APPENDIX A

DRAINMOD - COMPUTER PROGRAM DOCUMENTATION

The program documentation consists of five parts, as follows:

1. A brief description of each segment of the program and a discussion of its function.
2. A program listing complete with definitions of all variable names.
3. An example set of input data.
4. An example of the program output - results of the simulation.

Program Segments and Their Functions

A. Main Program

The main program is written in PL1. It reads year, month, and hourly rainfall for each hour of the month from HISARS files. It also reads the maximum and minimum daily temperatures and calculates PET using the Thornthwaite method. Inputs to main through the EXECUTE JCL card are the station ID for the hourly rainfall file and the station ID and latitude for the temperature file. These are usually the same station, but can be different so that PET can be estimated from temperature records at a nearby station when necessary. Other inputs are the beginning and ending years of simulation and the heat index for the PET calculation.

The main program transfers the hourly rainfall and daily ET value for the entire month to subroutine FORSUB. The simulation is made in FORSUB for the month; control is returned to the MAIN program; another month's data is read from the file, and the process is repeated until the simulation has been conducted for the desired period.

A FORTRAN version of MAIN was also developed to read hourly rainfall and daily PET directly from cards. This program was used to test the validity of DRAINMOD by reading in measured hourly rainfall and outlet water level elevations. Observed water table elevations were also read in and deviations between predicted and observed were computed. The predicted and observed water table depths were also plotted by the computer for visual comparison.

B. Subroutine FORSUB

FORSUB accepts hourly rainfall and daily PET values for a one month period from the main program. At the beginning of simulation it reads soil properties, crop parameters, and water management system parameters, and initializes variables. The basic water management simulation is carried out in this subroutine. It determines if rainfall occurs on a given day, calculates infiltration, surface runoff, drainage or subirrigation, water
table depth, depth of the dry zone, etc. These values may be printed out on a daily or monthly basis at the option of the user. It also calculates, stores and prints out water management system objective functions - those functions which the water management system is designed to provide at some minimal level. Objective functions or parameters are: working days during a given period, SEW-30, dry days during the growing season, or the amount of waste water irrigation. The operations of this subroutine depend on other subroutines which are called to read certain input data, to perform detailed calculations such as determining drainage flux, and to store and rank objective function values.

This subroutine can be divided into the following sections:

1. Obtain hourly rainfall and daily ET values from main program. Change values from inches to cm.

2. Read input parameters on the first time through the simulation. Most are read in directly; others are read in by calling subroutines PROP and ROOT.

3. Initialization of variables prior to beginning of simulation.

4. Determine hourly rainfall, PET, and initialize other variables for a new day.

5. Determine infiltration and conduct water balance on an hourly basis, if rain or irrigation occurs that day or if water was stored on the surface at the beginning of the day.

6. Conducts water balance calculations on a two-hour interval or one-day interval, depending on drainage flux, when there is no rain or surface irrigation.

7. Reevaluates the water balance for the day, determines water table depth, dry zone depth, etc., for the end of the day, and updates some variables to be used the next day.

8. Determines objective parameters, such as SEW-30 and working days, accumulates and stores these values and prints out daily values for all water management components if the user calls for daily output.


C. Subroutine PROP

This routine reads in the soil water characteristic (h v. \( \theta \)) as a table of values. It interpolates between the values of water contents, \( \theta \), at 1 cm increments of pressure head from 0 to -500 cm of water. The relationship between air volume in the profile and water table depth is determined from
the soil water characteristic by assuming a drained to equilibrium profile. Air volumes are calculated for incremental water table depths from 0 to 500 cm. As an alternative, the relationship between water table depth, air volume (or drainage volume) and steady state upward flux can be read in and interpolated for intermediate values at the user's option. In either case, the water table depth-air volume relationship is stored in arrays such that the air volume can be easily determined for a given water table or wet zone depth and the water table or wet zone depth can be immediately determined for a given air volume. For example, the value stored as VOL(1) would be the air volume for a water table depth of 0.0 cm, VOL(6) the volume for a 5 cm water table depth, etc. Conversely, the value stored as WTD(6) would be the water table depth corresponding to an air volume of 0.5 cm, WTD(51) corresponds to a volume of 5 cm and so on.

PROP also reads in a tabular relationship between water table depth and the Green-Ampt infiltration constants, A and B. These values are read in and interpolated for unit water table depth increments from 0 to 500 cm and stored in arrays for easy retrieval.

D. Subroutine ROOT

This subroutine reads in tabular values of effective root depth versus Julian data and interpolates between the values so that the root depth for any day can be called directly.

E. Subroutine SURIRR

This subroutine determines if surface irrigation for waste water disposal is scheduled and if conditions are suitable for irrigation. The amount of surface irrigation is considered as additional rain. If the air volume in the soil is less than the required air volume for surface irrigation, REQDAR, the irrigation day may be skipped (if INSIRR = 0) and no surface irrigation is done until the next preplanned day. If INSIRR > 0, the irrigation will be postponed to the next day rather than skipped as discussed in Chapter 3. If rainfall in excess of AMTRN occurs on the first scheduled hour of surface irrigation, the operation for that day is postponed and surface irrigation is tried again the next day. The rate of irrigation, AMTSIM(MO), is read in for each month. Simulations can also be conducted to apply the maximum amount of water possible at each irrigation by reading in a negative value for AMTSIM(MO). This option is discussed in more detail in Chapter 3. The program also counts the number of skips, number of postponements, and the number of irrigation days.

F. Subroutine WET

Determines the pressure head and water content distribution in the wet zone by assuming a hydrostatic condition above the water table.

G. Subroutine EVAP

The daily PET is distributed over the daylight hours of approximately 6:00 a.m. to 6:00 p.m. in this subroutine. PET for any hour, between these
times, HPET, is calculated by dividing the daily PET by 12, assumed number of daylight hours. Then, HPET for any hour in which rainfall occurs is set equal to zero. When the critical depth concept is used for determining the limit of upward water movement, HPET is also set equal to zero for any hour that the depth of dry zone exceeds the root depth. Finally, the daily PET, adjusted for hours when rainfall occurs is obtained by summing the hourly values. The hourly and daily PET values so determined are taken as the actual ET values in FORSUB when the critical depth concept is used. Otherwise, the PET values are used in subroutine ETFLUX to determine actual ET values.

H. Subroutine SOAK

This subroutine finds the infiltration constants A and B for the Green-Ampt infiltration equation, \( f = (A/F) + B \), where \( f \) is infiltration rate, and \( F \), cumulative infiltration. Infiltration constants vary from soil to soil and with initial water content or depth of water table. In this subroutine, the values of A and B are chosen from a stored array using the water table depth at the beginning of the infiltration event as the index. When a dry zone exists, an effective water table depth, which would correspond to the total air volume in the profile is defined and used as the index for obtaining A and B. Once the values of A and B are chosen, they are not changed until the infiltration event ends. The only exception is when the water table rises to the surface; then A is set to A = 0 and B is set equal to the sum of the drainage and ET fluxes.

I. Subroutine DRAINS

This subroutine determines the effective lateral hydraulic conductivity based on the conductivities of the profile layers from the input data and on the position of the water table. Then, the drainage (or subirrigation) flux is determined using the Hooghoudt equation as discussed in the text of the report. Convergence near the drain has already been accounted for by adjusting the depth from the drain to the impermeable layer in the input parameters.

J. Subroutine ETFLUX

This subroutine uses the adjusted PET values, either hourly or daily, obtained from subroutine EVAP to determine actual ET which may be limited by soil water conditions. The water table depth, rooting depth, depth of the dry zone, and upward flux from the water table are used as inputs to determine the actual ET. If upward flux is insufficient to meet the ET demand, water is removed from the root zone to make up the difference. If root zone water is not available, ET is limited to the amount that will be transferred by upward flux.

K. Subroutine YDITCH

The purpose of this subroutine is to determine the water level in the drain at all times during the simulation. For a conventional drainage system, this water level would probably be constant; i.e., the outlet would be designed to have sufficient capacity to hold the water level at a
constant elevation. For subirrigation, the water in the drainage outlet or drainage ditches would also probably be held at the elevation of the weir by pumping. However, in controlled drainage situations, the weir would be set at a given elevation and the ditch water level may be at or below that elevation depending on drainage and runoff. YDITCH was written to compute the water level in parallel ditch drains which are trapezoidal in cross-sections (Figure A.1).

If YD is the water level in the ditch, then the total volume of water would be:

\[ CV = \frac{B + (2\, YD)\, S}{2} \cdot YD \]  

(A.1)

Where \( S \) is the slope of the ditch bank, \( B \) is the bottom width and \( CV \) is the total volume of water stored in the ditch in cm³ per cm of ditch length. Hence, if \( CV \) is known, then \( YD \) could be found easily:

\[ YD = \frac{1}{2} \left( \frac{B}{S} \right) 2 + 4 \frac{CV^3}{S} - \frac{1}{2} \frac{B}{S} \text{ in cm} \]  

(A.2)

Figure A.1. Schematic of drainage ditch with water table control weir.

The change in \( CV \) during a given time increment can be found as:

\[ \Delta CV = (RO + DVOL) \cdot SDRAIN \]  

(A.3)

Where \( SDRAIN \) is the drain spacing, \( RO \) is the runoff in cm (cm³ per unit area), and \( DVOL \) is the drainage volume in cm. Thus, after a time increment, \( \Delta t \) the water available for ditch storage is:

\[ CV_{t+\Delta t} = CV_t + \Delta CV \]  

(A.4)

and the new \( YD \) can be obtained by substituting this value for \( CV \) in Equation A.2. However, the maximum value of \( YD \) is \( DDRAIN - DWEIR \) and this
corresponds to a maximum value \( CV_{\text{max}} \), which may be obtained from Equation A.1. Therefore, when the new value of \( YD \) is greater than \( YD_{\text{max}} \), the water lost from the system, \( W_{\text{LOSS}} \), may be determined as:

\[
W_{\text{LOSS}} = \frac{(CV_t + \Delta t - CV_{\text{max}})}{SDRAIN}
\]

(A.5)

in cm (or cm\(^3\)/cm\(^2\)).

When the ditch water level is higher than the water table in the field, subirrigation will occur and \( DV_{\text{OL}} \) will be negative. Then, the ditch water level will decrease with time.

When drain tubes, rather than parallel ditches empty into an outlet ditch or canal, the storage available in the outlet may be partitioned to the parallel drains by computing effective ditch dimensions. For example, consider a system of parallel drain tubes 500 m long spaced 50 m apart emptying into a rectangular canal 5 m wide. If the drain depth is 1 m, the storage volume available per tube above the drain depth would be 1 m x 5 m x 50 m = 250 m\(^3\). Since each tube is 500 m long, the storage per unit length is 250 m\(^3\)/500 m = 0.5 m\(^3\)/m. So, an effective ditch dimension for this case would be a rectangular ditch 0.5 m wide and 1 m deep. This assumes that drains enter the main ditch from only one side.

When drain tubes are used for both mains and laterals, storage would usually be negligible and small values of \( B \) and \( S \) would be used in the program. Internal division by \( S \) prohibits the use of \( S = 0 \) although \( B = 0 \) is allowed.

Note again that this subroutine is important when the program is used in the controlled drainage mode. When conventional drainage or subirrigation are used, the water level is normally assumed to be constant. A possible exception would be some schemes of subirrigation which would raise the water level in the field on a periodic basis, then allow it to decline.

L. Subroutine WORK

The purpose of this subroutine is to determine if conditions are suitable for field work on a given day. Three criteria are used to determine if the day is a working day. First, there must be a minimum air volume (or drained volume), \( A_{\text{MIN}} \). If the air volume is less than \( A_{\text{MIN}} \), it is not a working day. Second, if the rainfall exceeds a given amount, field operations are stopped on that day. Third, field operations cannot resume until a given amount of time has passed since rainfall caused them to be terminated.

Two working periods may be considered, usually spring seedbed preparation and fall harvest, with separate working day criteria and with specified maximum day lengths for each period. Partial working days may result when rainfall interrupts field operations; this possibility is also considered in the program.
M. Subroutine ORDER

This subroutine stores yearly totals for the objective functions (SEW-30, working days, etc.) determines the average values over the simulation period and prints out the yearly values along with their rank after the simulation is completed. At the end of the simulation, ORDER calls subroutine RANK for each objective function and it ranks the values from smallest to largest.

N. Subroutine RANK

The yearly values of the objective functions are ranked from smallest to largest by this subroutine.
THIS MAIN PROGRAM READS HOURLY PRECIP AND DAILY MAX AND MIN TEMPERATURES FROM EITHER CARDS OR DISK (I/O UNIT 4), DETERMINES PET USING THORNTHWAITE METHOD, AND TRANSFERS HOURLY PRECIP AND DAILY PET VALUES BY MONTH TO THE SUBROUTINE FORSUB.

DIMENSION E(241), TMAX(31), TMIN(31), RDA(24), TITLE(20)
DIMENSION FACTOR(12)
DIMENSION HOURLY(744), ET(31), SET(12), IDAYBG(12), REL(366)
INTEGER TMAX, TMIN, TITLE
DATA SET/0.3, 0.5, 0.8, 1.1, 1.4, 1.7, 1.6, 1.4, 1.1, 0.8, 0.4, 0.2/
DATA IDAYBG/0, 31, 60, 91, 121, 152, 182, 213, 244, 274, 305, 335/
READ(1, 610) TITLE
WRITE(6, 620) TITLE
READ(1, 600) IRID, ITID, IYST, IMST, IYED, LAT, HIDX
READ(1, 630) (FACTOR(K), K=1, 12)
I = LAT/100
J = LAT - I * 100
WRITE(6, 640) IRID, ITID, IYST, IMST, IYED, I, J, HIDX
WRITE(6, 645) (FACTOR(K), K=1, 12)
645 FORMAT('ET MULTIPLICATION FACTOR FOR EACH MONTH',/
*2X, 12F6.2/)
XLAT1 = FLOAT(I)
XLAT2 = FLOAT(J)
START OF THORNTHWAITE INITIAL CALCULATION
REL(1-366) ACCOUNTS FOR EVERYDAY IN A YEAR
RLAT = 0.0174533*XLAT1 + 0.0002909*XLAT2
SINLAT = SIN(RLAT)
COSLAT = COS(RLAT)
DO 50 ND=1, 366
XND = ND
XM = 0.0172264*(-6.0E-1*XND)
XLAM = 4.874239 + XM + 0.0334762*SIN(XM) + 0.0003502*SIN(XM + XM)
YD = 0.397900*SIN(XLAM)
XD = SQRT(1.0 - YD*YD)
D = ATAN2(YD, XD)
D = ATAN2(YD, XD)
YD = SQRT(1.0 - XD*XD)
REL(ND) = 0.0111111*ATAN2(YD, XD)*57.29578
50 CONTINUE
E(1-241) ACCOUNTS FOR DAILY TEMPERATURE VARIATION
Y = ALOG(HIDX)
F = 49239.5E-5 + HIDX*(1792.5E-5 + HIDX*(-771.5E-7 + HIDX *
1       675.E-9))
DO 60 NT =1,124
XNT = NT
X = -3863357.E-6 + F * (1021651.E-6 + ALOG(XNT) - Y)
ETEMP = EXP(X)
E(NT+65) = 24.E-2
60 CONTINUE
DO 70 I = 1,65
E(I)=-3863357.E-6 + F * (1021651.E-6 + ALOG(XNT) - Y)
ETEMP = EXP(X)
E(NT+65) = 24.E-2
70 CONTINUE
DO 80 I = 190,241
E(I)=24.E-2
80 CONTINUE
C
C POSITION THE RAINFALL AND TEMP FILES TO START SIMULATION
C
100    READ(2,700,END=300) ITDA,IYDAT,IMDAT,(TMAX(I),TMIN(I),I=1,31)
C IF NOT DESIRED STATION TRY AGAIN
IF(ITDA.NE.ITID) GO TO 100
C FOUND STATION, DESIRED YEAR AVAILABLE?
120    IF (IYDAT.EQ.IYST) GO TO 110
IF (IYDAT.GT.IYST) GO TO 300
C ELSE,
READ(2,700,END=300) ITDA,IYDAT,IMDAT,(TMAX(I),TMIN(I),I=1,31)
IF (ITDA.NE.ITID) GO TO 300
GO TO 120
C
C FOUND STATION AND YEAR, IS DESIRED MONTH AVAILABLE?
C
110    IF (IMDAT.EQ.IMST) GO TO 130
IF (IMDAT.GT.IMST) GO TO 210
C ELSE,
READ(2,700,END=300) ITDA,IYDAT,IMDAT,(TMAX(I),TMIN(I),I=1,31)
IF (ITDA.NE.ITID) GO TO 300
IF (IYDAT.NE.IYST) GO TO 200
C ELSE,
GO TO 110
C
200    WRITE(6,900) IMST,IYST,IMDAT,IYDAT
900    FORMAT( 'DESIRED MONTH ',I2,' COULD NOT BE FOUND WITHIN YEAR ',
*     ',I4,' , START SIMULATION AT MONTH ',I2,' AND YEAR ',I4)
IMST = IMDAT
IYST = IYDAT
GO TO 130
210    WRITE(6,910) IMST,IMDAT
910    FORMAT( 'DESIRED MONTH ',I2,' COULD NOT BE FOUND, START',
*     ' SIMULATION AT MONTH ',I2)
IMST = IMDAT
GO TO 130
C
C TEMP FILE POSITIONED, POSITION RAINFALL
C
C IF NOT DESIRED STATION, TRY AGAIN
C IF (IRDA.NE.IRID) GO TO 130
C FOUND STATION, IS DESIRED YEAR AVAILABLE?
C IF (IYDAR.EQ.IYST) GO TO 150
IF (IYDAR.GT.IYST) GO TO 310
C ELSE,
READ(4,710,END=310) IRDA,IYDAR,IMDAR,IDDAR,(RDA(I),I=1,24)
IF (IRDA.NE.IRID) GO TO 310
C ELSE,
GO TO 140
C
C
C 300 WRITE(6,950) ITID,IYST,ITDA,IYDAT,IMDAT
950 FORMAT(' STATION AND YEAR ',I6,1X,I4,' COULD NOT RE FOUND.',*
   ' LAST RECORD READ WAS ',I6,1X,I4,1X,I2)
GO TO 999
C
C 310 WRITE(6,960) IRID,IYST,IRDA,IYDAR,IHDAR
960 FORMAT(' RAINFALL STATION AND YEAR ',I6,1X,I4,' COULD NOT BE',*
   ' FOUND. LAST RECORD READ WAS ',I6,1X,I4,1X,I2)
GO TO 999
C
C FOUND STATION AND YEAR
C
C 150 IF (IMDAR.EQ.IMST) GO TO 160
IF (IMDAR.GT.IMST) GO TO 220
READ(4,710,END=310) IRDA,IYDAR,IMDAR,IDDAR,(RDA(I),I=1,24)
IF (IRDA.NE.IRID) GO TO 310
IF (IYDAR.NE.NST) GO TO 220
C ELSE,
GO TO 150
C
C 220 WRITE(6,930) IMST,IYDAR,IMDAR
930 FORMAT(' COULD NOT FIND MONTH ',I2,' BUT WILL ASSUME NO ',*
   'RAINFALL UP TO BUT NOT INCLUDING ',I4,1X,I2)
GO TO 160
C
C
C 160 CONTINUE
C SET "CURRENT POINTERS AS A REFERENCE
C IRCT = IRID
ITCT = ITID
IYCT = IYST
IMCT = IMST

C NOW START SIMULATION
C
DO 290 LOOP = 1,999999
   DO 170 I = 1,744
      HOURLY(I) = 0.0
170 CONTINUE
C IF MONTH DOESN'T EXIST FOR RAIN USE ZEROS
   IF (IMDAR.GT.IMCT) GO TO 250
C ELSE, READ MONTHLY RAINFALL
180 DO 190 I = 1,24
      HOURLY((IDDAR-1)*24 + I) = RDA(I)
190 CONTINUE
   READ(4,710,END=250) IRDA,IYDAR,IMDAR,IDDAR,(RDA(I),I=1,24)
   IF (((IYDAR.EQ.IRCT).AND.(IMDAR.GT.IYCT)).AND.
      *(IMDAR.EQ.IMCT)) GO TO 180
C RAINFALL READY, PREPARE TEMP DATA
250 DO 260 I = 1,31
      NT = T?MAX(I) + TMIN(I) +1
      ET(I) = SE(T(I))
      IF((NT.GT.1).AND.(IFLAG.EQ.0)) ET(I) = ET(I)*REL(IDAYRG(IVCT)+I)
260 CONTINUE
C TEMPERATURE READY, NOW SIMULATE WITH THIS MONTH
C CALL FORSUB(IYCT,IMCT,ET,HOURLY,LOOP,IYED,FACTOR(IMCT))
C READ NEXT MONTH OF TEMP DATA
C
IMCT = IMCT+1
   IF(IMCT.EQ.13) IYCT = IYCT+1
   IF(IMCT.EQ.13) IMCT = 1
   IF(IFLAG.EQ.1) GO TO 275
   READ(2,700,END=800) ITDA,IYDAT,IMDAT,(TMAX(I),TMIN(I),I=1,31)
275 IF(IMDAT.NE.IMCT) IFLAG = 1
   IF(IMDAT.EQ.IMCT) IFLAG = 0
   IF(IFLAG.EQ.1) GO TO 270
      IF (ITDA.NE.IYCT) GO TO 800
      IF (IYDAT.NE.IYED) GO TO 800
      IF (((IYDAT.EQ.IYED).AND.(IMDAT.GT.IMED)) GO TO 800
C SEE IF RAINFALL DATA IS CONSISTANT WITH TEMPERATURE
C
270 IF (IYDAT.GT.IYCT) GO TO 290
   IF (((IYDAT.EQ.IYCT).AND.(IMDAT.GE.IMCT)) GO TO 290
C ELSE, READ RAINFALL UNTIL CONSISTANT
   READ(4,710,END=810) IRDA,IYDAR,IMDAR,IDDAR,(RDA(I),I=1,24)
C IS THIS DESIRED RAINFALL
C
   IF (IRDA.NE.IRCT) GO TO 810
   GO TO 270
CONTINUE
WRITE(6,890)
FORMAT(' TERMINATE SIMULATION DUE TO END OF LOOP ')
GO TO 999
WRITE(6,830) ITDA,IYDAT,IMDAT
FORMAT(' SIMULATION TERMINATED NORMALLY. ',I6,1X,I4,1X,I2)
GO TO 999
WRITE(6,840) IRDA,IYDAR,IMDAR
FORMAT(' SIMULATION TERMINATED NORMALLY. ',I6,1X,I4,1X,I2)
GO TO 999
STOP

END
SUBROUTINE FORSUB(IR,MO,ET,HOURLY,LOOP,IEDYR,FACTOR)

C CONTINUE
WRITE(6,890)
FORMAT(' TERMINATE SIMULATION DUE TO END OF LOOP ')
GO TO 999
WRITE(6,830) ITDA,IYDAT,IMDAT
FORMAT(' SIMULATION TERMINATED NORMALLY. ',I6,1X,I4,1X,I2)
GO TO 999
WRITE(6,840) IRDA,IYDAR,IMDAR
FORMAT(' SIMULATION TERMINATED NORMALLY. ',I6,1X,I4,1X,I2)
GO TO 999
STOP

C FORMAT(2(I6,1X),2(I4,1X,I2,1X),I4,1X,F3.0)
FORMAT(12F5.2)
FORMAT(20A4)
FORMAT(1H1,26X,20A4/1X/
  * 47X,'INPUT PARAMETERS USED IN THIS SIMULATION'/1X/
  * 46X,'DESCRIPTION',44X,'(VARIABLE) VALUE UNIT'/
  * 1X,132(1H-))
FORMAT(' RAINFALL STATION NUMBER',78(1H.),'(RAINID)',5X,I6/
  * ' TEMPERATURE STATION NUMBER',75(1H.),'(TEMPID)',5X,I6/
  * ' STARTING YEAR OF SIMULATION',70(1H.),'(START YEAR)',7X,I4,
  * 3X,'YEAR'/
  * ' STARTING MONTH OF SIMULATION',68(1H.),'(START MONTH)',9X,I2,
  * 3X,'MONTH'/
  * ' ENDING YEAR OF SIMULATION',74(1H.),'(END YEAR)',7X,I4,
  * 3X,'YEAR'/
  * ' ENDING MONTH OF SIMULATION',72(1H.),'(END MONTH)',9X,I2,
  * 3X,'MONTH'/
  * ' TEMPERATURE STATION LATITUDE',71(1H.),'(TEMP LAT)',6X,I2,
  * '.','I2,3X,'DEG.MIN'/
  * ' HEAT INDEX',94(1H.),'(HID)',5X,F6.2/
FORMAT(I6,2X,I4,12/24I3/24I3/24I3/24I3)
FORMAT(I6,2X,I4,12,2X,24F4.2)
C C END
SUBROUTINE FORSUB(IR,MO,ET,HOURLY,LOOP,IEDYR,FACTOR)

C **********************************************************************
C • THIS SUBROUTINE IS THE MAIN BODY OF THE MODEL, DRAINMOD.
C • IT CONDUCTS THE BASIC WATER BALANCE CALCULATIONS ON INTERVALS OF 1
C • HR., 2HR., OR 1DAY.
C • INFILTRATION, SURFACE STORAGE, AND WATER MANAGEMENT PARAMETERS SUCH
C • AS SEW-30 ARE CALCULATED WITHIN THIS SUBROUTINE.
C • OTHER COMPONENTS SUCH AS DRAINAGE FLUX AND ET ARE CALLED FROM ADD-
C • TIONAL SUBROUTINES.
C **********************************************************************
COMMON/PARTAV, REQDAR, AMTRN, SI

COMMON/WATER(500), W(101), H(101), X(101), NN

COMMON/ABDB/EDT, ATT, AMA(M))

COMMON/EVAPQ/PET, DDZ, ROOTD

COMMON/DBLK/HDRAIN, DEPTH, CONK(5)

COMMON/SDBLK/DDRAIN, ADEPTH

COMMON/WND/STOR, GEE, STORRO

COMMON/DRLK/DRNSTO

SECTION 1

THIS SECTION RECEIVES DAILY PET AND HOURLY RAINFALL VALUES FOR ONE MONTH FROM THE MAIN PROGRAM AND CHANGES THE VALUE FROM INCHES TO CM.

DIMENSION ET(31), HOURSLY(744), DAYM(12), FACTOR(12)
DIMENSION DROOT(370)
INTEGER DAYM, DAY
DATA DAYM/31, 28, 31, 30, 31, 30, 31, 30, 31, 30, 31/,

IF(MO .EQ. 2) GO TO 5
IR1=IR/4
IR2=IR1*4
DAYM(2)=28
IF(IR .EQ. IR2) DAYM(2)=29
5 DO 10 I=1, 744
HOURSLY(I)=HOURSLY(I)*2.54
10 CONTINUE
DO 15 I=1, 31
ET(I)=ET(I)*2.54*FACTOR(MO)
15 CONTINUE
DAY=0
IF(LOOP.GT.1) GO TO 30
IRFST=IR

END OF SECTION 1

IF LOOP=0, I.E. FIRST TIME THROUGH THIS SECTION, GO TO SECTION 2 TO READ INITIAL DATA; OTHERWISE GO TO SECTION 4.

SECTION 2

STORAGE BLOCKS ARE ALLOCATED AND ARRAYS ARE DIMENSIONED. SOILS, SYSTEM PARAMETER AND PLANT ROOT DATA ARE READ IN AND LISTED ON THE OUTPUT IN THIS SECTION.

INTEGER BWKDY1, BWKDY2, SWKHR1, SWKHR2, EWKHR1, EWKHR2, EWKDY1, EWKDY2
INTEGER FDAYS, HOUR
COMMON /WK/SWKHR1, EWKHR1, SWKHR2, EWKHR2
COMMON /WK/AMIN1, ROUTA1, ROUTT1, AMIN2, ROUTA2, ROUTT2
COMMON/ICNT/ISICNT, ISKIP, IPST, IK, IPCNT
COMMON/JCNT/JSCNTM, JSKIPM, JPSTM
COMMON/DAY/FDAYS, NDAISI, INTDAY, NOIRR1, NOIRR2, NOIRR3, NOIRR4
COMMON/IHRS, IHREND, INSERR
COMMON/Par/STAV/REQPAR, AMTRN, AMTSI, DAMTSI
COMMON/WHX/WATER(500), W(101), H(101), X(101), NN
COMMON/ABDT/EDTWT, AA(500), BB(500), A, B
COMMON/EVAP/PET, DDZ, ROOTD
COMMON/DBLKLK/HDRAIN, DEPTH, CONK(5), DZ(5)
COMMON/DLKLK/DDRAIN, DDRAIN, DC, ADEPTH
COMMON/PO/DSTOR, GEE, STORRO
COMMON/DBLK/DRNSTO
COMMON/PLT/YODTWT(31),YCDTWT(31),XDATE(31)
COMMON/RAIN/R(24)
COMMON/ORDR/TOS1RR(50),TOTDD(50),TOTWD(50),SEW(50),IRY(50)

C DIMENSION RVLBM(12),FVLBM(12),ROM(12),DVOLM(12),PUMPVM(12)
DIMENSION DWEIER(12),DARCHNG(12),TLOSS(12)
DIMENSION DRYDAY(12),NEDAY(12),WRKDAY(12),WATDAY(12)
DIMENSION ISICNM(12),ISKIPM(12),IPOSTM(12),SIRRMO(12)
DIMENSION P(24),FRATE(24),HET(24),ACCR(24)
DIMENSION WTD(1000),VOL(501)
DIMENSION SWIER(12)
DIMENSION WATERL(31)
DIMENSION SEW(12)
DIMENSION UPFLUX(500),HPET1(24)
DIMENSION SUMAET(12)
DIMENSION AMTSIM(12)

C READ INPUT
READ(1,600)INSIRR,FDAYSI,INTDAY,IHRSTA,IHREND,NOIRR1,NOIRR2,
$NOIRR3,NOIRR4
READ(1,610)REQDAR,AMTRN,(AMTSIM(I),I=1,12)
READ(1,620)DDRAIN,HDRAIN,SDRAIN,STMAX,DEPTH,XNI,DC,ADEPTH
READ(1,620)STORRO,GEE
READ(1,625)(DZ(I),CONK(I),I=1,5)
C READ (1,630)AMINC,NOPORT,NNMONTH
READ(1,640)(DARCHNG(I),DWEIER(I),I=1,12)
READ(1,645) BWKDY1,EWKDY1,SWKHR1,EWKHR1,AMIN1,ROUTA1,ROUTT1
READ(1,645) BWKDY2,EWKDY2,SWKHR2,EWKHR2,AMIN2,ROUTA2,ROUTT2
READ(1,650)DITCHB,DITCHS,ROOTD,CRITD,WP,DTWT
READ(1,670)ISEWWS,ISEWD,ISEWME,ISEWDE,SEWX
READ(1,670)IDRYMS,IDRYS,DRYME,DRYDE
READ(1,670)INDET,INWIER
C IF INDET .GT.0 USE VALUES READ IN SUB PROP TO CALCULATE ET AS
C LIMITED BY SOIL CONDITIONS. IF INDET .GT.0 USE LIMITING DEPTH
C CONCEPT.
C START SEW CALCULATION ON ISEWDS IN MO. ISEWMW.
C END IT ON DAY ISEWDE IN MO. ISEWE.
C SEW CALCULATES DAYS W.T. IS ABOVE SEWX CM.
C
C PRINT INPUT
WRITE(6,790)
WRITE(6,800)DDRAIN,HDRAIN,SDRAIN,STMAX,DEPTH,XNI
WRITE(6,801)DC,ADEPTH
WRITE(6,802)STORRO,GEE
WRITE(6,810)AMIN1,ROUTA1,ROUTT1,AMIN2,ROUTA2,ROUTT2
WRITE(6,815) BWKDY1,EWKDY1,SWKHR1,EWKHR1,BWKDY2,EWKDY2,
$SWKHR2,EWKHR2
WRITE(6,820)ROOTD,CRITD,WP,DTWT,DITCHB,DITCHS
WRITE(6,850)FDAYSI,INTDAY,IHRSTA,IHREND,NOIRR1,NOIRR2,
$NOIRR3,NOIRR4
WRITE(6,860)REQDAR,AMTRN,(AMTSIM(I),I=1,12)
WRITE(6,861) (FACTOR(I),I=1,12)
861 FORMAT(//,' ET CORRECTION FACTOR FOR EACH MONTH',/4X,12F6.2/)
WRITE(6,822)
CST1=0.0
DO 824 I=1,5
CST2=DZ(I)
IF(CONK(I).GT.1E-5) WRITE(6,828)CST1,CST2,CONK(I)
824 CST1=CST2
WRITE(6,830)(DACHNG(I),I=1,12)
WRITE(6,840)(DWIER(I),I=1,12)
WRITE(6,835)NOPORT

C SOIL PROPERTIES
WRITE(6,870) INDET
CALL PROP(WTD,VOL,WATER,AA,BB,UPFLUX)

C SOME SOIL PROPERTIES ARE READ IN AND INITIALIZED IN SUBROUTINE PROP
CALL ROOT(DROOT)
JDAY=0

END OF SECTION 2

SECTION 3

DC=DC/24.
TOFSIR=IHREND-IHRSTA
IPCNT=0
EDTWT=DTWT
LRAIN = 0
DDAY=0.
ISKIP=0
IPOST=0
IK=0
ISICNT=0
IRRDAY=0
DEBT=0.0
DDZ=0.0
DRNSTO=0.0
STOR=0.0
TOTR=0.
TOTF=0.
TOTD=0.
TOTRO=0.
TOTNT=0.
TOTFD=0.
TOTWF=0.
TPUMPV=0.0
YTAV=0.0
YSUMET=0.0
WETZ=DTWT
ID=DTWT+1.0
YDEBT=0.0
CRITD1=CRITD+1.
ICRIT=CRITD1
CRITAV=VOL(ICRIT)
AVOL=VOL(ID)
TAV=AVOL
UPQ=UPFLUX(ID)
UPVOL=UPQ*24.
UPVOL2=UPQ
DELX=DEPTH/XNI
NI=XNI
NN=NI+1
NR1=NOIRR1
NR2=NOIRR2
NDAYS1=FDAYS1
DO 20 I=1,12
ISICNM(I)=0
ISKIPM(I)=0
IPOSTM(I)=0
SIRRMO(I)=0.
TWLOSS(I)=0.0
SUMAET(I)=0.0
RVOLM(I)=0.0
ROM(I)=0.0
FVOLM(I)=0.0
DVOLM(I)=0.0
PUMPVM(I)=0.0
WRKDAY(I)=0.0
WETDAY(I)=0.0
WATDAY(I)=0.0
DRYDAY(I)=0.
SWIER(I)=DWIER(I)
SEWM(I)=0.0
20 CONTINUE
DO 23 I=1,50
IRY(I)=0
SEW(I)=0.0
TOTDD(I)=0.0
TOTWD(I)=0.0
23 TOSIRR(I)=0.0
C
X(1)=0.0
DO 25 I=2,NN
X(I)=X(I-1)+DELX
25 CONTINUE
C
Consense SECTION 3

C **************************************************
C SECTION 4
C **************************************************
C * INCREMENT DAY, DETERMINE HOURLY RAINFALL, WEIR DEPTH, AND ROOT DEPTH
C * FOR NEW DAY. INITIALIZE VARIABLES FOR A NEW DAY.
C **************************************************

C 30 DAY=DAY+1
IRRDAY=IRRDAY+1
JDAY=JDAY+1
ROOTD=DROOT(JDAY)
AMTSI=AMTSIM(MO)
IF(AMTSI.LT.0.0)AMTSI=(TAV+AMTSI)/TOFSIR
IF(AMTSI.LT.0.0)AMTSI=0.0
C
DWIER(MO)=SWIER(MO)
PDEBT=ROOTD*(WATER(1)–WP)
IF(DAY.LT.DACHNG(MO).AND.MO.EQ.1)GO TO 31
IF(DAY.LT.DACHNG(MO))DWIER(MO)=DWIER(MO–1)
GO TO 32
31 DWIER(MO)=DWIER(12)
C
32 DAMTSI=0.0
DEEPET=DEPTH-DDZ
JPOSTM=0
JSKIPM=0
JSICNM=0
WLOSS=0.0
RO=0.0
RVL=0.0
DVOL=0.0
PUMPV=0.0
DELTWK=0.0
AMRAIN=0.0
STOR1=STOR
STOR2=STOR
AVOL1=AVOL
HSEW=0.0
C
C FIND HOURLY RAINFALL VALUES FOR NEW DAY
C
L=(DAY–1)*24
DO 35 I=1,24
K=L+I
R(I)=HOURLY(K)
AMRAIN=AMRAIN+R(I)
ACCR(I)=AMRAIN
35 CONTINUE
C
C CHECK IF SURFACE IRRIGATION IS PREPLANNED ON THAT DAY
IF(IRRDAY.EQ.FDAYS1.OR.IRRDAY.EQ.NDAYS1)CALL SURIRR
C
C FIND WATER CONTENT AND HEAD DISTRIBUTION
CALL WET(WETZ)
C
PET=ET(DAY)
C GET POTENTIAL DAILY EVAPOTRANSPIRATION FOR NEW DAY – DISTRIBUTES PET TO HOURLY VALUES
C
CALL EVAP(AET,HET,HPET1,TPET)
C
DO 40 I=1,24
IF(R(I).GT.0.0)GO TO 45
40 CONTINUE
   IRAIN=24
   IF(STOR.GT.0.001)GO TO 50
   GO TO 130
C
C IF IT RAINS OR IF PREVIOUS SURFACE STORAGE, FIND HOURLY INFILTRATION
C BY USING THREE MINUTE TIME INCREMENT
C
C END OF SECTION 4
C
C *****************************************************
C * SECTION 5
C * DETERMINES INFILTRATION AND CONDUCTS WATER BALANCE CALCULATIONS ON AN
C * HOURLY BASIS. ACCUMULATE TOTALS SO AT END OF SECTION 5 HAVE ESTIMATED
C * ALL PARAMETERS FOR THE DAY.
C *****************************************************
C * SECTION 5A - INFILTRATION CALCULATION
C *****************************************************
C
45 IRAIN=I
50 DT=1.0
   DDT=0.05
   DTMDT=DT-0.01*DDT
C
   RDT=23-LRAIN+IRAIN
   F(1)=0.001
   IF(RDT.LT.2.5)F(1)=F(LRAIN)
   IF(STOR.GT.0.01)F(1)=F(24)
   IF(DTWT.LT.0.001) F(1)=0.0
   IF(F(1).LT.0.001)F(1)=0.001
   YESF=F(1)
   LRAIN=1
C
   DO 55 I=1,24
   RVOL=RVOL+R(I)
   IF(R(I).GT.0.0001)LRAIN=I
55 CONTINUE
C
   J=1
   IF(F(J).LT.0.01)CALL SOAK
   IF((DAYSTG.E.2).AND.(DTWT.GT.0.0)) CALL SOAK
C DETERMINES INFILTRATION CONSTANTS FOR SMALL INITIAL INFILTRATION
C
60 CALL DRAINS(DTWT,DFLUX)
   IF(AVOL.LT.0.01)A=0.0
   IF((A.LT.0.00001).AND.(DTWT.GT.0.10)) CALL SOAK
   IF(A.EQ.0.0)B=HET(J)+DFLUX
   IF((A.EQ.0.0).AND.(B.LT.0.0))B=0.0
   FRATE(J)=A/F(J)+B
   IF(STOR.GT.0.0)GO TO 65
   IF(FRATE(J).GT.R(J))GO TO 90
C
65 RAT1=FRATE(J)
SUBROUTINE C

70 SUM=0.0
    F1=F(J)
    C
75 DF=RAT1*DDT
    F2=F1+DF
    RAT2=A/F2+B
    IF(STOR.GT.0.0)GO TO 80
    IF(RAT2.GT.R(J))RAT2=R(J)
80    DF=0.5*(RAT1+RAT2)*DDT
    SPR=STOR+R(J)*DDT
    IF(DF.GT.SPR)DF=SPR
    F1=F1+DF
    SUM=SUM+DDT
    RAT1=A/F1+B
    IF(STOR.GT.0.0)GO TO 85
    IF(RAT1.GT.R(J))GO TO 95
85    STOR=STOR+R(J)*DDT-DF
    IF(STOR.GT.STMAX)STOR=STMAX
    IF(SUM.GE.DTMDT)GO TO 100
    GO TO 75
    C
90    F1=F(J)+R(J)*DT
    RAT1=A/F1+B
    IF(RAT1.GT.R(J))GO TO 95
    RAT1=R(J)
    GO TO 70
    C
95    RAT1=R(J)
100    F(J)=F1

C * SECTION 5B - WATER BALANCE CALCULATION FOR ONE HOUR INTERVAL
C * REEVALUATION OF WETZ, DDZ ETC

105    FVOL=F(1)-YESF
110    WETZ=DTWT-DDZ
    IF(INDET.GT.0)GO TO 117
    IF(WETZ.GT.CRITD)GO TO 115
    IF(DEBT.GT.0.01)GO TO 115
    TVOL=FVOL-HET(J)-DVOL1
    AVOL1=AVOL1-TVOL
    GO TO 120
115    AVOL1=AVOL1+DVOL1
    DEBT=DEBT+HET(J)-FVOL
    IF(DEBT.GT.0.0)GO TO 120
    AVOL1=AVOL1+DEBT
    DEBT=0.0
    GO TO 120
CONTINUE
CALL ETFLUX(AVOL1,DEBT,FVOL,DVOL1,UPVOL2,HPET1(J),HET(J),PDEBT)

120 DDZ=DEBT/(WATER(1)-WP)
IF(AVOL1.GT.0.001)GO TO 125
STOR=STOR-AVOL1
IF(STOR.GT.STMAX)STOR=STMAX
F(J)=F(J)+AVOL1
FVOL=FVOL+AVOL1
AVOL1=10.*AVOL1+1.0
AV=10.*AVOL1+1.0
XV=IAVOL
WETZ=WTD(IAVOL)+(AV-XV)*(WTD(IAVOL+1)-WTD(IAVOL))
IWET=WETZ+4.
UPQ=UPFLUX(IWET)
IF(WETZ.GT.DEEPET)UPQ=0.0
UPVOL2=UPQ*DT
DTWT=WETZ+DDZ
TAV1=AVOL1+DEBT
STOR=STOR-2
STOR2=STOR
RO=R(J)-FVOL-DSTOR
CALL YDITCH(DWIER(MO),DVOL1,YD,RO,WLO,DITCHB,DITCHS)
IF(INWIER.GT.0.0)YD=DDRAIN-MIIER(M0)
HDRAIN=DEPTH-DDRAIN+YD
WL0SS=WL0SS+WL0
IF(DTWT.LT.SEWX)HSEW=HSEWCSEWX-DTWT
THE FOLLOWING STATEMENTS DETERMINE IF THIS HOUR IS COUNTED
AS AN HOUR IN WHICH FIELD WORK CAN BE DONE
DWRKDY=0.0
IF((JDAY .GE. BWKDY1) .AND. (JDAY .LE. EWKDY1))
* CALL WORK(1,J,TAV1,DWRKDY,ACCR(J),DDAY,YTAV)
IF((JDAY .GE. BWKDY2) .AND. (JDAY .LE. EWKDY2))
* CALL WORK(2,J,TAV1,DWRKDY,ACCR(J),DDAY,YTAV)
IF(R(J).LT.0.01)DDAY=DDAY+1./24.
DELTWK=DELTWK+DWRKDY
J=J+1
IF(J.GT.24)GO TO 155
F(J)=F(J-1)
IF(F(J).LT.0.001)F(J)=0.001
GO TO 60

WHEN CALCULATIONS HAVE BEEN MADE FOR HOUR, J=24, GO TO SECTION 7

END OF SECTION 5

SECTION 6

* WATER BALANCE CALCULATION WHEN HAVE NO RAIN OR SURFACE IRRIGATION
* DURING THE DAY OR SURFACE STORAGE AT THE BEGINING OF THE DAY.
* THE WATER BALANCE CALCULATION IS BASED ON A 1 DAY TIME INTERVAL IF
* DRAINAGE FLUX AT BEGINING OF DAY IS LESS THAN .02 CM./DAY AND ON A
* 2 HR. INTERVAL IF DFLUX IS GREATER THAN THAT VALUE.

***************
130 HOUR=0
YESF=0.0
FVOL=0.0
DO 135 I=1,24
F(I)=0.0
FRATE(I)=0.0
135 CONTINUE
C
CALL DRAINS(DTWT,DFLUX)
DVOL=24.*DFLUX
C IF INDET>0 USE SUBROUTINE ETFLUX TO ESTIMATE AET
C THEN CAN GET GOOD ESTIMATE OF DVOL
UPVOL=UPQ*24.0
IF(INDET.LE.0) GO TO 137
CALL ETFLUX(AVOL,DEBT,FVOL,DVOL,UPVOL,TPET,AET,PDEBT)
AVOL=AVOL
DDZ=DEBT*ROOTD/PDEBT
137 CONTINUE
C CHECK FOR DRAINAGE VOLUME. FOR SMALL VOLUME, TAKE 24 HOUR INCREMENT
C AND FOR LARGE VOLUME TAKE 2 HOURLY INCREMENT
IF(ABS(DVOL).LE.0.02)GO TO 145
AVOL=AVOL
DEBT=DEBT
AET=AET/12.
H2PET=TPET/12.
C
140 HOUR=HOUR+2
UPVOL=UPQ*2.0
DVOL=2.0*DFLUX
145 CONTINUE
IF(INDET.LE.0) GO TO 147
IF(HOUR.EQ.0) GO TO 147
CALL ETFLUX(AVOL,DEBT,FVOL,DVOL,UPVOL,H2PET,AET,PDEBT)
IF(AVOL.LT.0.0) AVOL=0.0
GO TO 148
147 TVOL=FVOL-AET-DVOL
AVOL=AVOL-TVOL
IF(AVOL.LT.0.0)AVOL=0.0
IF(WETZ.GT.CRITD)AVOL=AVOL+DVOL
148 IAVOL=10.*AVOL+1.0
AV=10.*AVOL+1.0
XV=IAVOL
WETZ=WDI(IAVOL)+(AV-XV)*(WDI(IAVOL+1)-WDI(IAVOL))
IWET=WETZ+1.
UPQ=UPFLUX(IWET)
DDZ=DEBT*ROOTD/PDEBT
DTWT=WETZ+DDZ
IF(WETZ.GT.DEEmT)UPQ=0.0
CALL YDITCH(DWIER(MO),DVOL,YD,RO,WLO,DITCHB,DITCHS)
IF(INWIER.GT.0.0)YD=DDRAIN-DWIER(MO)
HDRAIN=DEPTH-DDRAIN+YD
WLOSS=WLOSS+WLO
IF(DVOL.LT.0.0) PUMPV=PUMPV+DVOL
DVOL=DVOL+DVOL1
CALL DRAINS(DTWT,DFLUX)
IF(DTWT.LT.SEIJX)HSEW=HSEW+2.0*(SEWX-DTWT)
485A
IF(HOUR.GE.24)AET=AET*12.0
486A
IF(HOUR.GE.24)GO TO 155
487A
IF(HOUR.EQ.0)GO TO 150
488A
GO TO 140
489A

150 DVOL2=24.*DFLUX
490A
HSEW=12.0*HSEW
491A
DVOL=0.5*(DVOL1+DVOL2)
492A
IF(DVOL.LT.0.0) CALL YDITCH(DWIER(MO),DVOL,YD,RO,WLO,DITCHB,DITCHS)
493A
IF(DVOL.LT.0.0)YD=DDRAIN-DWIER(MO)
494A
HDRAIN=DEPTH-DDRAIN+YD
495A

END OF SECTION 6
496A

SECTION 7
500A
REEVALUATION OF WATER TABLE DEPTH, DRY ZONE DEPTH, WET ZONE DEPTH, AIR VOLUMES, AND RUNOFF AT END OF DAY. ALSO UPDATE SOME VARIABLES TO BE USED DURING NEXT DAY SUCH AS UPQ.
505A

155 FVOL=F(24)-YESF
509A
DEBT=YDEBT
510A
UPVOL=0.5*(24.0*UPQ+UPVOL)
511A
IF(INDET.LE.O)GO TO 157
512A
CALL ETFLUX(AVOL,DEBT,FVOL,DVOL,UPVOL,TPET ,AET,PDEBT)
513A
GO TO 165
514A

THE FOLLOWING SECTION (TO STATEMENT NO. 165) USES THE CRITICAL DEPTH CONCEPT TO ESTIMATE UPWARD MOVEMENT OF WATER FROM WATER TABLE IS LIMITED.
518A

157 CONTINUE
521A
WETZ=DWIER-DDZ
522A
IF(WETZ.GE.CRITD)GO TO 160
523A
IF(DEBT.GT.0.01)GO TO 160
524A
TVOL=FVOL-AET-DVOL
525A
AVOL=AVOL-TVOL
526A
GO TO 165
527A

THE NEXT ARE NEEDED WHEN HOURLY WETZ<CRITD BUT DEBT>0
539A
IF(DEBT.GE.0.) GO TO 165
AVOL=AVOL+DEBT
DEBT=0.

165 DDZ=DEBT/(WATER(1)-WP)
166 DSTOR=STOR-STOR1
RO=RVOL-DSTOR-FVOL
IF(AVOL.LT.0.0)AVOL=0.0
AV=10.*AVOL+1
IAVOL=AV
XV=IAVOL
WETZ=WTD(IAVOL)+((AV-XV)*(WTD(IAVOL+1)-WTD(IAVOL)))
IWET=WETZ+1.
UPQ=UPFLUX(IWET)
DTWT=WETZ+DDZ
IF(WETZ.GT.DEEPET)UPQ=0.0
TAV=AVOL+DEBT
TAV1=TAV
TV=10*TAV+1
ITAV=TV
XV=ITAV
EDTWT=WTD(ITAV)+(TV-XV)*(WTD(ITAV+1)-WTD(ITAV))
YDEBT=DEBT
SEWD=0.0

END OF SECTION 7

SECTION 8
DETERMINATION OF PLANT GROWTH AND TRAFFICABILITY PARAMETERS, OUTPUT OF DAILY SUMMARIES IF DESIRED, AND MONTHLY SUMMARY CALCULATIONS.

IF((MO.LT.ISEWMS).OR.(MO.GT.ISEWME)) GO TO 169
IF((MO.EQ.ISEWMS).AND.(DAY.LT.ISEWDS)) GO TO 169
IF((MO.EQ.ISEWME).AND.(DAY.GT.ISEWDE)) GO TO 169
IF(DTWT.GT.SEXW) GO TO 168
SEWD=SEWX-DTWT
168 CONTINUE
IF(HSEW.GT.0.01)SEWD=HSEW/24.0
169 CONTINUE

C DAILY SUMMARIES
WRITE(6,900)
WRITE(6,910)IR,MO
WRITE(6,920)DAY,RVOL,FVOL,AET,DVOL,AVOL,TAV,DDZ,WETZ,DTWT,
MONTHLY CALCULATIONS

175  RVOLM(MO) = RVOLM(MO) + RVOL
    FVOLM(MO) = FVOLM(MO) + FVOL
    ROM(MO) = ROM(MO) + RO
    DVOLM(MO) = DVOLM(MO) + DVOL
    PUMPV(MO) = PUMPV(MO) + PUMPV
    TWLOSS(MO) = TWLOSS(MO) + WLOSS
    SUMAET(MO) = SUMAET(MO) + AET
    SIRRMO(MO) = SIRRMO(MO) + DAMTSI
    ISICNM(MO) = ISICNM(MO) + JSICNM
    ISKIPM(MO) = ISKIPM(MO) + JSKIPM
    IPOSTM(MO) = IPOSTM(MO) + JPOSTM
    SEWM(MO) = SEWM(MO) + SEWD

176  IF(DDZ.GE.(ROOTD-1.0)) GO TO 172
    IF(RVOL .GT. 0.005) GO TO 176
    GO TO 173

    DRYDAY(M0) = DRYDAY(M0) + 1.0

    CONTINUE

DELTWK = 0.0
    IF((JDAY .GE. BWKDY1) .AND. (JDAY .LE. EWKDY1))
        CALL WORK(1,-1,TAV,DELTWK,0.0,DDAY,YTAV)
    IF((JDAY .GE. BWKDY2) .AND. (JDAY .LE. EWKDY2))
        CALL WORK(2,-1,TAV,DELTWK,0.0,DDAY,YTAV)

    DDAY = DDAY + 1

    WRKDAY(MO) = WRKDAY(MO) + DELT WK

    IF(TAV.LT.AMINC) WATDAY(MO) = WATDAY(MO) + I.

    IF(DAY.GE.DAYMT(MO)) GO TO 180
    YTAV = TAV
    GO TO 30

IF PREVIOUS DAY WAS LAST DAY OF MONTH GO TO SECTION 9; OTHERWISE
RETURN TO SECTION 4

END OF SECTION 8

*C ******************** SECTION 9 ****************************
*C * IF MONTH JUST COMPLETED WAS LESS THAN 12, RETURNS TO MAIN PROGRAM FOR *
*C * NEW SET OF RAINFALL AND ET DATA. IF MONTH=12, THIS SECTION PRINTS OUT *
*C * MONTHLY SUMMARIES, COMPUTES YEARLY SUMMARIES, PRINTS, AND DETERMINES *
*C * AVERAGES OVER PREVIOUS YEARS OF SIMULATION.  *
*C ******************** ******************************

180  DAYMT = DAYM(MO)
    WETDAY(MO) = DAYMT - WRKDAY(MO)
    IF(MO.LT.12) RETURN
    IF(NMONTH.NE.0) GO TO 181

C  MONTHLY SUMMARIES
WRITE(6,940)IR
WRITE(6,950)
WRITE(6,960)(MO,RVOLM(MO),FVOLM(MO),ROM(MO),DVOLM(MO),SUMAET(MO),
2DRYDAY(MO),WRKDAY(MO),
2TWLOSS(MO),SEWM(MO),SIRRMO(MO),
$SISICNM(MO),PUMPVM(MO),IPOSTM(MO),MO=1,12)

C
181 CONTINUE
YEARS=IR-IRFST+1
IYEAR=YEARS
IRY(IYEAR)=IR

C
DO 185 I=1,12
TOTR=TOTR+RVOLM(I)
YSUMET=YSUMET+SUMAET(I)
TOTF=TOTF+FVOLM(I)
TOTRO=TOTRO+ROM(I)
TOTD=TOTD+DVOLM(I)
TPUMPV=TPUMPV+PUMPVM(I)
TOTDD(IYEAR)=TOTDD(IYEAR)+DRYDAY(I)
TOSIRR(IYEAR)=TOSIRR(IYEAR)+SIRRMO(I)
TONT=TONT+WETDAY(I)
TOTWD(IYEAR)=TOTWD(IYEAR)+WRKDAY(I)
TOTFD=TOTFD+WATDAY(I)
TOTWF=TOTWF+TWLOSS(I)
SEW(IYEAR)=SEW(IYEAR)+SEWM(I)
WETDAY(I)=0.0
WRKDAY(I)=0.0
DRYDAY(I)=0.0
PUMPVM(I)=0.0
RVOLM(I)=0.0
FVOLM(I)=0.0
ROM(I)=0.0
WATDAY(I)=0.0
TWLOSS(I)=0.0
DVOLM(I)=0.0
SIRRMO(I)=0.0
SUMAET(I)=0.0
SISICNM(I)=0
ISKIPM(I)=0
SEWM(I)=0.0
IPOSTM(I)=0
185 CONTINUE

C
YEARY SUMMARIES
WRITE(6,990)TOTR,TOTF,TOTRO,TOTD,YSUMET,TOTDD(IYEAR),TOTWD(IYEAR),
$TOTWF,SEW(IYEAR),TOSIRR(IYEAR),TPUMPV

C
REINITIALIZATION
TOTR=0.
TOTF=0.
TOTRO=0.
YSUMET=0.0
TOTD=0.
TPUMPV=0.0
TOTNT=0.
TOTFD=0.
TOTWF=0.
ISKIP=0
IPOST=0
JDAY=0
IK=0
ISICNT=0
IRRDAY=0
NDAYSI=FDAYSI
NOIRR1=NR1
NOIRR2=NR2

IF(IR.EQ.IEDYR) CALL ORDER(IYEAR)

C

600 FORMAT(2I5,7I10)
610 FORMAT(2F10.5,12F5.2)
620 FORMAT(8E10.2)
625 FORMAT(10F5.2)
630 FORMAT(F10.2,2I5)
640 FORMAT(12(F2.0,F3.0))
645 FORMAT(2I3,2I2,3F10.2)
650 FORMAT(6E10.2)
660 FORMAT(20F4.1)
670 FORMAT(4I2,2X,F10.2)

C

790 FORMAT(1H1/I.X,'INPUT PARAMETER VALUES USED IN THIS SIMULATION')
800 FORMAT(/I.X,'DEPTH TO DRAIN=',F5.1,'CM'/'I.X,'EFFECTIVE DEPTH FROM $DRAIN TO IMPERMEABLE LAYER=',F5.1,'CM'/'I.X,'DISTANCE BETWEEN $DRAINS=',F7.1,'CM'
$/'I.X,'MAXIMUM DEPTH OF SURFACE PONDING=',F5.2,'CM'/'I.X,'EFFECTIVE $DEPTH IMPERMEABLE LAYER=',F6.1,'CM'/'I.X,'NUMBER OF DEPTH INCREMENTS $=',F5.0)
801 FORMAT(1X,'DRAINAGE COEFFICIENT(AS LIMITED BY SUBSURFACE OUTLET $)=',F5.2,'CM/DAY'/'I.X,'ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE $LAYER=',F5.1,'CM')
802 FORMAT(1X,'SURFACE STORAGE THAT MUST BE FILLED BEFORE WATER CAN $MOVE TO DRAIN (FIG.2-12) =',F5.2,'CM'/'I.X,'FACTOR -G- IN KIRKHAM $EQ. 2-17 =',F10.2)

810 FORMAT(1X,'MINIMUM AIR VOL REQUIRED FOR TRAFFICABILITY FOR FIRST $WORK PERIOD(AMIN1)=',F5.2,
$'CM'/'I.X,'MINIMUM DAILY RAINFALL TO STOP FIELD OPERATIONS FOR FIRST $PERIOD (ROUT1)=',F5.2,'CM'/
$1X,'MINIMUM TIME AFTER RAIN BEFORE CAN TILL FIRST PERIOD (ROUT1) $=',F5.0,'DAYS',
$1X,'MINIMUM AIR VOL REQUIRED FOR TRAFFICABILITY FOR SECOND WORK $PERIOD (AMIN2)=',F5.2,
$'CM'/'I.X,'MINIMUM DAILY RAINFALL TO STOP FIELD OPERATIONS FOR SECOND $PERIOD (ROUTA2)=',F5.2,'CM'/
$1X,'MINIMUM TIME AFTER RAIN BEFORE CAN TILL SECOND PERIOD (ROUTT2) $=',F5.0,'DAYS')
815 FORMAT(1X,'JULIAN DATE TO BEGIN CountING WORK DAYS- 1ST PERIOD=',
$I3
$1X,'JULIAN DATE TO END Counting WORK DAYS- FIRST PERIOD=',I3/
$1X,'HOUR TO BEGIN WORK- FIRST PERIOD=',I2/


A-26
$1X,'HOUR TO END WORK-FIRST PERIOD=',I2/1X,'JULIAN DATE TO BEGIN CO  E728A
SUNTING WORK DAYS-SECOND PERIOD=',I3/  F728A
$1X,'JULIAN DATE TO END COUNTING WORK DAYS- SECOND PERIOD=',I3/  GG728A
$1X,'HOUR TO BEGIN WORK- SECOND PERIOD=',I2/  729A
$1X,'HOUR TO END WORK- SECOND PERIOD=',I2/  730A
820 FORMAT (1X,'MAXIMUM ROOTING DEPTH=',F5.1,'CM'/1X,'CRITICAL DEPTH W  731A
SET ZONE=',F5.1,'CM'/1X,'INITIAL WATER TAB  732A
$LE DEPTH=',F5.1/1X,'WIDTH OF DITCH BOTTOM=',F5.1,'CM'/  733A
$1X,'SIDE SLOPES OF DITCH=',F5.1,':')  734A
822 FORMAT(/8X,'DEPTH',9X,'SATURATED HYDRAULIC CONDUCTIVITY'/)  735A
828 FORMAT(3X,F7.2,'- ',F7.2,12X,F11.5)  736A
830 FORMAT(1X,'/5X,'DEPTHS OF WIERS FROM THE SURFACE'//1X,'DATE',9X,'1/  737A
S','F3.0,3X,'2'/','F3.0,3X,'3'/','F3.0,3X,'4'/','F3.0,3X,'5'/','F3.0,3X,'6'/  738A
S','F3.0,3X,'7'/','F3.0,3X,'8'/','F3.0,3X,'9'/','F3.0,3X,'10'/','F3.0,2X,'11/  739A
S','F3.0,2X,'12'/','F3.0)  740A
835 FORMAT(/1X,'INDICATOR FOR DAILY SUMMERY=',I5)  741A
840 FORMAT(1X,'WIER DEPTH',12F8.1)  742A
850 FORMAT(1X,'FIRST DAY OF SURFACE IRRIGATION=',I2/1X,  743A
$ 'INTERVAL BETWEEN SURFACE IRRIGATION DAYS=',I2/1X,  744A
$ 'STARTING HOUR OF SURFACE IRRIGATION=',I3/1X,  745A
$ 'ENDING HOUR OF SURFACE IRRIGATION=',I3/1X,  746A
$ 'NO SURFACE IRRIGATION INTERVAL 1=',I4,2X,'I4,1X,  747A
$ 'NO SURFACE IRRIGATION INTERVAL 2=',I4,2X,'I4)  748A
860 FORMAT(1X,'MINIMUM AIR REQUIRED TO HAVE SURFACE IRRIGATION=',  749A
$ F6.2,'CM'/1X,'AMOUNT OF RAIN TO POSTPONE SURFACE IRRIGATION=',  750A
$ F6.2,'CM'/1X,'SURFACE IRRIGATION FOR ONE HOUR=',12F6.2,'CM')  751A
870 FORMAT(1X,'DETR',12,'WHEN DETR.GT. O USE READ IN VALUES TO DETE  752A
2RINE ET WHEN LIMITED BY SOIL CONDITIONS')  753A
900 FORMAT(1H1)  754A
910 FORMAT(2110)  755A
920 FORMAT(/2X,'DAY',3X,'RAIN',3X,'INFIL',6X,'ET',4X,'DRAIN',2X,  756A
$ 'AIR VOL',3X,'TVOL',4X,'DDZ',4X,'WETZ',3X,'DTWT',4X,'STOR',  757A
$ '1X,'RUNOFF',2X,'WLOSS',3X,'YD',3X,'DRNSTO',2X,'SEW',2X,'DMTSI')  758A
930 FORMAT(2X,I3,8F8.2,8F7.2)  759A
940 FORMAT(1H0,15X,'MONTHLY VOLUMES IN CENTIMETERS FOR YEAR',I6)  760A
950 FORMAT(2X,'MONTH',I3,'RAIN',I3,'INFIL',I3,'ET',I3,'DRAIN',I3,  761A
$ 'DRAINAGE',I3,'ET', 'DRY DAYS', 'WRK DAYS',  762A
$ 1X,'WATER LOSS',4X,'SEW',3X,'MIR',4X,'MCN',1X,'PUMP',2X,'MPT  763A
3')  764A
23X,F5.2,14,F7.3,I4)  766A
990 FORMAT(1H0/1X,'TOTALS',7F9.2,4X,4F9.2)  767A
C 768A
RETURN 769A
END 770A
C 771A
END OF SECTION 9 772A
C END OF FORSUB 773A
C RETURN TO MAIN FOR NEW SET OF DATA TO START SIMULATION FOR FIRST MONTH 774A
C OF THE NEXT YEAR. 775A
C 776A
C 777A
C 778A
C **************************************************************************************************************** 779A
C * DEFINITION OF TERMS IN SUBROUTINE FORSUB 780A
C
C * A. INPUTS TO SUBROUTINE LISTED IN ORDER OF INPUT
FDAYS1: FIRST DAY OF WASTE WATER IRRIGATION (JULIAN DATE).
INTDAY: INTERVAL BETWEEN IRRIGATION (DAYS).
IHRSTA: HOUR IRRIGATION STARTS.
IHREND: HOUR IRRIGATION ENDS.
NOIRR1: BEGINNING JULIAN DATE OF FIRST NO IRRIGATION INTERVAL.
NOIRR2: ENDING JULIAN DATE OF FIRST NO IRRIGATION INTERVAL.
NOIRR3: BEGINNING JULIAN DATE OF SECOND NO IRRIGATION INTERVAL.
NOIRR4: ENDING JULIAN DATE OF SECOND NO IRRIGATION INTERVAL.
REQDAR: AMOUNT OF DRAINED VOLUME OR AIR VOLUME, CM., BEFORE IRRIGATION OF WASTE WATER IS ALLOWED.
AMTRN: AMOUNT OF RAINFALL REQUIRED TO POSTPONE IRRIGATION TO NEXT DAY. RAINFALL MUST OCCUR ON FIRST HOUR OF SCHEDULED IRRIGATION.
AMTSIM(I): RATE OF IRRIGATION OF WASTEWATER (CM/HR) FOR EACH MONTH.
AMTSIM<0, THE RATE IRRIGATED IS (TAV+AMTSIM(I))/TOFSIR WHICH WOULD BE MAXIMUM AMOUNT SOIL WOULD ACCEPT ON THAT DAY.
AMTSI: RATE OF IRRIGATION OF WASTE WATER, CM/HR.
DDRAIN: DEPTH OF DRAIN, CM.
HDRAIN: EQUIVALENT DEPTH FROM WATER SURFACE IN DRAIN TO IMPERMEABLE LAYER, CM.
SDRAIN: DISTANCE BETWEEN TWO DRAINS, CM.
SMAX: MAXIMUM OR AVAILABLE SURFACE DEPRESSION STORAGE, CM.
DEPTH: EFFECTIVE DEPTH TO IMPERMEABLE LAYER FROM SOIL SURFACE, CM.
EFFECTIVE DEPTH MAY BE SMALLER THAN ACTUAL DEPTH TO ACCOUNT FOR CONVERGENCE NEAR DRAIN TUBES.
XNI: NUMBER OF DEPTH INCREMENTS.
DC: DRAINAGE COEFFICIENT; READ IN AS CM/DAY.
ADEPTH: ACTUAL DEPTH FROM SURFACE TO IMPERMEABLE LAYER.
STORRO: SURFACE STORAGE THAT MUST BE FILLED BEFORE SURFACE WEIR CAN MOVE TO THE DRAIN, CM, (FIG. 2-12).
GEE: FACTOR A IN KIRKHAM'S EQ. (EQ. 2-17).
DZ(I): DEPTH TO BOTTOM OF PROFILE LAYER I.
CONK: LATERAL HYDRAULIC CONDUCTIVITY, CM/HR, OF A PROFILE LAYER.
E.G. CONK(2) IS CONDUCTIVITY OF LAYER FROM DZ(1) TO DZ(2).
AMINC: MINIMUM AIR VOLUME IN PROFILE IN ORDER NOT TO HAVE CROP DAMAGED, CM.
NPORT: AN INDICATOR TO CONTROL PRINTOUT:
NPORT = 0 - MONTHLY SUMMARIES
NPORT .GT. 0 - DAILY SUMMARIES
DACHNG: THE DAY IN A MONTH WHEN THE WEIR DEPTH IS CHANGED TO DWIER.
FOR THAT MONTH, I.E., IF DACHNG(3) = 5, THEN THE WEIR DEPTH IS CHANGED TO DWIER(3) ON 5TH DAY OF THE MONTH OF MARCH.
DWIER: WEIR DEPTH FROM SURFACE, CM, FOR GIVEN MONTH. DWIER(2) IS DEPTH OF WEIR IN MONTH 2 (FEB).
BWKDY1: BEGINNING JULIAN DAY OF FIRST WORK PERIOD.
EWKDY1: ENDING JULIAN DATE OF FIRST WORK PERIOD.
SWKHR1: HOUR TO START WORK DURING PERIOD 1.
EWKHR1: HOUR TO END WORK DURING PERIOD 1.
AMINI: MINIMUM AIR VOLUME OR DRAINED VOLUME REQUIRED TO HAVE FIELD OPERATIONS DURING WORK PERIOD 1.
ROUTA1: RAINFALL REQUIRED TO STOP FIELD OPERATIONS DURING WORK PERIOD 1.
PERIOD 1.

ROUTE1: DAYS REQUIRED TO DRAIN OR DRY FIELD SO OPERATIONS CAN CONTINUE DURING WORK PERIOD 1.

BWKDYZ: BEGINNING JULIAN DAY OF SECOND WORK PERIOD.

EWKDY2: ENDING JULIAN DAY OF SECOND WORK PERIOD.

SWKHR2: HOUR TO START WORK DURING WORK PERIOD 2.

EWKRH2: HOUR TO END WORK DURING WORK PERIOD 2.

AMIN2: MINIMUM AIR VOLUME OR DRAINED VOLUME REQUIRED TO HAVE FIELD OPERATIONS DURING WORK PERIOD 2.

ROUTA2: RAINFALL REQUIRED TO STOP FIELD OPERATIONS DURING WORK PERIOD 2.

ROUTE2: DAYS REQUIRED TO DRAIN OR DRY FIELD SO OPERATIONS CAN CONTINUE DURING WORK PERIOD 2.

DITCHB: BOTTOM WIDTH OF THE DITCH, CM., WHEN OPEN DITCHES USED FOR DRAINS. EFFECTIVE WIDTH WHICH CONSIDERS STORAGE IN OUTLET WHEN DRAIN TUBES USED.

DITCHS: SIDE SLOPE OF THE DITCH.

CRITD: CRITICAL DEPTH OF WET ZONE, CM.

WP: WILTING POINT OR SOIL WATER CONTENT OF SURFACE LAYER AT LOWER LIMIT OF AVAILABILITY TO PLANT.

DTWT: DEPTH TO WATER TABLE AT BEGINNING OF SIMULATION. NOT INITIALIZED AT START OF EACH YEAR.

ISEWMS: MONTH TO START CALCULATING SEW VALUES. 05 MEANS START CALCULATION IN MAY.

ISEWDS: DAY OF MONTH TO START CALCULATING SEW.

ISEWME: MONTH TO END SEW CALCULATION.

ISEWDE: DAY OF MONTH TO END SEW CALCULATION.

SEWX: DEPTH ON WHICH SEW CALCULATION IS BASED, CM., E.G. SEWX=30 MEANS SEW CALCULATED AS DIFFERENCE BETWEEN WATER TABLE DEPTH AND 30 CM. IF W.T. = 20 CM., SEW = 30 - 10 CM DAYS FOR THAT DAY.

INDET: INDICATOR VARIABLE. IF INDET.GT.0, VALUES FOR UPWARD FLUX VS. WATER TABLE DEPTH ARE READ IN SUB. PROP TO CALCULATE SOIL LIMITED ET. IF INDET.LE.0, LIMITING DEPTH CONCEPT, CRITD, IS USED FOR ET.

INWIER: INDICATOR TO DETERMINE IF SUBIRRIGATION IS USED. IF INWIER .GE.0, SUBIRRIGATION IS USED AND DEPTH OF WATER IN OUTLET IS MAINTAINED AT WIER ELEVATION. IF INWIER.LE.0 HAVE CONVENTIONAL DRAINAGE OR CONTROLLED DRAINAGE IF DWIER IS ABOVE BOTTOM OF DRAIN.

INSIRR: IF INSIRR .GT. 0, POSTPONE IRRIGATION TILL NEXT DAY WHEN TAV LT. REQDAR. IF INSIRR =0, SKIP IRRIGATION FOR TAV LT.

TAV = TOTAL DAILY ET.

AVOL: AIR VOLUME OR DRAINED VOLUME IN WET ZONE.

AVOL1: ANOTHER VARIABLE FOR AIR VOLUME IN WET ZONE.

AWETDY: SUM OF WET DAYS FOR A GIVEN MONTH OVER ALL PAST YEARS SIMULATED.

- A29
AWRKDY: SUM OF WORK DAYS FOR A GIVEN MONTH OVER ALL PAST YEARS
SIMULATED.

B : CONSTANT IN GREEN-AMPT INFILTRATION EQUATION OBTAINED BY
INTERPOLATION.

CHECK : INDEX.

CONE : EFFECTIVE LATERAL HYDRAULIC CONDUCTIVITY, CM/HR.

CRITAV: AIR OR DRAINED VOLUME CORRESPONDING TO CRITICAL DEPTH.

DAYM : NUMBER OF DAYS A MONTH, E.G., DAYM(6) = DAYS IN JUNE = 30.

DAYMT : NUMBER OF DAYS OF THE MONTH.

DDT : TIME INCREMENT.

DDZ : DEPTH OF DRY ZONE, CM.

DEBT : THE AMOUNT OF WATER IN CM THAT HAS BEEN REMOVED FROM DRY
ZONE BY ET.

DEEPET: DISTANCE FROM BOTTOM OF ROOT ZONE TO IMPERMEABLE LAYER.

DELT : TIME INCREMENT.

DELTWK: THE FRACTION OF THE DAY WHICH IS SUITABLE FOR WORK. IE.
DELTWK = 0.5 MEANS THIS DAY HAS 0.5 WORK DAYS.

DELX : DEPTH INCREMENT, CM.

DF : CHANGE IN INFILTRATION, CM., DURING TIME INCREMENT, DDT.

DFLUX : DRAINAGE FLUX, CM/HR.

DROOT : EFFECTIVE ROOT DEPTH FOR A JULIAN DATE; E.G. DROOT(155) IS
ROOT DEPTH FOR DAY 155.

DRODAY: A DAY WHEN AMOUNT OF SOIL WATER SUPPLIED TO THE PLANTS IS
LESS THAN PET FOR THAT DAY.

DSTOR : DIFFERENCE IN SURFACE STORAGE FROM ONE HR. TO NEXT OR FROM
ONE DAY TO NEXT.

DT : TIME INCREMENT, HOUR.

DTWT : DEPTH TO WATER TABLE.

DVOL : DRAINAGE VOLUME, CM. SUMMED SO = TO DAILY DRAIN VOLUME AT
END OF DAY.

DVOL1 : ESTIMATE OF DRAINAGE VOLUME, CM., FOR TIME INCREMENT DT.

DVOL2 : ANOTHER ESTIMATE OF DRAINAGE VOLUME, CM., FOR TIME INCRE-
MENT DT.

DVOLM : TOTAL MONTHLY DRAINAGE VOLUME, CM.

DWRKDY: THE FRACTION OF A WORK DAY IN A GIVEN HOUR.

EDITWT: EFFECTIVE DEPTH TO WATER TABLE - ASSUMING TOTAL AIR VOLUME
WAS IN THE WETZ.

ET : EVAPOTRANSPIRATION, IN. ET(2) = ET FOR 2ND DAY OF THE
MONTH.

F : INFILTRATION FOR HOUR. F(2) MEANS INFILTRATION FOR 2ND HOUR
OF THE DAY, CM.

F1 : DUMMY VARIABLE FOR F.

F2 : DUMMY VARIABLE FOR F.

FRATE : INFILTRATION RATE, CM/HR. FRATE(6) MEANS INFILTRATION RATE
IN CM/HR AT THE END OF THE 6TH HOUR OF THE DAY.

FVOL : HOURLY OR DAILY INFILTRATION, CM.

FVOLM : TOTAL MONTHLY INFILTRATION, CM.

H : PRESSURE HEAD, CM.

HET : CALCULATED HOURLY ET, CM. HET(5) MEANS CALCULATED ET FOR
THE 5TH HOUR OF THE DAY.

HOUR : HOUR OF THE DAY.

HOURLY: HOURLY RAINFALL, IN. HOURLY(54) = HOURLY RAINFALL FOR 54TH
HOUR OF THE MONTH.

HSEW : HOURLY SEW, CM-HRS.

IAVOL : INTEGER VARIABLE FOR MODIFIED AIR VOLUME, CM, THAT COULD BE
USED TO FIND WET ZONE DEPTH AS, WETZ = WTD(IAVL).

IND = 2 MEANS DAY FALLS WITHIN SECOND WORK PERIOD.

IND : AN INDICATOR. IND = 1 MEANS DAY FALLS WITHIN FIRST WORK PERIOD.

IPOST : NUMBER OF TIMES SCHEDULED SURFACE IRRIGATION IS POSTPONED.

IPOSTM: TOTAL MONTHLY TIMES POSTPONE SURFACE IRRIGATION.

IR : CALENDAR YEAR.

IR1 : INDICES USED TO FIND EACH YEAR.

IR2 : INDICES USED TO FIND EACH YEAR.

IRAIN : FIRST HOUR RAINFALL RECORDED FOR THAT DAY.

IRRDAY: TOTAL DAYS WHEN HAVE SURFACE IRRIGATION.

ISICNM: TOTAL MONTHLY TIMES HAVE SURFACE IRRIGATION.

ISICNT: NUMBER OF TIMES HAVE SURFACE IRRIGATION.

ISKIP : NUMBER OF TIMES SCHEDULED SURFACE IRRIGATION IS SKIPPED TO NEXT DAY.

ISKIPM: TOTAL MONTHLY TIMES SKIP SURFACE IRRIGATION TO NEXT DAY.

IWER : INDEX = WETZ + 1.

IUEDR : END YEAR OF SIMULATION.

URY : CALENDAR YEAR.

IYEAR : NUMBER OF YEARS IN SIMULATION.

J : INDEX.

JDAY : JULIAN DAY OR DATE.

K : INDEX.

KRAT1 : DUMMY VARIABLE FOR INFILTRATION RATE.

KRAT2 : DUMMY VARIABLE FOR INFILTRATION RATE.

RCATE : INDEX.

RDT : TIME BETWEEN LAST RAINFALL IN PREVIOUS DAY AND FIRST RAINFALL ON PRESENT DAY, HRS.

RO : DAILY RUNOFF, CM.

ROM : MONTHLY RUNOFF VOLUME, CM.

ROOTD: ROOT DEPTH, CM. ROOTD(125) IS ROOT DEPTH ON JULIAN DAY 125.

ROOTD(1) INTERPOLATED FROM DATA READ IN SUBROUTINE ROOT.

RUNOFF: RUNOFF VOLUME, CM.

RVOG : TOTAL DAILY RUNFALL.

RVOGm : TOTAL MONTHLY RAINFALL, CM.

SEW : YEARLY SUM OF EXCESS WATER.

SEWD : SEW VALUE FOR DAY.

SEWM: TOTAL MONTHLY SEW, CM-DAYS.

SIRRMO: TOTAL MONTHLY SURFACE IRRIGATION, CM.
C * SPR : TOTAL WATER AVAILABLE FOR INFILTRATION IN TIME DDT, SUM OF
C * STOR + RAINFALL DURING DDT.
C * STOR : SURFACE STORAGE, CM.
C * STOR1 : TEMPORARY VARIABLE FOR SURFACE STORAGE.
C * STOR2 : TEMPORARY VARIABLE FOR SURFACE STORAGE.
C * SUMAET: MONTHLY TOTAL OF ET; SUMAET(10) MEANS TOTAL ET FOR OCTOBER.
C * SUMET: TOTAL YEARLY ET, CM.
C * TAV : TOTAL AIR VOLUME IN SOIL PROFILE; SUM OF AVOL AND DEBT.
C * TAVI : DUMMY VARIABLE FOR TAV.
C * TOFSIR: TIME OF SURFACE IRRIGATION, HOURS.
C * TOSIRR: TOTAL YEARLY IRRIGATION.
C * TOTD : TOTAL YEARLY DRAINAGE, CM.
C * TOTDD : TOTAL YEARLY DRY DAYS.
C * TOTF : TOTAL YEARLY INFILTRATION, CM.
C * TOTFD : TOTAL YEARLY WATDAYS.
C * TOTNT : TOTAL YEARLY WET DAYS.
C * TOTR : TOTAL YEARLY RAINFALL, CM.
C * TOTRO : TOTAL YEARLY RUNOFF, CM.
C * TOTWD : TOTAL YEARLY WORK DAYS.
C * TOTWF : TOTAL WATER REMOVED FROM FIELD BY SURFACE AND SUBSURFACE
C * DRAINAGE - DOES NOT INCLUDE WATER STORED IN DITCHES THEN
C * SUBIRRIGATED.
C * TPUMPV: TOTAL YEARLY SUBIRRIGATION, CM.
C * TVOL : TOTAL AIR VOLUME IN SOIL.
C * TVLOSS: TOTAL MONTHLY WATER LOST FROM SYSTEM.
C * URG: MAXIMUM UPWARD FLUX CORRESPONDING TO A GIVEN WET ZONE DEPTH,
C * CM/HR.
C * UPVOL: UPWARD FLOW IN GIVEN TIME INCREMENT, CM.
C * W : VOLUMETRIC WATER CONTENT, DIMENSIONLESS.
C * WATER : VOLUMETRIC WATER CONTENT, DIMENSIONLESS. WATER(9) MEANS
C * WATER CONTENT WHEN PRESSURE HEAD IS 8 CM (FROM SOIL WATER
C * CHARACTERISTICS).
C * WATDAY: A DAY WHEN WATER TABLE IS HIGH ENOUGH TO CAUSE CROP DAMAGE.
C * WETDAY: A DAY WHEN IT IS TOO WET TO CONDUCT TILLAGE (WETDAY).
C * WETZ : DEPTH OF WET ZONE, CM.
C * WLO : ANOTHER VARIABLE FOR WLOSS IF 1HR, 2HR, OR 1 DAY.
C * WLOSS : DAILY WATER LOSS, CM.
C * WRKDAY: THE DAYS WHEN TILLAGE CAN BE CONDUCTED (WORKDAY).
C * WTD : WATER TABLE DEPTH, CM. WTD(55) MEANS WTD WHEN AIR VOLUME IS
C * (55-1)/10 = 5.4 CM.
C * X : DEPTH INCREMENT, CM.
C * XV : REAL VARIABLE FOR IAVOL.
C * YEARS : NUMBER OF YEARS SIMULATED; USED TO FIND AVERAGES.
C * YEDEBT : DEBT AT END OF PREVIOUS DAY, CM.
C * YESF : YESTERDAY'S INFILTRATION, CM.
C * YESUMET: TOTAL YEARLY ET.
C
SUBROUTINE PROP(WTD,VOL,WATER,AA,BB,UPFLUX)

C ** THIS SUBROUTINE READS IN SOIL WATER CHARACTERISTIC, INTERPOLATES
C ** VALUES, AND CALCULATES RELATIONSHIP BETWEEN WATER TABLE DEPTH AND
C ** DRAINAGE VOLUME.
C ** AS AN ALTERNATIVE CAN READ IN DRAINED VOLUME - WATER TABLE DEPTH
C * RELATIONSHIP WHICH MAY ALSO INCLUDE UPWARD FLUX VALUES.  
C * A TABLE OF CONSTANTS FOR THE GREEN - AMPT INFILTRATION EQUATION FOR  
C * VARIOUS WATER TABLE DEPTHS IS READ IN AND INTERPOLATED.  
C * ALL SOIL PROPERTIES ARE STORED IN ARRAYS SO THAT THEY CAN BE EASILY  
C * RECALLED KNOWING THE WATER TABLE DEPTH.  
C ***********  
C READ SOIL PROPERTIES AND STORE THE INFORMATION INTO  
C PROPER ARRAYS BY INTERPOLATION  
DIMENSION THETA(50), HEAD(50), H(500), WATER(500), VOL(500), WTD(1000)  
DIMENSION D(10), E(10), F(10), AA(500), BB(500)  
DIMENSION AIA(500), BIB(500)  
DIMENSION XVOL(100), X(100)  
DIMENSION UPFLUX(500), FLUX(100)  
C  
C  
C THE FOLLOWING SECTION READS IN SOIL WATER CHARACTERISTIC, AND CAL- 
C CULATES RELATIONSHIP BETWEEN DRAINED VOLUME AND WATER TABLE DEPTH.  
C  
C READ(1,900) NUM, IVREAD  
READ(1,905)(THETA(I), HEAD(I), I=1, NUM)  
C DATA READ IN ORDER OF DECREASING WATER CONTENT  
DO 5 I = 1, NUM  
5 HEAD(I) = -HEAD(I)+1.0  
   I=1  
   WATER(1) = THETA(1)  
   P = WATER(1)  
   VOL(1) = 0  
   DO 10 J = 2, 500  
   AJ = J  
   IF(AJ.GT.HEAD(I+1)) I = I+1  
   AI = I  
   ATM = I-1  
   WATER(J) = THETA(I)*(AJ-HEAD(I))/(HEAD(I+1)-HEAD(I))  
   C(THETA(I+1)-THETA(I))  
   AVG = WATER(J)+WATER(J-1)/2  
   VOL(J) = VOL(J-1) + P-AVG  
10 CONTINUE  
C  
C THE FOLLOWING READS TABULAR VALUES FOR W.T. DEPTH VS. DRAINAGE VOLUME  
C AND UPWARD FLUX.  
C THE NUMBER OF VALUES READ IS IVREAD.  
C IF IVREAD .LE. 0, USE ABOVE W.T.D.-VOL. RELATIONSHIP AND CRITICAL  
C DEPTH CONCEPT FOR UPWARD FLUX.  
C  
C IF(IVREAD.LE.0) GO TO 14  
C IF WATER VOL VS. WATER TAB DEPTH IS READ IN GO TO NEXT STEPS  
READ(1,930)(X(I), XVOL(I), FLUX(I), I=1, IVREAD)  
DO 12 I=1, IVREAD  
12 X(I) = X(I)+1.0  
UPFLUX(I) = FLUX(I)  
VOL(I) = XVOL(I)
I=1
DO 11 L=2,500
XL=L
IF(XL.GT.X(I+1))I=I+1
XI=I
XIM=XI-1.
UPFLUX(L)=FLUX(I)+((XL-X(I))/(X(I+1)-X(I)))*(FLUX(I+1)-FLUX(I))
11 VOL(L)=XVOL(I)+((XL-X(I))/(X(I+1)-X(I)))*(XVOL(I+1)-XVOL(I))

CONVERT TO ARRAY SO CAN DIRECTLY DETERMINE WATER TABLE DEPTH (OR WET ZONE DEPTH) IF KNOW AIR VOLUME.

14 CONTINUE
DO 15 K = 1,500
15 VOL(K) = VOL(K)*10.0+1.0
I = 2
AI = I
WTD(1) = 0
DO 25 L = 2,500
AL = L
ALM = AL-1.0
IF(VOL(L).LT.AI) GO TO 25
WTD(I) = AL + (AI-VOL(L-1))/(VOL(L)-VOL(L-1))-1.0
I = I + 1
AI = I
IF(VOL(L).GT.AI) GO TO 20
25 CONTINUE
WRITE(6,915)
DO 30 I=1,500
VOL(I) = 0.1*(VOL(I)-1.0)
XI = I
AI = 0.1*(XI-1.0)
BI = I-1
AIA(I)=AI
BIB(I)=BI
30 CONTINUE
DO 50 I=1,500,10
WRITE(6,910)AIA(I),WTD(I),BIB(I),WATER(I),VOL(I),UPFLUX(I)

READ IN INFILTRATION CONSTANTS FOR GREEN-AMPT EQUATION AND INTERPOLATE

READ(1,900)NUMA
READ(1,920)(D(I),E(I),F(I),I=1,NLMA)
WRITE(6,940)
WRITE(6,945) (D(I),E(I),F(I),I=1,NUMA)
AA(I)=0.
BB(I)=0.
I=1
J=2
XJ=J-1
35 IP=I+1
RATIO=(XJ-D(I))/(D(IP)-D(I))
AA(J)=E(I)+RATIO*(E(IP)-E(I))
XJ=J-1
J=J+1
XJ=J-1
IF (XJ.GT.D(IP))I=I+1
IF(I.GE.NUMA)GO TO 45
GO TO 35
45 CONTINUE
900 FORMAT(2I2)
905 FORMAT(E10.2,10X,E10.2)
910 FORMAT(10X,6F20.4)
915 FORMAT(1H1,40X,'SOIL WATER CHARACTERISTICS AND RELATIONSHIP'/
  $ 38X,'BETWEEN WATER TABLE DEPTH AND DRAINED(VOID) VOLUME'//
  $ 18X,'VOLUME OF voidS',4X,'WATER TABLE DEPTH',
  $ 9X,'HEAD',12X,'WATER CONTENT',1X,'VOLUME voidS ABOVE W.T.',
  $ 3X,'UPFLUX')
920 FORMAT(3E10.2)
940 FORMAT(///10X,'GREEN AMPT INFILTRATION PARAMETERS'/12X,'W.T.D.',
  $ 9X,'A',9X,'B')
945 FORMAT(9X.3F11.3)
930 FORMAT(3F10.4)
RETURN
END
C ******************************************************************************
C  DEFINITION OF TERMS IN SUBROUTINE PROP
C
C  A. INPUTS TO SUBROUTINE LISTED IN ORDER OF INPUT
C
C  NUM : NUMBER OF THETA VS. PRESSURE HEAD POINTS READ TO INPUT SOIL
C  WATER CHARACTERISTIC.
C  IVREAD: THE NUMBER OF POINTS TO BE READ IN FOR THE WTD-DRAINAGE
C  VOLUME-UPWARD FLUX RELATIONSHIP. WHEN CRITICAL DEPTH CON-
C  EPT IS USED, READ 0.0 FOR UPWARD FLUX.
C  THETA: WATER CONTENT VALUE ON SOIL WATER CHARACTERISTIC.
C  HEAD: PRESSURE HEAD VALUE ON SOIL WATER CHARACTERISTIC, CM.
C  X(I): WATER TABLE DEPTH IN RELATION OF WTD AND DRAINAGE VOLUME,CM.
C  XVOL: AIR VOLUME OR DRAINED VOLUME. IN RELATION OF WTD AND DRAINED,
C  CM.
C  FLUX: UPWARD FLUX AS RELATION TO WTD, CM/DAY.
C  NUMA: NUMBER OF POINTS TO READ IN FOR RELATIONSHIP BETWEEN COEF-
C  FICIENTS OF GREEN-AMPT INFILTRATION EQUATION AND WATER TABLE.
C  D(I): WATER TABLE DEPTH.
C  E(I): GREEN-AMPT INFILTRATION COEFFICIENT A FOR WTD D(I).
C  F(I): GREEN-AMPT INFILTRATION COEFFICIENT B FOR WTD D(I).
C  *
C  B. OTHER PROGRAM VARIABLE IN PROP
C  AA: CONSTANT A OF INFILTRATION EQUATION INTERPOLATED FROM E AND
C  F VALUES READ IN AND STORED FOR INTEGER WTD FROM TO 500 CM.
C  STORED VALUES.
C  BB: CONSTANT B OF INFILTRATION EQUATION INTERPOLATED FROM E AND
C  F VALUES READ IN AND STORED FOR INTEGER WTD FROM TO 500 CM.
C  STORED VALUES.
C  VOL: AIR VOLUME ABOVE WTD (INTERPOLATED FROM XVOL VS X DATA READ
C  IN OR CALCULATED FROM SOIL WATER CHARACTERISTIC.
C  WATER: VOLUMETRIC WATER CONTENT, INTERPOLATED FROM SOIL WATER
C  ****************************
CHARACTERISTIC FOR INTEGER VALUES OF PRESSURE HEAD FROM 0 TO 500 CM.

WTD : WATER TABLE DEPTH IN CM (FROM 0 TO 500 CM), WTD(1) = 0.0, 168B

WTD(51) = WATER TABLE DEPTH CORRESPONDING TO AN AIR VOLUME OF (51 - 1)/10 = 5.0 CM, ETC. THEREFORE IF THE AIR VOLUME X CM THE CORRESPONDING WATER TABLE DEPTH WOULD BE WTD(10X+1) 173B

SUBROUTINE SURIRR

THIS SUBROUTINE DETERMINES IF CONDITIONS ARE SUITABLE FOR SURFACE IRRIGATION FOR WASTE WATER DISPOSAL.

IT ALSO COUNTS THE NUMBER OF IRRIGATION DAYS, SKIPS, AND POSTPONEMENTS.

INTEGER FDAYSI
COMMON/ICNT/ISICT,ISKIP,IPOST,IK,IPCNT
COMMON/JCNT/JSCNM,JSKIPM,JPOSTM
COMMON/IDAY/FDAYSI,NDAYSI,INTDAY,NOIRR1,NOIRR2,NOIRR3,NOIRR4
COMMON/IHR/IHRSTA,IHREND,INSIRR
COMMON/PAR/TAV,REQDAR,AMTRN,AMTSI,DAMTSI
COMMON/RAIN/R(24)

IF(NDAYSI.GE.NOIRR1.AND.NDAYSI.LE.NOIRR2)GO TO 30
IF(TAV.GT.REQDAR.AND.INSIRR.GT.0) GO TO 20
IF(R(IHRSTA).GT.AMTRN) GO TO 20
IHRP1=IHRSTA+1
DO 5 I=IHRP1,IHREND
R(I)=R(I)+AMTSI
5 CONTINUE
DAMTSI=AMTSI*(IHREND-IHRSTA)
JSCNM=JSCNM+1
ISICNT=ISICNT+1
GO TO 15

10 ISKIP=ISKIP+1
JSKIPM=JSKIPM+1
15 NDAYSI=FDAYSI+INTDAY*(ISICNT+ISKIP+IK)
IPCNT=0
GO TO 25

IF(NDAYSI.LT.REQDAR .AND. INSIRR.GT.0) GO TO 20
IF(R(IHRSTA).LT.REQUEST) GO TO 10
IHRP1=IHRSTA+1
DO 5 I=IHRP1,IHREND
R(I)=R(I)+AMTSI
5 CONTINUE
DAMTSI=AMTSI*(IHREND-IHRSTA)
JSCNM=JSCNM+1
ISICNT=ISICNT+1
GO TO 15

20 NDAYSI=NDAYSI+1
IPOST=IPOST+1
JPOSTM=JPOSTM+1
IPCNT=IPCNT+1
IF(IPCNT.GE.2) GO TO 10
25 IF(NDAYSI.GE.NOIRR1.AND.NDAYSI.LE.NOIRR2) GO TO 30

RETURN

30 NDAYSI=NDAYSI
DO 35 I=MDAYSI,NOIRR2,INTDAY
IK=IK+1
35 CONTINUE
DEFINITION OF TERMS IN SUBROUTINE SURIRR

FIRST DAY (JULIAN) OF SURFACE IRRIGATION.

ENDING HOUR OF SURFACE IRRIGATION.

INDEX = IHREND + 1.

STARTING HOUR OF SURFACE IRRIGATION.

INDEX TO KEEP THE COUNT OF DAYS WHEN THERE ARE NO SURFACE IRRIGATION INTERVALS (E.G., SOMETIMES NO SURFACE IRRIGATION DURING MARCH OR APRIL).

THE INTERVAL IN DAYS BEFORE THE NEXT DAY SURFACE IRRIGATION COMES.

A COUNTER FOR THE NUMBER OF TIMES IRRIGATION POSTPONED SINCE LAST IRRIGATION.

NUMBER OF POSTPONEMENTS OF SURFACE IRRIGATION, ACCUMULATES FOR A YEAR.

IRRIGATION DAY, COUNTER OF TOTAL DAYS.

NUMBER OF SURFACE IRRIGATION EVENTS ACCUMULATES FOR A YEAR.

NUMBER OF SKIPS OF SURFACE IRRIGATION EVENTS ACCUMULATES FOR A YEAR.

NUMBER OF MONTHLY POSTPONEMENTS OF SURFACE IRRIGATION (SI).

NUMBER OF MONTHLY SI EVENTS.

NUMBER OF MONTHLY SKIPS OF SI EVENTS.

INDEX FOR NDAYSI.

NEXT PLANNED DAY FOR SI.

OTHER TERMS ARE DEFINED IN FORSUB.
DEBT=0.0
RETURN

28 IF(XKD.GT.PDEBT)GO TO 30
ACTET=POTET
DEBT=DEBT+POTET-UPVOL
AVOL=AVOL+DVOL+UPVOL
RETURN

30 ACTET=PDEBT-DEBT+UPVOL
IF(ACTET.GE.0.0) GO TO 31
ACTET=0.0
DEBT=DEBT-UPVOL
AVOL=AVOL+DVOL+UPVOL
RETURN

31 CONTINUE
DEBT=PDEBT
AVOL=AVOL+DVOL+UPVOL
RETURN

50 IF(POTET.GT.UPVOL) GO TO 25
EXCESS=UPVOL-POTET
ACTET=POTET
DEBT=DEBT-FVOL
YDEB=DEBT
DEBT=DEBT-EXCESS
IF(DEBT.LT.0.0)GO TO 60
AVOL=AVOL+DVOL+UPVOL
GO TO 70
60 AVOL=AVOL+DVOL+ACTET+YDEB
70 IF(DEBT.LT.0.0)DEBT=0.0
RETURN
END

C
C******************************************************************************
C* DEFINITION OF TERMS IN SUBROUTINE ETFLUX *
C* ACTET : ACTUAL ET FOR TIME PERIOD.  *
C* DEBT : AMOUNT OF WATER REMOVED FROM DRY ZONE  .  *
C* EXCESS: DIFFERENCE BETWEEN AMOUNT OF WATER MOVING UPWARD FROM W.T. AND POTET.  *
C* POTET : POTENTIAL ET FOR TIME PERIOD--MAY BE 1 HR OR 1 DAY.  *
C* XXD : TEMPORARY VALUE FOR DEBT WHICH DEPENDS ON UPWARD FLUX, POTET PREVIOUS DEBT.  *
C* OTHER TERMS NOT DEFINED ABOVE ARE SAME AS DEFINED IN PORSUB  *
C******************************************************************************

SUBROUTINE DRAINS(DTWT,DFLUX)

C******************************************************************************
C* THIS SUBROUTINE FINDS THE EFFECTIVE LATERAL HYDRAULIC CONDUCTIVITY AND *
C* COMPUTES DRAINAGE OR SUBIRRIGATION FLUX.  *
C******************************************************************************

COMMON/DRABLK/HDRAIN,DEPTH,CONK(5),DZ(5)
COMMON/DLK/SDRAIN,DDRAIN,DC,ADEPETH
COMMON/POUND/STOR,C,STORRO
DIMENSION W(20)
Y=DTWT
IF(Y.GT.ADEPT) Y=ADEPT
ABOVE=0.0
DO 10 I=1,5
N=I
L=DZ(I)
IF(L.EQ.0) GO TO 15
IF(Y.GT.DZ(I)) GO TO 5
W(I)=DZ(I)-Y
X=DZ(I)-ABOVE
IF(W(I).GT.X) W(I)=X
GO TO 10
5 W(I)=0.0
10 ABOVE=DZ(I)
N=6
15 N=N-1
SUM=0.0
DEEP=0.0
DO 25 I=1,N
SUM=SUM+W(I)*CONK(I)
25 DEEP=DEEP+W(I)
IF( (DEEP.LE. .0001).OR.(SUM.LE. .0001) ) GO TO 35
CONK=SUM/DEEP
GO TO 45
35 CONTINUE
SUM=CONK(1)*DZ(1)
DEEP=DZ(1)
DO 40 I=2,5
SUM=SUM+CONK(I)*DZ(I)
40 DEEP=DEEP+DZ(I)
CONK=SUM/DEEP
45 CONTINUE
HDRAIN=DEPT-DDRAIN
IF(HDRAIN.LT.HDRAIN) HDRAIN=HDRAIN
IF((STOR.GT.STORRO).AND.(DTWT.LT.0.5)) GO TO 50
C
EM=DEPT-Y-HDRAIN
IF(EM.LT.-0.1) GO TO 42
DFLUX=4.0*CONK*EM*(2.0*HDRAIN+EM)/SDRAIN**2
IF(DFLUX.LT.DC) DFLUX=DC
IF(DFLUX.LT.0) DFLUX=0.0
IF(EM.LT.0) DFLUX=0.0
RETURN
42 DDRAIN=DDRAIN-0.10
DOT=HDRAIN+ADEPT-DEPT
DFLUX=4.0*CONK*EM*HDRAIN*(2.0+EM/DOT)/SDRAIN**2
IF((DEPT-HDRAIN).GE.DDRAIN) DFLUX=0.
RETURN
50 DFLUX=12.5663*CONK*(DEPT-HDRAIN+STOR)/(GEE*SDRAIN)
IF(DFLUX.LT.DC) DFLUX=DC
RETURN
END
C
C******************************************************************************
DEFINITION OF TERMS IN SUBROUTINE DRAINS

ABOVE: DEPTH OF TOP OF LAYER CONSIDERED.

CONE: EFFECTIVE SATURATED LATERAL HYDRAULIC CONDUCTIVITY - BASED ON W.T. DEPTH AND K OF LAYERS.

DDARNP: A VARIABLE USED INDICATING DISTANCE SLIGHTLY LESS THAN WHEN WATER TABLE IS BELOW DRAIN BOTTOM AND NO WATER IN DRAIN

DEEP: TOTAL THICKNESS OF SATURATED ZONE.

DEPTH: DEPTH TO IMPERMEABLE LAYER FROM SOIL SURFACE, CM.

DFLUX: DRAINAGE FLUX, CM/HR.

DOT: ACTUAL DEPTH FROM IMPERMEABLE LAYER TO WATER LEVEL ABOVE DRAIN DURING SUBIRRIGATION.

DTWT: DEPTH TO WATER TABLE FROM SOIL SURFACE, CM.

DZ(I): THICKNESS OF LAYER I.

EM: DISTANCE FROM WATER LEVEL IN THE DRAINS TO WATER TABLE AT MIDPOINT. EM NEGATIVE DURING SUBIRRIGATION.

HRAIN: DISTANCE BETWEEN THE WATER SURFACE IN THE DRAIN TO THE IMPERMEABLE LAYER, CM.

SRAIN: DISTANCE BETWEEN THE DRAINS, CM.

W: THICKNESS OF SATURATED ZONE IN LAYER CONSIDERED.

HDRAIN: DISTANCE BETWEEN THE WATER SURFACE IN THE DRAIN TO THE IMPERMEABLE LAYER, CM.

SDRAIN: DISTANCE BETWEEN THE DRAINS, CM.

W: THICKNESS OF SATURATED ZONE IN LAYER CONSIDERED.

TERMS NOT DEFINED HERE ARE SAME AS DEFINED IN FORSUB

SUBROUTINE YDITCH(DWIEP,DVOL,YD,RO,WLOSS,B,S)

SUBROUTINE TO DETERMINE WATER LEVEL IN OUTLET DITCH BASED ON WIER SETTING, DRAINAGE OR SUBIRRIGATION, AND RUNOFF.

THE AMOUNT OF WATER LOST FROM THE SYSTEM AND THAT REMAINING IN THE DITCH IS CALCULATED.

FIND WATER LOSS AND WATER DEPTH IN DRAIN

COMMON/DLK/SDRAIN,DDRAIN

V=DRNSTO+RO+DVOL
IF(V.LT.0.)V=0.
CV=V*SDRAIN
YD=((B/S)**2+.4*CV/S)**.5/2.-.5*B/S
IF(YD.GT.(DDRAIN-DWIEP))GO TO 10
DDSTO=V-DRNSTO
DRNSTO=V
DDSTO=V
WLOSS=0.
RETURN

YD=DDRAIN-DWIEP
CV=YD*(B+S*YD)
V=CV/SDRAIN
DDSTO=V-DRNSTO
DRNSTO=V
WLOSS = RO + DVL - DDSTO
RETURN

C

C **DEFINITION OF TERMS IN SUBROUTINE YDITCH**

C

C **B** : BOTTOM WIDTH OF THE DRAIN, CM.
C **CV** : TOTAL VOLUME OF WATER COMING TO THE DRAIN, CM.
C **DDSTO** : AMOUNT IF WATER STORED IN DRAIN DURING PRESENT TIME INCREMENT.
C **DRNSTO** : AMOUNT OF WATER (VOLUME PER UNIT AREA) STORED IN THE DRAIN AT THE END OF PREVIOUS TIME INCREMENT, CM.
C **DVOL** : WATER DRAINED THROUGH THE SYSTEM, CM.
C **DWIER** : WEIR DEPTH FROM THE SOIL SURFACE, CM.
C **RO** : RUNOFF VOLUME FROM SURFACE, CM.
C **S** : SIDE SLOPE OF DRAINAGE DITCH, CM/CM.
C **V** : AMOUNT OF WATER (VOL. PER UNIT AREA) THAT COULD BE IN OUTLET DITCH AT END OF PRESENT TIME INCREMENT.
C **WLOSS** : WATER LOST THROUGH THE DITCH, CM.
C **YD** : WATER HEIGHT IN THE DRAIN MEASURED FROM BOTTOM OF DITCH.

C **OTHER TERMS NOT DEFINED ARE SAME AS GIVEN IN FORSUB**

C

C

SUBROUTINE ROOT(DROOT)

C

C

C

DIMENSION DROOT(370), INDAY(50), ROOTIN(50)
READ(1,600) NO
600 FORMAT(12)
READ(1,610)(INDAY(I),ROOTIN(I),I=1,NO)
WRITE(6,630)
WRITE(6,635) (INDAY(I),ROOTIN(I),I=1,NO)
J=2
DROOT(I)=ROOTIN(1)
DO 10 I=2,366
AI=I
IF(I.GT.INDAY(J))J=J+1
DROOT(I)=ROOTIN(J-1)+((AI-INDAY(J-1))/(INDAY(J)-INDAY(J-1)))*2
10 CONTINUE
WRITE(6,615)
WRITE(6,620) (DROOT(I),I=1,360,30)
615 FORMAT(1H0,10X,'ROOT DEPTHS AS A FUNCTION OF TIME ARE READ IN'/
21X,'THE FOLLOWING REPRESENT MONTHLY VALUES'/4X,'MONTH 1 2
3 4 5 6 7 8 9 10 11 12')
620 FORMAT(10X,12F5.0)
630 FORMAT(/10X,'VALUES READ IN'/12X,'DAY',8X,'ROOT DEPTH')
DEFINITION OF TERMS IN SUBROUTINE ROOT

A. INPUTS TO SUBROUTINE ROOT
- N: NUMBER OF POINTS TO BE READ IN FOR JULIAN DATE - ROOT DEPTH
- INDAY: JULIAN DATE.
- ROOTIN: EFFECTIVE ROOT DEPTH ON INDAY.

B. DROOT(I): STORED ROOT DEPTH FOR EVERY DAY OF YEAR, I. DETERMINE BY INTERPOLATION FROM ROOTIN - INDAY RELATIONSHIP.

SUBROUTINE EVAP(ET, HET, HPET1, TPET)

THIS SUBROUTINE DISTRIBUTES DAILY PET OVER 12 HRS. FROM 0600 TO 1800.
WHEN RAINFALL .GT. 0 PET FOR THAT HOUR IS SET=0.
THEN HOURLY PET SUMMED TO GET DAILY PET.

FIND DAILY EVAPOTRANSPIRATION

COMMON/EVAP/PET, DDZ, ROOTD
COMMON/RAIN/R(24)
DIMENSION HET(24), HPET1(24)

FIGURE ET BASED ON 12 HRS
TPET=0.0
HPET=PET/12.0
DO 5 I=1,6
HET(I)=0.0
HPET1(I)=0.0
5 CONTINUE
DO 10 I=7,18
HET(I)=HPET
HPET1(I)=HPET
IF(DDZ.GT.ROOTD)HET(I)=0.0
IF(R(I).GT.0.0)HET(I)=0.0
IF(R(I).GT.0.0)HPET1(I)=0.0
10 CONTINUE
DO 15 I=19,24
HET(I)=0.0
HPET1(I)=0.0
15 CONTINUE
ET=0.0
DO 20 I=1,24
ET=ET+HET(I)
20 CONTINUE
TPET=TPET+HPET(I)
20 CONTINUE
RETURN
END

C ************** ALL TERMS DEFINED IN FORSUB AND PROP **************
C * FIND WATER CONTENT AND HEAD DISTRIBUTION IN WET ZONE *
C ************** ALL TERMS DEFINED IN FORSUB AND PROP **************

SUBROUTINE WET(DTWT)

COMMON/WHX/WATER(500),W(101),H(101),X(101),NN

DO 5 I=1,NN
  H(I)=X(I)-DTWT
  J=-H(I)+1.
  IF(J.LT.1)J=1
  W(I)=WATER(J)
5 CONTINUE
RETURN
END

SUBROUTINE SOAK

COMMON/ABDT/EDTWT,AA(500),BB(500),A,B

I=EDTWT+1
A=AA(I)
B=BB(I)
RETURN
END

SUBROUTINE WORK(IND,J,TAV,DWRK,ACC,DDAY,YTAV)

INTEGER SWKHR1,SWKHR2,EWKHR1,EWKHR2
COMMON /RAIN/ R(24)
COMMON /IVK/ SWKHR1,EWKHR1,SWKHR2,EWKHR2
COMMON /WRK/ AMIN1,ROUTA1,ROUTT1,AMIN2,ROUTA2,ROUTT2
IF(J.LT.0) GO TO 50
IF(IND.GT.1) GO TO 25
IF((ACC.GT.ROUTA1) .AND. (R(J) .GT. 0.005)) DDAY=0.0
IF((J.LE. SWKHR1) .OR. (J.GT. EWH9R1)) GO TO 60
IF(TAV.LT. AMIN1) GO TO 60
IF(DDAY .LT. ROUTT1) GO TO 60
DWRK=1.0/(EWKHR1-SWKHR1)
RETURN
25 IF((ACC.GT. ROUTA2) .AND. (R(J) .GT. 0.005)) DDAY=0.0
IF((J.LE. SWKHR2) .OR. (J.GT. EWH9R2)) GO TO 60
IF(TAV.LT. AMIN2) GO TO 60
IF(DDAY .LT. ROUTT2) GO TO 60
DWRK=1.0/(EWKHR2-SWKHR2)
RETURN
60 DWRK=0.0
RETURN
50 IF(IND.GT.1) GO TO 55
IF(TAV.LT. AMIN1) GO TO 60
IF(DDAY .LT. ROUTT1) GO TO 60
DWRK=1.0
IF(YTAV .LT. AMIN1) DWRK=(TAV-AMIN1)/(TAV-YTAV)
RETURN
55 IF(TAV .LT. AMIN2) GO TO 60
IF(DDAY .LT. ROUTT2) GO TO 60
DWRK=1.0
IF(YTAV .LT. AMIN2) DWRK=(TAV-AMIN2)/(TAV-YTAV)
RETURN
END

C ***************************************************
C * ALL TERMS ARE DEFINED IN SUBROUTINE FORSUB       *
C ***************************************************
C
SUBROUTINE ORDER(IYEAR)
C
C *******************************************************
C * THIS SUBROUTINE DETERMINES THE RANK OF TOTDD, TOTWD, SEW, AND TOSIRR
C * AND THEIR AVERAGES DURING THE SIMULATED YEARS.       *
C *******************************************************
C
COMMON /ORDR/TOSIRR(50),TOTDD(50),TOTWD(50),SEW(50),IRY(50)
DIMENSION NRANK1(50),NRANK2(50),NRANK3(50),NRANK4(50)
DATA SUMJKY,SUMSEW,SUMDDY,SUMIRR/40.0/
CALL RANK(TOTWD,NRANK1,IYEAR,IRY)
CALL RANK(SEW,NRANK2,IYEAR,IRY)
CALL RANK(TOTDD,NRANK3,IYEAR,IRY)
CALL RANK(TOSIRR,NRANK4,IYEAR,IRY)
WRITE(6,10)
DO 20 I=1,IYEAR
WRITE(6,10)I,TOTWD(I),NRANK1(I),SEW(I),NRANK2(I),TOTDD(I),
1 NRANK3(I),TOSIRR(I),NRANK4(I)
SUMJKY=SUMJKY+TOTWD(I)
SUMSEW=SUMSEW+SEW(I)
20 continuing