-DEC-53	453.17	26-JAN-54	453.72	23-FEB-54	455.11	30-MAR-54	456.42

FIGURE 6.16. Line Printer Listing of Water Level History

CONTAMINANT DATA - WELL NO. 399 1 2

CONTAMINANT TYPE -- NITRATE
CONTAMINANT CODE = 4
MEASURMENTS TO DATE = 37

18-APR-62	0	0	0.87E+02	21-JAN-63	0	0	0.15E+02	17-JUL-63	0	0	0.76E+02	2-JUL-69	9	0	0.11E+03
11-JAN-71	0	0	0.43E+02	10-MAR-71	0	0	0.74E+02	4-MAY-71	0	0	0.46E+02	30-JUN-71	0	0	0.63E+02
13-SEP-71	0	0	0.19E+02	28-SEP-71	0	0	0.23E+02	2-NOV-71	0	0	0.24E+02	6-JAN-72	0	0	0.50E+02
28-FEB-72	12	0	0.69E+02	9-MAY-72	0	0	0.37E+02	13-SEP-72	0	0	0.13E+02	5-MAR-73	0	0	0.27E+02
30-APR-73	0	0	0.26E+02	30-JUL-73	0	0	0.27E+02	3-OCT-73	0	0	0.22E+02	26-NOV-73	0	0	0.25E+02
29-JAN-74	0	0	0.21E+03	1-APR-74	0	0	0.29E+02	3-JUN-74	0	0	0.57E+02	29-JUL-74	0	0	0.38E+02
17-SEP-74	0	0	0.11E+02	25-NOV-74	0	0	0.95E+01	27-JAN-75	0	0	0.79E+01	31-MAR-75	0	0	0.79E+01
27-MAY-75	0	0	0.11E+02	28-JUL-75	0	0	0.83E+01	29-SEP-75	0	0	0.16E+02	24-NOV-75	0	0	0.14E+02
26-JAN-76	0	0	0.19E+02	29-MAR-76	0	1	0.19E+02	1-JUN-76	0	0	0.10E+02	3-AUG-76	0	0	0.12E+02
26-OCT-76	0	0	0.95E+01												

FIGURE 6.17. Line Printer Listing of Contaminant History

```
                      WELL NO.  399   1   2      TOTAL DEPTH=    101.00

DATE:  033050
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
      60.       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 6.18. Line Printer Listing of Well Log Data

6.2. SPECIAL APPLICATIONS AND MANIPULATIONS

This section describes the procedures involved in the generation and manipulation of surface files, the generation and use of map boundary files, special computer models that utilize these data and special utility programs.

Most of these functions are controlled by the PDP-9. However, some special applications programs are used only on the 11/45. All of these programs and user applications are outlined in this section.

INITIAL STARTUP PROCEDURES

To operate the programs in this section, the CIRMIS Loading procedures must be followed. Once these procedures have been completed, the display in Figure 6.19 will appear.

The programs in this section are defined as SPECIAL APPLICATIONS AND MANIPULATIONS shown under the heading SELECT A FUNCTIONAL CATEGORY.

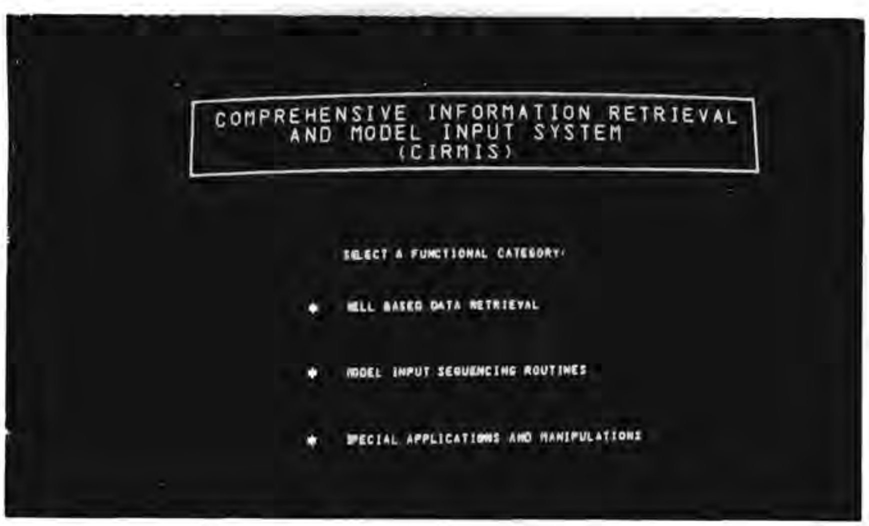


FIGURE 6.19. CIRMIS Monitor Control Page

NORMAL CIRMIS OPERATION

All operations under PDP-9 control normally interact with the 11/45 system. Because of this, specific projects and associated surfaces and maps can be filed at the 11/45 for easy access and the user can obtain complete specification requirements for any given project operation (see UPDATE under Operating the Special Function Programs). Inadvertent generation of files with erroneous specifications is prevented with this method because error messages advise the user of any discrepancies between user input specifications and the specifications already in the master file header. This preserves the integrity of the data by assuring that the proper specifications are adhered to.

BYPASSING CIRMIS OPERATION

At times it is desirable to bypass the normal file structured operations provided by CIRMIS, as when a single surface or map is required for use at the 11/45 by a specific program or model. A program called BYPASS CIRMIS CONTROL provides for this. This program is described in detail in the UTILITY Program section under Operating the Special Function Programs. These procedures must be strictly adhered to.

ABBREVIATED OPERATING SEQUENCE

- To begin operation of this portion of the CIRMIS system the user selected the option SPECIAL APPLICATIONS AND MANIPULATIONS shown in Figure 6.19. The present display page is replaced by that shown in Figure 6.20. Figure 6.21 shows the functions available to the user and the general project specifications presently being used.

FIGURE 6.20. Special Applications and Manipulations

- If normal CIRMIS operation is desired, the user selects the proper specifications under GENERAL PROJECT SPECIFICATIONS (see Appendix C) with the light pen and inputs the desired value on the CRT keyboard.
- The user then makes a selection under the title SELECT A SPECIAL FUNCTION and the display is replaced by a display correlated with this function (Figures 6.21 through 6.26).
- If required, the user selects the function specification(s) with the light pen and inputs the desired value on the CRT keyboard.
- The user then selects the START PROGRAM option.
- CIRMIS now queries the 11/45; if all specifications are correct, the program initializes the proper SPECIAL FUNCTION.

FIGURE 6.21. SURFACE GENERATOR Specifications

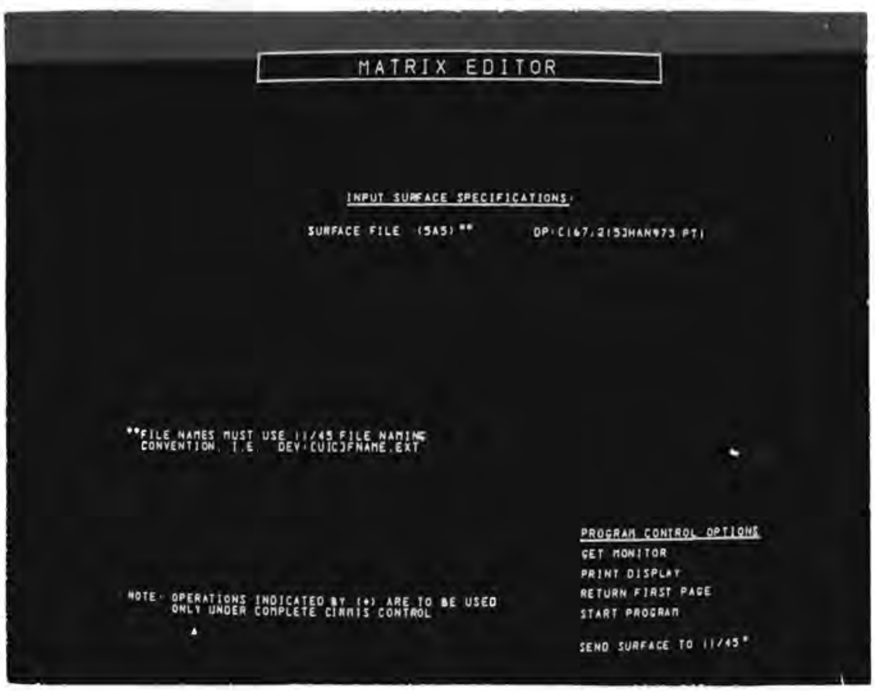


FIGURE 6.22. MATRIX EDITOR Specifications

FIGURE 6.23. SURFACE CONTOURING Specifications

FIGURE 6.24. Preliminary TRAVEL TIME Specifications

FIGURE 6.25. Preliminary PATHLINE Specifications

FIGURE 6.26. Utility Programs

DETAILED OPERATING SEQUENCE

Special Applications Selection Routine (Figure 6.20)

This routine has three modes of control and input which are described as follows:

1. SELECT A SPECIAL FUNCTION - All of the Functions (i.e. Special Application programs) under this label are light pen interactive and when selected replace the display shown in Figure 6.20 with one shown in Figures 6.21 through 6.26 (see SPECIAL FUNCTION OPTIONS and SPECIAL FUNCTION INPUT SPECIFICATIONS described below).
2. GENERAL PROJECT SPECIFICATIONS (INPUT) - is used only under complete CIRMIS control. This category is light pen interactive and values are input on the CRT keyboard.
   - PROJECT NAME (4A5) - Each project has a descriptive name.
   - MAP FILE (5A5) - Map file to be used as background display must be entered in standard 11/45 naming convention (see Appendix B). Up to ten (10) maps are allowed.
   - NODES IN X (I3) - Number of nodes in the X direction (fence posts, not spaces).
   - NODES IN Y (I3) - Number of nodes in the Y direction.
   - X INCREMENT (F10.0) - Map units per node in the X direction.
   - Y INCREMENT (F10.0) - Map units per node in the Y direction.

3. PROGRAM CONTROL OPTIONS

- GET MONITOR - When selected, returns control to the monitor (Figure 6.19).
- PRINT DISPLAY - Prints present display on the Info-max Printer/Plotter.
- SETUP NEW PROJECT - Used only under normal CIRMIS enter a new project into the 11/45 project file header according to the present project specifications.
  NOTE: If the project already exists it cannot be overwritten except by special consideration.

Special Function Options (Figures 6.21 through 6.26)

Inputs to the special functions are shown in Figures 6.21 through 6.26. The functions may require input specifications as shown in these figures. The options for these functions are described below.

PROGRAM CONTROL OPTIONS

- GET MONITOR - Described above.
- PRINT DISPLAY - Described above.
- RETURN FIRST PAGE - Replaces present display with that shown in Figure 6.20.
- START PROGRAM - The selected special function program is initialized.
  NOTE: If Program is operating under normal CIRMIS control the 11/45 project file header is monitored to see if input specifications match selected project.

- SEND SURFACE TO 11/45 - Used only under normal control to send a surface file to the 11/45.

Special Function Input Specifications

The following special functions may require surface name input. This input must adhere to the naming conventions described in Appendix B.

SURFACE GENERATOR (Figure 6.21)

- SURFACE FILE (5A5) - See Appendix B.
- MINIMUM VALUE (F10.0) - Minimum value or less expected to appear on surface being used.
- MAXIMUM VALUE (F10.0) - Maximum value or greater expected to appear on surface being used.

MATRIX EDITOR (Figure 6.22)

- SURFACE FILE (5A5) - See Appendix B.

SURFACE CONTOURING (Figure 6.23)

- SURFACE FILE (5A5) - See Appendix B.

TRAVEL TIME (Figure 6.24)

- STEP SIZE IN FEET - Constant step size to be used along a streamline.
- TIME INCREMENT IN DAYS - Constant time increment to be used. Supersedes constant step if greater than 0.

PATHLINE (Figure 6.25)

- STEP SIZE IN FEET - Same as travel time, above.
- TIME INCREMENT IN YEARS - Same as travel time.
- BEGIN MONTH (Ex:9) - Month of first time plane.

- BEGIN YEAR (Ex:1951) - Year of first time plane.
- END MONTH (Ex:10) - Month of last time plane.
- END YEAR (Ex:1955) - Year of last time plane.
- NO. OF SURFACES (Ex:50) - Total number of surfaces (time planes) to be used within the above time period.

UTILITY PROGRAMS (Figure 6.26)

MAP GENERATOR, BYPASS CIRMIS CONTROL, LOCATE ZEROS AND FILL ZEROS are light pen interactive labels. When selected a star will appear to the left of the label. The MAP GENERATOR may be used under CIRMIS control or after returning from the BYPASS CIRMIS option.

All of these special functions are described in greater detail in Category III of Operating the Special Function Programs.

OPERATING THE SPECIAL FUNCTION PROGRAMS

The Special Functions are divided into three discrete categories, each of which serves a distinct function. The functions in the first and third categories may be used under complete CIRMIS control or by bypassing CIRMIS control, while the calculational programs in Category II must be used only under complete CIRMIS control. These three categories are described as follows:

Category I - Surface File Manipulation

This category allows the user to generate, edit and display a surface file for use with other programs or models.

SURFACE GENERATOR Program

This program makes it possible to digitize a surface depicted by isopleths and form a matrix of values. This procedure may be used to generate new matrices or modify existing matrices. Figures 6.27 is a display of the Surface Generator Program and its associated options.

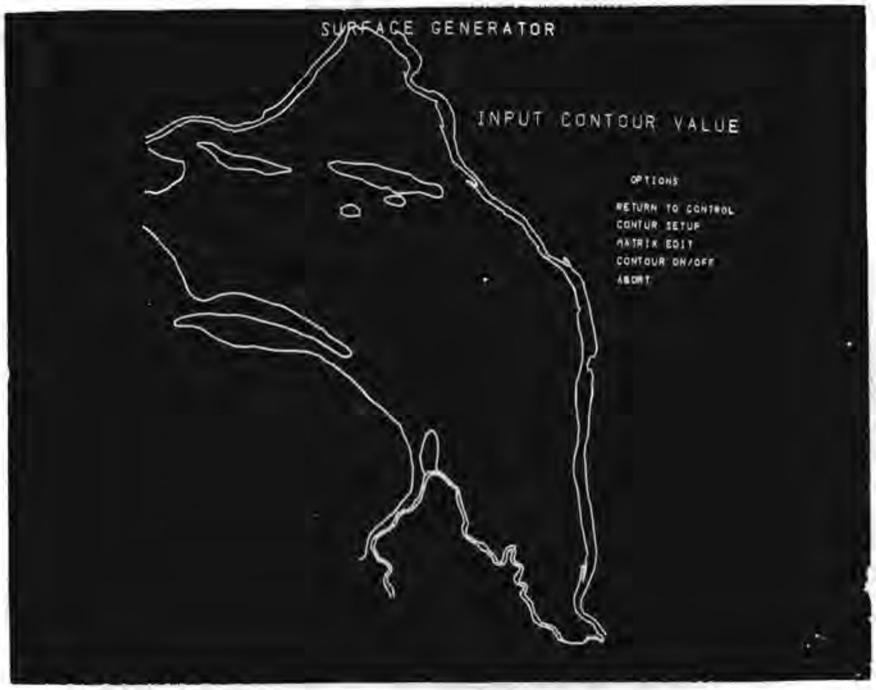


FIGURE 6.27. SURFACE FENERATOR Program (Instruction 1)

The options shown in Figure 6.27 are described as follows:

- RETURN TO CONTROL - Returns to special application and manipulation (Figure 6.20).
- CONTOUR SETUP - Transfers control to the Contouring Program.
- MATRIX EDIT - Transfers control to the Matrix Editor Program.
- CONTOUR ON/OFF - Displays or turns off contours generated and saved by the Contouring Program.
- ABORT - Aborts certain sequences of the digitizing sequence.

When the user is ready to digitize a surface he must follow this displayed instruction, INPUT CONTOUR VALUE, (i.e., as shown in Figure 6.29).

The value of the contour to be digitized is entered on the digitizer keyboard in floating point notation. When this has been done the instruction, DIGITIZE LINE, shown in Figure 6.28 appears.

FIGURE 6.28. SURFACE GENERATOR Instruction 2

The user then digitizes the contour. When ready to terminate the line he digitizes the last point twice.* When this has been done the instruction, DIGITIZE START PT ON NEXT CONTOUR OR FIRST PT TO CLOSE REGION, shown in Figure 6.29 appears.

If the user has another contour to digitize before closing a region he digitizes the start point on the next contour and the sequence continues as shown in Figures 6.27, 6.28, and 6.29.

* See Note on page 6-33.

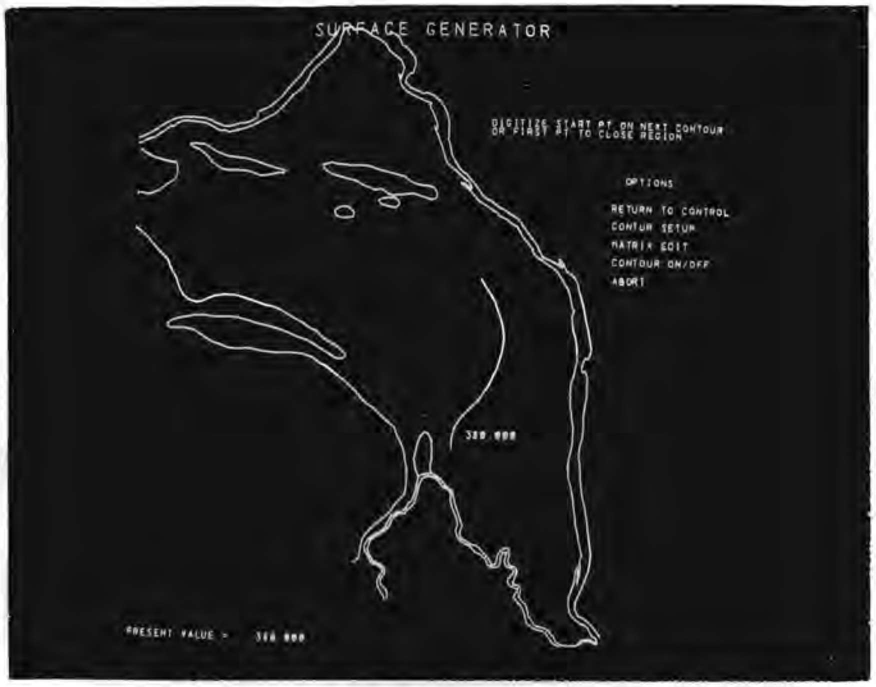


FIGURE 6.29. SURFACE GENERATOR Instruction 3

This can be done for any number of contours, as in a saddle region. The user must always digitize in a circular pattern; i.e., each complete digitizing sequence must follow either a clockwise or counter-clockwise rotation. In this way, a complete digitizing sequence has the form of a continuous closed loop in which the starting point on one digitized line is adjacent to the end point on the previous digitized line. When the last point on the last of the contour lines defining a region has been digitized, the message shown in Figure 6.29 will again appear. The user then closes the region by digitizing the first point on the first contour line. The program will begin interpolating to calculate the nodal values contained within the closed loop defined by the digitizing contours, as shown in Figure 6.30.

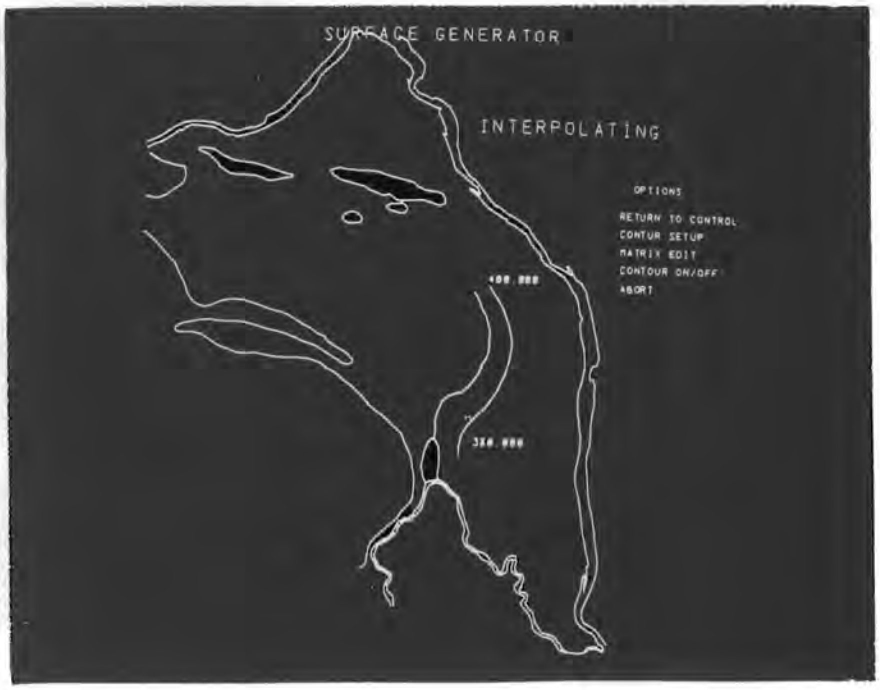


FIGURE 6.30. SURFACE GENERATOR Instruction 4

When the interpolation has been completed the message shown in Figure 6.31 will appear. The user may then use any of the light pen interactive options or begin digitizing a new region. If the user chooses to continue digitizing he must enter an option number followed by a carriage return on the digitizer keyboard. The two option numbers presently active are:

1) OPTION=1 Start new digitizing sequence.
2) OPTION=2 Save last digitized line so this sequence can continue.

The entire sequence is then repeated (Figure 6.27 through 6.31) until the entire map has been digitized.

FIGURE 6.31. SURFACE GENERATOR Instruction 5

NOTE: This procedure is used when digitizing lines (either line pairs or saddle regions with more than 2 lines). When digitizing concentric circles the digitizing sequence starts at the center point and radiates outward, as follows:

a) Enter value at center as requested.

b) Digitize center of circle twice.

c) Enter value of next concentric circle.

d) Digitize circle.

e) When the entire circle has been digitized, terminate the sequence by digitizing the start point on the circle.

This entire procedure is described in detail in Reference 2. The exception to the procedure given in this document is that both circular and line contours now use Options #1 and #2 described above.

MATRIX EDITOR Program

The MATRIX EDITOR program allows the user to view a surface matrix as either a horizontal or vertical matrix line cross section. The program has two basic modes of operation, AUTO SCAN and selected LINE mode.

In the AUTO SCAN mode the program displays each line (horizontal or vertical) of the matrix at a preset time delay, stepping through the matrix until all lines have been scanned.

In the LINE mode the user may select any horizontal or vertical matrix line and display it on the graph, along with the line preceding and the line following.

Figure 6.32 is a display of the MATRIX EDITOR Program and its associated option controls. After an option is selected with the light pen, any input values required are entered on the CRT keyboard.

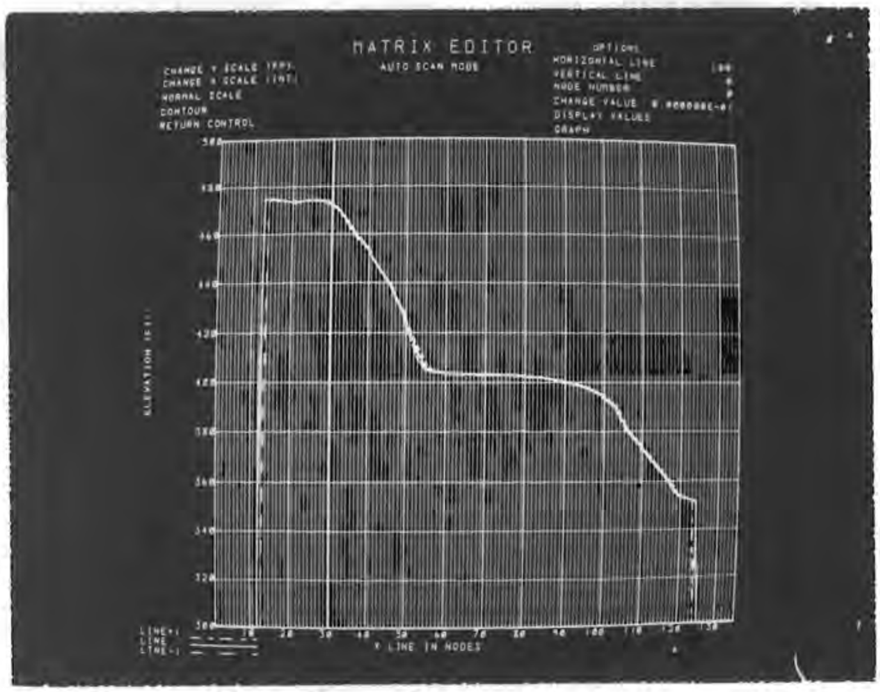


FIGURE 6.32. MATRIX EDITOR Program

The options shown in Figure 6.32 are:

- CHANGE Y SCALE (FP) - The minimum and maximum values of the graph ordinate may be changed to expand the graph for better detail (Figure 6.33).

- CHANGE X SCALE (INT) - The minimum and maximum values of the graph abscissa may be changed (Figure 6.33).
- NORMAL SCALE - Changes X and Y scaling back to that originally assigned (Figure 6.32).
- CONTOUR - Transfers control to the contouring program (Figure 6.23)
- RETURN CONTROL - Transfers control back to the Special Applications Program (Figure 6.20).
- AUTO SCAN MODE - Scans and displays each matrix line as specified. NOTE: Upon selecting this option the matrix line specification will appear.
- HORIZONTAL LINE - Displays the horizontal line (solid) which has been entered on the CRT keyboard along with the preceding line (dashed) and the following line (center line).
- VERTICAL LINE - Same as above, in the vertical direction.
- NODE NUMBER - When this option is selected and a node number is entered, the following operations can then be selected for that node.
- CHANGE VALUE - When this option is selected and a value is entered on the keyboard, the node specified above changes to the new value.
- DISPLAY VALUES - The display on the CRT is replaced by that shown in Figure 6.34. This display shows the actual values of five matrix lines with the node of the selected line defined by a small small box in the middle.

- GRAPH - Replace display shown in Figure 6.34 with that shown in Figure 6.32 or 6.33.

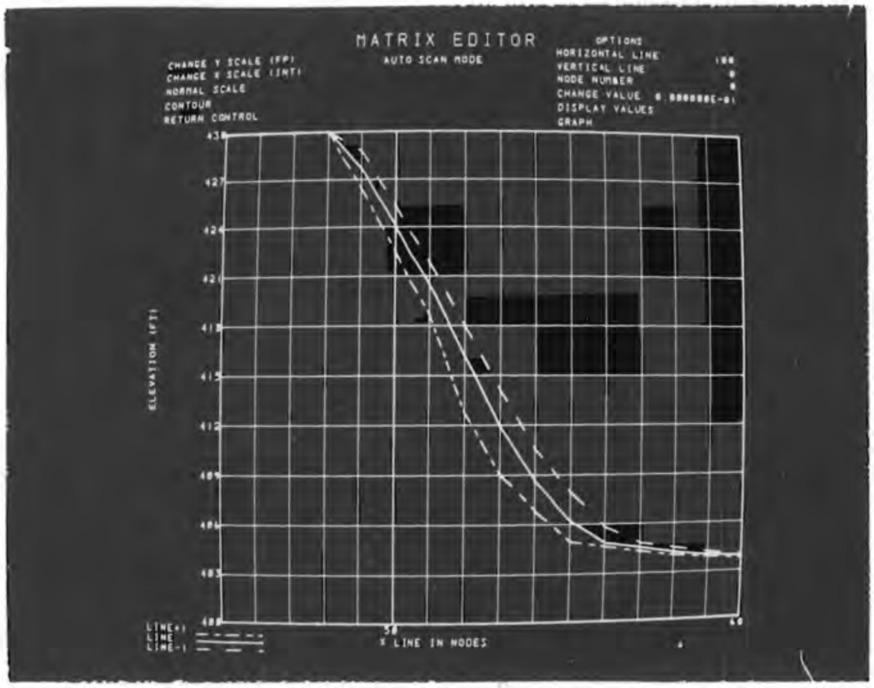


FIGURE 6.33. MATRIX EDITOR (Expanded Scale)

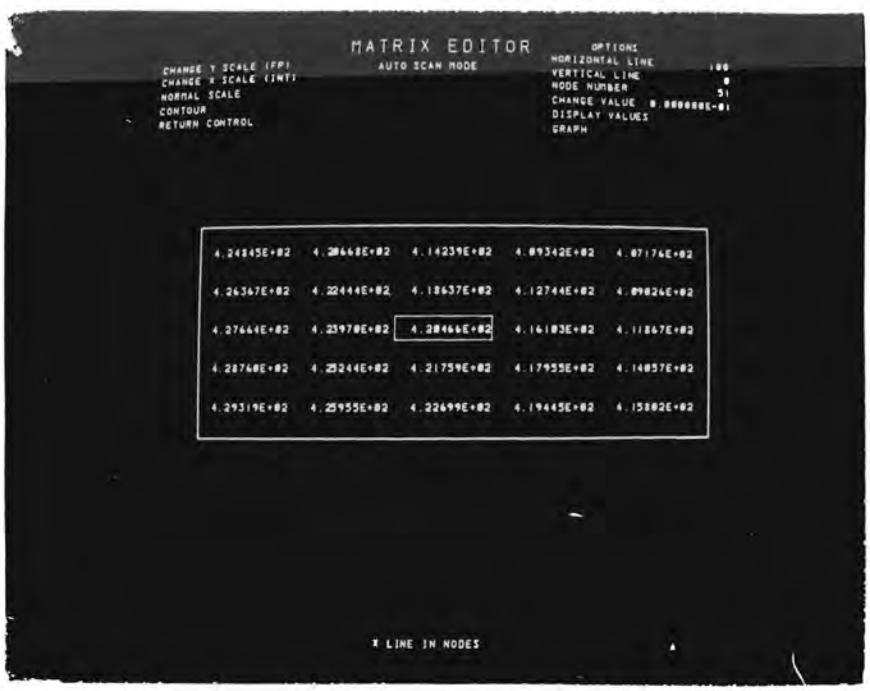


FIGURE 6.34. MATRIX EDITOR

SURFACE CONTOURING Program

This program provides a rapid method of displaying any contour level of the surface being operated on. Any level within the range of surface values may be entered on the CRT. Figure 6.35 is a display of the SURFACE CONTOURING Program and associated option controls. When the contour program is requested by the MATRIX EDITOR a labeled horizontal or vertical line will be displayed as shown in Figure 6.35. This depicts the line presently being operated on by the MATRIX EDITOR and the labels depict the nodes along this line.

FIGURE 6.35. SURFACE CONTOURING Program

The options shown in Figure 6.35 are:

- STORE CONTOUR - Store contour just generated for display by the calling program.
- CLEAR DISPLAY - All contours presently displayed will be removed from the screen.
- RETURN CALLING - The SPECIAL FUNCTION Program which was in operation prior to the contouring program will be restored.

- MOVE LABEL - Moves label depicting value of the contour to the location of the tracking cross.* This must be done after generation and display of a contour and prior to the generation of another.
- PRINT - Print the current display on the Info-max Printer/Plotter.

Category II - Calculation Programs

The calculational programs enable the user to calculate the path a particle takes from a preselected input location to a model boundary and its travel time along this path. These models are dependent upon complete CIRMIS interaction and no attempt should be made to bypass this interaction.

These programs require three types of surface data: 1) potential, 2) hydraulic conductivity, and 3) storage coefficient (Figures 6.36 and 6.37).

FIGURE 6.36. Surface Data Selector (Example 1)

*The tracking cross is light pen interactive and may be directed to any location on the screen by using the light pen.

FIGURE 6.37. Surface Data Selector (Example 2)

When the desired program is started, as described under SPECIAL FUNCTION OPTIONS, the surface data selector display will appear (i.e., Figures 6.36 and 6.37). These displays show which files have already been set up in the surface work files at the 11/45 (if any). If a different surface is to be used the desired title under SURFACE FILES (INPUT) is selected and the new name is entered on the CRT keyboard, where the naming convention should match that described in Appendix B.

When ready to proceed the user selects the START PROGRAM option. If the files do not match those presently in the 11/45 work file, Figure 6.38 appears. This display remains on the screen until a new work file has been generated, after which the selected program will be initialized.

FIGURE 6.38. Surface Data Selector (File Setup Message)

TRAVEL TIME Program

The TRAVEL TIME program calculates a streamline and time of travel for a steady state condition and displays the results on the CRT screen (Figure 6.39).

FIGURE 6.39. TRAVEL TIME Program

This program has several options, all of which are light pen interactive:

- RETURN TO CONTROL - Transfers control back to the Special Applications Program (Figure 6.20)
- GRADIENT - Changes direction of streamline to up or down gradient of the potential surface.
- STEP NODE (ALPHA) - Causes the streamline to progress one step at a time when the ALPHA key on the CRT keyboard is depressed.
- LIMIT (YRS) - The streamline terminates when the travel time exceeds the time limit entered on the CRT keyboard.
- CONTOURS - Displays contours which have been set up and saved using the contour program.
- DELAY - Delays each step momentarily so that the streamline progress may be scrutinized more closely.
- VELOCITY CURVE - When activated, allows the user to observe the velocity along a streamline. This is done by selecting the asterisk to the right of the label. Figure 6.40 will appear.
- CLEAR DISPLAY - Removes all of the streamlines presently being displayed from the screen.
- PRINT - Outputs the present display to the Info-Max Printer/Plotter.
- SETUP CONTOURS - Transfers control to the contouring program (Figure 6.23).

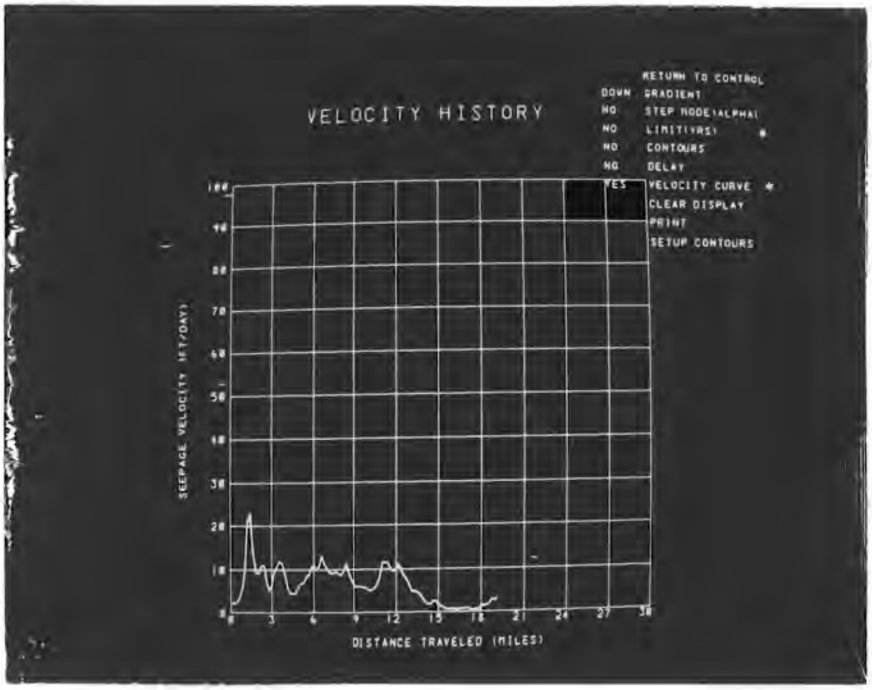


FIGURE 6.40. Travel Time Velocity Curve

PATHLINE Program

PATHLINE calculates a streamline and time of travel for a transient potential surface. This transient behavior is defined by a number of surfaces which have been set up using the VTT Program on the 11/45. Only the name of the first potential surface need be input along with the hydraulic conductivity and storage coefficient (Figures 6.36 and 6.37). The program control options are the same as for TRAVEL TIME, described above. The input sapecifications are described on pages 6-27 and 6-28.

Category III - Utility Programs

This category contains infrequently used functions that provide special capacities. Some of these are selected from those shown in Figure 6.26. Others are operated from the 11/45. They are described as follows:

MAP GENERATOR Program

The MAP GENERATOR program uses the graphic digitizer to digitize map boundaries. These boundaries are used with the CIRMIS Special Function programs as background displays or by the 11/45 programs as background maps to be plotted on the Calcomp or displayed on the Tektronix scope. The graphic digitizer provides input and the Univac scope provides display and control. The program allows for digitizing of lines depicting a boundary or the input of labels on a map. The MAP GENERATOR Program and associated options are shown in Figure 6.41.

FIGURE 6.41. MAP GENERATOR Program

The three types of controls shown in Figure 6.41 are:

1) TELETYPE KEYBOARD

Pen number and option are entered on the teletype as requested.

2) DIGITIZER KEYBOARD

The carriage return key (CR) terminates this portion of sequence and writes it out to the disc file. The delete key (DEL) allows the user to delete as many points as desired of a digitized line prior to writing it to the disc file.

3) CONTROL OPTIONS (LIGHT PEN)

The options shown under this title are light pen interactive and are described as:

- RETURN CALLING PROGRAM - Transfers control back to the Special Application Program (Figure 6.20).
- SEND MAP FILE TO 11/45 - Use this option only under complete CIRMIS control. Transfers the new digitized map to 11/45 and enters it in the master project file. See below for bypassing CIRMIS control.
- SET UP NEW MAP FILE ON DISC - Initializes a new map source file (BNDRY SCR) on Disc 1 in preparation for generating a new one.
- TURN OFF OPTION DISPLAY - Turns off option display page in preparation for digitizing a map boundary. After digitizing the minimum (bottom) left) and maximum (top right) corners of the map the digitizing sequence may begin.
- PRINT OPTION PAGE - Not active.

Following is a brief description of the sequence used in map generation:

Select: SETUP NEW MAP FILE ON DISC

Then

Select: TURN OFF OPTION DISPLAY

The present display will be replaced by one asking the user to digitize the MINIMUM (bottom left), then the MAXIMUM (top right) on the map to be digitized. When this has been completed, the following message will be output to the teletype:

INPUT PEN NO. & OPTION, THEN DIGITIZE POINTS(2I1)*

After the user inputs the pen number and option the following light pen interactive message will appear on the screen:

DISPLAY PROGRAM CONTROLS

This will return the program to the control page (Figure 23) when the user desires to terminate the sequence. If he elects to continue generating a boundary he digitizes the line (or types a label on the teletype as requested) and writes it to disc with a (CR) on the digitizer keyboard. The INPUT PEN NO. & OPTION message will again be typed and he may again continue or terminate and return to the control option. If the user wishes to terminate he selects the DISPLAY PROGRAM CONTROLS with the light pen and Figure 7.23 again appears.

Sending the Map File to the 11/45. The user has two options for doing this: 1) complete CIRMIS control, or 2) bypassing CIRMIS control. These are described as follows:

1. CIRMIS Control

The user selects

SEND MAP FILE TO 11/45

When this has been completed program control will return to Special Applications (Figure 6.20).

*NOTE: Always do label options last so they will be stored at the end of the file.

2. Bypass CIRMIS Control

The user selects

RETURN CALLING PROGRAM

Figure 2-2 will appear:

Control C(↑C)

PIP - now transfer file to 11/45

>T DL ← DK1 BNDRY SCR (CR)

Go to 11/45:

MCR > HEL [UIC]

MCR > PIP-receive file from PDP-9

>MAPNAME.EXT = DL:

Now use PIP to strip labels off end of file and place them in the command file. The boundary map is now ready for use with the CONTUR or BLOWUP programs.

BYPASS CIRMIS CONTROL Program

The BYPASS CIRMIS CONTROL program allows the user to bypass complete CIRMIS control, thereby adding flexibility to map boundary and surface file generation and use. Using complete CIRMIS control presupposes that the user has a specific project, along with associated maps and surface files, already in the 11/45 master data files or plans to set one up. However, this may not be the case. A user may only require a map boundary or surface file and may not be interested in the capabilities provided by the complete CIRMIS file structure. If this is the case and either a map or surface is required, this program must be called from the SPECIAL APPLICATIONS Program (Figures 6.20 and 6.26) prior to any further operations. Once this program has been started the display shown in Figure 6.42 will appear.

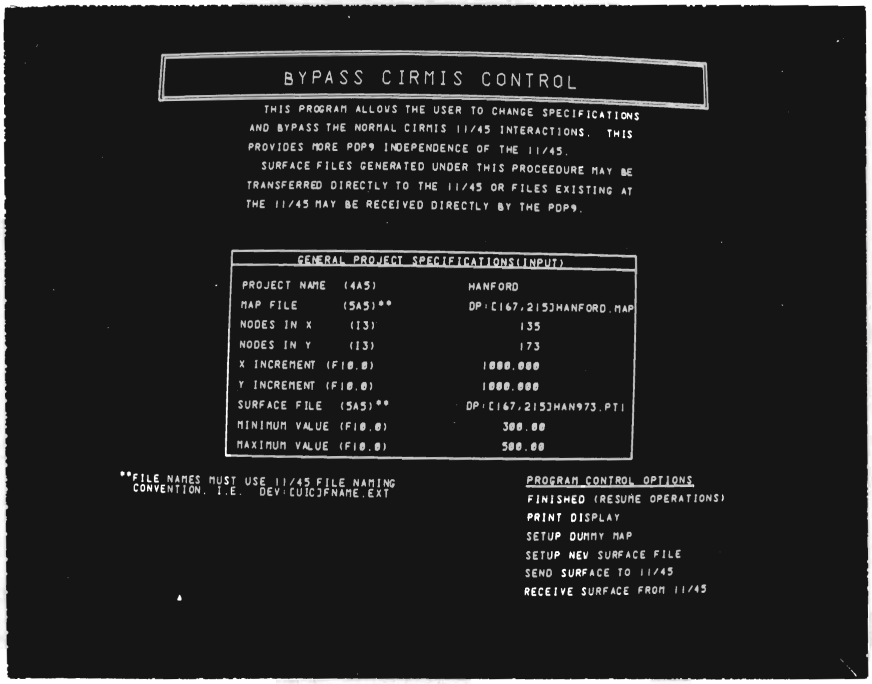


FIGURE 6.42. BYPASS CIRMIS CONTROL Program

The GENERAL PROJECT SPECIFICATIONS shown in Figure 6.42 are light pen interactive and the values are input on the CRT keyboard. They are:

- PROJECT NAME (4A5) - Optional: the user may wish to enter a project name for his own reference.
- MAP NAME (4A5) - Optional: the user may wish to enter a map name for his own reference.
- NODES IN X (I3) - Number of nodes in the X direction (fence posts, not spaces).
- NODES IN Y (I3) - Number of nodes in the Y direction
- X INCREMENT (F10.0) - Map units per node in X direction.
- Y INCREMENT (F10.0) - Map units per node in Y direction.
- SURFACE FILE (5A5) - If the user is to transfer a surface file to or from the 11/45, the convention shown by the

example in Figure 6.42 (i.e., UNIT:[UIC] NAME.EXT) must be used.

- MINIMUM VALUE (F10.0) - Minimum value or less expected to appear on surface being used.
- MAXIMUM VALUE (F10.0) - Maximum value or greater expected to appear on surface being used.

The PROGRAM CONTROL OPTIONS shown in Figure 6.42 are light pen interactive and are:

- FINISHED (RESUME OPERATIONS) - Return control to the Special Applications Program (Figure 6.20).
- PRINT DISPLAY - The present display will be output to the Info-Max Printer/Plotter.
- SETUP DUMMY MAP - Sets up a rectangular background display. This must be done if a background map is not available or if one is not to be set up using the Map Generator Program.
- SETUP NEW SURFACE FILE - This must be done if a new surface is to be digitized using the Surface Generator Program.
- SEND SURFACE TO 11/45 - The surface presently being operated on will be transferred to the 11/45 under the device, UIC, and name specified by the SURFACE NAME and using the other parameters shown under GENERAL PROJECT SPECIFICATIONS.
- RECEIVE SURFACE FROM 11/45 - Transfers the surface that has been specified under GENERAL PROJECT SPECIFICATIONS to the PDP-9.

UPDATE Program

UPDATE is operated on the PDP-11/45 and is used to bypass CIRMIS control in updating the entries in the master file header. Normally entries are placed in the PDP-11/45 master file header using PDP-9 CIRMIS control; however, the user may wish to insert or delete projects and/or associated map or surface files directly. This can be done with the UPDATE program and the modified master file header can be accessed by the PDP-9 CIRMIS control as if it were originally set up using the Special Application and Manipulation functions described in this manual.

This program can also be used to obtain only a listing of all projects and associated specifications contained in the master file header. Appendix B is such a listing.

Use the following procedures for operation of the UPDATE program:

```
MCR > HEL [167,215]
MCR > RUN UPDATE
```

The UPDATE Program will now output a series of questions to the user's terminal. These questions are self explanatory and by answering them the user may make the desired modifications in the file.

If a new surface or map file name is inserted into the directory the standard 11/45 file naming convention must be used as described in Appendix A. In addition, the actual data file must exist as specified in this input name.

6.3 MODEL INPUT SEQUENCING

This section describes the procedures involved in setting up of input parameters and control of Major Predictive Models controlled by the CIRMIS system.

Due to the size of these models and the large amounts of data required, they are run on a PDP-11/45 computer with large mass storage capabilities. Control of these programs is provided through the use of a smaller computer with visual interactive capabilities.

MONTR9

Figure 6.43 shows the first display page of the monitor. Various options of the CIRMIS system are shown under the title SELECT A FUNCTIONAL CATEGORY.

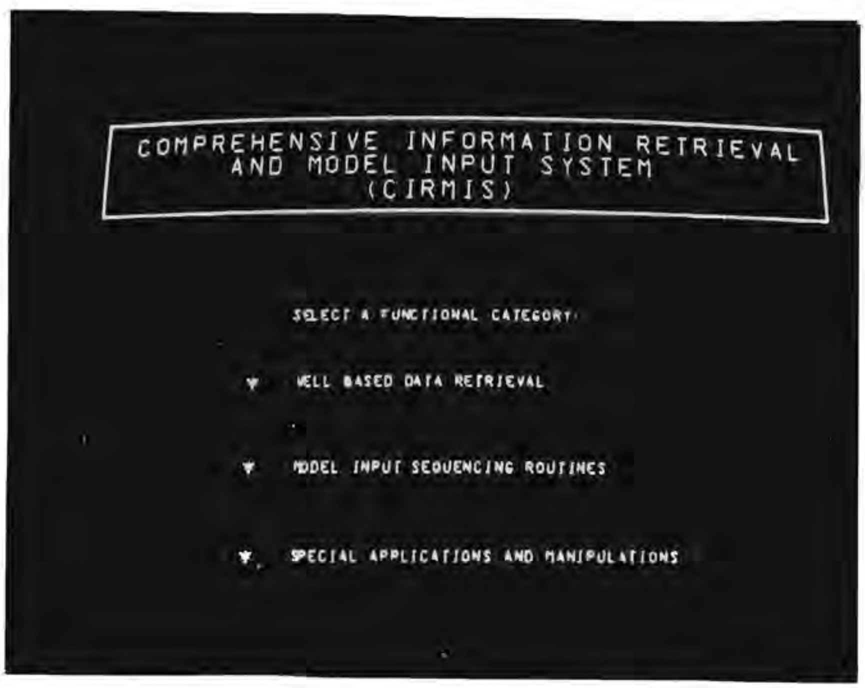


FIGURE 6.43. CIRMIS Monitor Control Page

CIRMIS STARTUP PROCEDURES

This portion of the CIRMIS system controls model operations at the 11/45 computer.

To begin operation, the user must follow the loading sequence described in Chapter 4. Once this has been accomplished and the display shown in Figure 6.43 appears the user can begin operation as described below.

ABBREVIATED OPERATION SEQUENCE

- To begin operation of this portion of the CIRMIS system the user selects the option MODEL INPUT SEQUENCING ROUTINES shown in Figure 6.43. The present display page is replaced by that shown in Figure 6.44. Figure 6.44 shows the models available to the user and the general project specifications presently being used.

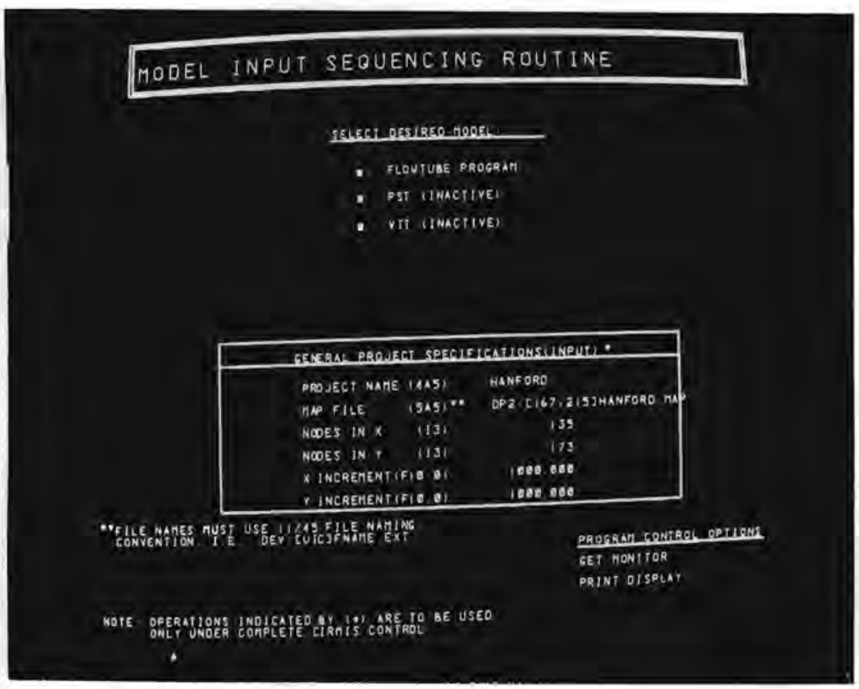


FIGURE 6.44. Model Input Sequencing Routine

- The user then selects the proper specifications (under GENERAL PROJECT SPECIFICATIONS) with the light pen and inputs the desired value on the CRT keyboard (see Appendix C for projects and specifications).
- The user then makes a selection under the title SELECT DESIRED MODEL and the display is replaced by a display correlated with the MODEL (Figure 6.45).
- If required, the user selects the model specification(s) with the light pen and inputs the desired value on the CRT keyboard.
- The user then selects the START PROGRAM option.
- CIRMIS now queries the 11/45; if all general project specifications are correct, the program initializes the proper model controller.

FIGURE 6.45. Preliminary Flowtube Specifications

DETAILED OPERATING SEQUENCE

Model Input Sequence Routine (Figure 6.44)

This routine has three categories which are described as follows:

1. SELECT DESIRED MODEL - at this time only the FLOWTUBE model can be selected. When selected the current display page is replaced by that shown in Figure 6.45 (see MODEL SPECIFICATIONS PAGE).

2. GENERAL PROJECT SPECIFICATIONS (INPUT) - is used only under complete CIRMIS control. This category is light pen interactive and values are input on the CRT keyboard.

   - PROJECT NAME (4A5) - Each project has a descriptive name (see Appendix C).
   - MAP FILE (545) - Map file to be used as background display must be entered in standard 11/45 naming convention (see Appendix B). Up to twelve (12) maps are allowed.
   - NODES IN X (I3) - Number of nodes in the X direction (fence posts, not spaces).
   - NODES IN Y (I3) - Number of nodes in the Y direction.
   - X INCREMENT (F10.0) - Map units per node in the X direction.
   - Y INCREMENT (F10.0) - Map units per node in the Y direction.

3. PROGRAM CONTROL OPTIONS

   - GET MONITOR - When selected, returns control to the monitor (Figure 6.43).
   - PRINT DISPLAY - Prints present display on the Info-max Printer/Plotter.

Model Specification Page - Program Control Options (Figure 6.45)

The control options for this display page are light pen interactive and are described as:

PROGRAM CONTROL OPTIONS

- GET MONITOR - Described above.
- PRINT DISPLAY - Described above.
- RETURN FIRST PAGE - Replaces present display with that shown in Figure 6.44.
- START PROGRAM - The selected Model is initialized. Note: The 11/45 project file header is monitored to see if input specifications match selected project.

Model Specification Page - Model Input Specifications (Figure 6.45)

Each Model may require a unique set of input parameters. This category is light pen interactive and values are input on the CRT keyboard. Following is a description of these parameters.

Flowtube (Figure 6.45)

• INITIAL FLOW TUBE WIDTH (FT) -	625.00
• MINIMUM WIDTH (FT) -	500.00
• MAXIMUM WIDTH (FT) -	1000.00
• WIDTH ADJUSTMENT FACTOR -	0.40
• INITIAL STEP SIZE (FT) -	625.00
• STEP REDUCTION FACTOR -	0.05
• MAXIMUM ANGLE OF DEVIATION (DEG) -	5.00

Once the Flowtube specifications have been entered the user selects the START PROGRAM option and the present display will be replaced with that shown in Figure 6.46.

OPERATING THE PREDICTIVE MODELS

FLOWTUBE (Transmissivity Iterative Routine)

This program is designed to use mathematical modeling in conjunction with field data to deduce a hydraulic conductivity distribution and is described in detail in Reference 3.

Figure 6.46 shows the surface files already set up in the work file at the 11/45 (if any). If a different surface is to be used the desired title under SURFACE FILES (INPUT) is selected and the new name is entered on the CRT keyboard, where the naming convention should match that described in Appendix B.

FIGURE 6.46. Surface Data Selector

The Flowtube Model requires all five types of surface data for operation. When ready to proceed the user selects the START PROGRAM option. If the files do not match those presently in the 11/45 work file, Figure 6.47 appears.

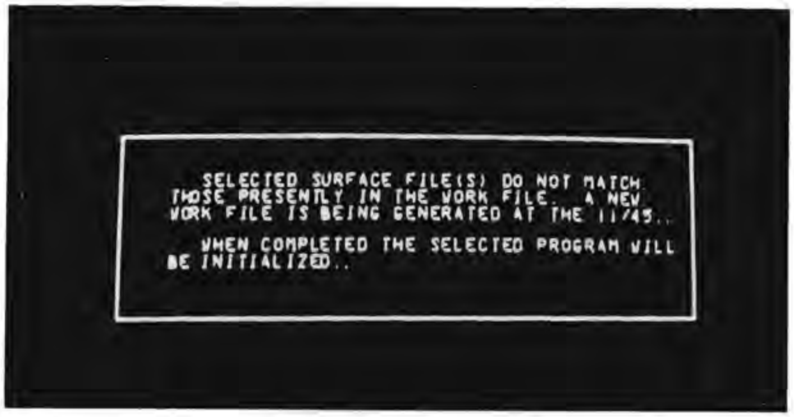


FIGURE 6.47. Surface Data Selector (File Setup Message)

Figure 6.47 remains on the screen until a new work file has been generated, after which the Flowtube program will be initialized (Figure 6.48).

Flowtube provides the user with the capability to generate flowtubes from input starting positions and hydraulic conductivity values and display the results on the CRT screen.

FIGURE 6.48. Initial Flowtube Display

The technique employed here to obtain a hydraulic conductivity distribution is based on numerical integration of the Boussinesq equation along instantaneous streamtubes of flow using a measured water table potential surface and solving for the conductivity. Since advantage is taken of the convergence properties of the streamtubes toward infiltration sites and channels of high transmissivity, only a small number of field-measured conductivities is required to obtain the entire distribution. Because it is not possible to use the same technique to obtain a storage coefficient distribution, it is necessary to either assume that it is constant or construct a distribution from available point measurements. The method, as used in the application to the Hanford unconfined aquifer, is very subjective and allows the hydrologist to use his knowledge on the hydrology of the aquifer in determining the hydraulic conductivity distribution.

FLOWTUBE Options

This program has several options, all of which are light pen interactive:

- RETURN TO CONTROL - Transfers control back to the MODEL INPUT SEQUENCING PROGRAM. (Figure 6.44)
- GRADIENT - Changes direction of Flowtube to up or down gradient of the potential surface.
- LINE DETECT - When YES stops flowtubes at a reference line.
- CONTROL MODE - Has three options for use with Tracking Cross.

  None: Normal control
  Lines: Displays horizontal and vertical lines through center of T.C. for positionery purposes
  Box: Sets corners of region to be calculated

- SETUP REF LINE - Selected twice for first and last points defining a reference line according to position of Tracking Cross.
- DELETE REF LINE - Removes reference line from screen.
- SETUP NEW GRAPH - Stores all flowtubes presently intersecting reference lines and replaces the present display with a new graph.
- RECALL GRAPH - Recalls a graph which has previously been set up.
- FILL REGION (11/45) - Begins calculating hydraulic conductivity values using the present reference curve and defined box.
- CLEAR DISPLAY - Removes all of the streamlines presently being displayed from the screen.
- PRINT - Outputs the present display to the Info-Max Printer/Plotter.
- SETUP CONTOURS - Transfers control to the contouring program.

Detailed Operating Sequence-FLOWTUBE

The techniques employed by the TIR method are to use wells at which field measured hydraulic conductivity values are available and to observe the flowtubes from these wells in order to establish reference lines at areas of convergence. Flowtubes from all of the wells with known conductivity which intersect an individual reference line are then calculated to establish a curve on this reference line. Once this curve has been established, the actual hydraulic conductivities at individual nodes can be calculated.

To do this, the following steps are taken:

- Set LINE DETECT to NO;
- DELETE REFERENCE LINE;
- Select two wells which define the outer portions of an envelope of convergence and display the flowtubes on the screen by entering conductivity values on CRT keyboard then digitizing the well location on map (Figure 6.49);

Figure 6.49. Determining Area of Flowtube Convergence

- Set up a reference line at some point orthogonal to these flowtubes by using the tracking cross to position the first desired line point then activating the SETUP REF LINE option. Move the tracking cross to the second desired location of the line and once again activate the SETUP REF LINE option (Figure 6.50);

FIGURE 6.50. Setting up Reference Line

- CLEAR DISPLAY - the flowtubes will disappear (Figure 6.51);

FIGURE 6.51. Selected Reference Line

- Set LINE DETECT to YES;
- Begin generating flowtubes from the wells within the envelope with known hydraulic conductivities. The flowtubes will stop at the reference line (Figure 6.52);

FIGURE 6.52. Flowtube from Selected Wells Intersecting Reference Line

- When all of these flowtubes have been generated, select the SETUP NEW GRAPH option;
- The present display is replaced by that shown in Figure 6.53;
- The user then analyzes the data on the graph and then draws a curve through which he feels best describes the hydraulic conductivity distribution along the reference line. This is done by positioning the large tracking cross near to the left border of the graph where the start of the curve will begin. The DRAW LINE option is then selected and the large tracking cross will be replaced by a smaller one which is then used to draw the desired curve;

- The user should become familiar with the Permeability graph options described on Page 6-65.

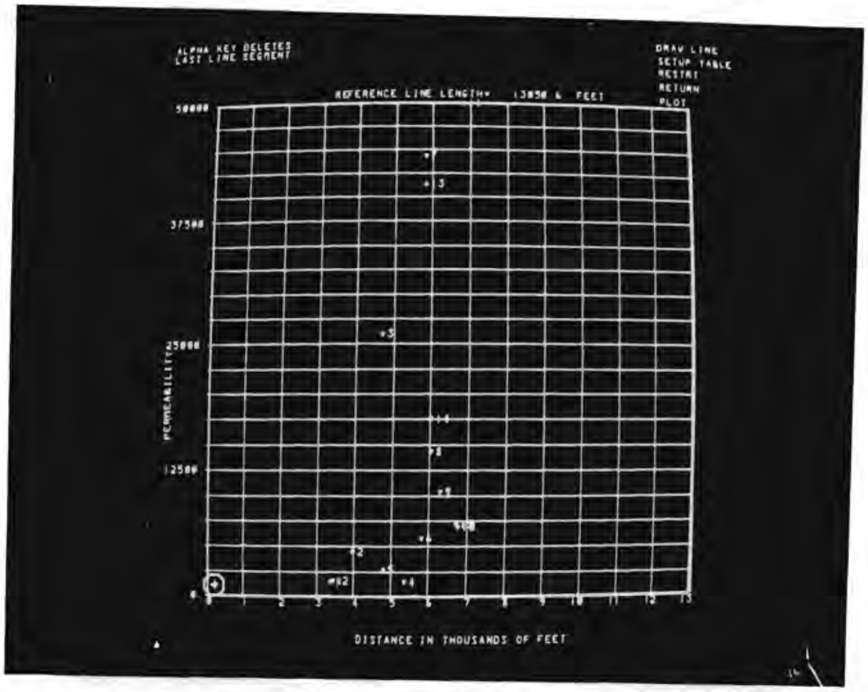


FIGURE 6.53. Calculated Hydraulic Conductivity Values at Reference Line

- Figure 6.54 shows a typical line drawn on the graph.

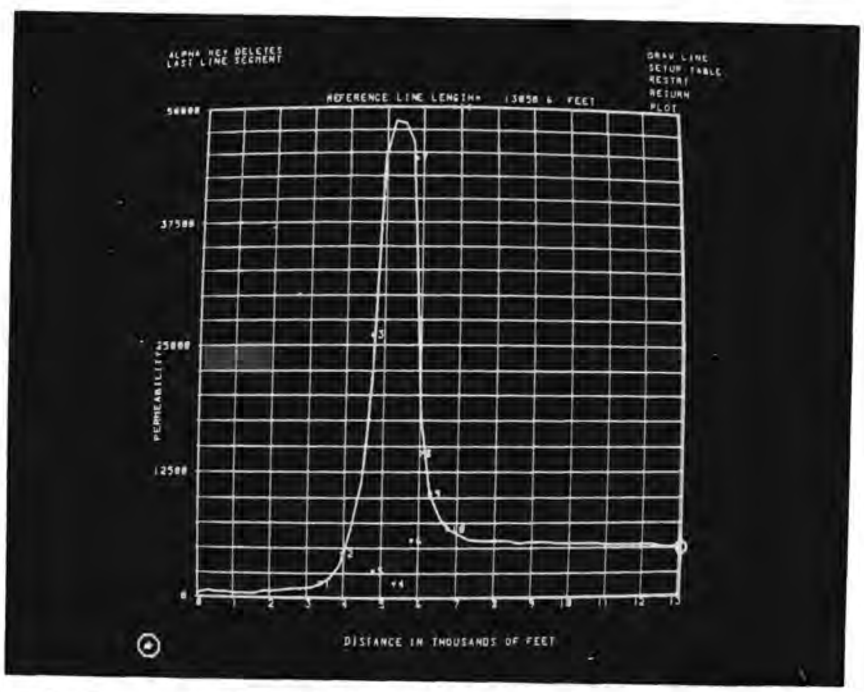


FIGURE 6.54. Best Fit Curve of Hydraulic Conductivity Along Reference Line

- When satisfied with the curve, the user selects the SETUP TABLE option. This is a very important step for the values of the curve must be stored in the permanent table for further use;
- Once the computer indicates that the function table has been completed the user selects the RETURN option which replaces the present display once again with that shown in Figure 6.52;
- The user now activates the CONTROL MODE option and horizontal and vertical lines will appear on the screen intersecting at the center of the tracking cross (Figure 6.55). These lines move with the tracking cross and aid in positioning the bottom left corner of a box to be drawn later to define the region to be calculated;

FIGURE 6.55. Initializing Region Where Conductivity Values Are to be Calculated

- Once this has been done the user selects the CONTROL MODE option again and the lines will disappear. The bottom left corner of the box has now been set;
- The tracking cross is then moved and a box will appear on the screen (Figure 6.56);

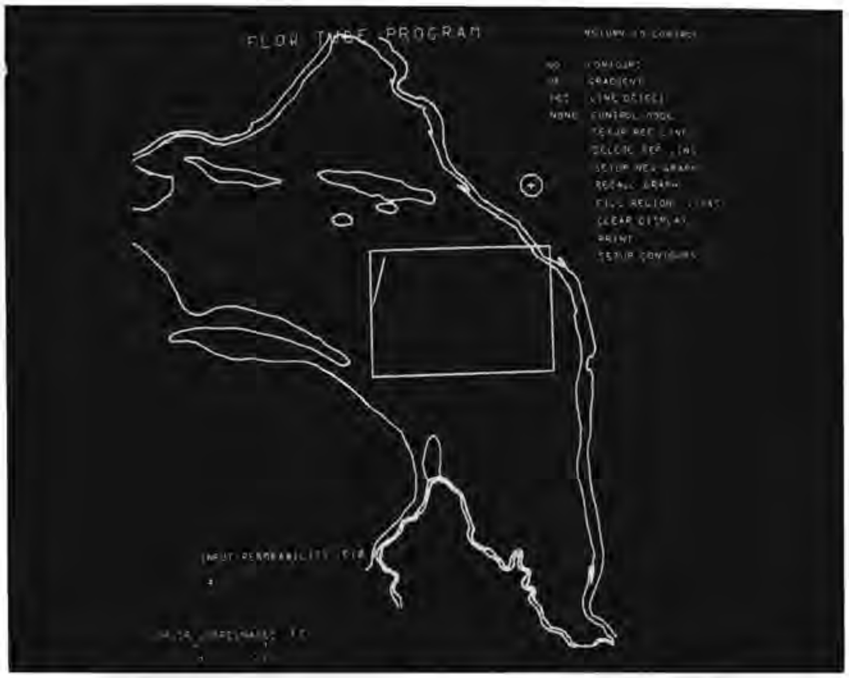


Figure 6.56. Completion of Region

- When the box defines the area desired for calculation, the CONTROL MODE option is again selected which then stores all of the parameters of the box;
- The FILL REGION (11/45) option is now selected and calculation of the nodes within the box is initiated (Figure 6.57);
- At any time during this calculation the status of the program can be monitored by raising AC switch 0 on the PDP-9 console, which will display the flowtube currently being calculated. This mode of operation increases operation time and therefore should be used infrequently. The AC switch 0 should normally be down; and

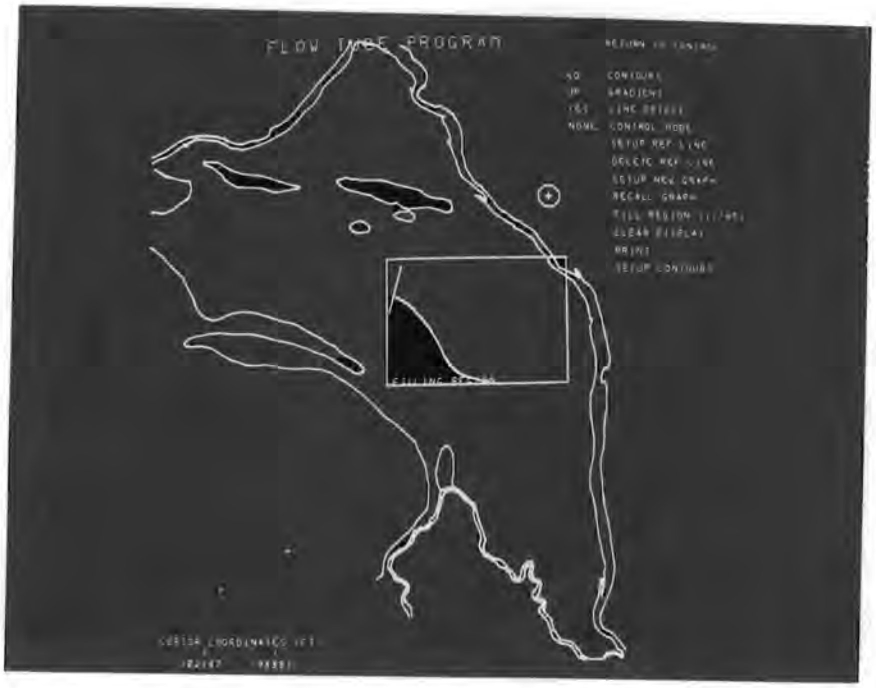


FIGURE 6.57. Calculating Hydraulic Conductivity Values Within Selected Region

- When the FILLING REGION label disappears from the screen, calculations have been completed and the user may continue with additional regions or return calling program to display the region already calculated (see SURFACE CONTOURING in the Special Applications Section).

Graph Option

In order for the 11/45 FLOWTUBE program to calculate a hydraulic conductivity distribution it is necessary to provide a function table containing a K value distribution along the reference line. To do this the user must evaluate the information representing the well values on the permeability graph (Figures 6.53 and 6.54). These values were generated by Flowtube from wells with known hydraulic conductivity and are displayed on the graph as numbered stars. The user draws a line through what he feels best represents the actual K curve along the reference line.

To aid in operation, the graph program allows the user to change the scale in the y direction. To do this the user simply types the minimum value then the maximum value on the CRT keyboard. Both of these are entered as floating point numbers followed by a carriage return (CR).

Several other options are provided for use with the permeability graph. These are light pen interactive and are defined as:

- DRAW LINE* - A small Tracking Cross replaces the larger one and may be used to draw a line on the graph. This should be drawn from the left to right.
- SETUP TABLE - Calculates and stores a function table defined by the hand drawn line.
- RESTRT - Deletes entire line and restarts large Tracking Cross
- RETURN - Returns control to FLOWTUBE
- PLOT - Plots present display on printer/plotter.

*The ALPHA key on the CRT Keyboard may be used to delete line segments at any time during the drawing procedure.

CHAPTER 7. COMPREHENSIVE INFORMATION RETRIEVAL AND MODEL INPUT SEQUENCE DOCUMENTATION

The material in this section documents CIRMIS well-based data, including the well header file, well data description and storage, and well data output. Special applications and manipulations programs are also documented, and the model input sequence is described. CIRMIS hardware and software configurations and CIRMIS programming standards and procedures are described in other sections of this manual.

CIRMIS WELL-BASED DATA

The well-based data portion of CIRMIS presently has 10 basic data types with capabilities for further expansion. These data types are shown in Table 7.1.

TABLE 7.1. CIRMIS Data Types

1. historical hydrograph data
2. historical contaminant data
3. well documentation
4. well log records
5. sieve analysis
6. pump test data
7. physical properties of soils
8. chemical properties of soils
9. hydrograph/VTT overlays
10. historical temperature data

There are presently capabilities for storing up to 32 different contaminant data types with capabilities for further expansion. These contaminant data are shown in Table 7.2.

TABLE 7.2. Contaminant Type Bit Locations (ICBIT's)

	Bit	Contaminant Type	Units	Contaminant Code EMA	Contaminant Code CIRMIS
ICBIT (1)					
	0	Total Alpha	pCi/ml	112	1
	1	Total Beta	pCi/ml	111	2
	2	Tritium	pCi/ml	108	3
	3	Nitrate	mg/l	115	4
	4	Strontium-90	pCi/ml	121	5
	5	Cesium-137	pCi/ml	24	6
	6	Cobalt-60	pCi/ml	10	7
	7	Uranium-236	ng/ml	104	8
	8	Plutonium-239	pCi/ml	103	9
	9	Ruthenium-106	pCi/ml	34	10
	10	Chromium	mg/l	114	11
	11	Flurode	ml/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
ICBIT (2)					
	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		199	22
	6	Sulphate	mg/l	200	23
	7	Sodium	mg/l	201	24
	8	Calcium	mg/l	202	25
	9	Total Gamma	pCi/ml	998	26
	10	Bicarbonate Ion	mg/l	188	27
	11	Carbonate Ion	mg/l	189	28
	12	Total Potassium	ppm	190	29
	13	Specific Conductivity	μMHOS/cm^3	191	30
	14	Boron	mg/l	192	31
	15	Low Alpha	pCi/ml	212	32

WELL DATA OUTPUT

The users' manual section describes operation of the CIRMIS system. These procedures will not be discussed here. However, Figures 7.1 through 7.7 show some of the output capabilities available.

Since CIRMIS is predominently graphics-oriented, most of the output is in graphic form. All of the data types may be output to the Calcomp plotter as shown in Figure 7.1 through 7.3, 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.

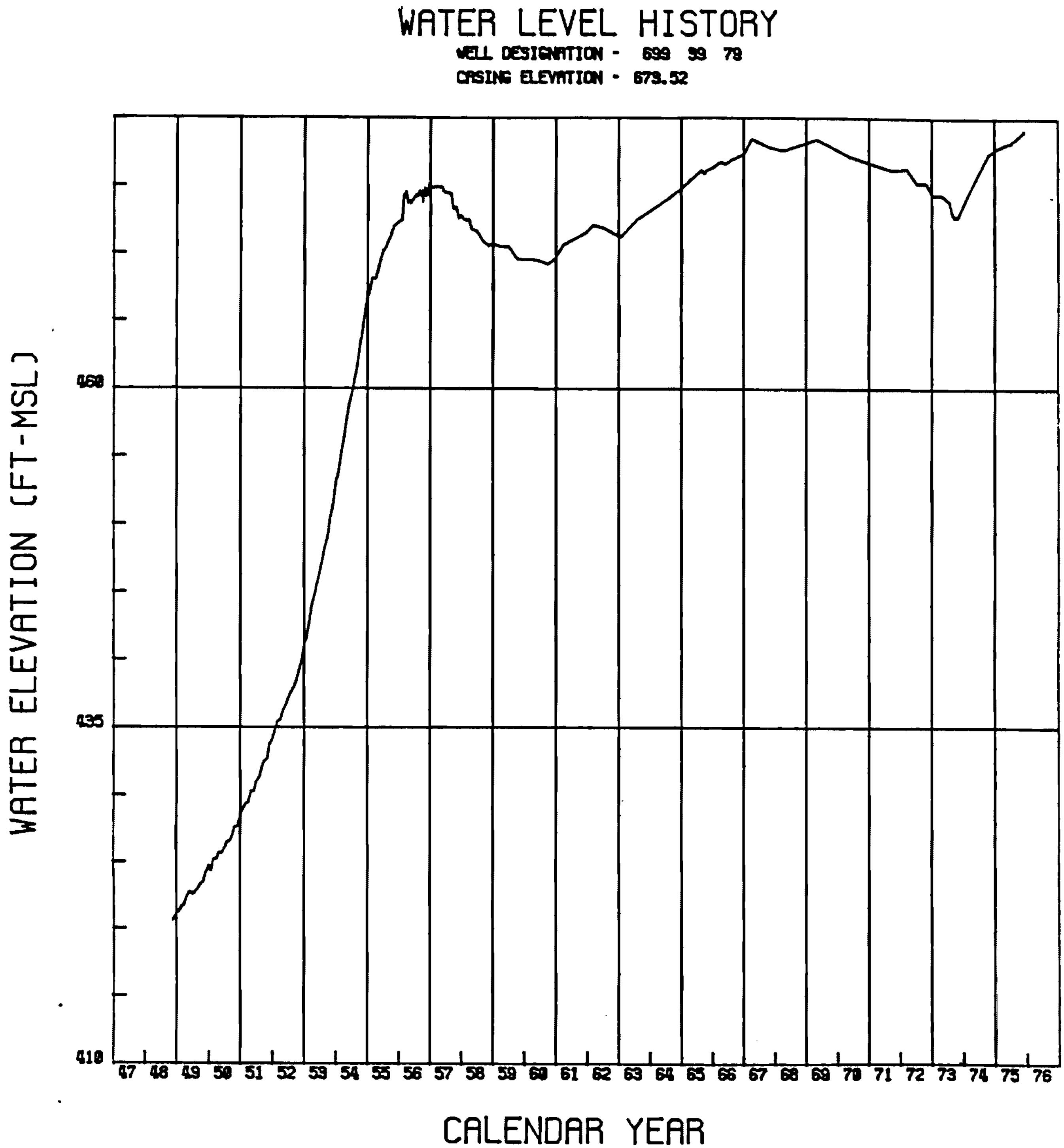


FIGURE 7.1. Calcomp Plot of Water Level History for Well 699--39--79

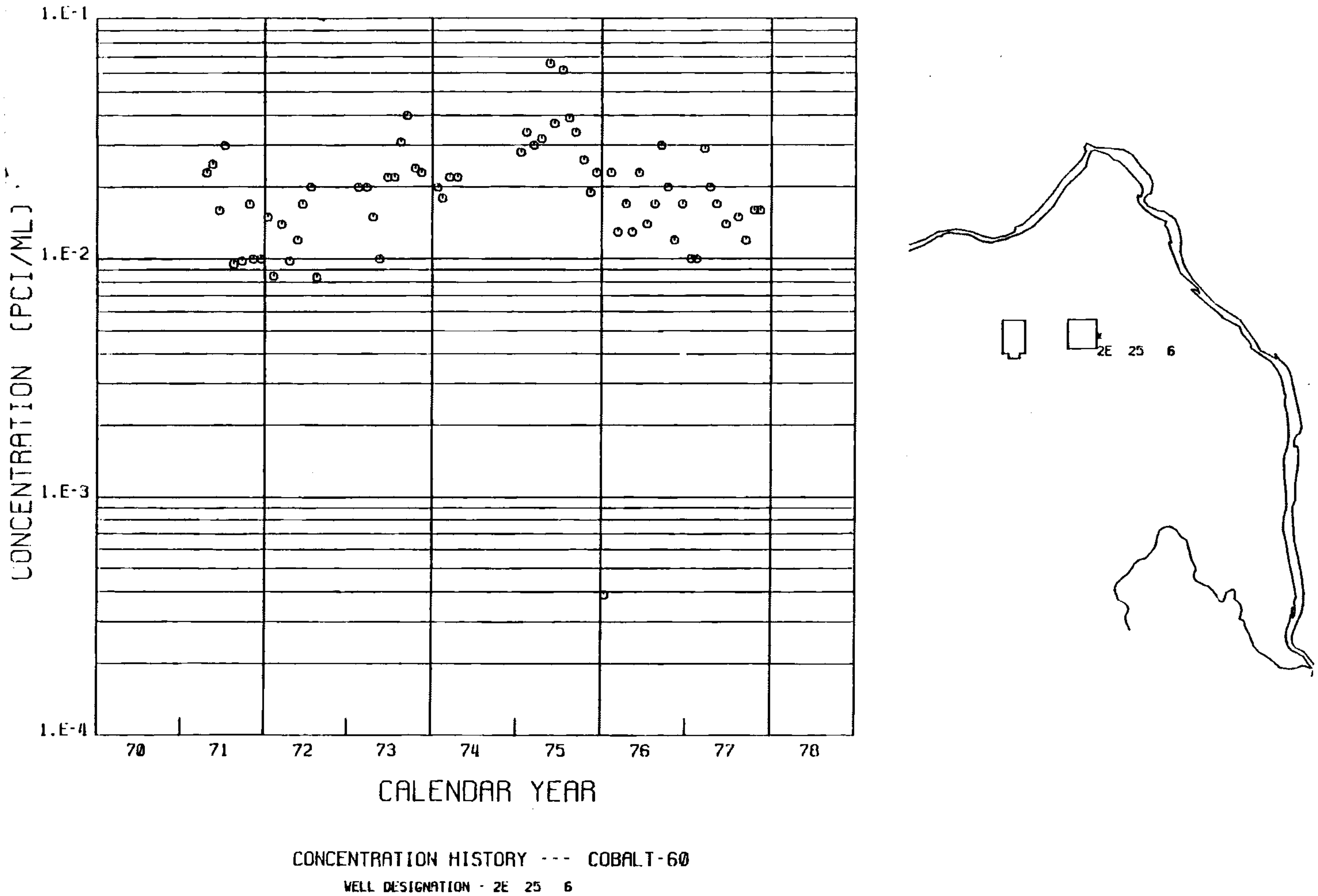


FIGURE 7.2. Calcomp Plot of Contaminant History for Well 2E-25-6

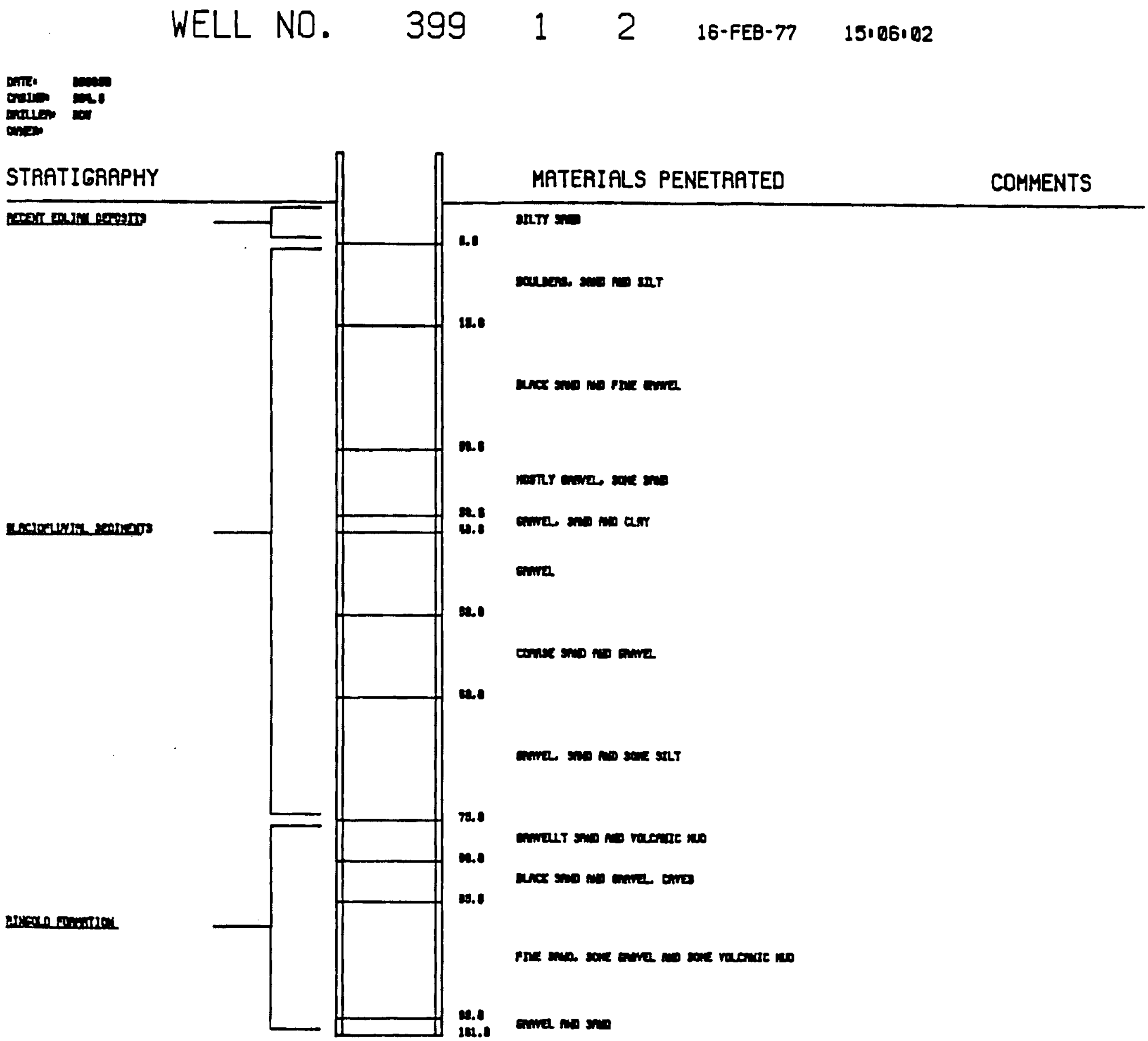


FIGURE 7.3. Calcomp Plot of Well Log Data for Well 399---1---2

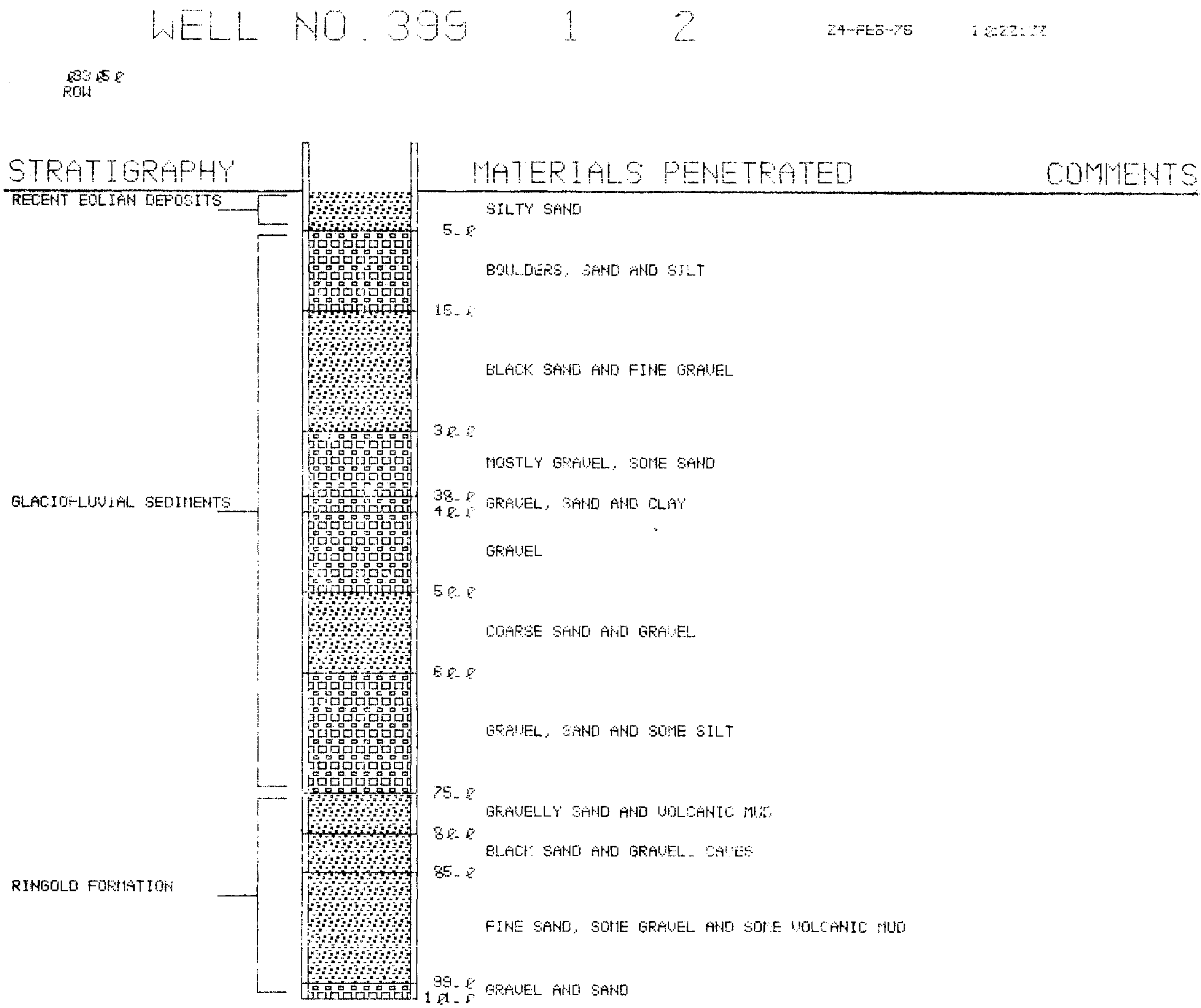


FIGURE 7.4. Gould Plot of Well Log Data for Well 399---1---2

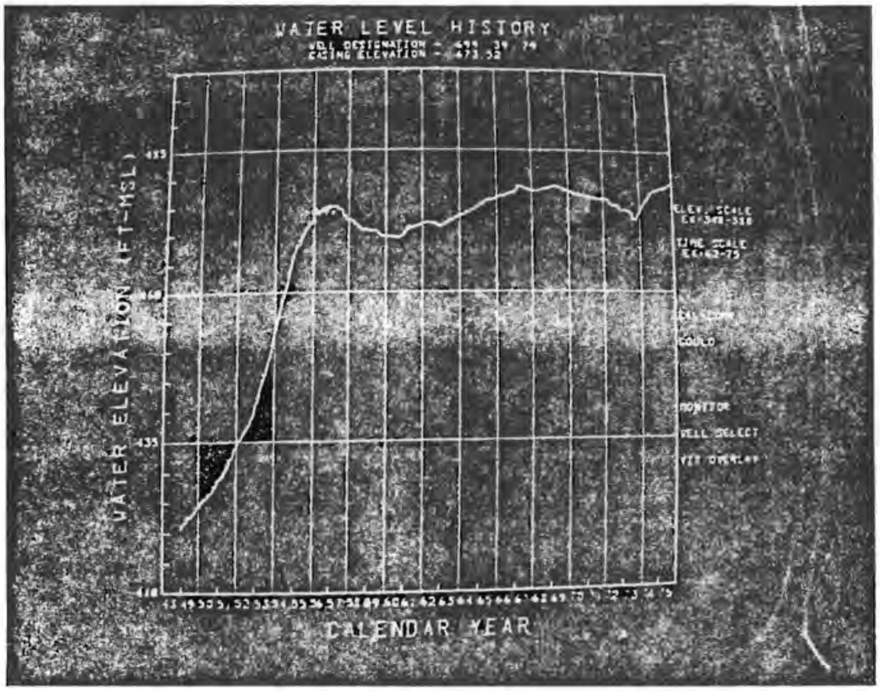


FIGURE 7.5. Scope Display of Water Level History for Well 699--39--79

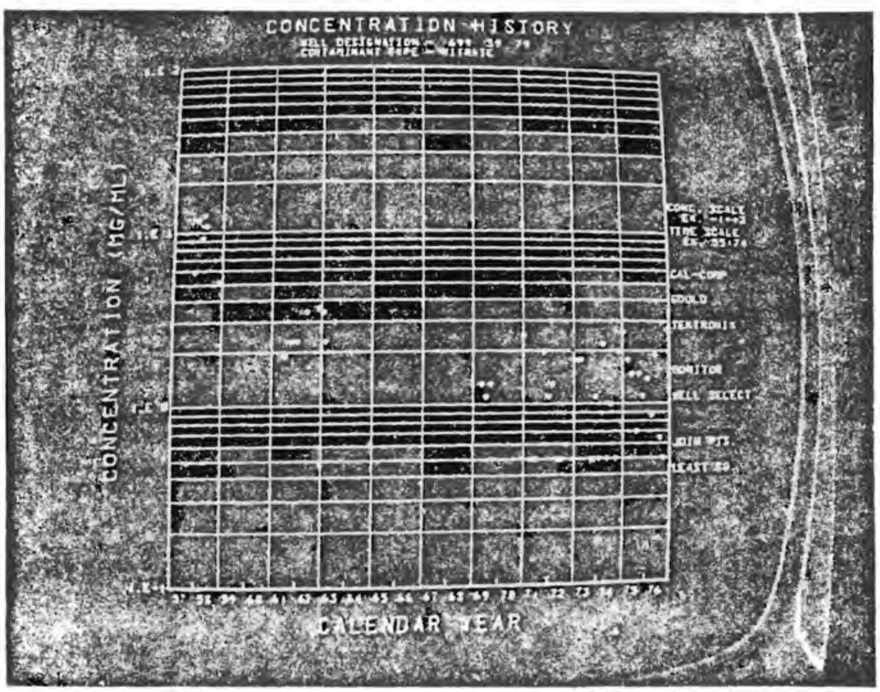


Figure 7.6. Scope Display of Contaminant History for Well 699--39--79

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 model, 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 (e.g., contours, cross sections, listings) 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 ot 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.

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 progorams are described below:

WELL NO. 399 1 2 TOTAL DEPTH= 101.00

DATE: 033050
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
60.	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 7.7. Line Printer Listing of Well Log Data for Well 399---1---2

Program Generator		Description
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 surface.
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.

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 Users' Manual Section.

When a project for a particular model is requested by the user through CIRMIS, 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

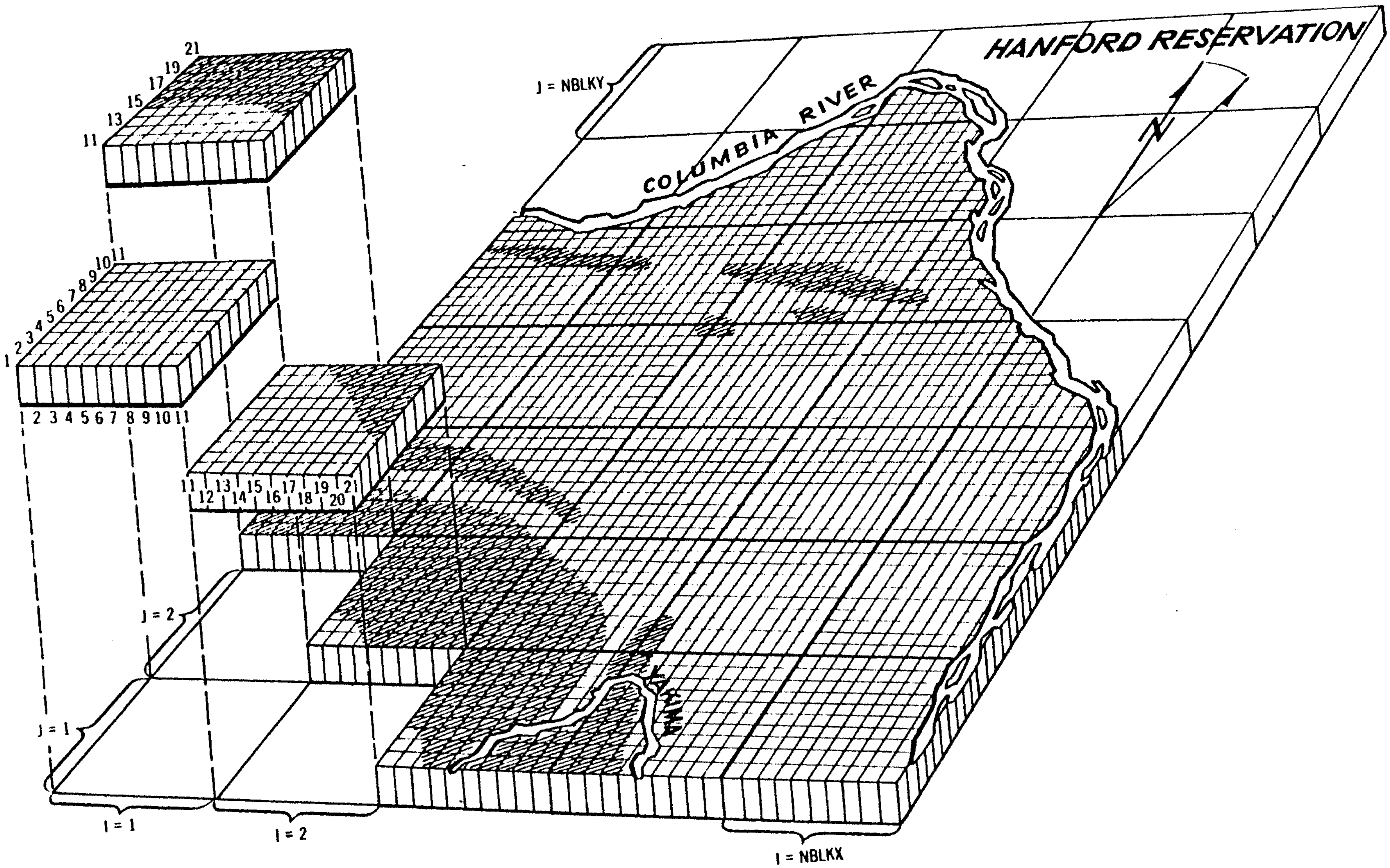


FIGURE 8.8. Example of 11 x 11 Matrix Blocking Method

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.

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 a user requests 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.

Some of the Special Applications Projects, 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 considerbly reduces program size. The method selected for restructuring divides the matrices into 11 x 11 blocks as shown in Figure 7.8. 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 interleaf 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 Ø) followed by the blocked data. An example HDATA file using four blocks is shown in Figure 7.9. The header block is described in Table 7.3.

Figure 7.10 is a representative display on the interactive scope. This figure shows a Hanford background map along with various options used by the particular program.

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	
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	
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 7.9. Example of Surface Type Data Storage

TABLE 7.3. "HDATA" File Q Header Block Format (Block Ø)

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=Ø; Do Nothing NSURF=3; Travel Program NSURF=5; Flowtube Program NSURF>5; Pathline Program	
IBUF(6)	NXX	Nodes in x Direction	Integer
IBUF(7)	NYY	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)	NODIL(1)*	Potential Surface(s)	Integer
(13)	(2)	Hydraulic Conductivity	↓
(14)	(3)	Storage Coefficient	
(15)	(4)	Aquifer Bottom	
(16)	(5)	Rate of Change	
IBUF(17)	FPOT(25)	Name of Potential File	Byte
↓	FHYC(25)	Name of Hydralic Conductivity File	↓
	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(NO = 1; file already set up

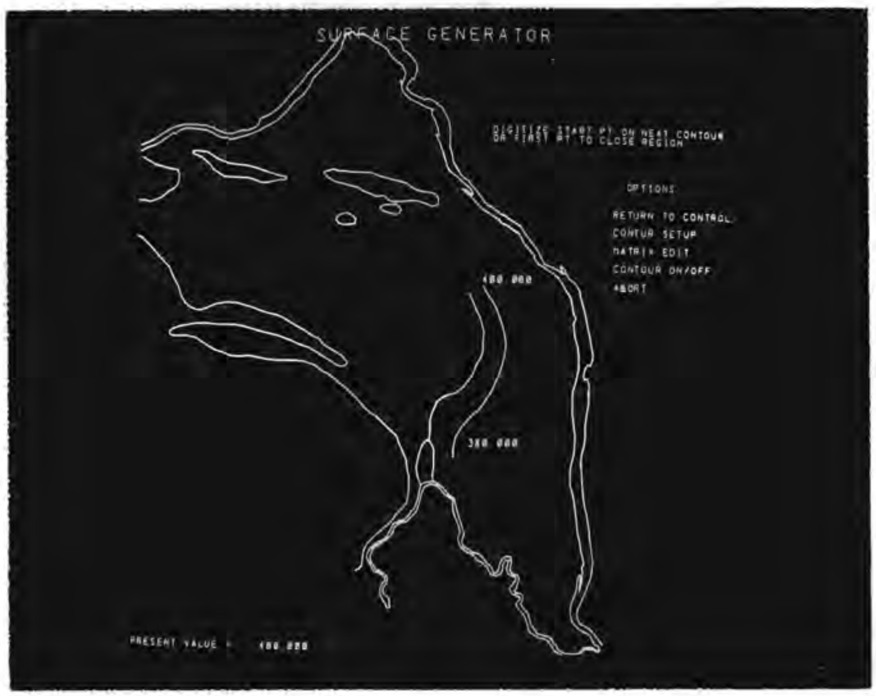


FIGURE 7.10. Representative Display of Hanford Background Map and Options Used with the Surface Generator Program

REFERENCES

1. D. R. Friedrichs, "Comprehensive Information Retrieval and Model Input Sequence (CIRMIS)," BNWL-2235, Battelle, Pacific Northwest Laboratory, 1977.

2. D. R. Friedrichs, "A Graphic Digitizer Program to Interpolate Matrix Grid Values: USERS Manual," BNWL-1652, Battelle, Pacific Northwest Laboratory, Richland, WA, 1973.

3. D. B. Cearlock, K. L. Kipp and D. R. Friedrichs, "The Transmissivity Iterative Calculation Routine - Theory and Numerical Implementation," BNWL-1706, Battelle, Pacific Northwest Laboratory, Richland, WA, 1972 (Updated 1975).

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

APPENDIX A

CIRMIS MASTER INDEX FILE WELL HEADER BLOCK

"WELLHDR" FILE Q

THIS IS A DIRECTORY LISTING OF THE ENTRIES CONTAINED IN THE MASTER INDEX FILE HEADER BLOCK FOR EACH INDIVIDUAL WELL CONTAINED IN THE CIRMIS DATA BASE.

LOCATION	NAME	DESCRIPTION	RECORD TYPE
IBUF(1)			
" (2)			
" (3)	WELDES(12)	WELL DESIGNATION.	
" (4)			
" (5)			
" (6)			
IBUF(7)	C(4)		
" (8)			
" (9)	YH	REAL COORDINATES.	
" (10)			
" (11)	XH		GENERAL INFORMATION
" (12)			
IBUF(13)	XCOORD		
" (14)		MODEL COORDINATES REFERENCED FROM BOTTOM - LEFT CORNER	
" (15)	YCOORD		
" (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 17-32 DATA.	
IBUF(22)			
.			
.	FREE		
.			
" (29)			

****

LOCATION	NAME	DESCRIPTION	RECORD TYPE
IBUF(30)	IDK	FILE Q DISC ADDRESS OF INITIAL ALLOCATION.	HISTORICAL WELL HYDROGRAPH RECORDS
" (31)	NPTS	NO. OF DATA ENTRIES IN INITIAL ALLOCATION.	
" (32)	IDKEX	FILE Q DISC ADDRESS OF EXTENDED ALLOCATION.	
" (33)	NPTEX	NO. OF DATA ENTRIES IN EXTENDED ALLOCATION.	
" (34)	INIDK	NO. OF DISC SECTORS IN INITIAL ALLOCATION.	
*********			
IBUF(35)	IDKNT	FILE Q DISC ADDRESS.	WELL STRUCTURES
" (36)	NSTRT	STARTING WORD.	
" (37)	NWORD	NO. OF WORDS.	
" (38)	FREE		
" (39)	"		
*********			
IBUF(40)	IBLK	FILE Q DISC ADDRESS.	WELL LOG RECORDS
" (41)	NSTRT	STARTING WORD.	
" (42)	NWRD	NO. OF WORDS.	
" (43)	FREE		
" (44)	"		
IBUF(45)	IDKNT	FILE Q DISC ADDRESS.	PHYSICAL PROPERTY RECORDS
" (46)	NCOUNT	NO. OF WORDS.	
" (47)	FREE		
" (48)	"		
" (49)	"		
*********			
IBUF(50)	IDKNT	FILE Q DISC ADDRESS OF INITIAL ALLOCATION.	HISTORICAL TEMPERATURE RECORDS
" (51)	NPTSIN	NO. OF DATA ENTRIES IN INITIAL ALLOCATION.	
" (52)	IDKEX	FILE Q DISC ADDRESS EXTENDED ALLOCATION.	
" (53)	NPTSEX	NO. OF DATA ENTRIES IN EXTENDED ALLOCATION.	
"(54)	INALOC	NO. OF DISC SECTORS IN INITIAL ALLOCATION.	
*********			

LOCATION	NAME	DESCRIPTION	RECORD TYPE
IBUF(55)	IDK	FILE Q DISC ADDRESS.	VTT SIMULATION DATA
" (56)	NPTS	NO. OF DATA ENTRIES.	
" (57)	FREE		
" (58)	"		
" (59)	"		
IBUF(61)	CTADR	FILE Q DISC ADDRESS OF CTMHDR	HISTORICAL CONTAMINATION RECORDS
*********			
IBUF(62) . . . " (219)	FREE		
IBUF(220) . " (231)	FORM(6)	FORMANS NAME.	
IBUF(232) . " (243)	DRLR(6)	DRILLERS NAME.	
IBUF(244) . . . " (250)	FREE		

IBUF(251)	IDISC	DISC NAME (I.E. DB OR DP)	USED BY MONITORS TO TRANSFER DEVICE AND DISC ADDRESSES TO SERVICE ROUTINES
IBUF(252)	IUNIT	DISC UNIT (I.E. 0,1 OR 2)	.
IBUF(253)	FREE		.
IBUF(254)	FREE		.
IBUF(255)	IWNAM	"WELLNAM" POINTER	.
IBUF(256)	IWHDR	"WELLHDR" POINTER	.

APPENDIX B

PDP-11/45 FILE NAMING CONVENTIONS

APPENDIX B

Surface or map file to be stored at the 11/45 for use by the CIRMIS system or by other programs must use standard 11/45 file naming conventions i.e., DEV: [UIC] FNAME. EXT.

Surface files should also conform to an additional naming procedure for the file name and extension (FNAME. EXT).

This procedure was adopted to eliminate confusion when surface files are needed at a future date where the exact project, surface name and time is required.

Below is a description this procedure:

Standard SETUP:

DEV: [UIC] XXXMYR.YYN

where:

DEV:---- Device and unit number

[UIC]---- User identification code if required

XXX ---- Three character project descriptor

Examples: HAN - Hanford

MOX - Moxee

CCO - Clark County

M ---- The month surface obtained (1 or 2 digits)

YR ---- The year surface obtained (last 2 digits of year. Ex: 74)

YY ---- Two character surface descriptor

a) PT - Potential surface

b) HC - Hydraulic conductivity

c) SC - Storage coefficient

d) DH - Rate of change (DH/DT)

e) AB - Aquifer bottom

f) TG - Topography

g) TM - Transmissivity

N ---- Aquifer number (1-9)

Examples

DP: [167,215]HAN973.PT1

DP1: [6,4]CC01175.HC1

MT:HAN168.SC1

Additional Benefits

This method also provides the user with automatic naming procedures for successive files like those used in the VTT Program.

For example if surfaces were to be calculated on a monthly basis for the Hanford potential surface beginning January 1975 this could be done as follows:

Original Surface

FPOT = DP: [167,215]HAN175.PT1

The following code takes this name and generates a new name dependent upon month and year.

```
C DECODE POTENTIAL NAME
3015    ICHRR=3
        IF(IMO.GT.9) ICHRR=4
        DO 31 I=1,25
        IF(FPOT(I).EQ.'.')GO TO 32
31      CONTINUE
32      NCHRS=I-1-ICHRR
        T(1)=FPOT(I)
        T(2)=FPOT(I+1)
        T(3)=FPOT(I+2)
        T(4)=FPOT(I+3)
        T(5)=0
        IDATE=IYR-1900+100*IMO
        IF(IYR.GE.2000) IDATE=1YR-2000+100*IMO
        INO=25-NCHR-ICHRR
        C set up new potential name
        ENCODE(25,33,FNAM) (FPOT(I),I=1,NCHRS),IDATE,
        1                  (T(I),I=1,INO)
33      FORMAT(<NCHRS>A1,I<ICHRR>,<INO>A1)
        OPEN(UNIT=2,NAME=FNAM,TYPE='OLD',FORM='UNFORMATED',
        1 READONLY)
```

It can be seen that in this manner a new surface may be set up according to the original surface characteristics but with different dates by simply setting the month and year variable.

NOTE: In the above coding FPOT, FNAM and T are byte arrays.

APPENDIX C

CIRMIS MASTER FILE DIRECTORY

```
*********** PRESENT DIRECTORY  09-SEP-76 **********

                    NO. OF PROJECTS =  13

*************************************************************************

PROJECT NAME:    HANFORD

NODESX  NODESY      XINC         YINC           NO. SURFACES     NO. MAPS
  135     173    1000.000     1000.000              14               2

  SURFACE DISC FILES             ZMIN        ZMAX
DP1:[167,215]HAN973.PT1         300.00      500.00
DP1:[167,215]HAN175.PT1         300.00      500.00
DP1:[167,215]HAN174.HC1           0.00   260000.00
DP1:[167,215]HAN973.AB1         100.00      500.00
DP1:[167,215]HAN973.DH1          -0.10        0.24
DP1:[167,215]HAN175.HC1           0.00   260000.00
DP1:[167,215]HAN473.SC1           0.00       10.00
DP1:[167,215]HAN174.SC1           0.00       10.00
DP1:[167,215]HAN176.TG1           0.00     4000.00
DP1:[167,215]HAN973.DH2          -0.10        0.04
DP1:[167,215]HAN376.HC1           0.00   260000.00
DP1:[167,215]HANTST.HC1           0.00   260000.00
DP1:[167,215]HAN973.SC1           0.00       10.00
DP0:[167,215]HANTST.HC1           0.00   260000.00

  MAP DISC FILES
DP1:[167,215]HANFORD.MAP
DP:[167,215]HANFORD.MAP


*************************************************************************

PROJECT NAME:    TRIDENT

NODESX  NODESY      XINC         YINC           NO. SURFACES     NO. MAPS
   68      35     500.000      500.000               6               1

  SURFACE DISC FILES             ZMIN        ZMAX
DP1:[167,215]TRD475.PT1         100.00      800.00
DP1:[167,215]TRD475.AQ1         100.00      800.00
DP1:[167,215]TRD475.AQ2         100.00      800.00
DP1:[167,215]TRD475.TR1         100.00    50000.00
DP1:[167,215]TRD475.HY1           0.00   260000.00
DP1:[167,215]TRD475.SG1           0.00       10.00

  MAP DISC FILES
DP1:[167,215]TRIDENT.MAP
```

```
PROJECT NAME:   HANFORD 2

NODESX  NODESY      XINC        YINC          NO. SURFACES     NO. MAPS
   68      87    2000.000    2000.000              12              2


  SURFACE DISC FILES               ZMIN        ZMAX
DP1:[6,4]HANPT1280.AQ1            100.00      500.00
DP1:[6,4]AQUPT1280.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]HANPT1280.AQ1            100.00      500.00
[167,215]AQUPT1280.AQ1            100.00      500.00
 0 1 1 1                            0.00   260000.00
DP:[205,200]VTTSN2.PT1              0.00      600.00
DP:[205,200]HAN7255.AB1             0.00      500.00
DP:[205,200]HAN168.HY1              0.00   260000.00


  MAP DISC FILES
DP1:[167,215]HANFORD.MAP
DP:[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.HY1             0.00      200.00
DP1:[167,215]TST125.SG1             0.00        1.00
DP0:[171,215]TST125.HC1             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:   WYODAK

NODESX  NODESY      XINC        YINC          NO. SURFACES     NO. MAPS
  121      59     100.000     100.000               1              1


  SURFACE DISC FILES               ZMIN        ZMAX
DP1:[167,215]WYD1175.TP1         4200.00     4700.00


  MAP DISC FILES
DP1:[167,215]WYODAK.MAP
```

PROJECT NAME: TRIGA 300A

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
25	33	250.000	250.000	4	1

SURFACE DISC FILES	ZMIN	ZMAX
DP1:[30,106]N3A376.HC1	0.00	260000.00
DP1:[30,106]N3A376.SC1	0.00	10.00
MT1:N3A376.PT1	300.00	500.00
DP1:[30,106]N3A376.PT1	300.00	500.00

MAP DISC FILES
DP1:[205,200]HAN300.BNO

****

PROJECT NAME: PATHLINE 2

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
81	81	250.000	250.000	5	1

SURFACE DISC FILES	ZMIN	ZMAX
DP1:[167,215]TST125.PT2	-100.00	100.00
DP1:[167,215]TST225.PT2	-100.00	100.00
DP1:[167,215]TST325.PT2	-100.00	100.00
DP1:[167,215]TST125.HC2	0.00	200.00
DP1:[167,215]TST125.SC2	0.00	1.00

MAP DISC FILES
DP1:[167,215]PATHTST.MAP

****

PROJECT NAME: CLARK COUNTY

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
43	52	2640.000	2640.000	6	1

.SURFACE DISC FILES	ZMIN	ZMAX
DP1:[201,220]CC0576.AT1	0.00	2000.00
DP1:[201,220]CC0576.AT2	-110.00	1100.00
DP1:[201,220]CC0576.AB1	-110.00	1100.00
DP1:[201,220]CC0576.AB2	-300.00	1000.00
DP1:[201,220]CC0576.PT1	0.00	500.00
DP1:[201,220]CC0576.PT2	0.00	500.00

MAP DISC FILES
DP1:[201,220]CLARK.MAP

```
PROJECT NAME:   PATHLINE 3

NODESX  NODESY      XINC        YINC           NO. SURFACES    NO. MAPS
   41      21   2000.000    2000.000                5              1


  SURFACE DISC FILES              ZMIN        ZMAX
DP1:[167,215]TST125.SC3           0.00        1.00
MT1:TST125.PT1                 -100.00      100.00
DP1:[167,215]TST125.HC3           0.00      600.00
MT0:TST125.PT1                 -100.00      100.00
DP0:[167,215]TS1554.PT1        -100.00      100.00


  MAP DISC FILES
DP2:[157,215]PATHTS3.MAP


*************************************************************************


PROJECT NAME:   PATHLINE 5

NODESX  NODESY      XINC        YINC           NO. SURFACES    NO. MAPS
  161      81    500.000     500.000                3              1


  SURFACE DISC FILES              ZMIN        ZMAX
DP2:[171,215]TS1554.PT5        -100.00      100.00
DP2:[171,215]TST125.HC5           0.00      600.00
DP2:[171,215]TST125.SC5           0.00        1.00


  MAP DISC FILES
DP2:[167,215]PATHTS3.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:[167,215]HAN973.PT1          300.00      500.00
DP:[167,215]HAN174.HC1            0.00   260000.00
DP:[167,215]HAN174.SC1            0.00       10.00


  MAP DISC FILES
DP:[167,215]HANFORD.MAP
```

PROJECT NAME: PATHLINE 38

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

SURFACE DISC FILES	ZMIN	ZMAX
DP:[171,215]TS1554.PT1	-100.00	100.00
DP:[171,215]TST125.HC3	0.00	600.00
DP:[171,215]TST125.SC3	0.00	1.00

MAP DISC FILES
DP:[171,215]PATHTS3.MAP

****

PROJECT NAME: PATHLINE 58

NODESX	NODESY	XINC	YINC	NO. SURFACES	NO. MAPS
161	81	500.000	500.000	3	1

SURFACE DISC FILES	ZMIN	ZMAX
DP:[171,215]TS1554.PT5	-100.00	100.00
DP:[171,215]TST125.HC5	0.00	600.00
DP:[171,215]TST125.SC5	0.00	1.00

MAP DISC FILES
DP:[171,215]PATHTS3.MAP

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