TRANSMISSIVITY ITERATIVE PROGRAM
USER'S MANUAL

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1972

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by

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Water and Land Resources Department

1972

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SUMMARY

This user's manual contains listings and functional definitions of the various directives available in the Iterative Sequence. These directives are used to operate the Iterative Sequence and to direct and complete the actual analysis. A complete and thorough description of each directive is contained in the report, "The Transmissivity Iterative Programs on the PDP-9: A Man-Machine Interactive System," BNWL-1707.

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TRANSMISSIVITY ITERATIVE PROGRAM
USER'S MANUAL

INTRODUCTION

This user's manual describes the operation of the set of programs developed to calculate the transmissivity distribution for the Hanford Reservation and perform travel time studies. Two other reports contain the theory upon which these programs are based and the details of the computer system and program set design.

The program set includes:

1. the Iterative Monitor;
2. Streamline Generation program;
3. Travel Time programs; and
4. Transmissivity Calculation programs.

A description of the operations involved in generating the transmissivity distribution using this program set on the interactive computer system is covered in a separate report, "The Transmissivity Iterative Programs on the PDP-9 Computer - A Man-Machine Interactive System," BNWL-1707.

ITERATIVE SEQUENCE OPERATING INSTRUCTIONS

This report is a detailed summary of the available options and operating instructions for each program in the Iterative Sequence.

NOMENCLATURE

Directives	The input neumonic to the computer which directs the computer to perform a certain task. Directives are three characters long.
TAG	The use tag for a data matrix; identifies the usage of a particular data matrix.
DEV	Any of the mass storage devices (disc and dectape) on this system. The device neumonic is three characters in either DKU or DTU, where U is the proper unit number of the device.
NAME	The directory name for a data file, 1 to 6 characters in length.
EXT	The directory extension for the data file, 1 to 3 characters in length.
TIME	The difference in time between time 2 and time 1 expressed in days. It must be positive and no larger than 131,072 days (359.1 years).
FUNCTION	The functional block to which the Iterative Monitor dispatches control.

ITERATIVE MONITOR (KONTRL)

The Iterative Monitor acts as a general supervisor for the Iterative Sequence, performing data retrieval and storage, initialization, certain data matrix operations, and dispatch of control to the proper functional block in the Iterative Sequence. All of the directives for the Iterative Monitor are input from the keyboard of the ASR35 teletype.

When the monitor is first called for execution, it responds:

ITERATIVE SEQUENCE MONITOR

>

After it has responded with the >, it is ready to accept directives. These directives are entered via the keyboard and are terminated with a CARRIAGE RETURN.

Directives

Task

INT

The graphic digitizer table is to be initialized. When this directive has been given, the computer will respond on the teletype

DIGITIZE (0,0) POINT

The computer is requesting that the digitizer cursor be placed at the (0,0) coordinate of the reference data map being used. When the cursor has been placed at the point, the button on the digitizer cursor is pressed to send the point to the computer. The computer will respond

DIGITIZE MAXIMUM X VALUE

The digitizer cursor should now be placed at the maximum x node on the reference data map being used and the button on the digitizer cursor should be pressed to enter the point into the computer.

GEN TAG NAME EXT

This directive establishes a new data matrix NAME EXT on disc unit 2 (DK2). It is filled entirely with zeros and is assigned to the use TAG.

After this directive has been given the computer will require the following additional information to set up this new data matrix:

HORIZONTAL DIMENSION (nodes in horizontal direction)

DirectivesTask

GEN TAG NAME EXT
(continued)

VERTICAL DIMENSION (nodes in vertical direction)
SECTORS PER SECTION (number of disc sectors per section)
OVERLAP (number of nodes in common)

(For a detailed explanation of these parameters, see Appendix III in a separate report, BNWL-1707).

ASG TAG DEV NAME EXT

This directive transfers a data matrix (NAME, EXT) from the physical device (DEV) to disc unit 2 (DK2). After the transfer has been completed, the matrix is assigned to use (TAG). This directive overlays any previous assignment to (TAG).

DEL TAG

Delete the current data matrix assigned to TAG.

SAV TAG DEV NAME EXT

Transfer the data matrix assigned to use (TAG) on disc unit 2 (DK2) to the physical device (DEV). The data matrix is identified on the device (DEV) by (NAME, EXT). If there currently is a file on (DEV) by that identification, it is deleted and this replaces it. If (NAME EXT) are not included in the directive, then the same name as in the assignment (TAG) will be used.

LST

List on the teletype the data matrix use assignments as they are currently specified.

COM TAG

Enter in the data matrix assigned to use (TAG) a comment string. This comment string is limited to 1 teletype line (64 characters). When this directive is given the computer will respond on the teletype with

COMMENTS

Directives

Task

COM TAG (continued)	The desired comments are entered via the keyboard and stored in the data matrix.
TIM	This sets the time value between T2 and T1 to Time.
EXQ FUNCTION	Dispatch control to the function (FUNCTION)
AVE	Form the average of the two data matrices assigned to use (PT1) and (PT2) and store the results in the data matrix assigned to use (PTA). $(PTA) = [(PT2) + (PT1)]/2$
DIF	Form the difference between the data matrix assigned to use (PT2) and the data matrix assigned to use (PT1) and store the results in the data matrix assigned to use (DPT). $(DPT) = (PT1) - (PT1)$
FIL TAG	Fill all of the internal zeros in the data matrix assigned to use (TAG).
SMU TAG	Smooth the data matrix assigned to use (TAG).
FILE NOT FOUND	A file identifier (NAME EXT) was given which was not found on the physical device (DEV).
DISC ERROR	An error has been detected in the disc transfers or operation.

Special Keys

↑U (Control U)	This key deletes everything previously typed on this directive; it is as if nothing had been typed. All previous input on this directive is ignored.
Rub Out	This deletes the last character typed from the current directive being input. Successive rub outs continue to delete the successive previous input character.

Errors Detected by Monitor

?

An error was made on directive input;
for example:

1. illegal character
2. improper input of a directive
3. illegal device
4. illegal use tag

STREAMLINE GENERATION (STREAM)

This functional block generates streamlines and draws contours for a groundwater system. The directives for Streamline are entered either at the graphic digitizer or at the console of the CRT display. When the program is called by the Monitor, it will respond by typing on the teletype

STREAMLINE GENERATION

and the overlay map assigned by the Monitor will be visible on the CRT display. The computer is now ready for directives to be input.

Directives

Task

Pressing Button on
Digitizer Cursor

This locates the origin of the streamline. When the cursor button is pressed, a stream path is drawn on the CRT. When the computer is ready to respond for drawing a streamline, a message appears in the lower left corner of the CRT:

DIGITIZE STREAMLINE ORIGIN

During the actual calculation this message is not visible.

✓

Sets direction of streamline from the input origin, whether the path is up or down gradient. It is simply a toggle switch, with the initial condition being up gradient.

Directives

Task

φ

Enter contour mode. When this button is pressed the program is set to draw contours and responds with a message in the lower left corner of the CRT:

ENTER CONTOUR VALUE

The contour value is then entered via the keys on the CRT console and input to the computer when the RETURN is pressed. The value is entered in scientific notation format ($\pm X.XXXXX\pm XX$).

The switch is a simple toggle type with the initial setting not in the contour mode.

Ω

Clear the display of all streamlines and contours. It returns the display to the overlay map only.

X

This is a save function. The current display can be protected from erasure by the X option. When this toggle switch, initially set so that the first time it is pressed it saves, is pressed whatever is on the display will not be erased. The next time it is pressed, the save protect option is removed.

α

When this is pressed the streamline generation is terminated and control is returned for further directives.

+

Exit the Streamline functional block and return to the Iterative Sequence Monitor.

Special Keys

CHAR ERASE

Deletes everything entered from the CRT keyboard. The entries from the keyboard start all over again as if nothing had been entered.

Errors Detected by Streamline

NEED TO INITIALIZE WITH MONITOR	The Streamline function block was entered before being initialized by the Iterative Sequence Monitor. This error returns user to the computer operating system monitor.
FILE NOT FOUND	A data matrix assignment to use (MAP) of (PT1) was not made before entering the Streamline function block. This error returns user to the Iterative Sequence Monitor.

TRAVEL TIME CALCULATIONS (TRAVPR), (TRAVTR)

This functional block calculates travel times along streamlines. The directives are identical to those for the Streamline functional block, with the addition of several options. The constant permeability version and the variable transmissivity version have the same directives. The neumonic TRAVPR refers to the constant permeability travel time model, while the TRAVTR neumonic refers to the variable transmissivity travel time model.

When the program is called by the monitor, it responds by typing on the teletype either

TRAVEL TIME CALCULATION (PERMEABILITY)

or

TRAVEL TIME CALCULATION (TRANSMISSIVITY)

Directives

Task

π	Places a limit on the travel time. When the travel time of a flow path exceeds this limit, the calculation is terminated and the program is ready to start another calculation. When this button is initially pressed, the computer responds with a message in the lower left corner of the CRT
-------	---

ENTER LIMIT VALUE

The limit is input with the display keyboard in scientific notation format and terminated with RETURN. When the value has been input the message

Directives

Task

π (continued) on the CRT changes back to

DIGITIZE STREAMLINE ORIGIN

This limit remains in effect until the program is taken out at a new limit by again pressing the button.

λ Put the program in step mode. At the end of each iteration the computer waits in an idle loop until released. This is a toggle switch which is initially in the normal free run form. In step mode, the program is released to do one more iteration each time this button is pushed.

Special Keys

These are identical to those of the Streamline program.

Errors Detected by Travel Time

These are the same as in the Streamline program.

TRANSMISSIVITY CALCULATIONS (FLOWSS), (FLOWTR)

The Transmissivity Calculations prepare for and calculate a transmissivity distribution for a groundwater system. All of the directives for this functional block are entered from the graphic digitizer and CRT display; they are the same for both the steady-state (FLOWSS) and transient (FLOWTR) models.

When the Iterative Monitor first calls the transmissivity functional block the computer responds by typing on the teletype either

TRANSMISSIVITY CALCULATION (STEADY STATE)

or

TRANSMISSIVITY CALCULATION (TRANSIENT)

Then a message appears in the lower left corner of the CRT

DIGITIZE FLOW TUBE ORIGIN

The program is now ready to accept directives from the digitizer, CRT keyboard or CRT light pen.

Directives

Task

DIGITIZER (Pressing
Button on Digi-
tizer Cursor)

This locates the origin of the flow tube.
At this time the message in the lower left
corner of the CRT changes to

ENTER TRANSMISSIVITY VALUE

The user is to enter the transmissivity
value at that point. This value is used
as the initial transmissivity value of
the flow tube. It is entered via the CRT
keyboard in scientific notation and ter-
minated with a RETURN ($\pm X.XXXXX\pm XX$).

During the flow tube calculation the
message in the lower left corner of the
CRT is not visible. When the computer
is ready to do another tube the message

DIGITIZE FLOW TUBE ORIGIN

will again appear.

CRT Keyboard

Ω

Remove all flow tube paths from display.

$\checkmark$

Change the direction of travel of the
flow tube up or down the gradient (the
initial direction is up the gradient).
This is a toggle switch.

+

Exit the flow tube program back to the
Iterative Monitor.

α

Abort the current calculation and return
to the point to accept the start of another
flow tube.

CURSOR HOME

Move the tracking cross to the lower-left
corner of the CRT display.

DirectivesTask

↑	Move the tracking cross vertically upward.
←	Move the tracking cross horizontally to the left.
→	Move the tracking cross horizontally to the right.
↓	Move the tracking cross vertically downward.
1	Set the step size of the tracking cross to 1 unit.
2	Set the step size of the tracking cross to 10 units.
3	Set the step size of the tracking cross to 100 units.
DELETE LINE	Set the center of the tracking cross to the end point from which to generate the reference line.
INSERT LINE	Draw reference line from the initial point to the center of the tracking cross.
ERASE DISPLAY	Remove the reference line from the CRT display.
]	Enter the line detect mode. This means that any flow tube that intersects the reference line will be terminated there and its transmissivity value and coordinate will be stored for generating the transmissivity distribution along the reference line.
[	Exit the line detect mode.
SOM V	Change the size of the tracking cross. This is a toggle switch which changes the size of the tracking cross from small to large and vice versa. The small cross is for drawing curves on the CRT, the large one is for locating points.

Directives

Task

J	Enter the draw mode. The curve entered into the computer by this key is defined by the curve drawn with the light pen and tracking cross. This curve is made up of segments of equal length in the horizontal direction.
ERASE LINE	Erase the last segment of the curve being entered.
-	Set up to draw the box defining the eligible modes for generation of the transmissivity. The first time this button is pressed a pair of hairlines appears on the CRT which can be transferred to any point with the tracking cross and light pen. Once the pair of lines has been located, the next pressing of the (-) switch locks that point as one of the corners of the box determining the region of eligible points. The box is now drawn by moving the tracking cross.
⊗	Set the box defining the region of eligible points for which the transmissivities are to be calculated.
TRACKING CROSS (Large)	Used to locate points on the CRT. These points can serve various purposes, depending on the keys pressed.
TRACKING CROSS (Small)	Draws curves made up of segments with a constant horizontal length which are entered into the computer.
<u>LIGHT PEN</u>	⊗ Indicates a light pen switch on the CRT display screen.
⊗ SET UP NEW LINE	Graph the data of transmissivities along the reference line for the first time.
⊗ DISPLAY CHART	Display the graph of transmissivity along the reference line after the graph has been formed.

Directives

Task

☒ CALCULATE T	Start calculating the transmissivities for the modes within the eligible region and the reference line. This stores them in a data matrix.
☒ FORM FUNCTION TABLE	The curve that has been entered by the tracking cross as the curve defining the actual transmissivity distribution along the reference line is stored for future retrieval.
☒ RETURN	Display the map of the system being analyzed.
REF LINE AT 32000 FT	A reference line longer than 32000 feet was drawn. This returns user to the start of the program, eliminating all previous actions.

Special Keys

CHAR ERASE	Deletes everything just entered by the display keyboard. Additional typing on the keyboard will be input as if nothing had been previously entered.
------------	---

Errors Detected by Transmissivity Calculation Program

INITIALIZE WITH ITERATIVE MONITOR	This functional block has not been initialized with the Iterative Monitor. This error returns the user to the Operating System Monitor.
FILE NOT FOUND	A required data matrix was not assigned by the Iterative Monitor. User is returned to the control of the Iterative Monitor.

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APPENDIX A

EXECUTIVE PROGRAM LISTING

LISTING
EXECUTIVE PROGRAM

```

.TITLE  PROGRAM TO INIT. AND CONTROL ITERATIVE SEQUENCE

/ 9-22-71
/ L E ADDISON

.DAT=135
.SCOM=100
.COMTB=.DAT+11

      .GLOBL  IWDAT.,P57.,WMSG.,UP57L.
      .GLOBL  IRDAT.,RCHR.,UP57C.,UP57B.
      .GLOBL  WDEC.,W6BIT.,P57.
      .GLOBL  RNUM.
      .GLOBL  MX.H,MX.V,MX.N,MX.O,MX.DS
      .GLOBL  MX.NH,MX.NV,MX.SH,MX.SV,MX.WC
      .GLOBL  MX.IFL,MX.OPT,MX.IWK,MX.RW
      .GLOBL  DKA.,DTD.

BEGIN  CAL+775 / .INIT -3
      1
      BEGIN
TEM1    0

      CLL
      LAW      -3          / DAT -3 = ITA.
      JMS*     IWDAT.      / INITIALIZE IOPS LIBRARY
      100000+LBUF        / LINE BUFFER
TEM2    0

      LAC      (200000 / ASSIGN DISC TO DAT+10
      XOR      DKA.
      DAC*     (.DAT+10
      .JNIT    10,0

      JMS*     WMSG.      / ITERATIVE CONTROL PROGRAM
      TITLE
      JMS      WCR

SNKE    .FSTAT  10,COMMON      / CHECK TO SEE IF OLD OR NEW
      SZA
      JMP      TWO           / OLD

ONE     .ENTER  10,COMMON
      .WRITE   10,2,BUFR,110
      .WAIT    10
      .CLOSE   10

ONE.    LAC      KONTRL+1
      DAC      NAME
      LAC      KONTRL+2
      DAC      NAME+1
      LAC      (041520
      DAC      NAME+2

      .FSTAT   10,NAME / CHECK ON THE PROGRAM UNIT
      SZA!CLA

```

```

LAC      (100000
TAD      (100000
XOR      DKA.
DAC*     (.DAT+7
.INIT    7,0,0          / AUTO ASSIGN PROGRAMS TO DAT+7

LAC      (041520          / CHECK ON DMP FILES
DAC      NAME+2
LAC      (KONTRL / TABLE OF PROGRAMS TO LOCATE
DAC*     (10
LAC      (DKNTRL-1
DAC*     (11
LAC      KONTRL
DAC      CNTR

LOOK1    LAC*      10
DAC      NAME
LAC*     10
DAC      NAME+1
ISZ*     (10

.FSTAT   7,NAME
DAC*     11

ISZ      CNTR
JMP      LOOK1

.FSTAT   10,COMMON          / GET DISC ADDRESS
DAC      COM2.+2          / SO SAVE
JMP      I.O

TWO      DAC      COM1.+2 / SAVE THE ADDRESS
DAC      COM2.+2

COM1.    .TRAN      10,0,7777,DKNTRL,112
.WAIT    10

I.O      JMS      WCR          / INPUT COMMAND FROM TELETYPE
JMS*     WMSG.
MSGBRK           / .ASCII /> /<175><177>

JMS      READ

LAC      (COMND-1          / ZERO OUT COMMAND BUFFER
DAC*     (10
DAC*     (11
LAW      -6
DAC      CNTR
DAC      TEN1
DZM*     11
ISZ      TEN1
JMP      .-2
DZM*     11

R6B      JMS*     RCHR.      / SEARCH FO FIRST LETTER
JMP      .+3          / NUMBER
JMP      .+2          / LETTER

```

```

        JMP      .-3      / PUNCT

        JMS*     UP57B.   / BACK UP POINTER

        LAM      -3       / TO MAKE 6-BIT CODES
        DAC      TEM1
        DZM      TEM2
        LAC      (ALSS+22
        DAC      R6B2

R6B1    LAM      -6
        TAD      R6B2
        DAC      R6B2    / UPDATE SHIFT

        JMS*     RCHR.    / GET THE INPUT CHAR
        TAD      (00      / DIGIT
        JMP      R6B2     / LETTER
        SAD      (015     / CR
        JMP      REDUN    / CR MEANS DONE WITH LINE

        SAD      (056     / (.)
        JMP      R6B2     / . PART OF NOME

R6B11   LAC      TEM2     / ANY OTHER PUNCT TERMINATES 3 CHR STRING
        DAC*     10
        ISZ      CNTR     / CAN HAVE 6 3 CHR STRINGS
        JMP      R6B
        JMP      DECOLD   / THAT'S ALL

R6B2    XCR      / SHIFTER
        XCR      TEM2
        DAC      TEM2
        ISZ      TEM1     / 3 CHR TO STRING
        JMP      R6B1
        JMP      R6B11

REDUN   LAC      TEM2     / TERM WITH CR
        DAC*     10

/ THE COMMAND DECODE AND DISPATCHER

DECOLD  LAC      COM1BL
        DAC*     (10
        LAC      COM1BL
        DAC      CNTR

        LAC      COMND
        SAD*     10
        JMP      .+5
        ISZ*     (10
        ISZ      CNTR
        JMP      .-5
        JMP      IO.ERR

        XCT*     10

/ TABLE OF COMMANDS FOR KONTRL

```

```

COMTBL      -24      / NUMBER OF COMMANDS

.SIXBT /A00/      / MAKE AN ASSIGNMENT
JMP      ASIGN
.SIXBT /ASG/
JMP      ASIGN
.SIXBT /D00/      / DELET OR REMOVE AN ASSIGNMENT
JMP      DELET
.SIXBT /DEL/
JMP      DELET
.SIXBT /C00/      / ENTER A COMMENT ON A MATRIX
JMP      COMENT
.SIXBT /COM/
JMP      COMENT
.SIXBT /L00/      / LIST THE ASSIGNMENTS
JMP      LIST
.SIXBT /LST/
JMP      LIST
.SIXBT /E00/      / EXECUTE A FUNCTION
JMP      EXCT
.SIXBT /EXQ/
JMP      EXCT
.SIXBT /I00/      / SET THE TIME VALUE
JMP      TYME
.SIXBT /TIM/
JMP      TYME
.SIXBT /I00/      / INIT THE DIGITIZER
JMP      IDIST
.SIXBT /INT/
JMP      IDIST
.SIXBT /G00/      / GENERATE A MATRIX
JMP      GENR
.SIXBT /GEN/
JMP      GENR
.SIXBT /AVE/      / TAKE THE AVERAGE
JMP      AVRQ
.SIXBT /DIF/      / TAKE THE DIFFERENCE
JMP      DIFFR
.SIXBT /FIL/      / FILL THE 0'S
JMP      PHIL
.SIXBT /SMU/      / SMOOTH THE DATA
JMP      SMUTH

```

/ TABLE OF REF TAGS

```

TAGS      .SIXBT /MAP/
          .SIXBT /PT1/
          .SIXBT /PT2/
          .SIXBT /PTA/
          .SIXBT /DPT/
          .SIXBT /TRN/
          .SIXBT /AQU/

```

/ TABLE OF PROGRAMS CALLED AND EXECUTED

```

KONTRL    -10      / NUMBER OF PROGRAMS

```

```

.SIXBT /KONTRL/
400000+ONE.
.SIXBT /STREAM/
DKSTRM
.SIXBT /FLOWSS/
DKFLOW
.SIXBT /FLOWTR/
DKFLTR
.SIXBT /TRAVTR/
DKTRVL
.SIXBT /TRAVPR/
DKTRVK
.SIXBT /INTERP/
DKINTR
.SIXBT /PERSPC/
DEPERS

```

```

/ ROUTINE TO ASSIGN A BIN FILE TO A TAG
/ INPUT IS FROM DISC OR DECTAPE
/ OUTPUT IS ON DISC 2

```

```

ASIGN   LAC      TAG      / THE TAG NAME
        JMS      TAGCAL   / CALCULATE POINTER FROM NAME
        LAC      DVICE    / DEVICE TO READ FROM CODE
        SNA
        JMP      IO.ERR
        LDD
        LSS+6!1000      / GET FIRST LETTER
        SAD      (004    / FIRST LETTER MUST BE A D FOR (DK? OR DT?)
        JMP
        JMP      IO.ERR / ERROR
        LSS+6!1000      / SECOND LETTER
        LDD      (024    / T FOR TAPE
        JMP      TYPE
        JHD      (015    / K FOR DISC
        JMP      DISC
        JMP      IO.ERR / ERROR

TAPE    LAC      DID.     / READ FROM DECTAPE
        JMP      .+2
DISC    LAC      DHA.     / READ FROM DISC
        DHC      CODE#

        LSS+6          / GET UNIT NUMBER
        BND      (7
        LSS+17!10000
        FOR      CODE
        SUC*      (.DAT+4 / WORK ON DAT+4
        LUNIT     +.0+0

        LAC      NAME+2   / CHECK TO SEE IF EXT
        SZA
        JMP      .+4
        LAC      NAME+1   / THE EXT WAS IN LAST 3 CHAR OF NAME
        DHC      NAME+2
        DZN      NAME+1

```

```

        .FSTAT  4,NAME
SNA
JMP      ST.ERR  / NOT FOUND

LAC      DEVICE
SAD      (041362 / DK2 , SO ALREADY THERE
JMP      TERM

        .SEEK   4,NAME
        .ENTER  10,NAME

RED1     .READ   4,0,BUFR,64
        .WAIT   4

LAC      BUFR
AND      (17
SAD      (6
JMP      RED2
SAD      (5
JMP      RED2

        .WRITE  10,0,BUFR,64
        .WAIT   10

JMP      RED1

RED2     .CLOSE  4
        .CLOSE  10

TERM     LAC      TAGPTR  / SAVE NAME
        TAD      (-1
        DAC*     (10
        LAC      NAME
        DAC*     10
        LAC      NAME+1
        DAC*     10
        LAC      NAME+2
        DAC*     10

        JMP      I.O

/ ROUTINE TO DELETE A FILE FROM A TAG

DELET    LAC      TAG      / TAG NAME
        JMS      TAGCAL  / CALCULATE TAG NAME
        TAD      (-1
        DAC*     (10
        DZM*     10
        DZM*     10
        DZM*     10

        JMP      I.O

/ ROUTINE TO MAKE COMMENTS ON DATA MATRIX

COMENT   LAC      TAG      / CHECK SO DON'T WRITE ON BOUNDARY MAP
        SAD      TAGS

```



```

      JMP      IO.ERR    / BOUNDARY MAP

      JMS      TAGCAL    / CALCULATE TAG POINTER
      LAD      C-1
      DAC*     C10
      LAC*     10        / GET MATRIX NAME FROM TAG
      SNA
      JMP      IO.ERR    / NO MATRIX ASSIGNED
      DAC      NAME
      LAC*     10
      DAC      NAME+1
      LAC*     10
      DAC      NAME+2

      JFSTAT    10,NAME  / GET ID WORDS
      DAC      TG2+2
      DAC      TG22+2

TG2    .TRAN    10,0,7777,BUFR,112
      .WAIT    10

NEWTG   JMS*     WMSG.    / WANT TO ENTER LABLES
      MSG8

      .READ    -3,2,BUFR+17,60
      .WAIT    -3

TG22    .TRAN    10,1,7777,BUFR,112
      .WAIT    10

      JMP      I.O

```

/ ROUTINE TO LIST THE TAG ASSIGNMENTS

```

LIST    JMS      WCR
      JMS      WCR
      JMS      WCR
      JMS      WCR
      JMS      WCR
      JMS      WCR

      LAC      MSGTBL
      DAC*     C10
      LAC      MSGTBL
      DAC      CNTR
      LAC      CPROJ-1
      DAC*     C11
      LAM      -1
      DAC      COMND

LS      JMS      WCR
      LAC*     10
      DAC      162

      JMS*     WMSG.
      0

```

```

LAC*      11
SNA
JMP      LE.
DAC      NAME
JMS*     W@BIT.
LAC*      11
DAC      NAME+1
JMS*     W@BIT.
LAC      (040
JMS*     P57.
LAC*      11
DAC      NAME+2
JMS*     W@BIT.
JMS      WCR

ISZ      COMND
SKP
JMP      LE.

.LSTAT    10,NAME / GET ID WORDS
DAC      TG1+2

TC1      .TRAN    10,0,777,BUFR,112
        .WAIT     10

LAC      BUFR+17 / CHECK TO SEE IF LABELS
SNA
JMP      LE      / NO LABELS

OLDTG    JMS*     WMSG.
        MSC9

.WRITE   -2,2,BUFR+17,60
.WAIT    -2

LE.      JMP      LE
        JMS      WCR
LAC*     11
LAC*     11
LE       ISZ     CNTR
        JMP      LS

        JMS      WCR
        JMS*     WMSG.
MSGTIM
LAC      TIME
JMS*     WDEC.

        JMS      WCR
        JMS      WCR
        JMS      WCR
        JMS      WCR
        JMS      WCR
        JMS      WCR

        JMP      I.O

```

/ TABLE OF MESSAGES FOR TESTING

MSGTBL 17

MSG10
MSG11
MSG12
MSG13
MSG14
MSG15
MSG16

/ NOW TO EXECUTE A PROGRAM

EXCT	LAC	(KONTRL	/ TABLE OF COMMANDS
	DAC	SRCHR#	
	ISZ	SRCHR	
	LAC	KONTRL	
	DAC	CNTR	/ NUMBER OF ENTRIES IN TABLE
S1	LAC*	SRCHR	/ FIRST WORD OF COMMAND (IN TABLE)
	SAD	TAG	/ FIRST WORD OF COMMAND (ENTERED)
	JMP	S2	/ FIRST PART MATCHES
	LAC	(3	
S1P1	TAD	SRCHR	/ INDEX TO NEXT COMMAND
	DAC	SRCHR	
	ISZ	CNTR	/ MORE COMMANDS
	JMP	S1	/ YEP
	JMP	10.ERR	/ NOPE
S2	ISZ	SRCHR	/ CHECK ON SECOND WORD
	LAC*	SRCHR	
	SAD	DEVICE	
	JMP	.+3	/ MADE A MATCH
	LAC	(2	
	JMP	S1P1	
	ISZ	SRCHR	/ INDEX TO JUMP
	LAC*	SRCHR	/ ADDRESS OF PROGRAM
GOTO	SPA		
	JMP	SPECIAL	
	DAC	QADR#	
COM2.	.TRAN	10, 1, 7777, DKONTRL, 112	/ SAVE THE COMMON
	.WAIT	10	
	.DKCA=37740		
	.DKAD=37742		
	.DKWC=37741		
	.DKRWS=37743		
	.DKBEG=37731		
	DZM*	(.DKCA	
	LAC*	QADR	
	SNA		

```

JMP      IO.ERR
DAC*     (.DKAD
LAC      (-37720
DAC*     (.DKWC
DZM*     (.DKRWS
JMP*     (.DKBEG

```

```

SPECIAL  DAC      QADR      / SPECIAL CONTRL
JMP*     QADR

```

/ ROUTINE TO INPUT TIME VALUE T2-T1 IN DAYS

```

TYME     LAC      (COMND     / LOCATION OF DATA INPUT
DAC*     (10
DZM      TIME      / CLEAR TIME

```

```

TYME1    LAC      -3         / 3 DIGITS TO WORD
DAC      CNTR
LAC*     10

```

```

TYME2    LMO

```

```

LLS+6:1000      / GET THE ASCII 6-BIT CHR CODE FOR DIGIT

```

```

SNA
JMP      1.0      / FIRST 0 MEANS DONE
IAD      (-60

```

```

SPA
JMP      IO.ERR   / LESS THAN 60
DAC      TEM1
IAD      (-12

```

```

SMA
THP      IO.ERR   / GREATER THAN 72

```

```

LACQ
IAC      TEM2
LAC      TIME
MUL:20000
12

```

```

LACQ
IAD      TEM1
DAC      TIME

```

```

LAC      TEM2
ISZ      CNTR
JMP      TYME2
JMP      TYME1

```

/ ROUTINE TO INIT THE DIGITIZER

```

IDIST    DZM      FLAG#     / CLEAR BUSY SWITCH
DZCB     / CLEAR (X,Y) BUFFERS
CAL+65   / .SETUP DIGITIZER
16
0
SRVC
DBK

```

```

JMS*     WMSG.      / TO TELL THE GUY TO INIT THE TABLE

```

```

MSG3
JMS      WCR

JMS      DZRD.  / ZERO THE TABLE
DZCB

JMS*     WMSG.  / TO TELL THE GUY TO SET MAXIMUM X
MSG4
JMS      WCR

JMS      DZRD.
LAC      DZ.X
DAC      MAXX

JMP      I.0

/ READ DIGITIZER
DZRD.    0
CLC
DAC      FLAG    / SET INPUT REQUEST
LAC      FLAG    / CHECK ON DONE
SZA
JMP      .-2
JMP*     DZRD.

/ INTERRUPT SERVICE ROUTINE
SRVC     0
DAC      AC      / SAVE AC
LACQ
DAC      MQ      / SAVE MQ
LACS
CMA
TAD      (EAE+501
DAC      SC      / SAVE SC
DZDF     / (X,Y) CURSOR FLAG. ?
SKF      / NO
JMP      .+3     / YEP
DZKF     / KEYBOARD FLAG
JMP      XIT     / NOPE SO IGNORE
LAC      FLAG    / INPUT DATA REQUEST
SNA
JMP      XIT     / NO REQUEST MADE
DZRX     / READ X
JMS      CONVT   / CONVERT TO SIGN BITS
DZRX-10  / READ X WITHOUT CLA
DAC      DZ.X    / STORE X POSITION
DZRY     / READ Y
JMS      CONVT
DZRY-10
DAC      DZ.Y    / STORE Y POSITION
DZCF     / CLEAR (X,Y) FLAG
DZCKF    / CLEAR KEYBOARD FLAG
DZM      FLAG    / CLEAR INPUT REQUEST FLAG

```

```

XIT      LAC      MQ
        LMQ      / RESTORE MQ
        LAC      .
SC       XX      / RESTORE STEP COUNT
        LAC      AC      / RESTORE AC
        DBR      / RESTORE API,L,EM,MP
        JMP*     SRVC     / RESTORE PC

```

/ THE VARIABLES

```

AC      0
MQ      0
DZ.X    0
DZ.Y    0

```

/ CONVERT X OR Y TO SIGN (X OR Y)

```

CONVT    0
        AND      (30000
        SAD      (30000 / 30000 IF SIGN IS NEG
        SKP
        CLA!SKP
        LAC      (740000
        JMP*     CONV

```

/ GENERATE A NEW BLANK MATRIX

```

GFNR     LAC      TAG      / TAG NAME
        TMS      TAGCAL   / CALCULATE TAG POINTER
        JMS*     WMSG.
        MSG3M
        TMS      RDEC      / READ HORIZONTAL DIMENSION
        DAC*     MX.H
        JMS*     WMSG.
        MSG4M
        JMS      RDEC      / READ VERT. DIMENSION OF MATRIX
        DAC*     MX.V
        JMS*     WMSG.
        MSG5M
        JMS      RDEC      / READ SECTORS PER SECTION
        DAC*     MX.N
        JMS*     WMSG.
        MSG6M
        JMS      RDEC      / READ OVERLAP
        DAC*     MX.O
        JMS      WCR
        JMS*     MX.OPT   / OPTIMIZE MATRIX CONFIGURATION
        LAC      NAME+1   / SET NAME IN PROPER LOCATION
        SZA
        JMP      .+3      / THERE IS AN EXT
        LAC      NAME     / NO EXT SO USE LAST 3 CHAR OF NAME
        DZM      NAME
        DAC      NAME+2   / EXT SET
        LAC      NAME
        DAC      NAME+1
        LAC      COMND+2
        DAC      NAME

```



```

        LAC      (2
        JMS*     MX,IFL
        NAME.

        JMP      TERM      / NOW MAKE ASSIGNMENT

/ FORM AVERAGE OF 2 MATRICES

AVRG      LAC      (JMS AVG)      / SET POINTER TO AVERAGE ROUTINE
        DAC      FUNCT

        LAC      (POTAVE
        JMS      MXINIT / INIT THE AVERAGE POTENTIAL MAP
        DAC      DKBUFF3 / SET TO OUTPUT BUFFER
        JMP      TM,AD      / DO THE THING

AVG      0      / THE ACTUAL AVERAGE FORMING ROUTINE

        CLL
        LAC*     10
        TAD*     11
        LMQ
        SZL!CLA!CLL
        LAC      (1
        LRS+1
        LACQ
        DAC*     12

        JMP*     AVG

/ ROUTINE TO FORM THE DIFFERENCE OF 2 MATRICES

DIFFER    LAC      (JMS DIF)      / SET POINTER TO DIFFERNECE ROUTINE
        DAC      FUNCT

        LAC      (DPOT
        JMS      MXINIT / INIT THE DIFFERENCE MAP
        DAC      DKBUFF3
        JMP      TM,AD      / DO THE THING

DIF      0      / THE ACTUAL DIFFERENCE THING

        LAC*     10      / BUF1
        JMS      TWO.S / 2'S COMPLIMENT
        TAD*     11      / BUF2
        DAC*     12

        JMP*     DIF

TM,AD     LAC      (POT1 / TAG POINTER FOR POTENTIAL TIME 1
        JMS      MXINIT / INIT TIME PLANE 1
        DAC      DKBUFF1 / IT IS BUF2-BUF1

        LAC      (POT2 / TAG POINTER FOR POTNETIAL TIME 2
        JMS      MXINIT / INIT TIME PLANE 2
        DAC      DKBUFF2

```

```

JMS      BUFCAL / SET UP BUFFER LOCATIONS

/ ROUTINE TO DO THE MASS MATRIX MANIPULATIONS

      LAC*    MX.NV / NUMBER OF VERTICAL DATA SECTIONS
JMS      TWO.S / 2'S COMPLIMENT
DAC      CNTR*Y
DZM      NY# / VERTICAL DATA SECTION POINTER

MAT1     LAC*    MX.NH / NUMBER OF HORIZONTAL DATA SECTIONS
JMS      TWO.S
DAC      CNTR*X
DZM      NX# / HORIZONTAL DATA SECTION POINTER

MAT2     LAC      NX
JMS      SECTNX
JMS      MX.IN / READ DATA SECTIONS

      LAC      BUF1 / ADDRESS FO BUFFER 1
TAD      (-1
DAC*     (10
LAC      BUF2 / ADDRESS FOR BUFFER 2
TAD      (-1
DAC*     (11
LAC      BUF3 / ADDRESS FOR BUFFER 3
TAD      (-1
DAC*     (12

      LAC*    MX.WC / MINUS WORD COUNTER OFR DATA SECTION
DAC      CNTR#

FUNCT    XX / DISPATCHER TO SPECIFICI FUNCTION

      ISZ     CNTR
JMP      FUNCT / MORE WORDS
JMS      MX.OUT / NOPE SO WRITE THEM

      ISZ     NX / INDEX HORZ. DATA SECTION
ISZ      CNTRX / MORE HORZ. DATA SECTIONS
JMP      MAT2 / YEP

      ISZ     NY / INDEX VERT. DATA SECTION
ISZ      CNTRY / MORE VERT. DATA SECTIONS
JMP      MAT1 / YEP

      JMP     1.0 / ALL DONE WITH THIS

/ ROUTINE TO FILL THE ZERO'S IN A MATRIX
/
/
/      P1      P4      P2
/      P0
/      P3
/
/ ONLY IF P0=0 ; THEN
/      P0 = SUMMATION P(I) / N
/      P(I)= NON-ZERO ELEMENTS
/      N = NUMBER OF NON-ZERO ELEMENTS

```

PHIL LAC (JMS FILL) / SET FUNCTION POINTER TO THIS THING
 DAC FUNCT.

 JMP TN.SD / DO IT

FILL 0 / THE ACTUAL FILLER

 LAC* 10

 SNA

 JMP .+3 / ZERO SO FILL IN

 LAC* 12 / SO DON'T MESS UP POINTER

 JMP* FILL

 LAC* (10

 TAD (-1

 DAC* (10

 JMS SMOTH

 JMP* FILL

/ ROUTINE TO SMOOTH A DATA MATRIX

/

/ P4
 / P1 P0 P2
 / P3
 /

/ AVERAGE THE NON-ZERO ELEMENTS

/ P0 = SUMMATION P(I) / N : I=0,1,2,3,4

/ P(I) = NON-ZERO ELEMENTS

/ N = NUMBER OF NON-ZERO ELEMENTS N=0,1,2,3,4,5

SMUTH LAC (JMS SMOTH) / SET FUNCTION POINTER
 DAC FUNCT.

 JMP TN.SD / DO THE THING

SMOTH 0 / THE ACTUAL SMOOTHING THING

 DZM ZCNTR / ZERO THE NON-ZERO COUNTER
 DZM TEM1

 LAC* 10

 SZA

 ISZ ZCNTR / NON-0

 DHC TEM2 / LOW ORDER ; P0

 LAC* (10

 DAC PP1 / P0

 TAD* MX.SH

 DAC PP2

 LAC* PP2 / P4

 JMS .ADD

 LAC PP1

 TAD INXDJ* / -MX.SH

	DAC	PP2	
	LAC*	PP2	/ P3
	JMS	.ADD	
	LAC	PP1	
	TAD	(-1	
	DAC	PP2	
	LAC*	PP2	/ P1
	JMS	.ADD	
	ISZ	PP1	
	LAC*	PP1	
	JMS	.ADD	/ P2
	LAC	ZCNTR	
	SNA		
	TAP	SMUE	
	LAC	TEM2	
	ENO		
	LAC	TEM1	
ZCNTR	DIV120000		
	0		
SMUE	LACQ		
	DAC*	12	
	JMP*	SMOTH	
.ADD	0		/ THE DOUBLE PRECISION ADD
	SNA		
	TMP*	.ADD	
	CLL		
	TAD	TEM2	
	DAC	TEM2	
	ISZ	ZCNTR	
	ISZ		
	ISZ	TEM1	
	JMP*	.ADD	
TM.SD	LAC*	MX.SH	/ THE ACTUAL DOER
	DAC	INDEX*	/ MX.SH
	JMS	TWO.S	
	DAC	INDEX	/ -MX.SH
	LAC	TAG	/ POINTER TO TAG
	TNS	TAGCAL	
	TNS	MXINIT	/ INIT THE ONE TO BE WORKED OVER
	DAC	DBUF1	/ DISC ADDRESS FOR BUFFER 1
	DAC	DBUF2	/ DISC ADDRESS FOR BUFFER 2
	DAC	DBUF3	/ DISC ADDRESS FOR BUFFER 3
	DAC	DBUF	/ DISC BUFFER FOR SINGLE SECTION READER
	TNS	BUFCAL	/ CALCULATE BUFFER ADDRESS
	LAC	BUF1	/ CORE LOCATION FOR FIRST BUFFER
	DAC	BUF	/ SET FOR SINGLE SECTION READER
	LAC	BUF3	

```

DAC      BUF2      / SET BUF2=BUF3; READ BUF2 = WRITE BUF

/ ROUTINE TO DO THE MASS MATRIX MANIPULATIONS

      LAC*      MX,NV      / NUMBER OF VERTICAL DATA SECTIONS
      JMS      TWO,S      / 2'S COMPLEMENT
      DAC      CNTRY
      DCM      NY      / VERTICAL DATA SECTION POINTER

MAT1.    LAC*      MX,NH      / NUMBER OF HORIZONTAL DATA SECTIONS
      JMS      TWO,S
      DAC      CNTRY
      DEN      NY      / HORIZONTAL DATA SECTION POINTER

MAT2.    LAC      NX
      JMS      SECTNX
      TAD      NK,IN      / READ DATA SECTIONS

      LAC      BUF1      / ADDRESS FOR BUFFER 1
      TAD      INDEX      / MX,SH
      DAC*      010
      LAC      BUF3      / ADDRESS FOR BUFFER 3
      TAD      INDEX
      DAC*      012

      LAC*      MX,SV      / VERT NODES
      TAD      0-2      / FOR OUTSIDE NODES
      JMS      TWO,S
      DAC      CNTLY*

MAT3.    LAC*      MX,SH
      TAD      0-2
      JMS      TWO,S
      DAC      CNT,X#

FUNCT.   XX      / DISPATCHER TO SPECIFIC FUNCTION

      ISZ      CNTLY      / MORE INTERNAL X NODES
      JMP      FUNCT.      / YEP
      LAC*      10      / NOPE
      LAC*      10
      LAC+     12
      LAC*     12

      ISZ      CNTLY      / MORE INTERNAL Y NODES
      JMP      MAT3.      / YEP

      JMS      MX,OUT      / NOPE SO WRITE THEM

      ISZ      NX      / INDEX HORZ. DATA SECTION
      ISZ      CNTRY      / MORE HORZ. DATA SECTIONS
      JMP      MAT2.      / YEP

      ISZ      NY      / INDEX VERT. DATA SECTION
      ISZ      CNTRY      / MORE VERT. DATA SECTIONS
      JMP      MAT1.      / YEP

```

FOLD	LAC*	MX.NV	/ NOW DO THE OVERLAP THINGS
	JMS	TWO.S	
	DAC	CNTRY	
	DEM	NY	/ VERTICAL DATA SECTION POINTER
FLD1	LAC*	MX.NH	
	JMS	TWO.S	
	DAC	CNTRX	
	DEM	NX	/ HORIZONTAL DATA SECTION POINTER
FLD2	LAC	NX	
	JMS	SECTNX	
	JMS	MX.IN	
	LAC	SECTN	
	DAC	SECTN*M	/ SAVE SECTION POINTER BEING MODIFIED
KASE1	LAC	NX	/ CASE 1 LEFT SIDE BOUNDARY
	SNA	.	
	JMP	KASE2	/ 0 : THERE IS NO LEFT SIDE DATA SECTION
	TAD	(-1	
	JMS	SECTNX	
	JMS	MXREAD	/ READ SECTION TO THE LEFT HORZ
	LAC*	MX.SV	
	JMS	TWO.S	
	DAC	CNTR	/ - NUMBER VERT NODES / SECTION
	LAC*	MX.O	
	JMS	TWO.S	
	TAD*	MX.SH	
	TAD	BUF1	
	DAC	PP1	/ LEFT NODE OF RIGHT SIDE OVERLAP
	LAC	BUF3	
	DAC	PP2	/ LEFT BOUNDARY OF SECTION BEING MOD
KAS1I	LAC*	PP1	
	DAC*	PP2	
	LAC	PP1	
	TAD	INDEX	
	DAC	PP1	/ TO INCREMENT VERT ADD MX.SH
	LAC	PP2	
	TAD	INDEX	
	DAC	PP2	
	ISZ	CNTR	
	JMP	KAS1I	
KASE2	LAC	NX	/ CASE 2 RIGHT SIDE BOUNDARY
	TAD	(1	
	SAD*	MX.NH	/ HORZ SECTION POINTER = MAX HORZ SECTION
	JMP	KASE3	/ YEP SO NO RIGHT SIDE BOUNDARY
	JMS	SECTNX	
	JMS	MXREAD	/ READ SECTION TO RIGHT HORZ

```

LAC*    MX.SV
JMS     TWO.S
DAC     CNTR      / - NUMBER OF VERT NODES / SECTION

LAC     BUF1
TAD*    MX.O
TAD     (-1
DAC     PP1      / RIGHT NODE OF LEFT SIDE OVERLAP
LAC     BUF3
TAD     INDEX
TAD     (-1
DAC     PP2      / RIGHT BOUNDARY OF SECTION BEING MOD

KAS2I   LAC*     PP1
        DAC*     PP2

LAC     PP1
TAD     INDEX    / TO INCREMENT VERT ADD MX.SH
DAC     PP1
LAC     PP2
TAD     INDEX
DAC     PP2

ISZ     CNTR
JMP     KAS2I

KASE3   LAC     NY      / CASE 3 UNDER SIDE BOUNDARY
        SNA
        JMP     KASE4   / 0 SO NO UNDERSIDE BOUNDARY

TAD     (-1
JMS     SECTNY
JMS     MXRLOD    / READ UNDERSIDE DATA SECTION

LAC*    .. MX.SH
JMS     TWO.S
DAC     CNTR      / - NUMBER HORZ NODES / SECTION

LAC*    MX.O
JMS     TWO.S
TAD*    MX.SV
DAC     .+3
LAC*    MX.SH
MUL     20000
0
LACQ
TAD     BUF1
TAD     (-1
DAC*    (10      / LOWER SIDE UPPER OVERLAP

LAC     BUF3
TAD     (-1
DAC*    (11      / LOWER SIDE SECTION BEING MOD

KAS3I   LAC*     10
        DAC*     11

```

	ISZ	CNTR	
	JMP	KAS3I	
KASE4	LAC	NY	/ CASE 4 UPPER SIDE BOUNDARY
	TAD	(1	
	SAD*	MX.NV	/ VERT SECTION POINTER = MAX VERT SECTION
	JMP	KASDUN	/ YEP SO NO UPPER BOUNDARY
	JMS	SECTNY	
	JMS	MXREAD	/ READ UPPER DATA SECTION
	LAC*	MX.SH	
	JMS	TWO.S	
	DAC	CNTR	/ - NUMBER HORZ NODES / SECTION
	LAC*	MX.O	
	TAD	(-1	
	DAC	.+3	
	LAC*	MX.SH	
	MUL!	20000	
		0	
	LACQ		
	TAD	BUF1	
	TAD	(-1	
	DAC*	(10	/ UPPER SIDE LOWER OVERLAP
	LAC*	MX.SH	
	DAC	.+4	
	LAC*	MX.SV	
	TAD	(-1	
	MUL!	20000	
		0	
	LACQ		
	TAD	BUF3	
	TAD	(-1	
	DAC*	(11	/ UPPER BOUNDARY BEING FILLED
KAS4I	LAC*	10	
	DAC*	11	
	ISZ	CNTR	
	JMP	KAS4I	
KASDUN	LAC	SECTNM	
	DAC	SECTN	
	JMS	MX.OUT	
	ISZ	NX	
	ISZ	CNTRX	
	JMP	FLD2	
	ISZ	NY	
	ISZ	CNTRY	
	JMP	FLD1	
	JMP	I.O	

/ ERRORS

```

IO.ERR  JMS*    WMSG.  / ERROR ON INPUT OF COMMAND
        ERR1
        TMP     I.O

ST.ERR  JMS*    WMSG.  / FILE NOT FOUND
        ERR2
        JMP     I.O

DSKERR  JMS*    WMSG.  / DISC ERROR
        ERR5
        JMP     I.O

```

/ ROUTINE TO CALCULATE THE TAG POINTER FROM TAG NAME

```

TAGCAL  0      / 0 MEANS NO TAG GIVEN
        CNA
        JMP     IO.ERR
        DAC     TEM1
        LAC     (TAGS-1 / TABLE OF TAGS
        DAC*    (10
        LAC     (-7
        DAC     CNTR / 7 TAGS
        DZM     TAGPTR#

        LAC     TEM1
        SAD*    10
        JMP     .+5
        ISZ     TAGPTR
        ISZ     CNTR / CHECK IF ANYMORE TAGS LEFT
        JMP     .-4
        JMP     IO.ERR / NOT VALID TAG
        LAC     TAGPTR / FOUND TAG SO CALCULATE TAG POINTER
        MUL!20000
        3
        LAC0
        TAD     (PROJ / TABPE OF DIRECTORY NAMES
        DAC     TAGPTR
        JMP*    TAGCAL

```

/ ROUTINE TO INPUT DATA MATRICES (2 OF THEM)

```

MX.IN   0

        LAC     SECTN
        CLL
        JMS*    MX.RW
        JMP     DSKERR

DKBUF1  0
BUF1    0
PP1     0
PP2     0

        LAC     SECTN
        CLL

```

```

JMS*    MX.RW
JMP      DSKERR
DKBUF2  0
BUF2    0
        0
        0

```

```

JMP*    MX.IN

```

```

/ INPUT DATA MATRIX (SHORTENED TO 1)

```

```

MXREAD  0
        CLL
JMS*    MX.RW
JMP      DSKERR
DKBUF   0
BUF     0
        0
        0

```

```

JMP*    MXREAD

```

```

/ ROUTINE TO WRITE DATA MATRIX ( 1 OF THEM )

```

```

MX.OUT  0

        LAC      SECTN
        STL
JMS*    MX.RW
JMP      DSKERR
DKBUF3  0
BUF3    0
        0
        0

```

```

JMP*    MX.OUT

```

```

/ FORM DATA SECTION WORD
/ SECTNX MEANS AC CONTAINS X SECTION ADDRESS
/ SECTNY MEANS AC CONTAINS Y SECTION ADDRESS

```

```

SECTNX  0
        LLS+11:10000
        XOR      NY
        DAC      SECTN#
        JMP*     SECTNX

```

```

SECTNY  0
        LRS+11:1000
        LAC      NX
        LLS+11
        DAC      SECTN
        JMP*     SECTNY

```

```

/ ROUTINE TO CALCULATE THE ADDRESS OF THE 3 BUFFERS

```

```

BUFCAL  0

```

```

DAC*      C1SCOM+3
TAD*      MX.WC      / - MINUS WORD COUNT PER SECTION
DAC       BUF1
TAD       C-1
TAD*      MX.WC
DAC       BUF2
TAD       C-1
TAD*      MX.WC
DAC       BUF3
JMP*      BUFCAL

```

/ ROUTINE TO CALCULATE 2'S COMPLIMENT

```

TWO.S     0
CMA
TAD       C1
JMP*      TWO.S

```

/ ROUTINE TO INIT THE FILES AND FIND DISC ADDRESS

```

MXINIT    0
DAC       .+3
LAC       C2
JMS*      MX.IWK
0
JMP       ST.ERR
JMP*      MXINIT

```

/ ROUTINE TO READ DECIMAL

```

RDEC      0
JMS       READ
JMS*      RNUM.
12
JMP*      RDEC

```

/ ROUTINE TO READ TELETYPE

```

READ      0
          READ -2,2,LBUF,32
          WAIT -2

          CLL
          LAW -2
          JMS* IRDAT.
          LBUF
          0
          JMP*  READ

```

/ WRITE CARRIAGE RETURN

```

WCR       0
          LAW 015
          JMS* P57.
          JMP* WCR

```

/ BUFFERS

```

BUFR      .BLOCK   160
LBUF      .BLOCK   100
COMMON    .SIXBT /COMMONBIN/

```

```

COMND     0          / COMMAND WORD
TAG       0          / TAG WORD
DEVICE    0          / DEVICE
NAME      .BLOCK   3          / FILE NAME AND EXT

```

```

/ THIS IS THE BUFFER THAT IS COMMON TO ALL PROGRAMS IN THE ITERATIVE
/ SEQUENCE

```

```

/ IT IS ONE DISC SECTOR LONG (112 WORDS)

```

```

/ IT IS DIVIDED INTO 3 SECTIONS

```

```

/      1. DISC ADDRESS OF THE PROGRAMS

```

```

/      2. MAPS

```

```

/      3. COMMON DATA

```

```

DKNTPL 0          / DISC ADDRESS OF MONITOR

```

```

DKSTPL 0          / DISC ADDRESS OF STREAM-LINE

```

```

DKFLOW 0          / DISC ADDRESS OF FLOW-TUBE (STEADY-STATE)

```

```

DKFLTR 0          / DISC ADDRESS OF FLOW-TUBE (TRANSIENT)

```

```

DKTRVL 0          / DISC ADDRESS OF TRAVEL-TIME (TRANSMISICIVITY)

```

```

DKTRVL 0          / DISC ADDRESS OF TRAVEL TIME (CONSTANT PERMIABILITY)

```

```

DKINTR 0          / DISC ADDRESS OF INTERP

```

```

DKPERS 0          / DISC ADDRESS OF PERSPECTIVE PROGRAM

```

```

        .BLOCK   14          / 20 DECIMAL PROGRAM SLOTS

```

```

PROJ     .BLOCK   3          / PROJECT BOUNDARY MAP

```

```

POT1     .BLOCK   3          / POTENTIAL MAP (TIME 1)

```

```

POT2     .BLOCK   3          / POTENTIAL MAP (TIME 2)

```

```

POTAVE   .BLOCK   3          / POTENTIAL MAP (POT1+POT2)/2

```

```

DPOT     .BLOCK   3          / POTENTIAL DIFFERENCE MAP (POT2-POT1)

```

```

TRN      .BLOCK   3          / TRANSMISICIVITY MAP

```

```

AQU      .BLOCK   3          / BOTTOM AQUIFER MAP

```

```

        .BLOCK   47          / 20 DECIMAL MAP SLOTS TOTAL

```

```

MAXX     0          / MAXIMUM HORIZONTAL VALUE ON MAP DIGITIZER

```

```

TIME     0          / TIME T2-T1 (DAYS) (INTEGER)

```

```

        .BLOCK   36          / 32 DECIMAL WORDS TOTAL

```

```

/ MESSAGES

```

```

TITLE    .ASCII /ITERATIVE CONTROL PROGRAM/<015><177>

```

```

MSG3     .ASCII /  DIGITIZE (0,0) POINT/<015><177>

```

```

MSG4     .ASCII /  DIGITIZE MAXIMUM X VALUE/<015><177>

```

```

MSG8     .ASCII /  COMMENTS      /<175><177>

```

```

MSG9     .ASCII /  ** /<175><177>

```

```

MSGTIM   .ASCII /TIME BETWEEN T2-T1 (DAYS)/<011><175><177>

```

```

MSG3M    .ASCII /  HORIZONTAL DIMENSION /<175><177>

```

```

MSG4M    .ASCII /  VERTICAL DIMENSION /<175><177>

```

```

MSG5M    .ASCII /  SECTORS PER SECTION /<175><177>

```

```

MSG6M  .ASCII / OVERLAP /<175><177>
MSGBRK .ASCII /> /<175><177>
ERR1   .ASCII /?/?<015><177>
ERR2   .ASCII /FILE NOT FOUND/<015><177>
ERR5   .ASCII /DISC ERROR/<015><177>
MSG10  .ASCII /(MAP) PROJECT BOUNDARY MAP/<011><175><177>
MSG11  .ASCII /(PT1) POTENTIAL MAP TIME 1/<011><175><177>
MSG12  .ASCII /(PT2) POTENTIAL MAP TIME 2/<011><175><177>
MSG13  .ASCII /(PTA) POTENTIAL MAP (P(T2)+P(T1))/2/<011><175><177>
MSG14  .ASCII /(DPT) TIME DIFFERENCE POTENTIAL (P(T2)-P(T1))/<011><175><177>
MSG15  .ASCII /(TRN) TRANSMISSIVITY MAP/<011><175><177>
MSG16  .ASCII /(AQU) AQUIFIER MAP/<011><175><177>
      .END

```

APPENDIX B

STREAMLINE PROGRAM LISTING

LISTING

STREAMLINE PROGRAM

```

      .TITLE  STREAMLINE SET-UP

/ 7-1-72
/ D R FRIEDRICHS
/ L E ADDISON

/ OPEN MATRIX FILE AND INITIALIZE FOR
/ STREAMLINE GENERATION AND DISPLAY

SET=ISZ
.DAT=135
.SCOM=100
.COMTB=.DAT+11

ESAJ=200000

      .GLOBL  MX.IWK,FPSL.,MX.RW,MX.AD2
      .GLOBL  MX.DS,MX.NH,MX.NS,MX.NV,MX.SH,MX.SV,MX.WC
      .GLOBL  MX.H,MX.V,MX.N,MX.O
      .GLOBL  IWDAT.,P57.,WMSG.,UP57.,UP57C.,UP57L.,UP57B.
      .GLOBL  RCHR.,RNUM.
      .GLOBL  DZIN.,DZRD.,DZWTR.
      .GLOBL  CMP.
      .GLOBL  DSIN.,DSRD.,DSWT.
      .GLOBL  DKD.,LODR.

/ THESE ARE THE FORTRAN SUBROUTINES USED
      .GLOBL  .AG,.AH,.AI,.AJ,.AK,.AL,.AM,.AN
      .GLOBL  .DA,FLOAT,IFIX,GRADSS

BEGIN  CAL+775 / .INIT -3
      1
      BEGIN
TEM1    0

      CLL
      LAD      -3      / DAT -3 = ITA.
      JPS*     IWDAT.  / INITIALIZE IOPS LIBRARY
      100000+LBUF / LINE BUFFER
TEM2    0

      LAC      DZIN.   / SET DIGITIZER SO DOESN'T CLEAR
      TAB      (2
      DAC      FRC
      LAC      (NOP
      DAC*     FRC

      LAC      DKD.    / AUTO SET 10
      KOR      (200000
      DAC*     (.DAT+10
      .INIT    10,0,0

      .FSTAT   10,COMMON      / COMMUNICATION DATA
      SNA
      JMP      ERROR4         / NO COMMUNICATION FILE
      DAC      COM.+2

```

```

COM.      .TRAN      10,0,7777,DKNTCL,112
         .WAIT      10

         JMS*        WMSG.
         TITLE
         TMS         MCR

GETMAP    LAC        (2          / LOAD THE BOUNDARY MAP
         JMS*        LODR.
         300000+.DKD.
         PROJ
         400000+.SCOM+2
         JMP         ERROR2      / LOAD ERROR

         DAC         LOR.*      / LOWER FREE CORE ADDRESS
         DAC         LINE5*     / USED FOR DISPLAY MANIPULATION

RSTAT     LAC        (2          / DISC UNIT NO.
         JMS*        MX.IWK     / INIT TO WORK ON FILE
         POT1
         JMP         ERROR2      / NOT FOUND
         DAC         DKADR      / REFERENCE DISC ADDRESS
         DAC         DKADR2

/ SETUP PROPER SCALING PARAMETER FOR CONTOUR DRAW.
LAC*      MX.H        / NODES IN X DIRECTION.
CMA
TAD*      MX.V        / NODES IN Y DIRECTION.
3NA
THP
LAC*      MX.H        / X IS LARGER.
TAD
(-1
DAC       CALXY1
DAC       CALXY2
JMP
.+3
LAC*      MX.V        / Y IS LARGER.
JMP
.-5
JMS*      FLOAT
JMP
.+1+1
.DSA      CALXY1
JMS*      .AN
.DSA      F1023
JMS*      .AH
.DSA      SCALE2      / 1023./(MAX NODES MATRIX)

LAC*      MX.WC       / - WORD COUNT PER SECTION
TAD*      (.SCOM+3      / HIGHEST FREE ADDRESS
DAC       WTRDAT      / STARTING CORE ADDRESS OF DATA
DAC       CORADR2
TAD
(-1
DAC       UPR.*       / UPPER FREE CORE ADDRESS

JMS*      DZIN.       / INIT THE DIGITIZER

/ SETUP ESAJ FOR PERMANENT DISPLAY FILE
LAC*      (.SCOM+2      / START OF SYSTEM BUFFER

```



```

TAD      (ESAJ
DAC      SIRMFL / TURN ON BOUNDARY
LAC      (ESAJ+CNTRFL
DHC*     LOR.   / EXIT FROM BOUNDARY MAP

GOBABY   JMS REMOVE / INITIALIZE STREAMLINE FILE*

      CLC
      DAC      SECTN* / CURRENT SECTION IN CORE

      CLL
      JMS*     DSIN. / INIT THE DISPLAY
      0
      0 / USE INTERNAL KEYBOARD
      0 / NO LIGHT PEN
      .DSA     OVFLW / DISPLAY OVERFLOW
      0 / NO COMMAND
      .DSA     KEYAD / FUNCTION KEYS
      0 / NO TRANSMITT
      .DSA     ECHO / ECHO FILE
      .DSA     TRACK / START OF BUFFER

      JMP      OUT

DISPLA   LAC KONTUR / CHECK ON INPUT FOR CONTOURS
      SMA / USE BIT 0 AS SENSE SWITCH
      JMP DISPAL / 0 SO DO NOT WANT CONTOURS

      LAC      (ESAJ+REAL2+2 / TURN ON MESSAGE
      DAC      REAL2
      DZM      REAL1

      LAC      (LBUF
      DAC*     UP57L.
      DZM*     UP57C.

      JMS*     DSRD.
      LBUF
      -20
      JMS*     DSWT.

/ READ FLOATING POINT NUMBER
      LAC      (SKP / INIT THE TOTAL WORD SIGN
      DAC      SIGN / INIT TO +

      JMS*     RCHR. / GET FIRST CHR
      JMP      RF1 / DIGIT
      JMP      DISPLA / LETTER - NO LETTERS ALLOWED -
      SAD      (053 / PUNCT - ASCII (+)
      JMP      -4 / WAS + SO ALREADY SET FOR IT
      SAD      (055 / ASCII (-)
      SKP
      JMP      DISPLA / NOT + OR -
      LAC      (NOP / SET TOTAL WORD SIGN TO NEG
      DAC      SIGN
      JMP      -12 / GO BACK FOR WORD

RF1      MUL!20000-16 / FORM FIRST DIGIT

```

	170-100		/ (10**4) * 2**4
	DAC	MANT	/ MANTISSA 10**4
	JMS*	UP57.	/ READ (.)
	SAD	(056	/ ASCII (.)
	SKP		
	JMP	DISPLA	/ NOT .
	LAC	(23420	/ 10**4
	DAC	MULT	/ MULTIPLIER OF INPUT DIGIT
LOOP	LAC	MULT	/ FORM POWER OF TEN FOR DIGIT
	IDIV!20000		
	12		
	LACQ		
	DAC	MULT	/ REDUCE BY 10 DEC
	JMS*	RCHR.	/ READ NEXT CHR
	JMP	RF2	/ DIGIT
	TNP	RF3	/ LETTER
	JNF	RF3	/ PUNCT
RF2	MULT!20000		
MANT	0		/ MULTIPLIER
	LACQ		
	TAD	MANT	
	DAC	MANT	
	JMP	LOOP	
RF3	LAC	MANT	/ 10**4 MANT
	MULT!20000		/ NEED TO REMOVE 10**4
	043335		/ (2**13)(2**13)/10**4
			/ AC = 2**13 MANTISSA
	NORM		/ NORMALIZE 2**((13+L) M = 2**17 2**((L-4) M
	DAC	MANT	
	LACS		/ EXPONENT
	CNA		/ -34-L-1 = -35-L
	TAD	(41	
	DAC	EXP2*	/ EXPONENT 2
	DEM	EXP10*	/ CLEAR FOR THE EXPONENT
	JMS*	UP57B.	/ BACK UP LINE BUFFER POINTER
RF4	JMS*	RCHR.	/ READ NEXT CHR
	JMP	RF5	/ DIGIT
	TAD	(100	/ LETTER
	SAD	(105	/ PUNCT ASCII(E)
	JMP	RF4	
	SAD	(053	/ ASCII(+)
	JMP	RF4	
	SAD	(015	/ CARRIAGE RETURN
	JMP	RF9	
	SAD	(055	/ ASCII (-)
	SKP!CLC		

	JMP	DISPLA	/ NOT (+), (-), (E), (CR)
	DAC	EXP10	/ SIGNAL (-) EXPONENT
	JMP	RF4	
RF5	JMS*	RMUM.	/ READ NUMBER
	LD		
	XOR	EXP10	
	SPA		
	TAD	(1	
	DAC	EXP10	
	ISZ*	UP57C.	
MORE	LAC	EXP10	/ REDUCE POWER OF TEN
	SPA		
	JMP	RF7	/ (-) REQUIRES SPECIAL ATTENTION
	SNA		
	JMP	RF9	/ FINISHED EXP10 = 0
	LAC	EXP2	
	TAD	(3	
	DAC	EXP2	/ EXP2=EXP2+3
	LAC	EXP10	
	TAD	(-1	
	DAC	EXP10	/ EXP00=EXP10-1
	LAC	(500000	/ (10**1=5/4*2**3) 2**17
	JMP	RF8	
RF7	LAC	EXP2	
	TAD	(-4	/ -3 FO 4/5*2**-3 , -1 FOR SCALING
	DAC	EXP2	
	ISZ	EXP10	/ EXP10=EXP10+1
	NOP		
	LAC	(631463	/ (10**-1=4/5*2**-3) 2**18
RF8	CLL		
	MUL		
MANT	0		/ AC = 2**16*ADJUSTMENT*MANT
	LLS+1		
	DAC	MANT	/ 2**17 MANT
	SNA/RCR		/ KEEP NORMALIZED
	JMP	MORE	
	DAC	MANT	/ SCALED TO BIG
	ISZ	EXP2	/ TAKE ONE OF THEM OFF
	TMP	MORE	
RF9	JMS*	UP57B.	
	LAC	MANT	
SIGN	SKP		/ SIGN OF TOTAL WORD
	CMA		
	DAC	DEL+1	
	LAC	EXP2	
	DAC	DEL	
CHANGE	SKP		/ CHANGE TO NOP FOR TRANSMISSIVITY.
	JMP	SFPL	
	JMS*	.AG	/ PUT IN SCALE FACTOR

```

        .PSA      DEL
        JMS*      .AK
        .DSA      F8192      / 8192./100.
        JMS*      .AH
        .DSA      DEL
        JMS*      IFIX
        JMP       .+1+1
        .DSA      DEL
        JMP       DAL.
SEPL    JMS*      FPSL.
        .DSA      DEL
DAL.    JMS      ALCNTR      / DRAW CONTOUR VALUE
        JMP       DISPLA

DISPAL  JMS      STREAM      / DRAW STREAM LINES
        JMP       DISPLA

/ DISPLAY OVERFLOW
OVFLW   0
        AND      (37777
        DAC      TEM2
        DCM*     TEM2
        JMP*     OVFLW

/ KEYBOARD INTERRUPT ROUTINE.
/
KEYBD   0
        DAC      CHAR#
        SAD      KTBL+1
        JMP      KYTRN
        LAC      KTFG
        SEQ
        JNP*     KEYBD
        LAC      KTBL
        DAC*     (15
        LAC      KDIBL
        DAC*     (16
KYBDLP  LAC*     15
        SNA
        JNP*     KEYBD
        SAD      CHAR
        JMP      .+3
        ISZ*     (16
        JMP      KYBDLP
        JMP*     16
KYTRN   CLA
        DAC      KTFG
        JNP*     KEYBD
KTFG    0
KTBL    .
        377
        536      /OMEGA--REMOVE ALL STREAMLINES.
        533      /DIVISION--UP OR DOWN GRADIENT.
        560      /PS1 -DRAW OR DELETE CONTOURS.
        453      /+--EXIT TO CONTROLLER.
        460      / 0--CONTOUR MODE SWITCH.

```

```

        561      / ALPHA ABORT
        0
/
KCTBL
        JMP*    KEYBD
/ REMOVE ALL STREAMLINES
        JMP     REMOVE
/ CHANGE GRADIENT
        JMP     GRADNT
/
        JMP     CN.D
/ EXIT TO CONTROLLER
        JMP     XIT
/ CONTOUR MODE
        JMP     .KONTR
/ ABORT CALCULATIONS
        JMP     ABORT
        0
/ REMOVE ALL STREAMLINES AND RE-INITIALIZE DISPLAY FILE.
REMOVE   JMS     REMOVE
        JMP*    KEYBD

REMOVE   0      / INITIALIZE THE DISPLAY FILE

        LAC     LINES      / STARTING ADDRESS DISPLAY BUFFER
        DAC     POINT1    / RESET STORAGE VECTOR TOP OF TABLE

        LAC     (ESAJ+CNTRFL
        DAC*    POINT1    / RESET SO DONT ENTER BUFFER

        DZN     FLAG      / CLEAR FLAG

        JMP*    REMOVE

/ CHANGE GRADIENT TO UP OR DOWN.
GRADNT   LAC     STEP+1
        XOR     (400000
        DAC     STEP+1
        JMP*    KEYBD

/ EXIT TO CONTROLLER
XIT       CAF
        .DKCA=37740
        .DKAD=37742
        .DKWC=37741
        .DKRWS=37743
        .DKBEG=37731
        DZN*    C.DKCA
        LAC     DKNTRL
        SNA
        JMP     ERROR4
        DAC*    C.DKAD
        LAC     (-37720
        DAC*    C.DKWC
        DZN*    C.DKRW
        JMP*    C.DKBEG
COMMON   .SIXBT /COMMONBIN/

```

```
.KONTR   LAC      KONTUR
        SPA/CLA
        CLC
        DAC      KONTUR#
        JMP*     KEYBD
```

```
/ ABORT CALCULATIONS
ABORT    DSIA
        DSOT
        DBR
        JMP      OUT
```

```
/
/ ADD OR SAVE WHAT IS IN CURRENT DISPLAY FILE
CN.D     LAC      KON#FLG
        XOR      (4000000
        DAC      KONFLG
        SPA
        JMP      .+4
        LAC      LOR.
        DAC      LINES
        JMP*     KEYBD
        LAC      POINT1
        JMP      .-3
```

```
/ CONVERT 13 BIT INTEGER TO DISPLAY SHORT VECTOR FORM.
/ RIGHT JUSTIFIED.
IN.SV    0
        GSM
        AND      (77
        SZL
        TAD      (101
        JMP*     IN.SV
```

```
/ ERRORS
ERROR1    JMS*     WMSG.
        ERR1
        JMP      BEGIN
```

```
ERROR2    JMS*     WMSG.
        ERR2
        JMP      BEGIN
```

```
ERROR4    JMS*     WMSG.
        ERR4
        .EXIT
```

```
/ WRITE CARRIAGE RETURN
WCR       0
        LAW      015
        JMS*     PS7.
        JMP*     WCR
```

```
/ BUFFERS
LBUF      .BLOCK   20
```

```
/ THIS IS THE BUFFER THAT IS COMMON TO ALL PROGRAMS IN THE ITERATIVE
```

```

/ SEQUENCE
/ IT IS ONE DISC SECTOR LONG (112 WORDS)
/ IT IS DIVIDED INTO 3 SECTIONS
/      1. DISC ADDRESS OF THE PROGRAMS
/      2. MAPS
/      3. COMMON DATA
DKNTRL  0      / DISC ADDRESS OF MONITOR
DKSTREAM 0      / DISC ADDRESS OF STREAM-LINE
DFFLOW  0      / DISC ADDRESS OF FLOW-TUBE (STEADY-STATE)
DFFLTR  0      / DISC ADDRESS OF FLOW-TUBE (TRANSIENT)
DFTIME  0      / DISC ADDRESS OF TRAVEL-TIME (TRANSMISCIVITY)
DITRUK  0      / DISC ADDRESS OF TRAVEL TIME (CONSTANT PERMIABILITY)
DINTRO  0      / DISC ADDRESS OF INTERP
DPMOD  0      / DISC ADDRESS OF MODIFY MATRIX
DKPRES  0      / DISC ADDRESS OF PERSPECTIVE PROGRAM
        .BLOCK 19      / 20 DECIMAL PROGRAM SLOTS

PROT    .BLOCK 3      / PROJECT BOUNDARY MAP
POT1    .BLOCK 3      / POTENTIAL MAP (TIME 1)
POT2    .BLOCK 3      / POTENTIAL MAP (TIME 2)
POTAVE  .BLOCK 3      / POTENTIAL MAP (POT1+POT2)/2
DPOTLT  .BLOCK 3      / POTENTIALDERIVATIVE (POT2-POT1)/(TIME2-TIME1)
TMN     .BLOCK 3      / TRANSMISCIVITY MAP
ABU     .BLOCK 3      / BOTTOM AQUIFIER MAP
        .BLOCK 47      / 20 DECIMAL MAP SLOTS TOTAL

MAXX    0      / MAXIMUM HORIZONTAL VALUE ON MAP DIGITIZER
        .BLOCK 32      / 32 DECIMAL ID WORDS TOTAL
/ DIGITIZER LINE LUFFER
DZLB    .BLOCK 5

/ MESSAGES
TITLE   .ASCII /STREAMLINE GENERATION/<015><177>

MSG5    .ASCII /DIGITIZE STREAMLINE ORIGIN/<015><177>

MSG6    .ASCII /ENTER CONTOUR VALUE X.XXXXXXX/<015><177>

ERR1    .ASCII /??/<015><177>

ERR2    .ASCII /FILE NOT FOUND/<015><177>

ERR4    .ASCII /NEED TO INITIALIZE WITH CONTROLLER/<015><177>

PATCH  .BLOCK 100    / PATCH BLOCK

        .TITLE STREAM
/ STREAM LINE CALCULATOR

/ L.F. ADDISON 12-4-70

STREAM  DISPLA

        LAC FLAG      / FLAG=1 IF IN CALCULATION OF STREAMLINE
        SZA
        JNF MORE.

```

```

JMS*    DZWTR.  / SEE IF DIGITIZER READY
.DSA    BUSY

LAC      DZLB
AND      C17
SZA'CLL!CIA  / MODE BITS 0=BINARY, 1=ASCII
BUSY    JNP      OUT

SIRT    LAC      POINT1  / SEE IF ROOM FOR MORE LINES
TAD      CS
JMS*    CMP.
LAC      UPR.
NOP      / >
JNP      OUT           / =
NOP      / <

LAC      POINT1  / POINTS TO 0 IN BUFFER
DRC*    C10
LAC      GSAJ+CNTRFL  / SET SO DISPLAY DOESN'T SEE
DRC*    POINT1

DZM      REAL1  / TURN OFF MESSAGE TO TO DIGITIZE
DZM      XERC   / ZERO FRACTIONS
DZM      XERC+1
DZM      YERC
DZM      YERC+1
DZM      XP     / ZERO CURRENT POSITION
DZM      XP+1
DZM      YP
DZM      YP+1

LAC      DZLB+2  / INPUT X
TRF      CONVRT  / CONVERT DIG UNITS TO NODES
DRC      S       / XXX.XXX

JMS*    FLOAT   / XS=FLOAT(X)/512.
TRF      L+1+1
.DSA     Z
JMS*    LAL
.DSA     F+12   / 512.
TRF*    L+0H
.DSA     XS

JMS      SCALE  / CONVERT TO DISPLAY UNITS
JNP      L+1+3
.DSA     XS
.DSA     KP
.DSA     XERC

TAD      C060000
DRC*    L0

LAC      DZLB+3  / INPUT Y
TRF      CONVRT  / ADJUST DIG UNITS TO NODES
DRC      Y       / YYY.YYY

JMS*    FLOAT   / YS=FLOAT(Y)/512.

```



```

JMP      .+1+1
.LDSA    Y
JMS*     .AL
.LDSA    F512      / 512.
JMS*     .AH
.LDSA    YS

JMS      SCALE      / CONVERT TO DISPLAY UNITS
JMP      .+1+3
.LDSA    YS
.LDSA    YP
.LDSA    YFRC

TAD      (140000
DAC*     10

JPM*     10
LAC      (ESAJ+CNTRFL
JAC*     10
JPM*     POINT1

LAC*     (10
JAC      POINT*2
TAD      (-1
JAC      POINT*1

ISZ FLAG      / SET TO START CALCULATIONS OF NEW STREAMLINE

JMP*     STREAM      / HAVE INIT SO DO OTHER THINGS

MORE.    LAC      POINT1      / CONT NUMBER OF DISPLA UPDATES
TAD      (1
JMS*     CMP.
LAC*     (,SCOM+3
NOP      / >
JMP      OUT / = NO ROOM
NOP      / <

CS       JMS*     GRADSS      / GET THE GRADIENT AND COMPONENTS
JMP      .+1+6
.LDSA    XP      / X POSITION
.LDSA    YP      / Y POSITION
.LDSA    PTEN      / POTENTIAL(X,Y)
.LDSA    GX      / GRADIENT - X
.LDSA    GY      / GRADIENT - Y
.LDSA    GRAD      / GRADIENT - MAG

JMS*     .AG      / XS=XP+(STEP)*(GX/GRAD)
.LDSA    GX
JMS*     .AL
.LDSA    GRAD
JMS*     .AK
.LDSA    STEP
JMS*     .AI
.LDSA    XP
JMS*     .AH
.LDSA    XS

```

```

JMS      SCALE      / CONVERT TO DISPLAY UNITS
JMP      .+1+3
.LDSA    XS
.LDSA    XP
.LDSA    XERC

JMS      IN.SV
LLS+7!CLQ
DRC      TEM#

JMS*     .AG         / YS=YP+(STEP)*(GY/GRAD)
.LDSA    GY
JMS*     .AL
.LDSA    GRAD
JMS*     .AK
.LDSA    STEP
JMS*     .AI
.LDSA    YP
JMS*     .AH
.LDSA    YS

JMS      SCALE
JMP      .+1+3
.LDSA    YS
.LDSA    YP
.LDSA    YERC

JMS      IN.SV
XOR      TEM
DRC      (4000000
DAC*     POINT1
TSZ      POINT1
LAC      (CSAJ+CENTREL
TSZ      POINT2
DAC*     POINT2
DZN*     POINT1

JMP*     STREAM      / NOPE

OUT      DZM FLAG#    / FINISHED SO SET FLAG TO DO ANOTHER
LAC      (LSAJ+REAL1+2 / SIGNAL ANOTHER LINE
DAC      REAL1
DPM      REAL2

JMS*     DZRD.
DZLB
-5

DZ*      STREAM

/ DIGITIZER TO FIX POINT
CONVPT   5           / (DZ.0-1)/MAXX)*MAX.H
DAC      CON1
LAC      MAXX
DAC      CON2
DAC      CON3

```

```

      CLC
      LAC*    RX111
      MUL
CON1   0
      DIV
CON2   0
      DAC     CON1    /REMAINDER
      LACQ
      LLSS+11!10000
      DAC     CON2
      LAC     CON1
      ERDIV
CON3   0
      LLSS+11!1000
      TAD     CON2
      JMP*    CONVRT

```

/ ROUTINE TO CONVERT TO DISPLAY UNITS

```

SCALE  0

      JMS*    .DA
      JMP     .+1+3
P2      0
P1      0
FRC     0

      JMS*    .AG      / DEL=((P2-P1)*1023./FLOAT(SCALE2))+FRC
      .DSA    P2+400000
      JMS*    .AJ
      .DSA    P1+400000
      JMS*    .AK
      .DSA    SCALE2
      JMS*    .AI
      .DSA    FRC+400000
      JMS*    .AH
      .DSA    DEL

      JMS*    IFIX      / INT=IFIX(DEL)
      JMP     .+1+1
      .DSA    DEL
      DAC     INT

      JMS*    FLOAT      / FRC=DEL-FLOAT(INT)
      JMP     .+1+1
      .DSA    INT
      JMS*    .AN
      .DSA    DEL
      JMS*    .AH
      .DSA    FRC+400000

      JMS*    .AG      / P1=P2
      .DSA    P2+400000
      JMS*    .AH
      .DSA    P1+400000

      LAC     INT

```

```

      JMP*      SCALE

/ PROGRAM TO RETRIVE DATA POINTS FOR GRADIENT
/ FORTRAN IV-SUPPORT PROGRAM
/ GRADIENT THAT SERVES @'S IN PT1,PT2,PT7,PT8,PT9,PT5
/ PT12,PT11 TO THE PRECEEDING POINT VALUE RESPECTIVELY
/ IF. PT1=0 SO PT1=PT2
/ IE. PT1=0 PT2=0 SO PT1=PT2=PT3
/ IE. PT3=0 ERROR CONDITION

/ CALLING SEQUENCE
/      DIMENSION ID(1)
/      CALL GRDPNT(IX,IY,ID)
/      IX,IY      X,Y, POSITION
/      ID          POINTS FOR DEIVATIVE

/ DERIVATIVE FORMULA
/       $DN=1/12 ( X.N-2. - 8X.N-1. + 8X.N+1. - X.N+2. )$ 
/ POINT DEFINITIONS
/
/          * 16      * 20
/          * 15      * 19
/      * 7      * 8      * 9      * 10      * 11      * 12
/      * 1      * 2      * 3      * 4      * 5      * 6
/          * 14      * 18
/          * 13      * 17

      GLOBAL GRDPNT,DATA

GRDPNT 0

      JMS*      .Jm
      JMP      .+3+1

X      0
Y      0
DATA   0

      LAC      (PT1      / SET SO FORTRAN SEE'S THIS MATRIX
      DAC*     DATA

      LAC*     X
      TAD      (3
      DAC X*PRIME      / THIS IS X IN INTEGER NODE

      LAC*     Y
      TAD      (3
      DAC Y*PRIME      /THIS IS Y IN INTEGER

      LAC XPRIME
      JMS* MX,AN2      / CALCULATE SECTION ADDRESS
      LAC YPRIME
      0

DELPTR 0
      TAP      OUT      / ILLEGAL SECTION WORD REACHED BOUNDARY
      CDD SECTN      / SECTION THIS X,Y
      TAP FOUND.      / THE SAME
      DAC SECTN      / DIFFERENT

```

```

      CLL          / READ
      IMS* MX,RW   / READ THE SECTION
      JMP ERROR2

DKADR  0          / STARTING DISC ADDRESS
WTRDAT 0          / STARTING CORE ADDRESS
NX0    0          / STARTING -X FOR SECTION
NY0    0          / STARTING -Y FOR SECTION

COUNT: LAC NX0
        TAD*      X
        DAC NXIN# / X COLUMN NUMBER

        LAC*      MX,SH / SMALL X DIMENSION
        DAC XWIDE / WIDTH OF X IN NODES
        CMA
        DAC      MXWD# / MXWD = -XWIDE

        LAC      NY0
        TAD*      Y

XWIDE  MUL!20000
        0          / NODES IN X
        LACQ      / DATA WORD FOR ROW ADJUSTMENT ( ADDRESS )
        AND NXIN / DATA WORD COLUMN ADJUSTMENT ( ADDRESS )
        TAD      WTRDAT / FIRST ADDRESS OF DATA
        TAD      (-3 / TO GET I-2, AND ADJUST FOR AUTO INDEX
        DAC*      (11 / ADDRESS DATA WORD -1

        LAC*      11
        DAC PT1 / X(I-2),Y(I)
        LAC*      11
        DAC PT2 / X(I-1),Y(I)
        LAC*      11
        DAC PT3 / X(I),Y(I)
        LAC*      11
        DAC PT4 / X(I+1),Y(I)
        LAC*      11
        DAC PT5 / X(I+2),Y(I)
        LAC*      11
        DAC PT6 / X(I+3),Y(I)

        LAC*      (11 / ADDRESS X(I+3),Y(I)
        ADD XWIDE / ADDRESS X(I+3),Y(I+1)
        TAD      (-6
        LAC*      (11 / ADDRESS X(I-3),Y(I+1)

        LAC*      11
        DAC PT7 / X(I-2),Y(I+1)
        LAC*      11
        DAC PT8 / X(I-1),Y(I+1)
        LAC*      11
        DAC PT9 / X(I),Y(I+1)
        LAC*      11
        DAC PT10 / X(I+1),Y(I+1)
        LAC*      11
        DAC PT11 / X(I+2),Y(I+1)
        LAC*      11

```

```

DAC PT12          / X(I-3),Y(I+1)

LAC* (I1          / ADDRESS X(I+3),Y(I+1)
ADD XWIDE
ADD XWIDE          / ADDRESS X(I+3),Y(I+3)
TAD (-3
DAC PT16          / ADDRESS X(I),Y(I+3)
TAD (1
DAC PT20          / ADDRESS X(I+1),Y(I+3)
ADD MXWD
DAC PT19          / ADDRESS X(I+1),Y(I-2)
TAD (-1
DAC PT15          / ADDRESS X(I),Y(I+2)
ADD MXWD
ADD MXWD
ADD MXWD
DAC PT14          / ADDRESS X(I),Y(I-1)
TAD (1
DAC PT18          / ADDRESS X(I+1),Y(I-1)
ADD MXWD
DAC PT17          / ADDRESS X(I+1),Y(I-2)
TAD (-1
DAC PT13          / ADDRESS X(I),Y(I-2)

```

```

LAC* PT13
DAC PT13
LAC* PT14
DAC PT14
LAC* PT15
DAC PT15
LAC* PT16
DAC PT16
LAC* PT17
DAC PT17
LAC* PT18
DAC PT18
LAC* PT19
DAC PT19
LAC* PT20
DAC PT20

```

```

FRST  LAC PT1 / TEST 1ST COLUMN
      SZA
      JMP SECD / PT1 NOT = 0
      LAC PT2 / PT1 = 0
      SZA
      TMP FRST1 / PT2 NOT = 0 SO PT1=PT2
      LAC PT3 / PT2 = 0
      SNA
      JMP OUT / PT3 = 0
      LAC PT2 / PT3 NOT = 0 SO PT1=PT2=PT3
FRST1 DAC PT1

```

```

SECD  LAC PT7 / TEST 2ND COLUMN
      SZA
      TMP THRD / PT7 NOT = 0
      LAC PT8 / PT7 = 0

```

```

        SZA
        JMP SECND1      / PT8 NOT = 0 SO PT7=PT8
        LAC PT9 / PT8 = 0
        SNA
        JMP OUT / PT9 = 0
        DAC PT8 / PT9 NOT = 0 SO PT7=PT8=PT9
SECND1  DAC PT7

THRD    LAC PT6 / TEST 3'RD COLUMN
        SZA
        JMP FORTH      / PT6 NOT = 0
        LAC PT5 / PT6 = 0
        SZA
        JMP THRD1      / PT5 NOT = 0 SO PT6 = PT5
        LAC PT4 / PT5 = 0
        SNA
        JMP OUT / PT4 = 0
        DAC PT5 / PT4 NOT = 0 SO PT6=PT5=PT4
THRD1   DAC PT6

FORTH   LAC PT12      / TEST 4'TH COLUMN
        SZA
        JMP FITH      / PT12 NOT = 0
        LAC PT11      / PT12=0
        SZA
        JMP FORTH1    / PT11 NOT = 0 SO PT12=PT11
        LAC PT10      / PT11 = 0
        SNA
        JMP OUT / PT10=0
        DAC PT11      / PT10 NOT = 0 SO PT12=PT11=PT10
FORTH1  DAC PT12

FITH    LAC          PT13      / CHECK OTHER DIRECTION 1
        SZA
        JMP          SIXTH    / PT13 NOT = 0
        LAC          PT14      / PT13 = 0
        SZA
        JMP          FITH1    / PT14 NOT = 0 SO PT13=PT14
        LAC          PT3
        DAC          PT14      / PT3=PT14=PT13
FITH1   DAC          PT13

SIXTH   LAC          PT17      / CHECK DIRECTION 2
        SZA
        JMP          SEVN     / PT17 NOT = 0
        LAC          PT18      / PT17 = 0
        SZA
        JMP          SIXTH1   / PT18 NOT = 0 SO PT17=PT18
        LAC          PT4
        DAC          PT18      / PT4=PT18=PT17
SIXTH1  DAC          PT17

SEVN    LAC          PT16      / CHECK DIRECTION 3
        SZA
        JMP          EIGHT    / PT16 NOT = 0
        LAC          PT15      / PT16 = 0
        SZA

```

	JMP	SEVN1	/ PT15 NOT = 0 SO PT16=PT15
	LAC	PT9	
	DAC	PT15	/ PT9=PT15-PT16
SEVN1	DAC	PT16	
EIGHT	LAC	PT20	/ CHECK DIRECTION 4
	SZA		
	JMP	INFLEC	/ PT20 NOT = 0
	LAC	PT19	/ PT20 = 0
	SZA		
	JMP	EIGHT1	/ PT19 NOT = 0 SO PT20 = PT19
	LAC	PT10	
	DAC	PT19	/ PT10=PT19-PT20
EIGHT1	DAC	PT20	
INFLEC	LAC	PT2	/ CHECK ON INFLECTION POINT
	CMA		
	ADD	PT3	
	DAC	X	/ PT3-PT2
	GSM		
	DAC	Y	/ ABS(PT3-PT2)
	LAC	PT14	
	CMA		
	ADD	PT3	
	DAC	DATA	/ PT3-PT14
	GSM		/ ABS(PT3-PT14)
	SAD	Y	/ ABS(PT3-PT14) + ABS(PT3-PT2)
	DAC	Y	
	LAC	DATA	
	ADD	X	
	GSM		/ ABS(PT3-PT2+PT3-PT14)
	SAD	Y	
	JMP		/ ABS(A+B) = ABS(A)+ABS(B) LOCAL MAX,MIN
	JMP*	GRDPNT	/ NOT A LOCAL MAX,MIN
	LAC	PT5	
	CMA		
	ADD	PT4	
	DAC	X	
	GSM		
	DAC	Y	
	LAC	PT18	
	CMA		
	ADD	PT4	
	DAC	DATA	
	GSM		
	ADD	Y	
	DAC	Y	
	LAC	DATA	
	ADD	X	
	GSM		
	SAD	Y	
	SKP		

JMP*	GRDPNT
LAC	PT8
CMA	
ADD	PT9
DAC	X
GSM	
DAC	Y
LAC	PT15
CMA	
ADD	PT9
DAC	DATA
GSM	
ADD	Y
DAC	Y
LAC	DATA
ADD	X
GSM	
SAD	Y
SKP	
JMP*	GRDPNT
LAC	PT11
CMA	
ADD	PT10
DAC	X
GSM	
DAC	Y
LAC	PT19
CMA	
ADD	PT10
DAC	DATA
GSM	
ADD	Y
DAC	Y
LAC	DATA
ADD	X
GSM	
SAD	Y
SKP	
JMP*	GRDPNT
DZM	X
LAC	PT2
CMA	
ADD	PT3
GSM	
SZL	
ISZ	X
LAC	PT5
CMA	

ADD	PT4
CTM	
571	
ISZ	X
LAC	PT8
CMA	
ADD	PT9
GSM	
5ZL	
ISZ	X
LAC	PT11
CMA	
ADD	PT10
GSM	
5ZL	
ISZ	X
LAC	X
3NA	
TMP	OUT
9AD	(4
9KP	
JMP*	GRDPNT
DBM	X
LAC	PT14
CMA	
ADD	PT3
GSM	
5ZL	
ISZ	X
LAC	PT18
CMA	
ADD	PT4
GSM	
7PI	
INZ	X
LAC	PT15
CMA	
ADD	PT9
GSM	
5ZL	
ISZ	X
LAC	PT19
CMA	
ADD	PT9
GSM	
5ZL	
ISZ	X
LAC	X

	SMA JMP SAB TMP JMP*	OUT (4 OUT GRDPNT
PT1	0	
PT2	0	
PT3	0	
PT4	0	
PT5	0	
PT6	0	
PT7	0	
PT8	0	
PT9	0	
PT10	0	
PT11	0	
PT12	0	
PT13	0	
PT14	0	
PT15	0	
PT16	0	
PT17	0	
PT18	0	
PT19	0	
PT20	0	
STEP	000000 000000	/ MAGNITUDE STEP SIZE (NODES)
SCALE	000000 000000	/ SCALE FACTOR (NUMBER DISPLAY NODES/MATRIX NODES)
F512	000012 000000	/ 512.
F1023	000012 377600	/ 1023.
F8192	001007 243656	/ 8192./100.
GX	0 0	/ X COMPONENT GRADIENT
GY	0 0	/ Y COMPONENT GRADIENT
GM	0 0	/ MAGNITUDE GRADIENT
POT	0 0	/ POTENTIAL
IZ	0 0	/ CURRENT X *X(I)*
IX	0 0	/ NEXT X *X(I+1)*
XFR	0 0	/ X FRACTION
YF	0 0	/ CURRENT Y *Y(I)*

```

YF      0      / NEXT Y *Y(I+1)*
YFRC    0      / Y FRACTION
        0

DEL      0      / DELTA STEP
        0

INT      0      / STEP LENGTH IN DISPLAY UNITS

TRACK    ESAT+1
        104500 / MESSAGE "STREAMLINE PROGRAM
        107750
        103124
        102105
        101115
        104111
        106105
        100120
        107117
        107122
        101515

REAL1    ESAT+REAL1+2
        ESAT+REAL2
        .NORIT
        LABSVC 10,35
        .DBIT /DIGITIZE STREAMLINE ORIGIN/(<400>
REAL2    0
        ESAT+ECHO
        .NORIT
        LABSVC 10,35
        .DBIT /ENTER CONTOUR VALUE/(<400>

ECHO     ESAT+3      / ECHO FILE
        ESAT+STRMFL
        +70
        700000
        100000
        440000
        .BLOCK 17
        ESAT+ECHO+1

STRMFL   ESAT+CTRFL      /VECTOR TABLE
CTRFL    ESAT+TRACK

        .TITLE DRAW COUTOUR LINES

/ 12 18-70
/ 1 1 GERHARDSTEIN

/ DRAW ALL CONTOUR LINES OF A VALUE
/ CYCLING SEQUENCE:
/ 1 1 VALUE
/ 1 1 ALCONTR
/ 1 1
/ 1 1
ALCONTR  0

```

```

DAC      ALCNTV
LAC      (ESAJ+CNTRFL
DAC*     POINT1
LAC      POINT1
TAD      CL
DAC      CNTR*FX
DZM      SECTN
ALCNT1   LAC      SECTN
XOR*     MX.NV
AND      (777
SNA
JMP      ALCNT2
JMP      ALCNT4
ALCNT3   LAC      SECTN
LRS+11
XOR*     MX.NH
AND      (777
SNA
JMP      ALCNTX
ALCNT4   LAC      SECTN
JMS      CNTR
ALCNTV   @
ISZ      SECTN
JMP      ALCNT1
ALCNT2   LAC      SECTN
AND      (777000
TAD      (1000
DAC      SECTN
JMP      ALCNT3
ALCNTX   DZM*     CNTRFX
ISZ      CNTRFX
LAC      (ESAJ+CNTRFL
DAC*     CNTRFX
DZM*     POINT1
LAC      CNTRFX
TAD      (-1
DAC      POINT1
NOP
NOP
JMP*     ALCNTR

/ DRAW ONE COUTOUR FROM SPECIFIED SECTION
/ CALLING SEQUENCE:
/      LAC      MATRIX SECTION NO.
/      JMS      CNTR
/ VALUE COUTOUR VALUE
/      .....

.GLOBL   MUL.,MX.RW
.GLOBL   MX.NH,MX.NV,MX.O,MX.SH,MX.SV,MX.WC
.OCT
CNTR     @
DAC      SECTN*  / SECTION NO.

CLL      / READ
JMS*     MX.RW   / READ MATRIX SECTION
XX       / ILLEGAL SECTION

```

```

DNADP2  0          / FILE DISC ADDRESS
CGRATE2  0          / MATRIX SECTION CORE ADDRESS
XX000   0
YY000   0

```

```

LAW      -1
TAD      XX00    / -X0 - 1
CNA      / X0
DAC      XX00
DHC      XLEFT#  / LEFT BOUNDARY
LAW      -1
TAD      YY00    / -Y0 - 1
CNA      / Y0
DAC      YY00
DHC      YLOW#   / LOWER BOUNDARY

```

```

LAC*     CNTR    / CONTOUR VALUE
ISZ      CNTR
CNA
DAC      TEM     / V

```

/ RE-FORMAT DATA IN MATRIX SECTION

```

LAC*     MX.WC   / -WORDS IN SECTION
DAC      CNT#
CNA      CGRAD2  / DATA S.A.
DAC      PT0#
DHC      TDZ#
CNTRL    LAC      / BITS = 0'S
LAC*     11%     / VOID
END*CLL
TAD      / IF VOID = 0, SET BITS = 1'S
DHC      TEN     / VOID = V
CNA
CHL      / SET LINK TO SIGN
LLS+4    / 16*(VOID-V) = W(I)
AND      (377777
SXL      / SET ACO TO SIGN
XOR      (400000
DHC*     1BX     / W(I) & 777760 + BITS(14-17)
ISZ      1BX
ISZ      CNT
JMP      CNTRL

```

/ CALCULATE SPIRAL COUNTERS
/ AND SEARCH LIMITS

```

LAW      -1
TAD*     MX.0
CNA
DAC      TEM     / -0
LAC      SECTN   / SECTION NO. WORD
LRS+11
AND      (777
TAD      (1      / NH +1
XOR*     MX.NH   / TEST FOR RIGHT SECTION
SZA/CLC      / -1
LAC      TEM     / -0
TAD*     MX.SH   / SH -0 SH -1

```

```

CMA          / -SH +0 -1      -SH
DAC          HCNT#           / -NO. HORIZ NODES IN SCAN AREA
CMA          / NODES -1
TAD          XLEFT
DAC          XRIGHT#        / RIGHT BOUNDARY

LLS+1011          /SECTN Y COORD.
TAD          (1             / NV +1
XOR*         MX.NV         / TEST FOR UPPER SECTION
SZA!CLC          /          -1
LAC          TEM           / -0
TAD*         MX.SV         / SV -0      SV +1
CMA          / -SV +0 -1      -SV
DAC          VCNT#         / -NO. VERT NODES IN SCAN AREA
CMA          / NODES -1
TAD          YLOW
DAC          YUPER#        / UPPER BOUNDARY

/ PERFORM SPIRAL SCAN OF THE MATRIX SECTION
/ STARTING POINT IS LOWER LEFT
LAC*         PT0
DAC          WD0#          / LOWER LEFT VALUE

/ SCAN RIGHT
LAC          HCNT
TAD          (1
JMP          .+4
CNTR2 LAC          HCNT
TAD          (1
DAC          HCNT
SMA
JMP          CNTREX        / DONE
DAC          CNT
DZH          IL0#          / IL0 = 0   (RIGHT)
LAC          PT0
TAD          (1           / POINT RIGHT OF PT0
JMS          DRAW
ISZ          XX00          / X00 = X00 +1
ISZ          CNT
JMP          .-5          / CNNTINUE RIGHT

/ SCAN UP
ISZ          IL0          / IL0 = 1   (UP)
LAC          VCNT
TAD          (1
DAC          VCNT
SMA
JMP          CNTREX        / DONE
DAC          CNT
LAC          PT0
TAD*         MX.SH         / POINT ABOVE PT0
JMS          DRAW
ISZ          YY00          / Y00 = Y00 +1
ISZ          CNT
JMP          .-5          / CONTINUE UP

/ SCAN LEFT

```

```

ISZ     IL0      / IL0 = 2  (LEFT)
LAC     HCNT
TAD     C1
DAC     HCNT
SMA
JMP     CNTREX   / DONE
DAC     CNT
LAW     -1
TAD     PT0      / POINT LEFT OF PT0
JMS     DRAW
LAW     -1
TAD     XX00
DAC     XX00      / X00 = X00 -1
ISZ     CNT
JMP     -7       / CONTINUE LEFT

```

```

/ SCAN DOWN
ISZ     IL0      / IL0 = 3  (DOWN)
LAC     VCNT
TAD     C1
DAC     VCNT
SMA
JMP     CNTREX   / DONE
DAC     CNT
LAW     -1
TAD*    MX.SH    / SH -1
CMA     / -SH
TAD     PT0      / POINT BELOW PT0
JMS     DRAW
LAW     -1
TAD     YY00
DAC     YY00      / Y00 = Y00 -1
ISZ     CNT
JMP     -11      / CONTINUE DOWN
JMP     CNTR2    / REPEAT

```

```

/ CONTOUR DRAW EXIT
CNTREX JMP*     CNTR

```

```

/ DRAW CONTOUR
DRAW    0

```

```

DAC     PT1
DAC     P1      / P1 = WD1 ADDRMP0
LAC*    P1      / WD1
XOR     WD0     / NEG IF INTERCEPT BETWEEN PT0 & PT1
SPA
JMP     DRAW0    / INTERCEPT FOUND
DRAWX   LAC     P11 / ADVANCE PT0 TO PT1
DAC     PT0
LAC*    PT0
DAC     WD0
JMP*    DRAW

```

```

/ SEND SHORT VECTOR IF ANY LEFT
DRAWX1  ISZ     CNT2
JMP     DRAWX
JMS     DRVECT

```



```

DRAW0    JMP      DRAWX
        LAC      IL0      / SCAN DIRECTION
        DAC      IL#
        TAD      (LRS+0    / TEST IF CONTOUR ALREADY DRAWN
        DAC      DRAW0A    / LRS+(IL)
        XOR      (2
        DAC      DRAW0B    / LRS+(IL)\2
        LAC      WD0
DRAW0A    XX              / SHIFT BIT TO AC17
        RAR              / AND THEN TO LINK
        SZL
        JMP      DRAWX    / CONTOUR DRAWN
        LAC*     P1        / CHECK P1 IN -IL DIRECTION
DRAW0B    XX              / FOR CROSSING
        RAR
        SZL
        JMP      DRAWX

/ INITIALIZE DRAW PARAMETERS
DZM      VQ#      / VECTOR QUADRANT = 0
LAC      PT0
DAC      P0#      / OBJECT POINT ADDR
LAC      XX00     / X0 OF INIT OBJ POINT
DAC      XX0#
LAC      YY00     / Y0 OF INIT OBJ POINT
DAC      YY0#

/ CALCULATE X,Y OF FIRST POINT IN CONTOUR
JMS      CALXY
/ SEND ABS VECTOR FOR CONTOUR STARTING POINT
LAC      XNEW
XOR      (660000
DAC*     CNTRFX
ISZ      CNTRFX
LAC      YNEW
XOR      (140000
DAC*     CNTRFX
ISZ      CNTRFX
LAW      -2        / SET FOR EVERY OTHER SHORT VECTOR
DAC      CNTZ#

LAC      XNEW      / STORE OLD X,Y
DAC      XOLD#
LAC      YNEW
DAC      YOLD#

/ DRAW NEXT LINE SEGMENT
/ CHECK IF SEGMENT DRAWN ALREADY
LINE     LAC      IL      / INTERCEPT LINE DIRECTION
        TAD      (LRS
        DAC      LINE0A
        XOR      (2
        DAC      LINE0B
        LAC*     P0
LINE0A    XX
        RAR
        SZL

```

```

        JMP      DRAWX1  / END OF CONTOUR LOOP
        LAC*     P1
LINE0B  XX
        RAR
        SCL
        JMP      DRAWX1  / END OF CONTOUR LOOP

```

/ TEST IF CONTOUR CROSSES A BOUNDARY

/ GOING OUT OF SECTION

```

        LAC      VQ0
        SAD      YLOW      / LOWER BOUNDARY
        LAM      0-4
        ORP      YUPPER    / UPPER BOUNDARY
        LAM      0-4
        SNA
        LAC      XX0
        SAD      XLEFT     / LEFT BOUNDARY
        LAM      1-4
        SAD      XRIGHT    / RIGHT BOUNDARY
        LAM      0-4
        SNA
        JMP      DRAW1     / NOT ON BOUNDARY
        AND      C3
        SAD      IL
        JMP      DRAW2     / TEST FOR VQ = 0
        XOR      C2
        SAD      IL
        JMP      DRAW3     / TEST FOR VQ = 3
        JMP      DRAW1
DRAW2   LAC      VQ
        XOR      C3
        SPP
DRAW3   LAC      VQ
        SXH
        JMP      DRAWX1    / CROSSES BOUNDARY

```

/ CALCULATE L1 : VQ AXIS NORMAL TO IL

/ L1 = (IL+1)&3 IF VQ = 0

/ L1 = (IL+1)&3 IF VQ = 3

```

DRAW1   LAC      VQ      / VECTOR QUADRANT
        SNA!CLC
        LAC      C1
        TAD      IL
        AND      C3
        ORC      L1#

```

/ ADDRESS P1, P2, P3

/ DELT1 = LFCN(IL)

/ DELT2 = LFCN(L1)

/ P1 = P0 + DELT0

/ P2 = P0 + DELT0 + DELT1

/ P3 = P0 + DELT1

```

        LAC      L1
        JMS      LFCN
        DDC      TEM
        TAD      P0
        DDC      P3#

```

```

LAC      TEM
TAD      P1
DAC      P2

/ TEST WHICH CASE
/ IE: WHICH INTERCEPT LINE
LAC*     P0
XOR*     P3
SPAICLC
JMP      .+4      / CASE (1)
LAC*     P3
XOR*     P2
SPAICLA
TAD      (-1      / CASE (2)
              / CASE (3)
TAD      (2
JMS*     MUL.
DRTAB2-DRTAB
TAD      (DRTAB-1
DAC*     (10

/ MARK P0, P1 TO SHOW THAT THIS VECTOR DRAWN
/ MARK P0 IN IL DIRECTION AND P1 IN IL\Z DIRECTION
LAC      IL
JMS      MARK
LAC*     P0
DAC*     P0
LAC      IL
XOR      (2
JMS      MARK
LAC*     P1
DAC*     P1

/ CALCULATE NEW P0,P1
XCT*     10
DAC      P0
XCT*     10
DAC      P1

/ CALCULATE NEW X0,Y0
XCT*     10      / LAC DIR OF NEW P0 FROM P0
LESS+1    / X,Y BIT IN MQ
RCR      / +,- BIT IN LINK
LLS+1001  / X,Y BIT
SZA
JMP      .+7
LAC      XX0      / INCREMENT OR DECREMENT X0
SZL
TAD      (-2
TAD      (1
DAC      XX0
JMP      .+6
LAC      YY0      / INCREMENT OR DECREMENT Y0
SZL
TAD      (-2
TAD      (1
DAC      YY0

```

```

/ CALCULATE NEW IL
    LAC    C2
    XCT*   10
    DAC    IL

/ CALCULATE NEW V0
    LAC    C3
    XCT*   10
    DAC    V0

/ CALCULATE NEW P1
    LAC    IL
    JMS    LFCN
    TAD    P0
    DAC    P1

/ CALCULATE NEW POINT IN CONTOUR
    JMS    CALXY
    ISZ    CNT2
    JNP    LINE
    LAM    -2
    DAC    CNT2
    JMS    DRVECT
    JNP    LINE

/ SEND SHORT OR LONG VECTOR
DRVECT  0
    LAC    YOLD
    CHA
    ADD    YNEW
    GSM
    SZL
    XOR    C4000000
    DAC    DY#

    LAC    XOLD
    CHA
    ADD    XNEW
    GSM
    SZL
    XOR    C4000000
    DAC    DX#

    AND    C1700
    SZA
    JNP    DRLONG
    LAC    DY
    AND    C1700
    SZA
    JNP    DRLONG

DRSHRT  LAC    DY      / SHORT VECTOR
        SPA
        XOR    C100
        LRS+7

```

```

        LAC      DX
        SPA
        XOR      (100
        LLS+7
        XOR      (400000
DRVCT1  DAC*     CNTRFX
        ISZ      CNTRFX

        LAC      XNEW
        DAC      XOLD
        LAC      YNEW
        DAC      YOLD
        JMP*     DRVECT
DELONG  LAC      DX      / LONG VECTOR
        SPA
        XOR      (402000
        XOR      (600000
        DAC*     CNTRFX
        ISZ      CNTRFX
        LAC      DY
        SPA
        XOR      (402000
        JMP      DRVCT1
/ CASES TABLE
/ CASE(1)
DPTAB   LAC      P3      / NEW P0
        LAC      P0      / NEW P1
        LAC      L1      / DIRECTION OF NEW P0 FROM P0
        XOR      L1      / NEW IL
        XOR      V0      / NEW V0

/ CASE(2)
DPTAB2  LAC      P3
        LAC      P2
        LAC      L1
        LAC      IL
        LAC      V0

/ CASE(3)
        LAC      P1
        LAC      P2
        LAC      IL
        LAC      L1
        XOR      V0

/ MARK DATA WORDS
MARK     0
        TAD      CLRS
        DAC      MARKRS
        TAD      (LLS!CLQ-LRS
        DAC      MARKLS
        ACT*     MARK
        ISZ      MARK
        DAC      TEM
MARKRS   XX

```

```

      LAR 00000000
      LAR 00000000
      LAR 00000000 MARK0
      LAR 00000000 (1
      LAR 00000000
      LAR 00000000 TEM
      LAR 00000000 MARK
      LAR 00000000 MARK
      LAR 00000000 MARK

```

/ LINE DIRECTION FUNCTION

```

LECON 0
      LAR 00000000
      LAR 00000000
      LAR 00000000 (CMA-SKP
      LAR 00000000 (SKP
      LAR 00000000 LECON5
      LAR 00000000
      LAR 00000000 (1
      LAR 00000000
      LAR 00000000 MX.5H
      LAR 00000000
      LAR 00000000 (1
      LAR 00000000 LECON

```

/ CALCULATE X,Y FOR DISPLAY

/ FROM X0, Y0, IL, ALFA=W0/(W0-W1)

```

CALXY 0
      / CALCULATE ALPHA = W0/(W0-W1)

```

```

      LAR 00000000 P1 / W1
      AND 00000000 (777760
      SPA
      KOR 00000000 (17
      DAC 00000000 TEM1
      LAR 00000000 P0 / W0
      AND 00000000 (777760
      SPA
      KOR 00000000 (17
      DAC 00000000 TEM0#
      LAR 00000000 TEM1
      LAR 00000000
      ADD 00000000 TEM0 / W0-W1
      GSM
      DAC 00000000 .+6
      LAR 00000000 TEM0 / W0
      CLQ
      SPA
      CMQ
      DIVS
      0
      LAR 00000000
      LAR 00000000
      CLC
      LAR 00000000

```

```

      LAR 00000000 XX0 / OBJECT POINT COORDINANT
      LAR 00000000

```

```

DAC      XNEW#
LAC      YY0
ALSS+12
DAC      YNEW#
LAC      IL      / INT LINE DIRECTION
RTR
CLS+1012      / 2**10 *ALFA
SNL
JMP      .+3      / + DIRECTION
DMA      / - DIRECTION
TAD      (1
LMQ
LAC      IL
RAR
LACQ
SZL
JMP      .+4
TAD      XNEW
DAC      XNEW      / 2**10 *XNEW
JMP      .+3
TAD      YNEW
DAC      YNEW      / 2**10 * YNEW
CLE
LAC      XNEW      / 1024 *X
IDIV
CALXY1  220
LACQ      / DISPLAY X COORD
SAD      (2000
LAC      (1777
DAC      XNEW
LAC      YNEW
IDIV
CALXY2  220
LACQ
SAD      (2000
LAC      (1777
DAC      YNEW
JMP*     CALXY
END

```

APPENDIX C

TRAVEL TIME PROGRAM LISTING

LISTING
TRAVEL TIME PROGRAM

```

.TITLE    PROGRAM TO CALCULATE TRAVEL TIME

/ 7-1-72
/ D R FRIEDRICHS
/ L E ADDISON

/ OPEN MATRIX FILE AND INITIALIZE FOR
/ STREAMLINE GENERATION AND DISPLAY

/ THIS VERSION HAS FORTRAN TIME CALCULATIONS

SET=ISZ
.DAT=135
.SCOM=100
.COMTB=.DAT+11

ESAJ=200000

.GLOBL MX.IWK
.GLOBL MX.DS,MX.NH,MX.NS,MX.NV,MX.SH,MX.SV,MX.WC
.GLOBL MX.H,MX.V,MX.N,MX.O
.GLOBL IUDAT.,P57.,WMSG.,UP57L.,UP57C.,UP57B.
.GLOBL RCHR.,UP57.,RNUM.
.GLOBL CMP.,MX.AD2,MX.RW
.GLOBL DZIN.,DZRD.,DZMTR.
.GLOBL FDIV.,SFIK.
.GLOBL SFLT.,IFIX.,IFLT.,SLFP.
.GLOBL DZIN.,DSRD.,DSMT.
.GLOBL DKD.,LODR.

/ THESE ARE THE FORTRAN FLOATING POINT ROUTINES
.GLOBL .AG.,.AH.,.AI.,.AJ.,.AK.,.AL.,.AM.,.AN
.GLOBL .DA,FLOAT,IFIX,TIME

BEGIN    CAL+775 / .INIT -3
1
BEGIN
TEM1     0

        CLL
        LAW      -3          / DAT -3 = TTA.
        JMS*     IUDAT.      / INITIALIZE IOPS LIBRARY
        100000=LBUF          / LINE BUFFER
TEM2     0

        LAC      DKD.        / ASSIGN DISC TO DAT+10
        XOR      (200000
        DAC*     (.DAT+10
        .INIT    10,0,0

        LSTAT    10,COMMON    / CHECK TO SEE IF INIT
        SNA      / 0 IS NOPE
        JMP      ERROR4 / SO GET OUT OF HERE
        DAC      COM.+2

COM.     .TRAN    10,0,7777,DKNTRL,112    / INPUT FILE SPECIFIER
        .WAIT    10

```

```

LAC      DZIN.    / TURN OF CLEAR DIGITIZER ON INIT
TAD      (2
DAC      .HLD.
LAC      (NOP
DAC*     .HLD.

JMS*     WMSG.    / TRAVEL TIME PROGRAM
TITLE
JMS      WCR

GETMAP   LAC      (2      / LOAD THE BOUNDARY MAP
JMS*     LODR.
400000+.DKD.
PROJ
400000+.SCOM+2
JMP      ERROR2    / LOAD ERROR

DAC      LOR.#1    / LOWER FREE CORE ADDRESS
DAC      LINES#    / USED FOR DISPLAY MANIPULATION

- ROTAT   LAC      (2      / DISC UNIT NO.
JMS*     MX.IWK    / INIT TO WORK ON FILE
POT1
JMP      ERROR2    / NAME:EXT POINTER
DAC      POTDKS    / REFERENCE DISC ADDRESS
DAC      DKADR2

LAC      (2      / CHECK ON TRANSM. DATA
JMS*     MX.IWK
TRN
JMP      ERROR2
DAC      TRNDKS

LAC      (2      / CHECK ON AQU. DATA
JMS*     MX.IWK
AQU
JMP      ERROR2
DAC      HSBDKS

/ SETUP PROPER SCALING PARAMETER FOR CONTOUR DRAW.
LAC*     MX.H      /NODES IN X DIRECTION
CMA
TAD*     MX.V      /NODES IN Y DIRECTION
SNA
JMP      .+6
LAC*     MX.H      / X IS LARGER
TAD      (-1
DAC      CALXY1
DAC      CALXY2
JMP      .+3
LAC*     MX.V      / Y IS LARGER
JMP      .-5
JMS*     FLOAT
JMP      .+1+1
.DSA     CALXY1
JMS*     .AN
.DSA     F1023    / 1023.

```

```

JMS*    .AH
.DSA    SCALE2

LAC*    MX.WC    / - WORD COUNT PER SECTION
TAD*    (.SCOM+3    / HIGHEST FREE ADDRESS
DAC     POTADR    / POTENTIAL DATA
DAC     CORAD2
TAD     (-1
TAD*    MX.WC
DAC     TRNADR    / TRANSM. DATA BUFFER
TAD     (-1
TAD*    MX.WC
DAC     HSBADR    / AQU. DATA BUFFER
TAD     (-1
DAC     UPR.#     / UPPER FREE CORE ADDRESS

JMS*    DZIN.    / INIT THE DIGITIZER

/ SETUP ESAJ FOR PERMANENT DISPLAY FILE
LAC*    (.SCOM+2    / START OF SYSTEM BUFFER
TAD     (ESAJ
DAC     STRMFL    / TURN ON BOUNDARY
LAC     (ESAJ+CNTRFL
DAC*    LOR.      / EXIT FROM BOUNDARY MAP

GOBABY  JMS REMOVE    /INITIALIZE STREAMLINE FILE*

CLC
DAC     SECTN#    / CURRENT SECTION IN CORE

DIL
JMS*    DSIN.      / INIT THE DISPLAY
0       / USE INTERNAL KEYBOARD
0       / NO LIGHT PEN
.DSA    OVFLW      / OVERFLOW
0       / NO COMMAND
.DSA    KEYBD      / FUNCTION KEYS
0       / NO TRANSMITT
.DSA    ECHO       / ECHO FILE
.DSA    TRACK      / START OF BUFFER

JMS*    DZRD.
DZLB
-5

JMP     STREAM
/ DISPLAY OVERFLOW
OVLW    0
AND     (37777
DAC     TEM1
DZM*    TEM1
JNP*    OVFLW

/ KEYBOARD INTERRUPT ROUTINE.
/
KEYBD    0
DAC     CHAR#

```

```

SAD      KTBL+1
JMP      KYTRN
LAC      KTFG
SPA
JMP*     KEYBD
LAC      KTBL
DAC*     (15
LAC      KDTBL
DAC*     (16
KYBDLP   LAC*     15
SNA
JMP*     KEYBD
SAD      CHAR
JMP      .+3
ISZ*     (16
JMP      KYBDLP
JMP*     16
KYTRN    CLA
DAC      KTFG
JMP*     KEYBD
KTFG     0
KTBL     .
377
536      /OMEGA--REMOVE ALL STREAMLINES.
533      /DIVISION--UP OR DOWN GRADIENT.
560      /PSI--DRAW OR DELETE CONTOURS.
535      /LANDA--ENTER STEP MODE
566      / EPSILON--TAKE A STEP IN STEP MODE
500      / PI--LIMIT
460      / 0 --CONTOUR MODE SWITCH
453      / + -- EXIT TO CONTROLLER
561      / ALPHA ABORT CALCULATIONS
0
/
KDTBL    .
JMP*     KEYBD
/ REMOVE ALL STREAMLINES
JMP      REMOVE
/ CHANGE GRADIENT
JMP      GRADNT
/ DRAW OR DELET CONTOURS
JMP      CN.D
/ENTER-LEAVE STEP MODE
JMP      .STPST
/ TAKE A STEP
JMP      .STEP
/ LIMIT
JMP      SETLIM
/ CONTOUR MODE
JMP      .KONTR
/ EXIT TO CONTROLLER
JMP      XIT
/ ABORT CALCULATIONS
JMP      ABORT
/
0
/ REMOVE ALL STREAMLINES AND RE-INITIALIZE DISPLAY FILE.

```

```

REMOVE    JMS      REMOVE
          JMP*     KEYBD

REMOVE    /
          / INITIALIZE THE DISPLAY FILE

          LAC      LINES      / STARTING ADDRESS DISPLAY BUFFER
          DAC      POINT1     / RESET STORAGE VECTOR TOP OF TABLE

          LAC      (BSAJ+CNTRFL
          DAC*     POINT1     / RESET SO DONT ENTER BUFFER

          JMP*     REMOVE

/  CHANGE GRADIENT TO UP OR DOWN.
GRADNT    LAC      .STEP+1
          XOR      (4000000
          DAC      .STEP+1
          JMP*     KEYBD

/
/  DRAW OR DELETE CONTOURS FROM FILE.
CN.D      LAC      KON#FLG
          XOR      (4000000
          DAC      KONFLG
          SPA
          JMP      .+4
          LAC      LOR.
          DAC      LINES
          JMP*     KEYBD
          LAC      POINT1
          DAC      LINES
          JMP*     KEYBD

/  ENTER LEAVE STEP MODE
.STPST    LAC      .STP1#
          SNA!CLA
          CLC
          DAC      .STP1
          DCM      .STP2#
          ISZ      .STP2
          JMP*     KEYBD

/  TAKE A STEP
.STEP     DEM      .STP2
          JMP*     KEYBD

/  LIMIT
SETLIM    LAC      STOPR#
          XOR      (4000000
          DAC      STOPR
          DCM      YERLEN#
          JMP*     KEYBD

/CONTOUR

```

```
.KONTR  LAC      KONTUR#
        XOR      (400000
        DAC      KONTUR
        JMP*     KEYBD
```

```
/ CONTROLLER
XIT     CAF
```

```
.DKCA=37740
.DKAD=37742
.DKWC=37741
.DKRWS=37743
.DKBEG=37731
```

```
DZM*    C.DKCA
LAC      DKNTRL
SNA
JMP      ERROR4
DAC*     C.DKAD
LAC      (-37720
DAC*     C.DKWC
DZM*     C.DKRWS
JMP*     C.DKBEG
```

```
COMMON .SIXBT /COMMONBIN/
```

```
/ ABORT CALCULATIONS
ABORT   DSIA
        DSCI
        DBR
        JMP     OUT
```

```
/ CONVERT 18 BIT INTEGER TO DISPLAY SHORT VECTOR FORM.
/ RIGHT JUSTIFIED.
```

```
IN.SV   0
        GSH
        AND      (77
        SZL
        TAD      (101
        JMP*     IN.SV
```

```
/ ERRORS
```

```
ERROR1  JMS*     WMSG.
        ERR1
        JMP      BEGIN
```

```
ERROR2  JMS*     WMSG.
        ERR2
        JMP      XIT
```

```
ERROR4  JMS*     WMSG.
        ERR4
        .EXIT
```

```
/ WRITE CARRIAGE RETURN
```

```

WCR      0
LAW      015
TMS*     P57.
JMP*     WCR

```

```

/ BUFFERS

```

```

LBUF      .BLOCK 20

```

```

/ THIS IS THE BUFFER THAT IS COMMON TO ALL PROGRAMS IN THE ITERATIVE
/ SEQUENCE

```

```

/ IT IS ONE DISC SECTOR LONG (112 WORDS)

```

```

/ IT IS DIVIDED INTO 3 SECTIONS

```

```

/      1. DISC ADDRESS OF THE PROGRAMS

```

```

/      2. MAPS

```

```

/      3. COMMON DATA

```

```

DKNTRL    0      / DISC ADDRESS OF MONITOR

```

```

DSTREAM   0      / DISC ADDRESS OF STREAM-LINE

```

```

DIFLOW    4      / DISC ADDRESS OF FLOW-TUBE (STEADY-STATE)

```

```

DIFLTR    8      / DISC ADDRESS OF FLOW-TUBE (TRANSIENT)

```

```

DTRVL     0      / DISC ADDRESS OF TRAVEL-TIME (TRANSMISSIVITY)

```

```

DTRVK     4      / DISC ADDRESS OF TRAVEL TIME (CONSTANT PERMIABILITY)

```

```

DINTER    8      / DISC ADDRESS OF INTERP

```

```

DPCOMB    0      / DISC ADDRESS OF MODIFY MATRIX

```

```

DKPERS    4      / DISC ADDRESS OF PERSPECTIVE PROGRAM

```

```

          .BLOCK 13      / 20 DECIMAL PROGRAM SLOTS

```

```

PROJ      .BLOCK 3      / PROJECT BOUNDARY MAP

```

```

POT1      .BLOCK 2      / POTENTIAL MAP (TIME 1)

```

```

POT2      .BLOCK 3      / POTENTIAL MAP (TIME 2)

```

```

POTAVE    .BLOCK 3      / POTENTIAL MAP (POT1+POT2)/2

```

```

DPOTDT    .BLOCK 3      / POTENTIAL DERIVATIVE (POT2-POT1)/(TIME2-TIME1)

```

```

TRN       .BLOCK 4      / TRANSMISSIVITY MAP

```

```

AOU       .BLOCK 3      / BOTTOM AQUIFER MAP

```

```

          .BLOCK 47      / 20 DECIMAL MAP SLOTS TOTAL

```

```

MAXX      0      / MAXIMUM HORIZONTAL VALUE ON MAP DIGITIZER

```

```

          .BLOCK 32      / 32 DECIMAL 10 WORDS TOTAL

```

```

/ DIGITIZED LINE BUFFER

```

```

DLB       .BLOCK 5

```

```

/ MESSAGES

```

```

TITLE     .ASCII /TRAVEL TIME PROGRAM/<015><177>

```

```

MSG5      .ASCII /DIGITIZE STREAMLINE ORIGIN/<015><177>

```

```

MSG9      .ASCII /ENTER CONTOUR VALUE X.XXXXEXX/<015><177>

```

```

ERR1      .ASCII /?/<015><177>

```

```

ERR2      .ASCII /FILE NOT FOUND/<015><177>

```

```

ERR4      .ASCII /NEED TO INITIALIZE WITH CONTROLLER/<015><177>

```

```

PATCH    .BLOCK 100     / PATCH BLOCK

```

```

          .TITLE STREAM

```

```

/ STREAM LINE CALCULATOR

```

/ L.E.ADDISON 12-4-70

STREAM NOP

LAC (CSAJ+REAL1+2
 DAC REAL1
 DZM REAL2
 DZM REAL3

KONTF. LAC KONFUR / DRAW COUNTOUR FLAG
 SMA
 JMP LIMIT.

LAC (CSAJ+REAL2+2
 DAC REAL2
 DZM REAL1
 DZM REAL3

JMS RFLTP.
 JMS* .AG
 .DSA EXP2
 JMS* .AK
 .DSA F8192 / 8192./100.
 JMS* .AH
 .DSA EXP2
 JMS* IFIX
 JMP .+1+1
 .DSA EXP2
 JMS ALCONTR
 JMP STREAM

LIMIT. LAC STOPR / LIMIT FLAG
 SMA
 JMP STRM.
 LAC YERLIM
 DZA
 JMP STRM.

LAC (CSAJ+REAL3+2
 DAC REAL3
 DZM REAL1
 DZM REAL2

JMS RFLTP.
 JMS* IFIX
 JMP .+1+1
 .DSA EXP2
 DAC YERLIM

STRM. JMS* DEWTR. / WAIT ON DIGITIZER
 .DSA BUSY

LAC DELB
 AND C17
 DZA!CLL!CLA / MODE BITS
 BUSY JMP STREAM


```

STRT      LAC POINT1      / SEE IF ROOM FOR LONG VECTORS
          LAD C5
          JMS* CMP.
          LAC      UPR.
          NOP      / >
          JNP OUT / = NO ROOM
          NOP      / <

          LAC POINT1      / POINTS TO 0 IN BUFFER
          DAC* C10
          LAC (ESAJ+CNTRFL      / SET SO DISPLAY WONT SEE MODS
          DAC* POINT1

          DZM      REAL1
          DZM      XERC
          DZM      XERC+1
          DZM      YERC
          DZM      YERC+1
          DZM      XP
          DZM      XP+1
          DZM      YP
          DZM      YP+1
          DZM      TOTDAY
          DZM      TOTDAY+1

          LAC      DZLB+2
          JMS      CONVRT
          DAC      X
          TMS*     FLOAT
          JNF      .+1+1
          LISA     X
          TMS*     LAL
          LISA     F+12
          JMS*     LAR
          LISA     XS
          JNF SCALE      / ADJUST TO DISPLAY UNITS
          JNF      .+1+3
          LISA     X7
          LISA     XP
          LISA     X+EC
          LAD C600000
          DAC*     10

          LAC      DZLB+3
          JMS      CONVRT
          DAC      Y
          TMS*     FLOAT
          JNF      .+1+1
          LISA     Y
          TMS*     LAL
          LISA     F+12
          JMS*     LAR
          LISA     YS
          JNF SCALE      / ADJUST TO DISPLAY UNITS
          JNF      .+1+3
          LISA     YS

```

```
.DSA      YP
.DSA      YERC
TAD (140000)
DAC*      10
```

```
DZK* 10
LAC (ESAJ+CNTRFL
DAC* 10
DZM* POINT1
```

```
LAC* (10
DAC POINT#2
TAD (-1
DAC POINT#1
```

```
JMS* : DZRD. / START TO READ ANOTHER
DZLB
-5
```

```
MORE      LAC      POINT1 / CONT DISPLAY UPDATES
          TAD      (1
          JMS*     CMP.
          LAC      UPR. / ROOM FOR MORE
          NOP      / >
          JMP      OUT / = NO MORE ROOM
          NOP      / <
```

```
CS        JMS*     TIME
          JMP      .+1+6
          .DSA     XP
          .DSA     XS
          .DSA     YP
          .DSA     YS
          .DCA     STEP
          .DSA     TODAY
```

```
TNS      SCALE
JMP      .+1+3
.DSA     XS
.DSA     XP
.DSA     XERC
JMS IN.SV
LLS+7!CLO
DAC TEM*
```

```
JMS SCALE / PUT IN DISPLAY SCALING
JMP      .+1+3
.DSA     YS
.DSA     YP
.DSA     YERC
JMS IN.SV
XOR TEM
XOR (400000
DAC* POINT1
ISZ POINT1
LAC (ESAJ+CNTRFL
ISZ POINT2
```

DAC* POIN12
 DZM* POIN11

/ CONVERT DAYS TO YEARS, MONTHS, DAYS

```
.YRS.  LAC      (ESAJ+STRMFL
        DAC      TIMSW

        LAC      TOTDAY+1      / NOW TO MAKE IT INTEGER
        SPA
        XOR      (400000      / DONT'T ALLOW NEG DAYS
        DAC      TOTDAY+1

        LAC      TOTDAY / GET THE EXPONENT
        AND      (37
        CMA
        TAD      (1
        TAD      (43
        AND      (77
        XOR      (LRS      / SHIFT TO RESCALE
        CIL
        DAC      .+4
        LAC      TOTDAY
        LMO
        LAC      TOTDAY+1
        RX      / THIS IS THE SHIFTER TO REMOVE POWER 2

        DIV!20000
        305
        DAC      TIME1
        900
        DAC      YEARS#
        IDIV!20000
        144
        DAC      TIME2
        LACQ
        JMS      ASCII
        XOR      (400
        DAC      DISYRS

        LAC      TIME2
        JMS      ASCII
        DAC      DISYRS+1

.MOS.  LAC      TIME1
        IDIV!20000
        36
        DAC      TIME1
        LACQ
        JMS      ASCII
        DAC      DISMOS

        LAC      TIME1
        JMS      ASCII
        DAC      DISDAY

        DZM      TIMSW
```

```

SSSSSS LAC      .STP1  / IN STEP MODE
        SNA
        JMP      CHKLIM

        LAC      .STP2
        SZA
        JMP      .-2
        ISZ      .STP2

CHKLIM  LAC      STOPR  / CHECK FOR LIMIT FLAG
        SNA
        JMP      MORE

        LAC      YERLIM
        SNA
        JMP      MORE

        JNS*     CMP.
        LAC      YEARS
        JMP      MORE      / YERLIM > YEARS
        JMP      STREAM    / YERLIM = YEARS
        JMP      STREAM    / YERLIM < YEARS

OUT      JMP      STREAM

/ DIGITIZER TO FIX POINT
CONVRT  0          / ((DZ.0-1)/MAXX)*MX.H
        DAC      CON1
        LAC      MAXX
        DAC      CON2
        DAC      CON3
        CLL
        LAC*     MX.H
        MUL

CON1     0
        DIV

CON2     0
        DAC      CON1      /REMAINDER
        LACQ
        LLSS+11!10000
        DAC      CON2
        LAC      CON1
        FRDIV

CON3     0
        LLSS+11!1000
        LHD      CON2
        JMP*     CONVRT

/ ROUTINE TO CONVERT TO DISPLAY UNITS

SCALE   0

        JMS*     .DA
        JMP      .+1+3

P2      0
P1      0

```

```

FRC      0

JMS*     .AG      /DEL=((P2-P1)*1023./FLOAT(SCALE2))+FRC
.DSA     P2+400000
JMS*     .AJ
.DSA     P1+400000
JMS*     .AK
.DSA     SCALE2
JMS*     .AI
.DSA     FRC+400000
JMS*     .AH
.DSA     DEL
JMS*     IFIX
JMP      .+1+1
.DSA     DEL      / INT=IFIX(DEL)
DAC      INT

JMS*     FLOAT    / FRC=DEL-FLOAT(INT)
JMP      .+1+1
.DSA     INT
JMS*     .AM
.DSA     DEL
JMS*     .AH
.DSA     FRC+400000

JMS*     .AG      / P1=P2
.DSA     P2+400000
JMS*     .AH
.DSA     P1+400000

LAC      INT

JMP*     SCALE

```

/ PROGRAM TO CONVERT TO DISPLAY ASCII

```

ASCII    0
IDIV!20000
12
TAD      (60
DAC      .HLD.
LACQ
TAD      (60
LIS+11!10000
XOR      .HLD.
XOR      (400
JMP*     ASCII

```

/ PROGRAM TO RETRIVE DATA POINTS FOR GRADIENT
 / FORTRAN IV SUPPORT PROGRAM
 / GRADIENT THAT SET'S 0'S IN PT1,PT2,PT7,PT8,PT6,PT5
 / PT12,PT11 TO THE PRECEEDING POINT VALUE RESPECTIVELY
 / IE. PT1=0 SO PT1=PT2
 / IE. PT1=0 PT2=0 SO PT1=PT2=PT3
 / IE. PT3=0 ERROR CONDITION

 / CALLING SEQUENCE

```

/      DIMENSION ID(1)
/      CALL GRDPNT(IX,IY,ID)
/      IX,IY      X,Y, POSITION
/      ID          POINTS FOR DERIVATIVE

/  DERIVATIVE FORMULA
/      DD=1/12 ( X.N-2. - 8X.N-1. + 8X.N+1. - X.N+2. )
/  POINT DEFINITIONS
/
/      * 16      * 20
/      * 15      * 19
/      * 7       * 8       * 9       * 10      * 11      * 12
/      * 1       * 2       * 3       * 4       * 5       * 6
/      * 14      * 13      * 17
/
      .GLOBL  GRDPNT,.DA

GRDPNT  0

      JMS*    .DA
      JMP     .+3+1

X      0
Y      0
DATA   0

      LAC     (PT1      / SET SO FORTRAN SEE'S THIS MATRIX
      DAC*    DATA

      LAC*    X
      TAD     (3
      DAC X*PRIME      / THIS IS X IN INTEGER MODE

      LAC*    Y
      TAD     (3
      DAC Y*PRIME      /THIS IS Y IN INTEGER

      LAC XPRIME
      JMS* MX.ADZ      / CALCULATE SECTION ADDRESS
      LAC YPRIME
      0

DELPTR  0
      TNP OUT / ILLEGAL SECTION WORD REACHED BOUNDARY
      SAD SECTN      / SECTION HAS X,Y
      TNP FOUND.     / THE SAME
      DAC SECTN      / DIFFERENT
      CLL          / READ
      JMS* MX.RW      / READ THE SECTION
      TNP ERROR2

POTDSS  0      / STARTING SECTION ADDRESS POTENTIAL
PCTADR  0      / STARTING CORE ADDRESS
NX0     0      / STARTING -X FOR SECTION
NY0     0      / STARTING -Y FOR SECTION

      CLL
      LAC     SECTN
      JMS*    MX.RW
      JMP     ERROR2

```

```

TRNDKS  0          / STARTING DISC ADDRESS TRANS.
TRNADR  0          / STARTING CORE ADDRESS FOR TRANS.
.HLD.   0
        0

        CLL
        LAC        SECTN
        JMS*       MX.RU
        JMP        ERROR2
HSBDKS  0          / STARTING DISC ADDRESS FOR AQUIFIER
HSBADR  0          / STARTING CORE ADDRESS FOR AQUIFIER
        0
        0

FOUND.  LAC NX0
        TAD*       X
        DAC NXIN*   / X COLUMN NUMBER

        LAC*       MX.SH / SMALL X DIMENSION
        DAC XWIDE   / WIDTH OF X IN NODES
        CMA
        DAC        MXWD# / MXWD = -XWIDE

        LAC        NY0
        TAD*       Y

        MUL!20000
XWIDE   0          / NODES IN X
        LACQ       / DATA WORD FOR ROW ADJUSTMENT ( ADDRESS )
        ADD NXIN   / DATA WORD COLUMN ADJUSTMENT ( ADDRESS )
        DAC        .HLD. / RELATIVE ADDRESS X(I),Y(I)
        TAD        POTADR / FIRST DATA ADDRESS
        TAD        (-3 / TO GET I-2 : AND ADJUST FOR AUTO INDEX
        DAC* (11    / ADDRESS DATA WORD -1

        LAC* 11
        DAC PT1 / X(I-2),Y(I)
        LAC* 11
        DAC PT2 / X(I-1),Y(I)
        LAC* 11
        DAC PT3 / X(I),Y(I)
        LAC* 11
        DAC PT4 / X(I+1),Y(I)
        LAC* 11
        DAC PT5 / X(I+2),Y(I)
        LAC* 11
        DAC PT6 / X(I+3),Y(I)

        LAC* (11    / ADDRESS X(I+3),Y(I)
        ADD XWIDE   / ADDRESS X(I+3),Y(I+1)
        TAD (-6
        DAC* (11    / ADDRESS X(I-3),Y(I+1)

        LAC* 11
        DAC PT7 / X(I-2),Y(I+1)
        LAC* 11
        DAC PT8 / X(I-1),Y(I+1)

```

```

LAC* 11
DAC PT9 / X(I),Y(I+1)
LAC* 11
DAC PT10 / X(I+1),Y(I+1)
LAC* 11
DAC PT11 / X(I+2),Y(I+1)
LAC* 11
DAC PT12 / X(I+3),Y(I+1)

LAC* (11 / ADDRESS X(I+3),Y(I+1)
ADD XWIDE
ADD XWIDE / ADDRESS X(I+3),Y(I+3)
TAD (-3
DAC PT16 / ADDRESS X(I),Y(I+3)
TAD (1
DAC PT20 / ADDRESS X(I+1),Y(I+3)
ADD MXWD
DAC PT19 / ADDRESS X(I+1),Y(I+2)
TAD (-1
DAC PT15 / ADDRESS X(I),Y(I+2)
ADD MXWD
ADD MXWD
ADD MXWD
DAC PT14 / ADDRESS X(I),Y(I-1)
TAD (1
DAC PT18 / ADDRESS X(I+1),Y(I-1)
ADD MXWD
DAC PT17 / ADDRESS X(I+1),Y(I-2)
TAD (-1
DAC PT13 / ADDRESS X(I),Y(I-2)

LAC* PT13
DAC PT13
LAC* PT14
DAC PT14
LAC* PT15
DAC PT15
LAC* PT16
DAC PT16
LAC* PT17
DAC PT17
LAC* PT18
DAC PT18
LAC* PT19
DAC PT19
LAC* PT20
DAC PT20

LAC .HLD. / GET TRANS.
TAD TRNADR
DAC TRN1
DAC TRN2
ISZ TRN2
TAD XWIDE
DAC TRN3
DAC TRN4
ISZ TRN4

```



```

LAC*      TRN1
DAC       TRN1      / T(X(I),Y(I))
LAC*      TRN2
DAC       TRN2      / T(X(I+1),Y(I))
LAC*      TRN3
DAC       TRN3      / T(X(I),Y(I+1))
LAC*      TRN4
DAC       TRN4      / T(X(I+1),Y(I+1))

LAC       .HLD.     / GET AQUIFER
TAD       HSBADR
DAC       HSB1
DAC       HSB2
ISZ       HSB2
TAD       XWIDE
DAC       HSB3
DAC       HSB4
ISZ       HSB4
LAC*      HSB1
DAC       HSB1      / H(X(I),Y(I))
LAC*      HSB2
DAC       HSB2      / H(X(I+1),Y(I))
LAC*      HSB3
DAC       HSB3      / H(X(I),Y(I+1))
LAC*      HSB4
DAC       HSB4      / H(X(I+1),Y(I+1))

FRST      LAC PT1 / TEST 1' ST COLUMN
          SZA
          TBE SECND      / PT1 NOT = 0
          LAC PT2 / PT1 = 0
          SZA
          TBE FRST1      / PT2 NOT = 0 SO PT1=PT2
          LAC PT3 / PT2 = 0
          SZA
          TBE OUT / PT3 = 0
          DAC PT2 / PT3 NOT = 0 SO PT1=PT2=PT3
FRST1     DAC PT1

SECND     LAC PT7 / TEST 2' ND COLUMN
          SZA
          TBE THRD      / PT7 NOT = 0
          LAC PT8 / PT7 = 0
          SZA
          JMP SECND1      / PT8 NOT = 0 SO PT7=PT8
          LAC PT9 / PT8 = 0
          SZA
          JMP OUT / PT9 = 0
          DAC PT8 / PT9 NOT = 0 SO PT7=PT8=PT9
SECND1    DAC PT7

THRD      LAC PT6 / TEST 3' RD COLUMN
          SZA
          JMP FORTH      / PT6 NOT = 0
          LAC PT5 / PT6 = 0
          SZA
          JMP THRD1      / PT5 NOT = 0 SO PT6 = PT5

```

```

      LAC PT4 / PT5 = 0
      SNA
      JMP OUT / PT4 = 0
      DAC PT5 / PT4 NOT = 0 SO PT6=PT5=PT4
THRD1  DNG PT6

FORTH  LAC PT12      / TEST 4TH COLUMN
      SZA
      JNE FITH      / PT12 NOT = 0
      LAC PT11      / PT12=0
      SZA
      JMP FORTH1     / PT11 NOT = 0 SO PT12=PT11
      LAC PT10      / PT11 = 0
      SNA
      JMP OUT / PT10=0
      DAC PT11      / PT10 NOT = 0 SO PT12=PT11=PT10
FORTH1  DAC PT12

FITH    LAC      PT13      / CHECK OTHER DIRECTION 1
      SZA
      JMP      SIXTH      / PT13 NOT = 0
      LAC      PT14      / PT13 = 0
      SZA
      JMP      FITH1     / PT14 NOT = 0 SO PT13=PT14
      LAC      PT3
      DAC      PT14      / PT3=PT14=PT13
FITH1   DAC      PT13

SIXTH   LAC      PT17      / CHECK DIRECTION 2
      SZA
      JMP      SEVN      / PT17 NOT = 0
      LAC      PT18      / PT17 = 0
      SZA
      JMP      SIXTH1    / PT18 NOT = 0 SO PT17=PT18
      LAC      PT4
      DAC      PT13      / PT4=PT18=PT17
SIXTH1  DAC      PT17

SEVN    LAC      PT16      / CHECK DIRECTION 3
      SZA
      JMP      EIGHT     / PT16 NOT = 0
      LAC      PT15      / PT16 = 0
      SZA
      JMP      SEVN1     / PT15 NOT = 0 SO PT16=PT15
      LAC      PT9
      DAC      PT15      / PT9=PT15=PT16
SEVN1   DAC      PT16

EIGHT   LAC      PT20      / CHECK DIRECTION 4
      SZA
      JMP      INFLEO    / PT20 NOT = 0
      LAC      PT19      / PT20 = 0
      SZA
      JMP      EIGHT1    / PT19 NOT = 0 SO PT20 = PT19
      LAC      PT10
      DAC      PT19      / PT10=PT19=PT20
EIGHT1  DAC      PT20

```

EC	LAC	PT2	/ CHECK ON INFLECTION POINT
	CMA		
	ADD	PT3	
	DAC	X	/ PT3-PT2
	GSM		
	QAC	Y	/ ABS(PT3-PT2)
	LAC	PT14	
	CMA		
	ADD	PT3	
	DAC	DATA	/ PT3-PT14
	GSM		/ ABS(PT3-PT14)
	ADI	Y	/ ABS(PT3-PT14) + ABS(PT3-PT2)
	DAC	Y	
	LAC	DATA	
	ADD	X	
	GSM		/ ABS(PT3-PT2+PT3-PT14)
	SAD	Y	
	SXF		/ ABS(A+B) = ABS(A)+ABS(B) LOCAL MAX, MIN
	JMP*	GRDPNT	/ NOT A LOCAL MAX, MIN
	LAC	PT5	
	CMA		
	ADD	PT4	
	DAC	X	
	GSM		
	QAC	Y	
	LAC	PT13	
	CMA		
	ADD	PT4	
	CBV	0016	
	GSM		
	QDL	Y	
	DAC	Y	
	LAC	DATA	
	ADD	X	
	GSM		
	QAD	Y	
	SXF		
	JMP*	GRDPNT	
	LAC	PT8	
	CMA		
	ADI	PT9	
	DAC	X	
	GSM		
	QAC	Y	
	LAC	PT15	
	CMA		
	ADD	PT9	
	DAC	DATA	
	GSM		

$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$

ADD	PT10
GSM	
SZL	
ISZ	X
LAC	X
SNA	
SNP	OUT
SAD	(4
SNP	
JNF*	GRDPNT
DCM	X
LAC	PT14
CNA	
ADD	PT3
GSM	
SZL	
ISZ	X
LAC	PT18
CNA	
ADD	PT4
GSM	
SZL	
ISZ	X
LAC	PT15
CNA	
ADD	PT9
GSM	
SZL	
ISZ	X
LAC	PT19
CNA	
ADD	PT9
GSM	
SZL	
ISZ	X
LAC	X
SNP	
JNP	OUT
SAD	(4
JNP	OUT
JNP*	GRDPNT

PT1	0
PT2	0
PT3	0
PT4	0
PT5	0
PT6	0
PT7	0
PT8	0

PT9 0
PT10 0
PT11 0
PT12 0
PT13 0
PT14 0
PT15 0
PT16 0
PT17 0
PT18 0
PT19 0
PT20 0

HSB1 0
HSB2 0
HSB3 0
HSB4 0

TRN1 0
TRN2 0
TRN3 0
TRN4 0

/ INPUT FLOATING POINT

RFLTP. 0

JMS* DSRD.
LBUF
-20
JMS* DSWT.

LAC (LBUF
DAC* UP57L.
DFM* UP57C.

LAC (SKP / INIT THE TOTAL WORD SIGN
DAC SIGN / INIT TO +

JMS* RCHR. / GET FIRST CHR
JMP RF1 / DIGIT
JMP STREAM / LETTER - NO LETTERS ALLOWED -
SAD (053 / PUNCT - ASCII (+)
JMP -4 / WAS + SO ALREADY SET FOR IT
SAD (055 / ASCII (-)
SKP
JMP STREAM / NOT + OR -
LAC (NOP / SET TOTAL WORD SIGN TO NEG
DAC SIGN
JMP -12 / GO BACK FOR WORD

RF1 MUL120000-16 / FORM FIRST DIGIT
470400 / (10**4) * 2**4
DAC MANT / MANTISSA 10**4
JMS* UP57. / READ (.)

	SAD	(056	/ ASCII (.)
	SKP		
	JMP	STREAM	/ NOT .
	LAC	(23420	/ 10**4
	DAC	MULT	/ MULTIPLIER OF INPUT DIGIT
LOOP	LAC	MULT	/ FORM POWER OF TEN FOR DIGIT
	IDIV	120000	
	12		
	LAC0		
	DAC	MULT	/ REDUCE BY 10 DEC
	JMS*	RCHR.	/ READ NEXT CHR
	JMP	RF2	/ DIGIT
	JMP	RF3	/ LETTER
	JMP	RF3	/ PUNCT
RF2	MUL	120000	
MULT	A		/ MULTIPLIER
	LAC0		
	TAD	MANT	
	DAC	MANT	
	JMP	LOOP	
RF3	LAC	MANT	/ 10**4 MANT
	MUL	120000	/ NEED TO REMOVE 10**4
	043335		/ (2**18)(2**13)/10**4
			/ AC = 2**13 MANTISSA
	NORM		/ NORMALIZE 2**((13+L) M = 2**17 2**((L-4) M
	DAC	MANT	
	LAC0		/ EXPONENT
	CMA		/ -34-L-1 = -35-L
	TAD	(41	
	DAC	EXP2	/ EXPONENT 2
	PCM	EXP10*	/ CLEAR FOR THE EXPONENT
	JMS*	UP57B.	/ BACK UP LINE BUFFER POINTER
RF4	JMS*	RCHR.	/ READ NEXT CHR
	JMP	RF5	/ DIGIT
	TAD	(100	/ LETTER
	SAD	(105	/ PUNCT ASCII(E)
	JMP	RF4	
	SAD	(053	/ ASCII(+)
	JMP	RF4	
	SAD	(015	/ CARRIAGE RETURN
	JMP	RF9	
	SAD	(055	/ ASCII (-)
	SKP!CLC		
	JMP	STREAM	/ NOT (+), (-), (E), (CR)
	DAC	EXP10	/ SIGNAL (-) EXPONENT
	JMP	RF4	

```

RF5      JMS*    RNUM.    / READ NUMBER
          12
          XOR     EXP10
          SPA
          TAB     (1
          DAC     EXP10
          ISZ*    UP57C.

MORE.    LAC     EXP10    / REDUCE POWER OF TDN
          SPA
          JMP     RF7      / (-) REQUIRES SPECIAL ATTENTION
          SNA
          JMP     RF9      / FINISHED EXP10 = 0
          LAC     EXP2
          TAB     (3
          DAC     EXP2    / EXP2=EXP2+3
          LAC     EXP10
          TAB     (-1
          DAC     EXP10    / EXP10=EXP10-1

          LAC     (500000 / ((10**1-1)/4*2**3) 2**17
          INP     R18

RF7      LAC     EXP2
          TAB     (-4      / -3 FOR 4/3*2**3, -1 FOR SCALING
          DAC     EXP2
          ISZ     EXP10    / EXP10=EXP10+1
          NRP

          LAC     (631463 / ((10**1-1)/4*2**3) 2**18

RF8      CUL
          M0L

MANT     2        / AC = 2**10*ADJUSTMENT+MANT
          LLS+1
          DAC     MANT     / 2**17 MANT
          SHLRCR    / KEEP NORMALIZED
          JMF     MORE.
          DAC     MANT     / SCALED TO 173
          ISZ     EXP2    / TAKE ONE OF THEM OFF
          INP     MORE.

RF9      LAC     MANT
SIGN     SHP                / SIGN OF 1016L WORD
          SNA
          DAC     MANT.
          JMP*    R18P.

EXP2     0
MANT.    0

```

/ FLOATING POINT VARIABLES

```

STEP     000000 / STEP LENGTH IN NODES
          000000
SCALE2   000000 / 1023/MAXX(MX.H OR MX.V)
          000000

```


FS12	000012	/ 512.
	200000	
F1023	000012	/ 1023.
	377600	
F8192	051007	/ 8192./100.
	243656	
XP	0	/ CURRENT X (NODES)
	0	
XS	0	/ NEXT X
	0	
XFRC	0	/ X FRACTION IN DISPLAY UNITS
	0	
YP	0	/ CURRENT Y (NODES)
	0	
YS	0	/ NEXT Y
	0	
YFRC	0	/ Y FRACTION IN DISPLAY UNITS
	0	
DEL	0	
	0	
INT	0	
TOTDAY	0	/ TRAVEL TIME DAYS
	0	
TIME1	0	/ HIGHER ORDER TRAVEL TIME INTEGER DAYS
TIME2	0	/ LOWER ORDER TRAVEL TIME INTEGER DAYS
TRACK	ESAJ+. +1	
	764500	/ MESSAGE "TRAVEL TIME PROGRAM
	127750	
	124122	
	101126	
	105114	
	040124	
	111115	
	105000	
	040120	
	122117	
	107122	
	101515	
REAL1	ESAJ+REAL1+2	
	.NORIT	
	ESAJ+REAL2	
	.ABSV 10,35	
	.9BIT /DIGITIZE STREAMLINE ORIGIN/<400>	
REAL2	0	
	ESAJ+REAL3	
	.ABSV 10,35	
	.9BIT /ENTER CONTOUR VALUE/<400>	
REAL3	0	
	ESAJ+ECHO	
	.ABSV 10,35	
	.9BIT /ENTER LIMIT VALUE IN YEARS/<400>	

```

ECHO      ESAJ+.+3          / ECHO FILE
          ESAJ+TIMFIL
          -20
          700000
          140000
          140000
          .BLOCK 17
          ESAJ+ECHO+1

```

```

/ TRAVEL TIME DISPLAY FILE
.NORIT

```

```

TIMFIL    .ABSVC 128,158
          .9BIT /TRAVEL TIME/<400>

          .ABSVC 64,128
          .9BIT /YEARS/<400>
          .ABSVC 168,128
          .9BIT /MONTH/<523>
          .ABSVC 206,128
          .9BIT /DAY/<523>

```

```

TIMSW     ESAJ+STRMFL

```

```

          .ABSVC 64,88
DISYRS    400000
          000000
          .ABSVC 192,88
DISMOS    400000
          .ABSVC 320,88
DISDAY    400000

```

```

STRMFL    ESAJ+CNTRFL
CNTRFL    ESAJ+TRACK

```

```

. TITLE   DRAW COUTOUR LINES

```

```

/ 12-18-70
/ L H GERHARDSTEIN

```

```

/ DRAW ALL CONTOUR LINES OF A VALUE
/ CALLING SEQUENCE:

```

```

/      LAC      VALUE
/      JMS      ALCNTR
/      .....
/      .OCT

```

```

ALCNTR    0
          DCC      ALCNTV
          LAC      (ESAJ+CNTRFL
          DAC*     POINT1
          LAC      POINT1
          TAD      C1
          DAC      CNTR*FX
          DEM      SECTN
ALCNT1    LAC      SECTN
          XOR*     MX.NV

```

```

                AND      (777
                SNA
                JMP      ALCNT2
                JMP      ALCNT4
ALCNT3.  LAC      SECTN
                LRS+11
                XOR*     MX.NH
                AND      (777
                SNA
                JMP      ALCNTX
ALCNT4  LAC      SECTN
                JMS      CNTR
ALCNTV  0
                ISZ      SECTN
                JMP      ALCNT1
ALCNT2  LAC      SECTN
                AND      (777000
                TAD      (1000
                DAC      SECTN
                JMP      ALCNT3
ALCNTX  DZM*     CNTRFX
                ISZ      CNTRFX
                LAC      (ESAJ+CNTRFL
                DAC*     CNTRFX
                DZM*     POINT1
                LAC      CNTRFX
                TAD      (-1
                DAC      POINT1
                NOP
                NOP
                JMP*     ALCNTR

```

```

/ DRAW ONE COUTOUR FROM SPECIFIED SECTION
/ CALLINE SEQUENCE:
/      LAC      MATRIX SECTION NO.
/      JMS      CNTR
/ VALUE COUTOUR VALUE
/      .....

```

```

                .GLOBL  MUL.,MX.RW
                .GLOBL  MX.NH,MX.NV,MX.O,MX.SH,MX.SV,MX.WC
                .OCT
CNTR  0
                DAC      SECTN#  / SECTION NO.

                CLL      / READ
                JMS*     MX.RW  / READ MATRIX SECTION
                XX      / ILLEGAL SECTION
DKADR2 0          / FILE DISC ADDRESS
CORADR2 0        / MATRIX SECTION CORE ADDRESS
XX00    0
YY00    0

                LAW      -1
                TAD      XX00  / -X0 -1
                CMA      / X0
                DAC      XX00

```

```

DAC      XLEFT#   / LEFT BOUNDARY
LAW      -1
TAD      YY00     / -Y0 -1
CMA
DAC      YY00
DAC      YLOW#    / LOWER BOUNDARY

LAC*     CNTR     / CONTOUR VALUE
ISZ      CNTR
CMA
DAC      TEM      / -V

/ RE-FORMAT DATA IN MATRIX SECTION
LAC*     MA.WC    / -WORDS IN SECTION
DAC      LIT#
LAC      CORAD2   / DATA S.P.
DAC      P10#
DAC      IUX#
CNTRL    CLO      / BITS = 0'S
LAC*     IUX      / V(I)
SNAICLL
CMQ      / IF V(I) = 0, SET BITS = 1'S
ADD      TEM      / V(I) -V
SPA
CML      / SET LINK TO SIGN
LLS+4    / 16*(V(I)-V) -N(I)
AND      (577777
SFI      / SET A09 TO SIGN
XOR      (4000000
DAC*     IUX      / W(I) & 7777000 -BITS(14-17)
ISZ      IUX
ISZ      C-1
JMP      CNTRL

/ CALCULATE SPIRAL COUNTERS
/ AND SEARCH LIMITS
LAW      -1
TAD*     MX.L0
CMA
DAC      TEM      / -0
LAC      SECTN    / SECTION NO. WORD
LAC+11
AND      (177
TAD      C1       / NH +1
XOR*     MA.NH    / TEST FOR RIGHT SECTION
SNAICLL   / -1
LAC      TEM      / -0
TAD*     MX.SH    / SH -0 SH -1
CMA      / -SH +0 -1 SH
DAC      HUNT#    / -NO HUNT MOVES IN SCAN AREA
CMA      / NOUES -1
TAD      XLEFT
DAC      XRIGHT#  / RIGHT BOUNDARY

LLS+1011   / SECTN Y COORD.
TAD      C1       / NV +1
XOR*     MX.NV    / TEST FOR UPPER SECTION

```

```

      SZAI:CLC      /          -1
      LAC          TEM      / -0
      TAD*         MX.SV    / SV -0      SV -1
      CMA          / -SV +0 -1      -SV
      DAC          VCNT*    / -NO. VERT NODES IN SCAN AREA
      CMA          / NODES -1
      TAD          YLOW
      DAC          YUPER*   / UPPER BOUNDARY

      / PERFORM SPIRAL SCAN OF THE MATRIX SECTION
      / STARTING POINT IS LOWER LEFT
      LAC*         PT0
      DAC          WD0*     / LOWER LEFT VALUE

      / SCAN RIGHT
      LAC          HCNT
      TAD          (1
      TMP          .+4
CNTR2  LAC          HCNT
      TAD          (1
      DAC          HCNT
      SMA
      JMP          CNTREX   / DONE
      DAC          CNT
      BDM          IL0*     / IL0 = 0 (RIGHT)
      LAC          PT0
      TAD          (1      / POINT RIGHT OF PT0
      JMS          DRAW
      ISZ          XX00     / X00 = X00 +1
      ISZ          CNT
      JMP          .-5      / CNNTINUE RIGHT

      / SCAN UP
      ISZ          IL0      / IL0 = 1 (UP)
      LAC          VCNT
      TAD          (1
      DAC          VCNT
      SMA
      JMP          CNTREX   / DONE
      DAC          CNT
      LAC          PT0
      TAD*         MX.SH    / POINT ABOVE PT0
      JMS          DRAW
      ISZ          YY00     / Y00 = Y00 +1
      ISZ          CNT
      JMP          .-5      / CONTINUE UP

      / SCAN LEFT
      ISZ          IL0      / IL0 = 2 (LEFT)
      LAC          HCNT
      TAD          (1
      DAC          HCNT
      SMA
      JMP          CNTREX   / DONE
      DAC          CNT
      LAW          -1
      TAD          PT0      / POINT LEFT OF PT0

```

```

JMS      DRAW
LAW      -1
TAD      XX00
DAC      XX00      / X00 = X00 -1
ISZ      CNT
JMP      -7      / CONTINUE LEFT

/ SCAN DOWN
ISZ      IL0      / IL0 = 3 (DOWN)
LAC      VCNT
TAD      (1
DAC      VCNT
SHA
JMP      CNTRX    / (DONE)
DAC      CNT
LAW      -1
TAD*     MX,SH    / SH -1
CMA      .        / -SH
TAD      PT0      / POINT BELOW PT0
JMS      DRAW
LAW      -1
TAD      YY00
DAC      YY00      / Y00 = Y00 -1
ISZ      CNT
JMP      -11     / CONTINUE DOWN
JMP      CNTR2    / REPEAT

/ CONTOUR DRAW EXIT
CNTRX    JMP*     CNTR

/ DRAW CONTOUR
DRAW      0
DAC      PT1
DAC      P1      / P1 = WD1 ADDRMP0
LAC*     P1      / WD1
XOR      WD0      / NEG IF INTERCEPT BETWEEN PT0 & PT1
SHA
JMP      DRAW0    / INTERCEPT FOUND
DRAWX    LAL      P1      / ADVANCE PT0 TO PT1
DAC      PT0
LAC*     PT0
DAC      WD0
JMP*     DRAW

/ SEND SHORT VECTOR IF ANY LEFT
DRAWX1    ISZ      CNTR2
JMP      DRAWX
JMS      DRVECT
JMP      DRAWX
DRAW0     LAC      IL0      / SCAN DIRECTION
DAC      IL#
TAD      LRS+0    / TEST IF CONTOUR ALREADY DRAWN
DAC      DRAW0A    / LRS+0(IL)
XOR      17
DAC      DRAW0B    / LRS+0(IL)+2
LAC      WD0
DRAW0A    XX      / SHIFT BIT TO AC17

```

```

      PAR                      / AND THEN TO LINK
      SZL
      JMP      DRAWX          / CONTOUR DRAWN
      LAC*     P1             / CHECK P1 IN -IL DIRECTION
DRAW0B  XX              / FOR CROSSING
      PAR
      SZL
      JMP      DRAWX

      / INITIALIZE DRAW PARAMETERS
      SET      VQ*           / VECTOR QUADRANT = 0
      LAC      P10
      DAC      P0*           / OBJECT POINT ADDR
      LAC      XX00          / X0 OF INIT OBJ POINT
      DAC      XX0*
      LAC      YY00          / Y0 OF INIT OBJ POINT
      DAC      YY0*

      / CALCULATE X,Y OF FIRST POINT IN CONTOUR
      JMS      CALXY
      / SEND ABS VECTOR FOR CONTOUR STARTING POINT
      LAC      XNEW
      XOR      (600000
      DAC*     CNTRFX
      ISZ      CNTRFX
      LAC      YNEW
      XOR      (140000
      DAC*     CNTRYX
      ISZ      CNTRYX
      BR       -1            / SET FOR EVERY OTHER SHORT VECTOR
      DAC      CNT2*

      LAC      XOLD          / STORE OLD X,Y
      DAC      XOLD*
      LAC      YNEW
      DAC      YOLD*

      / DRAW NEXT LINE SEGMENT
      / CHECK IF SEGMENT DRAWN ALREADY
LINE    LAC      IL          / INTERCEPT LINE DIRECTION
      TAD      (1RS
      DAC      LINE0A
      XOR      (2
      DAC      LINE0B
      LAC*     P0
LINE0A  XX
      PAR
      SZL
      JMP      DRAWX1        / END OF CONTOUR LOOP
      LAC*     P1
LINE0B  XX
      PAR
      SZL
      JMP      DRAWX1        / END OF CONTOUR LOOP

      / TEST IF CONTOUR CROSSES A BOUNDARY
      / GOING OUT OF SECTION

```

```

LAC      YY0
SAD      YLOW      / LOWER BOUNDARY
LAW      2-4
SAB      YUPPER     / UPPER BOUNDARY
LAW      0-4
SAB
LAC      XH0
SAD      XLEFT     / LEFT BOUNDARY
LAW      1-4
SAB      XRIGHT    / RIGHT BOUNDARY
LAW      3-4
SAB
JMP      DRAW1      / NOT ON BOUNDARY
SAB
SAD      1
JMP      DRAW2      / TEST FOR VQ = 0
XOR
SAD      1
JMP      DRAW3      / TEST FOR VQ = 3
SAB
JMP      DRAW3
DRAWF    LAC      VQ
XOR      0
SAB
DRAWF    LAC      VQ
SAB
JMP      DRAW1      / CROSSES BOUNDARY

```

/ CALCULATE L1 : VQ AXIS NORMAL TO IL

/ L1 = (IL*11)&3 IF VQ = 0

/ L1 = (IL-1)&3 IF VQ = 3

DRAW1 LAC VQ / VECTOR QUADRANT

SAB/CLO

LAC 01

SAB IL

AND 03

BAC L1#

/ ADDRESS = P1, P2, P3

/ DELT1 = LFCN(IL)

/ DELT2 = LFCN(L1)

/ P1 = P0 + DELT0

/ P2 = P1 + DELT0 + DELT1

/ P3 = P2 + DELT1

LAC L1

JMS LFCN

LAC TEN

ADD P0

LAC P1#

LAC TEN

ADD P1

BAC P2

/ TEST WHICH CASE

/ IE: WHICH INTERCEPT LINE

LAC P0

XOR P1

SAB/CLO


```

      JMP      L44          / CASE (1)
      LAC*     P3
      XOR*     P1
      SPACLA
      L44      (-1)        / CASE (2)
                          / CASE (3)

      L45      (-2)
      TRS*     MUL
      B4 AB2-DR1AP
      L46      (001AB-1)
      ASC*     (-10)

/ MARK P2 P1 TO SHOW THAT THIS VECTOR DRAWN
/ MARK P2 IN IL DIRECTION AND P1 IN ILS2 DIRECTION
      LAC      IL
      JMS      MARK
      LAC*     P0
      DAC*     P0
      LAC      IL
      XOR      (-2)
      JMS      MARK
      LAC*     P1
      DAC*     P1

/ CALCULATE NEW P0,P1
      ACT*     10
      PAC      P0
      ACT*     10
      PAC      P1

/ CALCULATE NEW X0,Y0
      ACT*     10          / LAC DIR OF NEW P0 FROM P0
      CDS+1      / X,Y BIT IN NO
      XIF          / +,- BIT IN LINK
      LLS+1001      / X,Y BIT
      S7A
      JMP      L47
      LAC      X00          / INCREMENT OR DECREMENT X0
      S7B
      L47      (-2)
      L48      (-1)
      PAC      X00
      JMP      L49
      LAC      Y00          / INCREMENT OR DECREMENT Y0
      S7C
      L49      (-2)
      L50      (-1)
      PAC      Y00

/ CALCULATE NEW IL
      LAC      (-1)
      ACT*     10
      DAC      IL

/ CALCULATE NEW Y0
      LAC      (-3)
      ACT*     10

```

```

          ORC      V0
/ CALCULATE NEW P1
          LAC      IL
          JMS      LFCN
          IAD      P0
          DAC      P1

/ CALCULATE NEW POINT IN CONTOUR
          JMS      CALXY
          ISZ      CNT2
          JMP      LINE
          LAW      -2
          DAC      CNT2
          JMS      DRVECT
          JMP      LINE

/ SEND SHORT OR LONG VECTOR
DRVECT 0
          LAC      YOLD
          CMA
          ADD      YNEW
          GSM
          SZL
          XOF      (400000
          DAC      DY*

          LAC      XOLD
          CMA
          ADD      XNEW
          GSM
          SZL
          XOF      (400000
          DAC      DX*

          AND      (1700
          SFA
          JMP      DRLONG
          LAC      DY
          AND      (1700
          SFA
          JMP      DRLONG

DRSHRT  LAC      DY      /SHORT VECTOR
          SPA
          XOF      (100
          LRS+7
          LAC      DX
          SPA
          XOF      (100
          LLS+7
          XOF      (400000

DRVC11  DAC*     CNTRFX
          ISZ      CNTRFX

```

```

        LAC      XNEW
        DAC      XOLD
        LAC      YNEW
        DAC      YOLD
        JMP*     DRVEC1

DRLONG  LAC      D1          /LONG VECTOR
        SPA
        XOR      (402000
        XOR      (800000
        DAC*     CNTRFX
        ISZ      CNTRFX
        LAC      DY
        SPA
        XOR      (402000
        JMP      DRVEC1

/ CASES TABLE
/ CASE(1)
DRTAB   LAC      P3          / NEW P0
        LAC      P0          / NEW P1
        LAC      L1          / DIRECTION OF NEW P0 FROM P0
        XOR      L1
        XOR      VQ          / NEW VQ

/ CASE(2)
DRTAB2  LAC      P3
        LAC      P2
        LAC      L1
        LAC      IL
        LAC      VQ

/ CASE(3)
        LAC      P1
        LAC      P2
        LAC      IL
        LAC      L1
        XOR      VQ

/ MARK DATA WORDS
MARK    /
        LAC      CLRS
        DAC      MARKDS
        LAC      CLS-CLQ-LRS
        DAC      MARKLS
        JMP*     MARK
        LAC      MARK
        DAC      LEM

MARKES  XG
        DAR
        SZL
        JMP      MARK
        LAC      CL

MARKLS  XG
        LAC      LEM
        JMP*     MARK
        LAC      MARK

```

```

      JMP*      MARK

/ LINE DETECTION FUNCTION
LFCN      0
      LPS+1
      S*0
      S*0      (C00)-SKP
      L*0      (SKP)
      D*0      (C00)
      L*0+1001
      L*0      (C)
      S*0
      L*0+      (M)SH
LFCNS      S*0
      L*0      (C)
      JMP*      LFCN

/ CALCULATE X,Y FOR DISPLAY
/ FROM X*, Y*, IL: ALPHA=W0/(W0+W1)
CALXY      0
      / CALCULATE ALPHA = W0/(W0+W1)
      L*0*      P1      / W1
      AND      (777760)
      L*0
      L*0      (17)
      D*0      TEN1
      L*0*      P0      / W0
      ADD      (777760)
      S*0
      L*0      (17)
      D*0      TEN0+
      L*0      TEN1
      L*0
      L*0      TEN1      / W0+W1
      S*0
      D*0      L*0
      L*0      TEN0      / W0
      C*0
      S*0
      CM*0
      D*VS
      Z
      L*00
      S*PL
      C*LC
      L*MO

      L*0      X*0      / OBJECT POINT COORDINANT
      L*SS+12
      D*0      X*0*W0
      L*0      Y*0
      L*SS+12
      D*0      Y*0*W0
      L*0      L1      / INT LINE DIRECTION
      C*LR
      L*SS+1012      / 2*-10 *ALPHA
      L*NI

```

```

      DIF      .+3      / + DIRECTION
      CMA      / - IRECTION
      TAD      (1
      LNO
      LAC      IL
      RAR
      LALO
      CRL
      JAP      .+4
      TAD      XNEW
      DAC      XNEW      / 2**10 *XNEW
      JMP      .+3
      TAD      YNEW
      DAC      YNEW      / 2**10 * YNEW
      CLE
      LAC      XNEW      / 1024 *X
      IDIV
CALXY1  220
      LALO      / DISPLAY X COORD
      SAB      (2000
      LAC      (1777
      DAC      XNEW
      LAC      YNEW
      IDIV
CALXY2  220
      LALO
      SAB      (2000
      LAC      (1777
      DAC      YNEW
      TAD *      CALXY

```

```

      .LND

```

```

SUBROUTINE TIME(X1,X2,Y1,Y2,STEP,TOTDAY)
C
C THIS IS THE ROUTINE TO CALCULATE TRAVEL TIMES
C THIS VERSION IS FOR USING TRANSMISSIVITY
C
C X1      X POSITION (I)      NODES
C X2      X POSITION (I+1)    NODES
C Y1      Y POSITION (I)      NODES
C Y2      Y POSITION (I+1)    NODES
C STEP    STEP LENGTH       NODES
C TOTDAY  TRAVEL TIME (TOTAL) DAYS
C
C
C DT=((H-H0)(SIGMA)(STEP))/((GRAD)(TRN))
C H      POTENTIAL          FEET
C H0     AQUIFIER           FEET
C SIGMA  POROSITY           UNITLESS
C STEP   STEP LENGTH       NODE
C GRAD   GRADIENT          FEET/NODE
C TRN    TRANSMISSIVITY     FT2/DAY
C
C
C DIMENSION ID(1),DATA(28)
C
C EQUIVALENCE (PT1,DATA(1)),(PT2,DATA(2)),(PT3,DATA(3))
C EQUIVALENCE (PT4,DATA(4)),(PT5,DATA(5)),(PT6,DATA(6))
C EQUIVALENCE (PT7,DATA(7)),(PT8,DATA(8)),(PT9,DATA(9))
C EQUIVALENCE (PT10,DATA(10)),(PT11,DATA(11)),(PT12,DATA(12))
C EQUIVALENCE (PT13,DATA(13)),(PT14,DATA(14)),(PT15,DATA(15))
C EQUIVALENCE (PT16,DATA(16)),(PT17,DATA(17)),(PT18,DATA(18))
C EQUIVALENCE (PT19,DATA(19)),(PT20,DATA(20))
C EQUIVALENCE (H01,DATA(21)),(H02,DATA(22)),(H03,DATA(23))
C EQUIVALENCE (H04,DATA(24))
C EQUIVALENCE (TR1,DATA(25)),(TR2,DATA(26)),(TR3,DATA(27))
C EQUIVALENCE (TR4,DATA(28))
C
C SCALE IS THE RELATIONSHIP FEET PER NODE
C DATA SCALE /1000./
C DATA SIGMA /0.1/
C
C IX=IFIX(X1)
C IY=IFIX(Y1)
C IF (IX.EQ.IXS.AND.IY.EQ.IYS) GO TO 550
C IXS=IX
C IYS=IY
C CALL GRDPNT(X1,IY,ID)
C
C DO 500 I=1,24,1
C DATA(I)=(FLOAT(ID(I))*100.)/2.**13
500 CONTINUE
C DO 525 I=25,28,1
C DATA(I)=10.0**((FLOAT(ID(I))/2.**13)
525 CONTINUE
C
C 550 FX=X1-FLOAT(IXS)
C FY=Y1-FLOAT(IYS)
C

```

```

GP1=PT1-8.*PT2+8.*PT4-PT5
GP2=PT2-8.*PT3+8.*PT5-PT6
GP3=PT7-8.*PT8+8.*PT10-PT11
GP4=PT8-8.*PT9+8.*PT11-PT12
C
GP1=GP1+FX*(GP2-GP1)
GP3=GP3+FX*(GP4-GP3)
GX=(GP1+FY*(GP3-GP1))/12.
C
GP1=PT13-8.*PT14+8.*PT9-PT15
GP2=PT14-8.*PT3+8.*PT15-PT16
GP3=PT17-8.*PT18+8.*PT10-PT19
GP4=PT18-8.*PT14+8.*PT19-PT20
C
GP1=GP1+FY*(GP2-GP1)
GP2=GP3+FY*(GP4-GP3)
C
GY=(GP1+FX*(GP2-GP1))/12.
C
GRAD=GX**2+GY**2
GRAD=SQRT(GRAD)
C
GP1=PT3+FX*(PT4-PT3)
GP2=PT9+FX*(PT10-PT9)
H=GP1+FY*(GP2-GP1)
C
GP1=H01+FX*(H02-H01)
GP2=H03+FX*(H04-H03)
H0=GP1+FY*(GP2-GP1)
C
GP1=TR1+FX*(TR2-TR1)
GP2=TR3+FY*(TR4-TR3)
TRN=GP1+FY*(GP2-GP1)
C
X2=X1+STEP*(GX/GRAD)
YC=Y1+STEP*(GY/GRAD)
C
D1=((H-H0)*SIGMA*ABS(STEP))/(GRAD*TRN)
DT=DT*(SCALE**2)
TODAY=TODAY+DT
C
RETURN
END

```

APPENDIX D

TRANSMISSIVITY PROGRAM (STEADY STATE) LISTING

LISTING

TRANSMISSIVITY PROGRAM (STEADY STATE)

```

.TITLE FLOW TUBE SET-UP

/      ** STEADY STATE VERSION **
/      SPECIAL WITH FORTRAN TRANSMISSIVITY CALCULATOR

/      1-8-77
/      D R FRIEDRICHS
/      L E ADDISON

/      OPEN MATRIX FILE AND INITIALIZE FOR
/      FLOW TUBE GENERATION AND DISPLAY

.DAT=135
.SCOM=100

ESAJ=200000

.GLOBAL SCALER,IPMX,
.GLOBAL UPS7,UP576,RCMP,IRNUM,
.GLOBAL MX,IKK,MN,H,MX,V,MX,RW,MX,FDZ
.GLOBAL MX,SH,MX,SV,MX,MC
.GLOBAL IWDAT,WMCG,UP57L,
.GLOBAL IRDAT,UP57C
.GLOBAL DZIN,DZPT,DZWT,
.GLOBAL FPSL,
.GLOBAL DSIN,DSF1,DSWT,
.GLOBAL LODR,CAP,
.GLOBAL DKD,HLOG,FG2,
.GLOBAL TRANS,TCALC

BEGIN CAL+775 / .INIT -3
1
BEGIN
TEM1 0

CLL
LAW -3 / DAT -5 = YTA.
JMS* IWDAT. / INITIALIZE IOPS LIBRARY
100000+LBUF / LINE BUFFER
TEM2 0

LAC (200000
XOR DKD.
DAC* (,DAT+10
.INIT 10,0,0

.FSTAT 10,COMMON / COMMON DATA
SNA .
JMP ERR05 / NO COMMON DATA SO EXIT
DAC COM,+2

COM. .TRAN 10,0,7777,DKNTRL,112
.WAIT 10

LAC DZIN. / SET SO DON'T ZERO THE DIGITIZER WHEN INIT
TAD (2
DAC SV

```

```

LAC      (NOP
DAC*     SV

JMS*     WMSG.
TITLE
GETMAP   LAC      (2
JMS*     LODR.
400000+DKD.
PROJ
400000+.SCOM+2
JMP      ERROR2
DAC      LOR.*

RSTAT    LAC      (2      / DISC UNIT NO.
JMS*     MX.IWK  / INIT TO WORK ON FILE
POT1     / NAME:EXT
JMP      ERROR2  / NOT FOUND
DAC      DKADR   / REFERENCE DISC ADDRESS

LAC      (2
JMS*     MX.IWK
TRN
JMP      ERROR2
DAC      DKADR0
DAC      DKADR1

/  SETUP PROPER SCALING PARAMETER.
LAC*     MX.H     /NODES IN X DIREC.
CMA
TAD*     MX.V     /NODES IN Y DIREC.

SMA
JMP      .+5
LAC*     MX.H     / X IS LARGER
TAD      (-1
DAC      SCALE2
JMP      .+3
LAC*     MX.V     / Y IS LARGER
JMP      .-4

LAC*     MX.WC    / - WORD COUNT PER SECTION
TAD*     (.SCOM+3  / HIGHEST FREE ADDRESS
DAC      WTRDAT   / ADDRESS OF DATA
DAC      CORAD1   / GENERATE TRANS MATRIX CORE BUFFERS
DAC      CORAD0
TAD      (-1
DAC      UPR.*    / UPPER FREE CORE LOCATION

JMS*     DZIN.    / INIT THE DIGITIZER

/  SETUP ESAJ FOR PERMANENT DISPLAY FILE
LAC*     (.SCOM+2
XOR      (ESAJ
TAD      (14
DAC      STRMFL

GOBABY   CLC

```

```

DAC      THUMBS* / GENERATE TRANS MATRIX SWITCH
DAC      SECTN*  / CURRENT DATA SECTION IN CORE

JMS      REMOVE  /INITIALIZE STREAMLINE FILE*

CLL              / USE INTDBNL KEYBOARD
JMS*    DSIN.    / INIT DISPLAY
0              / KEY BOARD
.DSA    LTPN     / LIGHT PEN
0              / OVERFLOW
0              / COMMAND
.DSA    KEYBD    / FUNCTION
0              / TRANSMIT
.DSA    ECHO     / ECHO FILE
.DSA    TRACK    / START OF DISPLAY BUFFER

JMP      FLODUN

DISPLA  NOP      / ENTRANCE DISPLAY ROUTINE

JMS      SETUP
JMS FLOTUB      / DRAW FLOW TUBE
JMP      .-1

/
/
/ KEYBOARD INTERRUPT ROUTINE.
/
KEYBD    0
DAC      CHAR
SAD      KTBL+1
JMP      KYTRN
LAC      KTFG
SPA
JMP*     KEYBD
LAC      KTBL
DAC*     (15
LAC      KDTBL
DAC*     (16
KYBDLP   LAC*     15
SNA
JMP*     KEYBD
SAD      CHAR
JMP      .+3
ISZ*     (16
JMP      KYBDLP
JMP*     16
KYTRN    CLA
DAC      KTFG
JMP*     KEYBD
KTFG     0
HOME     660077
          140077

/
/
SETUP    0
LAC      POS100

```

```

DAC      POS
LAC      NEG100
DAC      NEG
LAC      (DSFILE
DAC      DSPNTR#
LAC      (1      /CURSOR=1 (LARGE)
DAC      SIZE#   /CURSOR=0 (SMALL)
JMP*     SETUP

/
/
KTBL
.
377
417      /RIGHT
416      /LEFT
415      /DOWN
414      /UP
433      /CURSOR HOME
431      /POINT
427      /LINE
534      /SOM
461      /INCR=1 (CURSOR)
462      /INCR=10
463      /INCR=100
537      / L.P. DRAW
432      /ERASE TO END OF LINE--LP DRAW
412      /ERASE TO END OF DISPL--DELETE REF LINE
536      /OMEGA--REMOVE ALL STREAMLINES.
533      /DIVISION--UP OR DOWN GRADIENT.
476      / (RIGHT BRAC )-- INIT. LINE DETECT
541      / (LEFT BRAC )-- LEAVE LINE DETECT MODE
453      / + -- EXIT TO CONTROLLER
0

/
KDTBL
.
JMP*     KEYBD
JMP      RTIT
JMP      LFIT
JMP      DWIT
JMP      UPIT
JMP      CURS
JMP      KPOINT
JMP      KLINE
JMP      SOM
/  CURSOR INCREMENTS
JMP      UPSL
JMP      UPMD
JMP      UPLRG
/  LIGHT PEN DRAW RESPONSE
JMP      LPDRAW
/  ERAPLAST LINE
JMP      ERASE1
/  ERASE LAST REFERENCE LINE
JMP      ERASE2
/  REMOVE ALL STREAMLINES
JMP      RMOVE
/  CHANGE GRADIENT
JMP      GRAUNT

```

```

        JMP      DTECTN
        JMP      DTECOT
/ EXIT TO CONTROLLER
        JMP      XIT
        0

```

```

/ EXIT TO CONTROLLER
XIT      CAF

```

```

.DKCA=37740
.DKAD=37742
.DKWC=37741
.DKRWS=37743
.DKBEG=37731

```

```

        DZM*      (.DKCA / USE BOOT STRAP TO READ 70 FILE
        LAC        DKNTPL
        SNA
        JMP        ERRORS
        DAC*      (.DKAD
        LAC        (-37720
        DAC*      (.DKWC
        DZM*      (.DKRWS
        JMP*      (.DKBEG

```

```

COMMON .SIXBT /COMMONBIN/
        0

```

```

/
RTIT    LAC        TRACK+1
        ADD        POS
        DAC        TRACK+1
        JMP*      KEYBD
LFIT    LAC        TRACK+1
        ADD        NEG
        DAC        TRACK+1
        JMP*      KEYBD
DWIT    LAC        TRACK+2
        ADD        NEG
        DAC        TRACK+2
        JMP*      KEYBD
UPIT    LAC        TRACK+2
        ADD        POS
        DAC        TRACK+2
        JMP*      KEYBD
CURS    LAC        HOME
        DAC        TRACK+1
        LAC        HOME+1
        DAC        TRACK+2
        JMP*      KEYBD
KPOINT  LAC        TRACK+1
        DAC        RFLINE
        JMS        LV.IN
        DAC        RFLX1# /STORE VALUE OF X(1)
        LAC        TRACK+2
        DAC        RFLINE+1
        JMS        LV.IN
        DAC        RFLY1# /STORE VALUE OF Y(1)

```

```

        JMP*      KEYBD

KLINE   LAC      TRACK+1
        JMS      LV.IN
        DAC      RFLX2*  /STORE VALUE OF X(2)

        LAC      RFLX1
        CMA
        ADD      RFLX2
        DAC      LINEX#
        JMS      IN.LV
        XOR      (600000
        DAC      RFLINE+2      /SETUP DISPLAY.

        LAC      TRACK+2
        JMS      LV.IN
        DAC      RFLY2*  /STORE VALUE OF Y(2)

        LAC      RFLY1
        CMA
        ADD      RFLY2
        DAC      LINEY#
        JMS      IN.LV
        DAC      RFLINE+3      /SETUP DISPLAY.

SOM      JMP*      KEYBD
        LAC      (ESAJ+CHART
        DAC      DSFILE
        LAC      (ESAJ+TRACK1  /SET TO LRGE
        DAC      TRACK1-1      /TRACKING CROSS
        JMS      SETUP
        JMP*      KEYBD

/
/  SET CURSOR INCREMENT
/
UPSL     LAC      POS1
        DAC      POS
        LAC      NEG1
        DAC      NEG
        JMP*      KEYBD

UPMD     LAC      POS10
        DAC      POS
        LAC      NEG10
        DAC      NEG
        JMP*      KEYBD

UPLRG    JMS      SETUP
        JMP*      KEYBD

/
/  INITIALIZE FOR L.P. DRAW
LPDRAW   LAC      (ESAJ+TRACK2  /SET TO SMALL
        DAC      TRACK1-1      /TRACKING CROSS
        DZM      SIZE
        JMS      POINT
        JMP*      KEYBD

/  ERASE LAST DISPLAYED VECTOR FORMED BY L.P. DRAW.
ERASE1   LAC      XLAST
        TAD      (-20
        DAC      XLAST  /RESTORE LAST ABS X

```

```

XOR      (660000
DAC      TRACK+1 /MOVE T.C. TO LAST X

LAW 17777
TAD DSPNTR
DAC      DSPNTR
LAC*     DSPNTR
JMS      LV.IN
CMA
TAD      (1
TAD      YLAST
DAC      YLAST /RESTORE LAST ABS Y
XOR      (140000
DAC      TRACK+2 /MOVE T.C. TO LAST Y

LAW 17776 /MOVE FILE POINTER BACK
TAD      DSPNTR /TO LAST VECTOR.
DAC      DSPNTR

JMS      ENDPT

JMP*     KEYBD
/ ERASE LAST REF LINE
ERASE2   LAC      (660000
DAC      RFLINE
LAC      (120000
DAC      RFLINE+1
LAC      (600000
DAC      RFLINE+2
DZM      RFLINE+3
JMP*     KEYBD

/ REMOVE ALL STREAMLINES AND RE-INITIALIZE DISPLAY FILE.
REMOVE   JMS      REMOVE
JMP*     KEYBD

REMOVE   0 / INITIALIZE THE DISPLAY FILE

LAC      LOR. / STARTING ADDRESS DISPLAY BUFFER
DAC      POINT1 / RESET STORAGE VECTOR TOP OF TABLE

LAC      (ESAJ+TRACK
DAC*     POINT1 / RESET SO DONT ENTER BUFFER

DZM      FLAG / CLEAR FLAG

JMP*     REMOVE

/ CHANGE GRADIENT TO UP OR DOWN.
GRADNT   LAC      DIRECT
SPACLC
LAC      (1
DAC      DIRECT
JMP*     KEYBD
DIRECT   1

/ PUT INTO LINE DETECT MODE.

```

```
DTECIN  JMS      DTECKT
        JMP*     KEYBD
```

```
DTECKT  0

        ISZ      DTECFG
        LAC      (TABSTR+1
        DAC      STORE#  / STORAGE POINTER
        DZM      TABSTR  / COUNTER

        LAC      RFLX1   /X0
        DAC      TABLE
        LAC      RFLY1   /Y0
        DAC      TABLE+1
        LAC      RFLX2   /X1
        DAC      TABLE+2
        LAC      RFLY2   /Y1
        DAC      TABLE+3
        DZM      TABLE+4
        DZM      TABLE+5
        LAC      (377777
        DAC      TABLE+6

        JMP*     DTECKT
```

/ TAKE OUT OF LINE DETECT MODE

```
DTECOT  DZM      DTECFG
        JMP*     KEYBD
```

/ TABLE FOR LINE DETECTION

```
TABLE   0        / X0
        0        / Y0
        0        / X1
        0        / Y1
        0        / X2
        0        / Y2
        0        / PREVIOUS LENGTH
        0        / MANTISSA TRANSMISSIVITY
        0        / EXPONENT
```

```
TABSTR  .BLOCK   121      /VALUE,X,Y
```

/

/

```
LPTBLE  .
        SET1+3
        SET2+3
        SET3+3
        FNC1+3
        FNC2+3
        0
```

```
LPJUMP  .
        JMP      DISP1   /GO TO 1ST DISPLAY
        JMP      DISP2   /GO TO 2ND DISPLAY-CALC. NEW LINE
        JMP      DISP3   /GO TO 2ND DISPLAY-SAVE LAST LINE
        JMP      FNCTN    /SETUP FNCT TABLE FROM L.P. DRAW
        JMP      TRNCAL   /CALCULATE T VALUES.
```

/

/ LIGHT PEN ROUTINES


```

/
DISP1  LAC      (ESAJ+SET2
      DAC      TRACKE
      JMP      LPEXIT
DISP2  LAC      (ESAJ+DSFILE
      DAC      TRACKE
      LAC      (ESAJ+CHART
      DAC      DSFILE
      LAC      LINEX
      DAC      SAVEX#
      LAC      LINEY
      DAC      SAVEY#
      JMS      DIST
      JMP      GOSUB
DISP3  LAC      (LSAJ+DSFILE
      DAC      TRACKE
      JMP      LPEXIT
/  SETUP FUNCTION TABLE FROM L.P. DRAW ROUTINE
FNCTN  LAC      (DSFILE+2
      DAC      DSPNT2
      CMA
      TAD      DSPNTR
      RCR
      TAD      (1
      DAC      TOTPNT  /NO. OF Y PTS IN FILE.

      DZM      COUNTY#
      LAC      (FNCTBL
      DAC      FNPNTR

      LAC      SCFACX
      LRS+1
      DIVS!10000
      310000
      LRS+6!1000
      LACQ
      DAC      FNC.X#  /REAL X INCREMENT(16 DISPLAY UNITS)

      LAC*     DSPNT2  /GET FIRST Y FROM DISPLAY FILE
      JMS      LV.IN
      TAD      (-200
      JMP      ,+4
FNCTN1 LAC*     DSPNT2  /GET NEXT Y
      JMS      LV.IN
      TAD      LV.Y
      DAC      LV.Y
      LRSS+3!10000
      DIV -
UNITS2 0
      LRS+2!1000
      LACQ
/  CONVERT DISPLAY UNITS TO LOG
      TAD      MINLG2
      DAC*     FNPNTR  /STORE IN FUNCTION TABLE

      ISZ      COUNTY
      LAC      COUNTY

```

```

SAD      TOTPNT  /LAST POINT
JMP      .+5     /YES
ISZ      DSPNT2
ISZ      DSPNT2
ISZ      FNPNT2
JMP      FNCTN1

LAC      FNC.X
NORMS!10000
DAC      HOLD

LACS
CMA
TAD      (35
TAD      (LRS+17
DAC      SHFT1

CLL
LAC      (100000
DIV!10000
HOLD     0
LACQ
DAC      SCALEX
JMP      LPEXIT
/ TABLE USED IN FUNCTION GENERATION
STRT.X   0
SCALEX   0
SHFT1    0
TOTPNT   0
FNCTBL   .BLOCK 63      /STORAGE FOR 51 POINTS

/ *****
DSPNT2   0
FNPNT2   0

/ CALCULATE TRANSMISSIVITY VALUES FOR POINTS WHERE
/ FLOTUBES INTERSECT LINE.
TRNCAL   DZM      XNODE#
          DZM      YNODE#
          LAC      THUMBS
          SZALCLC
          CLA
          DAC      THUMBS
          JMP      LPEXIT

DIST     0
LAC      SAVEX
DAC      DIST1
LAC      SAVEY
DAC      DIST2
JMS      DISTON    / CALCULATE DISTANCE
HLT      / OVERFLOW

CLL
MULS
SCALE2   0

```

```

      DIV
      1777
      DAC      FRACT#
      LACQ
      DAC      WHOLE#
      LAC      FRACT
      FPDIV
      1777
      LAC      WHOLE
      LLS+14
      DAC      D
      JMP*     DIST
/
/ LIGHT PEN INTERRUPT ROUTINE.
/
LTPN      0
      AND      (37777
      DAC      LT2#
      CMA
      DAC      LT1#      /STORE NEG. STRIKE ADRES.

      ADD      (TRACK2+1      /L.P. STRIKE ON SMALL T.C.?
      JMS      CMP
      JMP      LTP1      /YES. AC=NO. OF STRIKE WITHIN TC.
                        /NO---CONTINUE

LPCRS      LAC      LT1
      ADD      (TRACK1+1      / STRIKE ON LARGE T.C.?
      JMS      CMP
      JMP      LTP1      /YES.
                        /NO---CONTINUE

      LAC      (LPJUMP /CHECK ON L.P. STRIKE FROM TABLE
      DAC      LPJUMP
      LAC      LPTBLE
      DAC*     (15
      ISZ      LPJUMP
      LAC*     15
      SAD      LT2
      JMP      .+4
      SZA
      JMP      .+5
      JNF      LPEXIT /NO MATCHES
      XCT*     LPJUMP
LTP1      TAD      (1BLSV
      DAC      DXADR
      TAD      (10
      DAC      DYADR

      LAC*     DXADR
      DAC      XINC#
      LAC*     DYADR
      DAC      YINC#

      LAC      TRACK+1
      JMS      LV.IN
      TAD      XINC

```

```

DAC      LV.X#
AND      (3777
XOR      (660000
DAC      TRACK+1 /MOVE CURSOR X
LAC      TRACK+2
JMS      LV.IN
TAD      YINC
DAC      LV.Y#
AND      (3777
XOR      (140000
DAC      TRACK+2 /MOVE CURSOR Y
LAC      SIZE
SNA
JMS      LONGLN
LPEXIT   NOP
DSEI
LAC      TRACK
DSIA
DSLB
JMP*     LTPN
/
SV.IN    0
CLL
CLQ
LRSS+7
JMS      SV
XCT*     SV.IN    /STORE INTEG. X VALUE
ISZ      SV.IN
LLSS+7
JMS      SV
XCT*     SV.IN    /STORE INTEG. Y VALUE
ISZ      SV.IN
JMP*     SV.IN
SV        0
AND      (177
TAD      (377700
SMA
JMP      .+3
CMA
TAD      (-77
TAD      (-377700
JMP*     SV
SAVE      0
/ CONVERT 18 BIT INTEGER TO DISPLAY SHORT VECTOR FORM.
/ RIGHT JUSTIFIED.
IN.SV     0
GSM
SZL
TAD      (101
JMP*     IN.SV
/
LV.IN     0
AND      (3777
TAD      (376000
SMA
JMP      .+3
CMA

```

```

TAD      (-1777
TAD      (-376000
JMP*     LV.IN
IN.LV    0
GSM
SZL
XOR      (2000
JMP*     IN.LV
/ ROUTINE TO CHECK IF L.P. STRIKE LIES WITHIN A TRACKING CROSS.
CMP      0
SMA!CMA
JMP      CMP1      /STRIKE IS L.T. REGION
DAC      TCMP
ADD      ( 11
SMA
JMP      CMP1      /STRIKE IS G.T. REGION
LAC      TCMP      /STRIKE IS WITHIN REGION
SKP      /LOAD AC WITH NO. OF STRIKE
CMP1     ISZ      CMP
JMP*     CMP
TCMP     0

CHAR     0
K1       1
MDFG     0
POS      0
NEG      0
POS1     1
NEG1     -1-1
POS10    10
NEG10    -10-1
POS100   100
NEG100   -100-1
INCR     0
/
POINT    0
ISZ      DSPNTR
LAC      TRACK+1
DAC*     DSPNTR
JMS      LV.IN
DAC      XLAST#

ISZ      DSPNTR
LAC      TRACK+2
DAC*     DSPNTR
JMS      LV.IN
DAC      YLAST#

JMS      ENDPT

DZM      DSFILE
JMP*     POINT

LONGLN   0
LAC      XLAST
CMA

```

```

ADD      LV.X
SAD      PDELX      / SPACING=DELTA X?
SKP
JMP*     LONGLN
JMS      IN.LV
XOR      (600000
DAC      SAVE1#
LAC      LV.X
DAC      XLAST

LAC      DSPNTR
DAC      SAVE2#

ISZ      DSPNTR
LAC      YLAST
CMA
ADD      LV.Y
JMS      IN.LV
DAC*     DSPNTR
LAC      LV.Y
DAC      YLAST

JMS      ENDPT

LAC      SAVE1
DAC*     SAVE2

JMP*     LONGLN

ENDPT    0
ISZ      DSPNTR
LAC      (ESAJ+CHART
DAC*     DSPNTR
JMP*     ENDPT

PDELX    20
GOSUB    LAC      D
SPA
JMP      ERROR3 / D GT 15.9999

LAC      (ESAJ+TRACK
DAC      ECHART
JMS*     SCALER
TT

D        0 /LENGTH OF REFERENCE LINE
DAC SCFAX /STORE SCALE FACTOR
DAC REFLIN

LAC TABSTR / FIND MAX PERM
CMA
TAD (1
DAC NNPT / NUMBER OF TABLE ENTRIES
DAC TABSTR / SAVE FOR THE FUTURE

DZM      MAX*LOG / SET MAXIMUM TO SMALLEST POSSIBLE
LAW      -1

```

	PCR		
	DAC	MIN*LOG	/ SET MIN TO MAXIMUM
	LAC	CTABSTR#	/ TABLE FORMAT. THIS IS FIRST LOG
MAXLOG	ADR2*		/ RETRIVAL POINTER
	JIS*	PPSL	/ FORM LOG
		999999-ADR2	
	DAC*	ADR2	/ STOPS
	JIS*	CHP	/ FIND MAX AND MIN
	LAC	MAXLOG	
	VUP		/ +
	DAC	MAXLOG	/ +
	JIS*	CHP	/ +
	LAC	MINLOG	
	JMP		/ +
	VUP		/ +
	DAC	MINLOG	/ +
	LOG	ADR2	/ ZERO CORRECTION
	ADR2*		/ +
	LAC	ADR2	
	TAD	(3	
	ES2	NOPT	
	JMP	MAXLOG	
	LAC	(X1	/ NOT FOR THE SCALE
	DAC	ADR2	/ THIS IS FOR SCALE PRINTING
	LAC	(172	
	DAC	ABSPT	/ THIS IS FOR GRAPHING
	LAC	MINLOG	/ MIN LOG
	LRSS+15		/ GET THE EXPONENT
	DAC	VALUE*	/ GET THE EXPONENT MAGNITUDE
	CNA		
	TAD	(	
	DAC	SPREAD	/ 2'S COMPLEMENT POWER OF TEN
	LRSS+15	(10	
	DAC	MINLOG	
	CNA		
	TAD	(1	
	DAC	MINLOG2*	
	LAC	MAXLOG	/ MAX LOG
	LRSS+15		
	TAD	SPREAD	
	TAD	(1	
	DAC	SPREAD	/ DELTA POWER OF TEN
	CLL		/ NOT FIND THE NUMBER OF DISPLAY UNITS
	LAC	(1130	/ SPREAD OVER 1130(3) DISPLAY UNITS
	IPIV		
SPREAD	0		
	LAC0		
	DAC	UNITS	/ NUMBER OF DISPLAY UNITS PER DECADE

	DAC	UNITS2	
	CMA		/ FOR FIRST TIME THROUGH
	TAD	(1	
	TAD	ABSPT	
	DAC	ABSPT	
	LAC	SPREAD	/ COUNTER ON LABLES
	CMA		
	DAC	NNPT	
MAKSCL	LAW	31	
	DAC*	ADR2	/ X POSITION VECTOR
	ISZ	ADR2	
	LAC	ABSPT	
	TAD	UNITS	
	DAC	ABSPT	/ Y POSITION
	XOR	(140000	
	DAC*	ADR2	
	ISZ	ADR2	
	LAC	(061060	/ ASCII (10)
	DAC*	ADR2	
	ISZ	ADR2	
	LAC	(052052	/ ASCII (**)
	DAC*	ADR2	
	ISZ	ADR2	
	LAC	VALUE	
	ISZ	VALUE	
	CLL		
	IDIV		
	12		
	TAD	(60	
	DAC*	ADR2	
	LACQ		
	TAD	(60	
	LLSS+11!	CLQ	
	XOR*	ADR2	
	DAC*	ADR2	
	ISZ	ADR2	
	LAC	(040455	/ ASCII (-)
	DAC*	ADR2	
	ISZ	ADR2	
	LAC	(ESAJ+XX1	
	DAC*	ADR2	
	ISZ	NNPT	
	JMP	MAKSCL	
	LAC	TABSTR	/ 2 ¹⁰ COMPLEMENT OF ENTREIES
	DAC	NNPT	
MAKUNT	LAC	(TABSTR+5	/ LOG
	DAC	ADR2	/ RETRIVAL POINTER


```

LAC*   ADR2
TAD     MINLOG  / SUBTRACT MIN POWER OF TEN
CLL
MUL
UNITS  0          / DISPLAY UNITS PER DECADE
LRSS+15
LACQ
DAC*   ADR2      / DISPLAY UNITS FOR LOG

LAC     ADR2
TAD     (4
ISZ     NNPT
JMP     MAKUNT

/ ZERO OUT PTFILE
LAC     (-24
DAC     NNPT
LAC     (PTFILE
DAC     PTFILE
ISZ     PTFILE
DZM*    PTFILE
ISZ     NNPT
JMP     .-3

DZM     LASTX#
DZM     LASTY#
LAC     (060160
DAC     ABSPT#
LAC     TABSTR  /NO. OF INTERSECTIONS
DAC     NNPT#
LAC     (TABSTR+1
DAC     ADR1#
LAC     (PTFILE+1
DAC     PTFILE

/ SETUP X VECTOR
NXTONE LAC*   ADR1
ISZ     ADR1
CMA
ADD     RFLX1  /X0 OF LINE IN DISPLAY UNITS
DAC     SAVEX  /X0-X
LAC*   ADR1
ISZ     ADR1
CMA
ADD     RFLY1  /Y0
DAC     SAVEY  /Y0-Y
JMS     DIST
LAC     D      /DIST. OF FLOW TUBE INTERRECTION
CLL     /FROM START OF REF LINE
MUL
1440
DIV
SCFACK  0
LACQ

DAC     SAVEX
CMA

```

```

ADD      LASTX
CMA

JMS      IN.LV
ADD      ABSPT  /PNSITION ABS. STARTING POINT.
XOR      (600000
DAC*     PTFILE
LAC      SAVEY
DAC      LASTX  /SAVE LAST ABSOLUTE X VALUE
ISZ      PTFILE
DZM      ABSPT

```

/ SETUP Y VECTOR

```

LAC*     ADR1
ISZ      ADR1
ISZ      ADR1

TAD      (200    /CONVERT TO ABSOLUTE
DAC      SAVEY  /DISPLAY UNITS.
CMA
ADD      LASTY
CMA

JMS      IN.LV
XOR      (120000
DAC*     PTFILE
LAC      SAVEY
DAC      LASTY  /SAVE LAST ABSOLUTE Y VALUE
ISZ      PTFILE
ISZ      NNPT
JMP      NXTONE  /GET NEXT POINT

LAC      (ESAJ+X1    /FINISHED
DAC      ECHART
JMP      LPEXIT

```

TT

```

XX1+4
XX1+5
X2+4
X3+4
X3+5
X4+4

```

/

X1 .BLOCK 120 / SAVED FOR LABLES

```

XX1 660470
     120200
     400110
     572120
     040061
     060060
     460000
X2   661000
     120200
     400110
     572120

```

```

      040062
      060060
      460000
X3    661510
      120200
      400110
      572120
      640063
      060060
      460000
X4    661620
      120200
      400110
      572120
      040064
      060060
      460000
      ESAJ+PTFILE+1

```

```

/ FILE TO STORE FLOWTUBE INTERSECTION POINTS
/ WITH INTERSECTING LINES

```

```

PTFILE .
      .BLOCK 50
      ESAJ+TRACK

```

```

/

```

```

/ ERRORS

```

```

ERROR1 JMS*      WMSG.
      ERR1
      JMP        BEGIN

```

```

ERROR2 JMS*      WMSG.
      ERR2
      JMP        BEGIN

```

```

ERROR3 JMS*      WMSG.
      ERR3
      JMS        REMOVE
      JMP        ERASE2

```

```

ERROR5 JMS*      WMSG.
      ERR5
      EXIT

```

```

/ BUFFERS

```

```

LBUF .BLOCK 20

```

```

/ THIS IS THE BUFFER THAT IS COMMON TO ALL PROGRAMS IN THE ITERATIVE
/ SEQUENCE

```

```

/ IT IS ONE DISC SECTOR LONG (112 WORDS)

```

```

/ IT IS DIVIDED INTO 3 SECTIONS

```

```

/      1. DISC ADDRESS OF THE PROGRAMS

```

```

/      2. MAPS

```

```

/      3. COMMON DATA

```

```

DKNTRL 0          / DISC ADDRESS OF MONITOR

```

```

DKSTRM 0          / DISC ADDRESS OF STREAM-LINE

```

```

DKFLOW 0          / DISC ADDRESS OF FLOW-TUBE (STEADY-STATE)

```

```

DKFLTR 0          / DISC ADDRESS OF FLOW-TUBE (TRANSIENT)

```

```

DKTRVL 0          / DISC ADDRESS OF TRAVEL-TIME (TRANSMISICIVITY)

```

```

DKTRVK  0      / DISC ADDRESS OF TRAVEL TIME (CONSTANT PERMIABILITY)
DKINTR  0      / DISC ADDRESS OF INTERP
DKCOMB  0      / DISC ADDRESS OF MODIFY MATRIX
DKPERS  0      / DISC ADDRESS OF PERSPECTIVE PROGRAM
        .BLOCK 13      / 20 DECIMAL PROGRAM SLOTS

PROJ    .BLOCK 3      / PROJECT BOUNDARY MAP
POT1    .BLOCK 3      / POTENTIAL MAP (TIME 1)
POT2    .BLOCK 3      / POTENTIAL MAP (TIME 2)
POTAVE  .BLOCK 3      / POTENTIAL MAP (POT1+POT2)/2
DPOTDT  .BLOCK 3      / POTENTIAL DERIVATIVE (POT2-POT1)/(TIME2-TIME1)
TRN     .BLOCK 3      / TRANSMISCIVITY MAP
AQU     .BLOCK 3      / BOTTOM AQUIFIERD MAP
        .BLOCK 47     / 20 DECIMAL MAP SLOTS TOTAL

MAXX    0      / MAXIMUM HORIZONTAL VALUE ON MAP DIGITIZER
TIME    0      / TIME T2-T1 DAYS INTEGER
        .BLOCK 36     / 32 DECIMAL ID WORDS TOTAL

/ DIGITIZER LINE BUFFER
DZLB    .BLOCK 16

/ MESSAGES
TITLE   .ASCII /FLOW TUBE GENERATION/<015><177>

ERR1    .ASCII /?/<015><177>

ERR2    .ASCII /FILE NOT FOUND/<015><177>

ERR3    .ASCII /REF LINE GT 32000 FT/<015><177>

ERR5    .ASCII /INITIALIZE WITH ITERATIVE CONTROLLER/<015><177>

        .TITLE FLOTUB
/ FLOW TUBE PERMIABILITY CALCULATOR

/ L.E.ADDISON 12-3-70

FLOTUB  DISPLA

        LAC FLAG      / FLAG=1 IF IN CALCULATION OF FLOW TUBE
        SZA
        JMP MORE.

        LAC THUMBS    / FLAG FOR AUTO INPUT OF X,Y
        SMA           / THUMBS DOWN USE DIGITIZER
        JMP AUTO      / THUMBS UP USE AUTO

        JMS* DZWTR.    / READ DIGITIZER
        .DSA BUSY

        LAC DZLB      / LINE BUFFER HEADER
        AND (17
        SZA!CLL!CLA    / MODE BITS 0=BINARY, 1=ASCII
        JMP* FLOTUB

        LAC DZLB+2    / X CO-ORD

```

```

DAC      DZ.X#
LAC      DZLB+3  / Y CO-ORD
DAC      DZ.Y#

LAC      DZ.X
JMS      CONVR1  / CONVERT DIGITIZER TO NODES
DAC      KX0#    / MIDPOINT X XXX.XXX

LAC      DZ.Y
JMS      CONVRT
DAC      KY0#    / MIDPOINT Y XXX.XXX

JMP      STRT01

AUTO     JMS      REMOVE  / CLEAR DISPLAY FILE
DZM      TABLE+4
DZM      TABLE+5
LAC      (377777
DAC      TABLE+6
DAC      DTECFG

LAC      XNODE    /LAST NODE ON LINE?
SAD*     MX.H
JMP      .+3      /YES
ISZ      XNODE    /NO--GET NEXT X
JMP      AUTO1
DZM      XNODE    /RESET X COUNT
LAC      YNODE
SAD*     MX.V      /LAST LINE?
JMP      .+3      /YES--DONE WITH ALL POINTS
ISZ      YNODE    /NO--GET NEXT LINE
JMP      AUTO1
CLC
DAC      THUMES
DZM      DTECFG
JMP*     FLOTUB

AUTO1    LAC      XNODE    / AUTO X
LLS+11!CLQ
DAC      KX0

LAC      YNODE
LLS+11!CLQ
DAC      KY0

LAC      TCONST  / INITIAL TRANSMISSIVITY
DAC      TRAN
LAC      TCONST+1
DAC      TRAN+1

JMP      STRT02

STRT01   DZM      REAL1    / TURN ON MESSAGE TO ENTER PERM
LAC      (ESAJ+REAL2+2
DAC      REAL2

```

```

STRTIN  JMS*   DSRD.
        LBUF
        -20
        JMS*   DSWT.
        LAC     (LBUF
        DAC*    UP57L.
        DZM*    UP57C.

```

```

/ READ FLOATING POINT NUMBER
/ X.XXXESXX

```

```

        JMS*    RCHR.  / GET FIRST CHR
        JMP     RF1    / DIGIT
        JMP     STRTIN / LETTER - NO LETTERS ALLOWED -
        JMP     STRTIN / PUNCT

RF1      MUL!20000-16  / FORM FIRST DIGIT
        470400        / (10**4) * 2**4
        DAC     MANT   / MANTISSA 10**4

        JMS*    UP57.  / READ (.)
        SAD     (056   / ASCII (.)
        SKP
        JMP     STRTIN / NOT .

        LAC     (23420 / 10**4
        DAC     MULT   / MULTIPLIER OF INPUT DIGIT

LOOP     LAC     MULT   / FORM POWER OF TEN FOR DIGIT
        IDIV!20000
        12
        LACQ
        DAC     MULT   / REDUCE BY 10 DEC

        JMS*    RCHR.  / READ NEXT CHR
        JMP     RF2    / DIGIT
        JMP     RF3    / LETTER
        JMP     RF3    / PUNCT

RF2      MUL!20000
MULT     0              / MULTIPLIER
        LACQ
        TAD     MANT
        DAC     MANT
        JMP     LOOP

RF3      LAC     MANT   / 10**4 MANT
        MUL!20000      / NEED TO REMOVE 10**4
        643335         / (2**18)(2**13)/10**4
                     / AC = 2**13 MANTISSA

        NORM
        DAC     MANT   / NORMALIZE 2**((13+L) M = 2**17 2**((L-4) M

        LACS
        CMA           / EXPONENT
                     / -34-L-1 = -35-L

```

	TAD	(41	
	DAC	EXP2#	/ EXPONENT 2
	D2M	EXP10#	/ CLEAR FOR THE EXPONENT
	JMS*	UP57B.	/ BACK UP LINE BUFFER POINTER
RF4	JMS*	RCHR.	/ READ NEXT CHR
	JMP	RI 5	/ DIGIT
	TAD	(100	/ LETTER
	SAD	(105	/ PUNCT ASCII(E)
	JMP	RF4	
	SAD	(053	/ ASCII(+)
	JMP	RF4	
	SAD	(015	/ CARRIAGE RETURN
	JMP	RF9	
	SAD	(055	/ ASCII (-)
	SKP!CLC		
	JMP	STRJIN	/ NOT (+), (-), (E), (CR)
	DAC	EXP10	/ SIGNAL (-) EXPONENT
	JMP	RF4	
RF5	JMS*	RNUM.	/ READ NUMBER
	12		
	XOR	EXP10	
	SP0		
	TAD	(1	
	DAC	EXP10	
	ISZ*	UP57C.	
MORE	LAC	EXP10	/ REDUCE POWER OF TDN
	SPA		
	JMP	RF7	/ (-) REQUIRES SPECIAL ATTENTION
	SNA		
	JMP	RF9	/ FINISHED EXP10 = 0
	LAC	EXP2	
	TAD	(3	
	DAC	EXP2	/ EXP2=EXP2+3
	LAC	EXP10	
	TAD	(-1	
	DAC	EXP10	/ EXP00=EXP10-1
	LAC	(500000	/ (10**1=5/4*2**3) 2**17
	JMP	RF8	
RF7	LAC	EXP2	
	TAD	(-4	/ -3 TO 4/5*2**3 , -1 FOR SCALING
	DAC	EXP2	
	ISZ	EXP10	/ EXP10=EXP10+1
	NUP		
	LAC	(631463	/ (10**1=4/5*2**3) 2**18
RF8	CLL		
	MUL		
MANT	0		/ AC = 2**16*ADJUSTMENT*MANT
	LLS+1		

```

DAC      MANT      / 2**17 MANT
SMA!RCR      / KEEP NORMALIZED
JMP      MORE
DAC      MANT      / SCALED TO BIG
ISZ      EXP2      / TAKE ONE OF THEM OFF
JMP      MORE

RF9      LAC      MANT
DAC      TRAN+1
LAC      EXP2
AND      (777
DAC      TRAN

STRT02   LAC POINT1      / SEE IF ROOM FOR LONG VECTORS
TAD (5
JMS* CMP.
LAC* (.SCOM+3
NOP      / >
JMP FLODUN      / = NO ROOM
NOP      / <

LAC POINT1      / POINTS TO 0 IN BUFFER
DAC* (10
LAC (ESAJ+TRACK / SET SO DISPLAY WONT SEE MODS
DAC* POINT1

LAC KX0
JMS SCALE      / ADJUST TO DISPLAY UNITS
TAD (660000
DAC* 10 / LONG VECTOR X

LAC KY0
JMS SCALE      / ADJUST TO DISPLAY UNITS
TAD (140000
DAC* 10 / LONG VECTOR Y

DZM* 10
LAC (ESAJ+TRACK
DAC* 10
DZM* POINT1

LAC* (10
DAC POINT#2
TAD (-1
DAC POINT#1

ISZ FLAG      / SET TO START CALCULATIONS OF NEW FLOW TUBE
ISZ      IK      / FIST TIME THROUGH IK=1

JMP* FLOTUB      / HAVE INIT SO DO OTHER THINGS

TRAN     .BLOCK 2      / TRANSMISSIVITY HOLDER
TCHART   0
TREAL    0
TCONST   12
372000

```



```

MORE.   LAC POINT1      / CONT NUMBER OF DISPLA UPDATES
        TAD (1
        JMS* CMP.       / CHECK TO SEE IF ROOM FOR UPDATE
        LAC* (.SCOM+3
        NOP             / >
        JMP FLODUN      / = NO ROOM
        NOP             / <

        JMS*   TRANSS   / FORTRAN ROUTINE TO CALCULATE TRANSMISSIVITY
        JMP    .+13
        .DSA   IK       / CONTROL WORD
        .DSA   KX0      / STRTING X
        .DSA   KY0      / STRTING Y
        .DSA   TRAN     / TRANSMISSIVITY
        .DSA   DIRECT   / UP-DOWN GRADIENT SWITCH
        .DSA   SCALE2   / (MX.H OR MX.Y) -1
        .DSA   ABSX.    / X,Y CO-ORD ABSOLUTE
        .DSA   ABSY.

```

```

ABSX.   0
ABSY.   0

```

```

        LAC   IK
        SZA           / 0 IF DO NOT DRAW VECTORS
        JMP    VECTS  / NO 0 THEN DO DRAW VECTORS
        LAC   (2
        DAC   IK
        JMP*   FLOTUB

```

```

VECTS   LAC   KX0
        JMS IN.SV
        LLS+7!CLO
        DAC TEM#

        LAC   KY0
        JMS IN.SV
        XOR TEM
        XOR (400000
        DAC* POINT1
        ISZ POINT1
        LAC (ESAJ+TRACK
        ISZ POINT2
        DAC* POINT2
        DZM* POINT1

```

```

TECT    LAC DTECFG      / DETECTION FLAG SET
        SNA
        JMP* FLOTUB     / NOPE

```

/ PROGRAM TO CHECK FOR LINE INTERSECTION

```

        LAC   TABLE+4
        SNA
        JMP PERIM4+2    / FIRST TIME THROUGH DETCT X2 SET = 0
CALDST  LAC TABLE      / CALCULATE DISTANCE BETWEEN (X0,Y0) (X3,Y3)
        CMA

```

```

ADD      ABSX.
DAC      DIST1
LAC      TABLE+1
CMA
ADD      ABSY.
DAC      DIST2
JMS DISTAN      / CALCULATE D
JMP      PERIM4+2      / DISTANC TO GREAT TO BE INTERSECTION
DAC DD1#      / D (X0,Y0) (X3,Y3)

DSTCAL   LAC TABLE+2      / CALCULATE DISTANCE BETWEEN (X1,Y1) (X3,Y3)
CMA
ADD      ABSX.
DAC      DIST1
LAC      TABLE+3
CMA
ADD      ABSY.
DAC      DIST2
JMS DISTAN      / XCORD1,YCORD1 ALREADY SET TO X3,Y3
JMP      PERIM4+2      / DISTANCE TO GREAT TO BE INTERSECTION
                        / D (X1,Y1) (X3,Y3)

SUM.     TAD DD1 / FORM LENGTH
DAC SUM#

PERIM3   LAC      SUM      / SUM(I+1)
JMS*     CMP.
LAC      TABLE+6 / SUM(I)
JMP      FOUND      / SUM(I+1)>SUM(I)
JMP      FOUND      / SUM(I+1)=SUM(I)
NOP      / SUM(I+1)<SUM(I)

PERIM4   LAC      SUM      / NOT MIN SO MUST SAVE
DAC      TABLE+6 / SAVE PERIMETER
LAC      ABSX.      / SAVE
DAC      TABLE+4
LAC      ABSY.
DAC      TABLE+5
LAC      TRAN
DAC      TABLE+7
LAC      TRAN+1
DAC      TABLE+10
JMP*     FLOTUB

FOUND    LAC      TABLE      / CHECK TO SEE IF IN WINDOW (SET WINDOW)
JMS*     CMP.
LAC      TABLE+2
JMP      .+6      / XX0>XX1
HLT
LAC      TABLE      / XX0<XX1
DAC      BOX.X0#
LAC      TABLE+2
JMP      .+4
LAC      TABLE+2
DAC      BOX.X0
LAC      TABLE
DAC      BOX.X1#

```

```

LAC      TABLE+1
JMS*     CMP.
LAC      TABLE+3
JMP      .+6      / YY0>YY1
HLT      / =
LAC      TABLE+1 / YY0<YY1
DAC      BOX.Y0#
LAC      TABLE+3
JMP      .+4
LAC      TABLE+3
DAC      BOX.Y0
LAC      TABLE+1
DAC      BOX.Y1#

LAC      TABLE+4 / CHECK TO SEE IF IN WINDOW
JMS*     CMP.
LAC      BOX.X0
NOP      / >
SKP      / =
JMP      PERIM4 / <

LAC      TABLE+4
JMS*     CMP.
LAC      BOX.X1
JMP      PERIM4 / >
NOP      / =
NOP      / <

LAC      TABLE+5
JMS*     CMP.
LAC      BOX.Y0
NOP      / >
SKP      / =
JMP      PERIM4 / <

LAC      TABLE+5
JMS*     CMP.
LAC      BOX.Y1
JMP      PERIM4 / >
NOP      / =
NOP      / <

```

```

JMP      TECTR    / FOUND INTERSECTION

```

```

/ CALCULATES DISTANCE (D) BETWEEN POINTS

```

```

/D**2 = (XCORD1-XCORD0)**2 + (YCORD1-YCORD0)**2
/ D = (D**2)**1/2

```

```

DISTAN  0
LAC      DIST1
ABS      / X**2 POSITIVE
CLL
DAC      DIST1

```

```

DIST1  MUL
        0
        SZA          /AC OVERFLOW
        JMP* DISTAN   / YES
        LACQ
        DAC DIST1          / (X1-X0)**2

        LAC          DIST2
        ABS
        CLL
        DAC DIST2
        MUL
DIST2   0
        SZA          /AC OVERFLOW
        JMP* DISTAN   / YES
        LACQ
        DAC DIST2          / (Y1-Y0)**2

        TAD DIST1     / FORM SUM
        SPA          / OVERFLOW IN SUM
        JMP* DISTAN   / YES
        ISZ DISTAN    / GOING WITH THIS ONE SO SET RETURN
        DAC DISTR#     / D**2

ROOT    LAC (100      / SQUARE ROOT BY NEWTONS METHOD
        DAC XN

ROOT1   LAC DISTR
        CLL
        IDIV
XN       0
        LACQ
        ADD XN
        RCR
        DAC XNP1#
        CMA
        ADD XN
        ABS          / ABS (XN-XNP1)
        TAD LIM      / CONVERGENCE LIMIT
        SPA
        JMP SQRT      / WITHIN LIMITS
        LAC XNP1
        DAC XN
        JMP ROOT1     / ITERATE AGAIN

SQRT    LAC XNP1

        JMP* DISTAN

LIM      -2          / CONVERGENCE LIMIT

TECTR   LAC          THUMBS / SEE IF IN GENERATE MODE
        SMA
        JMP          CHKSTR

        LAC          TABLE+4

```

```

DAC*    STORE
ISZ     STORE
LAC     TABLE+5
DAC*    STORE
ISZ     STORE
LAC     TABLE+10
DAC*    STORE
ISZ     STORE
LAC     TABLE+7
LLS+11
LRSS+11
DAC*    STORE
ISZ     STORE

ISZ     TABSTR
DZM     TABLE+4
DZM     TABLE+5
LAC     (37777
DAC     TABLE+6

JMP     FLODUN

CHKSTR  LAC     TABLE+4 / ROUTINE TO CALCULATE TRAN ADJUSTED
CMA
ADD     RFLX1
DAC     SAVEX

LAC     TABLE+5
CMA
ADD     RFLY1
DAC     SAVEY

JMS     DIST     /GET DIST. OF INTERSECTION
                     /FROM START OF REF LINE.

JMS*    FG2.     /GET T FROM FNC TABLE.
.DSA    STRT.X

DAC     TCHART / SFP LOG

/ CALCULATE TREAL = T1 + (TCHART-T2)

JMS*    TCALC
JMP     .+5
.DSA    TCONST
.DSA    TABLE+7
.DSA    TCHART
.DSA    TREAL

JMS     DISC     /TRANSFER T1 TO MATRIX

FLODUN  DZM     FLAG#
DZM     IK#

DZM     REAL2 / TURN ON ENTER ANOTHER TUBE

```

```

LAC      (ESAJ+REAL1+2
DAC      REAL1

JMS*     DZRD.
DZLB
-16

JMP*     FLOTUB

CONVRT   0          / (DZ.?/MAXX)MX.H DIGITIZER TO FIX POINT XXX.XXX .

DAC      CONV1

LAC      MAXX
DAC      CONV2
DAC      CONV3

LAC*     MX.H
MUL!20000
CONV1    0
DIV
CONV2    0

DAC      CONV1
LACQ
DAC      CONV2
LAC      CONV1
FRDIV
CONV3    0
LAC      CONV2    / AC,MQ(SF=2**18)
LLS+11

JMP*     CONVRT

SCALE    0          / ADJUST TO DISPLAY UNITS

DZM SCL#FLG
SMA
JMP .+3
ISZ SCLFLG
CMA
DAC SCLE1

LAC      SCALE2
LLS+11!30000
DAC SCLE2
LAC      (1777
MUL
SCLE1    0
DIV
SCLE2    0
LAC SCLFLG
SZA
CMQ
LACQ
JMP*     SCALE
/ TRANSFER DATA TO DISC MATRIX FILE

```

```

DISC      0
          CLC
          DAC      SECT#SV / SECTION JUST USED FOR TRANSS
          DAC      SECTN  / CLEAR SO ON RETURN DON'T GRAB WRONG SECT.
          CLA
          JMS      MX.DO  / SECTN 0
          / GET VALUE AT COORD. (XNODE,YNODE)
          LAW      1
          JMS      MX.DO  / SECTION 1
          LAW      2
          JMS      MX.DO  / SECTION 2
          LAW      3
          JMS      MX.DO  / SECTION 3
          JMP*     DISC

K.01      .NVREF    400000
          .64
          -6
          .NVREF    200000

MX.DO     0
          DAC      .+4    / SECTION SWITCH 0,1,2,OR 3
          LAC      XNODE  / X COORDINANT
          JMS*     MX.AD2
          LAC      YNODE
          0
          0
          JMP*     DISC   / ILLEGAL X OR Y
          LMQ
          LAC      .-3    / DELTA CORE ADDR
          TAD      CORAD0 / REFERENCE CORE ADDRESS
          DAC      CORADR / WORD CORE ADDR IN BUFFER
          LACQ     / SECTION NO. WORD

          SAD      SECTSV / IF ALREADY DONE ; DON'T DO AGAIN
          JMP*     MX.DO
          DAC      SECTSV

          CLL      / READ SECTION
          JMS*     MX.RW
          JMP*     DISC

DKADR1    0
CORAD1    0
          0
          0

          LAC      TREAL  / REAT TRANSS IN SFP LOG
          DAC*     CORADR

          LAC      SECTSV
          STL      / SAVE
          JMS*     MX.RW
          JMP*     DISC

DKADR0    0
CORAD0    0
CORADR    0
          0

```

```

      JMP*      MX.DO

/ PROGRAM TO RETRIVE DATA POINTS FOR GRADIENT
/ FORTRAN IV SUPPORT PROGRAM
/ GRADIENT THAT SET'S 0'S IN PT1,PT2,PT7,PT8,PT6,PT5
/ PT12,PT11 TO THE PRECEEDING POINT VALUE RESPECTIVELY
/ IE. PT1=0 SO PT1=PT2
/ IE. PT1=0 PT2=0 SO PT1=PT2=PT3
/ IE. PT3=0 ERROR CONDITION

/ CALLING SEQUENCE
/      DIMENSION ID(1)
/      CALL GRDPNT(IX,IY,ID)
/      IX,IY  X,Y. POSITION
/      ID     POINTS FOR DEIVATIVE

/ DERIVATIVE FORMULA
/      DX=1/12 ( X.N-2. - 8X.N-1. + 8X.N+1. - X.N+2. )
/ POINT DEFINITIONS
/
/      * 16      * 20
/      * 15      * 19
/      * 7       * 8       * 9       * 10      * 11      * 12
/      * 1       * 2       * 3       * 4       * 5       * 6
/      * 14      * 18
/      * 13      * 17

      .GLOBL  GRDPNT,.DA

GRDPNT  0

      JMS*    .DA
      JMP     .+3+1

X      0
Y      0
DATA   0

      LAC     (PT1      / SET SO FORTRAN SEE'S THIS MATRIX
DAC*     DATA

      LAC*    X
      TAD     (3
      DAC X*PRIME      / THIS IS X IN INTEGER NODE

      LAC*    Y
      TAD     (3
      DAC Y*PRIME      /THIS IS Y IN INTEGER

      LAC XPRIME
      JMS* MX.AD2      / CALCULATE SECTION ADDRESS
      LAC YPRIME
      0
DELPTR  0
      JMP FLODUN      / ILLEGAL SECTION WORD REACHED BOUNDARY
      SAD SECTN      / SECTION THIS X,Y
      JMP FOUND.      / THE SAME
      DAC SECTN      / DIFFERENT

```



```

      CLL          / READ
      JMS* MX,RW   / READ THE SECTION
      JMP ERROR2
DKADR  0          / STARTING SECTOR ADDRESS
WTRDAT 0          / STARTING CORE ADDRESS
NX0    0          / STARTING -X FOR SECTION
NY0    0          / STARTING -Y FOR SECTION

FOUND. LAC NX0
      TAD* X
      DAC NXIN*      / X COLUMN NUMBER

      LAC* MX,SH      / SMALL X DIMENSION
      DAC XWIDE      / WIDTH OF X IN NODES
      CMA
      DAC MXWD*      / MXWD = -XWIDE

      LAC NY0
      TAD* Y

      MUL!20000
XWIDE  0          / NODES IN X
      LACQ          / DATA WORD FOR ROW ADJUSTMENT ( ADDRESS )
      ADD NXIN      / DATA WORD COLUMN ADJUSTMENT ( ADDRESS )
      TAD WTRDAT    / FIRST DATA ADDRESS
      TAD (-3      / TO GET I-2 , AND ADJUST FOR AUTO INDEX
      DAC* (11      / ADDRESS DATA WORD -1

      LAC* 11
      DAC PT1 / X(I-2),Y(I)
      LAC* 11
      DAC PT2 / X(I-1),Y(I)
      LAC* 11
      DAC PT3 / X(I),Y(I)
      LAC* 11
      DAC PT4 / X(I+1),Y(I)
      LAC* 11
      DAC PT5 / X(I+2),Y(I)
      LAC* 11
      DAC PT6 / X(I+3),Y(I)

      LAC* (11      / ADDRESS X(I+3),Y(I)
      ADD XWIDE      / ADDRESS X(I+3),Y(I+1)
      TAD (-6
      DAC* (11      / ADDRESS X(I-3),Y(I+1)

      LAC* 11
      DAC PT7 / X(I-2),Y(I+1)
      LAC* 11
      DAC PT8 / X(I-1),Y(I+1)
      LAC* 11
      DAC PT9 / X(I),Y(I+1)
      LAC* 11
      DAC PT10      / X(I+1),Y(I+1)
      LAC* 11
      DAC PT11      / X(I+2),Y(I+1)
      LAC* 11

```

```

DAC PT12          / X(I+3),Y(I+1)

LAC* (11          / ADDRESS X(I+3),Y(I+1)
ADD XWIDE
ADD XWIDE          / ADDRESS X(I+3),Y(I+3)
TAD (-3
DAC PT16          / ADDRESS X(I),Y(I+3)
TAD (1
DAC PT20          / ADDRESS X(I+1),Y(I+3)
ADD MXWD
DAC PT19          / ADDRESS X(I+1),Y(I+2)
TAD (-1
DAC PT15          / ADDRESS X(I),Y(I+2)
ADD MXWD
ADD MXWD
ADD MXWD
DAC PT14          / ADDRESS X(I),Y(I-1)
TAD (1
DAC PT18          / ADDRESS X(I+1),Y(I-1)
ADD MXWD
DAC PT17          / ADDRESS X(I+1),Y(I-2)
TAD (-1
DAC PT13          / ADDRESS X(I),Y(I-2)

```

```

LAC*   PT13
DAC    PT13
LAC*   PT14
DAC    PT14
LAC*   PT15
DAC    PT15
LAC*   PT16
DAC    PT16
LAC*   PT17
DAC    PT17
LAC*   PT18
DAC    PT18
LAC*   PT19
DAC    PT19
LAC*   PT20
DAC    PT20

```

```

FRST  LAC PT1 / TEST 1ST COLUMN
      SZA
      JMP SECND          / PT1 NOT = 0
      LAC PT2 / PT1 = 0
      SZA
      JMP FRST1          / PT2 NOT = 0 SO PT1=PT2
      LAC PT3 / PT2 = 0
      SNA
      JMP FLODUN          / PT3 = 0
      DAC PT2 / PT3 NOT = 0 SO PT1=PT2=PT3
FRST1 DAC PT1

SECND LAC PT7 / TEST 2ND COLUMN
      SZA
      JMP THRD           / PT7 NOT = 0
      LAC PT8 / PT7 = 0

```

```

SZ A
JMP SECND1      / PT8 NOT = 0 SO PT7=PT8
LAC PT9 / PT8 = 0
SNA
JMP FLODUN      / PT9 = 0
DAC PT8 / PT9 NOT = 0 SO PT7=PT8=PT9
SECND1 DAC PT7

THRD  LAC PT6 / TEST 3'RD COLUMN
SZ A
JMP FORTH      / PT6 NOT = 0
LAC PT5 / PT6 = 0
SZ A
JMP THRD1      / PT5 NOT = 0 SO PT6 = PT5
LAC PT4 / PT5 = 0
SNA
JMP FLODUN      / PT4 = 0
DAC PT5 / PT4 NOT = 0 SO PT6=PT5=PT4
THRD1 DAC PT6

FORTH LAC PT12      / TEST 4'TH COLUMN
SZ A
JMP FITH      / PT12 NOT = 0
LAC PT11      / PT12=0
SZ A
JMP FORTH1    / PT11 NOT = 0 SO PT12=PT11
LAC PT10      / PT11 = 0
SNA
JMP FLODUN    / PT10=0
DAC PT11      / PT10 NOT = 0 SO PT12=PT11=PT10
FORTH1 DAC PT12

FITH  LAC PT13      / CHECK OTHER DIRECTION 1
SZ A
JMP SIXTH    / PT13 NOT = 0
LAC PT14      / PT13 = 0
SZ A
JMP FITH1    / PT14 NOT = 0 SO PT13=PT14
LAC PT3      / PT3=PT14=PT13
FITH1 DAC PT14
DAC PT13

SIXTH LAC PT17      / CHECK DIRECTION 2
SZ A
JMP SEVN     / PT17 NOT = 0
LAC PT18      / PT17 = 0
SZ A
JMP SIXTH1   / PT18 NOT = 0 SO PT17=PT18
LAC PT4      / PT4=PT18=PT17
DAC PT18
SIXTH1 DAC PT17

SEVN  LAC PT16      / CHECK DIRECTION 3
SZ A
JMP EIGHT    / PT16 NOT = 0
LAC PT15      / PT16 = 0
SZ A

```

	JMP	SEVN1	/ PT15 NOT = 0 SO PT16=PT15
	LAC	PT9	
	DAC	PT15	/ PT9=PT15=PT16
SEVN1	DAC	PT16	
EIGHT	LAC	PT20	/ CHECK DIRECTION 4
	SZA		
	JMP	INFLEC	/ PT20 NOT = 0
	LAC	PT19	/ PT20 = 0
	SZA		
	JMP	EIGHT1	/ PT19 NOT = 0 SO PT20 = PT19
	LAC	PT10	
	DAC	PT19	/ PT10=PT19=PT20
EIGHT1	DAC	PT20	
INFLEC	LAC	PT2	/ CHECK ON INFLECTION POINT
	CMA		
	ADD	PT3	
	DAC	X	/ PT3-PT2
	GSM		
	DAC	Y	/ ABS(PT3-PT2)
	LAC	PT14	
	CMA		
	ADD	PT3	
	DAC	DATA	/ PT3-PT14
	GSM		/ ABS(PT3-PT14)
	ADD	Y	/ ABS(PT3-PT14) + ABS(PT3-PT2)
	DAC	Y	
	LAC	DATA	
	ADD	X	
	GSM		/ ABS(PT3-PT2+PT3-PT14)
	SAD	Y	
	SKP		/ ABS(A+B) = ABS(A)+ABS(B) LOCAL MAX,MIN
	JMP*	GRDPNT	/ NOT A LOCAL MAX,MIN
	LAC	PT5	
	CMA		
	ADD	PT4	
	DAC	X	
	GSM		
	DAC	Y	
	LAC	PT18	
	CMA		
	ADD	PT4	
	DAC	DATA	
	GSM		
	ADD	Y	
	DAC	Y	
	LAC	DATA	
	ADD	X	
	GSM		
	SAD	Y	
	SKP		

JMP*	GRDPNT
LAC	PT8
CMA	
ADD	PT9
DAC	X
GSM	
DAC	Y
LAC	PT15
CMA	
ADD	PT9
DAC	DATA
GSM	
ADD	Y
DAC	Y
LAC	DATA
ADD	X
GSM	
SAD	Y
SKP	
JMP*	GRDPNT
LAC	PT11
CMA	
ADD	PT10
DAC	X
GSM	
DAC	Y
LAC	PT19
CMA	
ADD	PT10
DAC	DATA
GSM	
ADD	Y
DAC	Y
LAC	DATA
ADD	X
GSM	
SAD	Y
SKP	
JMP*	GRDPNT
DZM	X
LAC	PT2
CMA	
ADD	PT3
GSM	
SZL	
ISZ	X
LAC	PT5
CMA	

ADD	PT4
GSM	
SZL	
ISZ	X
LAC	PT8
CMA	
ADD	PT9
GSM	
SZL	
ISZ	X
LAC	PT11
CMA	
ADD	PT10
GSM	
SZL	
ISZ	X
LAC	X
SNA	
JMP	FLODUN
SAD	(4
SKP	
JMP*	GRDPNT
DZM	X
LAC	PT14
CMA	
ADD	PT3
GSM	
SZL	
ISZ	X
LAC	PT18
CMA	
ADD	PT4
GSM	
SZL	
ISZ	X
LAC	PT15
CMA	
ADD	PT9
GSM	
SZL	
ISZ	X
LAC	PT19
CMA	
ADD	PT9
GSM	
SZL	
ISZ	X
LAC	X

	SNA	
	JMP	FLODUN
	SAD	(4
	JMP	FLODUN
	JMP*	GRDPNT
PT1	0	
PT2	0	
PT3	0	
PT4	0	
PT5	0	
PT6	0	
PT7	0	
PT8	0	
PT9	0	
PT10	0	
PT11	0	
PT12	0	
PT13	0	
PT14	0	
PT15	0	
PT16	0	
PT17	0	
PT18	0	
PT19	0	
PT20	0	
TRACK	ESAJ+.+1	
	661000	
	141000	
	030000	
	ESAJ+TRACK1	
TRACK1	462120	
	404000	
	402010	
	400020	
	422010	
	424000	
	422110	
	400120	
	402110	
	020000	
	442000	
	400040	
	464120	
	410000	
	020000	
TRACKE	ESAJ+SET2	
/		
/		
/	SMALL TRACKING CROSS	
/		
TRACK2	461110	
	402000	
	401004	
	400010	
	421004	

```

422000
421104
400110
401104
020000
441000
400020
462110
404000
020000
ESAJ+TRACKE
/
DXADR 0
DYADR 0
/
TBLSV 0
      1
      1
      1
      0
      -1
      -1
      -1

      -1
      -1
      0
      1
      1
      1
      0
      -1
DSFILE ESAJ+CHART      /SAVE ROOM FOR 50 LONG VECTORS+ABS PT+ESAJ
      .BLOCK 150
CHART  ESAJ+.+1
      660160
      120200
      601440
      0
      660160
      120200
      600000
      1130
/
REFLIN END OF REFERENCE LINE
      660260
      124200
      600000
      001130
      742120
      120010
      105116
      104040
      117106
      040122
      105106
      056040
      114111

```



```

116505
/ XDISTANCE IN FEET
764454
120062
130040
104111
123124
101116
103105
040111
116040
106105
105524
/ TRANSMISSIVITY (FT**2/DAY)
774000
120310
124122
101116
123115
111123
123111
126111
124131
040050
106124
052052
062040
057104
101131
451000
FNC1 030000
761400
140070
540000
020000

761420 / FORM FUNCTION TABLE
140070
106117
122115
040106
125116
103124
111117
116040
124101
102114
SET1 505000
030000
761400
140030
540000
020000

761420 /RETURN TO MAP
140030
122105

```

	124125	
	122516	
X00	760160	
	120150	
	460000	
ECHART	ESAJ+X1	
/		
/		
SET2	030000	
	761400	
	141650	
	540000	
	020000	
	761420	
	121650	
	123105	/SETUP NEW LINE
	124125	
	120040	
	116105	
	127040	
	114111	
	116505	
SET3	030000	
	761400	
	141600	
	540000	
	020000	
	761420	
	121600	
	104111	/DISPLAY CHART
	123120	
	114101	
	131040	
	103110	
	101122	
	524000	
FNC2	030000	
	761400	
	141530	
	540000	
	020000	
	761420	
	121530	
	103101	/ CALCULATE TRANSMISSIVITIES
	114103	
	125114	
	101124	
	105040	
	524000	
RFLINE	660000	
	120000	
	600000	
	0	
RFEND	0	
/		

```

/
MESSAG ESAJ+.+1
      764500
      127750 / FLOW TUBE PROGRAM TITLE
      106114
      117127
      124125
      102105
      040120
      122117
      107122
      101515

REAL1  0
      ESAJ+REAL2
      .NORIT
      .ABSV  10,35
      .9BIT /DIGITIZE FLOTUB ORIGIN/<400>
REAL2  0
      ESAJ+ECHO
      .ABSV  10,35
      .9BIT /ENTER TRANSMISSIVITY X.XXXXEXX/<400>

ECHO   ESAJ+.+3
      ESAJ+STRMFL
      -20
      760010
      140010
      440000
      .BLOCK 17
      ESAJ+ECHO+1

STRMFL ESAJ+TRACK / VECTOR TABLE FOR DISPLAY

/*****
/ DUMMY PATCH FILE FOR DEBUGGING
PATCH .BLOCK 20
/*****/

.END

```

```

SUBROUTINE GRADSS(X,Y,H,GX,GY,GRAD)
C SUBROUTINE TO CALCULATE GRADIENTS
C STEADY STATE VERSION
C
C DIMENSION ID(1),DATA(20)
C
C EQUIVALENCE (PT1,DATA(1)),(PT2,DATA(2)),(PT3,DATA(3))
C EQUIVALENCE (PT4,DATA(4)),(PT5,DATA(5)),(PT6,DATA(6))
C EQUIVALENCE (PT7,DATA(7)),(PT8,DATA(8)),(PT9,DATA(9))
C EQUIVALENCE (PT10,DATA(10)),(PT11,DATA(11)),(PT12,DATA(12))
C EQUIVALENCE (PT13,DATA(13)),(PT14,DATA(14)),(PT15,DATA(15))
C EQUIVALENCE (PT16,DATA(16)),(PT17,DATA(17)),(PT18,DATA(18))
C EQUIVALENCE (PT19,DATA(19)),(PT20,DATA(20))
C
C IX=IFIX(X)
C IY=IFIX(Y)
C IF (IX.EQ.IXS.AND.IY.EQ.IYS) GO TO 550
C IXS=IX
C IYS=IY
C CALL GRDPNT (IX,IY,ID)
C
C DO 500 I=1,20,1
C DATA(I)=(FLOAT(ID(I))*100.)/2.**13
500 CONTINUE
C
550 FX=X-FLOAT (IX)
FY=Y-FLOAT (IY)
C
C GP1=PT1-8.*PT2+8.*PT4-PT5
C GP2=PT2-8.*PT3+8.*PT5-PT6
C GP3=PT7-8.*PT8+8.*PT10-PT11
C GP4=PT8-8.*PT9+8.*PT11-PT12
C
C GP1=GP1+FX*(GP2-GP1)
C GP3=GP3+FX*(GP4-GP3)
C GX=(GP1+FY*(GP3-GP1))/12.
C
C GP1=PT13-8.*PT14+8.*PT9-PT15
C GP2=PT14-8.*PT3+8.*PT15-PT16
C GP3=PT17-8.*PT18+8.*PT10-PT19
C GP4=PT18-8.*PT4+8.*PT19-PT20
C
C GP1=GP1+FY*(GP2-GP1)
C GP2=GP3+FY*(GP4-GP3)
C
C GY=(GP1+FX*(GP2-GP1))/12.
C
C GRAD=GX**2+GY**2
C GRAD=SQRT (GRAD)
C
C GP1=PT3+FX*(PT4-PT3)
C GP2=PT9+FX*(PT10-PT9)
C H=GP1+FY*(GP2-GP1)
C
C RETURN
C END

```

```

SUBROUTINE TRANSS(IK,IX,IY,TRAN,ITCH,IV,IAX,IAY)
C
C
C      VERSION TO CALCULATE STEADY STATE TRANSMISSIVITY
C       $T(I+1)=T(I)*(GRAD(I)*W(I))/(GRAD(I+1)*W(I+1))$ 
C      T      TRANSMISSIVITY
C      GRAD    GRADIENT
C      W      WIDTH
C
C      IK      CONTROL WORD
C      IX,IY   X,Y POSITION XXX.XXX
C      TRAN    TRANSMISSIVITY
C      ITCH    DIRECTION SWITCH
C      IV      VECTOR ADJUSTMENT
C      IAX,IAY ABSOLUTE X,Y POSITION DISPLAY UNITS
C
C      REAL KX0,KY0,KX1,KY1
C
C      ***** DATA STATEMENTS*****
C      W0      INITIAL FLOTUB WIDTH      (NODES)
C      WMAX    MAXIMUM FLOTUB WIDTH      (NODES)
C      WMIN    MINIMUM FLOTUB WIDTH      (NODES)
C      STEPR   STEP LENGTH                (NODES)
C      DATA W0 /0.25/
C      DATA WMAX,WMIN /0.50,0.125/
C      DATA STEPR /1.0/
C
C      POINT NAME DEFINITIONS
C
C      * (X1,Y1)      * (X3,Y3)
C
C      * (KX0,KY0)    * (KX1,KY1)
C
C      * (X0,Y0)      * (X2,Y2)
C
C      GO TO (2000,100) ,IK
C
100  WN=WNP1
      TN=TRAN
      GRADN=GRDNP1
C
      KX0=KX1
      KY0=KY1
      X0=X2
      Y0=Y2
      X1=X3
      Y1=Y3
C
C      CALL GRDENT(X0,Y0,GX,GY,GRAD)
C
C      X2=X0+(GX/GRAD)*STEP
C      Y2=Y0+(GY/GRAD)*STEP
C
C      CALL GRDENT(X1,Y1,GX,GY,GRAD)
C
C      X3=X1+(GX/GRAD)*STEP
C      Y3=Y1+(GY/GRAD)*STEP
C

```

```

WNP1=(X3-X2)**2+(Y3-Y2)**2
WNP1=SQRT(WNP1)
IF(WNP1.GT.WMAX) GO TO 1000
IF(WNP1.GT.WMIN) GO TO 1500
900 WNP1=WN+(WMAX-WMIN)*0.125
IF(WNP1.LE.WMAX) GO TO 2100
GO TO 1700

C
1000 WNP1=WN-(WMAX-WMIN)*0.125
IF(WNP1.GE.WMIN) GO TO 2100
GO TO 1700

C
1500 KX1=X2+(X3-X2)/2.
KY1=Y2+(Y3-Y2)/2.

C
CALL GRDENT(KX1,KY1,GX,GY,GRDNP1)

C
CTHETA=ABS(((X3-X2)*GX+(Y3-Y2)*GY)/(WNP1*GRDNP1))
IF(CTHETA.LT.0.5) GO TO 1800
1700 STEP=STEP-STEPR*0.125
IF(ABS(STEP).LT.WMIN/2.) GO TO 1750
KX1=KX0
KY1=KY0
WNP1=WN
GO TO 2100

C
1750 PAUSE

C
1800 STHETA=1.-CTHETA**2
STHETA=SQRT(STHETA)
WNP1=STHETA*WNP1
TRAN=TN*(GRADN*WN)/(GRDNP1*WNP1)

C
STEP=STEPR*DIR
FX=((KX1-KX0)*1023./VECTMX)+DDX
FY=((KY1-KY0)*1023./VECTMX)+DDY
IX=IFIX(FX)
IY=IFIX(FY)
DDX=FX-FLOAT(IX)
DDY=FY-FLOAT(IY)
IAX=IFIX(KX1*1023./VECTMX)
IAY=IFIX(KY1*1023./VECTMX)
RETURN

C
2000 WNP1=W0
DIR=FLOAT(ITCH)
STEP=STEPR*DIR
IK=2
VECTMX=FLOAT(IV)
KX1=FLOAT(IX)/512.
KY1=FLOAT(IY)/512.
DDX=0.
DDY=0.

C
2100 CALL GRDENT(KX1,KY1,GX,GY,GRDNP1)

C
IK=0

```

```

C      DY=(WNP1/2.)*GX/GRDNP1*DIR
      DX=(WNP1/2.)*GY/GRDNP1*DIR
C
C      2200      X2=KX1+DX
      Y2=KY1-DY
      X3=KX1-DX
      Y3=KY1+DY
C
C      RETURN
C
      END

```

```

      SUBROUTINE TCALC(T1,T2,ITC,ITR)
C
C   TREAL = T1 * (TCHART/T2)
C
C       TC = 10.** (FLOAT(ITC)/2.**13)
C
C       TR = T1*(TC/T2)
C
C       ITR = IFIX(ALOG10(TR)*2.**13)
C
      RETURN
      END

```


APPENDIX E

TRANSMISSIVITY PROGRAM (TRANSIENT STATE) LISTING

LISTING

TRANSMISSIVITY PROGRAM (TRANSIENT STATE)

```

.TITLE FLOW TUBE SET-UP

/      ** TRANSIENT STATE VERSION **
/      SPECIAL WITH FORTRAN TRANSMISSIVITY CALCULATOR

/      1-8-72
/      D R FRIEDRICHS
/      L E ADDISON

/      OPEN MATRIX FILE AND INITIALIZE FOR
/      FLOW TUBE GENERATION AND DISPLAY

.DAT=135
.SCOM=100

ESAJ=200000

      .GLOBL SCALER,IFIX.
      .GLOBL UP57.,UP57B.,RCHR.,RNUM.
      .GLOBL MX.IWK,MX.H,MX.V,MX.RW,MX.AD2
      .GLOBL MX.SH,MX.SV,MX.WC
      .GLOBL IWDAT.,WMSG.,UP57L.
      .GLOBL IRDAT.,UP57C.
      .GLOBL DZIN.,DZRD.,DZWTR.
      .GLOBL FPSL.
      .GLOBL DSIN.,DSRD.,DSWT.
      .GLOBL LODR.,CMP.
      .GLOBL DKD.,HLOG.,FG2.
      .GLOBL TRANTR,TMAPTR

BEGIN CAL+775 / .INIT -3
      1
      BEGIN
TEM1  0

      CLL
      LAW      -3      / DAT -3 = TTA.
      JMS*     IWDAT.  / INITIALIZE IOPS LIBRARY
      100000+LBUF / LINE BUFFER
TEM2  0

      LAC      (200000
      XOR      DKD.
      DAC*     (.DAT+10
      .INIT    10,0,0

      .FSTAT   10,COMMON      / COMMON DATA
      SNA
      JMP      ERROR5 / NO COMMON DATA SO EXIT
      DAC      COM.+2

COM.  .TRAN    10,0,7777,DKNTRL,112
      .WAIT 10

      LAC      DZIN. / SET SO DON7T ZERO THE DIGITIZER WHEN INIT
      TAD      (2
      DAC      SV

```

```

LAC      (NOP
DAC*     SV

JMS*     WMSG.
TITLE
GETMAP   LAC      (2
JMS*     LODR.
4000000+DKD.
PROJ
4000000+.SCOM+2
JMP      ERROR2
DAC      LOR.#

RSTAT    LAC      (2      / DISC UNIT NO.
JMS*     MX.IWK  / INIT TO WORK ON FILE
POTAVE   / NAME:EXT
JMP      ERROR2  / NOT FOUND
DAC      DKPAVE  / REFERENCE DISC ADDRESS FOR AVERAGE POTENTIAL

LAC      (2
JMS*     MX.IWK
DPOTDT   / NAME:EXT TIME DERIVATIVE MATRIX
JMP      ERROR2
DAC      DKDPOT  / REFERENCE DISC ADDRESS FOR DERIVATIVE DATA

LAC      (2
JMS*     MX.IWK
TRN
JMP      ERROR2
DAC      DKADR0
DAC      DEADF1

/  SETUP PROPER SCALING PARAMETER.
LAC*     MX.H     /NODES IN X DIREC.
CMA
TAD*     MX.V     /NODES IN Y DIREC.

SMA
JMP      .+5
LAC*     MX.H     / X IS LARGER
TAD      (-1
DAC      SCALE2
JMP      .+3
LAC*     MX.V     / Y IS LARGER
JMP      .-4

LAC*     MX.WC    / - WORD COUNT PER SECTION
TAD*     (.SCOM+3  / HIGHEST FREE ADDRESS
DAC      WTRDAT   / ADDRESS OF DATA
DAC      CORAD0   / CORE ADDRESS FOR TRANS. GENERATION
DAC      CORAD1
TAD      (-1
TAD*     MX.WC    / 2ND BUFFER FOR DERIVATIVE
DAC      DPDAT   / ADDRESS OF DERIVATIVE
TAD      (-1
DAC      UPR.#

```

```

JMS*    DZIN.    / INIT THE DIGITIZER

/ SETUP ESAJ FOR PERMANENT DISPLAY FILE
LAC*    (.SCOM+2
XOR     (ESAJ
TAD     (14
DAC     STRMFL

CLK      51          / .SETUP ON CLOCK
        16          / USED FOR STALL ON AUTO GEN
        0
        CLSRV

GOBABY   CLC
DAC      THUMBS# / + GENERATE TRANS. ; - DO NOT GENERATE TRANS.
DAC      SECTN# / CURRENT DATA SECTION IN CORE

JMS      REMOVE / INITIALIZE STREAMLINE FILE*

CLL      / USE INTDBNL KEYBOARD
JMS*     DSIN.    / INIT DISPLAY
0        / KEY BOARD
.DSA     LTPN     / LIGHT PEN
0        / OVERFLOW
0        / COMMAND
.DSA     KEYBD    / FUNCTION
0        / TRANSMIT
.DSA     ECHO     / ECHO FILE
.DSA     TRACK    / START OF DISPLAY BUFFER

DISPLA   JMS      SETUP
        JMP      FLODUN

F.F      JMS      FLOTUB
        JMP      .-1

/ KEYBOARD INTERRUPT ROUTINE.
/
KEYBD    0
        DAC      CHAR
        SAD      KTBL+1
        JMP      KYTRN
        LAC      KTFG
        SPA
        JMP*     KEYBD
        LAC      KTBL
        DAC*     (15
        LAC      KDTBL
        DAC*     (16
KYBDLP   LAC*     15
        SNA
        JMP*     KEYBD
        SAD      CHAR
        JMP      .+3
        ISZ*     (16
        JMP      KYBDLP
        JMP*     16

```

```

KYTRN  CLA
      DAC      KTFG
      JMP*     KEYBD

KTFG   0
HOME   660077
      140077

/
/
SETUP  0
      LAC      POS100
      DAC      POS
      LAC      NEG100
      DAC      NEG
      LAC      (DSFILE
      DAC      DSPNTR#
      LAC      (1      /CURSOR=1 (LARGE)
      DAC      SIZE#   /CURSOR=0 (SMALL)
      DZM LINSET#
      DZM      BOXSET#
      JMP*     SETUP

/
/
KTBL   .
      377
      417      /RIGHT
      416      /LEFT
      415      /DOWN
      414      /UP
      433      /CURSOR HOME
      431      /POINT
      427      /LINE
      534      /SOM
      461      /INCR=1 (CURSOR)
      462      /INCR=10
      463      /INCR=100
      537      / L.P. DRAW
      432      /ERASE TO END OF LINE--LP DRAW
      412      /ERASE TO END OF DISPL--DELETE REF LINE
      336      /OMEGA--REMOVE ALL STREAMLINES.
      533      /DIVISION--UP OR DOWN GRADIENT.
      476      / (RIGHT BRAC.)-- INIT. LINE DETECT
      541      / (LEFT BRAC.)---LEAVE LINE DETECT MODE
      453      / + -- EXIT TO CONTROLLER
      455      / - (FNCT) ---SETUP LINES OR PNT FOR BOX
      540      /BOX-----SETUP HI&LO (X&Y) OF BOX
      561      / ALPHA--ABORT CALCULATIONS
      0

/
KDTBL  .
      JMP*     KEYBD
      JMP      RTIT
      JMP      LFIT
      JMP      DMIT
      JMP      UPIT
      JMP      CURS
      JMP      KPOINT
      JMP      KLINE

```

```

        JMP      SOM
/  CURSOR INCREMENTS
        JMP      UPSL
        JMP      UPMD
        JMP      UPLRG
/  LIGHT PEN DRAW RESPONSE
        JMP      LPDRAW
/  ERAPLAST LINE
        JMP      ERASE1
/  ERASE LAST REFERENCE LINE
        JMP      ERASE2
/  REMOVE ALL STREAMLINES
        JMP      RMOVE
/  CHANGE GRADIENT
        JMP      GRADNT
        JMP      DTECIN
        JMP      DTECOT
/  EXIT TO CONTROLLER
        JMP      XIT
/  SETUP BOX FOR TRANSMISSIVITIES
        JMP      BXSTRT
        JMP      BOXEND
/  TERMINATE THIS CALCULATION (ABORT)
        JMP      ABRT
        0

```

```

/  EXIT TO CONTROLLER
XIT      CAF

```

```

.DKCA=37740
.DKAD=37742
.DKWC=37741
.DKRWS=37743
.DKBEG=37731

```

```

        DZM*     (.DKCA / USE BOOT STRAP TO READ ^Q FILE
        LAC      DKNTRL
        SNA
        JMP      ERROR5
        DAC*     (.DKAD
        LAC      (-37720
        DAC*     (.DKWC
        DZM*     (.DKRWS
        JMP*     (.DKBEG

```

```

COMMON  .SIXBT /COMMONBIN/
        0

```

```

/
RTIT    LAC      TRACK+1
        ADD      POS
        DAC      TRACK+1
        JMP*     KEYBD
LFIT    LAC      TRACK+1
        ADD      NEG
        DAC      TRACK+1
        JMP*     KEYBD
DWIT    LAC      TRACK+2

```

	ADD	NEG	
	DAC	TRACK+2	
	JMP*	KEYBD	
UPIT	LAC	TRACK+2	
	ADD	POS	
	DAC	TRACK+2	
	JMP*	KEYBD	
CURS	LAC	HOME	
	DAC	TRACK+1	
	LAC	HOME+1	
	DAC	TRACK+2	
	JMP*	KEYBD	
KPOINT	LAC	TRACK+1	
	DAC	RFLINE	
	JMS	LV.IN	
	DAC	RFLX1#	/STORE VALUE OF X(1)
	LAC	TRACK+2	
	DAC	RFLINE+1	
	JMS	LV.IN	
	DAC	RFLY1#	/STORE VALUE OF Y(1)
	JMP*	KEYBD	
KLINE	LAC	TRACK+1	
	JMS	LV.IN	
	DAC	RFLX2#	/STORE VALUE OF X(2)
	LAC	RFLX1	
	CMA		
	ADD	RFLX2	
	DAC	LINEX#	
	JMS	IN.LV	
	XOR	(600000	
	DAC	RFLINE+2	/SETUP DISPLAY.
	LAC	TRACK+2	
	JMS	LV.IN	
	DAC	RFLY2#	/STORE VALUE OF Y(2)
	LAC	RFLY1	
	CMA		
	ADD	RFLY2	
	DAC	LINEY#	
	JMS	IN.LV	
	DAC	RFLINE+3	/SETUP DISPLAY.
	JMP*	KEYBD	
SOM	LAC	(ESAJ+CHART	
	DAC	DSFILE	
	LAC	(ESAJ+TRACK1	/SET TO LRGE
	DAC	TRACK1-1	/TRACKING CROSS
	JMS	SETUP	
	JMP*	KEYBD	
/			
/	SET	CURSOR INCREMENT	
/			
UPSL	LAC	POS1	
	DAC	POS	
	LAC	NEG1	

```

DAC      NEG
UPMD     JMP*   KEYBD
        LAC     POS10
        DAC     POS
        LAC     NEG10
        DAC     NEG
        JMP*   KEYBD
UPLRG    JMS    SETUP
        JMP*   KEYBD
/
/  INITIALIZE FOR L.P. DRAW
LPDRAW   LAC     (ESAJ+TRACK2      /SET TO SMALL
        DAC     TRACK1-1          /TRACKING CROSS
        DZM     SIZE
        JMS     POINT
        JMP*   KEYBD
/  ERASE LAST DISPLAYED VECTOR FORMED BY L.P. DRAW.
ERASE1   LAC     XLAST
        TAD     (-20
        DAC     XLAST      /RESTORE LAST ABS X
        XOR     (660000
        DAC     TRACK+1 /MOVE T.C. TO LAST X

        LAW 17777
        TAD DSPNTR
        DAC     DSPNTR
        LAC*    DSPNTR
        JMS     LV.IN
        CMA
        TAD     (1
        TAD     YLAST
        DAC     YLAST      /RESTORE LAST ABS Y
        XOR     (140000
        DAC     TRACK+2 /MOVE T.C. TO LAST Y

        LAW 17776      /MOVE FILE POINTER BACK
        TAD     DSPNTR /TO LAST VECTOR.
        DAC     DSPNTR

        JMS     ENDPT

        JMP*   KEYBD
/  ERASE LAST REF LINE
ERASE2   LAC     (660000
        DAC     RFLINE
        LAC     (120000
        DAC     RFLINE+1
        LAC     (600000
        DAC     RFLINE+2
        DZM     RFLINE+3
        JMP*   KEYBD

/  REMOVE ALL STREAMLINES AND RE-INITIALIZE DISPLAY FILE.
REMOVE   JMS     REMOVE
        JMP*   KEYBD

REMOVE   0      / INITIALIZE THE DISPLAY FILE

```



```

LAC      LOR.      / STARTING ADDRESS DISPLAY BUFFER
DAC      POINT1    / RESET STORAGE VECTOR TOP OF TABLE

```

```

LAC      (ESAJ+TRACK
DAC*     POINT1    / RESET SO DONT ENTER BUFFER

```

```

DZM      FLAG      / CLEAR FLAG

```

```

JMP*     REMOVE

```

```

/ CHANGE GRADIENT TO UP OR DOWN.

```

```

GRADNT   LAC      DIRECT
          SPA!CLC
          LAC      (1
          DAC      DIRECT
          JMP*     KEYBD

```

```

DIRECT   1

```

```

/ PUT INTO LINE DETECT MODE.

```

```

DTECIN   JMS      DTECKT
          JMP*     KEYBD

```

```

DTECKT   0
          ISZ      DTECFG
          LAC      (TABSTR+1
          DAC      STORE# / STORAGE POINTER
          DZM      TABSTR / COUNTER

```

```

          LAC      RFLX1  /X0
          DAC      TABLE
          LAC      RFLY1  /Y0
          DAC      TABLE+1
          LAC      RFLX2  /X1
          DAC      TABLE+2
          LAC      RFLY2  /Y1
          DAC      TABLE+3
          DZM      TABLE+4
          DZM      TABLE+5
          LAC      (377777
          DAC      TABLE+6
          JMP*     DTECKT

```

```

/ TAKE OUT OF LINE DETECT MODE

```

```

DTECOT   DZM      DTECFG
          JMP*     KEYBD

```

```

/ TABLE FOR LINE DETECTION

```

```

TABLE    0        / X0
          0        / Y0
          0        / X1
          0        / Y1
          0        / X2
          0        / Y2
          0        / PREVIOUS LENGTH
          0        / MANTISSA TRANSMISSIVITY
          0        / EXPONENT

```

/ ROUTINE TO ABORT CALCULATION

```
ABRT   DSIA
       DSCI
       DBR
       JMP     FLODUN
```

```
TABSTR .BLOCK 121 /VALUE,X,Y
BXSTRT LAC LINSET
       SZA /SETUP POINT FOR BOX
       JMP BOXPNT /SETUP POINT LOCATOR LINES
       DZM BCNTR#
       LAC* BXXX
       DAC* BOXADR
       ISZ BXXX
       ISZ BOXADR
       ISZ BCNTR
       LAC BCNTR
       SAD (11
       SKP
       JMP .-10
```

```
       CLC
       DAC LINSET
       LAC (BOXFIL+2
       DAC BOXADR
       LAC (BXXX
       DAC BXXX
       JMS BOXLIN
       DZM BOXFIL
       JNP* KEYBD
BOXPNT DZM LINSET
       LAC TRACK+2
       XOR (060000
       DAC BOXFIL+2
       LAC (ESAJ+TRACKE
       DAC BOXFIL+3
       DZM BOXFIL+4
       LAC (600000
       DAC BOXFIL+5
       DAC BOXFIL+11
       CLC
       DAC BOXSET
       JMP* KEYBD
```

```
/
BOXEND LAC XLO# /FIND WHICH IS LARGEST X
       DAC LOWSVE#
       CMA
       ADD XHI#
       SMA
       JMP .+5
       LAC XHI /SWAP THE ORDER
       DAC XLO
       LAC LOWSVE
       DAC XHI
       LAC XLO
       JMS XY.SET
       DAC X.LO#
       LAC XHI
```

```

JMS      XY.SET
TAD      (1
DAC      X.HI#

/
LAC      YLO#      /FIND LARGEST Y
DAC      LOWSVE
CMA
ADD      YHI#
SMA
JMP      .+5      /IN RIGHT ORDER
LAC      YHI      /SWAP THE ORDER
DAC      YLO
LAC      LOWSVE
DAC      YHI
LAC      YLO
JMS      XY.SET
DAC      Y.LO#
LAC      YHI
JMS      XY.SET
TAD      (1
DAC      Y.HI#
DZM      BOXSET
JMP*     KEYBD

```

/ CONVERT DISPLAY UNITS TO REAL NODES

XY.SET 0

```

DAC      XY1.
LAC      SCALE2
MUL!30000
XY1.     0
DIV
1777
LACQ
TAD      (1
JMP*     XY.SET

```

```

BOXADR   BOXFIL+2
BXXX     .+1
120000
600000
121777
600000
0
601777
0
0
0

```

```

/
/
LPTBLE   .
SET1+3
SET2+3
SET3+3
FNC1+3
FNC2+3

```

```

0
LPJUMP  .
        JMP      DISP1    /GO TO 1ST DISPLAY
        JMP      DISP2    /GO TO 2ND DISPLAY-CALC. NEW LINE
        JMP      DISP3    /GO TO 2ND DISPLAY-SAVE LAST LINE
        JMP      FNCTN    /SETUP FNCT TABLE FROM L.P. DRAW
        JMP      TRNCAL   /CALCULATE T VALUES.

/
/      LIGHT PEN ROUTINES
/
DISP1   LAC      (ESAJ+SET2
        DAC      TRACKE
        JMP      LPEXIT
DISP2   LAC      (ESAJ+DSFILE
        DAC      TRACKE
        LAC      (ESAJ+CHART
        DAC      DSFILE
        LAC      LINEX
        DAC      SAVEX#
        LAC      LINEY
        DAC      SAVEY#
        JMS      DIST
        JMP      GOSUB
DISP3   LAC      (ESAJ+DSFILE
        DAC      TRACKE
        JMP      LPEXIT
/      SETUP FUNCTION TABLE FROM L.P. DRAW ROUTINE
FNCTN   LAC      (DSFILE+2
        DAC      DSPNT2
        CMA
        TAD      DSPNTR
        RCR
        TAD      (1
        DAC      TOTPNT   /NO. OF Y PTS IN FILE.

        DZM      COUNTY#
        LAC      (FNCTBL
        DAC      FNPNTR

        LAC      SCFACX
        LRS+1
        DIVS!10000
        310000
        LRS+6!1000
        LACQ
        DAC      FNC.X#   /REAL X INCREMENT(16 DISPLAY UNITS)

        LAC*     DSPNT2   /GET FIRST Y FROM DISPLAY FILE
        JMS      LV.IN
        TAD      (-200
        JMP      .+4
FNCTN1  LAC*     DSPNT2   /GET NEXT Y
        JMS      LV.IN
        TAD      LV.Y
        DAC      LV.Y
        LRSS+3!10000
        DIV

```

```

UNITS2  0
        LRS+2!1000
        LACQ
/  CONVERT DISPLAY UNITS TO LOG
        TAD      MINLG2
        DAC*     FNPNTR  /STORE IN FUNCTION TABLE

        ISZ      COUNTY
        LAC      COUNTY
        SAD      TOTPNT  /LAST POINT?
        JMP      .+5      /YES
        ISZ      DSPNT2
        ISZ      DSPNT2
        ISZ      FNPNTR
        JMP      FNCTN1

        LAC      FNC.,X
        NORMS!10000
        DAC      HOLD

        LACS
        CMA
        TAD      (35
        TAD      (LRS+17
        DAC      SHFT1

        CLL
        LAC      (100000
        DIV!10000
HOLD    0
        LACQ
        DAC      SCALEX
        JMP      LPEXIT
/  TABLE USED IN FUNCTION GENERATION
STRT.X  0
SCALEX  0
SHFT1   0
TOTPNT  0
FNCTBL  .BLOCK 63      /STORAGE FOR 51 POINTS

/  *****
DSPNT2  0
FNPNTR  0

/  CALCULATE TRANSMISSIVITY VALUES FOR POINTS WHERE
/  FLOTUBES INTERSECT LINE.
TRNCAL  LAC      X.LO
        DAC      XNODE#
        LAC      Y.LO
        DAC      YNODE#
        LAC      THUMBS
        SZA!CLC
        CLA
        DAC      THUMBS
        JMP      LPEXIT

```

DIST	0		
	LAC	SAVEX	
	DAC	DIST1	
	LAC	SAVEY	
	DAC	DIST2	
	JMS	DISTAN	/ CALCULATE DISTANCE
	HLT		/ OVERFLOW
	CLL		
	MULS		
SCALE2	0		
	DIV		
	1777		
	DAC	FRACT#	
	LAC0		
	DAC	WHOLE#	
	LAC	FRACT	
	FRDIV		
	1777		
	LAC	WHOLE	
	LLS+14		
	DAC	D	
	JMP*	DIST	
/			
/	LIGHT PEN INTERRUPT ROUTINE.		
/			
LTPN	0		
	AND	(37777	
	DAC	LT2#	
	CMA		
	DAC	LT1#	/STORE NEG. STRIKE ADRES.
	ADD	(TRACK2+1	/L.P. STRIKE ON SMALL T.C.?
	JMS	CMP	
	JMP	LTP1	/YES. AC=NO. OF STRIKE WITHIN TC. /NO---CONTINUE
LPCRS	LAC	LT1	
	ADD	(TRACK1+1	/ STRIKE ON LARGE T.C.?
	JMS	CMP	
	JMP	LTP1	/YES. /NO---CONTINUE
	LAC	(LPJUMP	/CHECK ON L.P. STRIKE FROM TABLE
	DAC	LPJUMP	
	LAC	LPTBLE	
	DAC*	(15	
	ISZ	LPJUMP	
	LAC*	15	
	SAD	LT2	
	JMP	.+4	
	SZA		
	JMP	.-5	
	JMP	LPEXIT	/NO MATCHES
	XCT*	LPJUMP	
LTP1	TAD	(TBLSV	
	DAC	DXADR	

	TAD	(10	
	DAC	DYADR	
	LAC*	DXADR	
	DAC	XINC#	
	LAC*	DYADR	
	DAC	YINC#	
	LAC	TRACK+1	
	JMS	LV.IN	
	TAD	XINC	
	DAC	LV.X#	
	AND	(3777	
	XOR	(060000	
	DAC	TRACK+1	/MOVE CURSOR X
	LAC	TRACK+2	
	JMS	LV.IN	
	TAD	YINC	
	DAC	LV.Y#	
	AND	(3777	
	XOR	(140000	
	DAC	TRACK+2	/MOVE CURSOR Y
	LAC	SIZE	
	SNA		
	JMS	LONGLN	
	LAC	LINSET	
	SZA		
	JMS	BOXLIN	
	LAC	BOXSET	
	SZA		
	JMS	BOX	
LPEXIT	NOP		
	DSEI		
	LAC	TRACK	
	DSIA		
	DSLBI		
	JMP*	LIPN	
/			
SV.IN	0		
	CLL		
	CLQ		
	LRSS+7		
	JMS	SV	
	XCT*	SV.IN	/STORE INTEG. X VALUE
	ISZ	SV.IN	
	LLSS+7		
	JMS	SV	
	XCT*	SV.IN	/STORE INTEG. Y VALUE
	ISZ	SV.IN	
	JMP*	SV.IN	
SV	0		
	AND	(177	
	TAD	(377700	
	SMA		
	JMP	.13	
	CMA		
	TAD	(-77	

```

        TAD      (-377700
        JMP*     SV
SAVE     0
/ CONVERT 18 BIT INTEGER TO DISPLAY SHORT VECTOR FORM.
/ RIGHT JUSTIFIED.
IN.SV    0
        GSM
        SZL
        TAD      (101
        JMP*     IN.SV
/
LV.IN    0
        AND      (3777
        TAD      (376000
        SMA
        JMP      .+3
        CMA
        TAD      (-1777
        TAD      (-376000
        JMP*     LV.IN
IN.LV    0
        GSM
        SZL
        XOR      (2000
        JMP*     IN.LV
/ ROUTINE TO CHECK IF L.P. STRIKE LIES WITHIN A TRACKING CROSS.
CMP      0
        SMA!CMA
        JMP      CMP1      /STRIKE IS L.T. REGION
        DAC      TCMP
        ADD      (-11
        SMA
        JMP      CMP1      /STRIKE IS G.T. REGION
        LAC      TCMP      /STRIKE IS WITHIN REGION
        SKP      /LOAD AC WITH NO. OF STRIKE
CMP1     ISZ      CMP
        JMP*     CMP
TCMP     0

CHAR     0
K1       1
MDFG     0
POS      0
NEG      0
POS1     1
NEG1     -1-1
POS10    10
NEG10    -10-1
POS100   100
NEG100   -100-1
INCR     0
/
POINT    0
        ISZ      DSPNTR
        LAC      TRACK+1
        DAC*     DSPNTR
        JMS      LV.IN

```



```

DAC      XLAST#
ISZ      DSPNTR
LAC      TRACK+2
DAC*     DSPNTR
JMS      LV.IN
DAC      YLAST#

JMS      ENDPT

DZM      DSFILE
JMP*     POINT

```

```

LONGLN   0
LAC      XLAST
CMA
ADD      LV.X
SAD      PDELX    / SPACING=DELTA X?
SKP
JMP*     LONGLN
JMS      IN.LV
XOR      (E00000
DAC      SAVE1#
LAC      LV.X
DAC      XLAST

LAC      DSPNTR
DAC      SAVE2#

ISZ      DSPNTR
LAC      YLAST
CMA
ADD      LV.Y
JMS      IN.LV
DAC*     DSPNTR
LAC      LV.Y
DAC      YLAST

JMS      ENDPT

LAC      SAVE1
DAC*     SAVE2

JMP*     LONGLN

```

```

ENDPT    0
ISZ      DSPNTR
LAC      (ESAJ+CHART
DAC*     DSPNTR
JMP*     ENDPT

```

```

PDELX    20
/ ROUTINE TO OUTPUT VERTICAL & HORIZONTAL LINES
/ THRU THE T.C. (FOR TRANSMISSIVITIES)
BOXLIN   0

```

```

LAC TRACK+1
DAC BOXFIL+1
AND (1777
DAC XLO
LAC TRACK+2
XOR (060000
DAC BOXFIL+6
AND (1777
DAC YLO
JMP* BOXLIN
/ ROUTINE TO DRAW A BOX FOR TRANSMISSIVITIES.
BOX 0
LAC TRACK+2
AND (1777
DAC YHI
CMA
ADD YLO
CMA
JMS IN.LV
DAC BOXFIL+6
XOR (2000
DAC BOXFIL+12
/
LAC TRACK+1
AND (1777
DAC XHI
CMA
ADD XLO
JMS IN.LV
XOR (600000
DAC BOXFIL+7
XOR (2000
DAC BOXFIL+3
JMP* BOX
GOSUB LAC D
SPA
JMP ERROR3 / D GT 15.9999

LAC (ESAJ+TRACK
DAC ECHART
JMS* SCALER
TT
D 0 /LENGTH OF REFERENCE LINE
DAC SCFACX /STORE SCALE FACTOR
DAC REFLIN

LAC TABSTR / FIND MAX PERM
CMA
TAD (1
DAC NNPT / NUMBER OF TABLE ENTRIES
DAC TABSTR / SAVE FOR THE FUTURE

DZM MAX*LOG / SET MAXIMUM TO SMALLEST POSSIBLE
LAW -1
RCR
DAC MIN*LOG / SET MIN TO MAXIMUM

```

MAKLOG	LAC	(TABSTR+3	/ TABLE FORMAT, THIS IS FIRST LOG
	DAC	ADR2#	/ RETRIVAL POINTER
	JMS*	FPSL.	/ FORM LOG
		400000+ADR2	
	DAC*	ADR2	/ STORE
	JMS*	CMP.	/ FIND MAX AND MIN
	LAC	MAXLOG	
	NOP		/ >
	DAC	MAXLOG	/ =
	JMS*	CMP.	/ <
	LAC	MINLOG	
	JMP	.+3	/ >
	NOP		/ =
	DAC	MINLOG	/ <
	ISZ	ADR2	/ ZERO EXPONENT
	DZM*	ADR2	
	LAC	ADR2	
	TAD	(3	
	ISZ	NNPT	
	JMP	MAKLOG	
	LAC	(X1	/ NOW FOR THE SCALE
	DAC	ADR2	/ THIS IS FOR SCALE PRINTING
	LAC	(172	
	DAC	ABSPT	/ THIS IS FOR GRAPHING
	LAC	MINLOG	/ MIN LOG
	LRSS+15		/ GET THE EXPONENT
	DAC	VALUE#	/ SAVE THE EXPONENT MAGNITUDE
	CMA		
	TAD	(1	
	DAC	SPREAD	/ 2'S COMPLIMENT POWER OF TEN
	LLSS+15	CLQ	
	DAC	MINLOG	
	CMA		
	TAD	(1	
	DAC	MINLG2#	
	LAC	MAXLOG	/ MAX LOG
	LRSS+15		
	TAD	SPREAD	
	TAD	(1	
	DAC	SPREAD	/ DELTA POWER OF TEN
	CLL		/ NOW FIND THE NUMBER OF DISPLAY UNITS
	LAC	(1130	/ SPREAD OVER 1130(8) DISPLAY UNITS
	IDIV		
SPREAD	0		
	LACQ		
	DAC	UNITS	/ NUMBER OF DISPLAY UNITS PER DECADE
	DAC	UNITS2	
	CMA		/ FOR FIRST TIME THROUGH

	TAD	(1	
	TAD	ABSPT	
	DAC	ABSPT	
	LAC	SPREAD	/ COUNTER ON LABLES
	CMA		
	DAC	NNPT	
MAKSCL	LAW	31	
	DAC*	ADR2	/ X POSITION VECTOR
	ISZ	ADR2	
	LAC	ABSPT	
	TAD	UNITS	
	DAC	ABSPT	/ Y POSITION
	XOR	(140000)	
	DAC*	ADR2	
	ISZ	ADR2	
	LAC	(061060	/ ASCII (10)
	DAC*	ADR2	
	ISZ	ADR2	
	LAC	(052052	/ ASCII (**)
	DAC*	ADR2	
	ISZ	ADR2	
	LAC	VALUE	
	ISZ	VALUE	
	CLL		
	IDIV		
	12		
	TAD	(60	
	DAC*	ADR2	
	LACQ		
	TAD	(60	
	LLSS+11!	CLQ	
	XOR*	ADR2	
	DAC*	ADR2	
	ISZ	ADR2	
	LAC	(040455	/ ASCII (-)
	DAC*	ADR2	
	ISZ	ADR2	
	LAC	(ESAJ+XX1	
	DAC*	ADR2	
	ISZ	NNPT	
	JMP	MAKSCL	
	LAC	TABSTR	/ 2'S COMPLEMENT OF ENTREIES
	DAC	NNPT	
	LAC	(TABSTR+3	/ LOG
MAKUNT	DAC	ADR2	/ RETRIVAL POINTER
	LAC*	ADR2	
	TAD	MINLOG	/ SUBTRACT MIN POWER OF TEN
	CLL		

```

UNITS    MUL
         0          / DISPLAY UNITS PER DECADE
         LRSS+15
         LACQ
         DAC*      ADR2    / DISPLAY UNITS FOR LOG

```

```

         LAC      ADR2
         TAD      (4
         ISZ      NNPT
         JMP      MAKUNT

```

/ ZERO OUT PTFILE

```

         LAC      (-24
         DAC      NNPT
         LAC      (PTFILE
         DAC      PTFILE
         ISZ      PTFILE
         DZM*     PTFILE
         ISZ      NNPT
         JMP      .-3

```

```

         DZM      LASTX#
         DZM      LASTY#
         LAC      (060160
         DAC      ABSPT#
         LAC      TABSTR /NO. OF INTERSECTIONS
         DAC      NNPT#
         LAC      (TABSTR+1
         DAC      ADR1#
         LAC      (PTFILE+1
         DAC      PTFILE

```

/ SETUP X VECTOR

```

NXTONE  LAC*      ADR1
         ISZ      ADR1
         CMA
         ADD      RFLX1 /X0 OF LINE IN DISPLAY UNITS
         DAC      SAVEX /X0-X
         LAC*      ADR1
         ISZ      ADR1
         CMA
         ADD      RFLY1 /Y0
         DAC      SAVEY /Y0-Y
         JMS      DIST
         LAC      D      /DIST. OF FLOW TUBE INTERRECTION
         CLL      /FROM START OF REF LINE
         MUL
         1440
         DIV
SCFACX  0
         LACQ

         DAC      SAVEX
         CMA
         ADD      LASTX
         CMA

```

```

JMS      IN.LV
ADD      ABSPT      /PNSITION ABS. STARTING POINT.
XOR      (600000
DAC*     PTFILE
LAC      SAVEX
DAC      LASTX      /SAVE LAST ABSOLUTE X VALUE
ISZ      PTFILE
DZM      ABSPT

```

/ SETUP Y VECTOR

```

LAC*     ADR1
ISZ      ADR1
ISZ      ADR1

TAD      (200      /CONVERT TO ABSOLUTE
DAC      SAVEY      /DISPLAY UNITS.
CMA
ADD      LASTY
CMA

```

```

JMS      IN.LV
XOR      (120000
DAC*     PTFILE
LAC      SAVEY
DAC      LASTY      /SAVE LAST ABSOLUTE Y VALUE
ISZ      PTFILE
ISZ      NNPT
TMP      NXTONE      /GET NEXT POINT

```

```

LAC      (ESAJ+X1      /FINISHED
DAC      ECHART
JMP      LPEXIT

```

TT

```

XX1+4
XX1+5
X2+4
X3+4
X3+5
X4+4

```

/

```

X1      .BLOCK      120      / SAVED FOR LABLES
XX1

```

```

660470
120200
400110
572120
040061
060060
460000

```

X2

```

661000
120200
400110
572120
040062
060060
460000

```

```

X3      661310
        120200
        400110
        572120
        040063
        060060
        460000
X4      661620
        120200
        400110
        572120
        040064
        060060
        460000
        ESAJ+PTFILE+1

```

```

/ FILE TO STORRE FLOWTUBE INTERSECTION POINTS
/ WITH INTERSECTING LINES
PTFILE .

```

```

        .BLOCK 50
        ESAJ+TRACK

```

```

/
/ ERRORS

```

```

ERROR1  JMS*      WMSG.
        ERR1
        JMP       BEGIN

```

```

ERROR2  JMS*      WMSG.
        ERR2
        JMP       BEGIN

```

```

ERROR3  JMS*      WMSG.
        ERR3
        JMS       REMOVE
        JMP       ERASE2

```

```

ERROR5  JMS*      WMSG.
        ERR5
        .EXIT

```

```

/ BUFFERS

```

```

LBUF    .BLOCK 20

```

```

/ THIS IS THE BUFFER THAT IS COMMON TO ALL PROGRAMS IN THE ITERATIVE
/ SEQUENCE

```

```

/ IT IS ONE DISC SECTOR LONG (112 WORDS)

```

```

/ IT IS DIVIDED INTO 3 SECTIONS

```

```

/      1. DISC ADDRESS OF THE PROGRAMS

```

```

/      2. MAPS

```

```

/      3. COMMON DATA

```

```

DKNTRL  0          / DISC ADDRESS OF MONITOR

```

```

DKSTRM  0          / DISC ADDRESS OF STREAM-LINE

```

```

DKFLOW  0          / DISC ADDRESS OF FLOW-TUBE (STEADY-STATE)

```

```

DKFLTR  0          / DISC ADDRESS OF FLOW-TUBE (TRANSIENT)

```

```

DKTRVL  0          / DISC ADDRESS OF TRAVEL-TIME (TRANSMISCIVITY)

```

```

DKTRVK  0          / DISC ADDRESS OF TRAVEL TIME (CONSTANT PERMIABILITY)

```

```

DKINTR  0          / DISC ADDRESS OF INTERP

```

```

DKCOMB  0          / DISC ADDRESS OF MODIFY MATRIX

```

```

DKPERS  0      / DISC ADDRESS OF PERSPECTIVE PROGRAM
        .BLOCK 13      / 20 DECIMAL PROGRAM SLOTS

PROJ    .BLOCK 3      / PROJECT BOUNDARY MAP
POT1    .BLOCK 3      / POTENTIAL MAP (TIME 1)
POT2    .BLOCK 3      / POTENTIAL MAP (TIME 2)
POTAVE  .BLOCK 3      / POTENTIAL MAP (POT1+POT2)/2
DPOTDT  .BLOCK 3      / POTENTIALDERIVATIVE (POT2-POT1)/(TIME2-TIME1)
TRN     .BLOCK 3      / TRANSMISCIVITY MAP
AQU     .BLOCK 3      / BOTTOM AQUIFIERD MAP
        .BLOCK 47     / 20 DECIMAL MAP SLOTS TOTAL

MAXX    0      / MAXIMUM HORIZONTAL VALUE ON MAP DIGITIZER
TIME    0      / TIME T2-T1 DAYS INTEGER
        .BLOCK 36     / 32 DECIMAL ID WORDS TOTAL

/ DIGITIZER LINE BUFFER
DZLB    .BLOCK 16

/ MESSAGES
TITLE   .ASCII /FLOW TUBE GENERATION/<015><177>

ERR1    .ASCII /?/<015><177>

ERR2    .ASCII /FILE NOT FOUND/<015><177>

ERR3    .ASCII /REF LINE GT 32000 FT/<015><177>

ERR5    .ASCII /INITIALIZE WITH ITERATIVE CONTROLLER/<015><177>

        .TITLE FLOTUB
/ FLOW TUBE PERMIABILITY CALCULATOR

/ L.E.ADDISON 12-3-70

FLOTUB  DISPLA

        LAC FLAG      / FLAG=1 IF IN CALCULATION OF FLOW TUBE
        SZA
        JMP MORE.

        LAC THUMBS    / FLAG FOR AUTO INPUT OF X,Y
        SMA           / THUMBS DOWN USE DIGITIZER
        JMP AUTO      / THUMBS UP USE AUTO

        JMS* DZWTR.    / READ DIGITIZER
        .DSA BUSY

        LAC DZLB      / LINE BUFFER HEADER
        AND (17
        SZA!CLL!CLA    / MODE BITS 0=BINARY, 1=ASCII
BUSY    JMP* FLOTUB

        LAC DZLB+2    / X CO-ORD
        DAC DZ.X#
        LAC DZLB+3    / Y CO-ORD
        DAC DZ.Y#

```



```

LAC DZ.X
JMS      CONVRT / CONVERT DIGITIZER TO NODES
DAC      KX0#   / MIDPOINT X XXX.XXX

LAC DZ.Y
JMS      CONVRT
DAC      KY0#   / MIDPOINT Y XXX.XXX

JMP      STRT01

CLSRV    0      / CLOCK SERVICE ROUTINE USED IN STALL
CLOF
DBR
JMP      FLODUN

GTIME    -44000 / STALL TIME APPROX. 5 MIN.

AUTO     JMS      REMOVE / CLEAR DISPALY FILE
          DZM      TABLE+4 / INIT DETECTION TBL
          DZM      TABLE+5
          LAC      (37777
          DAC      TABLE+6
          DAC      DTECFG

          LAC      GTIME
          DAC*     (7
          CLON

          LAC      XNODE /LAST NODE ON LINE?
          JMS*     CMP.
          LAC      X.HI
          JMP      .+3    / >
          NOP      / =
          JMP      AUTO1  / <
          LAC      X.LO
          DAC      XNODE
          LAC      YNODE
          JMS*     CMP.
          LAC      Y.HI
          JMP      .+4    / >
          NOP      / =
          ISZ      YNODE / <
          JMP      AUTO1
          CLC
          DAC      THUMBS
          DZM      DTECFG
          JMP*     FLOTUB

AUTO1     LAC      XNODE / AUTO X
          ISZ      XNODE
          LLS+11!CLQ
          DAC      KX0

          LAC      YNODE
          LLS+11!CLQ

```

```

DAC      KY0

LAC      TCONST / INITIAL TRANSMISSIVITY
DAC      TRAN
LAC      TCONST+1
DAC      TRAN+1

JMP      STRT02

STRT01   DZM      REAL1 / TURN ON MESSAGE TO ENTER PERM
LAC      (ESQ)+REAL2+2
DAC      REAL2

STRTIN   JMS*     DCRD.
LBUF
-20
JMS*     DSWT.
LAC      (LBUF
DAC*     UPS7L.
DZM*     UPS7C.

/ READ FLOATING POINT NUMBER
/ X.XXXESXX

JMS*     RCHR. / GET FIRST CHR
JMP      RF1 / DIGIT
JMP      STRTIN / LETTER - NO LETTERS ALLOWED -
JMP      STRTIN / PUNCT

RF1      MUL!20000 16 / FORM FIRST DIGIT
470400 / (10**4) * 2**4
DAC      MANT / MANTISSA 10**4

JMS*     UPS7. / READ (.)
SAD      (050 / ASCII (.)
SKP
JMP      STRTIN / NOT .

LAC      (23420 / 10**4
DAC      MULT / MULTIPLIER OF INPUT DIGIT

LOOP     LAC      MULT / FORM POWER OF TEN FOR DIGIT
IDIV!20000
12
LACQ
DAC      MULT / REDUCE BY 10 DEC

JMS*     RCHR. / READ NEXT CHR
JMP      RF2 / DIGIT
JMP      RF3 / LETTER
JMP      RF3 / PUNCT

RF2      MUL!20000
MULT     0 / MULTIPLIER
LACQ
TAD      MANT

```

	DAC	MANT	
	JMP	LOOP	
RF3	LAC	MANT	/ 10**4 MANT
	MUL!20000		/ NEED TO REMOVE 10**4
	643335		/ (2**18)(2**13)/10**4
			/ AC = 2**13 MANTISSA
	NORM		/ NORMALIZE 2**((13+L) M = 2**17 2**(L-4) M
	DAC	MANT	
	LACS		/ EXPONENT
	CMA		/ -34-L-1 = -35-L
	TAD	(41	
	DAC	EXP2#	/ EXPONENT 2
	DZM	EXP10#	/ CLEAR FOR THE EXPONENT
	JMS*	UP57B.	/ BACK UP LINE BUFFER POINTER
RF4	JMS*	RCHR.	/ READ NEXT CHR
	JMP	RF5	/ DIGIT
	TAD	(100	/ LETTER
	SAD	(105	/ PUNCT ASCII(E)
	JMP	RF4	
	SAD	(053	/ ASCII(+)
	JMP	RF4	
	SAD	(015	/ CARRIAGE RETURN
	JMP	RF9	
	SAD	(055	/ ASCII (-)
	SKP!CLC		
	JMP	STR TIN	/ NOT (+), (-), (E), (CR)
	DAC	EXP10	/ SIGNAL (-) EXPONENT
	JMP	RF4	
RF5	JMS*	RNUM.	/ READ NUMBER
	12		
	XOR	EXP10	
	SPA		
	TAD	(1	
	DAC	EXP10	
	ISZ*	UP57C.	
MORE	LAC	EXP10	/ REDUCE POWER OF TDN
	SPA		
	JMP	RF7	/ (-) REQUIRES SPECIAL ATTENTION
	SNA		
	JMP	RF9	/ FINISHED EXP10 = 0
	LAC	EXP2	
	TAD	(3	
	DAC	EXP2	/ EXP2=EXP2+3
	LAC	EXP10	
	TAD	(-1	
	DAC	EXP10	/ EXP00=EXP10-1
	LAC	(500000	/ (10**1=5/4*2**3) 2**17
	JMP	RF8	

```

RF7      LAC      EXP2
        TAD      (4      / -3 F0 4/5*2**-3 , -1 FOR SCALING
        DAC      EXP2
        ISZ      EXP10    / EXP10=EXP10+1
        NOP

        LAC      (631463 / (10**-1=4/5*2**-3) 2**18

RF8      CLL
        MUL
MANT      0      / AC = 2**16*ADJUSTMENT*MANT
        LLS+1
        DAC      MANT      / 2**17 MANT
        SMAIRCK      / KEEP NORMALIZED
        JMP      MORE
        DAC      MANT      / SCALED TO BIG
        ISZ      EXP2      / TAKE ONE OF THEM OFF
        JMP      MORE

RF9      LAC      MANT
        DAC      TRAN+1
        LAC      EXP2
        AND      (777
        DAC      TRAN

STRT02   LAC POINT1      / SEE IF ROOM FOR LONG VECTORS
        TAD      (5
        JMS* CMP,
        LAC      UMR,
        NOP      / >
        JMP FLUDGE      / = NO ROOM
        NOP      / <

        LAC POINT1      / POINTS TO 0 IN BUFFER
        DAC* (10
        LAC (ESAJ+TRACK / SET SO DISPLAY WONT SEE MODS
        DAC* POINT1

        LAC KX0
        JMS SCALE      / ADJUST TO DISPLAY UNITS
        TAD (660000
        DAC* 10 / LONG VECTOR X

        LAC KY0
        JMS SCALE      / ADJUST TO DISPLAY UNITS
        TAD (140000
        DAC* 10 / LONG VECTOR Y

        DZM* 10
        LAC (ESAJ+TRACK
        DAC* 10
        DZM* POINT1

        LAC* (10
        DAC POINT#2

```

```

TAD (-1
DAC POINT#1

ISZ FLAG      / SET TO START CALCULATIONS OF NEW FLOW TUBE
ISZ      IK    / FIRST TIME THROUGH IK=1

JMP* FLOTUB    / HAVE INIT SO DO OTHER THINGS

TRAN .BLOCK 2    / TRANSMISSIVITY HOLDER
TCHART 0
TREAL 0
TCNST 12
      372000

MORE. LAC POINT1    / CONT NUMBER OF DISPLA UPDATES
TAD (1
JMS* CMP.    / CHECK TO SEE IF ROOM FOR UPDATE
LAC      UPR.
NOP      / >
JMP FLODUN    / = NO ROOM
NOP      / <

JMS*   TRANTR    / FORTRAN ROUTINE TO CALCULATE TRANSMISSIVITY
JMP    .+15
.DSA   IK        / CONTROL WORD
.DSA   KX0       / STRTING X
.DSA   KY0       / STRTING Y
.DSA   TRAN      / TRANSMISSIVITY
.DSA   DIRECT    / UP-DOWN GRADIENT SWITCH
.DSA   SCALE2    / (MX.H OR MX.Y) -1
.DSA   TIME      / TIME T2-T1 (DAYS)
.DSA   ABSX.     / X,Y CO-ORD ABSOLUTE
.DSA   ABSY.
.DSA   ADJUST    / PRODUCT (W(I-1)*G(I-1))/(W(I)*G(I))

ABSX. 0
ABSY. 0

LAC    THUMBS
SPA
JMP    VECTS

LAC    ABSX.
JMS*   CMP.
LAC    XLO
JMP    .+3      / >
SKP    / =
JMP    FLODUN   / <
JMS*   CMP.
LAC    XHI
JMP    FLODUN   / >
JMP    .+2      / =
NOP    / <
LAC    ABSY.
JMS*   CMP.
LAC    YLO
JMP    .+3      / >

```

```

SKP          / =
JMP          FLODUN / <
JMS*        CMP.
LAC         YHI
JMP          FLODUN / >
JMP          .+2    / =
NOP          / <

```

```

VECTS  LAC      KX0
        JMS IN.SV
        LLS+7!CLQ
        DAC TEM#

        LAC      KY0
        JMS IN.SV
        XOR TEM
        XOR (400000
        DAC* POINT1
        ISZ POINT1
        LAC (ESAJ+TRACK
        ISZ POINT2
        DAC* POINT2
        OZH* POINT1

```

```

TECT  LAC DTECFG      / DETECTION FLAG SET
        SNA
        JMP* FLOTUB    / NOPE

```

/ PROGRAM TO CHECK FOR LINE INTERSECTION

```

        LAC      TABLE+4
        SNA
        JMP PERIM4+2    / FIRST TIME THROUGH DETCT X2 SET = 0
CALDST  LAC TABLE      / CALCULATE DISTANCE BETWEEN (X0,Y0) (X3,Y3)
        CMA
        ADD      ABSX.
        DAC      DIST1
        LAC      TABLE+1
        CMA
        ADD      ABSY.
        DAC      DIST2
        JMS DISTAN      / CALCULATE D
        JMP      PERIM4+2 / DISTANC TO GREAT TO BE INTERSECTION
        DAC DD1*        / D (X0,Y0) (X3,Y3)

DSTCAL  LAC TABLE+2    / CALCULATE DISTANCE BETWEEN (X1,Y1) (X3,Y3)
        CMA
        ADD      ABSX.
        DAC      DIST1
        LAC      TABLE+3
        CMA
        ADD      ABSY.
        DAC      DIST2
        JMS DISTAN      / XCORD1,YCORD1 ALREADY SET TO X3,Y3
        JMP      PERIM4+2 / DISTANCE TO GREAT TO BE INTERSECTION
        / D (X1,Y1) (X3,Y3)

```

SUM.	TAD DD1 / FORM LENGTH	
	DAC SUM#	
PERIM3	LAC SUM / SUM(I+1)	
	JMS* CMP.	
	LAC TABLE+6 / SUM(I)	
	JMP FOUND / SUM(I+1)>SUM(I)	
	NOP / SUM(I+1)=SUM(I)	
	NOP / SUM(I+1)<SUM(I)	
PERIM4	LAC SUM / NOT MIN SO MUST SAVE	
	DAC TABLE+6 / SAVE PERIMETER	
	LAC ABSX. / SAVE	
	DAC TABLE+4	
	LAC ABSY.	
	DAC TABLE+5	
	LAC TRAN	
	DAC TABLE+7	
	LAC TRAN+1	
	SMA	
	JMP .+4	
	DZM TABLE+7	
	ISZ TABLE+7	
	LAC (200000	
	DAC TABLE+10	
	JMP* FLOTUB	
FOUND	LAC TABLE / CHECK TO SEE IF IN WINDOW (SET WINDOW)	
	JMS* CMP.	
	LAC TABLE+2	
	JMP .+6 / XX0>XX1	
	HLT	
	LAC TABLE / XX0<XX1	
	DAC BOX.X0#	
	LAC TABLE+2	
	JMP .+4	
	LAC TABLE+2	
	DAC BOX.X0	
	LAC TABLE	
	DAC BOX.X1#	
	LAC TABLE+1	
	JMS* CMP.	
	LAC TABLE+3	
	JMP .+6 / YY0>YY1	
	HLT / =	
	LAC TABLE+1 / YY0<YY1	
	DAC BOX.Y0#	
	LAC TABLE+3	
	JMP .+4	
	LAC TABLE+3	
	DAC BOX.Y0	
	LAC TABLE+1	
	DAC BOX.Y1#	
	LAC TABLE+4 / CHECK TO SEE IF IN WINDOW	
	JMS* CMP.	

LAC	TABLE+4	
JMS*	CMP.	
LAC	BOX.X1	
JMP	PERIM4	/ >
NOP		/ =
NOP		/ <

LAC	TABLE+5	
JMS*	CMP.	
LAC	BOX.Y0	
NOP		/ >
SKP		/ =
JMP	PERIM4	/ <

LAC	TABLE+5	
JMS*	CNP.	
LAC	BOX.Y1	
JMP	PERIM4	/ >
NOP		/ =
NOP		/ <

/ CALCULATES DISTANCE (D) BETWEEN POINTS

```

/D**2 = (XCORD1-XCORD0)**2 + (YCORD1-YCORD0)**2
/ D = (D**2)**1/2

```

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```

TAD DIST1      / FORM SUM
SPA           / OVERFLOW IN SUM
JMP* DISTAN    / YES
ISZ DISTAN     / GOING WITH THIS ONE SO SET RETURN
DAC DISTR*     / D**2

LAW          -1000  / SET SO DON'T TRY TO MANY TIMES
DAC          DIST1

ROOT         LAC (100      / SQUARE ROOT BY NEWTONS METHOD
DAC XN

ROOT1        LAC DISTR
CLL
IDIV
XN.          0
LACQ
ADD XN
RCR
DAC XNP1#
CMA
ADD XN
ABS          / ABS (XN-XNP1)
TAD LIM      / CONVERGENCE LIMIT
SPA
JMP SQRT      / WITHIN LIMITS
LAC XNP1
DAC XN

ISZ          DIST1  / STALLED OUT

JMP ROOT1     / ITERATE AGAIN

SQRT         LAC XNP1

JMP* DISTAN

LIM          -1      / CONVERGENCE LIMIT

TECTR        LAC        THUMBS  / SEE IF IN GENERATE MODE
SMA
JMP          CHKSTR

LAC          TABLE+4
DAC*         STORE
ISZ          STORE
LAC          TABLE+5
DAC*         STORE
ISZ          STORE
LAC          TABLE+10
DAC*         STORE
ISZ          STORE
LAC          TABLE+7
LLS+11
LRSS+11

```

```

DAC* STORE
ISZ STORE

ISZ TABSTR
DZM TABLE+4
DZM TABLE+5
LAC (37777
DAC TABLE+6

JMP FLODUN

CHKSTR LAC      TABLE+4 / ROUTINE TO CALCULATE TRAN ADJUSTED
CMA
ADD      RFLX1
DAC      SAVEX

LAC      TABLE+5
CMA
ADD      RFLY1
DAC      SAVEY

JMS      DIST      /GET DIST. OF INTERSECTION
                        /FROM START OF REF LINE.

JMS*     FG2.      /GET T FROM FNC TABLE.
.DSA     STRT.X

DAC      TCHART    / SFP LOG

/ CALCULATE  TREAL = T1 + (TCHART-T2)

JMS*     TMAPTR
JMP      .+10
.DSA     TCONST
.DSA     TABLE+7
.DSA     TCHART
.DSA     TREAL
.DSA     ADJST
ADJST    .BLOCK    2

JMS      DISC      /TRANSFER T1 TO MATRIX

FLODUN   CLOF
DZM      FLAG#
DZM      IK#

DZM      REAL2     / TURN ON ENTER ANOTHER TUBE
LAC      (ESAJ+REAL1+2
DAC      REAL1

JMS*     DZRD.
DZLB
-16

JMP      F.F

CONVRT   0          / (DZ.?/MAXX)MX.H DIGITIZER TO FIX POINT XXX.XXX

```

```

DAC      CONV1

LAC      MAXX
DAC      CONV2
DAC      CONV3

LAC*     MX.H
MUL!20000
CONV1    0
DIV
CONV2    0

DAC      CONV1
LACQ
DAC      CONV2
LAC      CONV1
FRDIV
CONV3    0
LAC      CONV2    / AC,MQ(SF=2**18)
LLS+11

JMP*     CONVRT

SCALE    0        / ADJUST TO DISPLAY UNITS

DZM SCL*FLG
SMA
JMP .+3
ISZ SCLFLG
CMA
DAC SCLE1

LAC      SCALE2
LLS+11!30000
DAC SCLE2
LAC      (1777
MUL
SCLE1    0
DIV
SCLE2    0
LAC SCLFLG
SZA
CMQ
LACQ
JMP* SCALE
/ TRANSFER DATA TO DISC MATRIX FILE
DISC     0
CLC
DAC      SECTN    / DESTROY SECTION SO WHEN RETURN
DAC      SECT*SV  / SAVE SECTION POINTER
CLA
JMS      MX.DO    / SECTN 0
/ GET VALUE AT COORD. (XNODE,YNODE)
/ LOAD SCALED FIXED POINT LOG FOR MATRIX.
LAW      1
JMS      MX.DO

```

```

        LAW      2
        JMS      MX.DO
        LAW      3
        JMS      MX.DO / SECTION 3
        JMP*     DISC

K.01    .NVREF   400000
        .64
        -6
        .NVREF   200000

MX.DO   0
        DAC      .+4 / SECTION SWITCH 0,1,2,OR 3
        LAC      XNODE / X COORDINANT
        JMS*     MX.ADZ
        LAC      YNODE
        0
        0
        JMP*     DISC / ILLEGAL X OR Y
        LMQ
        LAC      .-3 / DELTA CORE ADDR
        TAD      CORAD0 / REFERENCE CORE ADDRESS
        DAC      CORADR / WORD CORE ADDR IN BUFFER
        LACQ     / SECTION NO. WORD
        SAD      SECTSV / LAST ONE DONE
        JMP*     MX.DO
        DAC      SECTSV
        CLL
        JMS*     MX.RW
        JMP*     DISC

DKADR1  0
CORAD1  0
        0
        0

        LAC      TREAL / TRUE TRANSS. IN SFP LOG
        DAC*     CORADR

        LAC      SECTSV
        STL
        JMS*     MX.RW
        JMP*     DISC

DKADR0  0
CORAD0  0
CORADR  0
        0

        JMP*     MX.DO

/ PROGRAM TO RETRIVE DATA POINTS FOR GRADIENT
/ FORTRAN IV SUPPORT PROGRAM
/ GRADIENT THAT SET'S 0'S IN PT1,PT2,PT7,PT8,PT6,PT5
/ PT12,PT11 TO THE PRECEEDING POINT VALUE RESPECTIVELY
/ IE. PT1=0 SO PT1=PT2
/ IE. PT1=0 PT2=0 SO PT1=PT2=PT3
/ IE. PT3=0 ERROR CONDITION

```

```

/ CALLING SEQUENCE
/     DIMENSION ID(1)
/     CALL GRDPNT(IX,IY,ID)
/     IX,IY    X,Y, POSITION
/     ID       POINTS FOR DEIVATIVE

/ DERIVATIVE FORMULA
/     DX=1/12 ( X.N-2. - 8X.N-1. + 8X.N+1. - X.N+2. )
/ POINT DEFINITIONS
/
/           * 16      * 20
/           * 15      * 19
/     * 7      * 8      * 9      * 10      * 11      * 12
/     * 1      * 2      * 3      * 4      * 5      * 6
/           * 14      * 18
/           * 13      * 17

      .GLOBL  GRDPNT, .DA

GRDPNT  0

      JMS*    .DA
      JMP     .+3+1

X       0
Y       0
DATA    0

      LAC     (PT1      / SET SO FORTRAN SEE'S THIS MATRIX
      DAC*    DATA

      LAC*    X
      TAD     (3
      DAC X*PRIME      / THIS IS X IN INTEGER NODE

      LAC*    Y
      TAD     (3
      DAC Y*PRIME      /THIS IS Y IN INTEGER

      LAC XPRIME
      JMS* MX.ADZ      / CALCULATE SECTION ADDRESS
      LAC YPRIME
      0
DELPTR  0
      JMP FLODUN      / ILLEGAL SECTION WORD REACHED BOUNDARY
      SAD SECTN      / SECTION THIS X,Y
      JMP FOUND.      / THE SAME
      DAC SECTN      / DIFFERENT
      CLL         / READ
      JMS* MX.RW      / READ THE SECTION
      JMP ERROR2

DKPAVE  0      / STARTING SECTOR ADDRESS (P(T2)+P(T1))/2
WTRDAT  0      / STARTING CORE ADDRESS
NX0     0      / STARTING -X FOR SECTION
NY0     0      / STARTING -Y FOR SECTINN

      CLL
      LAC     SECTN
      JMS*    MX.RW

```

```

      JMP      ERROR2
DKDPOT 0      / STARTING SECTOR ADDRESS (P(R2)-P(T1))/(T2-T1)
DPDAT  0
      0
      0

FOUND.  LAC NX0
      TAD*    X
      DAC NXIN#      / X COLUMN NUMBER

      LAC*    MX.SH   / SMALL X DIMENSION
      DAC XWIDE      / WIDTH OF X IN NODES
      CMA
      DAC      MXWD#   / MXWD = -XWIDE

      LAC      NY0
      TAD*    Y

      MUL!20000
XWIDE  0      / NODES IN X
      LACQ     / DATA WORD FOR ROW ADJUSTMENT ( ADDRESS )
      ADD NXIN / DATA WORD COLUMN ADJUSTMENT ( ADDRESS )
      DAC      DPT1 / RELATIVE ADDRESS X(I),Y(I)
      TAD      WTRDAT / FIRST DATA ADDRESS
      TAD      (-3   / TO GET I-2 , AND ADJUST FOR AUTO INDEX
      DAC* (11      / ADDRESS DATA WORD -1

      LAC* 11
      DAC PT1 / X(I-2),Y(I)
      LAC* 11
      DAC PT2 / X(I-1),Y(I)
      LAC* 11
      DAC PT3 / X(I),Y(I)
      LAC* 11
      DAC PT4 / X(I+1),Y(I)
      LAC* 11
      DAC PT5 / X(I+2),Y(I)
      LAC* 11
      DAC PT6 / X(I+3),Y(I)

      LAC* (11      / ADDRESS X(I+3),Y(I)
      ADD XWIDE      / ADDRESS X(I+3),Y(I+1)
      TAD (-6
      DAC* (11      / ADDRESS X(I-3),Y(I+1)

      LAC* 11
      DAC PT7 / X(I-2),Y(I+1)
      LAC* 11
      DAC PT8 / X(I-1),Y(I+1)
      LAC* 11
      DAC PT9 / X(I),Y(I+1)
      LAC* 11
      DAC PT10      / X(I+1),Y(I+1)
      LAC* 11
      DAC PT11      / X(I+2),Y(I+1)
      LAC* 11
      DAC PT12      / X(I+3),Y(I+1)

```

```

LAC* (11          / ADDRESS X(I+3),Y(I+1)
ADD XUTDE
ADD XWIDE        / ADDRESS X(I+3),Y(I+3)
TAD (-3
DAC PT16        / ADDRESS X(I),Y(I+3)
TAD (1
DAC PT20        / ADDRESS X(I+1),Y(I+3)
ADD MXWD
DAC PT19        / ADDRESS X(I+1),Y(I+2)
TAD (-1
DAC PT15        / ADDRESS X(I),Y(I+2)
ADD MXWD
ADD MXWD
ADD MXWD
DAC PT14        / ADDRESS X(I),Y(I-1)
TAD (1
DAC PT18,        / ADDRESS X(I+1),Y(I-1)
ADD MXWD
DAC PT17        / ADDRESS X(I+1),Y(I-2)
TAD (-1
DAC PT13        / ADDRESS X(I),Y(I-2)

```

```

LAC*   PT13
DAC    PT13
LAC*   PT14
DAC    PT14
LAC*   PT15
DAC    PT15
LAC*   PT16
DAC    PT16
LAC*   PT17
DAC    PT17
LAC*   PT18
DAC    PT18
LAC*   PT19
DAC    PT19
LAC*   PT20
DAC    PT20

```

```

LAC    DPT1      / GET DERIVATIVE
TAD    DPTDAT
DAC    DPT1
DAC    DPT2
ISZ    DPT2
TAD    XWIDE
DAC    DPT3
DAC    DPT4
ISZ    DPT4
LAC*   DPT1
DAC    DPT1      / (X(I),Y(I))
LAC*   DPT2
DAC    DPT2      / (X(I+1),Y(I))
LAC*   DPT3
DAC    DPT3      / (X(I),Y(I+1))
LAC*   DPT4
DAC    DPT4      / (X(I+1),Y(I+1))

```

```

FRST   LAC PT1 / TEST 1'ST COLUMN
      SZA
      JMP SECND      / PT1 NOT = 0
      LAC PT2 / PT1 = 0
      SZA
      JMP FRST1      / PT2 NOT = 0 SO PT1=PT2
      LAC PT3 / PT2 = 0
      SNA
      JMP FLODUN     / PT3 = 0
      DAC PT2 / PT3 NOT = 0 SO PT1=PT2=PT3
FRST1  DAC PT1

SECND  LAC PT7 / TEST 2'ND COLUMN
      SZA
      JMP THRD      / PT7 NOT = 0
      LAC PT8 / PT7 = 0
      SZA
      JMP SECND1     / PT8 NOT = 0 SO PT7=PT8
      LAC PT9 / PT8 = 0
      SNA
      JMP FLODUN     / PT9 = 0
      DAC PT8 / PT9 NOT = 0 SO PT7=PT8=PT9
SECND1 DAC PT7

THRD   LAC PT6 / TEST 3'RD COLUMN
      SZA
      JMP FORTH      / PT6 NOT = 0
      LAC PT5 / PT6 = 0
      SZA
      JMP THRD1      / PT5 NOT = 0 SO PT6 = PT5
      LAC PT4 / PT5 = 0
      SNA
      JMP FLODUN     / PT4 = 0
      DAC PT5 / PT4 NOT = 0 SO PT6=PT5=PT4
THRD1  DAC PT6

FORTH  LAC PT12      / TEST 4'TH COLUMN
      SZA
      JMP FITH      / PT12 NOT = 0
      LAC PT11      / PT12=0
      SZA
      JMP FORTH1     / PT11 NOT = 0 SO PT12=PT11
      LAC PT10      / PT11 = 0
      SNA
      JMP FLODUN     / PT10=0
      DAC PT11      / PT10 NOT = 0 SO PT12=PT11=PT10
FORTH1 DAC PT12

FITH   LAC PT13      / CHECK OTHER DIRECTION 1
      SZA
      JMP SIXTH     / PT13 NOT = 0
      LAC PT14      / PT13 = 0
      SZA
      JMP FITH1     / PT14 NOT = 0 SO PT13=PT14
      LAC PT3
      DAC PT14      / PT3=PT14=PT13

```


FIFTH1	DAC	PT13	
SIXTH	LAC	PT17	/ CHECK DIRECTION 2
	SZA		
	JMP	SEVN	/ PT17 NOT = 0
	LAC	PT18	/ PT17 = 0
	SZA		
	JMP	SIXTH1	/ PT18 NOT = 0 SO PT17=PT18
	LAC	PT4	
	DAC	PT18	/ PT4=PT18=PT17
SIXTH1	DAC	PT17	
SEVN	LAC	PT16	/ CHECK DIRECTION 3
	SZA		
	JMP	EIGHT	/ PT16 NOT = 0
	LAC	PT15	/ PT16 = 0
	SZA		
	JMP	SEVN1	/ PT15 NOT = 0 SO PT16=PT15
	LAC	PT9	
	DAC	PT15	/ PT9=PT15=PT16
SEVN1	DAC	PT16	
EIGHT	LAC	PT20	/ CHECK DIRECTION 4
	SZA		
	JMP	INFLEC	/ PT20 NOT = 0
	LAC	PT19	/ PT20 = 0
	SZA		
	JMP	EIGHT1	/ PT19 NOT = 0 SO PT20 = PT19
	LAC	PT10	
	DAC	PT19	/ PT10=PT19=PT20
EIGHT1	DAC	PT20	
INFLEC	LAC	PT2	/ CHECK ON INFLECTION POINT
	CMA		
	ADD	PT3	
	DAC	X	/ PT3-PT2
	GSM		
	DAC	Y	/ ABS(PT3-PT2)
	LAC	PT14	
	CMA		
	ADD	PT3	
	DAC	DATA	/ PT3-PT14
	GSM		/ ABS(PT3-PT14)
	ADD	Y	/ ABS(PT3-PT14) + ABS(PT3-PT2)
	DAC	Y	
	LAC	DATA	
	ADD	X	
	GSM		/ ABS(PT3-PT2+PT3-PT14)
	SAD	Y	
	SKP		/ ABS(A+B) = ABS(A)+ABS(B) LOCAL MAX,MIN
	JMP*	GRDPNT	/ NOT A LOCAL MAX,MIN.
	LAC	PT5	
	CMA		
	ADD	PT4	

DAC	X
GSM	
DAC	Y
LAC	PT18
CMA	
ADD	PT4
DAC	DATA
GSM	
ADD	Y
DAC	Y
LAC	DATA
ADD	X
GSM	
SAD	Y
SKP	
JMP*	GRDPNT
LAC	PT8
CMA	
ADD	PT9
DAC	X
GSM	
DAC	Y
LAC	PT15
CMA	
ADD	PT9
DAC	DATA
GSM	
ADD	Y
DAC	Y
LAC	DATA
ADD	X
GSM	
SAD	Y
SKP	
JMP*	GRDPNT
LAC	PT11
CMA	
ADD	PT10
DAC	X
GSM	
DAC	Y
LAC	PT19
CMA	
ADD	PT10
DAC	DATA
GSM	
ADD	Y
DAC	Y
LAC	DATA

ADD	X
GSM	
SAD	Y
SKP	
JMP*	GRDPNT

DZM	X
-----	---

LAC	PT2
CMA	
ADD	PT3
GSM	
SZL	
ISZ	X

LAC	PT5
CMA	
ADD	PT4
GSM	
SZL	
ISZ	X

LAC	PT8
CMA	
ADD	PT9
GSM	
SZL	
ISZ	X

LAC	PT11
CMA	
ADD	PT10
GSM	
SZL	
ISZ	X

LAC	X
SNA	
JMP	FLODUN
SAD	(4
SKP	
JMP*	GRDPNT

DZM	X
-----	---

LAC	PT14
CMA	
ADD	PT3
GSM	
SZL	
ISZ	X

LAC	PT18
CMA	
ADD	PT4
GSM	
SZL	

	ISZ	X
	LAC	PT15
	CMA	
	ADD	PT9
	GSM	
	SZL	
	ISZ	X
	LAC	PT19
	CMA	
	ADD	PT9
	GSM	
	SZL	
	ISZ	X
	LAC	X
	SNA	
	JMP	FLODUN
	SAD	(4
	JMP	FLODUN
	JMP*	GRDPNT

PT1	0
PT2	0
PT3	0
PT4	0
PT5	0
PT6	0
PT7	0
PT8	0
PT9	0
PT10	0
PT11	0
PT12	0
PT13	0
PT14	0
PT15	0
PT16	0
PT17	0
PT18	0
PT19	0
PT20	0

DPT1	0
DPT2	0
DPT3	0
DPT4	0

TRACK	ESAJ+.+1
	661000
	141000
	030000
	ESAJ+TRACK1
TRACK1	462120
	404000
	402010

```

400020
422010
424000
422110
400120
402110
020000
442000
400040
464120
410000
020000
BOXFIL ESAJ+TRACKE
      .BLOCK 12
TRACKE ESAJ+SET2
/
/
/ SMALL TRACKING CROSS
/
TRACK2 461110
      402000
      401004
      400010
      421004
      422000
      421104
      400110
      401104
      020000
      441000
      400020
      462110
      404000
      020000
      ESAJ+TRACKE
/
DXADR 0
DYADR 0
/
TBLSV 0
      1
      1
      1
      0
      -1
      -1
      -1

      -1
      -1
      0
      1
      1
      1
      0
      -1
DSFILE ESAJ+CHART /SAVE ROOM FOR 50 LONG VECTORS+ABS PT+ESAJ

```

	.BLOCK	150
CHART	ESAJ+.+1	
	660160	
	120200	
	601440	
	0	
	660160	
	120200	
	600000	
	1130	
/	END OF REFERENCE LINE	
REFLIN	660260	
	124200	
	600000	
	001130	
	742120	
	120010	
	105116	
	104040	
	117106	
	040122	
	105106	
	056040	
	114111	
	116505	
/	XDISTANCE IN FEET	
	764454	
	120062	
	130040	
	104111	
	123124	
	101116	
	103105	
	040111	
	116040	
	106105	
	105524	
/	TRANSMISSIVITY (FT**2/DAY)	
	774000	
	120310	
	124122	
	101116	
	123115	
	111123	
	123111	
	126111	
	124131	
	040050	
	106124	
	052052	
	062040	
	057104	
	101131	
	451000	
FNC1	030000	
	761400	
	140070	

```

540000
020000

761420 / FORM FUNCTION TABLE
140070
106117
122115
040106
125116
103124
111117
116040
124101
102114
505000
SET1 030000
761400
140030
540000
020000

761420 /RETURN TO MAP
140030
122105
124125
122516
X00 760160
120150
460000
ECHART ESAJ+X1
/
/
SET2 030000
761400
141650
540000
020000

761420
121650
123105 /SETUP NEW LINE
124125
120040
116105
127040
114111
116505
SET3 030000
761400
141600
540000
020000
761420
121600
104111 /DISPLAY CHART
123120
114101

```

```

131040
103110
101122
524000
FNC2 030000
761400
141530
540000
020000

761420
121530
103101 / CALCULATE TRANSMISSIVITIES
114103
125114
101124
105040
524000
RFLINE 660000
120000
600000
0
RFEND 0
/
/
MESSAG ESAJ+.+1
764500
127750 / FLOW TUBE PROGRAM TITLE
106114
117127
124125
102105
040120
122117
107122
101515

REAL1 0
ESAJ+REAL2
.NORIT
.ABSVC 10,35
.9BIT /DIGITIZE FLOTUB ORIGIN/<400>
REAL2 0
ESAJ+ECHO
.ABSVC 10,35
.9BIT /ENTER TRANSMISSIVITY X.XXXXEXX/<400>

ECHO ESAJ+.+3
ESAJ+STRMFL
-20
760010
140010
440000
.BLOCK 17
ESAJ+ECHO+1

```


STRMFL ESAJ+TRACK / VECTOR TABLE FOR DISPLAY

/*****
/ DUMMY PATCH FILE FOR DEBUGGING
PATCH .BLOCK 20
/*****/

.END

```

SUBROUTINE GRDENT(X,Y,GX,GY,GRAD,D)
C SUBROUTINE TO CALCULATE GRADIENTS
C TRANSIENT STATE VERSION
C
C DIMENSION ID(1),DATA(24)
C
C EQUIVALENCE (PT1,DATA(1)),(PT2,DATA(2)),(PT3,DATA(3))
C EQUIVALENCE (PT4,DATA(4)),(PT5,DATA(5)),(PT6,DATA(6))
C EQUIVALENCE (PT7,DATA(7)),(PT8,DATA(8)),(PT9,DATA(9))
C EQUIVALENCE (PT10,DATA(10)),(PT11,DATA(11)),(PT12,DATA(12))
C EQUIVALENCE (PT13,DATA(13)),(PT14,DATA(14)),(PT15,DATA(15))
C EQUIVALENCE (PT16,DATA(16)),(PT17,DATA(17)),(PT18,DATA(18))
C EQUIVALENCE (PT19,DATA(19)),(PT20,DATA(20))
C EQUIVALENCE (DPT1,DATA(21)),(DPT2,DATA(22))
C EQUIVALENCE (DPT3,DATA(23)),(DPT4,DATA(24))
C
C IX=IFIX(X)
C IY=IFIX(Y)
C TO SPEED UP ONLY ADDRESS DISC IF NEED TO
C IF (IX.EQ.IXS.AND.IY.EQ.IYS) GO TO 550
C IXS=IX
C IYS=IY
C CALL GRDPNT (IX,IY,ID)
C
C DO 500 I=1,24,1
C DATA(I)=(FLOAT(ID(I))*100.)/2.**13
500 CONTINUE
C
550 FX=X-FLOAT (IX)
FY=Y-FLOAT (IY)
C
C GP1=PT1-8.*PT2+8.*PT4-PT5
C GP2=PT2-8.*PT3+8.*PT5-PT6
C GP3=PT7-8.*PT8+8.*PT10-PT11
C GP4=PT8-8.*PT9+8.*PT11-PT12
C
C GP1=GP1+FX*(GP2-GP1)
C GP3=GP3+FX*(GP4-GP3)
C GX=(GP1+FY*(GP3-GP1))/12.
C
C GP1=PT13-8.*PT14+8.*PT9-PT15
C GP2=PT14-8.*PT3+8.*PT15-PT16
C GP3=PT17-8.*PT18+8.*PT10-PT19
C GP4=PT18-8.*PT4+8.*PT19-PT20
C
C GP1=GP1+FY*(GP2-GP1)
C GP2=GP3+FY*(GP4-GP3)
C
C GY=(GP1+FX*(GP2-GP1))/12.
C
C GRAD=GX**2+GY**2
C GRAD=SQRT (GRAD)
C
C GP1=DPT1+FX*(DPT2-DPT1)
C GP2=DPT3+FX*(DPT4-DPT3)
C D=GP1+FY*(GP2-GP1)
C

```

RETURN
END

```

SUBROUTINE TRANTR(IX,IX,IY,TRAN,ITCH,IV,IT,IAX,IAY,ADJST)
C
C
C   VERSION TO CALCULATE TRANSIENT STATE TRANSMISSIVITY
C    $T(I+1)=T(I)*(\text{GRAD}(I)*W(I))/(\text{GRAD}(I+1)*W(I+1))$ 
C        $+(STEP*SIGMA/2.)*(W(I)D(I)-W(I+1)D(I+1))/(\text{GRAD}(I+1)*W(I+1))$ 
C   T      TRANSMISSIVITY
C   GRAD    GRADIENT
C   W      WIDTH
C   STEP    DISTANCE BETWEEN NODES   (FEET)
C   SIGMA    POROSITY
C   D      DERIVATIVE
C
C   IK      CONTROL WORD
C   IX,IY   X,Y POSITION XXX.XXX
C   TRAN    TRANSMISSIVITY
C   ITCH    DIRECTION SWITCH
C   IV      VECTOR ADJUSTMENT
C   IT      TIME BETWEEN T2;T1   (DAYS)
C   IAX,IAY ABSOLUTE X,Y POSITION DISPLAY UNITS
C   ADJST    PRODUCT USED IN BACKWARD CALCULATION
C
C   REAL KX0,KY0,KX1,KY1
C
C   **** DATA STATEMENTS****
C   W0      INITIAL FLOTUB WIDTH      (NODES)
C   WMAX     MAXIMUM FLOTUB WIDTH      (NODES)
C   WMIN     MINIMUM FLOTUB WIDTH      (NODES)
C   STEPR    STEP LENGTH              (NODES)
C   SIGMA    POROSITY
C   DNODE    DISTANCE BETWEEN NODES   (FEET)
C   DATA W0 /0.25/
C   DATA WMAX,WMIN /0.50,0.125/
C   DATA STEPR /0.25/
C   DATA SIGMA /0.1/
C   DATA DNODE /1000./
C
C   POINT NAME DEFINITIONS
C
C   * (X1,Y1)      * (X3,Y3)
C
C   * (KX0,KY0)     * (KX1,KY1)
C
C   * (X0,Y0)      * (X2,Y2)
C
C   GO TO (2000,100) ,IK
C
100  WN=WNP1
    TN=TRAN
    GRADN=GRDNP1
    DN=DNP1
C
    KX0=KX1
    KY0=KY1
    X0=X2
    Y0=Y2
    X1=X3
    Y1=Y3

```

```

C      CALL GRDENT(X0,Y0,GX,GY,GRAD,D)
C
C      X2=X0+(GX/GRAD)*STEP*DIR
C      Y2=Y0+(GY/GRAD)*STEP*DIR
C
C      CALL GRDENT(X1,Y1,GX,GY,GRAD,D)
C
C      X3=X1+(GX/GRAD)*STEP*DIR
C      Y3=Y1+(GY/GRAD)*STEP*DIR
C
C      WNP1=(X3-X2)**2+(Y3-Y2)**2
C      WNP1=SQRT(WNP1)
C      IF(WNP1.GT.WMAX) GO TO 1000
C      IF(WNP1.GT.WMIN) GO TO 1500
900    WNP1=WN+(WMAX-WMIN)*0.125
C      IF(WNP1.LE.WMAX) GO TO 2100
C      GO TO 1700
C
C      WNP1=WN-(WMAX-WMIN)*0.125
C      IF(WNP1.GE.WMIN) GO TO 2100
C      GO TO 1700
C
C      KX1=X2+(X3-X2)/2.
C      KY1=Y2+(Y3-Y2)/2.
C
C      CALL GRDENT(KX1,KY1,GX,GY,GRDNP1,DNP1)
C
C      CTHETA=ABS(((X3-X2)*GX+(Y3-Y2)*GY)/(WNP1*GRDNP1))
C      IF(CTHETA.LT.0.0582) GO TO 1800
1700   STEP=STEP-STEPR*0.125
C      IF(ABS(STEP).LT.WMIN/2.) GO TO 1750
C      KX1=KX0
C      KY1=KY0
C      WNP1=WN
C      GO TO 2100
C
C      1750   PAUSE
C
C      1800   STHETA=1.-CTHETA**2
C      STHETA=SQRT(STHETA)
C      WNP1=STHETA*WNP1
C      TRAN=(TN*(GRADN*WN))+ (PK*(WN*DN+WNP1*DNP1)/TIME)
C      TRAN=TRAN/(GRDNP1*WNP1)
C      ADJST=ADJST*((WN*GRADN)/(WNP1*GRDNP1))
C
C      STEP=STEPR
C      FX=((KX1-KX0)*1023./VECTMX)+DDX
C      FY=((KY1-KY0)*1023./VECTMX)+DDY
C      IX=IFIX(FX)
C      IY=IFIX(FY)
C      DDY=FY-FLOAT(IY)
C      DDY=FY-FLOAT(IY)
C      IAX=IFIX(KX1*1023./VECTMX)
C      IAY=IFIX(KY1*1023./VECTMX)
C      RETURN
C

```

```

2000      WNP1=W0
          DIR=FLOAT(ITCH)
          STEP=STEPR
          VECTMX=FLOAT(IV)
          TIME=FLOAT(IT)
          KX1=FLOAT(IX)/512.
          KY1=FLOAT(IY)/512.
          DDX=0.
          DDY=0.
          IK=2
          ADJST=1.

C
2100      CALL GRDENT(KX1,KY1,GX,GY,GRDNP1,DNP1)
          PK=ABS(SIGMA*DNODE**2*STEP/2.)

C
          DY=(WNP1/2.)*GX/GRDNP1*DIR
          DX=(WNP1/2.)*GY/GRDNP1*DIR

C
2200      X2=KX1+DX
          Y2=KY1-DY
          X3=KX1-DX
          Y3=KY1+DY

C
          GO TO 100

C
          END

```

```

SUBROUTINE TMAPTR(TIN,TACT,TPRED,TMAP,ADJST)
C
C THIS IS THE SUBROUTINE TO DO BACKWARD CALCULATIONS
C TRANSIENT TERM VERSION
C
C TIN      TRAN USED TO START TUBE
C TACT     TRAN CALCULATED BY TUBE
C TPRED    TRAN PREDICTED BY FUNCTION TABLE
C TMAP     TRAN TO BE ENTERED IN MAP
C ADJST    ITERATIVE STEP ADJUSTMENT FACTOR
C
C INTEGER TPRED,TMAP
C
C TIN      FLOATING POINT
C TPRED    SCALED FIX POINT LOG
C TACT     FLOATING POINT
C TMAP     SCALED FIX POINT LOG
C
TP=10.**((FLOAT(TPRED)/2.**13)
TM=TIN+(TP-TACT)/ADJST
IF(TM) 100,100,200
100 TM=1.
200 TMAP=IFIX(ALOG10(TM)*2.**13)
RETURN
END

```

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