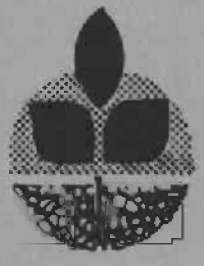
OR-NATURE: THE NUMERICAL ANALYSIS OF TRANSPORT OF WATER AND SOLUTES THROUGH SOIL AND PLANTS

VOLUME V. PROGRAM LISTING

Special Report 757

December 1985



Agricultural Experiment Station
Oregon State University, Corvallis

OR-NATURE: THE NUMERICAL ANALYSIS OF TRANSPORT OF WATER AND SOLUTES THROUGH SOIL AND PLANTS

VOLUME V. PROGRAM LISTING

M. J. UNGS, L. BOERSMA, S. AKRATANAKUL

This is one of five volumes about numerical analysis of water and solute transport through soil.

AUTHORS: M. J. Ungs, engineer, Tetra-Tech, Lafayette, California; L. Boersma, professor, Department of Soil Science, Oregon State University; and S. Akratanakul, professor, Department of Soil Science, Kasetsart University, Thailand.

FOREWORD

This report presents numerical solutions for the problems of transient, one-dimensional transfer of water and solutes in the layer of soil important for plant growth. It presents solutions to problems of infiltration of rainfall or irrigation water, evaporation, redistribution of water in the soil, and uptake of water and nutrients by plant roots. The numerical analysis presented in this report was prepared in response to the recognition that computer programs which deal with these problems are usually only applicable to very specific problems and are not easily generalized. This report was written on the premise that a manual should be available for the numerical analysis of these problems, one which can be used by persons not highly skilled in using computers. The program can be used by research workers who have a limited understanding of computer programming.

The report is presented in five volumes. The first volume gives the theoretical background of the program and should be of most interest to research workers familiar with the mathematical analysis of the problem and computer programming. The second volume presents the manual for the use of the program. The user does not have to be familiar with, or understand, the content of the first volume to use the manual. A discussion of potential numerical problems and a listing of computer generated error messages is given in Volume III. The fourth volume presents examples of the use of the program, and the fifth volume is a listing of the program.

ACKNOWLEDGMENTS

This publication reports work initiated under a Research Grant from the Pacific Northwest Forest and Range Experiment Station, Portland, Oregon, entitled "Physical and Chemical Factors Affecting the Transport and Distribution of Nutrient Ions in Soils Developed on Volcanic Materials" (FSPNW-GRANT Number 20). Dr. L. Boersma was project leader. Michael Ungs and Suntaree Akratanakul were graduate students at Oregon State University during the conduct of the studies reported here.

Completion of the project was supported by funds from the Oregon Agricultural Experiment Station in the form of allotments from the Regional Research Fund established by the Hatch Act, as amended August 11, 1955, and administered by the Cooperative State Research Service, U.S. Department of Agriculture.

```
      PROGRAM NATURE(INPUT,OUTPUT=64,PUNCH=64,TAPE5=INPUT,TAPE6=OUTPUT, OR-A    1
     1 TAPE7=PUNCH)                                                     OR-A    2
C                                                                       OR-A    3
C                              OR-NATURE                                OR-A    4
C                                                                       OR-A    5
C                                                                       OR-A    6
C                             VERSION 1.1                               OR-A    7
C                                                                       OR-A    8
C     COMPATIBLE WITH STANDARD FORTRAN 4 ,AS DESCRIBED IN ANSI X3.9-1966OR-A    9
C                                                                       OR-A   10
C                    PROGRAMMED BY  MICHAEL J. UNGS      MARCH, 1982    OR-A   11
C                                                                       OR-A   12
C                                                                       OR-A   13
C        NUMERICAL ANALYSIS OF WATER AND SOLUTE TRANSPORT IN THE SOIL    OR-A   14
C        INCLUDING MODELS OF ROOT UPTAKE AND SOLUTE SORPTION             OR-A   15
C                                                                       OR-A   16
C                                                                       OR-A   17
      INTEGER BCTOPC,BCTOPW,BCBTMC,BCBTMW,OUT,XORDER,SCAN,SAVE,PNCH     OR-A   18
      INTEGER TBLBCB,TBLBCT,TBLBWB,TBLBWT,TBLCST,TBLDSZ,TBLDWZ,TBLFCB,  OR-A   19
     1TBLFCT,TBLFWB,TBLFWT,TBLKWZ,TBLQPS,TBLRAC,TBLRAW,TBLRD,TBLWP      OR-A   20
      INTEGER TBLCO,TBLFO,TBLPW,TBLSO,TBLWO,TBLZO,TBLZF,WILTED,BEST     OR-A   21
      INTEGER TBLCG,TBLCTX,TBLRPF,START,TBLKPZ,TBLDWP,TBLKFZ            OR-A   22
      INTEGER OUTPUT,TBLPF,TBLWF,TBLDWF,TBLDFZ                          OR-A   23
      REAL KWZSAT,KWZDRY,KZPIK,KZIK,KZK1,KZKN                           OR-A   24
      COMMON TITLE(200),DUMMYB(200),DUMMYC(200),DUMMYD(200),DUMMYE(200),OR-A   25
     1DUMMYF(200),DUMMYG(200),DUMMYH(200),DUMMYI(200),DUMMYJ(200),DUMMYKOR-A   26
     2(200)                                                             OR-A   27
      COMMON /BEAR/ FGUESS(200),FOLD1(200),FOLD2(200),F(200)            OR-A   28
      COMMON /BEGIN/ START                                              OR-A   29
      COMMON /CNVRGE/ ARATIO,QRATIO,SRATIO,WRATIO,ITRMAX,ACLRAT         OR-A   30
      COMMON /DATA/ BCTOPC,BCTOPW,BCBTMC,BCBTMW,JWORH,MODE,JSORB        OR-A   31
      COMMON /DELTA/ ATCOEF,BTCOEF,CTCOEF,DTK,DTK1,DTMAX,DTMIN,K1DELT   OR-A   32
      COMMON /DEPTH/ N,Z(200)                                           OR-A   33
      COMMON /FLUX/ A(200),G(200),QZ(200)                               OR-A   34
      COMMON /IO/ IN,OUT,PNCH                                           OR-A   35
      COMMON /ISOTRM/ CNSTS(4)                                          OR-A   36
      COMMON /LIQUID/ CGUESS(200),COLD1(200),COLD2(200),C(200)          OR-A   37
      COMMON /MATRIC/ PGUESS(200),POLD1(200),POLD2(200),PSI(200)        OR-A   38
      COMMON /MOIST/ WGUESS(200),WOLD1(200),WOLD2(200),THETA(200)       OR-A   39
      COMMON /PRNT/ NSKIP,NPRINT,OUTPUT                                 OR-A   40
      COMMON /QFLIP/ DRY,SAT                                            OR-A   41
      COMMON /QFLUX/ QWBTM,QWTOP,QCBTM,QCTOP                            OR-A   42
      COMMON /QITR/ QCOLD(2),QPOLD(2),QMIN                              OR-A   43
      COMMON /ROOTS/ CNVRSN,TCR,PPSURF(3),PWILT,RR,TR,WILTED            OR-A   44
      COMMON /SLIDER/ FDRY,FSAT,PICK(50),NUMPCK,JWHS                    OR-A   45
      COMMON /SOLID/ SGUESS(200),SOLD1(200),SOLD2(200),S(200)           OR-A   46
      COMMON /TABBCB/ NUMBCB,TBLBCB,XBCB(50),YBCB(50)                   OR-A   47
```

```
      COMMON /TABBCT/ NUMBCT,TBLBCT,XBCT(50),YBCT(50)                    OR-A  48
      COMMON /TABBWB/ NUMBWB,TBLBWB,XBWB(50),YBWB(50)                    OR-A  49
      COMMON /TABBWT/ NUMBWT,TBLBWT,XBWT(50),YBWT(50)                    OR-A  50
      COMMON /TABCO/ NUMCO,TBLCO,XCO(200),YCO(200)                       OR-A  51
      COMMON /TABCG/ NUMCG,TBLCG,XCG(50),YCG(50)                         OR-A  52
      COMMON /TABCST/ NUMCST,TBLCST,XCST(50),YCST(50)                    OR-A  53
      COMMON /TABCTX/ NUMCTX,TBLCTX,XCTX(50),YCTX(50)                    OR-A  54
      COMMON /TABDFZ/ NUMDFZ,TBLDFZ,XDFZ(50),YDFZ(50)                    OR-A  55
      COMMON /TABDSZ/ NUMDSZ,TBLDSZ,XDSZ(50),YDSZ(50)                    OR-A  56
      COMMON /TABDWF/ NUMDWF,TBLDWF,XDWF(50),YDWF(50)                    OR-A  57
      COMMON /TABDWP/ NUMDWP,TBLDWP,XDWP(50),YDWP(50)                    OR-A  58
      COMMON /TABDWZ/ NUMDWZ,TBLDWZ,XDWZ(50),YDWZ(50)                    OR-A  59
      COMMON /TABFCB/ NUMFCB,TBLFCB,XFCB(50),YFCB(50)                    OR-A  60
      COMMON /TABFCT/ NUMFCT,TBLFCT,XFCT(200),YFCT(200)                  OR-A  61
      COMMON /TABFWB/ NUMFWB,TBLFWB,XFWB(50),YFWB(50)                    OR-A  62
      COMMON /TABFWT/ NUMFWT,TBLFWT,XFWT(200),YFWT(200)                  OR-A  63
      COMMON /TABKFZ/ NUMKFZ,TBLKFZ,XKFZ(50),YKFZ(50)                    OR-A  64
      COMMON /TABKPZ/ NUMKPZ,TBLKPZ,XKPZ(50),YKPZ(50)                    OR-A  65
      COMMON /TABKWZ/ NUMKWZ,TBLKWZ,XKWZ(50),YKWZ(50)                    OR-A  66
      COMMON /TABPO/ NUMPO,TBLPO,XPO(200),YPO(200)                       OR-A  67
      COMMON /TABPF/ NUMPF,TBLPF,XPF(50),YPF(50)                         OR-A  68
      COMMON /TABPW/ NUMPW,TBLPW,XPW(50),YPW(50)                         OR-A  69
      COMMON /TABQPS/ NUMQPS,TBLQPS,XQPS(200),YQPS(200)                  OR-A  70
      COMMON /TABRAC/ NUMRAC,TBLRAC,XRAC(50),YRAC(50)                    OR-A  71
      COMMON /TABRAW/ NUMRAW,TBLRAW,XRAW(50),YRAW(50)                    OR-A  72
      COMMON /TABRD/ NUMRD,TBLRD,XRD(50),YRD(50)                         OR-A  73
      COMMON /TABRPF/ NUMRPF,TBLRPF,XRPF(50),YRPF(50)                    OR-A  74
      COMMON /TABSO/ NUMSO,TBLSO,XSO(200),YSO(200)                       OR-A  75
      COMMON /TABWO/ NUMWO,TBLWO,XWO(200),YWO(200)                       OR-A  76
      COMMON /TABWF/ NUMWF,TBLWF,XWF(50),YWF(50)                         OR-A  77
      COMMON /TABWP/ NUMWP,TBLWP,XWP(50),YWP(50)                         OR-A  78
      COMMON /TABZO/ NUMZO,TBLZO,ZO(200)                                 OR-A  79
      COMMON /TABZF/ NUMZF,TBLZF,ZF(200)                                 OR-A  80
      COMMON /UNIT/ ULNGTH(2),UPTNTL(6),UTIME(3),UMASS(3)                OR-A  81
      COMMON /WDATA/ GRAV,KWZDRY,KWZSAT,PDRY,PSAT,WDRY,WSAT              OR-A  82
C                                                                        OR-A  83
C                                                                        OR-A  84
C        ATCOEF,BTCOEF,CTCOEF     COEFFICIENTS ASSOCIATED WITH THE       OR-A  85
C                                   TIME STEP-SIZE COMPUTATION IN        OR-A  86
C                                   SUBROUTINE  STEP,  WHEN K1DELT=1     OR-A  87
C                                                                        OR-A  88
C        BEST      INTEGER DECISION VARIABLE                             OR-A  89
C                    0  NO ACTION IS TAKEN                               OR-A  90
C                    1  FOR EVERY DATA SET THAT  IS FED IN, GENERATE A   OR-A  91
C                         PRINTOUT  OF THE TABULAR X VALUES AND 3        OR-A  92
C                         ADDITIONAL INTERSPACED X VALUES USING ALL 10   OR-A  93
C                         TYPES OF INTERPOLATION.  FROM THESE TABLE      OR-A  94
```

```
      PROGRAM NATURE(INPUT,OUTPUT=64,PUNCH=64,TAPE5=INPUT,TAPE6=OUTPUT, OR-A   1
     1 TAPE7=PUNCH)                                                     OR-A   2
C                                                                       OR-A   3
C                              OR-NATURE                                OR-A   4
C                                                                       OR-A   5
C                                                                       OR-A   6
C                             VERSION 1.1                               OR-A   7
C                                                                       OR-A   8
C     COMPATIBLE WITH STANDARD FORTRAN 4 ,AS DESCRIBED IN ANSI X3.9-1966OR-A   9
C                                                                       OR-A  10
C                    PROGRAMMED BY  MICHAEL J. UNGS      MARCH, 1982    OR-A  11
C                                                                       OR-A  12
C                                                                       OR-A  13
C        NUMERICAL ANALYSIS OF WATER AND SOLUTE TRANSPORT IN THE SOIL    OR-A  14
C        INCLUDING MODELS OF ROOT UPTAKE AND SOLUTE SORPTION             OR-A  15
C                                                                       OR-A  16
C                                                                       OR-A  17
      INTEGER BCTOPC,BCTOPW,BCBTMC,BCBTMW,OUT,XORDER,SCAN,SAVE,PNCH     OR-A  18
      INTEGER TBLBCB,TBLBCT,TBLBWB,TBLBWT,TBLCST,TBLDSZ,TBLDWZ,TBLFCB,  OR-A  19
     1TBLFCT,TBLFWB,TBLFWT,TBLKWZ,TBLQPS,TBLRAC,TBLRAW,TBLRD,TBLWP      OR-A  20
      INTEGER TBLC0,TBLP0,TBLPW,TBLS0,TBLW0,TBLZ0,TBLZF,WILTED,BEST     OR-A  21
      INTEGER TBLCG,TBLCTX,TBLRPF,START,TBLKPZ,TBLDWP,TBLKFZ            OR-A  22
      INTEGER OUTPUT,TBLPF,TBLWF,TBLDWF,TBLDFZ                          OR-A  23
      REAL KWZSAT,KWZDRY,KZPIK,KZIK,KZK1,KZKN                           OR-A  24
      COMMON TITLE(200),DUMMYB(200),DUMMYC(200),DUMMYD(200),DUMMYE(200),OR-A  25
     1DUMMYF(200),DUMMYG(200),DUMMYH(200),DUMMYI(200),DUMMYJ(200),DUMMYKOR-A  26
     2(200)                                                             OR-A  27
      COMMON /BEAR/ FGUESS(200),FOLD1(200),FOLD2(200),F(200)            OR-A  28
      COMMON /BEGIN/ START                                              OR-A  29
      COMMON /CNVRGE/ ARATIO,QRATIO,SRATIO,WRATIO,ITRMAX,ACLRAT         OR-A  30
      COMMON /DATA/ BCTOPC,BCTOPW,BCBTMC,BCBTMW,JWORH,MODE,JSORB        OR-A  31
      COMMON /DELTA/ ATCOEF,BTCOEF,CTCOEF,DTK,DTK1,DTMAX,DTMIN,K1DELT   OR-A  32
      COMMON /DEPTH/ N,Z(200)                                           OR-A  33
      COMMON /FLUX/ A(200),G(200),QZ(200)                               OR-A  34
      COMMON /IO/ IN,OUT,PNCH                                           OR-A  35
      COMMON /ISOTRM/ CNSTS(4)                                          OR-A  36
      COMMON /LIQUID/ CGUESS(200),COLD1(200),COLD2(200),C(200)          OR-A  37
      COMMON /MATRIC/ PGUESS(200),POLD1(200),POLD2(200),PSI(200)        OR-A  38
      COMMON /MOIST/ WGUESS(200),WOLD1(200),WOLD2(200),THETA(200)       OR-A  39
      COMMON /PRNT/ NSKIP,NPRINT,OUTPUT                                 OR-A  40
      COMMON /QFLIP/ DRY,SAT                                            OR-A  41
      COMMON /QFLUX/ QWBTM,QWTOP,QCBTM,QCTOP                            OR-A  42
      COMMON /QITR/ QCOLD(2),QPOLD(2),QMIN                              OR-A  43
      COMMON /ROOTS/ CNVRSN,TCR,PPSURF(3),PWILT,RR,TR,WILTED            OR-A  44
      COMMON /SLIDER/ FDRY,FSAT,PICK(50),NUMPCK,JWHS                    OR-A  45
      COMMON /SOLID/ SGUESS(200),SOLD1(200),SOLD2(200),S(200)           OR-A  46
      COMMON /TABBCB/ NUMBCB,TBLBCB,XBCB(50),YBCB(50)                   OR-A  47
```

```
      COMMON /TABBCT/ NUMBCT,TBLBCT,XBCT(50),YBCT(50)                    OR-A  48
      COMMON /TABBWB/ NUMBWB,TBLBWB,XBWB(50),YBWB(50)                    OR-A  49
      COMMON /TABBWT/ NUMBWT,TBLBWT,XBWT(50),YBWT(50)                    OR-A  50
      COMMON /TABCO/ NUMCO,TBLCO,XCO(200),YCO(200)                       OR-A  51
      COMMON /TABCG/ NUMCG,TBLCG,XCG(50),YCG(50)                         OR-A  52
      COMMON /TABCST/ NUMCST,TBLCST,XCST(50),YCST(50)                    OR-A  53
      COMMON /TABCTX/ NUMCTX,TBLCTX,XCTX(50),YCTX(50)                    OR-A  54
      COMMON /TABDFZ/ NUMDFZ,TBLDFZ,XDFZ(50),YDFZ(50)                    OR-A  55
      COMMON /TABDSZ/ NUMDSZ,TBLDSZ,XDSZ(50),YDSZ(50)                    OR-A  56
      COMMON /TABDWF/ NUMDWF,TBLDWF,XDWF(50),YDWF(50)                    OR-A  57
      COMMON /TABDWP/ NUMDWP,TBLDWP,XDWP(50),YDWP(50)                    OR-A  58
      COMMON /TABDWZ/ NUMDWZ,TBLDWZ,XDWZ(50),YDWZ(50)                    OR-A  59
      COMMON /TABFCB/ NUMFCB,TBLFCB,XFCB(50),YFCB(50)                    OR-A  60
      COMMON /TABFCT/ NUMFCT,TBLFCT,XFCT(200),YFCT(200)                  OR-A  61
      COMMON /TABFWB/ NUMFWB,TBLFWB,XFWB(50),YFWB(50)                    OR-A  62
      COMMON /TABFWT/ NUMFWT,TBLFWT,XFWT(200),YFWT(200)                  OR-A  63
      COMMON /TABKFZ/ NUMKFZ,TBLKFZ,XKFZ(50),YKFZ(50)                    OR-A  64
      COMMON /TABKPZ/ NUMKPZ,TBLKPZ,XKPZ(50),YKPZ(50)                    OR-A  65
      COMMON /TABKWZ/ NUMKWZ,TBLKWZ,XKWZ(50),YKWZ(50)                    OR-A  66
      COMMON /TABPO/ NUMPO,TBLPO,XPO(200),YPO(200)                       OR-A  67
      COMMON /TABPF/ NUMPF,TBLPF,XPF(50),YPF(50)                         OR-A  68
      COMMON /TABPW/ NUMPW,TBLPW,XPW(50),YPW(50)                         OR-A  69
      COMMON /TABQPS/ NUMQPS,TBLQPS,XQPS(200),YQPS(200)                  OR-A  70
      COMMON /TABRAC/ NUMRAC,TBLRAC,XRAC(50),YRAC(50)                    OR-A  71
      COMMON /TABRAW/ NUMRAW,TBLRAW,XRAW(50),YRAW(50)                    OR-A  72
      COMMON /TABRD/ NUMRD,TBLRD,XRD(50),YRD(50)                         OR-A  73
      COMMON /TABRPF/ NUMRPF,TBLRPF,XRPF(50),YRPF(50)                    OR-A  74
      COMMON /TABSO/ NUMSO,TBLSO,XSO(200),YSO(200)                       OR-A  75
      COMMON /TABWO/ NUMWO,TBLWO,XWO(200),YWO(200)                       OR-A  76
      COMMON /TABWF/ NUMWF,TBLWF,XWF(50),YWF(50)                         OR-A  77
      COMMON /TABWP/ NUMWP,TBLWP,XWP(50),YWP(50)                         OR-A  78
      COMMON /TABZO/ NUMZO,TBLZO,ZO(200)                                 OR-A  79
      COMMON /TABZF/ NUMZF,TBLZF,ZF(200)                                 OR-A  80
      COMMON /UNIT/ ULNGTH(2),UPTNTL(6),UTIME(3),UMASS(3)                OR-A  81
      COMMON /WDATA/ GRAV,KWZDRY,KWZSAT,PDRY,PSAT,WDRY,WSAT              OR-A  82
C                                                                        OR-A  83
C                                                                        OR-A  84
C     ATCOEF,BTCOEF,CTCOEF     COEFFICIENTS ASSOCIATED WITH THE          OR-A  85
C                                TIME STEP-SIZE COMPUTATION IN           OR-A  86
C                                SUBROUTINE  STEP,  WHEN K1DELT=1        OR-A  87
C                                                                        OR-A  88
C     BEST      INTEGER DECISION VARIABLE                                OR-A  89
C                 0  NO ACTION IS TAKEN                                  OR-A  90
C                 1  FOR EVERY DATA SET THAT  IS FED IN, GENERATE A      OR-A  91
C                      PRINTOUT  OF THE TABULAR X VALUES AND 3           OR-A  92
C                      ADDITIONAL INTERSPACED X VALUES USING ALL 10      OR-A  93
C                      TYPES OF INTERPOLATION.  FROM THESE TABLE         OR-A  94
```

```
C                 PRINTOUTS ,ONE SHOULD BE ABLE TO DETERMINE     OR-A  95
C                 THE BEST METHOD OF INTERPOLATION FOR THE       OR-A  96
C                 PARTICULAR DATA BEING USED.  PROGRAM STOPS     OR-A  97
C                 AT END OF THE TABLE PRINTOUT .                 OR-A  98
C                                                                OR-A  99
C       IN        AN ASSIGNED FIXED-POINT CONSTANT REFERRING TO THE    OR-A 100
C           INPUT DEVICE TO BE USED FOR READING IN DATA CARDS    OR-A 101
C                                                                OR-A 102
C       JSORB     INTEGER DECISION VARIABLE                      OR-A 103
C           0  NO   SORPTION/DESORPTION TAKES PLACE              OR-A 104
C           (1,2,3,4) MODEL   SORPTION    AS AN EQUILIBRIUM      OR-A 105
C                   PROCESS WITH A                               OR-A 106
C           1  LINEAR ISOTHERM                                   OR-A 107
C           2  LANGMUIR                                          OR-A 108
C           3  FREUNDLICH                                        OR-A 109
C           4  ANY OTHER NON-LINEAR ISOTHERM                     OR-A 110
C           (5,6,7,8,9) MODELING   SORPTION/DESORPTION AS        OR-A 111
C                   A NON-EQUILIBRIUM PROCESS WITH A             OR-A 112
C           5  LINEAR ISOTHERM                                   OR-A 113
C           6  BILINEAR                                          OR-A 114
C           7  LANGMUIR                                          OR-A 115
C           8  FREUNDLICH                                        OR-A 116
C           9  ANY OTHER NON-LINEAR ISOTHERM                     OR-A 117
C                                                                OR-A 118
C       JWORH     INTEGER DECISION VARIABLE                      OR-A 119
C           0  SOLVE THE WATER FLOW EQUATION IN TERMS OF         OR-A 120
C                 VOLUMETRIC   WATER  CONTENT - THETA-           OR-A 121
C           1  SOLVE THE WATER FLOW EQUATION IN TERMS OF MATRICOR-A 122
C                POTENTIAL - PSI -                               OR-A 123
C                                                                OR-A 124
C       K1DELT    INTEGER DECISION VARIABLE SPECIFYING THE METHOD    OR-A 125
C           OF COMPUTING THE TIME STEP-SIZE  DTK1                OR-A 126
C           =  0    USE THE METHOD OF HANKS AND BOWERS(1969)     OR-A 127
C           =  1    DTK1=ATCOEF+BTCOEF*DTK+CTCOEF*TIME           OR-A 128
C           =  2    THE USER MUST SUPPLY AN EMPIRICAL FUNCTION   OR-A 129
C                     TO DEFINE THE STEP-SIZE IN                 OR-A 130
C                     SUBROUTINE  STEP                           OR-A 131
C                                                                OR-A 132
C       MAXSET    MAXIMUM NUMBER OF ELEMENTS ALLOWED IN ANY DATA     OR-A 133
C           SET ARRAY                                            OR-A 134
C                                                                OR-A 135
C       MODE      INTEGER DECISION VARIABLE                      OR-A 136
C           0  SOLVE THE COUPLED SYSTEM OF EQUATIONS FOR         OR-A 137
C                 WATER FLOW AND SOLUTE TRANSPORT                OR-A 138
C           1  SOLVE ONLY THE WATER FLOW EQUATION                OR-A 139
C           2  SOLVE ONLY THE SOLUTE TRANSPORT EQUATION          OR-A 140
C                                                                OR-A 141
```

```
C     NPRINT    DECISION VARIABLE(INTERNALLY SPECIFIED BY NSKIP)      OR-A 142
C                 = 0     DO NOT PRINT OUT ANY INFORMATION          OR-A 143
C                 = 1     PRINT OUT   WATER , SOLUTE AND POTENTIAL  OR-A 144
C                           VALUES FOR THIS TIME STEP               OR-A 145
C                                                                   OR-A 146
C     NSKIP     PRINTOUT  SKIPPER, PROGRAM WILL PRINT OUT   WATER   OR-A 147
C                 AND SOLUTE VALUES EVERY "NSKIP" TIME STEPS        OR-A 148
C                                                                   OR-A 149
C     NUMMAX    MAXIMUM NUMBER OF SPATIAL NODES ALLOWED .  IF A     OR-A 150
C                 LARGER SIZE IS DESIRED, ALL DIMENSION STATEMENTS  OR-A 151
C                 OF ALL SUBROUTINES HAVE TO BE CHANGED             OR-A 152
C                                                                   OR-A 153
C     OUT       AN ASSIGNED FIXED-POINT CONSTANT REFERRING TO THE   OR-A 154
C                 OUTPUT DEVICE TO BE USED FOR PRINTING OUT PROGRAM OR-A 155
C                 RESULTS                                           OR-A 156
C                                                                   OR-A 157
C     OUTPUT    DECISION VARIABLE CONCERNING THE OUTPUT DEVICE      OR-A 158
C                 THROUGH WHICH DATA IS TO BE ROUTED.               OR-A 159
C                = 0  PRINTED OUTPUT IS ROUTED TO DEVICE NUMBER "OUT".OR-A 160
C                       THERE IS NO PUNCHED OUTPUT. THE PRINTED OUTPUTOR-A 161
C                       OCCURS AT THE END OF EVERY NSKIP TIME STEPS. OR-A 162
C                = 1  IN ADDITION TO PRINTED OUTPUT, THE FOLLOWING  OR-A 163
C                       DATA IS PUNCHED OUT BY DEVICE NUMBER  "PNCH" OR-A 164
C                       AT THE END OF EVERY NSKIP TIME STEPS        OR-A 165
C                       (TIME),/,( Z(I),THETA(I),PSI(I),C(I),S(I),A(I),OR-A 166
C                       G(I),QZ(I) ), I=1,...,N    WHICH IS EXPRESSED OR-A 167
C                       IN FORMAT (8E10.4)                          OR-A 168
C                       HENCE, A TOTAL OF  N+1 CARDS PER TIME STEP  OR-A 169
C                       ARE PUNCHED                                 OR-A 170
C                = 2  PRINTED OUTPUT IS SUPPRESSED, PUNCHED OUTPUT  OR-A 171
C                       IS ROUTED TO DEVICE NUMBER "PNCH".          OR-A 172
C                                                                   OR-A 173
C     PNCH      AN ASSIGENED FIXED-POINT CONSTANT REFERRING TO THE  OR-A 174
C                 OUTPUT DEVICE TO BE USED FOR PUNCHING OUT DATA    OR-A 175
C                 CARDS OR TO BE USED TO STORE DATA ON MAGNETIC TAPE OR-A 176
C     SAVE  =     0       NO ACTION IS TAKEN                        OR-A 177
C                 1       AT THE END OF THE PROGRAM, PUNCH OUT THE  OR-A 178
C                           FINAL SPATIAL NODE DISTRIBUTION,SOLUTE  OR-A 179
C                           (LIQUID AND SOLID PHASES) CONCENTRATION, OR-A 180
C                           VOLUMETRIC   WATER  CONTENT AND MATRIC  OR-A 181
C                           POTENTIAL.  THE DATA IS PUNCHED SO THAT OR-A 182
C                           IT CAN BE DIRECTLY USED AS THE INITIAL  OR-A 183
C                           CONDITIONS FOR SOME FUTURE RUN          OR-A 184
C     SCAN  =     0  NO ACTION IS TAKEN                             OR-A 185
C                 1  SCAN ALL TBL(.) INPUT DATA VALUES TO DETERMINE OR-A 186
C                      IF THEY ARE CONSISTENT WITH THE OTHER PROGRAM OR-A 187
C                      PARAMETERS                                   OR-A 188
```

```
C                                                                       OR-A 189
C       START     INTEGER DECISION VARIABLE TO BE USED WHEN SOLVING     OR-A 190
C                   THE   WATER  FLOW EQUATION                          OR-A 191
C                   = -1    FOR ALL TIME STEPS, SOLVE IN TERMS OF       OR-A 192
C                             DIFFUSIVITY POTENTIAL.  THE DIFFUSIVITY   OR-A 193
C                             AND CONDUCTIVITY COEFFICIENTS ARE         OR-A 194
C                             GENERATED ACCORDING TO THE SPECIFIED      OR-A 195
C                             JWORH.  HENCE IF JWORH=0, USE DFZ,KFZ,FW  OR-A 196
C                                          IF JWORH=1, USE KFZ,PW,FP    OR-A 197
C                   = 0     NO ACTION IS TAKEN                          OR-A 198
C                   = KS    FROM TIME LEVEL  K=0 TO  K=KS  SOLVE THE    OR-A 199
C                           DIFFUSIVITY POTENTIAL EQUATION FOR TIMES    OR-A 200
C                           GREATER THAN  K=KS, SOLVE AS SPECIFIED      OR-A 201
C                           BY  JWORH.                                  OR-A 202
C                           NOTE.  THE PURPOSE OF  START  IS TO         OR-A 203
C                           STABLIZE THE SOLUTION BY STARTING WITH      OR-A 204
C                           DIFFUSIVITY POTENTIAL AND THEN SWITCHING    OR-A 205
C                           BACK.                                       OR-A 206
C                           FOR BEST RESULTS SET START=11.OR GREATER    OR-A 207
C                                                                       OR-A 208
C       TBL(.)    TYPE OF INTERPOLATION SCHEME TO BE USED ON TABULAR    OR-A 209
C                   VALUES OF FUNCTION  Y VERSUS X                      OR-A 210
C                  -1       (FUNCTION IS NOT USED)                      OR-A 211
C                   0       (EMPIRICAL EQUATION IS TO BE USED)          OR-A 212
C                   1       (LINEAR INTERPOLATION OF  Y VERSUS X )      OR-A 213
C       TBL =       2       (QUADRATIC INTERPOLATION OF Y VERSUS X)     OR-A 214
C                   3       (CUBIC SPLINE INTERPOLATION OF  Y VERSUS X)OR-A 215
C                   4       (LINEAR INTERPOLATION OF  LN(Y) VERSUS X )  OR-A 216
C                   5       (CUBIC SPLINE INTERPOLATION OF  LN(Y) VS X)OR-A 217
C                   6       (LINEAR INTERPOLATION OF  Y VS LN(X) )      OR-A 218
C                   7       (CUBIC SPLINE INTERPOLATION OF  Y VS LN(X))OR-A 219
C                   8       (LINEAR INTERPOLATION OF  LN(Y) VS LN(X) )  OR-A 220
C                   9       (CUBIC SPLINE INTERPOLATION                 OR-A 221
C                             OF  LN(Y) VS LN(X) )                      OR-A 222
C                   10      (PIECEWISE-CONSTANT VALUES OF  Y VERSUS X )OR-A 223
C                                                                       OR-A 224
C       TGRID     TIME AT WHICH THE NEW          GRID SYSTEM IS TO      OR-A 225
C                   TAKE EFFECT (IF AT ALL)  WITH UNITS OF  ( T )       OR-A 226
C       TIME0     PROGRAM STARTS WITH THE TIME OF  TIME = TIME0         OR-A 227
C       TIMEF     PROGRAM ENDS WHEN  TIME=TIMEF                         OR-A 228
C       XORDER    = 0  NO ACTION IS TAKEN                               OR-A 229
C                 = 1  CHECK TABULAR DATA TO MAKE SURE THAT X(1) ,X(2),OR-A 230
C                        ...,X(N) ARE IN ASCENDING ORDER                OR-A 231
C                                                                       OR-A 232
C                                                                       OR-A 233
C       ASSIGN THE INPUT/OUTPUT DEVICE NUMBERS FOR YOUR PARTICULAR      OR-A 234
C     COMPUTER(I.E., TO INPUT DATA CARDS, OUTPUT PRINTOUTS , AND TO     OR-A 235
```

```
C     OUTPUT PUNCHED DATA CARDS).                                                    OR-A 236
      IN = 5                                                                         OR-A 237
      OUT = 6                                                                        OR-A 238
      PNCH = 7                                                                       OR-A 239
C                     MAXIMUM SIZE OF DATA SET ARRAY                                 OR-A 240
                                                                                     OR-A 241
      MAXSET = 50                                                                    OR-A 242
C                   MAXIMUM NUMBER OF SPATIAL NODES                                  OR-A 243
      NUMMAX = 200                                                                   OR-A 244
C                                                                                    OR-A 245
C                                                                                    OR-A 246
      DZK1 = 0.                                                                      OR-A 247
      DZKN = 0.                                                                      OR-A 248
      WRITE (OUT,120)                                                                OR-A 249
  120 FORMAT (1H1,////////////)                                                      OR-A 250
      WRITE (OUT,140)                                                                OR-A 251
  140 FORMAT (58X,18HPROGRAM  OR-NATURE,//,62X,11HVERSION 1.1,/////////)             OR-A 252
C     READ IN 3 TITLE CARDS(USE 3 BLANK CARDS IF NOT USED)                           OR-A 253
      READ (IN,160) (TITLE(J),J=1,80)                                                OR-A 254
  160 FORMAT (80A1)                                                                  OR-A 255
      READ (IN,160) (DUMMYB(J),J=1,80)                                               OR-A 256
      READ (IN,160) (DUMMYC(J),J=1,80)                                               OR-A 257
      WRITE (OUT,180) (TITLE(J),J=1,80)                                              OR-A 258
  180 FORMAT (///,30X,80A1)                                                          OR-A 259
      WRITE (OUT,180) (DUMMYB(J),J=1,80)                                             OR-A 260
      WRITE (OUT,180) (DUMMYC(J),J=1,80)                                             OR-A 261
      IF(SAVE.EQ.1) WRITE(PNCH,160) (TITLE (J),J=1,80)                               OR-A 262
      IF(SAVE.EQ.1) WRITE(PNCH,160) (DUMMYB(J),J=1,80)                               OR-A 263
      IF(SAVE.EQ.1) WRITE(PNCH,160) (DUMMYC(J),J=1,80)                               OR-A 264
      WRITE (OUT,200)                                                                OR-A 265
  200 FORMAT (//////////)                                                            OR-A 266
C                     PROGRAM CARD 1                                                 OR-A 267
      READ (IN,240) JSORB,JWORH,MODE,ITRMAX,NSKIP,OUTPUT,K1DELT                      OR-A 268
C                     PROGRAM CARD 2                                                 OR-A 269
      READ (IN,240) XORDER,SCAN,SAVE,START,BEST                                      OR-A 270
C                     PROGRAM CARD 3                                                 OR-A 271
      READ (IN,260) ACLRAT,GRAV,PWILT,DRY,SAT,RR,CNVRSN                              OR-A 272
C                     PROGRAM CARD 4                                                 OR-A 273
      READ (IN,260) ARATIO,QRATIO,SRATIO,WRATIO                                      OR-A 274
C                     PROGRAM CARD 5                                                 OR-A 275
      READ (IN,260) TIME0,TIMEF,DTMIN,DTMAX,TGRID                                    OR-A 276
C                     PROGRAM CARD 6                                                 OR-A 277
      READ (IN,260) (CNSTS(I),I=1,4)                                                 OR-A 278
C                     PROGRAM  CARD 7                                                OR-A 279
      READ (IN,260) ATCOEF,BTCOEF,CTCOEF                                             OR-A 280
C                     PROGRAM CARD 8                                                 OR-A 281
      READ (IN,220) ULNGTH,UPTNTL,UTIME,UMASS                                        OR-A 282
  220 FORMAT (2A1,8X,6A1,4X,3A1,7X,3A1)
```

```
      READ (IN,240) NUMZO,TBLZO                                          OR-A 283
240   FORMAT (7I5)                                                       OR-A 284
      IF (TBLZO.GT.0) READ (IN,260) (ZO(I),I=1,NUMZO)                    OR-A 285
260   FORMAT (8E10.4)                                                    OR-A 286
      READ (IN,240) NUMZF,TBLZF                                          OR-A 287
      IF (TBLZF.GT.0) READ (IN,260) (ZF(I),I=1,NUMZF)                    OR-A 288
      READ (IN,240) NUMCO,TBLCO                                          OR-A 289
      IF (TBLCO.GT.0) READ (IN,260) (XCO(I),YCO(I),I=1,NUMCO)            OR-A 290
      READ (IN,240) NUMPO,TBLPO                                          OR-A 291
      IF (TBLPO.GT.0) READ (IN,260) (XPO(I),YPO(I),I=1,NUMPO)            OR-A 292
      READ (IN,240) NUMSO,TBLSO                                          OR-A 293
      IF (TBLSO.GT.0) READ (IN,260) (XSO(I),YSO(I),I=1,NUMSO)            OR-A 294
      READ (IN,240) NUMWO,TBLWO                                          OR-A 295
      IF (TBLWO.GT.0) READ (IN,260) (XWO(I),YWO(I),I=1,NUMWO)            OR-A 296
      READ (IN,240) NUMBCB,TBLBCB                                        OR-A 297
      IF (TBLBCB.GT.0) READ (IN,260) (XBCB(I),YBCB(I),I=1,NUMBCB)        OR-A 298
      READ (IN,240) NUMFCB,TBLFCB                                        OR-A 299
      IF (TBLFCB.GT.0) READ (IN,260) (XFCB(I),YFCB(I),I=1,NUMFCB)        OR-A 300
      READ (IN,240) NUMBCT,TBLBCT                                        OR-A 301
      IF (TBLBCT.GT.0) READ (IN,260) (XBCT(I),YBCT(I),I=1,NUMBCT)        OR-A 302
      READ (IN,240) NUMFCT,TBLFCT                                        OR-A 303
      IF (TBLFCT.GT.0) READ (IN,260) (XFCT(I),YFCT(I),I=1,NUMFCT)        OR-A 304
      READ (IN,240) NUMBWB,TBLBWB                                        OR-A 305
      IF (TBLBWB.GT.0) READ (IN,260) (XBWB(I),YBWB(I),I=1,NUMBWB)        OR-A 306
      READ (IN,240) NUMFWB,TBLFWB                                        OR-A 307
      IF (TBLFWB.GT.0) READ (IN,260) (XFWB(I),YFWB(I),I=1,NUMFWB)        OR-A 308
      READ (IN,240) NUMBWT,TBLBWT                                        OR-A 309
      IF (TBLBWT.GT.0) READ (IN,260) (XBWT(I),YBWT(I),I=1,NUMBWT)        OR-A 310
      READ (IN,240) NUMFWT,TBLFWT                                        OR-A 311
      IF (TBLFWT.GT.0) READ (IN,260) (XFWT(I),YFWT(I),I=1,NUMFWT)        OR-A 312
      READ (IN,240) NUMCG,TBLCG                                          OR-A 313
      IF (TBLCG.GT.0) READ (IN,260) (XCG(I),YCG(I),I=1,NUMCG)            OR-A 314
      READ (IN,240) NUMCST,TBLCST                                        OR-A 315
      IF (TBLCST.GT.0) READ (IN,260) (XCST(I),YCST(I),I=1,NUMCST)        OR-A 316
      READ (IN,240) NUMCTX,TBLCTX                                        OR-A 317
      IF (TBLCTX.GT.0) READ (IN,260) (XCTX(I),YCTX(I),I=1,NUMCTX)        OR-A 318
      READ (IN,240) NUMDSZ,TBLDSZ                                        OR-A 319
      IF (TBLDSZ.GT.0) READ (IN,260) (XDSZ(I),YDSZ(I),I=1,NUMDSZ)        OR-A 320
      READ (IN,240) NUMDWZ,TBLDWZ                                        OR-A 321
      IF (TBLDWZ.GT.0) READ (IN,260) (XDWZ(I),YDWZ(I),I=1,NUMDWZ)        OR-A 322
      READ (IN,240) NUMKWZ,TBLKWZ                                        OR-A 323
      IF (TBLKWZ.GT.0) READ (IN,260) (XKWZ(I),YKWZ(I),I=1,NUMKWZ)        OR-A 324
      READ (IN,240) NUMPW,TBLPW                                          OR-A 325
      IF (TBLPW.GT.0) READ (IN,260) (XPW(I),YPW(I),I=1,NUMPW)            OR-A 326
      READ (IN,240) NUMQPS,TBLQPS                                        OR-A 327
      IF (TBLQPS.GT.0) READ (IN,260) (XQPS(I),YQPS(I),I=1,NUMQPS)        OR-A 328
      READ (IN,240) NUMRAC,TBLRAC                                        OR-A 329
```

```
      IF (TBLRAC.GT.0) READ (IN,260) (XRAC(I),YRAC(I),I=1,NUMRAC)        OR-A 330
      READ (IN,240) NUMRAW,TBLRAW                                        OR-A 331
      IF (TBLRAW.GT.0) READ (IN,260) (XRAW(I),YRAW(I),I=1,NUMRAW)        OR-A 332
      READ (IN,240) NUMRD,TBLRD                                          OR-A 333
      IF (TBLRD.GT.0) READ (IN,260) (XRD(I),YRD(I),I=1,NUMRD)            OR-A 334
      READ (IN,240) NUMRPF,TBLRPF                                        OR-A 335
      IF (TBLRPF.GT.0) READ (IN,260) (XRPF(I),YRPF(I),I=1,NUMRPF)        OR-A 336
      READ (IN,240) NUMWP,TBLWP                                          OR-A 337
      IF (TBLWP.GT.0) READ (IN,260) (XWP(I),YWP(I),I=1,NUMWP)            OR-A 338
      IF (OUTPUT.EQ.0) GO TO 360                                         OR-A 339
      IF (OUTPUT.EQ.1) WRITE (OUT,280) NSKIP                             OR-A 340
  280 FORMAT (26X,72HTHIS COMPUTER PROGRAM WILL BOTH PRINT AND PUNCH OUTOR-A 341
     1 DATA EVERY  NSKIP = ,I3,11H TIME STEPS)                           OR-A 342
      IF (OUTPUT.EQ.2) WRITE (OUT,300) NSKIP                             OR-A 343
  300 FORMAT (20X,61HTHIS COMPUTER PROGRAM WILL ONLY PUNCH OUT DATA EVERORR-A 344
     1Y NSKIP = ,I3,36H TIME STEPS.  THERE IS NO PRINTOUT .)             OR-A 345
      WRITE (OUT,320) PNCH                                               OR-A 346
  320 FORMAT (///,63X,12HDATA PUNCHED,//,45X,48H( TIME,QPOLD(2),QWTOP,QWOR-A 347
     1BTM,QCTOP,QCBTM,TR,TCR ),/,45X,62H( EVPRTE,FLTRTE,TRNSPR,CTRSUM,CCOR-A 348
     2MPTE,SCMPTE,WCMPTE,PPSURF(3) ),/,45X,62H(( Z(I),THETA(I),PSI(I),C(OR-A 349
     3I),S(I),A(I),G(I),QZ(I) ),I=1,...,N),/,33X,79HDATA IS PUNCHED IN FOR-A 350
     4ORMAT (8E10.4) AND IS ROUTED TO OUTPUT DEVICE  PNCH(LUN) = ,I3,//,OR-A 351
     533X,68HHENCE, A TOTAL OF  N+2  CARDS ARE PUNCHED OUT EVERY NSKIP TOR-A 352
     6IME STEPS)                                                         OR-A 353
      IF (OUTPUT.EQ.1) WRITE (OUT,340) OUT                               OR-A 354
  340 FORMAT (/,33X,49HPRINTOUT  IS ROUTED TO OUTPUT DEVICE  OUT(LUN) = OR-A 355
     1,I3)                                                               OR-A 356
      WRITE (PNCH,160) (TITLE(J),J=1,80)                                 OR-A 357
      WRITE (PNCH,160) (DUMMYB(J),J=1,80)                                OR-A 358
      WRITE (PNCH,160) (DUMMYC(J),J=1,80)                                OR-A 359
C        CHECK  FOR ERRORS IN DATA                                       OR-A 360
  360 CALL ERROR (BEST,MAXSET,NUMMAX,SCAN,TIME0,TIMEF,TGRID,XORDER,SAVE)OR-A 361
                                                                         OR-A 362
C                                                                        OR-A 363
      IF (MODE.EQ.2) START = 0                                           OR-A 364
C             SPATIAL NODE LOCATIONS                                     OR-A 365
      CALL INTLZ                                                         OR-A 366
      WRITE (OUT,380)                                                    OR-A 367
  380 FORMAT (1H1,//////)                                                OR-A 368
      CALL ORDER (NUMZ0,Z0,Z0,3HZ0 )                                     OR-A 369
      N = NUMZ0                                                          OR-A 370
      N1 = N-1                                                           OR-A 371
      DO 400 I=1,N                                                       OR-A 372
  400 Z(I) = Z0(I)                                                       OR-A 373
C          REGRID     NODE DISTRIBUTION (IF USED)                      OR-A 374
      CALL FNLZ                                                          OR-A 375
      IF (TBLZF.GE.0) CALL ORDER (NUMZF,ZF,ZF,3HZF )                     OR-A 376
C
```

```
C        INITIAL   WATER  CONTENT AND MATRIC POTENTIAL                    OR-A 377
      IF (JWORH.NE.0) GO TO 440                                           OR-A 378
C                                                                         OR-A 379
C     IF ONE IS GOING TO SOLVE THE WATER FLOW EQUATION IN TERMS OF        OR-A 380
C     VOLUMETRIC WATER CONTENT, SPECIFY THE INITIAL   WATER  CONTENT      OR-A 381
C                                                                         OR-A 382
      CALL INTLW                                                          OR-A 383
      IF (MODE.EQ.2) GO TO 480                                            OR-A 384
C        COMPUTE THE INITIAL MATRIC POTENTIAL FROM DATA SET  PW           OR-A 385
      DO 420 I=1,N                                                        OR-A 386
420   CALL PSIW (THETA(I),PSI(I),DUM)                                     OR-A 387
      GO TO 480                                                           OR-A 388
C     IF ONE IS GOING TO SOLVE THE WATER FLOW EQUATION IN TERMS OF        OR-A 389
C     MATRIC POTENTIAL, SPECIFY THE INITIAL MATRIC POTENTIAL              OR-A 390
 440  CALL INTLP                                                          OR-A 391
      IF (MODE.EQ.2) GO TO 480                                            OR-A 392
      DO 460 I=1,N                                                        OR-A 393
C        COMPUTE THE INITIAL   WATER  CONTENT FROM DATA SET  WP           OR-A 394
460   CALL WPSI (PSI(I),THETA(I),DUM)                                     OR-A 395
C     INITIAL LIQUID PHASE SOLUTE CONCENTRATION                           OR-A 396
 480  IF (TBLC0.GE.0) CALL INTLC                                          OR-A 397
C     INITIAL SOLID PHASE CONCENTRATION, IF THERE IS                      OR-A 398
C     ANY   SORPTION/DESORPTION                                           OR-A 399
      IF (JSORB.GE.5.AND.TBLS0.GE.0) CALL INTLS                           OR-A 400
C                                                                         OR-A 401
C        INITIALIZE THE REMAINING ARRAYS                                  OR-A 402
      DO 500 I=1,N                                                        OR-A 403
      CGUESS(I) = C(I)                                                    OR-A 404
      COLD1(I)  = C(I)                                                    OR-A 405
      COLD2(I)  = C(I)                                                    OR-A 406
      PGUESS(I) = PSI(I)                                                  OR-A 407
      POLD1(I)  = PSI(I)                                                  OR-A 408
      POLD2(I)  = PSI(I)                                                  OR-A 409
      SGUESS(I) = S(I)                                                    OR-A 410
      SOLD1(I)  = S(I)                                                    OR-A 411
      SOLD2(I)  = S(I)                                                    OR-A 412
      WGUESS(I) = THETA(I)                                                OR-A 413
      WOLD1(I)  = THETA(I)                                                OR-A 414
500   WOLD2(I)  = THETA(I)                                                OR-A 415
      JWHS = JWORH                                                        OR-A 416
      NPRINT = 1                                                          OR-A 417
      NPNCH = 1                                                           OR-A 418
      ITGRID = 0                                                          OR-A 419
      DTLMT = DTMIN/100.                                                  OR-A 420
      IF(DTLMT.LE.0.) DTLMT=(TIMEF-TIME0)*1.E-05                          OR-A 421
      IF (MODE.EQ.2) GO TO 960                                            OR-A 422
      IF (JWORH.EQ.1) GO TO 640                                           OR-A 423
```

```
      WDRY = DRY                                                        OR-A 424
      WSAT = SAT                                                        OR-A 425
      IF (DRY.LT.0..OR.SAT.LE.0.) WRITE (OUT,520) MODE,JWORH,DRY,SAT    OR-A 426
  520 FORMAT (////////////,56X,14HERROR CODE   1,//,50X,26HERROR IN    PROOR-A 427
     1GRAM NATURE,//,59X,9H MODE  = ,I3,/,60X,8HJWORH = ,I3,/,60X,      OR-A 428
     28H DRY  = ,E11.4,/,60X,8H SAT  = ,E11.4,//,20X,95HTHE VOLUMETRIC  OR-A 429
     3 WATER  CONTENT AT AIR-DRY AND SATURATED CONDITIONS MUST BE A POSIOR-A 430
     4TIVE QUANTITY,/,20X,72HCHECK TO MAKE SURE THAT THE DATA IN PROGRAMOR-A 431
     5 CARD 3 ARE CORRECTLY PUNCHED)                                    OR-A 432
      IF (DRY.LT.0..OR.SAT.LE.0.) STOP                                  OR-A 433
      IF (NUMPW.LE.0) GO TO 620                                         OR-A 434
      IF (WDRY.GE.XPW(1).AND.WSAT.LE.XPW(NUMPW)) GO TO 620              OR-A 435
      WRITE (OUT,540) WDRY,WSAT,XPW(1),NUMPW,XPW(NUMPW)                 OR-A 436
  540 FORMAT (////////////,56X,14HERROR CODE   2,//,50X,26HERROR IN    PROOR-A 437
     1GRAM NATURE,///,53X,20HERROR IN DATA SET PW,//,20X,89HTHE RANGE OFOR-A 438
     2 DATA SET PW IS TOO LIMITED, YOU MUST SPECIFY XPW(1) AND XPW(NUMPWOR-A 439
     3) SUCH THAT,/,20X,79HTHE VALUES OF VARIABLES DRY AND SAT ARE INCLUOR-A 440
     4DED WITHIN THEIR RANGE BUT YOU SET,//,63X,6HDRY = ,E11.4,/,63X,   OR-A 441
     56HSAT = ,E11.4,/,59X,10HXPW( 1) = ,E11.4,/,59X,4HXPW(,I2,4H) = ,  OR-A 442
     6E11.4,///,13X,112HINCREASE THE X RANGE(  WATER ) OF DATA SET PW ANOR-A 443
     7D THE CORRESPONDING VALUES OF YPW(1) AND YPW(NUMPW) AND RESUBMIT) OR-A 444
      WRITE (OUT,560)                                                   OR-A 445
  560 FORMAT (/////,30X,79HDATA SET PW IS LISTED BELOW WHERE XPW(I) CONTOR-A 446
     1AIN VALUES OF   WATER  CONTENT AND,/,30X,82HYPW(I) CONTAIN VALUES OR-A 447
     2OF MATRIC POTENTIAL FROM THE SOIL-WATER CHARACTERISTIC CURVE,///)  OR-A 448
      DO 600 I=1,NUMPW                                                  OR-A 449
      WRITE (OUT,580) I,XPW(I),I,YPW(I)                                 OR-A 450
  580 FORMAT (42X,4HXPW(,I3,4H) = ,E11.4,10X,4HYPW(,I3,4H) = ,E11.4)    OR-A 451
  600 CONTINUE                                                          OR-A 452
      STOP                                                              OR-A 453
  620 CALL PSIW (WDRY,PDRY,DUM)                                         OR-A 454
      CALL PSIW (WSAT,PSAT,DUM)                                         OR-A 455
      GO TO 940                                                         OR-A 456
  640 PDRY = DRY                                                        OR-A 457
      PSAT = SAT                                                        OR-A 458
      IF (DRY.GE.0.) WRITE (OUT,660) MODE,JWORH,DRY                     OR-A 459
  660 FORMAT (////////////,56X,14HERROR CODE   3,//,50X,26HERROR IN    PROOR-A 460
     1GRAM NATURE,////,49X,28HDATA ERROR IN PROGRAM CARD 3,//,60X,      OR-A 461
     28H MODE = ,I3,/,60X,8HJWORH = ,I3,/,61X,7H DRY = ,E11.4,//,20X,   OR-A 462
     397HTHE MATRIC POTENTIAL AT AIR-DRY (UNSATURATED) CONDITIONS MUST BOR-A 463
     4E EXPRESSED AS A NEGATIVE QUANTITY,/,20X,72HCHECK TO MAKE SURE THAOR-A 464
     5T THE DATA IN PROGRAM CARD 3  IS CORRECTLY PUNCHED)               OR-A 465
      IF (DRY.GE.0.) STOP                                               OR-A 466
      IF (SAT.GT.0.) WRITE (OUT,680) MODE,JWORH,SAT                     OR-A 467
  680 FORMAT (////////////,56X,14HERROR CODE   4,//,50X,26HERROR IN    PROOR-A 468
     1GRAM NATURE,////,49X,28HDATA ERROR IN PROGRAM CARD 3,//,60X,      OR-A 469
     28H MODE = ,I3,/,60X,8HJWORH = ,I3,/,61X,7H SAT = ,E11.4,//,29X,   OR-A 470
```

```
     380HTHE MATRIC POTENTIAL AT SATURATION           MUST BE LESS THANOR-A 471
     4 OR EQUAL TO ZERO,/,29X,71HCHECK TO MAKE SURE THAT THE DATA IN PROOR-A 472
     5GRAM CARD 3 IS CORRECTLY PUNCHED)                                 OR-A 473
      IF (SAT.GT.0.) STOP                                               OR-A 474
      IF (NUMWP.LE.0) GO TO 800                                         OR-A 475
      IF (PDRY.GE.XWP(1).AND.PSAT.LE.XWP(NUMWP)) GO TO 800              OR-A 476
      IF (PDRY.LT.XWP(1)) WRITE (OUT,700) PDRY,XWP(1)                   OR-A 477
  700  FORMAT (////////////,56X,14HERROR CODE   5,//,50X,26HERROR IN    PROOR-A 478
     1GRAM NATURE,///,53X,20HERROR IN DATA SET WP,//,32X,74HTHE RANGE OFOR-A 479
     2 DATA SET WP IS TOO LIMITED, YOU MUST SPECIFY XWP(1) SUCH THAT,/, OR-A 480
     332X,86HTHE VALUE OF PARAMETER  DRY  IS GREATER(MORE POSITIVE) THENOR-A 481
     4 THAT OF XWP(1) BUT YOU SET,//,62X,6HDRY = ,E11.4,/,59X,9HXWP(1) =OR-A 482
     5 ,E11.4,///,20X,97HINCREASE THE X RANGE(POTENTIAL) OF DATA SET WP OR-A 483
     6AND THE CORRESPONDING VALUE OF YWP(1) AND RESUBMIT)               OR-A 484
      IF (PSAT.GT.XWP(NUMWP)) WRITE (OUT,720) NUMWP,NUMWP,PSAT,NUMWP,XWPOR-A 485
     1(NUMWP),NUMWP                                                    OR-A 486
  720  FORMAT (////////////,56X,14HERROR CODE   6,//,50X,26HERROR IN    PROOR-A 487
     1GRAM NATURE,///,53X,20HERROR IN DATA SET WP,//,30X,63HTHE RANGE OFOR-A 488
     2 DATA SET WP  IS TOO LIMITED, YOU MUST SPECIFY XWP(,I3,12H)  SUCH OR-A 489
     3THAT,/,30X,72HTHE VALUE OF PARAMETER  SAT  IS SMALLER(MORE NEGATIVOR-A 490
     4E) THEN THAT OF XWP(,I3,13H) BUT YOU SET,//,63X,6HSAT = ,E11.4,/, OR-A 491
     558X,4HXWP(,I3,4H) = ,E11.4,///,32X,76HINCREASE THE X RANGE(MATRIC OR-A 492
     6POTENTIAL) OF DATA SET WP AND THE CORRESPONDING ,/,32X,33HVALUE OFOR-A 493
     7   WATER  CONTENT IN YWP(,I3,14H) AND RESUBMIT)                   OR-A 494
      WRITE (OUT,740)                                                   OR-A 495
  740  FORMAT (/////,30X,80HDATA SET WP IS LISTED BELOW, WHERE XWP(I) CONOR-A 496
     1TAIN VALUES OF MATRIC POTENTIAL AND,/,30X,82HYWP(I) CONTAIN VALUESOR-A 497
     2 OF   WATER  CONTENT FROM THE SOIL-WATER CHARACTERISTIC CURVE,///)OR-A 498
      DO 780 I=1,NUMWP                                                  OR-A 499
      WRITE (OUT,760) I,XWP(I),I,YWP(I)                                 OR-A 500
  760  FORMAT (42X,4HXWP(,I3,4H) = ,E11.4,10X,4HYWP(,I3,4H) = ,E11.4)    OR-A 501
  780  CONTINUE                                                          OR-A 502
       STOP                                                             OR-A 503
  800  CALL WPSI (PDRY,WDRY,DUM)                                         OR-A 504
       CALL WPSI (PSAT,WSAT,DUM)                                        OR-A 505
C                                                                       OR-A 506
C                                                                       OR-A 507
C      IN ORDER TO USE THE START OPTION AND  K(PSI), ONE NEEDS THE      OR-A 508
C      RELATION   PSI(THETA)                                            OR-A 509
       IF (TBLPW.LT.0) GO TO 820                                        OR-A 510
       IF (TBLPW.GT.0) GO TO 860                                        OR-A 511
C      MAKE SURE THAT AN EMPIRICAL FORMULA  IS ACTUALLY SPECIFIED       OR-A 512
C      FOR PW                                                           OR-A 513
       WCK1 = WDRY+(WSAT-WDRY)*.3                                       OR-A 514
       CALL PSIW (WCK1,PCK1,DUM)                                        OR-A 515
       WCK2 = WDRY+(WSAT-WDRY)*.7                                       OR-A 516
       CALL PSIW (WCK2,PCK2,DUM)                                        OR-A 517
```

```
      IF (PCK2.NE.PCK1) GO TO 860                                       OR-A 518
C          GENERATE  XPW ARRAY                                          OR-A 519
 820  XPW(1) = WDRY                                                     OR-A 520
      YPW(1) = PDRY                                                     OR-A 521
      NUMPW = NUMPCK                                                    OR-A 522
      XPW(NUMPW) = WSAT                                                 OR-A 523
      YPW(NUMPW) = PSAT                                                 OR-A 524
      TBLPW = 4                                                         OR-A 525
      IF (PSAT.GE.0.) TBLPW = 1                                         OR-A 526
      NN1 = NUMPW-1                                                     OR-A 527
      DO 840 I=2,NN1                                                    OR-A 528
      YPW(I) = PDRY+(PSAT-PDRY)*PICK(I)                                 OR-A 529
 840  CALL WPSI (YPW(I),XPW(I),DUM)                                     OR-A 530
C                                                                       OR-A 531
C                              D(THETA)/D(PSI)                          OR-A 532
C                                                                       OR-A 533
C                                                                       OR-A 534
 860  TBLDWP = -1                                                       OR-A 535
      IF (TBLWP.LE.0) GO TO 900                                         OR-A 536
      TBLDWP = 1                                                        OR-A 537
      NUMDWP = NUMPCK                                                   OR-A 538
      DO 880 I=1,NUMDWP                                                 OR-A 539
      WI = WDRY+(WSAT-WDRY)*PICK(I)                                     OR-A 540
      CALL PSIW (WI,XDWP(I),DUM)                                        OR-A 541
 880  CALL WPSI (XDWP(I),DUM,YDWP(I))                                   OR-A 542
      XDWP(1) = PDRY                                                    OR-A 543
      XDWP(NUMDWP) = PSAT                                               OR-A 544
      IF (PSAT.NE.0.) NUMDWP = NUMDWP+1                                 OR-A 545
C     THE SLOPE IS ZERO IN THE SATURATION RANGE                         OR-A 546
      IF (PSAT.NE.0.) XDWP(NUMDWP) = 0.                                 OR-A 547
      IF (PSAT.NE.0.) YDWP(NUMDWP) = 0.                                 OR-A 548
C     EXTEND THE TABLE TO POSITIVE VALUES OF MATRIC POTENTIAL           OR-A 549
      NUMDWP = NUMDWP+1                                                 OR-A 550
      XDWP(NUMDWP)=(ABS(PDRY)+ABS(PSAT))*10.                            OR-A 551
      YDWP(NUMDWP) = 0.                                                 OR-A 552
C                     GENERATE    K(PSI)                              OR-A 553
C     GENERATE THE KPZ TABLE OF CONDUCTIVITY AS A FUNCTION OF MATRIC    OR-A 554
C     POTENTIAL                                                         OR-A 555
C     IN THE TABLE USE THE MATRIC POTENTIAL CORRESPONDING TO THAT OF THEOR-A 556
C     SPECIFIC VALUES OF WATER CONTENT                                  OR-A 557
  900 NUMKPZ = NUMPCK                                                   OR-A 558
      TBLKPZ = 1                                                        OR-A 559
      DO 920 I=2,NUMKPZ                                                 OR-A 560
      WI = WDRY+(WSAT-WDRY)*PICK(I)                                     OR-A 561
      CALL PSIW (WI,XKPZ(I),DUM)                                        OR-A 562
 920  CALL KWZ (WI,YKPZ(I))                                             OR-A 563
      XKPZ(1) = PDRY                                                    OR-A 564
      XKPZ(NUMKPZ) = PSAT
```

```
      CALL KWZ (WSAT,YKPZ(NUMKPZ))                                      OR-A 565
      CALL KWZ (WDRY,YKPZ(1))                                           OR-A 566
C     EXTEND THE TABLE TO POSITIVE VALUES OF MATRIC POTENTIAL           OR-A 567
      NUMKPZ = NUMKPZ+1                                                 OR-A 568
      XKPZ(NUMKPZ)=(ABS(PDRY)+ABS(PSAT))*10.                            OR-A 569
      CALL KWZ (WSAT,YKPZ(NUMKPZ))                                      OR-A 570
C        COMPUTE THE HYDRAULIC CONDUCTIVITY AT SATURATION               OR-A 571
  940 CALL KWZ (WSAT,KWZSAT)                                            OR-A 572
C        COMPUTE THE HYDRAULIC CONDUCTIVITY AT AIR-DRY CONDITIONS       OR-A 573
      CALL KWZ (WDRY,KWZDRY)                                            OR-A 574
      QMIN = ABS(KWZSAT)/1.E+06                                         OR-A 575
      IF(KWZDRY.EQ.0.) GO TO 960                                        OR-A 576
      IF(ABS(KWZDRY).LT.QMIN) QMIN=ABS(KWZDRY)                          OR-A 577
  960 EVPRTE = 0.                                                       OR-A 578
      TRNSPR = 0.                                                       OR-A 579
      FLTRTE = 0.                                                       OR-A 580
C     COMPUTE THE INITIAL VOLUME OF WATER PER UNIT AREA IN THE SOIL     OR-A 581
      CALL INTGRT (1,N,Z,THETA,WACCUM,3HWZ1)                            OR-A 582
      WCMPTE = WACCUM                                                   OR-A 583
C     COMPUTE THE INITIAL TOTAL LIQUID PHASE SOLUTE MASS PER UNIT AREA  OR-A 584
C     OF THE SOIL COLUMN                                                OR-A 585
      DO 980 I=1,N                                                      OR-A 586
  980 DUMMYB(I) = C(I)*THETA(I)                                         OR-A 587
      CALL INTGRT (1,N,Z,DUMMYB,CACCUM,3HCZ1)                           OR-A 588
      CCMPTE = CACCUM                                                   OR-A 589
      CALL INTGRT (1,N,Z,S,SCMPTE,3HSZ1)                                OR-A 590
C     INITIALLY ALL OF THE PLANTS AND THEIR ROOTS ARE LIVING (IF ANY)   OR-A 591
      TR = 0.                                                           OR-A 592
      TCR = 0.                                                          OR-A 593
      CTRSUM = 0.                                                       OR-A 594
      WILTED = 0                                                        OR-A 595
      JTRIP = 0                                                         OR-A 596
      K1 = 0                                                            OR-A 597
      TIME = TIME0                                                      OR-A 598
      DTK = DTMIN                                                       OR-A 599
C                  INITIAL DARCIAN FLUX IS EVALUATED AT  (I+1/2,0)     OR-A 600
      IF (JWORH.EQ.1) GO TO 1020                                        OR-A 601
      DO 1000 I=1,N1                                                    OR-A 602
      WKI = (THETA(I)+THETA(I+1))/2.                                    OR-A 603
      CALL DWZ (WKI,DZIK)                                               OR-A 604
      CALL KWZ (WKI,KZIK)                                               OR-A 605
      QZ(I) = -DZIK*(THETA(I+1)-THETA(I))/(Z(I+1)-Z(I))+KZIK*GRAV       OR-A 606
      IF (ABS(QZ(I)).LE.QMIN) QZ(I) = 0.                                OR-A 607
 1000 CONTINUE                                                          OR-A 608
      GO TO 1060                                                        OR-A 609
 1020 DO 1040 I=1,N1                                                    OR-A 610
      PKI = (PSI(I)+PSI(I+1))/2.                                        OR-A 611
```

```
      CALL INTRP (NUMKPZ,TBLKPZ,XKPZ,YKPZ,PKI,KZIK,DUM,3HKP )          OR-A 612
      QZ(I) = -KZIK*((PSI(I+1)-PSI(I))*CNVRSN/(Z(I+1)-Z(I))-GRAV)      OR-A 613
      IF (ABS(QZ(I)).LE.QMIN) QZ(I) = 0.                               OR-A 614
 1040 CONTINUE                                                         OR-A 615
 1060 QWTOP = QZ(1)                                                    OR-A 616
      QWBTM = QZ(N1)                                                   OR-A 617
C     INITIALIZE THE BOUNDARY CONDITION PARAMETERS                     OR-A 618
      IF (MODE.NE.2) CALL BCWTOP (TIME,FTOP)                           OR-A 619
      IF (MODE.NE.2) CALL BCWBTM (TIME,FBTM)                           OR-A 620
      IF (MODE.NE.1) CALL BCCTOP (TIME,FCTOP)                          OR-A 621
      IF (MODE.NE.1) CALL BCCBTM (TIME,FCBTM)                          OR-A 622
C        COMPUTE THE INITIAL TIME STEP-SIZE                            OR-A 623
      CALL STEP (TIME)                                                 OR-A 624
      IF (DTK1.LT.DTMIN) DTK1 = DTMIN                                  OR-A 625
      IF (DTK1.GT.DTMAX) DTK1 = DTMAX                                  OR-A 626
      DTK = DTK1                                                       OR-A 627
      IF (MODE.EQ.1) GO TO 1100                                        OR-A 628
C                                                                      OR-A 629
C                          INITIAL GUESS                               OR-A 630
      IF (BCTOPC.NE.1) GO TO 1080                                      OR-A 631
      CGUESS(1) = FCTOP                                                OR-A 632
      COLD1(1)  = FCTOP                                                OR-A 633
      COLD2(1)  = FCTOP                                                OR-A 634
 1080 IF (BCBTMC.NE.1) GO TO 1100                                      OR-A 635
      CGUESS(N) = FCBTM                                                OR-A 636
      COLD1(N)  = FCBTM                                                OR-A 637
      COLD2(N)  = FCBTM                                                OR-A 638
 1100 IF (MODE.EQ.2) GO TO 1300                                        OR-A 639
C                                                                      OR-A 640
      IF (JWORH.EQ.1) GO TO 1160                                       OR-A 641
C                          1ST TYPE B.C.                               OR-A 642
      IF (BCTOPW.NE.1) GO TO 1120                                      OR-A 643
      WGUESS(1) = FTOP                                                 OR-A 644
      WOLD1(1)  = FTOP                                                 OR-A 645
      WOLD2(1)  = FTOP                                                 OR-A 646
      GO TO 1140                                                       OR-A 647
 1120 IF (BCTOPW.NE.4) GO TO 1140                                      OR-A 648
C                        4TH TYPE B.C.                                 OR-A 649
C     ASSUME ALL OF THE WATER GOES INTO THE 1ST NODE SPACING           OR-A 650
      WGUESS(1) = FTOP*DTK1/(Z(2)-Z(1))+THETA(1)                       OR-A 651
      IF (WGUESS(1).GT.WSAT) WGUESS(1) = WSAT                          OR-A 652
      IF (WGUESS(1).LT.WDRY) WGUESS(1) = WDRY                          OR-A 653
 1140 IF (BCBTMW.NE.1) GO TO 1220                                      OR-A 654
      WGUESS(N) = FBTM                                                 OR-A 655
      WOLD1(N)  = FBTM                                                 OR-A 656
      WOLD2(N)  = FBTM                                                 OR-A 657
      GO TO 1220                                                       OR-A 658
```

```
 1160 IF (BCTOPW.NE.1) GO TO 1180                                        OR-A 659
      PGUESS(1) = FTOP                                                   OR-A 660
      POLD1(1)  = FTOP                                                   OR-A 661
      POLD2(1)  = FTOP                                                   OR-A 662
      GO TO 1200                                                         OR-A 663
 1180 IF (BCTOPW.NE.4) GO TO 1200                                        OR-A 664
C                      4TH TYPE B.C.                                     OR-A 665
      W1 = FTOP*DTK1/(Z(2)-Z(1))+THETA(1)                                OR-A 666
      IF (W1.GT.WSAT) W1 = WSAT                                          OR-A 667
      IF (W1.LT.WDRY) W1 = WDRY                                          OR-A 668
      CALL PSIW (W1,PGUESS(1),DUM)                                       OR-A 669
      IF (PGUESS(1).GT.PSAT) PGUESS(1) = PSAT                            OR-A 670
      IF (PGUESS(1).LT.PDRY) PGUESS(1) = PDRY                            OR-A 671
 1200 IF (BCBTMW.NE.1) GO TO 1220                                        OR-A 672
      PGUESS(N) = FBTM                                                   OR-A 673
      POLD1(N)  = FBTM                                                   OR-A 674
      POLD2(N)  = FBTM                                                   OR-A 675
C                                                                        OR-A 676
C     IF USING THE START OPTION, SOLVE IN TERMS OF DIFFUSIVITY POTENTIALOR-A 677
 1220 IF (START.NE.0) CALL TRNSFM                                        OR-A 678
C                                                                        OR-A 679
      IF (MODE.NE.2.AND.START.EQ.0) WRITE (OUT,1240) WDRY,PDRY,UPTNTL,   OR-A 680
     1KWZDRY,WLNGTH,UTIME,WSAT,PSAT,UPTNTL,KWZSAT,ULNGTH,UTIME           OR-A 681
 1240 FORMAT (/////,34X,67HAIR-DRY AND SATURATED VALUES OF   WATER ,POTEOR-A 682
     1NTIAL AND CONDUCTIVITY,///,13X,25HAIR-DRY     THETA(DRY) = ,E12.5,OR-A 683
     25X,11HPSI(DRY) = ,E12.5,1X,1H(,6A1,1H),4X,9HK(DRY) = ,E12.5,1X,1H(OR-A 684
     3,2A1,1H/,3A1,1H),//,13X,25HSATURATION  THETA(SAT) = ,E12.5,5X,     OR-A 685
     411HPSI(SAT) = ,E12.5,1X,1H(,6A1,1H),4X,9HK(SAT) = ,E12.5,1X,1H(,   OR-A 686
     52A1,1H/,3A1,1H),//)                                                OR-A 687
      IF (MODE.NE.2.AND.START.NE.0) WRITE (OUT,1260) WDRY,PDRY,FDRY,     OR-A 688
     1KWZDRY,WSAT,PSAT,FSAT,KWZSAT                                       OR-A 689
 1260 FORMAT (/////,34X,68HAIR-DRY AND SATURATED VALUES OF   WATER , POTOR-A 690
     1ENTIAL AND CONDUCTIVITY,///,5X,25HAIR-DRY     THETA(DRY) = ,E12.5,OR-A 691
     25X,11HPSI(DRY) = ,E12.5,5X,9HF(DRY) = ,E12.5,5X,9HK(DRY) = ,E12.5,OR-A 692
     3//,5X,25HSATURATION  THETA(SAT) = ,E12.5,5X,11HPSI(SAT) = ,E12.5,  OR-A 693
     45X,9HF(SAT) = ,E12.5,5X,9HK(SAT) = ,E12.5,//)                      OR-A 694
      IF (MODE.NE.2.AND.TBLOPS.GE.0) WRITE (OUT,1280) PWILT,UPTNTL       OR-A 695
 1280 FORMAT (//,20X,57HPLANT SURFACE WILTING POTENTIAL IS SPECIFIED AS OR-A 696
     1 PWILT = ,E13.6,1X,1H(,6A1,1H),//)                                 OR-A 697
C                                                                        OR-A 698
C             IS THE START OPTION BEING USED                             OR-A 699
      IF (START.NE.0) JWORK = 2                                          OR-A 700
C                                                                        OR-A 701
C                                                                        OR-A 702
C      CHECK IF DATA IS TO BE PUNCHED OUT                                OR-A 703
 1300 IF (OUTPUT.LE.0) GO TO 1360                                        OR-A 704
      WRITE (PNCH,1320) TIME0,QPOLD(2),QWTOP,QWBTM,QCTOP,QCBTM,TR,TCR    OR-A 705
```

```
      WRITE (PNCH,1320) EVPRTE,FLTRTE,TRNSPR,CTRSUM,CCMPTE,SCMPTE,WCMPTEOR-A 706
     1,PPSURF(3)                                                       OR-A 707
 1320 FORMAT (8E10.4)                                                  OR-A 708
      DO 1340 I=1,N                                                    OR-A 709
 1340  WRITE (PNCH,1320) Z(I),THETA(I),PSI(I),C(I),S(I),A(I),G(I),QZ(I) OR-A 710
                                                                       OR-A 711
 1360 WRITE (OUT,1380)                                                 OR-A 712
 1380 FORMAT (1H1,  ///,58X,18HINITIAL CONDITIONS,////)                OR-A 713
      IF (JWORH.EQ.2) WRITE (OUT,1400) ULNGTH,UTIME,UPTNTL,ULNGTH,UMASS,OR-A 714
     1ULNGTH,UMASS,ULNGTH,UMASS,ULNGTH,UTIME,UMASS,ULNGTH,UTIME,ULNGTH, OR-A 715
     2 UTIME                                                           OR-A 716
 1400  FORMAT(2X,11HDIFFUSIVITY,2X,8H  WATER ,5X,6HMATRIC,7X,5HDEPTH,5X, OR-A 717
     14HNODE,8X,20HSOLUTE CONCENTRATION,  9X,9HROOT SINK,3X,9HROOT SINK,OR-A 718
     2  3X,12HDARCIAN FLUX,/, 3X,9HPOTENTIAL,4X,7HCONTENT,4X,          OR-A 719
     39HPOTENTIAL, 22X,6HLIQUID, 6X,6HLIQUID,6X,5HSOLID,/, 7X,1HF, 9X, OR-A 720
     45HTHETA,8X,3HPSI,10X,1HZ,8X,1HI,8X,  1HC,8X,7HC*THETA, 7X,1HS,11X,OR-A 721
     5 1HA,11X,1HG,12X,2HQZ,/,  2X,1H(,2A1,4H**2/, 3A1,1H),14X,1H(,6A1, OR-A 722
     61H),6X,1H(,2A1,1H),11X,1H(,3A1,1H/,2A1,4H**3), 1X,1H(,3A1,1H/,   OR-A 723
     7 2A1,4H**3),1X,1H(,3A1,1H/, 2A1,4H**3), 2X,3H(1/,3A1,1H),1X,     OR-A 724
     8 1H(,3A1,1H/, 2A1,4H**3/,3A1,1H),2X,1H(,2A1,1H/,3A1,1H),//,4X,   OR-A 725
     97H(I,K+1),5X,7H(I,K+1),5X,7H(I,K+1),7X,3H(I),13X,7H(I,K+1),5X,    OR-A 726
     A 7H(I,K+1),5X,7H(I,K+1),3X,9H(I,K+1/2),3X,9H(I,K+1/2), 2X,       OR-A 727
     B 13H(I+1/2,K+1/2),//)                                            OR-A 728
      IF(JWORH.NE.2) WRITE(OUT,1420) UPTNTL,ULNGTH,UMASS,ULNGTH,UMASS, OR-A 729
     1ULNGTH,UMASS,ULNGTH,UTIME,UMASS,ULNGTH,UTIME,ULNGTH,UTIME        OR-A 730
 1420  FORMAT(1X,16H  WATER CONTENT , 2X,16HMATRIC POTENTIAL, 3X,5HDEPTH,OR-A 731
     1 3X,4HNODE, 9X,20HSOLUTE CONCENTRATION,  9X,9HROOT SINK,5X,      OR-A 732
     2 9HROOT SINK,4X,12HDARCIAN FLUX,/, 54X,6HLIQUID,5X,6HLIQUID,7X,  OR-A 733
     35HSOLID,7X,5HWATER,8X,6HSOLUTE,10X,5HWATER,/, 7X,5HTHETA,13X,    OR-A 734
     43HPSI,12X,1HZ,6X,1HI, 8X,1HC,8X,7HC*THETA, 8X,1HS,11X,1HA,13X,1HG,OR-A 735
     5  13X,2HQZ,/, 23X,1H(,6A1,1H), 8X,1H(,2A1,1H), 8X,1H(,3A1,1H/,2A1,OR-A 736
     6 4H**3),1X,1H(,3A1,1H/,2A1,4H**3),1X,1H(,3A1,1H/,2A1,4H**3),3X,  OR-A 737
     7 3H(1/,3A1,1H),3X,1H(,3A1,1H/,2A1,4H**3/,3A1,1H),3X,1H(,2A1,1H/, OR-A 738
     8  3A1,1H),//, 6X,7H(I,K+1),10X,7H(I,K+1), 9X,3H(I),11X,7H(I,K+1), OR-A 739
     9 5X,7H(I,K+1),5X,7H(I,K+1),4X,9H(I,K+1/2),4X,9H(I,K+1/2),4X,     OR-A 740
     A 13H(I+1/2,K+1/2),//)                                            OR-A 741
      IF (JWORH.EQ.2) WRITE (OUT,1440) (F(I),THETA(I),PSI(I),Z(I),I,C(I)OR-A 742
     1, DUMMYB(I),S(I),A(I),G(I),QZ(I),I=1,N)                          OR-A 743
 1440  FORMAT(1X,E11.4,1X,E11.4,1X,E11.4, 1X,E11.4,3X,I3,1X,E11.4,1X,   OR-A 744
     1  E11.4,1X,E11.4,1X,E11.4,1X,E11.4,2X,E11.4)                     OR-A 745
      IF(JWORH.NE.2) WRITE(OUT,1460) (THETA(I),PSI(I),Z(I),I,C(I),     OR-A 746
     $ DUMMYB(I),S(I),A(I),G(I),QZ(I),I=1,N)                           OR-A 747
 1460  FORMAT(2X,E12.5,6X,E12.5, 2X,E11.4,1X, I3,1X,E11.4, 1X,E11.4,   OR-A 748
     1 1X,E11.4,1X,E11.4,3X,E11.4,4X,E11.4)                            OR-A 749
      WRITE (OUT,1980) TIME,UTIME                                      OR-A 750
      BLNCE = 0.                                                       OR-A 751
      CBLNCE = 0.                                                      OR-A 752
      WBLNCE = 0.
```

```
      WRITE (OUT,2000) WACCUM,ULNGTH,WCMPTE,ULNGTH,BLNCE,ULNGTH,WBLNCE  OR-A 753
      IF (MODE.NE.2) WRITE (OUT,2020) FLTRTE,ULNGTH,EVPRTE,ULNGTH,TRNSPROR-A 754
     1,ULNGTH                                                          OR-A 755
      IF (MODE.EQ.1) GO TO 1480                                        OR-A 756
      WRITE (OUT,2040) CTRSUM,UMASS,ULNGTH                             OR-A 757
      WRITE (OUT,2060)                                                 OR-A 758
      IF (JSORB.LE.0) WRITE (OUT,2120) CACCUM,UMASS,ULNGTH,CCMPTE,UMASS,OR-A 759
     1ULNGTH,BLNCE,UMASS,ULNGTH,CBLNCE                                 OR-A 760
      IF (JSORB.GE.1) WRITE (OUT,2100) CCMPTE,UMASS,ULNGTH             OR-A 761
      IF (JSORB.GE.1) WRITE (OUT,2060)                                 OR-A 762
      IF (JSORB.GE.1) WRITE (OUT,2160) SCMPTE,UMASS,ULNGTH             OR-A 763
 1480 WRITE (OUT,1500)                                                 OR-A 764
 1500 FORMAT (////////////)                                            OR-A 765
 1520 TIME = TIME+DTK1                                                 OR-A 766
      IF (TIME.GT.TIMEF) DTK1 = DTK1+TIMEF-TIME                        OR-A 767
      IF (TIME.GT.TIMEF) TIME = TIMEF                                  OR-A 768
      K1 = K1+1                                                        OR-A 769
C     CHECK IF THE START OPTION IS BEING FINISHED(IF USED)              OR-A 770
      IF (START.LE.0) GO TO 1560                                       OR-A 771
      IF (K1.LE.START) GO TO 1560                                      OR-A 772
      JWORH = JWHS                                                     OR-A 773
      START = 0                                                        OR-A 774
      IF (K1.GT.2) GO TO 1560                                          OR-A 775
      DO 1540 I=1,N                                                    OR-A 776
      IF (JWHS.EQ.0) CALL INTRP (NUMWF,TBLWF,XWF,YWF,FGUESS(I),WGUESS(I)OR-A 777
     1,DUM,3HWF )                                                      OR-A 778
      IF (JWHS.EQ.1) CALL INTRP (NUMPF,TBLPF,XPF,YPF,FGUESS(I),PGUESS(I)OR-A 779
     1,DUM,3HPF )                                                      OR-A 780
 1540 CONTINUE                                                         OR-A 781
 1560 IF (MODE.EQ.2.OR.NPRINT.EQ.0.OR.OUTPUT.EQ.2) GO TO 1600          OR-A 782
      CALL BCWTOP (TIME,DUM)                                           OR-A 783
      IF (BCTOPW.EQ.4) WRITE (OUT,1580) UTIME,ULNGTH,UTIME             OR-A 784
 1580 FORMAT (35X,6HTIME (,3A1,1H),6X,10HITERATIONS,6X,23H  SURFACE  WATOR-A 785
     1ER FLUX (,2A1,1H/,3A1,1H),2X,12HAT (1/2,K+1),//,51X,4HMAXI,2X,   OR-A 786
     24HMINI,13X,14HPOTENTIAL FLUX,5X,11HACTUAL FLUX,//)               OR-A 787
 1600 NPRINT = 0                                                       OR-A 788
      IF (NSKIP.LE.0) GO TO 1620                                       OR-A 789
      MOD1 = K1/NSKIP                                                  OR-A 790
      IF ((K1-MOD1*NSKIP).EQ.0) NPRINT = 1                             OR-A 791
 1620 IF (ABS(TIME-TIMEF).LE.DTLMT) NPRINT = 1                         OR-A 792
      IF (NPRINT.EQ.1) NPNCH = NPNCH+1                                 OR-A 793
      IF (MODE.EQ.2) GO TO 1800                                        OR-A 794
      IF (JWORH.EQ.0) CALL WATER (TIME,WDRY,WSAT,WGUESS,WOLD1,WOLD2,   OR-A 795
     1THETA,K1,JWHS,NUMMAX)                                            OR-A 796
      IF (JWORH.EQ.1) CALL WATER (TIME,PDRY,PSAT,PGUESS,POLD1,POLD2,PSI,OR-A 797
     1K1,JWHS,NUMMAX)                                                  OR-A 798
      IF (JWORH.EQ.2) CALL WATER (TIME,FDRY,FSAT,FGUESS,FOLD1,FOLD2,F,K1OR-A 799
```

```
     1,JWHS,NUMMAX)                                                    OR-A 800
      Z2 = Z(2)-Z(1)                                                   OR-A 801
      Z1 = Z(N)-Z(N1)                                                  OR-A 802
      QWTOP = QCOLD(2)                                                 OR-A 803
C     COMPUTE THE DARCIAN FLUX AT (I+1/2,K+1/2)                        OR-A 804
C        QZ HAS UNITS OF ( L**3 FLUID/L**2 GROSS/T)                    OR-A 805
      IF (START.NE.0) GO TO 1740                                       OR-A 806
      IF (JWHS.EQ.1) GO TO 1680                                        OR-A 807
      DO 1640 I=1,N1                                                   OR-A 808
      WPIK = (THETA(I)+THETA(I+1)+WOLD2(I) +WOLD2(I+1) )/4.            OR-A 809
      CALL DWZ (WPIK,DZPIK)                                            OR-A 810
      CALL KWZ (WPIK,KZPIK)                                            OR-A 811
      QZ(I) = -DZPIK*(THETA(I+1)+WOLD2(I+1) -THETA(I)-WOLD2(I) )/2./(Z(IOR-A 812
     1+1)-Z(I))+KZPIK*GRAV                                             OR-A 813
      IF (ABS(QZ(I)).LE.QMIN) QZ(I) = 0.                               OR-A 814
 1640 CONTINUE                                                         OR-A 815
      IF (BCTOPW.EQ.4) GO TO 1660                                      OR-A 816
      WIK = (THETA(1)+THETA(2))/2.                                     OR-A 817
      CALL DWZ (WIK,DZIK)                                              OR-A 818
      CALL KWZ (WIK,KZIK)                                              OR-A 819
C     COMPUTE THE   WATER  FLUX(DARCIAN) THROUGH THE UPPER AND LOWER   OR-A 820
C     SURFACES BY MEANS OF A BACKWARD-DIFFERENCE SCHEME AT TIME LEVEL  OR-A 821
C     K+1                                                              OR-A 822
C                                  QTOP(1/2,K+1)                       OR-A 823
      QWTOP = (KZIK/Z2*GRAV-WOLD2(1) /DTK1+THETA(1)*(DZIK/Z2/Z2+1./DTK1)OR-A 824
     1-THETA(2)*DZIK/Z2/Z2)*Z2                                         OR-A 825
 1660 WIK = (THETA(N1)+THETA(N))/2.                                    OR-A 826
      CALL DWZ (WIK,DZIK)                                              OR-A 827
      CALL KWZ (WIK,KZIK)                                              OR-A 828
C                                  QBTM(N+1/2,K+1)                     OR-A 829
      QWBTM = (THETA(N1)*DZIK/Z1/Z1+THETA(N)*(-1./DTK1-DZIK/Z1/Z1)+WOLD OR-A 830
     12(N) /DTK1+KZIK*GRAV/Z1)*Z1                                      OR-A 831
      GO TO 1800                                                       OR-A 832
C                                                                      OR-A 833
 1680 DO 1700 I=1,N1                                                   OR-A 834
      PPIK = (PSI(I)+PSI(I+1)+POLD2(I) +POLD2(I+1) )/4.                OR-A 835
      CALL INTRP (NUMKPZ,TBLKPZ,XKPZ,YKPZ,PPIK,KZPIK,DUM,3HKP )        OR-A 836
      QZ(I) = -KZPIK*(PSI(I+1)+POLD2(I+1) -PSI(I)-POLD2(I) )/2./(Z(I+1)-OR-A 837
     1Z(I))*CNVRSN+KZPIK*GRAV                                          OR-A 838
      IF (ABS(QZ(I)).LE.QMIN) QZ(I) = 0.                               OR-A 839
 1700 CONTINUE                                                         OR-A 840
      IF (BCTOPW.EQ.4) GO TO 1720                                      OR-A 841
      PIK = (PSI(1)+PSI(2))/2.                                         OR-A 842
      CALL INTRP (NUMKPZ,TBLKPZ,XKPZ,YKPZ,PIK,KZIK,DUM,3HKP1)          OR-A 843
      P1KH = (PSI(1)+POLD2(1) )/2.                                     OR-A 844
      IF (TBLWP.LE.0) CALL WPSI (P1KH,DUM,SMC1KH)                      OR-A 845
      IF (TBLWP.GT.0) CALL INTRP (NUMDWP,TBLDWP,XDWP,YDWP,P1KH,SMC1KH, OR-A 846
```

```
     1DUM,3HDW5)                                                        OR-A 847
      QWTOP = (KZIK*GRAV/Z2-POLD2(1) *SMC1KH/DTK1+PSI(1)*(KZIK*CNVRSN/Z2OR-A 848
     1/Z2+SMC1KH/DTK1)-PSI(2)*KZIK*CNVRSN/Z2/Z2)*Z2                     OR-A 849
 1720 PIK = (PSI(N)+PSI(N1))/2.                                         OR-A 850
      CALL INTRP (NUMKPZ,TBLKPZ,XKPZ,YKPZ,PIK,KZIK,DUM,3HKP2)           OR-A 851
      PNKH = (PSI(N)+POLD2(N) )/2.                                      OR-A 852
      IF (TBLWP.LE.0) CALL WPSI (PNKH,DUM,SMCNKH)                       OR-A 853
      IF (TBLWP.GT.0) CALL INTRP (NUMDWP,TBLDWP,XDWP,YDWP,PNKH,SMCNKH,  OR-A 854
     1DUM,3HDW6)                                                        OR-A 855
      QWBTM = (PSI(N1)*KZIK*CNVRSN/Z1/Z1+PSI(N)*(-SMCNKH/DTK1-KZIK*     OR-A 856
     1CNVRSN/Z1/Z1)+POLD2(N) *SMCNKH/DTK1+KZIK*GRAV/Z1)*Z1              OR-A 857
      GO TO 1800                                                        OR-A 858
C     DIFFUSIVITY POTENTIAL-BASED FLOW                                  OR-A 859
 1740 DO 1760 I=1,N1                                                    OR-A 860
      FPIK = (F(I)+F(I+1)+FOLD2(I) +FOLD2(I+1) )/4.                     OR-A 861
      CALL INTRP (NUMKFZ,TBLKFZ,XKFZ,YKFZ,FPIK,KZPIK,DUM,3HKF )         OR-A 862
      QZ(I) = -(F(I+1)+FOLD2(I+1) -F(I)-FOLD2(I) )/2./(Z(I+1)-Z(I))+    OR-A 863
     1KZPIK*GRAV                                                        OR-A 864
      IF (ABS(QZ(I)).LE.QMIN) QZ(I) = 0.                                OR-A 865
 1760 CONTINUE                                                          OR-A 866
      IF (BCTOPW.EQ.4) GO TO 1780                                       OR-A 867
      F1KH = (F(1)+FOLD2(1) )/2.                                        OR-A 868
      FK1 = (F(1)+F(2))/2.                                              OR-A 869
      CALL INTRP (NUMKFZ,TBLKFZ,XKFZ,YKFZ,FK1,KZK1,DUM,3HKF1)           OR-A 870
      IF (JWHS.EQ.0) CALL INTRP (NUMDFZ,TBLDFZ,XDFZ,YDFZ,F1KH,DZK1,DUM, OR-A 871
     13HDF )                                                            OR-A 872
      IF (JWHS.EQ.0.AND.DZK1.EQ.0.) COEF1 = 1.E+10                      OR-A 873
      IF (JWHS.EQ.0.AND.DZK1.NE.0.) COEF1 = 1./DZK1                     OR-A 874
      IF (JWHS.EQ.1) CALL INTRP (NUMDWF,TBLDWF,XDWF,YDWF,F1KH,COEF1,DUM,OR-A 875
     13HDW )                                                            OR-A 876
      QWTOP = (KZK1/Z2*GRAV-FOLD2(1) *COEF1/DTK1+F(1)*(1./Z2/Z2+COEF1/  OR-A 877
     1DTK1)-F(2)/Z2/Z2)*Z2                                              OR-A 878
 1780 FNKH = (F(N)+FOLD2(N) )/2.                                        OR-A 879
      FKN = (F(N)+F(N1))/2.                                             OR-A 880
      CALL INTRP (NUMKFZ,TBLKFZ,XKFZ,YKFZ,FKN,KZKN,DUM,3HKF2)           OR-A 881
      IF (JWHS.EQ.0) CALL INTRP (NUMDFZ,TBLDFZ,XDFZ,YDFZ,FNKH,DZKN,DUM, OR-A 882
     13HDF1)                                                            OR-A 883
      IF (JWHS.EQ.0.AND.DZKN.EQ.0.) COEFN = 1.E+10                      OR-A 884
      IF (JWHS.EQ.0.AND.DZKN.NE.0.) COEFN = 1./DZKN                     OR-A 885
      IF (JWHS.EQ.1) CALL INTRP (NUMDWF,TBLDWF,XDWF,YDWF,FNKH,COEFN,DUM,OR-A 886
     13HDW1)                                                            OR-A 887
      QWBTM = (KZKN/Z1*GRAV+F(N1)/Z1/Z1+F(N)*(-COEFN/DTK1-1./Z1/Z1)+FOLDOR-A 888
     12(N) *COEFN/DTK1)*Z1                                              OR-A 889
 1800 IF (MODE.EQ.1) GO TO 1900                                         OR-A 890
      CALL SOLUTE (TIME,K1)                                             OR-A 891
C                                                                       OR-A 892
C     COMPUTE THE TOTAL        LIQUID PHASE SOLUTE IN THE SOIL COLUMN ATOR-A 893
```

```
C     TIME  K+1                                                                  OR-A 894
      DO 1820 I=1,N                                                             OR-A 895
1820  DUMMYB(I) = C(I)*THETA(I)                                                 OR-A 896
      IF (BCTOPC.EQ.3) CALL INTGRT (1,N,Z,DUMMYB,CCMPTE,3HCZ2)                  OR-A 897
      IF (BCTOPC.NE.3) CALL INTGRT (2,N,Z,DUMMYB,CCMPTE,3HCZ3)                  OR-A 898
C     COMPUTE THE TOTAL SOLID PHASE SOLUTE IN THE SOIL COLUMN AT TIME           OR-A 899
C     K+1                                                                       OR-A 900
      OLDSI = SCMPTE                                                            OR-A 901
      IF (JSORB.GE.1.AND.BCTOPC.EQ.3) CALL INTGRT (1,N,Z,S,SCMPTE,3HSZ2)        OR-A 902
      IF (JSORB.GE.1.AND.BCTOPC.NE.3) CALL INTGRT (2,N,Z,S,SCMPTE,3HSZ3)        OR-A 903
C     SOLUTE FLUX THROUGH THE SOIL SURFACE                                      OR-A 904
C     USE A BACKWARD-DIFFERENCE SCHEME                                          OR-A 905
      IF (BCTOPC.EQ.3) GO TO 1860                                               OR-A 906
      IF (MODE.EQ.2.OR.BCTOPW.NE.4) GO TO 1840                                  OR-A 907
      QCTOP = 0.                                                                OR-A 908
      IF (QWTOP.LE.0.) GO TO 1860                                               OR-A 909
 1840 Z2 = Z(2)-Z(1)                                                            OR-A 910
C                                  QCTOP(1/2,K+1/2)                           OR-A 911
      W1K = (THETA(1)+WOLD2(1) +THETA(2)+WOLD2(2) )/4.                          OR-A 912
      CALL DSZ (W1K,QZ(1),DSZ1K)                                                OR-A 913
      T1C = W1K*DSZ1K/2./Z2/Z2+QZ(1)/4./Z2                                      OR-A 914
      T2C = -W1K*DSZ1K/2./Z2/Z2+QZ(1)/4./Z2                                     OR-A 915
      QCTOP = (C(1)*(THETA(1)/DTK1+T1C)+C(2)*(T2C)+COLD2(1) *(-WOLD2(1)         OR-A 916
     1/DTK1+T1C)+COLD2(2) *(T2C))*Z2                                            OR-A 917
 1860 IF (BCBTMC.EQ.3) GO TO 1880                                               OR-A 918
      Z1 = Z(N)-Z(N1)                                                           OR-A 919
C                                  QCBTM(N+1/2,K+1/2)                         OR-A 920
      WNK = (THETA(N)+WOLD2(N) +THETA(N1)+WOLD2(N1) )/4.                        OR-A 921
      CALL DSZ (WNK,QZ(N1),DSZNK)                                               OR-A 922
      T1C = -WNK*DSZNK/2./Z1/Z1-QZ(N1)/4./Z1                                    OR-A 923
      T2C = WNK*DSZNK/2./Z1/Z1-QZ(N1)/4./Z1                                     OR-A 924
      QCBTM = (C(N1)*(-T1C)+C(N)*(-THETA(N)/DTK1-T2C)+COLD2(N1) *(-T1C))+       OR-A 925
     1COLD2(N) *(WOLD2(N) /DTK1-T2C))*Z1                                        OR-A 926
C      ACCUMULATIVE SOLUTE UPTAKE BY THE ROOTS( A NEGATIVE QUANTITY)            OR-A 927
1880  IF (MODE.NE.1                  ) CTRSUM = CTRSUM+TCR*DTK1                 OR-A 928
C     TOTAL LIQUID PHASE SOLUTE IN THE SOIL COLUMN AT TIME  K+1                 OR-A 929
C     COMPUTED BY SUMMING FLUXES                                                OR-A 930
      CACCUM = CACCUM+(QCTOP-QCBTM+TCR)*DTK1-SCMPTE+OLDSI                       OR-A 931
C     IGNORE THE FLUX SUMMATION ON THE FIRST TIME STEP, SINCE IT IS             OR-A 932
C     ALWAYS IN ERROR.                                                          OR-A 933
      IF (K1.EQ.1) CACCUM = CCMPTE                                              OR-A 934
C     ALSO UPDATE AFTER A REGRIDDING OF THE SPACE NODES                         OR-A 935
      IF (ITGRID.EQ.1) CACCUM = CCMPTE                                          OR-A 936
      IF (MODE.EQ.2) GO TO 1920                                                 OR-A 937
C                                                                               OR-A 938
C     CALCULATE THE VOLUME OF WATER IN THE SOIL COLUMN AT TIME                  OR-A 939
C     LEVEL K+1 ON THE BASIS OF THE COMPUTED NODE VALUES                        OR-A 940
```

```
 1900 IF (BCTOPW.EQ.4) CALL INTGRT (1,N,Z,THETA,WCMPTE,3HWZ2)           OR-A 941
      IF (BCTOPW.NE.4) CALL INTGRT (2,N,Z,THETA,WCMPTE,3HWZ3)           OR-A 942
C     THE TOTAL VOLUME OF   WATER  WHICH SHOULD BE IN THE SOIL COLUMN ATOR-A 943
C     TIME LEVEL  K+1  ( L**3 FLUID/L**2 GROSS)                         OR-A 944
      WACCUM = WACCUM+(QWTOP-QWBTM+TR)*DTK1                             OR-A 945
C     IGNORE THE FLUX SUMMATION ON THE FIRST TIME STEP, SINCE IT IS     OR-A 946
C     ALWAYS IN ERROR.                                                  OR-A 947
      IF (K1.EQ.1) WACCUM = WCMPTE                                      OR-A 948
C     ALSO UPDATE AFTER A REGRIDDING OF THE SPACE NODES                 OR-A 949
      IF (ITGRID.EQ.1) WACCUM = WCMPTE                                  OR-A 950
C        ACCUMULATED   WATER  LOSS THROUGH TRANSPIRATION( A NEGATIVE    OR-A 951
C        QUANTITY)                                                      OR-A 952
      TRNSPR = TRNSPR+TR*DTK1                                           OR-A 953
      IF (BCTOPW.NE.4) GO TO 1920                                       OR-A 954
C           ACCUMULATED WATER  INPUTED DURING INFILTRATION ( A POSITIVE OR-A 955
C        QUANTITY)                                                      OR-A 956
      IF (QWTOP.GT.0.) FLTRTE = FLTRTE+QWTOP*DTK1                       OR-A 957
C        ACCUMULATED   WATER  LOSS THROUGH EVAPORATION ( A NEGATIVE     OR-A 958
C        QUANTITY)                                                      OR-A 959
      IF (QWTOP.LT.0.) EVPRTE = EVPRTE+QWTOP*DTK1                       OR-A 960
 1920 IF (NPRINT.EQ.0) GO TO 2280                                       OR-A 961
C     CHECK IF DATA IS TO BE PUNCHED OUT                                OR-A 962
      IF (OUTPUT.EQ.0) GO TO 1960                                       OR-A 963
      QPOUT = QWTOP                                                     OR-A 964
      IF (BCTOPW.EQ.4) QPOUT = QPOLD(2)                                 OR-A 965
      WRITE (PNCH,1320) TIME,QPOUT,QWTOP,QWBTM,QCTOP,QCBTM,TR,TCR       OR-A 966
      WRITE (PNCH,1320) EVPRTE,FLTRTE,TRNSPR,CTRSUM,CCMPTE,SCMPTE,WCMPTEOR-A 967
     1,PPSURF(3)                                                        OR-A 968
      DO 1940 I=1,N                                                     OR-A 969
1940  WRITE (PNCH,1320) Z(I),THETA(I),PSI(I),C(I),S(I),A(I),G(I),QZ(I)  OR-A 970
      IF (ABS(TIME-TIMEF).LE.DTLMT) GO TO 1960                          OR-A 971
      IF (OUTPUT.EQ.2) GO TO 2280                                       OR-A 972
 1960 WRITE (OUT,1980) TIME,UTIME                                       OR-A 973
1980  FORMAT (1H1,  ////,45X,10HAT TIME = ,E13.6,1X,1H(,3A1,1H),//)     OR-A 974
      IF (MODE.EQ.2) GO TO 2030                                         OR-A 975
C                  MASS BALANCE                                       OR-A 976
      BLNCE = WCMPTE-WACCUM                                             OR-A 977
      WBLNCE = 0.                                                       OR-A 978
      IF (WCMPTE.NE.0.) WBLNCE = BLNCE/WCMPTE                           OR-A 979
      WRITE (OUT,2000) WACCUM,ULNGTH,WCMPTE,ULNGTH,BLNCE,ULNGTH,WBLNCE  OR-A 980
 2000 FORMAT (//,10X,80HAMOUNT OF WATER IN THE SOIL COLUMN (BY SUMMING UOR-A 981
     1P THE FLUXES*DELTA T)  WACCUM = ,E13.6,1X,1H(,2A1,1H),/,10X,      OR-A 982
     262HAMOUNT OF WATER IN THE SOIL COLUMN (BY INTEGRATING THETA VS Z),OR-A 983
     39X,9HWCMPTE = ,E13.6,1X,1H(,2A1,1H),/,17X,73HTHERE IS A MASS BALANOR-A 984
     4CE OF  WATER  IF THE DIFFERENCE IS ZERO   BALANCE = ,E13.6,1X,1H(,OR-A 985
     52A1,1H),/,58X,32H(IN DECIMAL PER CENT)  WBLNCE = ,E13.6)          OR-A 986
      WRITE (OUT,2020) FLTRTE,ULNGTH,EVPRTE,ULNGTH,TRNSPR,ULNGTH        OR-A 987
```

```
2020 FORMAT (//,29X,61HACCUMULATED   WATER  INPUTED DURING INFILTRATIONOR-A 988
     1    FLTRTE = ,E13.6,1X,1H(,2A1,1H),/,29X,45HACCUMULATED   WATER  LOR-A 989
     20SS THROUGH EVAPORATION,7X,9HEVPRTE = ,E13.6,1X,1H(,2A1,1H),/,29X,OR-A 990
     347HACCUMULATED   WATER  LOSS THROUGH TRANSPIRATION,5X,9HTRNSPR = ,OR-A 991
     4E13.6,1X,1H(,2A1,1H))                                             OR-A 992
2030  IF (MODE.NE.1) WRITE (OUT,2040) CTRSUM,UMASS,ULNGTH               OR-A 993
 2040 FORMAT (29X,43HACCUMULATED SOLUTE LOSS THROUGH ROOT UPTAKE,9X,     OR-A 994
     19HCTRSUM = ,E13.6,1X,1H(,3A1,1H/,2A1,4H**2))                      OR-A 995
      WRITE (OUT,2060)                                                  OR-A 996
 2060 FORMAT (//)                                                       OR-A 997
 2080 IF (MODE.EQ.1) GO TO 2180                                         OR-A 998
      BLNCE = CCMPTE-CACCUM                                             OR-A 999
      CBLNCE = 0.                                                       OR-A1000
      IF (CCMPTE.NE.0.) CBLNCE = BLNCE/CCMPTE                           OR-A1001
      IF (JSORB.GE.1) WRITE (OUT,2100) CCMPTE,UMASS,ULNGTH              OR-A1002
 2100 FORMAT (10X,78HAMOUNT OF LIQUID PHASE SOLUTE IN THE SOIL COLUMN (BOR-A1003
     1Y INTEGRATING THETA*C VS Z),7X,9HCCMPTE = ,E13.6,1X,1H(,3A1,1H/,  OR-A1004
     22A1,4H**2))                                                       OR-A1005
      IF (JSORB.LE.0) WRITE (OUT,2120) CACCUM,UMASS,ULNGTH,CCMPTE,UMASS,OR-A1006
     1ULNGTH,BLNCE,UMASS,ULNGTH,CBLNCE                                  OR-A1007
 2120 FORMAT (10X,94HAMOUNT OF LIQUID PHASE SOLUTE IN THE SOIL COLUMN (BOR-A1008
     1Y SUMMING UP THE FLUXES*DELTA T)  CACCUM = ,E13.6,1X,1H(,3A1,1H/, OR-A1009
     22A1,4H**2),/,10X,78HAMOUNT OF LIQUID PHASE SOLUTE IN THE SOIL COLUOR-A1010
     3MN (BY INTEGRATING THETA*C VS Z),7X,9HCCMPTE = ,E13.6,1X,1H(,3A1, OR-A1011
     41H/,2A1,4H**2),/,32X,72HTHERE IS A MASS BALANCE OF SOLUTE IF THE DOR-A1012
     5IFFERENCE IS ZERO   BALANCE = ,E13.6,1X,1H(,3A1,1H/,2A1,4H**2),/, OR-A1013
     672X,32H(IN DECIMAL PER CENT)  CBLNCE = ,E13.6)                    OR-A1014
      IF (JSORB.GE.1) WRITE (OUT,2140)                                  OR-A1015
 2140 FORMAT (//)                                                       OR-A1016
      IF (JSORB.GE.1) WRITE (OUT,2160) SCMPTE,UMASS,ULNGTH              OR-A1017
 2160 FORMAT (7X,81HAMOUNT OF SOLID PHASE SOLUTE ADSORBED BY THE SOIL COOR-A1018
     1LUMN (BY INTEGRATING  S VS Z),7X,9HSCMPTE = ,E13.6,1X,1H(,3A1,1H/,OR-A1019
     22A1,4H**2))                                                       OR-A1020
 2180  IF (TBLCG .LE.-1.OR.JTRIP.GE.1) GO TO 2220                       OR-A1021
      WRITE (OUT,2200) PPSURF(3),UPTNTL,TR,ULNGTH,UTIME,TCR,UMASS,ULNGTHOR-A1022
     1,UTIME                                                            OR-A1023
 2200 FORMAT (//,35X,26HPLANT SURFACE POTENTIAL = ,E13.6,1X,1H(,6A1,1H),OR-A1024
     1//,20X,41HACTUAL TRANSPIRATION THROUGH THE PLANT = ,E13.6,1X,1H(, OR-A1025
     22A1,1H/,3A1,1H),//,18X,43HRATE OF SOLUTE UPTAKE BY THE ROOT SYSTEMOR-A1026
     3 = ,E13.6,1X,1H(,3A1,1H/,2A1,4H**2/,3A1,1H))                      OR-A1027
 2220 WRITE (OUT,2240)                                                  OR-A1028
 2240 FORMAT (/////)                                                    OR-A1029
      DO 2250 I=1,N                                                     OR-A1030
 2250  DUMMYB(I)=C(I)*THETA(I)                                          OR-A1031
      IF (JWORH.EQ.2) WRITE (OUT,1400) ULNGTH,UTIME,UPTNTL,ULNGTH,UMASS,OR-A1032
     1 ULNGTH,UMASS,ULNGTH,UMASS,ULNGTH,UTIME,UMASS,ULNGTH,UTIME,ULNGTH,OR-A1033
     2 UTIME                                                            OR-A1034
```

```
      IF (JWORH.NE.2) WRITE (OUT,1420) UPTNTL,ULNGTH,UMASS,ULNGTH,      OR-A1035
     1 UMASS,ULNGTH,UMASS,ULNGTH,UTIME,UMASS,ULNGTH,UTIME,ULNGTH,       OR-A1036
     2 UTIME                                                            OR-A1037
      IF (JWORH.EQ.2) WRITE (OUT,1440) (F(I),THETA(I),PSI(I),Z(I),I,C(I)OR-A1038
     1, DUMMYB(I),S(I),A(I),G(I),QZ(I),I=1,N)                           OR-A1039
      IF (JWORH.NE.2) WRITE (OUT,1460) (THETA(I),PSI(I),Z(I),I,C(I),    OR-A1040
     1 DUMMYB(I),S(I),A(I),G(I),QZ(I),I=1,N)                            OR-A1041
      WRITE (OUT,2260)                                                  OR-A1042
 2260 FORMAT (////)                                                     OR-A1043
C        COMPUTE A NEW TIME STEP -SIZE                                  OR-A1044
 2280 DTK = DTK1                                                        OR-A1045
      CALL STEP (TIME)                                                  OR-A1046
C        CHECK THE STEP LIMITS                                          OR-A1047
      IF(DTMAX.LT.DTK1) DTK1=DTMAX                                      OR-A1048
      IF(DTMIN.GT.DTK1) DTK1=DTMIN                                      OR-A1049
      IF (ITGRID.EQ.1) ITGRID = 0                                       OR-A1050
      IF (MODE.EQ.2) GO TO 2320                                         OR-A1051
      DO 2300 I=1,N                                                     OR-A1052
      FOLD1(I)  = FOLD2(I)                                              OR-A1053
      FOLD2(I)  = F(I)                                                  OR-A1054
      POLD1(I)  = POLD2(I)                                              OR-A1055
      POLD2(I)  = PSI(I)                                                OR-A1056
      WOLD1(I)  = WOLD2(I)                                              OR-A1057
2300  WOLD2(I)  = THETA(I)                                              OR-A1058
 2320 IF (MODE.EQ.1) GO TO 2360                                         OR-A1059
      DO 2340 I=1,N                                                     OR-A1060
      SOLD1(I)  = SOLD2(I)                                              OR-A1061
      SOLD2(I)  = S(I)                                                  OR-A1062
      COLD1(I)  = COLD2(I)                                              OR-A1063
2340  COLD2(I)  = C(I)                                                  OR-A1064
 2360 PPSURF(1) = PPSURF(2)                                             OR-A1065
      PPSURF(2) = PPSURF(3)                                             OR-A1066
      IF (TBLOPS.LE.-1) GO TO 2420                                      OR-A1067
C     CHECK TO SEE IF THE PLANTS HAVE WILTED                           OR-A1068
      IF (JTRIP.GE.1) GO TO 2420                                        OR-A1069
      IF (PPSURF(3).LT.PWILT) WILTED = 1                                OR-A1070
      IF (WILTED.EQ.0) GO TO 2420                                       OR-A1071
C     PLANTS HAVE JUST DIED FROM WILTING                               OR-A1072
      JTRIP = 1                                                         OR-A1073
      WRITE (OUT,2380) TIME,UTIME,PWILT,UPTNTL                          OR-A1074
 2380 FORMAT (//////////,50X,42HWARNING     PLANTS HAVE PERMANENTLY WILTOR-A1075
     1ED,////,20X,24HTHIS OCCURRED AT TIME = ,E14.6,1X,3A1,5X,41HWHEN THOR-A1076
     2E PLANT SURFACE POTENTIAL EXCEEDED,/,20X,38HTHE SPECIFIED WILT POTOR-A1077
     3ENTIAL, PWILT = ,E14.6,1X,6A1,///,20X,93HPROGRAM SHALL CONTINUE BUOR-A1078
     4T THERE WILL NO LONGER BE ANY   WATER  OR SOLUTE UPTAKE BY THE ROOOR-A1079
     5TS,/,20X,45HAND THERE WILL NO LONGER BE ANY TRANSPIRATION,///)    OR-A1080
      TCR = 0.                                                          OR-A1081
```

```
      TR = 0.                                                                  OR-A1082
      DO 2400 I=1,N                                                            OR-A1083
      G(I) = 0.                                                                OR-A1084
2400  A(I) = 0.                                                                OR-A1085
C     CHECK IF A NEW GRID SYSTEM IS TO TAKE EFFECT                             OR-A1086
 2420 IF (TBLZF.LT.0) GO TO 2460                                               OR-A1087
      IF (TIME.LT.TGRID) GO TO 2460                                            OR-A1088
      CALL REGRID                                                              OR-A1089
C      THE VALUE OF N MAY BE DIFFERENT AFTER REGRIDDING                        OR-A1090
      IF (OUTPUT.GT.0.AND.NUMZ0.NE.NUMZF) WRITE (OUT,2440) NUMZ0,NUMZF         OR-A1091
 2440 FORMAT (/////,65X,7HWARNING,//,20X,59HYOU HAVE CHANGED THE NUMBER       OR-A1092
     1OF SPATIAL NODES FROM  NUMZ0 = ,I3,13H TO  NUMZF = ,I3,/,20X,           OR-A1093
     2100HIN ADDITION YOU ARE PUNCHING OUT DATA EVERY NSKIP TIME STEPS.       OR-A1094
     3 THE NUMBER OF NODES BEING PUNCHED OUT,/,20X,37HPER TIME STEP HAS       OR-A1095
     4CHANGED ACCORDINGLY)                                                    OR-A1096
      N1 = N-1                                                                OR-A1097
      ITGRID = 1                                                              OR-A1098
C     ONLY ONE REGRIDDING  IS ALLOWED                                         OR-A1099
      TBLZF = -1                                                              OR-A1100
 2460 IF (ABS(TIME-TIMEF).GT.DTLMT) GO TO 1520                                OR-A1101
      IF (OUTPUT.EQ.0) GO TO 2500                                             OR-A1102
      NP2 = N+2                                                               OR-A1103
      WRITE (OUT,2480) NPNCH,NP2,PNCH                                         OR-A1104
 2480 FORMAT (25X,87HAT TIME=TIME0,TIMEF AND AT THE END OF EVERY NSKIP TOR-A1105
     1IME STEP, THE   WATER /SOLUTE VALUES,/,10X,19HWERE PUNCHED OUT AS,OR-A1106
     265H   ( TIME,QPOLD(2),QWTOP,QWBTM,QCTOP,QCBTM,TR,TCR,EVPRTE,FLTRTEOR-A1107
     3 ),/,32X,48H( TRNSPR,CTRSUM,CCMPTE,SCMPTE,WCMPTE,PPSURF(3) ),/,32XOR-A1108
     4,62H(( Z(I),THETA(I),PSI(I),C(I),S(I),A(I),G(I),QZ(I) ),I=1,...,N)OR-A1109
     5,/,20X,34HDATA WAS PUNCHED IN FORMAT(8E10.4),///,36X,31HNUMBER OF OR-A1110
     6DATA SETS PUNCHED  = ,I3,/,35X,32HNUMBER OF DATA CARDS PER SET  = OR-A1111
     7,I3,/,20X,47HPUNCHED OUTPUT DATA WAS ROUTED TO PNCH(LUN)  = ,I3)  OR-A1112
C        PUNCH OUT FINAL VALUES                                                OR-A1113
 2500 CONTINUE                                                                OR-A1114
      IF (SAVE.EQ.1) CALL DUMP (TIMEF)                                        OR-A1115
      IF (OUTPUT.NE.0.AND.SAVE.EQ.1) WRITE (OUT,2520) N,TIMEF                 OR-A1116
 2520 FORMAT (//////////,10X,101HIN ADDITION TO THE ABOVE OUTPUT, THE FOOR-A1117
     1LLOWING STATE VARIABLES HAVE BEEN PUNCHED OUT  Z,C,PSI,S,THETA,/, OR-A1118
     210X,5HWITH ,I3,17H NODES AT TIME = ,E12.5,/,10X,66HONE CAN USE THEOR-A1119
     3SE CARDS AS INITIAL CONDITIONS IN A RESTART PROBLEM)                    OR-A1120
      IF (SAVE.EQ.1.AND.OUTPUT.EQ.0) WRITE (OUT,2540) N,TIMEF                 OR-A1121
 2540 FORMAT (//////////,10X,77HTHE FOLLOWING STATE VARIABLES HAVE BEEN OR-A1122
     1PUNCHED OUT  Z,C  ,PSI,S,THETA  WITH ,I3,17H NODES AT TIME = ,E12.OR-A1123
     25,/,10X,78HTHESE CARDS HAVE BEEN PUNCHED SUCH THAT ONE CAN USE THEOR-A1124
     3H AS INITIAL CONDITIONS)                                                OR-A1125
      WRITE (OUT,2560) TIMEF,UTIME                                            OR-A1126
 2560 FORMAT (/////,25X,64HPROGRAM  OR-NATURE  HAS ENDED AT THE SPECIFIEOR-A1127
     1D TIME OF  TIMEF = ,E11.4,1H(,3A1,1H))                                  OR-A1128
```

```
      STOP                                                              OR-A1129
      END                                                               OR-A1130


      SUBROUTINE ERROR (BEST,MAXSET,NUMMAX,SCAN,TIME0,TIMEF,TGRID,XORDEROR-A1131
     1,SAVE)                                                            OR-A1132
C                                                                       OR-A1133
C                                                                       OR-A1134
C        CHECK DATA FOR ERRORS AND GENERATE TABLES FOR OPTION BEST      OR-A1135
C                                                                       OR-A1136
C                                                                       OR-A1137
      INTEGER BCTOPC,BCTOPW,BCBTMC,BCBTMW,OUT,XORDER,SCAN,PNCH          OR-A1138
      INTEGER TBLBCB,TBLBCT,TBLBWB,TBLBWT,TBLCST,TBLDSZ,TBLDWZ,TBLFCB,  OR-A1139
     1TBLFCT,TBLFWB,TBLFWT,TBLKWZ,TBLQPS,TBLRAC,TBLRAW,TBLRD,TBLWP      OR-A1140
      INTEGER TBLC0,TBLP0,TBLPW,TBLS0,TBLW0,TBLZ0,TBLZF,WILTED,BEST     OR-A1141
      INTEGER TBLCG,TBLCTX,TBLRPF,START,OUTPUT,SAVE                     OR-A1142
      REAL KWZSAT,KWZDRY                                                OR-A1143
      COMMON DUMMYA(200),DUMMYB(200),DUMMYC(200),DUMMYD(200),DUMMYE(200)OR-A1144
     1,DUMMYF(200),DUMMYG(200),DUMMYH(200),DUMMYI(200),DUMMYJ(200),     OR-A1145
     2DUMMYK(200)                                                       OR-A1146
      COMMON /BEAR/ FGUESS(200),FOLD1(200),FOLD2(200),F(200)            OR-A1147
      COMMON /BEGIN/ START                                              OR-A1148
      COMMON /CNVRGE/ ARATIO,QRATIO,SRATIO,WRATIO,ITRMAX,ACLRAT         OR-A1149
      COMMON /DATA/ BCTOPC,BCTOPW,BCBTMC,BCBTMW,JWORH,MODE,JSORB        OR-A1150
      COMMON /DELTA/ ATCOEF,BTCOEF,CTCOEF,DTK,DTK1,DTMAX,DTMIN,K1DELT   OR-A1151
      COMMON /FLUX/ A(200),G(200),QZ(200)                               OR-A1152
      COMMON /IO/ IN,OUT,PNCH                                           OR-A1153
      COMMON /ISOTRM/ CNSTS(4)                                          OR-A1154
      COMMON /LIQUID/ CGUESS(200),COLD1(200),COLD2(200),C(200)          OR-A1155
      COMMON /MATRIC/ PGUESS(200),POLD1(200),POLD2(200),PSI(200)        OR-A1156
      COMMON /MOIST/ WGUESS(200),WOLD1(200),WOLD2(200),THETA(200)       OR-A1157
      COMMON /PRNT/ NSKIP,NPRINT,OUTPUT                                 OR-A1158
      COMMON /QFLIP/ DRY,SAT                                            OR-A1159
      COMMON /QFLUX/ QWBTM,QWTOP,QCBTM,QCTOP                            OR-A1160
      COMMON /QITR/ QCOLD(2),QPOLD(2),QMIN                              OR-A1161
      COMMON /ROOTS/ CNVRSN,TCR,PPSURF(3),PWILT,RR,TR,WILTED            OR-A1162
      COMMON /SLIDER/ FDRY,FSAT,PICK(50),NUMPCK,JWHS                    OR-A1163
      COMMON /SOLID/ SGUESS(200),SOLD1(200),SOLD2(200),S(200)           OR-A1164
      COMMON /TABBCB/ NUMBCB,TBLBCB,XBCB(50),YBCB(50)                   OR-A1165
```

```
      COMMON /TABBCT/ NUMBCT,TBLBCT,XBCT(50),YBCT(50)                    OR-A1166
      COMMON /TABBWB/ NUMBWB,TBLBWB,XBWB(50),YBWB(50)                    OR-A1167
      COMMON /TABBWT/ NUMBWT,TBLBWT,XBWT(50),YBWT(50)                    OR-A1168
      COMMON /TABCO/ NUMCO,TBLCO,XCO(200),YCO(200)                       OR-A1169
      COMMON /TABCG/ NUMCG,TBLCG,XCG(50),YCG(50)                         OR-A1170
      COMMON /TABCST/ NUMCST,TBLCST,XCST(50),YCST(50)                    OR-A1171
      COMMON /TABCTX/ NUMCTX,TBLCTX,XCTX(50),YCTX(50)                    OR-A1172
      COMMON /TABDSZ/ NUMDSZ,TBLDSZ,XDSZ(50),YDSZ(50)                    OR-A1173
      COMMON /TABDWZ/ NUMDWZ,TBLDWZ,XDWZ(50),YDWZ(50)                    OR-A1174
      COMMON /TABFCB/ NUMFCB,TBLFCB,XFCB(50),YFCB(50)                    OR-A1175
      COMMON /TABFCT/ NUMFCT,TBLFCT,XFCT(200),YFCT(200)                  OR-A1176
      COMMON /TABFWB/ NUMFWB,TBLFWB,XFWB(50),YFWB(50)                    OR-A1177
      COMMON /TABFWT/ NUMFWT,TBLFWT,XFWT(200),YFWT(200)                  OR-A1178
      COMMON /TABKWZ/ NUMKWZ,TBLKWZ,XKWZ(50),YKWZ(50)                    OR-A1179
      COMMON /TABPO/ NUMPO,TBLPO,XPO(200),YPO(200)                       OR-A1180
      COMMON /TABPW/ NUMPW,TBLPW,XPW(50),YPW(50)                         OR-A1181
      COMMON /TABQPS/ NUMQPS,TBLQPS,XQPS(200),YQPS(200)                  OR-A1182
      COMMON /TABRAC/ NUMRAC,TBLRAC,XRAC(50),YRAC(50)                    OR-A1183
      COMMON /TABRAW/ NUMRAW,TBLRAW,XRAW(50),YRAW(50)                    OR-A1184
      COMMON /TABRD/ NUMRD,TBLRD,XRD(50),YRD(50)                         OR-A1185
      COMMON /TABRPF/ NUMRPF,TBLRPF,XRPF(50),YRPF(50)                    OR-A1186
      COMMON /TABSO/ NUMSO,TBLSO,XSO(200),YSO(200)                       OR-A1187
      COMMON /TABWO/ NUMWO,TBLWO,XWO(200),YWO(200)                       OR-A1188
      COMMON /TABWP/ NUMWP,TBLWP,XWP(50),YWP(50)                         OR-A1189
      COMMON /TABZO/ NUMZO,TBLZO,ZO(200)                                 OR-A1190
      COMMON /TABZF/ NUMZF,TBLZF,ZF(200)                                 OR-A1191
      COMMON /UNIT/ ULNGTH(2),UPTNTL(6),UTIME(3),UMASS(3)                OR-A1192
      COMMON /WDATA/ GRAV,KWZDRY,KWZSAT,PDRY,PSAT,WDRY,WSAT              OR-A1193
C                                                                        OR-A1194
C           ZERO OUT ARRAYS AND OTHER PARAMETERS                         OR-A1195
      DO 20 I=1,NUMMAX                                                   OR-A1196
      A(I) = 0.                                                          OR-A1197
      DUMMYB(I) = 0.                                                     OR-A1198
      C(I) = 0.                                                          OR-A1199
      F(I) = 0.                                                          OR-A1200
      FGUESS(I) = F(I)                                                   OR-A1201
      FOLD1(I)  = F(I)                                                   OR-A1202
      FOLD2(I)  = F(I)                                                   OR-A1203
      G(I) = 0.                                                          OR-A1204
      PSI(I) = 0.                                                        OR-A1205
      QZ(I) = 0.                                                         OR-A1206
      S(I) = 0.                                                          OR-A1207
20    THETA(I) = 0.                                                      OR-A1208
      WDRY = 0.                                                          OR-A1209
      WSAT = 0.                                                          OR-A1210
      FDRY = 0.                                                          OR-A1211
      FSAT = 0.                                                          OR-A1212
```

```
      QCOLD(1) = 0.                                                    OR-A1213
      QCOLD(2) = 0.                                                    OR-A1214
      QWTOP = 0.                                                       OR-A1215
      QWBTM = 0.                                                       OR-A1216
      QCBTM = 0.                                                       OR-A1217
      QCTOP = 0.                                                       OR-A1218
      QMIN = 0.                                                        OR-A1219
      QPOLD(1) = 0.                                                    OR-A1220
      QPOLD(2) = 0.                                                    OR-A1221
C     ITS VERY IMPORTANT TO HAVE A GOOD DISTRIBUTION OF TABLE          OR-A1222
C     VALUES IN BOTH THE DRY AND SATURATED REGIONS                     OR-A1223
      NUMPCK = 20                                                      OR-A1224
      PICK(1) = 0.                                                     OR-A1225
      PICK(2) = .005                                                   OR-A1226
      PICK(3) = .01                                                    OR-A1227
      PICK(4) = .0175                                                  OR-A1228
      PICK(5) = .025                                                   OR-A1229
      PICK(6) = .05                                                    OR-A1230
      PICK(7) = .075                                                   OR-A1231
      PICK(8) = .1                                                     OR-A1232
      DO 40 I=9,16                                                     OR-A1233
40    PICK(I) = PICK(I-1)+.1                                           OR-A1234
      PICK(17) = .95                                                   OR-A1235
      PICK(18) = .97                                                   OR-A1236
      PICK(19) = .99                                                   OR-A1237
      PICK(20) = 1.                                                    OR-A1238
      DO 60 I=1,3                                                      OR-A1239
60    PPSURF(I) = 0.                                                   OR-A1240
C                              ECHO INPUT DATA                         OR-A1241
C                                                                      OR-A1242
      WRITE (OUT,80)                                                   OR-A1243
 80   FORMAT (60X,19HYOU ARE SOLVING THE,//)                           OR-A1244
      IF (JWORH.EQ.0.AND.MODE.NE.2.AND.START.GE.0) WRITE (OUT,100)     OR-A1245
 100  FORMAT (38X,64HWATER FLOW EQUATION AS A FUNCTION OF VOLUMETRIC   WOR-A1246
     1ATER  CONTENT)                                                   OR-A1247
      IF (JWORH.EQ.1.AND.MODE.NE.2.AND.START.GE.0) WRITE (OUT,120)     OR-A1248
 120  FORMAT (43X,53HWATER FLOW EQUATION AS A FUNCTION OF MATRIC POTENTIOR-A1249
     1AL)                                                              OR-A1250
      IF (JWORH.EQ.0.AND.MODE.NE.2.AND.START.EQ.-1) WRITE (OUT,140)    OR-A1251
 140  FORMAT (28X,93HWATER FLOW EQUATION AS A FUNCTION OF DIFFUSIVITY POOR-A1252
     1TENTIAL WHICH IS BASED ON   WATER  CONTENT)                      OR-A1253
      IF (JWORH.EQ.1.AND.MODE.NE.2.AND.START.EQ.-1) WRITE (OUT,160)    OR-A1254
 160  FORMAT (28X,93HWATER FLOW EQUATION AS A FUNCTION OF DIFFUSIVITY POOR-A1255
     1TENTIAL WHICH IS BASED ON MATRIC POTENTIAL)                      OR-A1256
      IF (MODE.EQ.0) WRITE (OUT,180)                                   OR-A1257
 180  FORMAT (//,65X,8HAND  THE,///)                                   OR-A1258
      IF (MODE.NE.1.AND.JSORB.GE.1) WRITE (OUT,200)                    OR-A1259
```

```
200  FORMAT (24X,91HSOLUTE MASS TRANSPORT EQUATION INCLUDING BOTH THE LOR-A1260
     1IQUID AND THE SOLID PHASES OF THE SOLUTE)                        OR-A1261
      IF (MODE.NE.1.AND.JSORB.LE.0) WRITE (OUT,220)                    OR-A1262
220  FORMAT (54X,30HSOLUTE MASS TRANSPORT EQUATION)                   OR-A1263
      IS = START+1                                                     OR-A1264
      IF (START.GT.0) WRITE (OUT,240) START                            OR-A1265
240  FORMAT (///////,25X,61HHOWEVER, IN ORDER TO IMPROVE THE STARTING PROR-A1266
     1OCESS, THE FIRST ,I3,19H TIME STEPS WILL BE,/,25X,67HSOLVED AS A FOR-A1267
     2UNCTION OF THE DIFFUSIVITY POTENTIAL AND THEN SWITCHED)          OR-A1268
      IF (START.GT.0.AND.JWORH.EQ.0) WRITE (OUT,260) IS                OR-A1269
260  FORMAT (23X,81HBACK TO THE WATER CONTENT-BASED SOLUTION OF THE WATOR-A1270
     1ER FLOW EQUATION AT TIME STEP ,I5)                               OR-A1271
      IF (START.GT.0.AND.JWORH.EQ.1) WRITE (OUT,280) IS                OR-A1272
280  FORMAT (25X,84HBACK TO THE MATRIC POTENTIAL-BASED SOLUTION OF THE OR-A1273
     1WATER FLOW EQUATION AT TIME STEP ,I5)                            OR-A1274
      WRITE (OUT,300)                                                  OR-A1275
300  FORMAT (1H1,//////////)                                          OR-A1276
      WRITE (OUT,320) IN,OUT,PNCH,MAXSET,NUMMAX                        OR-A1277
320  FORMAT (55X,21HECHO  OF  INPUT  DATA,/////,1X,10H(INTERNAL),5X,  OR-A1278
     19H  IN   = ,I5,8X,9H  OUT  = ,I5,8X,9H PNCH  = ,I5,8X,9HMAXSET = ,OR-A1279
     2I5,8X,9HNUMMAX = ,I5)                                            OR-A1280
      WRITE (OUT,340) JSORB,JWORH,MODE,ITRMAX,NSKIP,OUTPUT,K1DELT,XORDEROR-A1281
     1,SCAN,SAVE,START,BEST                                            OR-A1282
340  FORMAT (1X,10H(CARD  1 ),5X,9H JSORB = ,I5,8X,9H JWORH = ,I5,8X,  OR-A1283
     19H MODE  = ,I5,8X,9HITRMAX = ,I5,8X,9H NSKIP = ,I5,/,1X,19H(CARD  OR-A1284
     21 CONTINUED),18X,9HOUTPUT = ,I5,8X,9HK1DELT = ,I5,/,1X,10H(CARD  2OR-A1285
     3 ),5X,9HXORDER = ,I5,8X,9H SCAN  = ,I5,8X,9H SAVE  = ,I5,8X,     OR-A1286
     49H START = ,I5,8X,9H BEST  = ,I5)                                OR-A1287
      WRITE (OUT,360) ACLRAT,GRAV,PWILT,DRY,SAT,RR,CNVRSN,ARATIO,QRATIO,OR-A1288
     1SRATIO,WRATIO,TIME0,TIMEF,DTMIN,DTMAX,TGRID                      OR-A1289
360  FORMAT (1X,10H(CARD  3 ),5X,9HACLRAT = ,E11.4,2X,9H GRAV  = ,E11.40R-A1290
     1,2X,9H PWILT = ,E11.4,2X,9H  DRY  = ,E11.4,2X,9H  SAT  = ,E11.4,/,OR-A1291
     21X,19H(CARD  3 CONTINUED),18X,9H  RR   = ,E11.4,2X,9HCNVRSN = ,E110R-A1292
     3.4,/,1X,10H(CARD  4 ),5X,9HARATIO = ,E11.4,2X,9HQRATIO = ,E11.4,2XOR-A1293
     4,9HSRATIO = ,E11.4,2X,9HWRATIO = ,E11.4,/,1X,10H(CARD  5 ),5X,   OR-A1294
     59H TIME0 = ,E11.4,2X,9H TIMEF = ,E11.4,2X,9H DTMIN = ,E11.4,2X,  OR-A1295
     69H DTMAX = ,E11.4,2X,9H TGRID = ,E11.4)                          OR-A1296
      WRITE (OUT,380) (CNSTS(I),I=1,4)                                 OR-A1297
380  FORMAT (1X,10H(CARD  6 ),3X,11HCNSTS(1) = ,E11.4,1X,10HCNSTS(2)= ,OR-A1298
     1E11.4,1X,10HCNSTS(3)= ,E11.4,1X,10HCNSTS(4)= ,E11.4)             OR-A1299
      WRITE (OUT,400) ATCOEF,BTCOEF,CTCOEF                             OR-A1300
400  FORMAT (1X,10H(CARD  7 ),5X,9HATCOEF = ,E11.4,2X,9HBTCOEF = ,E11.4OR-A1301
     1,2X,9HCTCOEF = ,E11.4)                                           OR-A1302
      WRITE (OUT,420) ULNGTH,UPTNTL,UTIME,UMASS                        OR-A1303
420  FORMAT (1X,10H(CARD  8 ),5X,9HULNGTH = ,2A1,11X,9HUPTNTL = ,6A1,8XOR-A1304
     1,8HUTIME = ,3A1,11X,8HUMASS = ,2A1)                              OR-A1305
      WRITE (OUT,440) NUMZ0,TBLZ0,NUMZF,TBLZF,NUMC0,TBLC0,NUMP0,TBLP0, OR-A1306
```

```
     1NUMSO,TBLSO,NUMWO,TBLWO                                          OR-A1307
 440  FORMAT (1X,10H(SET   ZO),5X,9H NUMZO = ,I5,8X,9H TBLZO = ,I5,/,1X,OR-A1308
     110H(SET   ZF),5X,9H NUMZF = ,I5,8X,9H TBLZF = ,I5,/,1X,10H(SET   COR-A1309
     20),5X,9H NUMCO = ,I5,8X,9H TBLCO = ,I5,/,1X,10H(SET   PO),5X,     OR-A1310
     39H NUMPO = ,I5,8X,9H TBLPO = ,I5,/,1X,10H(SET   SO),5X,9H NUMSO = OR-A1311
     4,I5,8X,9H TBLSO = ,I5,/,1X,10H(SET   WO),5X,9H NUMWO = ,I5,8X,    OR-A1312
     59H TBLWO = ,I5)                                                  OR-A1313
      WRITE (OUT,460) NUMBCB,TBLBCB,NUMFCB,TBLFCB,NUMBCT,TBLBCT,NUMFCT, OR-A1314
     1TBLFCT,NUMBWB,TBLBWB,NUMFWB,TBLFWB                               OR-A1315
 460  FORMAT (1X,10H(SET  BCB),5X,9HNUMBCB = ,I5,8X,9HTBLBCB = ,I5,/,1X,OR-A1316
     110H(SET  FCB),5X,9HNUMFCB = ,I5,8X,9HTBLFCB = ,I5,/,1X,10H(SET  BCOR-A1317
     2T),5X,9HNUMBCT = ,I5,8X,9HTBLBCT = ,I5,/,1X,10H(SET  FCT),5X,     OR-A1318
     39HNUMFCT = ,I5,8X,9HTBLFCT = ,I5,/,1X,10H(SET  BWB),5X,9HNUMBWB = OR-A1319
     4,I5,8X,9HTBLBWB = ,I5,/,1X,10H(SET  FWB),5X,9HNUMFWB = ,I5,8X,    OR-A1320
     59HTBLFWB = ,I5)                                                  OR-A1321
      WRITE (OUT,480) NUMBWT,TBLBWT,NUMFWT,TBLFWT,NUMCG,TBLCG,NUMCST,   OR-A1322
     1TBLCST,NUMCTX,TBLCTX,NUMDSZ,TBLDSZ,NUMDWZ,TBLDWZ,NUMKWZ,TBLKWZ    OR-A1323
 480  FORMAT (1X,10H(SET  BWT),5X,9HNUMBWT = ,I5,8X,9HTBLBWT = ,I5,/,1X,OR-A1324
     110H(SET  FWT),5X,9HNUMFWT = ,I5,8X,9HTBLFWT = ,I5,/,1X,10H(SET  CGOR-A1325
     2 ),5X,9HNUMCG  = ,I5,8X,9HTBLCG  = ,I5,/,1X,10H(SET  CST),5X,     OR-A1326
     39HNUMCST = ,I5,8X,9HTBLCST = ,I5,/,1X,10H(SET  CTX),5X,9HNUMCTX = OR-A1327
     4,I5,8X,9HTBLCTX = ,I5,/,1X,10H(SET  DSZ),5X,9HNUMDSZ = ,I5,8X,    OR-A1328
     59HTBLDSZ = ,I5,/,1X,10H(SET  DWZ),5X,9HNUMDWZ = ,I5,8X,9HTBLDWZ = OR-A1329
     6,I5,/,1X,10H(SET  KWZ),5X,9HNUMKWZ = ,I5,8X,9HTBLKWZ = ,I5)      OR-A1330
      WRITE (OUT,500) NUMPW,TBLPW,NUMQPS,TBLQPS,NUMRAC,TBLRAC,NUMRAW,   OR-A1331
     1TBLRAW,NUMRD,TBLRD,NUMRPF,TBLRPF,NUMWP,TBLWP                     OR-A1332
 500  FORMAT (1X,10H(SET   PW),5X,9H NUMPW = ,I5,8X,9H TBLPW = ,I5,/,1X,OR-A1333
     110H(SET  QPS),5X,9HNUMQPS = ,I5,8X,9HTBLQPS = ,I5,/,1X,10H(SET  RAOR-A1334
     2C),5X,9HNUMRAC = ,I5,8X,9HTBLRAC = ,I5,/,1X,10H(SET  RAW),5X,     OR-A1335
     39HNUMRAW = ,I5,8X,9HTBLRAW = ,I5,/,1X,10H(SET   RD),5X,9H NUMRD = OR-A1336
     4,I5,8X,9H TBLRD = ,I5,/,1X,10H(SET  RPF),5X,9HNUMRPF = ,I5,8X,    OR-A1337
     59HTBLRPF = ,I5,/,1X,10H(SET   WP),5X,9H NUMWP = ,I5,8X,9H TBLWP = OR-A1338
     6,I5)                                                             OR-A1339
C                                                                      OR-A1340
C     CHECK IF THE TABULAR DATA WAS PROPERLY FED IN                    OR-A1341
      IF (XORDER.EQ.0) GO TO 540                                       OR-A1342
C                                                                      OR-A1343
C        ALL X TABLE VALUES MUST BE IN ASCENDING ORDER                 OR-A1344
C                                                                      OR-A1345
      WRITE (OUT,520)                                                  OR-A1346
 520  FORMAT (1H1,//////////,37X,52HTHE FOLLOWING DATA SETS WERE SPECIFIOR-A1347
     1ED BY DATA CARDS,///)                                           OR-A1348
      IF (TBLBCB.GT.0) CALL ORDER (NUMBCB,XBCB,YBCB,3HBCB)             OR-A1349
      IF (TBLBCT.GT.0) CALL ORDER (NUMBCT,XBCT,YBCT,3HBCT)             OR-A1350
      IF (TBLBWB.GT.0) CALL ORDER (NUMBWB,XBWB,YBWB,3HBWB)             OR-A1351
      IF (TBLBWT.GT.0) CALL ORDER (NUMBWT,XBWT,YBWT,3HBWT)             OR-A1352
      IF (TBLCO.GT.0) CALL ORDER (NUMCO,XCO,YCO,3HCO )                 OR-A1353
```

```
      IF (TBLCG.GT.0) CALL ORDER (NUMCG,XCG,YCG,3HCG )                  OR-A1354
      IF (TBLCST.GT.0) CALL ORDER (NUMCST,XCST,YCST,3HCST)              OR-A1355
      IF (TBLCTX.GT.0) CALL ORDER (NUMCTX,XCTX,YCTX,3HCTX)              OR-A1356
      IF (TBLDSZ.GT.0) CALL ORDER (NUMDSZ,XDSZ,YDSZ,3HDSZ)              OR-A1357
      IF (TBLDWZ.GT.0) CALL ORDER (NUMDWZ,XDWZ,YDWZ,3HDWZ)              OR-A1358
      IF (TBLFCB.GT.0) CALL ORDER (NUMFCB,XFCB,YFCB,3HFCB)              OR-A1359
      IF (TBLFCT.GT.0) CALL ORDER (NUMFCT,XFCT,YFCT,3HFCT)              OR-A1360
      IF (TBLFWB.GT.0) CALL ORDER (NUMFWB,XFWB,YFWB,3HFWB)              OR-A1361
      IF (TBLFWT.GT.0) CALL ORDER (NUMFWT,XFWT,YFWT,3HFWT)              OR-A1362
      IF (TBLKWZ.GT.0) CALL ORDER (NUMKWZ,XKWZ,YKWZ,3HKWZ)              OR-A1363
      IF (TBLPO.GT.0) CALL ORDER (NUMPO,XPO,YPO,3HPO )                  OR-A1364
      IF (TBLPW.GT.0) CALL ORDER (NUMPW,XPW,YPW,3HPW )                  OR-A1365
      IF (TBLQPS.GT.0) CALL ORDER (NUMQPS,XQPS,YQPS,3HQPS)              OR-A1366
      IF (TBLRAC.GT.0) CALL ORDER (NUMRAC,XRAC,YRAC,3HRAC)              OR-A1367
      IF (TBLRAW.GT.0) CALL ORDER (NUMRAW,XRAW,YRAW,3HRAW)              OR-A1368
      IF (TBLRD.GT.0) CALL ORDER (NUMRD,XRD,YRD,3HRD )                  OR-A1369
      IF (TBLRPF.GT.0) CALL ORDER (NUMRPF,XRPF,YRPF,3HRPF)              OR-A1370
      IF (TBLSO.GT.0) CALL ORDER (NUMSO,XSO,YSO,3HSO )                  OR-A1371
      IF (TBLWO.GT.0) CALL ORDER (NUMWO,XWO,YWO,3HWO )                  OR-A1372
      IF (TBLWP.GT.0) CALL ORDER (NUMWP,XWP,YWP,3HWP )                  OR-A1373
  540 WRITE (OUT,560)                                                   OR-A1374
  560 FORMAT (1H1,//////////)                                           OR-A1375
      WRITE (OUT,580) ULNGTH,UPTNTL,UTIME,UMASS,CNVRSN,ULNGTH,UPTNTL    OR-A1376
  580 FORMAT (///,23X,86HTHE FOLLOWING NOTATION IS USED TO EXPRESS THE UOR-A1377
     1NITS OF LENGTH,POTENTIAL, TIME AND MASS,//,42X,20HUNIT OF LENGTH  OR-A1378
     2  = ,2A1,5X,22H(L FLUID AND  L GROSS),/,42X,20HUNIT OF POTENTIAL =OR-A1379
     3 ,6A1,1X,13H(L POTENTIAL),/,42X,20HUNIT OF TIME      = ,3A1,4X,   OR-A1380
     43H(T),/,42X,20HUNIT OF MASS      = ,3A1,4X,3H(M),//,25X,52HCONVERSOR-A1381
     5ION OF POTENTIAL TO  PRESSURE HEAD  CNVRSN = ,E12.5,1X,1H(,2A1,   OR-A1382
     61H/,6A1,1H),////)                                                 OR-A1383
      WRITE (OUT,600)                                                   OR-A1384
  600 FORMAT (///,35X,62HTHE FOLLOWING VARIABLES ARE EXPRESSED IN  THE  OR-A1385
     1INDICATED UNITS,////,34X,28HROOT SINK UPTAKE OF   WATER ,6X,      OR-A1386
     229HA   (L**3 FLUID/L**3 GROSS/T),/,32X,33HLIQUID PHASE SOLUTE CONCOR-A1387
     3ENTRATION,3X,18HC   (M/L**3 FLUID),/,37X,23HUNSATURATED DIFFUSIVITOR-A1388
     4Y,8X,18HD   (L**2 GROSS/T),/,38X,21HDIFFUSIVITY POTENTIAL,9X,     OR-A1389
     526HF   (L**3 FLUID/L GROSS/T),/,35X,26HROOT SINK UPTAKE OF SOLUTE,OR-A1390
     67X,20HG   (M/L**3 GROSS/T),/,36X,24HUNSATURATED CONDUCTIVITY,8X,  OR-A1391
     729HK   (L**3 FLUID/L**2 GROSS/T),/,41X,16HMATRIC POTENTIAL,10X,   OR-A1392
     818HPSI  (L POTENTIAL),/,42X,12HDARCIAN FLUX,14X,29HQZ  (L**3 FLUIDOR-A1393
     9/L**2 GROSS/T)/,33X,32HSOLID PHASE SOLUTE CONCENTRATION,3X,       OR-A1394
     A18HS   (M/L**3 GROSS),/,35X,27HVOLUMETRIC  WATER  CONTENT,4X,     OR-A1395
     B29HTHETA (L**3 FLUID/L**3 GROSS),/,46X,4HTIME,16X,9HTIME  (T),/,  OR-A1396
     C46X,5HDEPTH,17X,13HZ   (L GROSS),//)                              OR-A1397
      IF (BEST.EQ.0) GO TO 720                                          OR-A1398
C                                                                       OR-A1399
C                                                                       OR-A1400
```

```
C       DUMP THE INTERPOLATION TABLES OF THE DATA SETS FED IN                OR-A1401
C                                                                            OR-A1402
      WRITE (OUT,620)                                                        OR-A1403
  620 FORMAT (1H1)                                                           OR-A1404
      WRITE (OUT,640)                                                        OR-A1405
  640 FORMAT (///////////,45X,40HAN INTERPOLATION REVIEW OF ALL DATA SETSOR-A1406
     1,//////,10X,104HEVERY DATA SET WHICH IS FED IN AS AN ARRAY (WITH AOR-A1407
     2T LEAST THREE VALUES OF X AND Y) WILL BE INTERPOLATED.,/,10X,      OR-A1408
     3112HINTERPOLATION WILL BE COMPUTED AT EACH SPECIFIED VALUE OF X (POR-A1409
     4IVOTAL VALUES ARE INDICATED BY A  **) AND AT THREE,/,10X,          OR-A1410
     515HEVENLY SPACED  ,79HINTERMEDIATE VALUES OF X(I.E., AT INTERVALS OR-A1411
     60F .25,.50,AND .75 OF X(I+1)-X(I)).,/,10X,85HALL TEN METHODS OF INOR-A1412
     7TERPOLATION WILL BE USED TO COMPUTE THE CORRESPONDING VALUE OF Y,/OR-A1413
     8,10X,114HAND ITS DERIVATIVE  DY/DX FOR EACH VALUE OF X. THE INTERPOR-A1414
     9OLATED VALUES OF Y  AND DY/DX ARE PRINTED OUT UNDER THEIR,/,10X,  OR-A1415
     A95HRESPECTIVE TITLE HEADINGS. NOTE THAT THE INTERPOLATED VALUES OFOR-A1416
     B Y CORRESPONDING TO  ** X VALUES,/,10X,61H(I.E. PIVOTAL VALUES) AROR-A1417
     CE ALWAYS EQUAL TO THE Y VALUE FED IN.,//////////)                   OR-A1418
      WRITE (OUT,660)                                                      OR-A1419
  660 FORMAT (54X,22HTYPES OF INTERPOLATION,///,40X,41HTBL = 1   LINEAR OR-A1420
     1INTERPOLATION OF  Y VS X,/,46X,38H2   QUADRATIC INTERPOLATION OF  OR-A1421
     2Y VS X,/,46X,41H3   CUBIC SPLINE INTERPOLATION OF  Y VS X,/,46X,  OR-A1422
     339H4   LINEAR INTERPOLATION OF  LN(Y) VS X,/,46X,45H5   CUBIC SPLIOR-A1423
     4NE INTERPOLATION OF  LN(Y) VS X,/,46X,39H6   LINEAR INTERPOLATION OR-A1424
     50F  Y VS LN(X),/,46X,45H7   CUBIC SPLINE INTERPOLATION OF  Y VS LNOR-A1425
     6(X),/,46X,43H8   LINEAR INTERPOLATION OF  LN(Y) VS LN(X),/,46X,   OR-A1426
     749H9   CUBIC SPLINE INTERPOLATION OF  LN(Y) VS LN(X),/,46X,       OR-A1427
     847H10  PIECEWISE-CONSTANT INTERPOLATION OF  Y VS X)                OR-A1428
      WRITE (OUT,680)                                                      OR-A1429
  680 FORMAT (////,8X,115HTO EFFECTIVELY USE THIS REVIEW, CHECK EACH COLOR-A1430
     1UMN OF INTERPOLATION AND REJECT THOSE  METHODS    WHICH GIVE Y VALOR-A1431
     2UES,/,8X,113HWITH THE WRONG SIGN(AN OSCILLATION) AND REJECT THOSE OR-A1432
     3 METHODS  WHOSE DERIVATIVES ALSO OSCILLATE IN SIGN(WHEN THEY,/,8X,OR-A1433
     410HSHOULDNT).,/////////)                                           OR-A1434
      WRITE (OUT,620)                                                      OR-A1435
      IF (TBLC0.GT.0.AND.NUMC0.GE.3) CALL TABLED (NUMC0,XC0,YC0,3HC0 )     OR-A1436
      IF (TBLP0.GT.0.AND.NUMP0.GE.3) CALL TABLED (NUMP0,XP0,YP0,3HP0 )     OR-A1437
      IF (TBLS0.GT.0.AND.NUMS0.GE.3) CALL TABLED (NUMS0,XS0,YS0,3HS0 )     OR-A1438
      IF (TBLW0.GT.0.AND.NUMW0.GE.3) CALL TABLED (NUMW0,XW0,YW0,3HW0 )     OR-A1439
      IF (TBLFCB.GT.0.AND.NUMFCB.GE.3) CALL TABLED (NUMFCB,XFCB,YFCB,      OR-A1440
     13HFCB)                                                              OR-A1441
      IF (TBLFCT.GT.0.AND.NUMFCT.GE.3) CALL TABLED (NUMFCT,XFCT,YFCT,      OR-A1442
     13HFCT)                                                              OR-A1443
      IF (TBLFWB.GT.0.AND.NUMFWB.GE.3) CALL TABLED (NUMFWB,XFWB,YFWB,      OR-A1444
     13HFWB)                                                              OR-A1445
      IF (TBLFWT.GT.0.AND.NUMFWT.GE.3) CALL TABLED (NUMFWT,XFWT,YFWT,      OR-A1446
     13HFWT)                                                              OR-A1447
```

```
      IF (TBLCG.GT.0.AND.NUMCG.GE.3) CALL TABLED (NUMCG,XCG,YCG,3HCG )  OR-A1448
      IF (TBLCST.GT.0.AND.NUMCST.GE.3) CALL TABLED (NUMCST,XCST,YCST,   OR-A1449
     13HCST)                                                            OR-A1450
      IF (TBLCTX.GT.0.AND.NUMCTX.GE.3) CALL TABLED (NUMCTX,XCTX,YCTX,   OR-A1451
     13HCTX)                                                            OR-A1452
      IF (TBLDSZ.GT.0.AND.NUMDSZ.GE.3) CALL TABLED (NUMDSZ,XDSZ,YDSZ,   OR-A1453
     13HDSZ)                                                            OR-A1454
      IF (TBLDWZ.GT.0.AND.NUMDWZ.GE.3) CALL TABLED (NUMDWZ,XDWZ,YDWZ,   OR-A1455
     13HDWZ)                                                            OR-A1456
      IF (TBLKWZ.GT.0.AND.NUMKWZ.GE.3) CALL TABLED (NUMKWZ,XKWZ,YKWZ,   OR-A1457
     13HKWZ)                                                            OR-A1458
      IF (TBLPW.GT.0.AND.NUMPW.GE.3) CALL TABLED (NUMPW,XPW,YPW,3HPW )  OR-A1459
      IF (TBLQPS.GT.0.AND.NUMQPS.GE.3) CALL TABLED (NUMQPS,XQPS,YQPS,   OR-A1460
     13HQPS)                                                            OR-A1461
      IF (TBLRAC.GT.0.AND.NUMRAC.GE.3) CALL TABLED (NUMRAC,XRAC,YRAC,   OR-A1462
     13HRAC)                                                            OR-A1463
      IF (TBLRAW.GT.0.AND.NUMRAW.GE.3) CALL TABLED (NUMRAW,XRAW,YRAW,   OR-A1464
     13HRAW)                                                            OR-A1465
      IF (TBLRD.GT.0.AND.NUMRD.GE.3) CALL TABLED (NUMRD,XRD,YRD,3HRD )  OR-A1466
      IF (TBLRPF.GT.0.AND.NUMRPF.GE.3) CALL TABLED (NUMRPF,XRPF,YRPF,   OR-A1467
     13HRPF)                                                            OR-A1468
      IF (TBLWP.GT.0.AND.NUMWP.GE.3) CALL TABLED (NUMWP,XWP,YWP,3HWP )  OR-A1469
      WRITE (OUT,700)                                                   OR-A1470
  700 FORMAT (////////////,30X,73HREVIEW IS FINISHED. PICK THE BEST INTERPOR-A1471
     1OLATION SCHEME FOR EACH DATA SET.,/,20X,95HREPUNCH THE TBL(...) VAOR-A1472
     2LUES IN THE DATA SETS IF YOU FIND A BETTER TYPE, SET BEST=0 AND REOR-A1473
     3SUBMIT,///,55X,22HPROGRAM SHALL NOW STOP)                         OR-A1474
      STOP                                                              OR-A1475
  720 IF (SCAN.EQ.0) GO TO 3040                                         OR-A1476
      KFLAG = 0                                                         OR-A1477
      IF (GRAV.NE.0..AND.GRAV.NE.1.) KFLAG = 1                          OR-A1478
      IF (TIME0.LT.0..OR.TIMEF.LE.0..OR.DTMIN.LE.0..OR.DTMAX.LE.0.)     OR-A1479
     1 KFLAG = 2                                                        OR-A1480
      IF (TIMEF.LT.TIME0) KFLAG = 3                                     OR-A1481
      IF (DTMAX.LT.DTMIN) KFLAG = 4                                     OR-A1482
      IF (ACLRAT.LE.0.) KFLAG = 5                                       OR-A1483
      IF (ITRMAX.LE.0) KFLAG = 6                                        OR-A1484
      IF (ARATIO.LT.0..OR.QRATIO.LT.0..OR.SRATIO.LT.0..OR.WRATIO.LT.0.) OR-A1485
     1KFLAG = 7                                                         OR-A1486
      IF (K1DELT.LT.0.OR.K1DELT.GT.2) KFLAG = 8                         OR-A1487
      IF (K1DELT.NE.1) GO TO 740                                        OR-A1488
      IF (ATCOEF.LT.0..OR.BTCOEF.LT.0..OR.CTCOEF.LT.0.) KFLAG = 9       OR-A1489
      IF (ATCOEF.EQ.0..AND.BTCOEF.EQ.0..AND.CTCOEF.EQ.0.) KFLAG = 10    OR-A1490
  740 IF (TBLZF.GE.0.AND.NUMZF.LT.5) KFLAG = 11                         OR-A1491
      IF (NUMZ0.LT.5) KFLAG = 12                                        OR-A1492
      IF (SAVE.NE.0.AND.SAVE.NE.1) KFLAG = 13                           OR-A1493
      IF (OUTPUT.LT.0.OR.OUTPUT.GT.2) KFLAG = 14                        OR-A1494
```

```
      IF (SCAN.LT.0.OR.SCAN.GT.1) KFLAG = 15                                 OR-A1495
      IF (XORDER.LT.0.OR.XORDER.GT.1) KFLAG = 16                             OR-A1496
      IF (MODE.LT.0.OR.MODE.GT.2) KFLAG = 17                                 OR-A1497
      IF (KFLAG.NE.0) GO TO 2340                                             OR-A1498
C     ARE THE TBL(.) VALUES TO BE SCANNED CONSISTENT                         OR-A1499
      IFLAG = 0                                                              OR-A1500
      IF (MODE.NE.2.AND.JWORH.EQ.1.AND.TBLWP.LT.0) IFLAG = 1                 OR-A1501
      IF (MODE.NE.2.AND.JWORH.EQ.0.AND.TBLPW.LT.0) IFLAG = 2                 OR-A1502
      IF (JWORH.EQ.0.AND.TBLWO.LT.0) IFLAG = 3                               OR-A1503
      IF (JWORH.EQ.1.AND.TBLPO.LT.0.AND.MODE.NE.2) IFLAG = 4                 OR-A1504
      IF (MODE.NE.1.AND.JSORB.GE.5.AND.TBLSO.LT.0) IFLAG = 5                 OR-A1505
      IF (MODE.NE.1.AND.TBLCO.LT.0) IFLAG = 6                                OR-A1506
      IF (MODE.NE.1.AND.TBLBCB.LT.0) IFLAG = 7                               OR-A1507
      IF (MODE.NE.1.AND.TBLBCT.LT.0) IFLAG = 8                               OR-A1508
      IF (MODE.NE.1.AND.TBLDSZ.LT.0) IFLAG = 9                               OR-A1509
      IF (MODE.NE.1.AND.TBLFCB.LT.0) IFLAG = 10                              OR-A1510
      IF (MODE.NE.1.AND.TBLFCT.LT.0) IFLAG = 11                              OR-A1511
      IF (MODE.NE.2.AND.TBLBWB.LT.0) IFLAG = 12                              OR-A1512
      IF (MODE.NE.2.AND.TBLBWT.LT.0) IFLAG = 13                              OR-A1513
      IF (              JWORH.EQ.0.AND.TBLDWZ.LT.0) IFLAG = 14               OR-A1514
      IF (MODE.NE.2.AND.TBLFWB.LT.0) IFLAG = 15                              OR-A1515
      IF (MODE.NE.2.AND.TBLFWT.LT.0) IFLAG = 16                              OR-A1516
      IF (MODE.NE.2.AND.TBLKWZ.LT.0) IFLAG = 17                              OR-A1517
      IF (TBLZO.LT.0) IFLAG = 18                                             OR-A1518
      IF (TGRID.LT.TIMEO.AND.TBLZF.GE.0) IFLAG = 19                          OR-A1519
      IF (MODE.EQ.1.AND.JSORB.NE.0) IFLAG = 20                               OR-A1520
      IF (CNVRSN.LE.0.) IFLAG = 21                                           OR-A1521
      IF (START.LT.-1) IFLAG = 22                                            OR-A1522
      IF (START.NE.0.AND.MODE.EQ.2) IFLAG = 23                               OR-A1523
      IF (MODE.EQ.2.AND.JWORH.NE.0) IFLAG = 24                               OR-A1524
      IF (JWORH.NE.0.AND.JWORH.NE.1) IFLAG = 25                              OR-A1525
      ICHECK = 0                                                             OR-A1526
      IF (PWILT.GE.0.) ICHECK = 1                                            OR-A1527
      IF (MODE.NE.2.AND.ICHECK.EQ.1.AND.TBLQPS.GE.0) IFLAG = 26              OR-A1528
      IF (BEST.NE.0.AND.BEST.NE.1) IFLAG = 27                                OR-A1529
      IF (MODE.EQ.2.AND.TBLDWZ.LT.0) IFLAG = 28                              OR-A1530
      IF (MODE.EQ.2.AND.TBLKWZ.LT.0) IFLAG = 29                              OR-A1531
      IF (IFLAG.NE.0) GO TO 760                                              OR-A1532
      JFLAG = 0                                                              OR-A1533
      IF (NUMBCB.GT.MAXSET.OR.NUMBCT.GT.MAXSET.OR.NUMBWB.GT.MAXSET.OR.       OR-A1534
     1NUMBWT.GT.MAXSET) JFLAG = 1                                            OR-A1535
      IF (NUMCST.GT.MAXSET.OR.NUMDSZ.GT.MAXSET.OR.NUMDWZ.GT.MAXSET)          OR-A1536
     1 JFLAG = 2                                                             OR-A1537
      IF (NUMFCB.GT.MAXSET.OR.NUMFWB.GT.MAXSET.OR.NUMKWZ.GT.MAXSET.OR.       OR-A1538
     1NUMPW.GT.MAXSET) JFLAG = 3                                             OR-A1539
      IF (NUMRAC.GT.MAXSET.OR.NUMRAW.GT.MAXSET.OR.NUMRD.GT.MAXSET.OR.        OR-A1540
     1NUMWP.GT.MAXSET) JFLAG = 5                                             OR-A1541
```

```
      IF (NUMCG.GT.MAXSET.OR.NUMCTX.GT.MAXSET.OR.NUMRPF.GT.MAXSET)      OR-A1542
                                                                        OR-A1543
     1 JFLAG = 6
      IF (NUMCO.GT.NUMMAX.OR.NUMPO.GT.NUMMAX.OR.NUMSO.GT.NUMMAX.OR.NUMWOOR-A1544
     1.GT.NUMMAX.OR.NUMZO.GT.NUMMAX.OR.NUMZF.GT.NUMMAX) JFLAG = 7       OR-A1545
      IF (NUMFCT.GT.NUMMAX.OR.NUMFWT.GT.NUMMAX.OR.NUMQPS.GT.NUMMAX)     OR-A1546
                                                                        OR-A1547
     1 JFLAG = 8
      IF (JFLAG.NE.0) GO TO 2000                                        OR-A1548
                                                                        OR-A1549
      GO TO 3040                                                        OR-A1550
  760 WRITE (OUT,780) JWORH,MODE,JSORB,START
  780 FORMAT (////,50X,26HERROR IN SUBROUTINE  ERROR,///,42X,42HTHE FOLLOR-A1551
     10WING PARAMETERS WERE SPECIFIED AS,//,57X,8HJWORH = ,I3,/,57X,    OR-A1552
     28H MODE = ,I3,/,57X,8HJSORB = ,I3,/,57X,8HSTART = ,I3,///,39X,    OR-A1553
     349HTHERE IS AN INCONSISTENCY IN THE DATA GIVEN BELOW,//,50X,       OR-A1554
     425HERROR MESSAGE WILL FOLLOW,/////)                               OR-A1555
      GO TO (800,840,880,920,960,1000,1040,1080,1120,1160,1200,1240,1280OR-A1556
     1,1320,1360,1400,1440,1480,1560,1600,1640,1680,1720,1760,1800,1840,OR-A1557
     21880,1920,1960), IFLAG                                            OR-A1558
                                                                        OR-A1559
  800 WRITE (OUT,820) TBLWP                                             OR-A1560
  820 FORMAT (56X,14HERROR CODE   7,////,20X,15HSINCE  TBLWP = ,I3,     OR-A1561
     169H  YOU FAILED TO INCLUDE DATA SET WP WHICH SPECIFIES THE WATER CONTR-A1562
     2ONTENT,/,20X,34H AS A FUNCTION OF MATRIC POTENTIAL)               OR-A1563
      GO TO 1520                                                        OR-A1564
  840 WRITE (OUT,860) TBLPW                                             OR-A1565
  860 FORMAT (56X,14HERROR CODE   8,////,20X,15HSINCE  TBLPW = ,I3,     OR-A1566
     172H  YOU FAILED TO INCLUDE DATA SET PW WHICH SPECIFIES THE MATRIC OR-A1567
     2POTENTIAL,/,20X,31H AS A FUNCTION OF WATER CONTENT)               OR-A1568
      GO TO 1520                                                        OR-A1569
  880 WRITE (OUT,900) TBLWO                                             OR-A1570
  900 FORMAT (56X,14HERROR CODE   9,////,20X,15HSINCE  TBLWO = ,I3,     OR-A1571
     181H  YOU FAILED TO INCLUDE DATA SET WO  WHICH SPECIFIES THE INITIAOR-A1572
     2L   WATER  CONTENT)                                               OR-A1573
      GO TO 1520                                                        OR-A1574
  920 WRITE (OUT,940) TBLPO                                             OR-A1575
  940 FORMAT (56X,14HERROR CODE  10,////,20X,15HSINCE  TBLPO = ,I3,     OR-A1576
     181H  YOU FAILED TO INCLUDE DATA SET PO  WHICH SPECIFIES THE INITIA
     2L MATRIC POTENTIAL)                                               OR-A1577
      GO TO 1520                                                        OR-A1578
  960 WRITE (OUT,980) TBLSO                                             OR-A1579
  980 FORMAT (56X,14HERROR CODE  11,////,20X,15HSINCE  TBLSO = ,I3,     OR-A1580
     171H  YOU FAILED TO INCLUDE DATA SET SO  WHICH SPECIFIES THE INITIAOR-A1581
     2L SOLUTE,/,20X,32HCONCENTRATION IN THE SOLID PHASE)               OR-A1582
      GO TO 1520                                                        OR-A1583
 1000 WRITE (OUT,1020) TBLCO                                            OR-A1584
 1020 FORMAT (56X,14HERROR CODE  12,////,20X,15HSINCE  TBLCO = ,I3,     OR-A1585
     171H  YOU FAILED TO INCLUDE DATA SET CO  WHICH SPECIFIES THE INITIAOR-A1586
     2L SOLUTE,/,20X,33HCONCENTRATION IN THE LIQUID PHASE)              OR-A1587
      GO TO 1520                                                        OR-A1588
```

```
1040 WRITE (OUT,1060) TBLBCB                                              OR-A1589
1060 FORMAT (56X,14HERROR CODE  13,////,20X,16HSINCE  TBLBCB = ,I3,       OR-A1590
    180H  YOU FAILED TO INCLUDE DATA SET BCB  WHICH SPECIFIES THE TYPE    OR-A1591
    20F LOWER BOUNDARY,/,20X,33HCONDITION FOR THE SOLUTE EQUATION)        OR-A1592
     GO TO 1520                                                           OR-A1593
1080 WRITE (OUT,1100) TBLBCT                                              OR-A1594
1100 FORMAT (56X,14HERROR CODE  14,////,20X,16HSINCE  TBLBCT = ,I3,       OR-A1595
    172H  YOU FAILED TO INCLUDE DATA SET BCT  WHICH SPECIFIES THE UPPEROR-A1596
    2 BOUNDARY,/,20X,32HCONDITION OF THE SOLUTE EQUATION)                 OR-A1597
     GO TO 1520                                                           OR-A1598
1120 WRITE (OUT,1140) TBLDSZ                                              OR-A1599
1140 FORMAT (56X,14HERROR CODE  15,////,20X,16HSINCE  TBLDSZ = ,I3,       OR-A1600
    184H  YOU FAILED TO INCLUDE DATA SET DSZ  WHICH SPECIFIES THE APPAROR-A1601
    2ENT SOLUTE DISPERSION,/,20X,35HCOEFFICIENT FOR THE SOLUTE EQUATIONOR-A1602
    3)                                                                    OR-A1603
     GO TO 1520                                                           OR-A1604
1160 WRITE (OUT,1180) TBLFCB                                              OR-A1605
1180 FORMAT (56X,14HERROR CODE  16,////,20X,16HSINCE  TBLFCB = ,I3,       OR-A1606
    179H  YOU FAILED TO INCLUDE DATA SET FCB  WHICH SPECIFIES THE RIGHTOR-A1607
    2-HAND SIDE VALUE,/,20X,55HOF THE LOWER BOUNDARY CONDITION FOR THE OR-A1608
    3SOLUTE EQUATION)                                                     OR-A1609
     GO TO 1520                                                           OR-A1610
1200 WRITE (OUT,1220) TBLFCT                                              OR-A1611
1220 FORMAT (56X,14HERROR CODE  17,////,20X,16HSINCE  TBLFCT = ,I3,       OR-A1612
    173H  YOU FAILED TO INCLUDE DATA SET FCT  WHICH SPECIFIES THE RIGHTOR-A1613
    2-HAND SIDE,/,20X,61HVALUE OF THE UPPER BOUNDARY CONDITION FOR THE OR-A1614
    3SOLUTE EQUATION)                                                     OR-A1615
     GO TO 1520                                                           OR-A1616
1240 WRITE (OUT,1260) TBLBWB                                              OR-A1617
1260 FORMAT (56X,14HERROR CODE  18,////,20X,16HSINCE  TBLBWB = ,I3,       OR-A1618
    171H  YOU FAILED TO INCLUDE DATA SET BWB  WHICH SPECIFIES THE TYPE    OR-A1619
    20F LOWER,/,20X,46HBOUNDARY CONDITION FOR THE WATER FLOW EQUATION)    OR-A1620
     GO TO 1520                                                           OR-A1621
1280 WRITE (OUT,1300) TBLBWT                                              OR-A1622
1300 FORMAT (56X,14HERROR CODE  19,////,20X,16HSINCE  TBLBWT = ,I3,       OR-A1623
    171H  YOU FAILED TO INCLUDE DATA SET BWT  WHICH SPECIFIES THE TYPE    OR-A1624
    20F UPPER,/,20X,46HBOUNDARY CONDITION FOR THE WATER FLOW EQUATION)    OR-A1625
     GO TO 1520                                                           OR-A1626
1320 WRITE (OUT,1340) TBLDWZ                                              OR-A1627
1340 FORMAT (56X,14HERROR CODE  20,////,10X,16HSINCE  TBLDWZ = ,I3,       OR-A1628
    137H  YOU FAILED TO INCLUDE DATA SET DWZ.,/,10X,109HTHE SOIL-WATER    OR-A1629
    2DIFFUSIVITY COEFFICIENT IS ALWAYS NEEDED WHEN SOLVING THE WATER FLOR-A1630
    30W EQUATION AS A FUNCTION OF,/,10X,75HVOLUMETRIC   WATER  CONTENT.OR-A1631
    4  YOU ALSO NEED TO SPECIFY DWZ WHEN SOLVING THE,/,10X,31HSOLUTE MAOR-A1632
    5SS TRANSPORT EQUATION.)                                              OR-A1633
     GO TO 1520                                                           OR-A1634
1360 WRITE (OUT,1380) TBLFWB                                              OR-A1635
```

```
1380 FORMAT (56X,14HERROR CODE  21,////,20X,16HSINCE  TBLFWB = ,I3,     OR-A1636
    173H  YOU FAILED TO INCLUDE DATA SET FWB  WHICH SPECIFIES THE RIGHTOR-A1637
    2-HAND SIDE,/,20X,65HVALUE OF THE LOWER BOUNDARY CONDITION FOR THE OR-A1638
    3WATER FLOW EQUATION)                                               OR-A1639
     GO TO 1520                                                         OR-A1640
1400 WRITE (OUT,1420) TBLFWT                                            OR-A1641
1420 FORMAT (56X,14HERROR CODE  22,////,20X,16HSINCE  TBLFWT = ,I3,     OR-A1642
    173H  YOU FAILED TO INCLUDE DATA SET FWT  WHICH SPECIFIES THE RIGHTOR-A1643
    2-HAND SIDE,/,20X,65HVALUE OF THE UPPER BOUNDARY CONDITION FOR THE OR-A1644
    3WATER FLOW EQUATION)                                               OR-A1645
     GO TO 1520                                                         OR-A1646
1440 WRITE (OUT,1460) TBLKWZ                                            OR-A1647
1460 FORMAT (56X,14HERROR CODE  23,////,20X,16HSINCE  TBLKWZ = ,I3,     OR-A1648
    138H  YOU FAILED TO INCLUDE DATA SET KWZ. ,/,20X,85HONE MUST ALWAYSOR-A1649
    2 SPECIFY THE SOIL WATER HYDRAULIC CONDUCTIVITY WHEN SOLVING EITHEROR-A1650
    3 THE,/,20X,58HWATER FLOW EQUATION OR THE SOLUTE MASS TRANSPORT EQUOR-A1651
    4ATION.)                                                            OR-A1652
     GO TO 1520                                                         OR-A1653
1480 WRITE (OUT,1500) TBLZ0                                             OR-A1654
1500 FORMAT (56X,14HERROR CODE  24,////,20X,15HSINCE  TBLZ0 = ,I3,      OR-A1655
    164H  YOU FAILED TO INCLUDE DATA SET Z0  WHICH SPECIFIES THE INITIAOR-A1656
    2L,/,20X,33HSPATIAL DISTRIBUTION OF THE NODES)                      OR-A1657
                                                                        OR-A1658
1520 WRITE (OUT,1540)                                                   OR-A1659
1540 FORMAT (///,20X,81HTHIS DATA SET MUST BE SPECIFIED AND CAN BE ENTEOR-A1660
    1RED EITHER AS AN EMPERICAL FORMULA,/,20X,95HOR AS DATA ARRAYS.  PUOR-A1661
    2NCH UP THIS DATA SET, SELECT THE CORRECT VALUE OF TBL(...), AND REOR-A1662
    3SUBMIT.,/,20X,66HALSO CHECK TO SEE IF JWORH,MODE,AND JSORB ARE COROR-A1663
    4RECTLY SPECIFIED.)                                                 OR-A1664
     STOP                                                               OR-A1665
1560 WRITE (OUT,1580) TBLZF,TIME0,TGRID                                 OR-A1666
1580 FORMAT (56X,14HERROR CODE  25,////,20X,14HWITH  TBLZF = ,I3,       OR-A1667
    163H YOU SPECIFIED THAT A REGRIDDING OF THE NODES WAS TO TAKE PLACEOR-A1668
    2,/,20X,92HBUT YOU INCORRECTLY SPECIFIED THE TIME IT WAS TO TAKE PLOR-A1669
    3ACE.  TGRID MUST BE GREATER OR EQUAL,/,20X,21HTO TIME0  BUT YOU SEOR-A1670
    4T,//,50X,8HTIME0 = ,E12.5,/,50X,8HTGRID = ,E12.6)                  OR-A1671
     STOP                                                               OR-A1672
1600 WRITE (OUT,1620) JSORB                                             OR-A1673
1620 FORMAT (56X,14HERROR CODE  26,////,20X,87HBY SETTING  MODE=1, YOU OR-A1674
    1SPECIFIED THAT YOU ONLY WANTED TO SOLVE THE WATER FLOW EQUATION,/,OR-A1675
    220X,24HBUT BY SETTING  JSORB = ,I3,48H YOU ALSO ASKED FOR SOLUTE  OR-A1676
    3 SORPTION/DESORPTION,//,20X,79HTHIS IS INCONSISTENT SINCE THERE ISOR-A1677
    4 NO SORPTION TERM IN THE WATER FLOW EQUATION)                      OR-A1678
     STOP                                                               OR-A1679
1640 WRITE (OUT,1660) CNVRSN                                            OR-A1680
1660 FORMAT (56X,14HERROR CODE  27,////,10X,18HYOU SET  CNVRSN = ,E12.5OR-A1681
    1,18H ON PROGRAM CARD 3,//, 6X,116HTHIS PARAMETER CONVERTS THE UNITOR-A1682
    2 OF MATRIC POTENTIAL TO THAT OF  PRESSURE HEAD(E.G. CNVRSH = 1033
```

```
     3CM H20/ATMOSPHERE),//,10X,50HTHIS PARAMETER MUST HAVE A VALUE GREAOR-A1683
     4TER THAN ZERO)                                                    OR-A1684
      STOP                                                              OR-A1685
 1680 WRITE (OUT,1700) START                                            OR-A1686
 1700 FORMAT (56X,14HERROR CODE  28,////,20X,75HSTART CAN ONLY TAKE ON VOR-A1687
     1ALUES GREATER OR EQUAL TO  -1  BUT YOU SET START = ,I5)           OR-A1688
      STOP                                                              OR-A1689
 1720 WRITE (OUT,1740)                                                  OR-A1690
 1740 FORMAT (56X,14HERROR CODE  29,////,20X,72HTHE START OPTION IS ONLYOR-A1691
     1 USED WHEN SOLVING THE    WATER FLOW    EQUATION,///,20X,        OR-A1692
     252HYOU TRIED TO USE IT WHEN SOLVING THE SOLUTE EQUATION,///,20X,  OR-A1693
     362HSET  START = 0  IF YOU ONLY WANT TO SOLVE FOR SOLUTE(MODE = 2))OR-A1694
      STOP                                                              OR-A1695
 1760 WRITE (OUT,1780)                                                  OR-A1696
 1780 FORMAT (56X,14HERROR CODE  30,////,20X,79HWHEN SOLVING THE SOLUTE OR-A1697
     1EQUATION ALL BY ITSELF(MODE = 2), YOU MUST ALSO INCLUDE,/,20X,    OR-A1698
     298HINFORMATION ON THE WATER CONTENT.  SET  JWORH=0  AND FEED IN THOR-A1699
     3E INITIAL WATER CONTENT BY MEANS OF,/,20X,11HDATA SET W0)         OR-A1700
      STOP                                                              OR-A1701
 1800 WRITE (OUT,1820) JWORH                                            OR-A1702
 1820 FORMAT (56X,14HERROR CODE  31,////,20X,67HTHE ONLY VALUES THAT THEOR-A1703
     1 JWORH PARAMETER CAN HAVE ARE EITHER 0 OR 1,/,20X,20HBUT YOU SET JOR-A1704
     2WORH = ,I3,//,20X,38HCHECK TO MAKE SURE YOU FED IT IN RIGHT,///,  OR-A1705
     320X,99HNOTE THAT WHEN  JWORH=0  SOLVE THE WATER FLOW EQUATION AS AOR-A1706
     4 FUNCTION OF VOLUMETRIC   WATER  CONTENT,/,36X,72HJWORH=1  SOLVE TOR-A1707
     5HE WATER FLOW EQUATION AS A FUNCTION OF MATRIC POTENTIAL)         OR-A1708
      STOP                                                              OR-A1709
 1840 WRITE (OUT,1860) PWILT,UPTNTL                                     OR-A1710
 1860 FORMAT (56X,14HERROR CODE  32,////,20X,54HYOU SPECIFIED THE PLANT OR-A1711
     1WILTING POTENTIAL AS  PWILT = ,E12.5,2H (,6A1,1H),//,20X,         OR-A1712
     257HHOWEVER, PLANT POTENTIAL IS A NEGATIVE, NON ZERO QUANTITY)     OR-A1713
      STOP                                                              OR-A1714
 1880 WRITE (OUT,1900) BEST                                             OR-A1715
 1900 FORMAT (56X,14HERROR CODE  33,////,20X,96HTHE INTERPOLATION TABLE OR-A1716
     1PARAMETER  BEST  CAN ONLY HAVE THE VALUE OF  0 OR 1  BUT YOU SET BOR-A1717
     2EST = ,I3)                                                        OR-A1718
      STOP                                                              OR-A1719
 1920 WRITE (OUT,1940) TBLDWZ                                           OR-A1720
 1940 FORMAT (56X,14HERROR CODE  34,////,20X,77HWHEN SOLVING THE SOLUTE OR-A1721
     1EQUATION ALL BY ITSELF(MODE=2), YOU MUST ALSO INCLUDE,/,20X,      OR-A1722
     284HTHE SOIL WATER DIFFUSIVITY FUNCTION(I.E. SO THAT THE DARCIAN FLOR-A1723
     3UX CAN BE DETERMINED),/,20X,29HYOU INCORRECTLY SET TBLDWZ = ,I3,/,OR-A1724
     420X,97HNOTE  IF THETE IS NO   WATER  FLUX, OR IF IT IS A CONSTANT,OR-A1725
     5 SET TBLDWZ=0 ON DATA CARD SET DWZ AND,/,20X,29HSET DWZI=0. IN SUBOR-A1726
     6ROUTINE DWZ)                                                      OR-A1727
      STOP                                                              OR-A1728
 1960 WRITE (OUT,1980) TBLKWZ                                           OR-A1729
```

```
1980 FORMAT (56X,14HERROR CODE  35,////,20X,77HWHEN SOLVING THE SOLUTE OR-A1730
    1EQUATION ALL BY ITSELF(MODE=2), YOU MUST ALSO INCLUDE,/,20X,       OR-A1731
    285HTHE SOIL WATER CONDUCTIVITY FUNCTION(I.E. SO THAT THE DARCIAN FOR-A1732
    3LUX CAN BE DETERMINED),/,20X,30HYOU INCORRECTLY SET  TBLKWZ = ,I3,OR-A1733
    4/,20X,97HNOTE  IF THERE IS NO   WATER  FLUX OR IF IT IS A CONSTANTOR-A1734
    5(E.G. DARCIAN Q = THETA*PORE VEL = KWZI),/,20X,82HTHEN SET  TBLKWZOR-A1735
    6 = 0 IN DATA CARD SET KWZ AND SET KWZI=CONSTANT  IN SUBROUTINE KWZOR-A1736
                                                                       OR-A1737
    7)                                                                 OR-A1738
     STOP                                                              OR-A1739
2000 IF (JFLAG.GE.7) GO TO 2240                                        OR-A1740
     WRITE (OUT,2020) MAXSET                                           OR-A1741
2020 FORMAT (//////////,50X,25HERROR IN SUBROUTINE ERROR,///,20X,      OR-A1742
    171HONE OF THE FOLLOWING ARRAYS IS LARGER THEN THAT SPECIFIED BY  MOR-A1743
    2AXSET = ,I3,//,20X,102HIF YOU WANT TO MAKE  MAXSET  LARGER, ALL OFOR-A1744
    3 THE DIMENSION STATEMENTS OF THE PROGRAM HAVE TO BE UPRATED,/,20X,OR-A1745
    460HOTHERWISE YOU SHOULD REDUCE THE SIZE OF THIS DATA SET ARRAY.,//OR-A1746
    5/,35X,59HONE OF THE FOLLOWING DATA SET ARRAYS IS LARGER THAN  MAXSOR-A1747
    6ET,//////)                                                       OR-A1748
     GO TO (2040,2080,2120,2120,2160,2200), JFLAG                      OR-A1749
2040 WRITE (OUT,2060) NUMBCB,NUMBCT,NUMBWB,NUMBWT                      OR-A1750
2060 FORMAT (56X,14HERROR CODE  36,////,20X,9HNUMBCB = ,I3,5X,         OR-A1751
    19HNUMBCT = ,I3,5X,9HNUMBWB = ,I3,5X,9HNUMBWT = ,I3)               OR-A1752
     STOP                                                              OR-A1753
2080 WRITE (OUT,2100) NUMCST,NUMDSZ,NUMDWZ                             OR-A1754
2100 FORMAT (56X,14HERROR CODE  37,////,20X,9HNUMCST = ,I3,5X,         OR-A1755
    19HNUMDSZ = ,I3,5X,9HNUMDWZ = ,I3)                                 OR-A1756
     STOP                                                              OR-A1757
2120 WRITE (OUT,2140) NUMFCB,NUMFWB,NUMKWZ,NUMPW                       OR-A1758
2140 FORMAT (56X,14HERROR CODE  38,////,20X,9HNUMFCB = ,I3,5X,         OR-A1759
    19HNUMFWB = ,I3,5X,9HNUMKWZ = ,I3,5X,8HNUMPW = ,I3)                OR-A1760
     STOP                                                              OR-A1761
2160 WRITE (OUT,2180) NUMRAC,NUMRAW,NUMRD,NUMWP                        OR-A1762
2180 FORMAT (56X,14HERROR CODE  39,////,20X,9HNUMRAC = ,I3,5X,         OR-A1763
    19HNUMRAW = ,I3,5X,8HNUMRD = ,I3,5X,8HNUMWP = ,I3)                 OR-A1764
     STOP                                                              OR-A1765
2200 WRITE (OUT,2220) NUMCG,NUMCTX,NUMRPF                              OR-A1766
2220 FORMAT (56X,14HERROR CODE  40,////,20X,8HNUMCG = ,I5,5X,9HNUMCTX =OR-A1767
    1 ,I3,5X,9HNUMRPF = ,I3)                                           OR-A1768
     STOP                                                              OR-A1769
2240 WRITE (OUT,2260) NUMMAX                                           OR-A1770
2260 FORMAT (//////////,50X,19HIN SUBROUTINE ERROR,///,20X,71HONE OF THOR-A1771
    1E FOLLOWING ARRAYS IS LARGER THEN THAT SPECIFIED BY  NUMMAX = ,I3,OR-A1772
    2//,20X,102HIF YOU WANT TO MAKE  NUMMAX  LARGER, ALL OF THE DIMENSIOR-A1773
    30N STATEMENTS OF THE PROGRAM HAVE TO BE UPRATED,/,20X,60HOTHERWISEOR-A1774
    4 YOU SHOULD REDUCE THE SIZE OF THIS DATA SET ARRAY.,///,35X,       OR-A1775
    559HONE OF THE FOLLOWING DATA SET ARRAYS IS LARGER THAN  NUMMAX,///OR-A1776
    6///)
```

```
      IF (JFLAG.EQ.8) GO TO 2300                                        OR-A1777
      WRITE (OUT,2280) NUMCO,NUMPO,NUMSO,NUMWO,NUMZO,NUMZF              OR-A1778
 2280 FORMAT (56X,13HERROR CODE 41,////,18X,8HNUMCO = ,I3,5X,8HNUMPO = ,OR-A1779
     1I3,5X,8HNUMSO = ,I3,5X,8HNUMWO = ,I3,5X,8HNUMZO = ,I3,5X,         OR-A1780
     28HNUMZF = ,I3)                                                    OR-A1781
      STOP                                                              OR-A1782
 2300 WRITE (OUT,2320) NUMFCT,NUMFWT,NUMQPS                             OR-A1783
 2320 FORMAT (56X,14HERROR CODE  42,////,36X,9HNUMFCT = ,I3,5X,         OR-A1784
     19HNUMFWT = ,I3,5X,9HNUMQPS = ,I3)                                 OR-A1785
      STOP                                                              OR-A1786
 2340 WRITE (OUT,780) JWORH,MODE,JSORB,START                            OR-A1787
      GO TO (2360,2400,2440,2480,2520,2560,2600,2640,2680,2720,2760,2800OR-A1788
     1,2840,2880,2920,2960,3000), KFLAG                                 OR-A1789
 2360 WRITE (OUT,2380) GRAV                                             OR-A1790
 2380 FORMAT (56X,14HERROR CODE  43,////,40X,16HYOU SET  GRAV = ,E12.5, OR-A1791
     118H ON PROGRAM CARD 3,/,39X,49HBUT  GRAV  CAN ONLY HAVE THE FOLLOWOR-A1792
     2ING TWO VALUES,//,50X,30HGRAV = 0.  FOR HORIZONTAL FLOW,/,50X,    OR-A1793
     328HGRAV = 1.  FOR VERTICAL FLOW,///,30X,71HTHE PROGRAM USES THE   OR-A1794
     4GRAV PRAMETER  IN THE FOLLOWING WAY(FOR EXAMPLE),//,42X,47HDARCIANOR-A1795
     5 FLUX  Q = -DWZ*D(THETA)/D(Z) + KWZ*GRAV)                         OR-A1796
      STOP                                                              OR-A1797
 2400 WRITE (OUT,2420) TIMEO,TIMEF,DTMIN,DTMAX                          OR-A1798
 2420 FORMAT (56X,14HERROR CODE  44,////,35X,61HTHE FOLLOWING PARAMETERSOR-A1799
     1 WERE SPECIFIED ON PROGRAM CARD 5  AS,//,55X,8HTIMEO = ,E12.5,/,  OR-A1800
     255X,8HTIMEF = ,E12.5,/,55X,8HDTMIN = ,E12.5,/,55X,8HDTMAX = ,E12.5OR-A1801
     3,///,26X,78HALL OF THESE PARAMETERS MUST BE GREATER THAN ZERO, EXCOR-A1802
     4EPT FOR TIMEO WHICH MUST,/,26X,32HBE GREATER THAN OR EQUAL TO ZEROOR-A1803
     5)                                                                 OR-A1804
      STOP                                                              OR-A1805
 2440 WRITE (OUT,2460) TIMEO,TIMEF                                      OR-A1806
 2460 FORMAT (56X,14HERROR CODE  45,////,52X,28HFROM PROGRAM CARD 5, YOUOR-A1807
     1 SET,//,55X,8HTIMEO = ,E12.5,/,55X,8HTIMEF = ,E12.5,///,47X,      OR-A1808
     249HBUT TIMEF  MUST BE GREATER THAN OR EQUAL TO TIMEO )            OR-A1809
      STOP                                                              OR-A1810
 2480 WRITE (OUT,2500) DTMIN,DTMAX                                      OR-A1811
 2500 FORMAT (56X,14HERROR CODE  46,////,52X,28HFROM PROGRAM CARD 5, YOUOR-A1812
     1 SET,//,55X,8HDTMIN = ,E12.5,/,55X,8HDTMAX = ,E12.5,///,41X,      OR-A1813
     250HBUT DTMAX  MUST BE GREATER THAN OR EQUAL TO  DTMIN)            OR-A1814
      STOP                                                              OR-A1815
 2520 WRITE (OUT,2540) ACLRAT                                           OR-A1816
 2540 FORMAT (56X,14HERROR CODE  47,////,42X,19HYOU SET   ACLRAT = ,E12.OR-A1817
     15,19H  ON PROGRAM CARD 3,//,20X,87HTHIS ACCELERATION PARAMETER IS OR-A1818
     2USED WHEN MAKING INITIAL GUESSES FOR THE NEXT TIME LEVEL,/,20X,   OR-A1819
     342HHENCE, IT MUST ALWAYS BE GREATER THAN ZERO,//,20X,35HNOTE  USUAOR-A1820
     4LLY ONE SETS  ACLRAT = 1.)                                        OR-A1821
      STOP                                                              OR-A1822
 2560 WRITE (OUT,2580) ITRMAX                                           OR-A1823
```

```
2580 FORMAT (56X,14HERROR CODE  48,////,41X,19HYOU SET   ITRMAX = ,I3, OR-A1824
    119H  ON PROGRAM CARD 1,//,20X,77HOBVIOUSLY, THE MAXIMUM NUMBER OF OR-A1825
    2ALLOWED ITERATIONS MUST BE GREATER THAN ZERO)                     OR-A1826
     STOP                                                              OR-A1827
2600 WRITE (OUT,2620) ARATIO,QRATIO,SRATIO,WRATIO                      OR-A1828
2620 FORMAT (56X,14HERROR CODE  49,////,34X,66HON PROGRAM CARD 4,  YOU OR-A1829
    1SPECIFIED THE FOLLOWING CONVERGENCE RATIOS,//,55X,9HARATIO = ,E12.OR-A1830
    25,/,55X,9HQRATIO = ,E12.5,/,55X,9HSRATIO = ,E12.5,/,55X,9HWRATIO =OR-A1831
    3 ,E12.5,///,32X,70HALL CONVERGENCE RATIOS(EVEN IF NOT USED) MUST NOR-A1832
    4AVE NON-NEGATIVE VALUES)                                          OR-A1833
     STOP                                                              OR-A1834
2640 WRITE (OUT,2660) K1DELT                                           OR-A1835
2660 FORMAT (56X,14HERROR CODE  50,////,20X,44HON PROGRAM CARD 1,  YOU OR-A1836
    1SPECIFIED  K1DELT = ,I3,//,20X,65HHOWEVER,  K1DELT  CAN ONLY HAVE OR-A1837
    2THE VALUES OF 0,1,2  AND NO OTHER )                               OR-A1838
     STOP                                                              OR-A1839
2680 WRITE (OUT,2700) ATCOEF,BTCOEF,CTCOEF                             OR-A1840
2700 FORMAT (56X,14HERROR CODE  51,////,47X,38HON PROGRAM CARD 7,  YOU OR-A1841
    1SPECIFIED THAT,//,55X,9HATCOEF = ,E12.5,/,55X,9HBTCOEF = ,E12.5,/,OR-A1842
    255X,9HCTCOEF = ,E12.5,///,20X,94HTHESE COEFFICIENTS MUST HAVE NON-OR-A1843
    3NEGATIVE VALUES, OTHERWISE YOU MIGHT GET A NEGATIVE TIME STEP,/,  OR-A1844
    420X,48HBECAUSE  DT(K+1)=ATCOEF+BTCOEF*DT(K)+CTCOEF*TIME)          OR-A1845
     STOP                                                              OR-A1846
2720 WRITE (OUT,2740) ATCOEF,BTCOEF,CTCOEF                             OR-A1847
2740 FORMAT (56X,14HERROR CODE  52,////,47X,38HON PROGRAM CARD 7,  YOU OR-A1848
    1SPECIFIED THAT,//,55X,9HATCOEF = ,E12.5,/,55X,9HBTCOEF = ,E12.5,/,OR-A1849
    255X,9HCTCOEF = ,E12.5,///,30X,73HWHEN  K1DELT=1,  ATCOEF,BTCOEF,CTOR-A1850
    3COEF  CAN NOT ALL BE SIMULTANEOUSLY ZERO,//,30X,50HSTEP-SIZE  DT(KOR-A1851
    4+1)=ATCOEF+BTCOEF*DT(K)+CTCOEF*TIME)                              OR-A1852
     STOP                                                              OR-A1853
2760 WRITE (OUT,2780) TBLZF,NUMZF                                      OR-A1854
2780 FORMAT (56X,14HERROR CODE  53,////,44X,45HON THE  ZF  DATA SET CAROR-A1855
    1D, YOU SPECIFIED THAT,/,57X,8HTBLZF = ,I3,/,57X,8HNUMZF = ,I3,//, OR-A1856
    230X,75HNUMZF SPECIFIES THE NUMBER OF NEW SPACE NODES AND MUST BE GOR-A1857
    3REATER THAN FOUR,//,30X,68HIF YOU DIDNT INTEND TO USE THE REGRIDDIOR-A1858
    4NG PROCEDURE, SET  TBLZF = -1)                                    OR-A1859
     STOP                                                              OR-A1860
2800 WRITE (OUT,2820) TBLZ0,NUMZ0                                      OR-A1861
2820 FORMAT (56X,14HERROR CODE  91,////,41X,45HON THE  Z0  DATA SET CAROR-A1862
    1D, YOU SPECIFIED THAT,//,57X,8HTBLZ0 = ,I3,/,57X,8HNUMZ0 = ,I3,//,OR-A1863
    221X,83HNUMZ0 SPECIFIES THE NUMBER OF SPACE NODES IN THE SOIL AND MOR-A1864
    3UST BE GREATER THAN FOUR,//,12X,102HAT LEAST THIS MANY NODES ARE NOR-A1865
    4EEDED IN ORDER TO SOLVE THE EQUATIONS BY THE FINITE-DIFFERENCE TECOR-A1866
    5HNIQUE)                                                           OR-A1867
     STOP                                                              OR-A1868
2840 WRITE (OUT,2860) SAVE                                             OR-A1869
2860 FORMAT (56X,14HERROR CODE  92,////,37X,49HON PROGRAM CARD NUMBER 2OR-A1870
```

```
     1,  YOU SPECIFIED  SAVE = ,I4,/,28X,69HHOWEVER, THE SAVE PARAMETER OR-A1871
     2CAN ONLY HAVE THE INTEGER VALUES OF (0,1))                        OR-A1872
      STOP                                                              OR-A1873
 2880 WRITE (OUT,2900) OUTPUT                                           OR-A1874
 2900 FORMAT (56X,14HERROR CODE  93,////,36X,50HON PROGRAM CARD NUMBER 1OR-A1875
     1, YOU SPECIFIED  OUTPUT = ,I4,/,26X,73HHOWEVER, THE OUTPUT PARAMETOR-A1876
     2ER CAN ONLY HAVE THE INTEGER VALUES OF (0,1,2))                   OR-A1877
      STOP                                                              OR-A1878
 2920 WRITE (OUT,2940) SCAN                                             OR-A1879
 2940 FORMAT (56X,14HERROR CODE  94,////,36X,49HON PROGRAM CARD NUMBER 2OR-A1880
     1,  YOU SPECIFIED  SCAN = ,I4,/,28X,70HHOWEVER, THE SCAN PARAMETER OR-A1881
     2 CAN ONLY HAVE THE INTEGER VALUES OF (0,1))                       OR-A1882
      STOP                                                              OR-A1883
 2960 WRITE (OUT,2980) XORDER                                           OR-A1884
 2980 FORMAT (56X,14HERROR CODE  95,///,36X,50HON PROGRAM CARD NUMBER 2,OR-A1885
     1 YOU SPECIFIED  XORDER = ,I4,/,29X,68HHOWEVER, THE XORDER PARAMETEOR-A1886
     2R CAN ONLY HAVE THE INTEGER VALUES (0,1))                         OR-A1887
      STOP                                                              OR-A1888
 3000 WRITE (OUT,3020) MODE                                             OR-A1889
 3020 FORMAT (56X,14HERROR CODE  96,////,36X,49HON PROGRAM CARD NUMBER 1OR-A1890
     1,  YOU SPECIFIED  MODE = ,I4,/,29X,68HHOWEVER, THE MODE PARAMETER OR-A1891
     2CAN ONLY HAVE THE INTEGER VALUES (0,1,2))                         OR-A1892
      STOP                                                              OR-A1893
 3040  RETURN                                                           OR-A1894
      END                                                               OR-A1895
```

```
      SUBROUTINE WATER (TIME,DRY,SAT,GUESS,OLD1,OLD2,FLOW,K1,JWHS,      OR-A1896
     1NUMMAX)                                                           OR-A1897
C        SOLVE THE WATER FLOW EQUATION                                  OR-A1898
C                                                                       OR-A1899
C                                                                       OR-A1900
C     WHEN  JWHS=0   SOLVE THE FLOW EQUATION IN TERMS OF THE VOLUMETRIC OR-A1901
C                       WATER  CONTENT                                  OR-A1902
C     WHEN  JWHS=1   SOLVE THE FLOW EQUATION IN TERMS OF THE MATRIC     OR-A1903
C                      POTENTIAL                                        OR-A1904
C     WHEN  START IS NOT EQUAL TO ZERO   APPLY THE KIRCHHOFF TRANSFORM  OR-A1905
C             TO THE FLOW EQUATION AND SOLVE IN TERMS OF THE            OR-A1906
C             DIFFUSIVITY POTENTIAL                                     OR-A1907
```

```
C                                                                       OR-A1908
      INTEGER BCTOPC,BCTOPW,BCBTMC,BCBTMW,OUT,PNCH,WILTED               OR-A1909
      INTEGER FAIL,TBLDFZ,TBLDWF,TBLKFZ,TBLFP,TBLFW,TBLPF,TBLQPS,TBLWF, OR-A1910
     1START,TBLDWP,TBLKPZ,TBLWP,OUTPUT,SHORT,GOLDEN                     OR-A1911
      REAL KWZDRY,KWZSAT,KZNIK,KZPIK,KZK1,KZKN                          OR-A1912
      REAL MIN,MINLMT,MAX,MAXLMT,MAXOLD                                 OR-A1913
      COMMON DUMMY(200),WGIKH(200),PGIKH(200),BACK(200),CALPHA(200),    OR-A1914
     1CGIKH(200),FCCOLD(200),FCOLD(200),FGGOLD(200),FGOLD(200),FGO(200) OR-A1915
      COMMON /BEAR/ FGUESS(200),FOLD1(200),FOLD2(200),F(200)            OR-A1916
      COMMON /BEGIN/ START                                              OR-A1917
      COMMON /CNVRGE/ ARATIO,QRATIO,SRATIO,WRATIO,ITRMAX,ACLRAT         OR-A1918
      COMMON /DATA/ BCTOPC,BCTOPW,BCBTMC,BCBTMW,JWORH,MODE,JSORB        OR-A1919
      COMMON /DELTA/ ATCOEF,BTCOEF,CTCOEF,DTK,DTK1,DTMAX,DTMIN,K1DELT   OR-A1920
      COMMON /DEPTH/ N,Z(200)                                           OR-A1921
      COMMON /FLUX/ A(200),G(200),QZ(200)                               OR-A1922
      COMMON /IO/ IN,OUT,PNCH                                           OR-A1923
      COMMON /LIQUID/ CGUESS(200),COLD1(200),COLD2(200),C(200)          OR-A1924
      COMMON /MATRIC/ PGUESS(200),POLD1(200),POLD2(200),PSI(200)        OR-A1925
      COMMON /MOIST/ WGUESS(200),WOLD1(200),WOLD2(200),THETA(200)       OR-A1926
      COMMON /PRNT/ NSKIP,NPRINT,OUTPUT                                 OR-A1927
      COMMON /QITR/ QCOLD(2),QPOLD(2),QMIN                              OR-A1928
      COMMON /ROOTS/ CNVRSN,TCR,PPSURF(3),PWILT,RR,TR,WILTED            OR-A1929
      COMMON /TABDFZ/ NUMDFZ,TBLDFZ,XDFZ(50),YDFZ(50)                   OR-A1930
      COMMON /TABDWF/ NUMDWF,TBLDWF,XDWF(50),YDWF(50)                   OR-A1931
      COMMON /TABDWP/ NUMDWP,TBLDWP,XDWP(50),YDWP(50)                   OR-A1932
      COMMON /TABFP/ NUMFP,TBLFP,XFP(50),YFP(50)                        OR-A1933
      COMMON /TABFW/ NUMFW,TBLFW,XFW(50),YFW(50)                        OR-A1934
      COMMON /TABKFZ/ NUMKFZ,TBLKFZ,XKFZ(50),YKFZ(50)                   OR-A1935
      COMMON /TABKPZ/ NUMKPZ,TBLKPZ,XKPZ(50),YKPZ(50)                   OR-A1936
      COMMON /TABPF/ NUMPF,TBLPF,XPF(50),YPF(50)                        OR-A1937
      COMMON /TABQPS/ NUMQPS,TBLQPS,XQPS(200),YQPS(200)                 OR-A1938
      COMMON /TABWF/ NUMWF,TBLWF,XWF(50),YWF(50)                        OR-A1939
      COMMON /TABWP/ NUMWP,TBLWP,XWP(50),YWP(50)                        OR-A1940
      COMMON /UNIT/ ULNGTH(2),UPTNTL(6),UTIME(3),UMASS(3)               OR-A1941
      COMMON /WDATA/ GRAV,KWZDRY,KWZSAT,PDRY,PSAT,WDRY,WSAT             OR-A1942
      DIMENSION GUESS(NUMMAX),OLD1(NUMMAX),OLD2(NUMMAX),FLOW(NUMMAX)    OR-A1943
                                                                        OR-A1944
C                                                                       OR-A1945
C                                                                       OR-A1946
C                                                                       OR-A1947
C                                                                       OR-A1948
C                                                                       OR-A1949
C       DRY       FLOW AT AIR-DRY CONDITIONS                            OR-A1950
C       FLOW(I)     WATER  CONTENT AT NODE I  AND TIME LEVEL  K+1       OR-A1951
C       GOLDEN    NUMBER OF TIMES THAT THE GOLDEN SECTION SEARCH        OR-A1952
C                   TECHNIQUE HAS BEEN CALLED.                          OR-A1953
C       GUESS(I)  GUESSED VALUE OF WATER CONTENT FOR NODE I  ON         OR-A1954
C                   ITERATION LEVEL  M
```

```
C        K1         FUTURE TIME, LEVEL K+1                                  OR-A1955
C                                                                           OR-A1956
C        MAX        MAXIMUM VALUE OF FLOW ALLOWED                           OR-A1957
C        MIN        MINIMUM VALUE OF FLOW ALLOWED                           OR-A1958
C        OLD2(I)      WATER  CONTENT AT NODE I AND TIME LEVEL  K            OR-A1959
C        OLD1(I)      WATER  CONTENT AT NODE I AND TIME LEVEL  K-1          OR-A1960
C        SAT        FLOW AT SATURATION CONDITIONS                           OR-A1961
C        SHORT=-1   SUBROUTINE WATER WILL NOT USE THE 1ST TYPE B.C.         OR-A1962
C                    SHORT CUT BECAUSE IT FAILED ON THIS TIME STEP.         OR-A1963
C        SHORT=0    NO ACTION IS TAKEN                                      OR-A1964
C        SHORT=1    UNDER CERTAIN CONDITIONS, SUCH AS WHEN THE SOIL         OR-A1965
C                    SURFACE GOES EITHER AIR-DRY OR SATURATED, A FOURTH-    OR-A1966
C                    ORDER TYPE BOUNDARY CONDITION IS TREATED AS A 1ST      OR-A1967
C                    TYPE B.C.  IF THIS PROCEDURE FAILS, SET SHORT=-1 .     OR-A1968
C        TIME       THE TIME AT WHICH THE    FLOW EQUATION IS TO BE         OR-A1969
C                     EVALUATED AT, LEVEL  K+1                              OR-A1970
C                                                                           OR-A1971
      DZK1 = 0.                                                             OR-A1972
      DZKN = 0.                                                             OR-A1973
      GOLDEN = 0                                                            OR-A1974
      ITR = 0                                                               OR-A1975
      MAXI = 0                                                              OR-A1976
      MINI = 0                                                              OR-A1977
      MQMAX = ITRMAX*10                                                     OR-A1978
      IF (MQMAX.GT.500) MQMAX = 500                                         OR-A1979
C         NUMBER OF ADDITIONAL ITERATIONS ALLOWED                           OR-A1980
      MAXDEL = 25                                                           OR-A1981
      IF (MAXDEL.GE.MQMAX) MAXDEL = MQMAX/4                                 OR-A1982
      MDEL = MQMAX-MAXDEL                                                   OR-A1983
      SHORT = 0                                                             OR-A1984
C        PRECISION OF COMPUTER SYSTEM (ERROR DUE TO ROUND-OFF)              OR-A1985
      TLRNCE = 1.E-05                                                       OR-A1986
        QCC=0.                                                              OR-A1987
  120 CALL BCWTOP (TIME,FTOP)                                               OR-A1988
      CALL BCWBTM (TIME,FBTM)                                               OR-A1989
      FAIL = 0                                                              OR-A1990
      IFAIL = 0                                                             OR-A1991
      IFMAX = ITRMAX                                                        OR-A1992
      M = 0                                                                 OR-A1993
      MQFAIL = 0                                                            OR-A1994
      MR = 0                                                                OR-A1995
      QC = 0.                                                               OR-A1996
      QP = 0.                                                               OR-A1997
  140 MQ = 0                                                                OR-A1998
      NITR = N                                                              OR-A1999
      NMINI = 10                                                            OR-A2000
      IF (NMINI.GE.N) NMINI = N                                             OR-A2001
```

```
      N1 = N-1                                                                  OR-A2002
      IF (K1.GT.2) GO TO 180                                                    OR-A2003
C     ON THE FIRST TWO TIME STEPS, SET THE GUESS EQUAL TO THE OLD VALUE         OR-A2004
      DO 160 I=1,N                                                              OR-A2005
160   GUESS(I) = OLD2(I)                                                        OR-A2006
      PPSURF(3) = PPSURF(2)                                                     OR-A2007
      GO TO 220                                                                 OR-A2008
C        EXTRAPOLATE TO OBTAIN THE FIRST GUESSED VALUE                          OR-A2009
 180  DO 200 I=1,N                                                              OR-A2010
200   GUESS(I) = OLD2(I) +ACLRAT*DTK1/DTK*(OLD2(I) -OLD1(I) )                   OR-A2011
      IF(TBLQPS.LE.-1.OR.WILTED.EQ.1) GO TO 220                                 OR-A2012
      PPSURF(3) = PPSURF(2)+ACLRAT*DTK1/DTK*(PPSURF(2)-PPSURF(1))               OR-A2013
      IF (PPSURF(3).GT.0.) PPSURF(3) = 0.                                       OR-A2014
      IF (PPSURF(3).LT.PWILT) PPSURF(3) = PWILT                                 OR-A2015
 220  IF (BCTOPW.EQ.1) GUESS(1)=FTOP                                            OR-A2016
      IF (BCBTMW.EQ.1) GUESS(N) = FBTM                                          OR-A2017
      IF (START.EQ.0) GO TO 260                                                 OR-A2018
      IF (BCTOPW.NE.1) GO TO 240                                                OR-A2019
      IF (JWHS.EQ.0) CALL INTRP (NUMFW,TBLFW,XFW,YFW,FTOP,GUESS(1),DUM,         OR-A2020
     13HFW )                                                                    OR-A2021
      IF (JWHS.EQ.1) CALL INTRP (NUMFP,TBLFP,XFP,YFP,FTOP,GUESS(1),DUM,         OR-A2022
     13HFP )                                                                    OR-A2023
      FTOP = GUESS(1)                                                           OR-A2024
 240  IF (BCBTMW.NE.1) GO TO 260                                                OR-A2025
      IF (JWHS.EQ.0) CALL INTRP (NUMFW,TBLFW,XFW,YFW,FBTM,GUESS(N),DUM,         OR-A2026
     13HFW1)                                                                    OR-A2027
      IF (JWHS.EQ.1) CALL INTRP (NUMFP,TBLFP,XFP,YFP,FBTM,GUESS(N),DUM,         OR-A2028
     13HFP1)                                                                    OR-A2029
      FBTM = GUESS(N)                                                           OR-A2030
C                INITIALIZE THE ARRAYS                                        OR-A2031
 260  IF (K1.GT.1) GO TO 280                                                    OR-A2032
      ISTOLD = 0                                                                OR-A2033
      IF (START.NE.0) ISTOLD = 1                                                OR-A2034
      MAXOLD = SAT                                                              OR-A2035
      IQPOS = 0                                                                 OR-A2036
C     DETERMINE THE MINIMUM AND MAXIMUM VALUES OF WATER CONTENT ALLOWED         OR-A2037
 280  MIN = DRY                                                                 OR-A2038
      MAX = SAT                                                                 OR-A2039
      IF (JWHS.NE.1) GO TO 360                                                  OR-A2040
C     CHECK IF THERE HAS BEEN A SWITCH IN THE START OPTION                      OR-A2041
      XMOLD = MAXOLD                                                            OR-A2042
      IF (ISTOLD.EQ.1.AND.START.EQ.0) CALL INTRP (NUMPF,TBLPF,XPF,YPF,          OR-A2043
     1MAXOLD,XMOLD,DUM,3HPF1)                                                   OR-A2044
      MAXOLD = XMOLD                                                            OR-A2045
      IF (ISTOLD.EQ.1.AND.START.EQ.0) ISTOLD = 0                                OR-A2046
      IF (BCTOPW.NE.1.AND.BCBTMW.NE.1) GO TO 340                                OR-A2047
      IF (BCTOPW.EQ.1.AND.BCBTMW.NE.1) GO TO 300                                OR-A2048
```

```
      IF (BCTOPW.NE.1.AND.BCBTMW.EQ.1) GO TO 320                        OR-A2049
      IF(FBTM.GT.MAXOLD) MAXOLD=FBTM                                    OR-A2050
      IF(FTOP.GT.MAXOLD) MAXOLD=FTOP                                    OR-A2051
      GO TO 340                                                         OR-A2052
  300 IF (FTOP.GT.MAXOLD) MAXOLD = FTOP                                 OR-A2053
      GO TO 340                                                         OR-A2054
  320 IF (FBTM.GT.MAXOLD) MAXOLD = FBTM                                 OR-A2055
  340 MAX = MAXOLD                                                      OR-A2056
C     COMPUTE THE NUMERICAL TOLERANCE ALLOWED FOR EITHER AIR-DRY OR     OR-A2057
C     SATURATED CONDITIONS                                              OR-A2058
  360 SIGN = 1.                                                         OR-A2059
      IF (MIN.LT.0.) SIGN = -1.                                         OR-A2060
      MINLMT = MIN*(1.-SIGN*1.E-03)                                     OR-A2061
      SIGN = 1.                                                         OR-A2062
      IF (MAX.LT.0.) SIGN = -1.                                         OR-A2063
      MAXLMT = MAX*(1.+SIGN*1.E-03)                                     OR-A2064
      SMLST = ABS(MAX-MIN)*TLRNCE                                       OR-A2065
      IF (MAXLMT.EQ.0.) MAXLMT = SMLST                                  OR-A2066
      IF (MINLMT.EQ.0.) MINLMT = -SMLST                                 OR-A2067
      DO 380 I=1,N                                                      OR-A2068
      IF (GUESS(I).LT.MIN) GUESS(I) = MIN                               OR-A2069
      IF (GUESS(I).GT.MAX) GUESS(I) = MAX                               OR-A2070
  380 CONTINUE                                                          OR-A2071
      DO 400 I=1,N                                                      OR-A2072
      FCOLD(I) = GUESS(I)                                               OR-A2073
      FGOLD(I) = GUESS(I)                                               OR-A2074
      FCCOLD(I) = GUESS(I)                                              OR-A2075
  400 FGGOLD(I) = GUESS(I)                                              OR-A2076
      IF (BCTOPW.EQ.4) GO TO 460                                        OR-A2077
      IF (SHORT) 580,420,440                                            OR-A2078
C      WITH 1ST AND 2ND TYPE BC, USE MINI-ITERATOR FIRST TO COMPUTE THE OR-A2079
C     WATER CONTENT                                                     OR-A2080
  420 IQPOS = 0                                                         OR-A2081
      MQ = -1                                                           OR-A2082
      NITR = NMINI                                                      OR-A2083
      N1 = NITR-1                                                       OR-A2084
      GO TO 580                                                         OR-A2085
C     SPECIAL CASE (WHEN AT THE LIMITS)                                 OR-A2086
  440 MQ = 0                                                            OR-A2087
       GO TO 580                                                        OR-A2088
  460 MQ = 1                                                            OR-A2089
      IF (ABS(FTOP).LE.QMIN) FTOP = 0.                                  OR-A2090
      QP = FTOP                                                         OR-A2091
      IF (QP.LE.0.) IQPOS = 0                                           OR-A2092
      IF (OLD2(1) .LE.MIN.AND.OLD2(2) .LE.MIN.AND.QP.LE.0.) WRITE (OUT, OR-A2093
     1480) TIME,K1,OLD2(1) ,OLD2(2) ,QP,MIN                             OR-A2094
  480 FORMAT (//////////,56X,14HERROR CODE  54,////,50X,26HERROR IN SUBROR-A2095
```

```
     1OUTINE  WATER,//////,48X,41HTHE FOLLOWING PARAMETERS HAD THE VALUEOR-A2096
     2 OF,//,62X,7HTIME = ,E12.5,/,63X,6HK1   = ,I3,/,58X,11HOLD2(1)  = ,OR-A2097
     3E12.5,/,58X,11HOLD2(2)  = ,E12.5,/,63X,6HQP   = ,E12.5,/,63X,      OR-A2098
     46HDRY = ,E12.5,//,20X,91HSINCE THE TOP TWO NODES ARE AIR-DRY, IT IOR-A2099
     5S IMPOSSIBLE TO SATISFY ANY SURFACE FLUX CONDITION,/,20X,          OR-A2100
     635HWHICH IS LESS THAN OR EQUAL TO ZERO,///,20X,73HEITHER CHANGE THOR-A2101
     7E VALUE OF  FTOPW IN SUBROUTINE  BCWTOP(IF TBLFWT = 0) OR,/,20X,  OR-A2102
     842HCHANGE THE VALUE OF  YFWT  IN DATA SET FWT,2X,60HOR INCREASE THOR-A2103
     9E INITIAL   WATER  CONTENT IN THE SOIL COLUMN.)                    OR-A2104
      IF (OLD2(1) .LE.MIN.AND.OLD2(2) .LE.MIN.AND.QP.LE.0.) STOP        OR-A2105
      IF (FTOP.EQ.0.) GO TO 580                                         OR-A2106
      IF (QP.GT.0.) IQPOS = IQPOS+1                                     OR-A2107
      DO 500 I=1,N                                                      OR-A2108
      IF (IQPOS.EQ.2) GUESS(I) = OLD2(I)                                OR-A2109
500   FGO(I) = GUESS(I)                                                 OR-A2110
C                                                                       OR-A2111
C        INITIALLY START OUT IN THE FLUX MINI-ITERATOR MODE             OR-A2112
      MQ = -1                                                           OR-A2113
      NITR = NMINI                                                      OR-A2114
      N1 = NITR-1                                                       OR-A2115
C     (WAS THERE A CHANGE IN SIGN)                                      OR-A2116
      IF (QPOLD(2)/QP.LE.0.) GO TO 560                                  OR-A2117
C     (HAS THE ABSOLUTE VALUE OF THE POTENTIAL FLUX DECREASED)          OR-A2118
      IF (ABS(QCOLD(2)).GE.ABS(QP)) GO TO 560                           OR-A2119
      IF (QCOLD(1).EQ.0.) GO TO 560                                     OR-A2120
      IF (QCOLD(2)/QCOLD(1).LE.0.) GO TO 560                            OR-A2121
      IF (SHORT.EQ.-1) GO TO 540                                        OR-A2122
C     CHECK IF THE SURFACE NODE HAS BECOME EITHER SATURATED OR AIR-DRY. OR-A2123
C     FIRST CONVERT THE SURFACE VALUE INTO VOLUMETRIC WATER CONTENT, W1.OR-A2124
      W1 = WOLD2(1)                                                     OR-A2125
      IF (JWHS.EQ.1) CALL INTRP (NUMWP,TBLWP,XWP,YWP,POLD2(1) ,W1,DUM,  OR-A2126
     13HWP )                                                            OR-A2127
C     THE SURFACE NODE IS ASSUMED TO BE EITHER AIR-DRY OR SATURATED  IF OR-A2128
C     THE   WATER  CONTENT IS WITHIN  WLMT  OF THESE EXTREMES.          OR-A2129
      WLMT = ABS(WSAT-WDRY)*.01                                         OR-A2130
      W1S = ABS(W1-WSAT)                                                OR-A2131
      W1D = ABS(W1-WDRY)                                                OR-A2132
      IF (W1S.GT.WLMT.AND.W1D.GT.WLMT) GO TO 540                        OR-A2133
      SHORT = 1                                                         OR-A2134
      BCTOPW = 1                                                        OR-A2135
      IF (JWHS.EQ.1) GO TO 520                                          OR-A2136
      FTOP = WDRY                                                       OR-A2137
      IF (W1S.LE.WLMT) FTOP = WSAT                                      OR-A2138
      GO TO 140                                                         OR-A2139
  520 FTOP = PDRY                                                       OR-A2140
      IF (W1S.LE.WLMT) FTOP = PSAT                                      OR-A2141
      GO TO 140                                                         OR-A2142
```

```
C                                                                       OR-A2143
C     NOTE THE OUTER FLUX INTERVAL IS DENOTED BY (AK,BK) AND            OR-A2144
C     THE INNER FLUX INTERVAL AS (TK,TKP).  THUS THE FLUX VALUES ARE    OR-A2145
C     ARRANGED IN ASCENDING ORDER(ABSOLUTE) AS  (AK,TK,TKP,BK) WHEN     OR-A2146
C     BEING USED BY THE FLUX ITERATOR                                   OR-A2147
 540  QG = QCOLD(2)+ACLRAT*DTK1/DTK*(QCOLD(2)-QCOLD(1))                 OR-A2148
      IF (QG/QP.LE.0.) QG = QCOLD(2)                                    OR-A2149
      IF (ABS(QG).GT.ABS(QP).OR.QG.EQ.0.) GO TO 560                     OR-A2150
      QGAK = 0.                                                         OR-A2151
      QGBK = QP                                                         OR-A2152
C     MAKE SURE THAT QC IS FALLING BEFORE SETTING  B                    OR-A2153
      IF (QCOLD(1).EQ.0.) GO TO 560                                     OR-A2154
      IF (ABS(QCOLD(2)/QCOLD(1)).LE.0.98) QGBK = QCOLD(2)*2.            OR-A2155
      IF (ABS(QGBK).LE.ABS(QG).OR.ABS(QGBK).GE.ABS(QP)) QGBK = QP       OR-A2156
      FTOP = QG                                                         OR-A2157
      GO TO 580                                                         OR-A2158
 560  QGAK = 0.                                                         OR-A2159
      QGBK = QP                                                         OR-A2160
      QG = QGBK                                                         OR-A2161
      FTOP = QG                                                         OR-A2162
C                                                                       OR-A2163
 580  ITR = ITR+1                                                       OR-A2164
      IF (MQ.LE.-1) MINI = MINI+1                                       OR-A2165
      IF (MQ.GE.0) MAXI = MAXI+1                                        OR-A2166
      IF (M.LT.IFMAX) GO TO 1040                                        OR-A2167
      IF (MQ.LE.0.AND.BCTOPW.EQ.4) GO TO 2120                           OR-A2168
      FAIL = FAIL+1                                                     OR-A2169
      IF (M.EQ.ITRMAX) WRITE (OUT,600) M,WRATIO                         OR-A2170
 600  FORMAT (//,56X,14HERROR CODE  55,////,60X,7HWARNING,///,10X,      OR-A2171
     1102HTHE FINITE-DIFFERENCE SOLUTION TO THE WATER FLOW EQUATION IN SOR-A2172
     2UBROUTINE WATER FAILED TO CONVERGE AFTER,/,10X,I3,63H ITERATIONS. OR-A2173
     3 CONVERGENCE CRITERION WAS SPECIFIED AS  WRATIO = ,E10.4)         OR-A2174
      IF (FAIL.GE.2) GO TO 720                                          OR-A2175
C     ADDITIONAL ITERATIONS ARE ALLOWED                                 OR-A2176
      IFMAX = ITRMAX+MAXDEL                                             OR-A2177
      WRITE (OUT,620) MAXDEL                                            OR-A2178
 620  FORMAT (/,55X,19HFAILURE TO CONVERGE,//,40X,26HPROGRAM WILL CONTINOR-A2179
     1UE FOR ,I3,22H ADDITIONAL ITERATIONS)                             OR-A2180
      IF (START.EQ.0.AND.JWHS.EQ.0) WRITE (OUT,640)                     OR-A2181
 640  FORMAT (10X,103HAT THE END OF EACH ADDITIONAL ITERATION, THE WORSTOR-A2182
     1 GUESS VALUE OF  VOLUMETRIC   WATER  CONTENT IS GIVEN)            OR-A2183
      IF (START.EQ.0.AND.JWHS.EQ.1) WRITE (OUT,660)                     OR-A2184
 660  FORMAT (10X,93HAT THE END OF EACH ADDITIONAL ITERATION, THE WORST OR-A2185
     1GUESSED VALUE OF MATRIC POTENTIAL IS GIVEN)                       OR-A2186
      IF (START.NE.0) WRITE (OUT,680)                                   OR-A2187
 680  FORMAT (10X,98HAT THE END OF EACH ADDITIONAL ITERATION, THE WORST OR-A2188
     1GUESSED VALUE OF DIFFUSIVITY POTENTIAL IS GIVEN)                  OR-A2189
```

```
      WRITE (OUT,700)                                                   OR-A2190
  700 FORMAT (10X,94HALONG WITH ITS CORRESPONDING COMPUTED VALUE AND THEOR-A2191
     1 DECIMAL PERCENT DIFFERENCE BETWEEN THE TWO,///,10X,9HITERATION,5XOR-A2192
     2,10HWORST NODE,10X,7HGUESSED,10X,8HCOMPUTED,5X,18HPERCENT DIFFERENOR-A2193
     3CE,/,13X,3HITR,29X,5HVALUE,13X,5HVALUE,11X,9H(DECIMAL),9X,1HM,2X, OR-A2194
     42HMQ,1X,6HMQFAIL,1X,4HNITR,          //)                         OR-A2195
      GO TO 1040                                                        OR-A2196
  720 WRITE (OUT,740)                                                   OR-A2197
  740 FORMAT (//////////,56X,14HERROR CODE  56,////,50X,37HSUBROUTINE   WOR-A2198
     1ATER  FAILED TO CONVERGE)                                         OR-A2199
      WRITE (OUT,2320) M,MQ,MR,ITR,MAXI,MINI,IQPOS,MQFAIL,MQMAX,NMINI, OR-A2200
     1NITR,SHORT,GOLDEN                                                 OR-A2201
      WRITE (OUT,760) TIME,DTMIN,DTK,DTK1,K1,JWHS,BCTOPW,FTOP,BCBTMW,   OR-A2202
     1FBTM,START,MIN,MAX,DRY,SAT                                        OR-A2203
  760 FORMAT (50X,8H TIME = ,E12.5,/,50X,8HDTMIN = ,E12.5,/,50X,        OR-A2204
     18H DTK  = ,E12.5,/,50X,8H DTK1 = ,E12.5,/,50X,8H   K1 = ,I5,/,50X,OR-A2205
     28HJWHS  = ,I5,/,49X,9HBCTOPW = ,I3,/,48X,10H  FTOP  = ,E12.5,/,49XOR-A2206
     3,9HBCBTMW = ,I3,/,48X,10H  FBTM  = ,E12.5,/,50X,8HSTART = ,I3,/,  OR-A2207
     450X,8H MIN  = ,E12.5,/,50X,8H MAX  = ,E12.5,/,50X,8H DRY  = ,E12.5OR-A2208
     5,/,50X,8H SAT  = ,E12.5)                                          OR-A2209
      IT1 = ITR-1                                                       OR-A2210
  780 IT2 = ITR-2                                                       OR-A2211
      WRITE (OUT,800) ITR,TIME,UTIME                                    OR-A2212
  800 FORMAT(/////,20X,94HGIVEN BELOW IS A LIST OF 7 ARRAYS FROM SUBROUTOR-A2213
     1INE WATER CONTAINING THE VALUES OF WATER CONTENT,/,20X,100HFROM THOR-A2214
     2E LAST TWO INTEGRATION STEPS, THE GUESSED AND COMPUTED VALUES OF TOR-A2215
     3HE LAST TWO ITERATION STEPS,/,20X,43HAND THE MOST CURRENT ITERATIOOR-A2216
     4N GUESS VALUES,/,20X,30HEVALUATED ON ITERATION NUMBER ,I3,        OR-A2217
     533H OF SUBROUTINE  WATER  AT TIME = ,E12.5,2H (,3A1,1H))          OR-A2218
      IF (JWHS.EQ.0.AND.START.EQ.0) WRITE (OUT,820) ULNGTH,ULNGTH       OR-A2219
  820 FORMAT (//////,35X,60HCOMPUTED AND GUESSED VALUES OF VOLUMETRIC   WOR-A2220
     1ATER  CONTENT (,2A1,4H**3/,2A1,4H**3))                            OR-A2221
      IF (JWHS.EQ.1.AND.START.EQ.0) WRITE (OUT,840) UPTNTL              OR-A2222
  840 FORMAT (////,35X,49HCOMPUTED AND GUESSED VALUES OF MATRIC POTENTIAOR-A2223
     1L (,6A1,1H))                                                      OR-A2224
      IF (START.NE.0) WRITE (OUT,860) ULNGTH,UTIME                      OR-A2225
  860 FORMAT (////,35X,54HCOMPUTED AND GUESSED VALUES OF DIFFUSIVITY POTOR-A2226
     1ENTIAL (,2A1,4H**2/,3A1,1H))                                      OR-A2227
      WRITE (OUT,880) IT2,IT2,IT1,IT1,ITR                               OR-A2228
  880 FORMAT (////,3X,4HTIME,12X,3HK-1,13X,1HK,13X,3HK+1,12X,3HK+1,12X, OR-A2229
     13HK+1,12X,3HK+1,12X,3HK+1,/,1X,9HITERATION,39X,I3,12X,I3,12X,I3,  OR-A2230
     212X,I3,12X,I3,/,2X,6HSTATUS,9X,6HACTUAL,9X,6HACTUAL,10X,5HGUESS,8XOR-A2231
     3,8HCOMPUTED,9X,5HGUESS,9X,8HCOMPUTED,8X,5HGUESS,//,2X,6HNODE I,8X,OR-A2232
     49H OLD1(I) ,6X,9H OLD2(I) ,6X,9HFGGOLD(I),6X,9HFCCOLD(I),7X,      OR-A2233
     58HFGOLD(I),7X,8HFCOLD(I),6X,9H GUESS(I),//)                       OR-A2234
      DO 920 I=1,N                                                      OR-A2235
      WRITE (OUT,900) I,OLD1(I) ,OLD2(I) ,FGGOLD(I),FCCOLD(I),FGOLD(I), OR-A2236
```

```
     1FCOLD(I),GUESS(I)                                                 OR-A2237
  900  FORMAT (4X,I3,3X,7(4X,E11.4))                                    OR-A2238
  920  CONTINUE                                                         OR-A2239
       DZ21 = Z(2)-Z(1)                                                 OR-A2240
       FK1 = (OLD2(1) +GUESS(1))/2.                                     OR-A2241
       IF (FK1.LT.MIN) FK1 = MIN                                        OR-A2242
       IF (FK1.GT.MAX) FK1 = MAX                                        OR-A2243
       IF (JWHS.EQ.1) GO TO 960                                         OR-A2244
       IF (START.EQ.0) CALL DWZ (FK1,DK1)                               OR-A2245
       IF (START.NE.0) CALL INTRP (NUMDFZ,TBLDFZ,XDFZ,YDFZ,FK1,DK1,DUM, OR-A2246
      13HDF2)                                                           OR-A2247
       DTZ = DK1*DTK1/DZ21/DZ21                                         OR-A2248
       WRITE (OUT,940) DK1,ULNGTH,UTIME,DZ21,ULNGTH,DTK1,UTIME,DTZ      OR-A2249
  940  FORMAT(////,38X,65HCHECK IF THE SPACE AND TIME STEP-SIZES VIOLATE OR-A2250
     1THE CRITERION THAT,//,43X,54HDIFFUSIVITY *DEL(T)/DEL(Z)**2  SHOULDOR-A2251
     2 BE LESS THAN  .5,//,44X,52HON THIS PARTICULAR TIME STEP AND AT THOR-A2252
     3E SOIL SURFACE,//,51X,14HDIFFUSIVITY = ,E11.4,2H (,2A1,4H**2/,3A1,OR-A2253
     41H),/,56X,9HDEL(Z) = ,E11.4,2H (,2A1,1H),/,56X,9HDEL(T) = ,E11.4, OR-A2254
     52H (,3A1,1H),//,44X,38HHENCE, DIFFUSIVITY*DEL(T)/DEL(Z)**2 = ,E11.OR-A2255
     64)                                                                OR-A2256
       GO TO 1020                                                       OR-A2257
  960  PK1 = FK1                                                        OR-A2258
       IF (START.NE.0) CALL INTRP (NUMPF,TBLPF,XPF,YPF,FK1,PK1,DUM,3HPF2)OR-A2259
       CALL INTRP (NUMKPZ,TBLKPZ,XKPZ,YKPZ,PK1,KZK1,DUM,3HKP3)          OR-A2260
       IF (TBLWP.LE.0) CALL WPSI (PK1,DUM,SMC1)                         OR-A2261
       IF (TBLWP.GT.0) CALL INTRP (NUMDWP,TBLDWP,XDWP,YDWP,PK1,SMC1,DUM, OR-A2262
      13HDW7)                                                           OR-A2263
       IF (SMC1.EQ.0.) GO TO 1020                                       OR-A2264
       DK1 = KZK1*CNVRSN/SMC1                                           OR-A2265
       DTZ = DK1*DTK1/DZ21/DZ21                                         OR-A2266
       WRITE (OUT,980) DK1,ULNGTH,UTIME,DZ21,ULNGTH,DTK1,UTIME,DTZ      OR-A2267
  980  FORMAT(////,38X,65HCHECK IF THE SPACE AND TIME STEP-SIZES VIOLATE OR-A2268
     1THE CRITERION THAT,//,32X,77HCONDUCTIVITY*D(PSI)/D(THETA)*CNVRSN*DOR-A2269
     2EL(T)/DEL(Z)**2  SHOULD BE LESS THAN  .5,//,38X,62HON THIS PARTICUOR-A2270
     3LAR TIME STEP AND EVALUATED AT THE SOIL SURFACE,///,38X,38HCONDUCTOR-A2271
     4IVITY*D(PSI)/D(THETA)*CNVRSN = ,E11.4,2H (,2A1,4H**2/,3A1,1H),/,  OR-A2272
     567X,9HDEL(Z) = ,E11.4,2H (,2A1,1H),/,67X,9HDEL(T) = ,E11.4,2H (,  OR-A2273
     63A1,1H),//,38X,55HCONDUCTIVITY*D(PSI)/D(THETA)*CNVRSN*DEL(T)/DEL(ZOR-A2274
     7)**2 = ,E11.4)                                                    OR-A2275
       WRITE (OUT,1000)                                                 OR-A2276
 1000 FORMAT (//////,36X,64HTRY SOLVING THIS PROBLEM IN TERMS OF VOLUMETOR-A2277
     1RIC   WATER  CONTENT)                                             OR-A2278
 1020 STOP                                                              OR-A2279
C                                                                       OR-A2280
 1040 M = M+1                                                           OR-A2281
C                                                                       OR-A2282
C                  THE PLANT SURFACE POTENTIAL ITERATOR                 OR-A2283
```

```
C                                                                       OR-A2284
C     CHECK IF THIS RUN HAS ANY PLANTS AT ALL (I.E., NO TRANSPIRATION)  OR-A2285
C        CHECK IF THE PLANTS HAVE WILTED                                OR-A2286
                                                                        OR-A2287
      TR = 0.                                                           OR-A2288
      IF (TBLQPS.LE.-1.OR.WILTED.EQ.1) GO TO 1280                       OR-A2289
C     ALL COEFFICIENTS OF THE PLANT SURFACE POTENTIAL ITERATOR ARE      OR-A2290
C     EVALUATED AT TIME LEVEL K+1/2.                                    OR-A2291
      TKH = TIME-DTK1/2.                                                OR-A2292
C      POTENTIAL RATE OF TRANSPIRATION THROUGH THE PLANT STEMS AT       OR-A2293
C     TIME LEVEL  K+1/2.                                                OR-A2294
      CALL PTRNS (TKH,QPS)                                              OR-A2295
      IF (QPS.EQ.0.) PPSURF(3) = PPSURF(2)                              OR-A2296
      IF (QPS.EQ.0.) GO TO 1280                                         OR-A2297
      IF (START.NE.0) GO TO 1080                                        OR-A2298
      DO 1060 I=1,N                                                     OR-A2299
      IF (JWHS.EQ.0) CALL PSIW (GUESS(I),PSI(I),DUM)                    OR-A2300
      IF (JWHS.EQ.1) CALL WPSI (GUESS(I),THETA(I),DUM)                  OR-A2301
 1060 CONTINUE                                                          OR-A2302
      GO TO 1120                                                        OR-A2303
C     COMPUTE BOTH THE   WATER  CONTENT AND MATRIC POTENTIAL, USING     OR-A2304
C     GUESSED VALUES OF DIFFUSIVITY POTENTIAL, F(K+1)                   OR-A2305
 1080 DO 1100 I=1,N                                                     OR-A2306
      CALL INTRP (NUMPF,TBLPF,XPF,YPF,GUESS(I),PSI(I),DUM,3HPF3)       OR-A2307
1100  CALL INTRP (NUMWF,TBLWF,XWF,YWF,GUESS(I),THETA(I),DUM,3HWF1)     OR-A2308
C                                                                       OR-A2309
 1120 DO 1140 I=1,N                                                     OR-A2310
      CGUESS(I) = (COLD2(I) +ACLRAT*DTK1/DTK*(COLD2(I) -COLD1(I) ))     OR-A2311
C                            C(I,K+1/2)                                 OR-A2312
      CGIKH(I) = (CGUESS(I)+COLD2(I) )/2.                               OR-A2313
C                            PSI(I,K+1/2)                               OR-A2314
      PGIKH(I) = (PSI(I)+POLD2(I) )/2.                                  OR-A2315
C                            THETA(I,K+1/2)                             OR-A2316
1140  WGIKH(I) = (THETA(I)+WOLD2(I) )/2.                                OR-A2317
C     COMPUTE THE ROOT SINK SUM TERMS   I.E., SUM, SUMZFP               OR-A2318
      CALL SINKW (N,CGIKH,WGIKH,PGIKH,PPSURF(3),SUM,SUMZFP,TKH)         OR-A2319
      MR = 0                                                            OR-A2320
 1160 IF (MR.GT.ITRMAX) WRITE (OUT,1180) MR,RATIO,ARATIO,PSP,PPSURF(3)  OR-A2321
 1180 FORMAT (//////////,56X,14HERROR CODE  57,////,50X,26HERROR IN SUBROR-A2322
     1OUTINE  WATER,//,20X,11HAFTER MR = ,I3,69H ITERATIONS , THE PLANT OR-A2323
     2SURFACE POTENTIAL ITERATOR FAILED TO CONVERGE,/,20X,18HITS LAST  ROR-A2324
     3ATIO = ,E12.5,53H BUT THE CONVERGENCE RATIO IS SPECIFIED AS  ARATIOR-A2325
     40 = ,E12.5,/,20X,35HTHE LAST  COMPUTED VALUE OF  PSP = ,E12.5,    OR-A2326
     531H BUT THE ESTIMATE  PPSURF(3) = ,E12.5)                         OR-A2327
      IF (MR.GT.ITRMAX) STOP                                            OR-A2328
      IF (PPSURF(3).GT.0.) PPSURF(3) = 0.                               OR-A2329
      MR = MR+1                                                         OR-A2330
 C       STOMATAL EFFICIENCY
```

```
      CALL STHATA (PPSURF(3),CST,DCSTDP)                                OR-A2331
C     ACTUAL TRANSPIRATION DEMAND                                       OR-A2332
      TR = QPS*CST                                                      OR-A2333
C                                 D(TR)/D(PSP)                        OR-A2334
      DTRDPS = QPS*DCSTDP                                               OR-A2335
      IF (TR.GE.0.) GO TO 1200                                          OR-A2336
      IF (SUM.EQ.0.) PPSURF(3) = PWILT                                  OR-A2337
      IF (SUM.EQ.0.) GO TO 1240                                         OR-A2338
C     CALCULATE THE PLANT SURFACE POTENTIAL PSP(K+1/2) (L POTENTIAL)    OR-A2339
      PSP = (TR-SUMZFP)/SUM                                             OR-A2340
      RATIO = ABS(PPSURF(3)-PSP)                                        OR-A2341
      IF (PPSURF(3).NE.0.) RATIO = RATIO/ABS(PPSURF(3))                 OR-A2342
      IF (RATIO.LE.ARATIO) GO TO 1240                                   OR-A2343
C     ITERATE ON THE GUESSED VALUE OF THE PLANT SURFACE POTENTIAL       OR-A2344
C     UNTIL IT APPROACHES THE COMPUTED VALUE                            OR-A2345
C                                                                       OR-A2346
C                         NEWTON-RAPHSON ITERATION SCHEME               OR-A2347
C                                                                       OR-A2348
      H=PPSURF(3)-PSP                                                   OR-A2349
      DHDPS=1.-DTRDPS/SUM                                               OR-A2350
      IF(DHDPS.EQ.0.) GO TO 1240                                        OR-A2351
      PPSURF(3)=PPSURF(3)-H/DHDPS                                       OR-A2352
      GO TO 1160                                                        OR-A2353
C                                                                       OR-A2354
 1200 IF (TR.LE.0.) GO TO 1240                                          OR-A2355
      WRITE (OUT,1220) TIME,MR,PPSURF(3),QPS,TR                         OR-A2356
 1220 FORMAT (////////////,56X,14HERROR CODE  58,////,49X,40H*****  ERROR OR-A2357
     1IN SUBROUTINE WATER   *****,//,43X,52HAT TIME OF FAILURE, THESE PAOR-A2358
     2RAMETERS WERE DEFINED AS,//,62X,7HTIME = ,E12.5,/,64X,5HMR = ,I3,/OR-A2359
     3,57X,12HPPSURF(3) = ,E12.5,/,63X,6HQPS = ,E12.5,/,64X,5HTR = ,E12.OR-A2360
     45,///,32X,74HNOTE, THE PLANT TRANSPIRATION RATES   QPS AND TR MUSTOR-A2361
     5 HAVE NEGATIVE VALUES,/,32X,41HBUT PROGRAM HAS DETECTED A POSITIVEOR-A2362
     6 VALUE)                                                           OR-A2363
      STOP                                                              OR-A2364
C                                                                       OR-A2365
C        COMPUTE THE ROOT FLUX SINK TERMS  A(I,K+1/2)  USING THE JUST   OR-A2366
C     COMPUTED PLANT SURFACE POTENTIAL                                  OR-A2367
 1240 CALL SINKW (N,CGIKH,WGIKH,PGIKH,PPSURF(3),DUM,DUM,TKH)            OR-A2368
C     THE ACTUAL RATE OF TRANSPIRATION(A NEGATIVE QUANTITY) AT TIME     OR-A2369
C     LEVEL K+1/2, TR,  WITH UNITS OF (L**3 FLUID/L**2 GROSS/T)         OR-A2370
      TR = 0.                                                           OR-A2371
      NTR1 = N-1                                                        OR-A2372
      DO 1260 I=2,NTR1                                                  OR-A2373
1260  TR = TR+A(I)*(Z(I+1)-Z(I-1))/2.                                   OR-A2374
C                                                                       OR-A2375
C                                                                       OR-A2376
 1280 Z2 = Z(2)-Z(1)                                                    OR-A2377
```

```
C     USE A BACKWARD-DIFFERENCE SCHEME ON BOTH THE UPPER AND LOWER      OR-A2378
C     BOUNDARY CONDITION                                                OR-A2379
      IF (SHORT.EQ.1) GO TO 1360                                        OR-A2380
      IF (BCTOPW.NE.1) GO TO 1300                                       OR-A2381
      AI = 0.                                                           OR-A2382
      BI = 1.                                                           OR-A2383
      CI = 0.                                                           OR-A2384
      DI = GUESS(1)                                                     OR-A2385
      GO TO 1460                                                        OR-A2386
 1300 IF (BCTOPW.NE.2) GO TO 1340                                       OR-A2387
C                          FLOW(1+1/2,K+1)                            OR-A2388
      RHS = FTOP                                                        OR-A2389
      IF (START.EQ.0) GO TO 1320                                        OR-A2390
      FK1 = (GUESS(1)+GUESS(2))/2.                                      OR-A2391
      IF (JWHS.EQ.0) CALL INTRP (NUMDFZ,TBLDFZ,XDFZ,YDFZ,FK1,COEF,DUM,  OR-A2392
     13HDF3)                                                            OR-A2393
      IF (JWHS.EQ.1) CALL INTRP (NUMKFZ,TBLKFZ,XKFZ,YKFZ,FK1,COEF,DUM,  OR-A2394
     13HKF3)                                                            OR-A2395
      IF (JWHS.EQ.1) COEF = COEF*CNVRSN                                 OR-A2396
      RHS = FTOP*COEF                                                   OR-A2397
 1320 AI = 0.                                                           OR-A2398
      BI = -1./Z2                                                       OR-A2399
      CI = 1./Z2                                                        OR-A2400
      DI = RHS                                                          OR-A2401
      GO TO 1460                                                        OR-A2402
 1340 IF (BCTOPW.NE.4) GO TO 1420                                       OR-A2403
C                           FLOW(1+1/2,K+1)                           OR-A2404
 1360 FK1 = (GUESS(1)+GUESS(2))/2.                                      OR-A2405
      F1KH = (GUESS(1)+OLD2(1) )/2.                                     OR-A2406
      IF (START.NE.0) GO TO 1400                                        OR-A2407
      IF (JWHS.EQ.1) GO TO 1380                                         OR-A2408
      CALL DWZ (FK1,DZK1)                                               OR-A2409
      CALL KWZ (FK1,KZK1)                                               OR-A2410
      AI = 0.                                                           OR-A2411
      BI = -1./DTK1-DZK1/Z2/Z2                                          OR-A2412
      CI = DZK1/Z2/Z2                                                   OR-A2413
      DI = OLD2(1) *(-1./DTK1)+KZK1*GRAV/Z2-FTOP/Z2                     OR-A2414
      GO TO 1460                                                        OR-A2415
 1380 CALL INTRP (NUMKPZ,TBLKPZ,XKPZ,YKPZ,FK1,KZK1,DUM,3HKP4)           OR-A2416
      IF (TBLWP.LE.0) CALL WPSI (F1KH,DUM,SMC1KH)                       OR-A2417
      IF (TBLWP.GT.0) CALL INTRP (NUMDWP,TBLDWP,XDWP,YDWP,F1KH,SMC1KH,  OR-A2418
     1DUM,3HDW8)                                                        OR-A2419
      AI = 0.                                                           OR-A2420
      BI = -SMC1KH/DTK1-KZK1*CNVRSN/Z2/Z2                               OR-A2421
      CI = KZK1*CNVRSN/Z2/Z2                                            OR-A2422
      DI = OLD2(1) *(-SMC1KH/DTK1)+KZK1*GRAV/Z2-FTOP/Z2                 OR-A2423
      GO TO 1460                                                        OR-A2424
```

```
 1400 CALL INTRP (NUMKFZ,TBLKFZ,XKFZ,YKFZ,FK1,KZK1,DUM,3HKF4)           OR-A2425
      IF (JWHS.EQ.0) CALL INTRP (NUMDFZ,TBLDFZ,XDFZ,YDFZ,F1KH,DZK1,DUM, OR-A2426
     13HDF4)                                                           OR-A2427
      COEF1 = 1.E+10                                                   OR-A2428
      IF (JWHS.EQ.0.AND.DZK1.NE.0.) COEF1 = 1./DZK1                    OR-A2429
      IF (JWHS.EQ.1) CALL INTRP (NUMDWF,TBLDWF,XDWF,YDWF,F1KH,COEF1,DUM,OR-A2430
     13HDW2)                                                           OR-A2431
      AI = 0.                                                          OR-A2432
      BI = -COEF1/DTK1-1./Z2/Z2                                        OR-A2433
      CI = 1./Z2/Z2                                                    OR-A2434
      DI = OLD2(1) *(-COEF1/DTK1)+KZK1*GRAV/Z2-FTOP/Z2                 OR-A2435
      GO TO 1460                                                       OR-A2436
 1420 WRITE (OUT,1440) BCTOPW                                          OR-A2437
 1440 FORMAT (////////////,56X,14HERROR CODE  59,////,51X,26HERROR IN SUBROR-A2438
     1OUTINE  WATER,//,35X,17HYOU SET BCTOPW = ,I3,38H BUT NO SUCH BOUNDOR-A2439
     2ARY CONDITION EXISTS)                                            OR-A2440
      STOP                                                             OR-A2441
 1460 IF (SHORT.NE.1) GO TO 1480                                       OR-A2442
      AI = 0.                                                          OR-A2443
      BI = 1.                                                          OR-A2444
      CI = 0.                                                          OR-A2445
      DI = GUESS(1)                                                    OR-A2446
 1480 BACK(1) = DI/BI                                                  OR-A2447
      CALPHA(1) = CI/BI                                                OR-A2448
C                                                                      OR-A2449
C             CRANK-NICOLSON FINITE-DIFFERENCE SCHEME                  OR-A2450
C                                                                      OR-A2451
C        COMPUTE THE MAIN ELEMENTS OF THE TRI-DIAGONAL MATRIX          OR-A2452
      DO 1580 I=2,N1                                                   OR-A2453
C        UNEQUALLY SPACED SPACE NODES ARE ALLOWED                      OR-A2454
      Z1 = Z(I)-Z(I-1)                                                 OR-A2455
      Z2 = Z(I+1)-Z(I)                                                 OR-A2456
      Z3 = (Z(I+1)-Z(I-1))/2.                                          OR-A2457
      Z13 = Z1*Z3                                                      OR-A2458
      Z23 = Z2*Z3                                                      OR-A2459
C     EVALUATE THE DIFFUSIVITY, CONDUCTIVITY, AND SINK COEFFICIENTS AT OR-A2460
C     THE K+1/2 TIME LEVEL                                             OR-A2461
C                          FLOW(I-1/2,K+1/2)                           OR-A2462
      FNIK = (OLD2(I-1) +GUESS(I-1)+OLD2(I) +GUESS(I))/4.              OR-A2463
C                            FLOW(I,K+1/2)                             OR-A2464
      FIKH = (OLD2(I) +GUESS(I))/2.                                    OR-A2465
C                           FLOW(I+1/2,K+1/2)                          OR-A2466
      FPIK = (OLD2(I+1) +GUESS(I+1)+OLD2(I) +GUESS(I))/4.              OR-A2467
      IF (START.NE.0) GO TO 1520                                       OR-A2468
      IF (JWHS.EQ.1) GO TO 1500                                        OR-A2469
C                              VOLUMETRIC   WATER CONTENT              OR-A2470
      CALL DWZ (FPIK,DZPIK)                                            OR-A2471
```

```
      CALL DWZ (FNIK,DZNIK)                                                  OR-A2472
      CALL KWZ (FPIK,KZPIK)                                                  OR-A2473
      CALL KWZ (FNIK,KZNIK)                                                  OR-A2474
      AI = DZNIK/2./Z13                                                      OR-A2475
      BI = -1./DTK1-(DZPIK/Z23+DZNIK/Z13)/2.                                 OR-A2476
      CI = DZPIK/2./Z23                                                      OR-A2477
      DI = OLD2(I-1) *(-AI)+OLD2(I) *(-2./DTK1-BI)+OLD2(I+1) *(-CI)+         OR-A2478
     1(KZPIK-KZNIK)/Z3*GRAV-A(I)                                             OR-A2479
      GO TO 1560                                                             OR-A2480
C                              MATRIC POTENTIAL                             OR-A2481
C                SPECIFIC MOISTURE CAPACITY   D(THETA)/D(PSI)               OR-A2482
C                                  SMC(I,K+1/2)                             OR-A2483
 1500 IF (TBLWP.LE.0) CALL WPSI (FIKH,DUM,SMCIKH)                            OR-A2484
      IF (TBLWP.GT.0) CALL INTRP (NUMDWP,TBLDWP,XDWP,YDWP,FIKH,SMCIKH,       OR-A2485
     1DUM,3HDW9)                                                             OR-A2486
      CALL INTRP (NUMKPZ,TBLKPZ,XKPZ,YKPZ,FPIK,KZPIK,DUM,3HKP5)              OR-A2487
      CALL INTRP (NUMKPZ,TBLKPZ,XKPZ,YKPZ,FNIK,KZNIK,DUM,3HKP6)              OR-A2488
      AI = KZNIK*CNVRSN/2./Z13                                               OR-A2489
      BI = -SMCIKH/DTK1-(KZPIK/Z23+KZNIK/Z13)*CNVRSN/2.                      OR-A2490
      CI = KZPIK*CNVRSN/2./Z23                                               OR-A2491
      DI = OLD2(I-1) *(-AI)+OLD2(I) *(-2.*SMCIKH/DTK1-BI)+OLD2(I+1) *(-      OR-A2492
     1CI)+(KZPIK-KZNIK)/Z3*GRAV-A(I)                                         OR-A2493
      GO TO 1560                                                             OR-A2494
C                              DIFFUSIVITY POTENTIAL                        OR-A2495
 1520 CALL INTRP (NUMKFZ,TBLKFZ,XKFZ,YKFZ,FPIK,KZPIK,DUM,3HKF5)              OR-A2496
      CALL INTRP (NUMKFZ,TBLKFZ,XKFZ,YKFZ,FNIK,KZNIK,DUM,3HKF6)              OR-A2497
      IF (JWHS.EQ.1) GO TO 1540                                              OR-A2498
C                          WATER CONTENT-BASED                              OR-A2499
      CALL INTRP (NUMDFZ,TBLDFZ,XDFZ,YDFZ,FIKH,DZIK,DUM,3HDF5)               OR-A2500
      IF (DZIK.EQ.0.) DZIK = 1.E-10                                          OR-A2501
      AI = .5/Z13                                                            OR-A2502
      BI = -(1./Z23+1./Z13)/2.-1./DTK1/DZIK                                  OR-A2503
      CI = .5/Z23                                                            OR-A2504
      DI = OLD2(I-1) *(-AI)+OLD2(I) *(-2./DTK1/DZIK-BI)+OLD2(I+1) *(-CI)     OR-A2505
     1+(KZPIK-KZNIK)/Z3*GRAV-A(I)                                            OR-A2506
      GO TO 1560                                                             OR-A2507
C                              MATRIC POTENTIAL-BASED                       OR-A2508
C                            D(THETA)/DF  AT (I,K+1/2)                      OR-A2509
 1540 CALL INTRP (NUMDWF,TBLDWF,XDWF,YDWF,FIKH,DWDF,DUM,3HDW3)               OR-A2510
      AI = .5/Z13                                                            OR-A2511
      BI = -(1./Z23+1./Z13)/2.-DWDF/DTK1                                     OR-A2512
      CI = .5/Z23                                                            OR-A2513
      DI = OLD2(I-1) *(-AI)+OLD2(I) *(-2.*DWDF/DTK1-BI)+OLD2(I+1) *(-CI)     OR-A2514
     1+(KZPIK-KZNIK)/Z3*GRAV-A(I)                                            OR-A2515
 1560 APHA = BI-AI*CALPHA(I-1)                                               OR-A2516
      BACK(I) = (DI-AI*BACK(I-1))/APHA                                       OR-A2517
      CALPHA(I) = CI/APHA                                                    OR-A2518
```

```
 1580 CONTINUE                                                          OR-A2519
      IF (MQ.LT.0) GO TO 1600                                           OR-A2520
      Z1 = Z(NITR)-Z(N1)                                                OR-A2521
      IF (BCBTMW.NE.1) GO TO 1620                                       OR-A2522
C        1ST TYPE B.C. AT THE BOTTOM                                    OR-A2523
 1600 AI = 0.                                                           OR-A2524
      BI = 1.                                                           OR-A2525
      CI = 0.                                                           OR-A2526
      DI = GUESS(NITR)                                                  OR-A2527
      GO TO 1760                                                        OR-A2528
 1620 IF (BCBTMW.NE.2) GO TO 1660                                       OR-A2529
C        2ND TYPE B.C. AT THE BOTTOM                                    OR-A2530
C                                FLOW(N-1/2,K+1)                       OR-A2531
      FKN = (GUESS(NITR)+GUESS(N1))/2.                                  OR-A2532
      RHS = FBTM                                                        OR-A2533
      IF (START.EQ.0) GO TO 1640                                        OR-A2534
      IF (JWHS.EQ.0) CALL INTRP (NUMDFZ,TBLDFZ,XDFZ,YDFZ,FKN,COEF,DUM,  OR-A2535
     13HDF6)                                                            OR-A2536
      IF (JWHS.EQ.1) CALL INTRP (NUMKFZ,TBLKFZ,XKFZ,YKFZ,FKN,COEF,DUM,  OR-A2537
     13HKF7)                                                            OR-A2538
      IF (JWHS.EQ.1) COEF = COEF*CNVRSN                                 OR-A2539
      RHS = FBTM*COEF                                                   OR-A2540
 1640 AI = -1./Z1                                                       OR-A2541
      BI = 1./Z1                                                        OR-A2542
      CI = 0.                                                           OR-A2543
      DI = RHS                                                          OR-A2544
      GO TO 1760                                                        OR-A2545
 1660 IF (BCBTMW.NE.4) GO TO 1720                                       OR-A2546
C                                FLOW(N-1/2,K+1)                       OR-A2547
      FKN = (GUESS(NITR)+GUESS(N1))/2.                                  OR-A2548
      FNKH = (GUESS(NITR)+OLD2(NITR) )/2.                               OR-A2549
      IF (START.NE.0) GO TO 1700                                        OR-A2550
      IF (JWHS.EQ.1) GO TO 1680                                         OR-A2551
      CALL KWZ (FKN,KZKN)                                               OR-A2552
      CALL DWZ (FKN,DZKN)                                               OR-A2553
      AI = DZKN/Z1/Z1                                                   OR-A2554
      BI = -1./DTK1-DZKN/Z1/Z1                                          OR-A2555
      CI = 0.                                                           OR-A2556
      DI = OLD2(NITR) *(-1./DTK1)-KZKN*GRAV/Z1+FBTM/Z1                  OR-A2557
      GO TO 1760                                                        OR-A2558
 1680 CALL INTRP (NUMKPZ,TBLKPZ,XKPZ,YKPZ,FKN,KZKN,DUM,3HKP7)          OR-A2559
      IF (TBLWP.LE.0) CALL WPSI (FNKH,DUM,SMCNKH)                       OR-A2560
      IF (TBLWP.GT.0) CALL INTRP (NUMDWP,TBLDWP,XDWP,YDWP,FNKH,SMCNKH,  OR-A2561
     1DUM,3HDWP)                                                        OR-A2562
      AI = KZKN*CNVRSN/Z1/Z1                                            OR-A2563
      BI = -SMCNKH/DTK1-KZKN*CNVRSN/Z1/Z1                               OR-A2564
      CI = 0.                                                           OR-A2565
```

```
      DI = OLD2(NITR) *(-SMCNKH/DTK1)-KZKN*GRAV/Z1+FBTM/Z1                OR-A2566
      GO TO 1760                                                          OR-A2567
 1700 CALL INTRP (NUMKFZ,TBLKFZ,XKFZ,YKFZ,FKN,KZKN,DUM,3HKF8)             OR-A2568
      IF (JWHS.EQ.0) CALL INTRP (NUMDFZ,TBLDFZ,XDFZ,YDFZ,FNKH,DZKN,DUM,  OR-A2569
     13HDF7)                                                              OR-A2570
      COEFN = 1.E+10                                                      OR-A2571
      IF (JWHS.EQ.0.AND.DZKN.NE.0.) COEFN = 1./DZKN                       OR-A2572
      IF (JWHS.EQ.1) CALL INTRP (NUMDWF,TBLDWF,XDWF,YDWF,FNKH,COEFN,DUM,OR-A2573
     13HDW4)                                                              OR-A2574
      AI = 1./Z1/Z1                                                       OR-A2575
      BI = -COEFN/DTK1-1./Z1/Z1                                           OR-A2576
      CI = 0.                                                             OR-A2577
      DI = OLD2(NITR) *(-COEFN/DTK1)-KZKN*GRAV/Z1+FBTM/Z1                 OR-A2578
      GO TO 1760                                                          OR-A2579
 1720 WRITE (OUT,1740) BCBTMW                                             OR-A2580
 1740 FORMAT (///////////,56X,14HERROR CODE  60,////,50X,26HERROR IN SUBROR-A2581
     1OUTINE  WATER,//,34X,17HYOU SET BCBTMW = ,I3,38H BUT NO SUCH BOUNDOR-A2582
     2ARY CONDITION EXISTS)                                               OR-A2583
      STOP                                                                OR-A2584
 1760 APHA = BI-AI*CALPHA(N1)                                             OR-A2585
      BACK(NITR) = (DI-AI*BACK(N1))/APHA                                  OR-A2586
      FLOW(NITR) = BACK(NITR)                                             OR-A2587
      DO 1780 I=1,N1                                                      OR-A2588
      NODEI = NITR-I                                                      OR-A2589
      NI1 = NODEI+1                                                       OR-A2590
 1780  FLOW(NODEI) = BACK(NODEI)-CALPHA(NODEI)*FLOW(NI1)                  OR-A2591
      FWORST = 0.                                                         OR-A2592
      GWORST = 0.                                                         OR-A2593
      IWORST = 1                                                          OR-A2594
      MQFAIL = 0                                                          OR-A2595
      RWORST = 0.                                                         OR-A2596
      IF (MQ.EQ.0.OR.BCTOPW.NE.4) GO TO 1820                              OR-A2597
C     TERMINATE FLUX ITERATION IF AN UNFEASIBLE FLOW IS COMPUTED          OR-A2598
C      IN ANY OF THE TOP 3 NODES                                          OR-A2599
      DO 1800 I=1,3                                                       OR-A2600
      IF (FLOW(I).GT.MAXLMT.OR.FLOW(I).LT.MINLMT) MQFAIL = I              OR-A2601
 1800 CONTINUE                                                            OR-A2602
      IF (MQFAIL.LE.0) GO TO 1820                                         OR-A2603
      IWORST = MQFAIL                                                     OR-A2604
      FWORST = FLOW(MQFAIL)                                               OR-A2605
      GWORST = GUESS(IWORST)                                              OR-A2606
      RWORST = ABS(GUESS(MQFAIL)-FWORST)                                  OR-A2607
      IF (GUESS(MQFAIL).NE.0.) RWORST = RWORST/ABS(GUESS(MQFAIL))         OR-A2608
 1820 DO 1840 I=1,NITR                                                    OR-A2609
C     DON"T ITERATE WITH UNFEASIBLE FLOW SOLUTIONS                        OR-A2610
      IF (FLOW(I).LT.MIN) FLOW(I) = MIN                                   OR-A2611
      IF (FLOW(I).GT.MAX) FLOW(I) = MAX                                   OR-A2612
```

```
 1840 CONTINUE                                                          OR-A2613
C                                                                       OR-A2614
C                                                                       OR-A2615
C     ITERATE UNTIL THE WORST GUESS OF WATER CONTENT IS REDUCED TO      OR-A2616
C     WITHIN THE PRESCRIBED CRITERION  WRATIO                           OR-A2617
C      LOCATE THE WORST MADE GUESS                                      OR-A2618
      IF (MQFAIL.GE.1) GO TO 1880                                       OR-A2619
      DO 1860 I=1,NITR                                                  OR-A2620
      RATIO = ABS(GUESS(I)-FLOW(I))                                     OR-A2621
      IF (RATIO.LE.SMLST) GO TO 1860                                    OR-A2622
      IF (GUESS(I).NE.0.) RATIO = ABS(RATIO/GUESS(I))                   OR-A2623
      IF (RATIO.LT.RWORST) GO TO 1860                                   OR-A2624
      RWORST = RATIO                                                    OR-A2625
      IWORST = I                                                        OR-A2626
 1860 CONTINUE                                                          OR-A2627
      FWORST = FLOW(IWORST)                                             OR-A2628
      GWORST = GUESS(IWORST)                                            OR-A2629
 1880 IF (FAIL.EQ.1) WRITE (OUT,1900) ITR,IWORST,GWORST,FWORST,RWORST,M,OR-A2630
     1MQ,MQFAIL,NITR                                                    OR-A2631
 1900 FORMAT (13X,I3,11X,I3,11X,E11.4,7X,E11.4,7X,E11.4,7X,I3,1X,I3,3X, OR-A2632
     1I2,4X,I3)                                                         OR-A2633
      IF (FAIL.NE.0.AND.M.GE.IFMAX) GO TO 580                           OR-A2634
C                                                                       OR-A2635
C                                                                       OR-A2636
      DO 1980 I=1,NITR                                                  OR-A2637
      FCCOLD(I) = FCOLD(I)                                              OR-A2638
      FGGOLD(I) = FGOLD(I)                                              OR-A2639
      FCOLD(I) = FLOW(I)                                                OR-A2640
      FGOLD(I) = GUESS(I)                                               OR-A2641
      IF(ITR.LE.3) GO TO 1960                                           OR-A2642
      DELG = FGOLD(I)-FGGOLD(I)                                         OR-A2643
      DELC = FCOLD(I)-FCCOLD(I)                                         OR-A2644
      IF (DELC.EQ.0..OR.DELG.EQ.0.) GO TO 1960                          OR-A2645
C     OPTIMIZATION FUNCTION "H"  AND ITS DERIVATIVE WITH RESPECT TO THE OR-A2646
C     GUESSED VALUE OF WATER CONTENT  "DHDF".                           OR-A2647
      H=FGOLD(I)-FCOLD(I)                                               OR-A2648
      DHDF=1.-DELC/DELG                                                 OR-A2649
      IF (DHDF.EQ.0.) GO TO 1960                                        OR-A2650
C     NEW GUESS IS BASED ON A NEWTON-RAPHSON  ITERATION SCHEME          OR-A2651
      DELF = -H/DHDF                                                    OR-A2652
      HOLD=FGGOLD(I)-FCCOLD(I)                                          OR-A2653
      IF(H.EQ.0.) GO TO 1940                                            OR-A2654
      IF(H.GE.0..AND.DHDF/DELG.GT.0..AND.HOLD/H.GT.0.) GO TO 1960       OR-A2655
      IF(H.LT.0..AND.DHDF/DELG.LT.0..AND.HOLD/H.GT.0.) GO TO 1960       OR-A2656
1940  GUESS(I) = FGOLD(I)+DELF                                          OR-A2657
      GO TO 1980                                                        OR-A2658
C     IF NOT USING THE NEWTON-RAPHSON ITERATOR , USE THE SUCCESSIVE     OR-A2659
```

```
C     AVERAGING TECHNIQUE FOR THE NEXT GUESS.                                  OR-A2660
 1960 GUESS(I) = (FGOLD(I)+FCOLD(I))/2.                                        OR-A2661
 1980 CONTINUE                                                                 OR-A2662
C                                                                              OR-A2663
C     CHECK IF THE GUESSED VALUES ARE WITHIN THE UPPER AND LOWER               OR-A2664
C     ALLOWED EXTREMES                                                         OR-A2665
      DO 2020 I=1,NITR                                                         OR-A2666
      IF (GUESS(I).LT.MIN) GUESS(I) = MIN                                      OR-A2667
      IF (GUESS(I).GT.MAX) GUESS(I) = MAX                                      OR-A2668
 2020 CONTINUE                                                                 OR-A2669
      IF (MQFAIL.NE.0.AND.MQ.GE.0) GO TO 2120                                  OR-A2670
      IF (MQFAIL.NE.0.AND.M.GE.5.AND.GOLDEN.EQ.0) GO TO 2120                   OR-A2671
      IF (MQFAIL.NE.0.AND.M.GE.3.AND.GOLDEN.GT.0) GO TO 2120                   OR-A2672
      IF (RWORST.LE.WRATIO) GO TO 2060                                         OR-A2673
C     ONLY ITERATE ON WATER CONTENT VALUES DURING THE MINI MODE SCHEME         OR-A2674
      IF (MQ.GE.0) GO TO 2100                                                  OR-A2675
      IF (IFAIL.EQ.1) WRITE (OUT,2040) ITR,RWORST,IWORST,FWORST,M,MQ,          OR-A2676
     1MQFAIL,NITR                                                              OR-A2677
 2040 FORMAT (1X,I3,76X,E9.2,2X,I3,2X,E11.4,2X,I3,1X,I3,3X,I2,4X,I3)           OR-A2678
      MQ = MQ-1                                                                OR-A2679
      NMINI = IWORST+10                                                        OR-A2680
      IF (NMINI.GE.N) NMINI = N                                                OR-A2681
      NITR = NMINI                                                             OR-A2682
      N1 = NITR-1                                                              OR-A2683
      IF (IWORST.LT.N) GO TO 580                                               OR-A2684
      IF (BCTOPW.NE.4) GO TO 2080                                              OR-A2685
      MQ = 1                                                                   OR-A2686
      GO TO 580                                                                OR-A2687
 2060 IF (MQ.EQ.0) GO TO 2660                                                  OR-A2688
      M = 0                                                                    OR-A2689
      IF(BCTOPW.EQ.4.AND.ABS(QP).LE.QMIN) GO TO 2660                           OR-A2690
       IF(BCTOPW.EQ.4) GO TO 2120                                              OR-A2691
 2080 MQ = 0                                                                   OR-A2692
      NITR = N                                                                 OR-A2693
      N1 = N-1                                                                 OR-A2694
      GO TO 580                                                                OR-A2695
 2100 IF (BCTOPW.EQ.4) GO TO 2120                                              OR-A2696
      IF (IWORST.GE.N) GO TO 2080                                              OR-A2697
C       MINI-ITERATOR WITH FIRST AND SECOND TYPE BC                            OR-A2698
      MQ = -1                                                                  OR-A2699
      NMINI = IWORST+10                                                        OR-A2700
      IF (NMINI.GE.N) NMINI = N                                                OR-A2701
      NITR = NMINI                                                             OR-A2702
      N1 = NMINI-1                                                             OR-A2703
      GO TO 580                                                                OR-A2704
C                                                                              OR-A2705
C                                                                              OR-A2706
```

```
C                    THE  FLUX  ITERATOR                                    OR-A2707
C        USE A GOLDEN SECTION SEARCH(A DIRECT METHOD) TO FIND THE           OR-A2708
C     MAXIMUM FEASIBLE FLUX MAGNITUDE.                                      OR-A2709
C                                                                           OR-A2710
C                                                                           OR-A2711
C     COMPUTED SURFACE FLUX AT (  1/2,K+1)                                  OR-A2712
 2120 Z2 = Z(2)-Z(1)                                                        OR-A2713
      IF (START.NE.0) GO TO 2160                                            OR-A2714
      IF (JWHS.EQ.1) GO TO 2140                                             OR-A2715
      QC = (KZK1/Z2*GRAV-OLD2(1) /DTK1+FLOW(1)*(DZK1/Z2/Z2+1./DTK1)-FLOWOR-A2716
     1(2)*DZK1/Z2/Z2)*Z2                                                    OR-A2717
      GO TO 2180                                                            OR-A2718
 2140 QC = (KZK1/Z2*GRAV-OLD2(1) *SMC1KH/DTK1+FLOW(1)*(CNVRSN*KZK1/Z2/Z2OR-A2719
     1+SMC1KH/DTK1)-FLOW(2)*CNVRSN*KZK1/Z2/Z2)*Z2                           OR-A2720
      GO TO 2180                                                            OR-A2721
 2160 QC = (KZK1/Z2*GRAV-OLD2(1) *COEF1/DTK1+FLOW(1)*(1./Z2/Z2+COEF1/       OR-A2722
     1DTK1)-FLOW(2)/Z2/Z2)*Z2                                               OR-A2723
 2180 IF (ABS(QC).LE.QMIN) QC = 0.                                          OR-A2724
      QCC = QC                                                              OR-A2725
      IF (SHORT.EQ.1) GO TO 2680                                            OR-A2726
      QGG = QG                                                              OR-A2727
      IF (ABS(QP).LE.QMIN) GO TO 580                                        OR-A2728
      RATIOQ = ABS(QP-QC)                                                   OR-A2729
      IF (QP.NE.0.) RATIOQ = RATIOQ/ABS(QP)                                 OR-A2730
      RATIOG = ABS(QC-QG)*5.                                                OR-A2731
      IF (QG.NE.0.) RATIOG = RATIOG/ABS(QG)                                 OR-A2732
      IF (GOLDEN.GE.6) GO TO 2220                                           OR-A2733
      DO 2200 I=1,NITR                                                      OR-A2734
      IF (MQ.GE.1.AND.RWORST.GT.WRATIO) GUESS(I) = FCOLD(I)                 OR-A2735
C     NEVER USE A GUESS OF WATER CONTENT THAT HAS PREVIOUSLY FAILED OR      OR-A2736
C     ONE WHOSE COMPUTED FLUX WAS UNFEASIBLE                                OR-A2737
2200  FGO(I) = GUESS(I)                                                     OR-A2738
 2220 IF (ITR.LT.MDEL.OR.IFAIL.NE.0) GO TO 2260                             OR-A2739
      IFAIL = 1                                                             OR-A2740
      WRITE (OUT,2240) MAXDEL                                               OR-A2741
 2240 FORMAT (///////,56X,14HERROR CODE  61,////,40X,56HFLUX ITERATOR INOR-A2742
     1 SUBROUTINE WATER IS FAILING TO CONVERGE,//,42X,27HPROGRAM WILL COOR-A2743
     2NTINUE FOR  ,I3,22H ADDITIONAL ITERATIONS,//,35X,66HAFTER EACH FLUOR-A2744
     3X ITERATION THE PROGRAM WILL LIST THE FOLLOWING DATA,/////,2X,    OR-A2745
     43HITR,4X,4HQGAK,7X,4HQGBK,8X,2HQG,9X,2HQC,8X,4HFTOP,6X,6HRATIOG,4XOR-A2746
     5,6HRATIOQ,4X,6HRWORST,1X,6HIWORST,1X,12HFLOW(IWORST),2X,1HM,2X,   OR-A2747
     62HMQ,1X,6HMQFAIL,1X,4HNITR,//)                                    OR-A2748
 2260 IF (IFAIL.EQ.1) WRITE (OUT,2280) ITR,QGAK,QGBK,QGG,QCC,FTOP,RATIOGOR-A2749
     1,RATIOQ,RWORST,IWORST,FWORST,M,MQ,MQFAIL,NITR                      OR-A2750
 2280 FORMAT (1X,I3,1X,5(E10.3,1X),3(E9.2,1X),1X,I3,2X,E11.4,2X,I3,1X,I3OR-A2751
     1,3X,I2,4X,I3)                                                     OR-A2752
C         CHECK FLUX MAXI-ITERATOR FOR  QP CONVERGENCE                    OR-A2753
```

```
      IF (MQ.GE.0.AND.RATIOQ.LE.QRATIO.AND.RWORST.LE.WRATIO) GO TO 2640 OR-A2754
C          CHECK FLUX MINI-ITERATOR FOR  QP  CONVERGENCE                 OR-A2755
      IF (MQ.LE.-1.AND.RATIOG.LE.QRATIO.AND.RATIOQ.LE.QRATIO.AND.MQFAIL.OR-A2756
     1EQ.0) GO TO 2560                                                    OR-A2757
      IF (ITR.LT.MQMAX.OR.ITR.EQ.1) GO TO 2380                            OR-A2758
      WRITE (OUT,2300)                                                    OR-A2759
 2300 FORMAT (//////////,56X,14HERROR CODE  62,////,38X,53HFLUX ITERATOROR-A2760
     1 FAILED TO CONVERGE IN SUBROUTINE  WATER,///)                       OR-A2761
      WRITE (OUT,2320) M,MQ,MR,ITR,MAXI,MINI,IQPOS,MQFAIL,MQMAX,NMINI,   OR-A2762
     1NITR,SHORT,GOLDEN                                                   OR-A2763
 2320 FORMAT (////,32X,64HAT THE TIME OF FAILURE, THE FOLLOWING VARIABLEOR-A2764
     1S HAD THE VALUE OF,//,50X,8H  M   = ,I3,/,50X,8H  MQ  = ,I4,/,50X,OR-A2765
     28H  MR  = ,I3,/,52X,6HITR = ,I3,/,51X,7HMAXI = ,I3,/,51X,7HMINI = OR-A2766
     3,I3,/,50X,8HIQPOS = ,I3,/,49X,9HMQFAIL = ,I3,/,50X,8HMQMAX = ,I3,/OR-A2767
     4,50X,8HNMINI = ,I3,/,50X,8HNITR  = ,I3,/,50X,8HSHORT = ,I3,/,49X, OR-A2768
     59HGOLDEN = ,I3)                                                     OR-A2769
      WRITE (OUT,2340) TIME,DTMIN,DTMAX,DTK,DTK1,K1,ARATIO,QRATIO,WRATIOOR-A2770
 2340 FORMAT (51X,7HTIME = ,E12.5,/,50X,8HDTMIN = ,E12.5,/,50X,         OR-A2771
     18HDTMAX = ,E12.5,/,50X,8H DTK  = ,E12.5,/,50X,8H DTK1 = ,E12.5,/, OR-A2772
     250X,8H  K1  = ,I5,/,49X,9HARATIO = ,E12.5,/,49X,9HQRATIO = ,E12.5,OR-A2773
     3/,49X,9HWRATIO = ,E12.5)                                            OR-A2774
      WRITE (OUT,2360) QP,QG,QC,BCTOPW,FTOP,QGAK,QGTK,QGTKP,QGBK,QCOLD(1OR-A2775
     1),QCOLD(2),QPOLD(1),QPOLD(2),RATIOG,RATIOQ,RWORST,IWORST,MIN,MAX  OR-A2776
 2360 FORMAT (51X,7HQP   = ,E12.5,/,51X,7HQG   = ,E12.5,/,51X,7HQC   = ,OR-A2777
     1E12.5,/,49X,9HBCTOPW = ,I3,/,50X,8HFTOP  = ,E12.5,/,50X,8HQGAK  = OR-A2778
     2,E12.5,/,50X,8HQGTK  = ,E12.5,/,49X,9HQGTKP  = ,E12.5,/,50X,      OR-A2779
     38HQGBK  = ,E12.5,/,47X,11HQCOLD(1) = ,E12.5,/,47X,11HQCOLD(2) = , OR-A2780
     4E12.5,/,47X,11HQPOLD(1) = ,E12.5,/,47X,11HQPOLD(2) = ,E12.5,/,49X,OR-A2781
     59HRATIOG = ,E12.5,/,49X,9HRATIOQ = ,E12.5,/,49X,9HRWORST = ,E12.5,OR-A2782
     6/,49X,9HIWORST = ,I3,/,52X,6HMIN = ,E12.5,/,52X,6HMAX = ,E12.5)   OR-A2783
      GO TO 780                                                           OR-A2784
 2380 IF (RWORST.GT.WRATIO.AND.MQ.GE.1) GO TO 2600                        OR-A2785
      IF (MQFAIL.NE.0.AND.MQ.GE.1) GO TO 2600                             OR-A2786
      IF (GOLDEN.NE.0) GO TO 2400                                         OR-A2787
      IF (RATIOG.LE.QRATIO.AND.MQFAIL.EQ.0) QGAK = QG                     OR-A2788
      QG = .328*(QGBK-QGAK)+QGAK                                          OR-A2789
      GOLDEN = 1                                                          OR-A2790
      GO TO 2520                                                          OR-A2791
 2400 IF (GOLDEN.NE.1) GO TO 2440                                         OR-A2792
      GOLDEN = 2                                                          OR-A2793
      IF (MQFAIL.NE.0.OR.RATIOG.GT.QRATIO) GO TO 2420                     OR-A2794
      IF (RATIOG.LE.QRATIO) QGAK = QG                                     OR-A2795
      QGTK = .328*(QGBK-QGAK)+QGAK                                        OR-A2796
      QGTKP = .618*(QGBK-QGAK)+QGAK                                       OR-A2797
      QG = QGTKP                                                          OR-A2798
      GO TO 2520                                                          OR-A2799
 2420 QGTKP = .2*(QGBK-QGAK)+QGAK                                         OR-A2800
```

```
      QGTK = .1*(QGBK-QGAK)+QGAK                                        OR-A2801
      QG = QGTKP                                                        OR-A2802
      GO TO 2520                                                        OR-A2803
 2440 IF (GOLDEN.NE.2) GO TO 2460                                       OR-A2804
      GOLDEN = 3                                                        OR-A2805
      QG = QGTK                                                         OR-A2806
      GO TO 2520                                                        OR-A2807
C     IF A AND B  CONVERGE BUT QG DOESN"T, ASSUME CONVERGENCE AT  A     OR-A2808
 2460 GOLDEN = GOLDEN+1                                                 OR-A2809
      IF (ABS((QGBK-QGAK)/QG).LE.QRATIO.AND.RATIOG.GT.QRATIO) GO TO 2480OR-A2810
      IF (NQFAIL.EQ.0.AND.RATIOG.LE.QRATIO) GO TO 2500                  OR-A2811
C     IF THE LAST FLUX GUESS FAILED TO CONVERGE, THEN MOVE  B  TOWARDS  OR-A2812
C     ZERO                                                              OR-A2813
C     THE NEXT INTERVAL OF UNCERTAINTY IS CHOSEN AS                     OR-A2814
      QGAK = QGAK                                                       OR-A2815
      QGBK = QGTKP                                                      OR-A2816
      QGTKP = QGTK                                                      OR-A2817
      QGTK = .328*(QGBK-QGAK)+QGAK                                      OR-A2818
      IF (ABS(QGTK).GE.ABS(QGTKP)) QGTK = .328*(QGTKP-QGAK)+QGAK        OR-A2819
      QG = QGTK                                                         OR-A2820
      GO TO 2520                                                        OR-A2821
 2480 QGG = QGAK                                                        OR-A2822
C     CHECK IF THE COMPUTED VALUE HAS JUMPED THE  (A,B) LIMITS          OR-A2823
      IF (ABS(QC).GE.ABS(QGAK).AND.ABS(QC).LE.ABS(QGBK)) GO TO 2560     OR-A2824
      IF (ABS(QC).LT.ABS(QGAK)) QGAK = QC-(QGBK-QGAK)*.1                OR-A2825
      IF (ABS(QC).GT.ABS(QGBK)) QGBK = QC+(QGBK-QGAK)*.1                OR-A2826
      QG = QC                                                           OR-A2827
      FTOP = QC                                                         OR-A2828
C       REVERT BACK TO THE MINI-ITERATOR MODE                           OR-A2829
      NMINI = 10                                                        OR-A2830
      M = 0                                                             OR-A2831
      GOLDEN = 0                                                        OR-A2832
      MQ = -1                                                           OR-A2833
      NITR = NMINI                                                      OR-A2834
      N1 = NITR-1                                                       OR-A2835
      GO TO 580                                                         OR-A2836
C     SINCE THE FLUX ITERATOR CONVERGED, MOVE  A  TO THE RIGHT(AWAY     OR-A2837
C     FROM ZERO)                                                        OR-A2838
C     THE NEXT INTERVAL OF UNCERTAINTY IS CHOSEN AS                     OR-A2839
 2500 QGBK = QGBK                                                       OR-A2840
      QGAK = QGTK                                                       OR-A2841
      QGTK = QGTKP                                                      OR-A2842
      QGTKP = .618*(QGBK-QGAK)+QGAK                                     OR-A2843
      IF (ABS(QGTKP).LE.ABS(QGTK)) QGTKP = .618*(QGBK-QGTK)+QGTK        OR-A2844
      QG = QGTKP                                                        OR-A2845
 2520 IF (MQ.GE.1) GO TO 2540                                           OR-A2846
C     IF QG HAS CONVERGED AND QGAK HAS CONVERGED TO QGBK, REVERT BACK   OR-A2847
```

```
C     TO THE MAXI-ITERATOR MODE                                                 OR-A2848
      IF (ABS((QGBK-QGAK)/QG).LE.QRATIO.AND.RATIOG.LE.QRATIO) GO TO 2560OR-A2849
      FTOP = QG                                                                 OR-A2850
      MQ = MQ-1                                                                 OR-A2851
      GO TO 580                                                                 OR-A2852
C        RETURN TO FLUX MINI-ITERATOR MODE IF QG FAILED TO  CONVERGE            OR-A2853
 2540 IF (RATIOG.GT.QRATIO.OR.MQFAIL.NE.0) GO TO 2600                           OR-A2854
C        FLUX CONVERGENCE CAN ONLY OCCUR IN THE MAXI MODE                       OR-A2855
      IF (ABS((QGBK-QGAK)/QG).LE.QRATIO) GO TO 2640                             OR-A2856
      FTOP = QG                                                                 OR-A2857
      MQ = MQ+1                                                                 OR-A2858
      GO TO 580                                                                 OR-A2859
C     SINCE THE TOP  NMINI  NODES AND FLUX HAVE CONVERGED IN THE                OR-A2860
C     MINI MODE, FREE ALL NODES AND REVERT TO THE MAXI MODE                     OR-A2861
 2560 MQ = 1                                                                    OR-A2862
      NITR = N                                                                  OR-A2863
      N1 = N-1                                                                  OR-A2864
      FTOP = QGG                                                                OR-A2865
      QG = QGG                                                                  OR-A2866
C     USE THE OLD GUESS SINCE IT WAS SUCCESSFUL                                 OR-A2867
      DO 2580 I=1,N                                                             OR-A2868
 2580 GUESS(I) = FGOLD(I)                                                       OR-A2869
      GO TO 580                                                                 OR-A2870
C        REVERT TO THE MINI-ITERATOR MODE                                       OR-A2871
 2600 NMINI = IWORST+10                                                         OR-A2872
      IF (NMINI.GE.N) NMINI = N                                                 OR-A2873
      M = 0                                                                     OR-A2874
      MQ = -1                                                                   OR-A2875
      NITR = NMINI                                                              OR-A2876
      N1 = NMINI-1                                                              OR-A2877
      QGAK = QGAK                                                               OR-A2878
      QGBK = QGG                                                                OR-A2879
      QG = QGG                                                                  OR-A2880
      FTOP = QG                                                                 OR-A2881
      IEXPND = 0                                                                OR-A2882
      IF (ABS((QGBK-QGAK)/QGG).LE.QRATIO) IEXPND = 1                            OR-A2883
      IF (IEXPND.EQ.0) GO TO 2620                                               OR-A2884
C       EXPAND THE A AND B LIMITS                                               OR-A2885
      QGAK = QGAK*.8                                                            OR-A2886
      QGBK = QGBK*1.2                                                           OR-A2887
      IF (ABS(QGBK).GT.ABS(QP)) QGBK = QP                                       OR-A2888
 2620 IF (IWORST.LT.N) GO TO 580                                                OR-A2889
C           IF IWORST EQUALS N, REVERT BACK TO THE MAXI MODE                    OR-A2890
      MQ = 1                                                                    OR-A2891
      NITR = N                                                                  OR-A2892
      N1 = N-1                                                                  OR-A2893
      GO TO 580                                                                 OR-A2894
```

```
 2640 FAIL = 0                                                          OR-A2895
C                                                                       OR-A2896
 2660 IF (SHORT.NE.1) GO TO 2700                                        OR-A2897
C       COMPUTE THE ACTUAL SURFACE FLUX                                 OR-A2898
      GO TO 2120                                                        OR-A2899
C     CHECK IF THE COMPUTED FLUX IS LESS THAN THE POTENTIAL FLUX AT THE OR-A2900
C     SOIL SURFACE WHEN  SHORT=1.  IF NOT, START ALL OVER AGAIN         OR-A2901
 2680 IF (ABS(QCC).LE.ABS(QP)) GO TO 2700                               OR-A2902
      SHORT = -1                                                        OR-A2903
      GO TO 120                                                         OR-A2904
 2700 IF (START.NE.0) GO TO 2740                                        OR-A2905
      DO 2720 I=1,N                                                     OR-A2906
      IF (JWHS.EQ.0) CALL PSIW (FLOW(I),PSI(I),DUM)                     OR-A2907
      IF (JWHS.EQ.1) CALL WPSI (FLOW(I),THETA(I),DUM)                   OR-A2908
 2720 CONTINUE                                                          OR-A2909
      GO TO 2780                                                        OR-A2910
 2740 DO 2760 I=1,N                                                     OR-A2911
C       COMPUTE THE SOIL   WATER  CONTENT AT TIME LEVEL K+1             OR-A2912
      CALL INTRP (NUMWF,TBLWF,XWF,YWF,FLOW(I),THETA(I),DUM,3HWF2)       OR-A2913
C        COMPUTE THE MATRIC POTENTIAL AT TIME LEVEL K+1                 OR-A2914
2760  CALL INTRP (NUMPF,TBLPF,XPF,YPF,FLOW(I),PSI(I),DUM,3HPW )         OR-A2915
 2780 IF (FAIL.NE.0.OR.IFMAX.NE.ITRMAX) WRITE (OUT,2800)                OR-A2916
 2800 FORMAT (///,25X,92HWATER CONTENT ITERATOR IN SUBROUTINE WATER HAS OR-A2917
     1CONVERGED AND PROGRAM OR-NATURE WILL CONTINUE,///)                OR-A2918
      IF (IFAIL.EQ.1) WRITE (OUT,2820)                                  OR-A2919
 2820 FORMAT (///,26X,83HFLUX ITERATOR IN SUBROUTINE WATER HAS CONVERGEDOR-A2920
     1 AND PROGRAM OR-NATURE WILL CONTINUE,///)                         OR-A2921
      IF (SHORT.EQ.1) BCTOPW = 4                                        OR-A2922
      IF (SHORT.EQ.1) MQ = 1                                            OR-A2923
      QCOLD(1) = QCOLD(2)                                               OR-A2924
      QCOLD(2) = 0.                                                     OR-A2925
      IF (MQ.NE.0) QCOLD(2) = QCC                                       OR-A2926
      QPOLD(1) = QPOLD(2)                                               OR-A2927
      QPOLD(2) = 0.                                                     OR-A2928
      IF (MQ.NE.0) QPOLD(2) = QP                                        OR-A2929
      IF (OUTPUT.NE.2.AND.BCTOPW.EQ.4) WRITE (OUT,2840) TIME,MAXI,MINI, OR-A2930
     1QP,QCC                                                            OR-A2931
 2840 FORMAT (33X,E12.5,6X,I3,3X,I3,15X,E11.4,6X,E11.4)                 OR-A2932
      RETURN                                                            OR-A2933
      END                                                               OR-A2934
```

```
      SUBROUTINE SOLUTE (TIME,K1)                                       OR-A2935
                                                                        OR-A2936
C                                                                       OR-A2937
C                                                                       OR-A2938
C     AT TIME LEVEL K+1, SOLVE THE MASS TRANSPORT EQUATION              OR-A2939
C     INCLUDING BOTH THE LIQUID AND SOLID SOLUTE PHASES                 OR-A2940
C                                                                       OR-A2941
C                                                                       OR-A2942
      INTEGER BCTOPC,BCTOPW,BCBTMC,BCBTMW,OUT,PNCH,WILTED               OR-A2943
      INTEGER FAIL,TBLQPS,OUTPUT                                        OR-A2944
      COMMON BACK(200),CALPHA(200),SCOLD(200),SCCOLD(200),SGOLD(200),   OR-A2945
     1SGGOLD(200),DUMMYG(200),DUMMYH(200),DUMMYI(200),DUMMYJ(200),DUMMYKOR-A2946
     2(200)                                                             OR-A2947
      COMMON /CNVRGE/ ARATIO,QRATIO,SRATIO,WRATIO,ITRMAX,ACLRAT         OR-A2948
      COMMON /DATA/ BCTOPC,BCTOPW,BCBTMC,BCBTMW,JWORH,MODE,JSORB        OR-A2949
      COMMON /DELTA/ ATCOEF,BTCOEF,CTCOEF,DTK,DTK1,DTMAX,DTMIN,K1DELT   OR-A2950
      COMMON /DEPTH/ N,Z(200)                                           OR-A2951
      COMMON /FLUX/ A(200),G(200),QZ(200)                               OR-A2952
      COMMON /IO/ IN,OUT,PNCH                                           OR-A2953
      COMMON /ISOTRM/ CNSTS(4)                                          OR-A2954
      COMMON /LIQUID/ CGUESS(200),COLD1(200),COLD2(200),C(200)          OR-A2955
      COMMON /MOIST/ WGUESS(200),WOLD1(200),WOLD2(200),THETA(200)       OR-A2956
      COMMON /PRNT/ NSKIP,NPRINT,OUTPUT                                 OR-A2957
      COMMON /QFLUX/ QWBTM,QWTOP,QCBTM,QCTOP                            OR-A2958
      COMMON /ROOTS/ CNVRSN,TCR,PPSURF(3),PWILT,RR,TR,WILTED            OR-A2959
      COMMON /SOLID/ SGUESS(200),SOLD1(200),SOLD2(200),S(200)           OR-A2960
      COMMON /TABQPS/ NUMQPS,TBLQPS,XQPS(200),YQPS(200)                 OR-A2961
      COMMON /UNIT/ ULNGTH(2),UPTNTL(6),UTIME(3),UMASS(3)               OR-A2962
C                                                                       OR-A2963
C                                                                       OR-A2964
      TLRNCE=1.E-02                                                     OR-A2965
      INTL = 0                                                          OR-A2966
      IF (JSORB.GE.2.AND.JSORB.LE.9) INTL = 1                           OR-A2967
      ITR = 0                                                           OR-A2968
      FAIL = 0                                                          OR-A2969
      IFMAX = ITRMAX                                                    OR-A2970
      MAXDEL = 25                                                       OR-A2971
      MS = 0                                                            OR-A2972
      MINIS = 0                                                         OR-A2973
      IF (JSORB.GT.1) MINIS = -1                                        OR-A2974
      NITR = N                                                          OR-A2975
      NMINI=20                                                          OR-A2976
      IF (NMINI.GE.N) NMINI = N                                         OR-A2977
      IF (JSORB.GT.1) NITR = NMINI                                      OR-A2978
      IF(NMINI.EQ.N) MINIS=0
```

```
      IF(NMINI.EQ.N) NITR=N                                              OR-A2979
      N1 = NITR-1                                                        OR-A2980
      SMAX=0.                                                            OR-A2981
C         INITIALIZE THE UPPER AND LOWER BOUNDARY CONDITIONS             OR-A2982
      CALL BCCTOP (TIME,FTOP)                                            OR-A2983
      CALL BCCBTM (TIME,FBTM)                                            OR-A2984
C                                                                        OR-A2985
C     THE FIRST GUESS FOR SOLUTE CONCENTRATION                           OR-A2986
C                                                                        OR-A2987
      IF (K1.GT.2) GO TO 40                                              OR-A2988
      DO 20 I=1,N                                                        OR-A2989
      CGUESS(I) = COLD2(I)                                               OR-A2990
20    SGUESS(I) = SOLD2(I)                                               OR-A2991
      GO TO 80                                                           OR-A2992
 40   DO 60 I=1,N                                                        OR-A2993
      CGUESS(I) = (COLD2(I) +ACLRAT*DTK1/DTK*(COLD2(I) -COLD1(I) ))      OR-A2994
60    SGUESS(I) = (SOLD2(I) +ACLRAT*DTK1/DTK*(SOLD2(I) -SOLD1(I) ))      OR-A2995
C                                                                        OR-A2996
 80   IF (BCTOPC.EQ.1) CGUESS(1) = FTOP                                  OR-A2997
      IF (BCBTMC.EQ.1) CGUESS(N) = FBTM                                  OR-A2998
      DO 100 I=1,N                                                       OR-A2999
      IF (SGUESS(I).LT.0.) SGUESS(I) = 0.                                OR-A3000
      IF (CGUESS(I).LT.0.) CGUESS(I) = 0.                                OR-A3001
      SCOLD(I)=SGUESS(I)                                                 OR-A3002
      SGOLD(I)=SGUESS(I)                                                 OR-A3003
      SCCOLD(I)=SGUESS(I)                                                OR-A3004
100   SGGOLD(I)=SGUESS(I)                                                OR-A3005
C      OBTAIN A MORE ACCURATE INITIAL GUESS OF S BY CALLING THE          OR-A3006
C     SORPTION MODELS                                                    OR-A3007
      IF (INTL.EQ.0) GO TO 180                                           OR-A3008
      N1=N-1                                                             OR-A3009
      DO 120 I=2,N1                                                      OR-A3010
120   C(I) = CGUESS(I)                                                   OR-A3011
      GO TO 680                                                          OR-A3012
 140  INTL = 0                                                           OR-A3013
      N1=NITR-1                                                          OR-A3014
      DO 160 I=2,N1                                                      OR-A3015
C     AVERAGE THE LINEAR EXTRAPOLATION GUESS WITH THE JUST COMPLETED     OR-A3016
C     COMPUTATION OF S FROM THE SORPTION MODELS.                         OR-A3017
      SI=(S(I)+SGUESS(I))/2.                                             OR-A3018
      SCOLD(I)=SI                                                        OR-A3019
      SGOLD(I)=SI                                                        OR-A3020
      SCCOLD(I)=SI                                                       OR-A3021
      SGGOLD(I)=SI                                                       OR-A3022
160   SGUESS(I) = SI                                                     OR-A3023
 180  ITR = ITR+1                                                        OR-A3024
      IF (MS.LT.IFMAX) GO TO 400                                         OR-A3025
```

```
      FAIL = FAIL+1                                                     OR-A3026
      IF (MS.EQ.ITRMAX) WRITE (OUT,200) MS,SRATIO                       OR-A3027
  200 FORMAT (//////,56X,14HERROR CODE  63,////,60X,7HWARNING,///,5X,   OR-A3028
     1121HTHE FINITE-DIFFERENCE SOLUTION TO THE SOLUTE MASS TRANSPORT EQOR-A3029
     2UATION(SOLID PHASE) FAILED TO CONVERGE IN SUBROUTINE SOLUTE,/,5X, OR-A3030
     312HAFTER  MS = ,I3,66H ITERATIONS. THE CONVERGENCE CRITERION WAS SOR-A3031
     4PECIFIED AS  SRATIO = ,E13.6)                                     OR-A3032
      IF (FAIL.GE.2) GO TO 280                                          OR-A3033
C     ADDITIONAL ITERATIONS ARE ALLOWED                                 OR-A3034
      IFMAX = ITRMAX+MAXDEL                                             OR-A3035
      WRITE (OUT,220) MAXDEL                                            OR-A3036
  220 FORMAT (///,60X,19HFAILURE TO CONVERGE,//,40X,26HPROGRAM WILL CONTOR-A3037
     1INUE FOR ,I3,22H ADDITIONAL ITERATIONS)                           OR-A3038
      WRITE (OUT,240)                                                   OR-A3039
  240 FORMAT (///,10X,93HAT THE END OF EACH ADDITIONAL ITERATION, THE WOOR-A3040
     1RST GUESSED VALUE OF SOLUTE( SOLID)   IS GIVEN,/,10X,95HALONG WITHOR-A3041
     2 ITS  CORRESPONDING COMPUTED VALUE AND THE DECIMAL PERCENT DIFFEREOR-A3042
     3NCE BETWEEN THE TWO,///,10X,9HITERATION,5X,10HWORST NODE,10X,     OR-A3043
     47HGUESSED,10X,8HCOMPUTED,10X,18HPERCENT DIFFERENCE,/,             OR-A3044
     5 13X,3HITR,29X,5HVALUE,13X,5HVALUE,16X,9H(DECIMAL),8X,2HMS,2X,5HMIOR-A3045
     6NIS, 2X,4HNITR ,//)                                               OR-A3046
      GO TO 400                                                         OR-A3047
  280 WRITE (OUT,300)                                                   OR-A3048
  300 FORMAT (//////////,56X,14HERROR CODE  64,////,43X,37HSUBROUTINE SOOR-A3049
     1LUTE  FAILED TO CONVERGE)                                         OR-A3050
      WRITE (OUT,320) TIME,DTMIN,DTK,DTK1,K1,BCTOPC,FTOP,BCBTMC,FBTM,   OR-A3051
     1FAIL,JSORB,NMINI,MS,MINIS,N,NITR,SMAX                             OR-A3052
  320 FORMAT (////,30X,64HAT THE TIME OF FAILURE, THE FOLLOWING VARIABLEOR-A3053
     1S HAD THE VALUE OF,//,50X,8H TIME = ,E12.5,/,50X,8HDTMIN = ,E12.5,OR-A3054
     2/,50X,8H DTK  = ,E12.5,/,50X,8H DTK1 = ,E12.5,/,50X,8H  K1  = ,I5,OR-A3055
     3/,49X,9HBCTOPC = ,I3,/,48X,10HFTOP(C) = ,E12.5,/,49X,9HBCBTMC = , OR-A3056
     4I3,/,48X,10HFBTM(C) = ,E12.5,/,50X,8H FAIL = ,I3,/,50X,8HJSORB = ,OR-A3057
     5I3,/,50X,8HNMINI = ,I3,/,53X,5HMS = ,I3,/,50X,8HMINIS = ,I3,/,54X,OR-A3058
     64HN = ,I3,/,51X,7HNITR = ,I3,/, 51X,7HSMAX =  ,E12.5)             OR-A3059
      WRITE (OUT,340) MS,TIME                                           OR-A3060
  340 FORMAT (////,20X,98HGIVEN BELOW IS A LIST OF 8   ARRAYS  CONCERNINOR-A3061
     1G THE SOLUTE CONCENTRATION (SOLID OR   SORBED PHASE),/,20X,       OR-A3062
     217HEVALUATED ON THE ,I3,44HTH ITERATION OF SUBROUTINE SOLUTE AT TIOR-A3063
     3ME = ,E13.6,////,3X,4HTIME,8X,3HK-1,11X,1HK,11X,3HK+1,10X,3HK+1,  OR-A3064
     410X,3HK+1,10X,3HK+1,10X,3HK+1,10X,3HK+1,10X,3HK+1,/,1X,9HITERATIONOR-A3065
     5,31X,4HMS-2, 9X,4HMS-2, 9X,4HMS-1, 9X,4HMS-1,10X,2HMS,11X,2HMS,11XOR-A3066
     6,/,2X,6HSTATUS,5X,6HACTUAL,7X,6HACTUAL,8X,5HGUESS,6X,8HCOMPUTED,7XOR-A3067
     7,5HGUESS,7X,8HCOMPUTED,6X,5HGUESS,7X,8HCOMPUTED,5X,8HCOMPUTED,//, OR-A3068
     82X,6HNODE I,4X,9HSOLD1(I) ,4X,9HSOLD2(I) ,4X,9HSGGOLD(I),4X,      OR-A3069
     99HSCCOLD(I),5X,8HSGOLD(I),5X,8HSCOLD(I),4X,9HSGUESS(I),5X,        OR-A3070
     A8H  S(I)  ,5X,8H  C(I)  ,//)                                      OR-A3071
      DO 380 I=1,N                                                      OR-A3072
```

```
      WRITE(OUT,360) I,SOLD1(I) ,SOLD2(I) ,SGGOLD(I),SCCOLD(I),SGOLD(I),OR-A3073
     1 SCOLD(I),SGUESS(I),S(I),C(I)                                      OR-A3074
  360 FORMAT (4X,I3,1X,9(2X,E11.4))                                      OR-A3075
  380 CONTINUE                                                           OR-A3076
      STOP                                                               OR-A3077
  400 MS = MS+1                                                          OR-A3078
C                                                                        OR-A3079
C                                                                        OR-A3080
C                        UPPER BOUNDARY CONDITION                        OR-A3081
C                                                                        OR-A3082
C                                                                        OR-A3083
C     NOTE.  THERE ARE NO ROOT UPTAKE OR SOLUTE UPTAKE OR   SORPTION     OR-A3084
C     SINKS ON EITHER THE FIRST OR LAST NODES.                           OR-A3085
C                                                                        OR-A3086
      Z2 = Z(2)-Z(1)                                                     OR-A3087
C                                                                        OR-A3088
      IF (BCTOPC.NE.1) GO TO 420                                         OR-A3089
C        1ST TYPE B.C. FOR SOLUTE                                        OR-A3090
C                  C(1,K+1) = F(TOP)                                     OR-A3091
      AI = 0.                                                            OR-A3092
      BI = 1.                                                            OR-A3093
      CI = 0.                                                            OR-A3094
      DI = FTOP                                                          OR-A3095
      GO TO 500                                                          OR-A3096
  420 IF (BCTOPC.NE.2) GO TO 440                                         OR-A3097
C        2ND TYPE B.C. FOR SOLUTE                                        OR-A3098
C                  DC/DZ = F(TOP)                                        OR-A3099
      AI = 0.                                                            OR-A3100
      BI = -1./Z2                                                        OR-A3101
      CI = 1./Z2                                                         OR-A3102
      DI = FTOP                                                          OR-A3103
      GO TO 500                                                          OR-A3104
  440 IF (BCTOPC.NE.3) GO TO 460                                         OR-A3105
C                  3RD TYPE B.C. ON THE SURFACE FOR THE SOLUTE EQUATION OR-A3106
C                                                                        OR-A3107
C                              THETA(1+1/2,K+1/2)                        OR-A3108
      W1K = (THETA(1)+WOLD2(1) +THETA(2)+WOLD2(2) )/4.                   OR-A3109
      CALL DSZ (W1K,QZ(1),DSZ1K)                                         OR-A3110
      T1C = W1K*DSZ1K/2./Z2/Z2+QZ(1)/4./Z2                               OR-A3111
      T2C = -W1K*DSZ1K/2./Z2/Z2+QZ(1)/4./Z2                              OR-A3112
      AI = 0.                                                            OR-A3113
      BI = THETA(1)/DTK1+T1C                                             OR-A3114
      CI = T2C                                                           OR-A3115
      DI = COLD2(1) *(WOLD2(1) /DTK1-T1C)+COLD2(2) *(-T2C)+FTOP/Z2       OR-A3116
      GO TO 500                                                          OR-A3117
  460 WRITE (OUT,480) BCTOPC                                             OR-A3118
  480 FORMAT (//////////,56X,14HERROR CODE  65,////,40X,34HERROR FLAG FROR-A3119
```

```
     1OH SUBROUTINE  SOLUTE,//,10X,18HYOU SET  BCTOPC = ,I3,38H BUT NO SOR-A3120
     2UCH BOUNDARY CONDITION EXISTS)                                    OR-A3121
      STOP                                                              OR-A3122
 500  BACK(1) = DI/BI                                                   OR-A3123
      CALPHA(1) = CI/BI                                                 OR-A3124
C                                                                       OR-A3125
C                                                                       OR-A3126
      DO 520 I=2,N1                                                     OR-A3127
      Z1 = Z(I)-Z(I-1)                                                  OR-A3128
      Z2 = Z(I+1)-Z(I)                                                  OR-A3129
      Z3 = (Z(I+1)-Z(I-1))/2.                                           OR-A3130
      Z23 = Z2*Z3                                                       OR-A3131
      Z13 = Z1*Z3                                                       OR-A3132
C        THETA(I+1/2,K+1/2)                                             OR-A3133
      WPIK = (THETA(I+1)+WOLD2(I+1) +THETA(I)+WOLD2(I) )/4.             OR-A3134
C                THETA(I-1/2,K+1/2)                                     OR-A3135
      WNIK = (THETA(I-1)+WOLD2(I-1) +THETA(I)+WOLD2(I) )/4.             OR-A3136
C                                                                       OR-A3137
C     EVALUATE THE SOLUTE DIFFUSIVITY                                   OR-A3138
      CALL DSZ (WPIK,QZ(I),DSZPIK)                                      OR-A3139
      CALL DSZ (WNIK,QZ(I-1),DSZNIK)                                    OR-A3140
C        ROOT UPTAKE OF LIQUID PHASE SOLUTE (I,K+1/2)                   OR-A3141
C                                                                       OR-A3142
C                         C(I,K+1/2)                                    OR-A3143
      CIKH = (CGUESS(I)+COLD2(I) )/2.                                   OR-A3144
      IF (CIKH.LE.0.) CIKH = 0.                                         OR-A3145
C                         THETA(I,K+1/2)                                OR-A3146
      WIKH = (THETA(I)+WOLD2(I) )/2.                                    OR-A3147
C                          TIME(K+1/2)                                  OR-A3148
      TKH = TIME-DTK1/2.                                                OR-A3149
C     CHECK IF THE PLANT HAS WILTED OR NOT.  IF IT HAS, NO UPTAKE CAN   OR-A3150
C     OCCUR                                                             OR-A3151
      IF (                  TBLCG .NE.-1) CALL SINKC (CIKH,WIKH,TKH,Z(I),IOR-A3152
     1,A(I),G(I))                                                       OR-A3153
C                                                                       OR-A3154
C                                                                       OR-A3155
C     WHERE     G   HAS THE UNITS OF (M/L**3 GROSS/T)                   OR-A3156
C     AND       A   HAS THE UNITS OF (L**3 FLUID/L**3 GROSS/T)          OR-A3157
C                                                                       OR-A3158
C     EVALUATE THE COEFFICIENTS OF THE TRI-DIAGONAL MATRIX              OR-A3159
C        RETARDATION COEFFICIENT FOR A LINEAR EQUILIBRIUM ISOTHERM      OR-A3160
      RK1 = 1.                                                          OR-A3161
      IF (JSORB.EQ.1.AND.THETA(I).NE.0.) RK1 = 1.+CNSTS(1)/THETA(I)     OR-A3162
      RK = 1.                                                           OR-A3163
      IF (JSORB.EQ.1.AND.WOLD2(I) .NE.0.) RK = 1.+CNSTS(1)/WOLD2(I)     OR-A3164
      AI = WNIK*DSZNIK/2./Z13+QZ(I-1)/4./Z3                             OR-A3165
      BI = -WPIK*DSZPIK/2./Z23-WNIK*DSZNIK/2./Z13+(-QZ(I)+QZ(I-1))/(4.* OR-A3166
```

```
     1Z3)-THETA(I)*RK1/DTK1                                                  OR-A3167
      CI = WPIK*DSZPIK/2./Z23-QZ(I)/4./Z3                                    OR-A3168
      DI = COLD2(I-1) *(-AI)+COLD2(I) *(-BI-THETA(I)*RK1/DTK1-WOLD2(I) *OR-A3169
     1RK/DTK1)+COLD2(I+1) *(-CI)-G(I)                                        OR-A3170
      IF (JSORB.GE.2) DI = DI+(SGUESS(I)-SOLD2(I) )/DTK1                     OR-A3171
      APHA = BI-AI*CALPHA(I-1)                                               OR-A3172
      BACK(I) = (DI-AI*BACK(I-1))/APHA                                       OR-A3173
      CALPHA(I) = CI/APHA                                                    OR-A3174
  520 CONTINUE                                                               OR-A3175
C                                                                            OR-A3176
C                                                                            OR-A3177
      IF (MINIS.LT.0) GO TO 540                                              OR-A3178
C                                                                            OR-A3179
      Z1 = Z(NITR)-Z(N1)                                                     OR-A3180
      IF (BCBTMC.NE.1) GO TO 560                                             OR-A3181
C             1ST TYPE B.C. AT THE BOTTOM                                    OR-A3182
C                  C(N,K+1) = F(BTM)                                         OR-A3183
  540 AI = 0.                                                                OR-A3184
      BI = 1.                                                                OR-A3185
      CI = 0.                                                                OR-A3186
      DI = CGUESS(NITR)                                                      OR-A3187
      GO TO 640                                                              OR-A3188
  560 IF (BCBTMC.NE.2) GO TO 580                                             OR-A3189
C                  2ND TYPE B.C. AT THE BOTTOM                               OR-A3190
C                  DC/DZ = F(BTM)                                            OR-A3191
      AI = -1./Z1                                                            OR-A3192
      BI = 1./Z1                                                             OR-A3193
      CI = 0.                                                                OR-A3194
      DI = FBTM                                                              OR-A3195
      GO TO 640                                                              OR-A3196
  580 IF (BCBTMC.NE.3) GO TO 600                                             OR-A3197
C                  3RD TYPE B.C. AT THE BOTTOM                               OR-A3198
C                                                                            OR-A3199
C                                  THETA(N-1/2,K+1/2)                        OR-A3200
      WNK = (THETA(NITR)+WOLD2(NITR) +THETA(N1)+WOLD2(N1) )/4.               OR-A3201
      CALL DSZ (WNK,QZ(N1),DSZNK)                                            OR-A3202
      T3C = -WNK*DSZNK/2./Z1/Z1-QZ(N1)/4./Z1                                 OR-A3203
      T4C = WNK*DSZNK/2./Z1/Z1-QZ(N1)/4./Z1                                  OR-A3204
      AI = T3C                                                               OR-A3205
      BI = THETA(NITR)/DTK1+T4C                                              OR-A3206
      CI = 0.                                                                OR-A3207
      DI = COLD2(NITR) *(WOLD2(NITR) /DTK1-T4C)+COLD2(N1) *(-T3C)-FBTM/ OR-A3208
     1Z1                                                                     OR-A3209
      GO TO 640                                                              OR-A3210
  600 WRITE (OUT,620) BCBTMC                                                 OR-A3211
  620 FORMAT (////////////,56X,14HERROR CODE  66,////,40X,33HERROR FLAG FROR-A3212
     1OM SUBROUTINE SOLUTE,//,10X,18HYOU SET  BCBTMC = ,I3,38H BUT NO SUOR-A3213
```

```
     2CH BOUNDARY CONDITION EXISTS)                                          OR-A3214
      STOP                                                                   OR-A3215
 640  APHA = BI-AI*CALPHA(N1)                                                OR-A3216
      BACK(NITR) = (DI-AI*BACK(N1))/APHA                                     OR-A3217
      C(NITR) = BACK(NITR)                                                   OR-A3218
      DO 660 I=1,N1                                                          OR-A3219
      NI = NITR-I                                                            OR-A3220
660   C(NI) = BACK(NI)-CALPHA(NI)*C(NI+1)                                    OR-A3221
      IF (JSORB.LE.0.OR.JSORB.GE.10) GO TO 1200                              OR-A3222
 680  DO 960 I=2,N1                                                          OR-A3223
      S(I) = 0.                                                              OR-A3224
C      COMPUTE THE   SORPTION/DESORPTION CONTRIBUTION.                       OR-A3225
C       SET  S = 0.   IF C IS LESS THAN ZERO                                 OR-A3226
C                  C(I,K+1/2)                                                OR-A3227
      CIKH = (C(I)+COLD2(I) )/2.                                             OR-A3228
      IF (C(I).LE.0.) CIKH = COLD2(I) /2.                                    OR-A3229
      IF (CIKH.LE.0.) CIKH = 0.                                              OR-A3230
C                         THETA(I,K+1/2)                                     OR-A3231
      WIKH = (THETA(I)+WOLD2(I) )/2.                                         OR-A3232
C                                                                            OR-A3233
C     THE COEFFICIENTS ARE EVALUATED AT  ( I,K+1 )                           OR-A3234
      GO TO (700,720,740,760,780,800,820,840,860), JSORB                     OR-A3235
C                  EQUILIBRIUM .  LINEAR ISOTHERM                            OR-A3236
 700  S(I) = CNSTS(2)                                                        OR-A3237
      IF (C(I).GT.0.) S(I) = S(I)+CNSTS(1)*C(I)                              OR-A3238
      GO TO 940                                                              OR-A3239
C                  EQUILIBRIUM .  LANGMUIR ISOTHERM                          OR-A3240
 720  S(I) = CNSTS(3)                                                        OR-A3241
      IF (C(I).GT.0.) S(I) = S(I)+CNSTS(1)*C(I)/(1.+CNSTS(2)*C(I))           OR-A3242
      GO TO 940                                                              OR-A3243
C                  EQUILIBRIUM .  FREUNDLICH ISOTHERM                        OR-A3244
 740  S(I) = CNSTS(3)                                                        OR-A3245
      IF (C(I).GT.0.) S(I) = S(I)+CNSTS(1)*(C(I)**CNSTS(2))                  OR-A3246
      GO TO 940                                                              OR-A3247
 760  CONTINUE                                                               OR-A3248
C                  EQUILIBRIUM .  GENERAL NON-LINEAR ISOTHERM                OR-A3249
C                                                                            OR-A3250
C     INSERT THE SOLUTION TO  S(I)  HERE WHEN  JSORB=4                       OR-A3251
C                                                                            OR-A3252
      S(I) = 0.                                                              OR-A3253
C                                                                            OR-A3254
C                                                                            OR-A3255
      GO TO 940                                                              OR-A3256
C                  NON-EQUILIBRIUM .  LINEAR ISOTHERM                        OR-A3257
C     USING A CENTERED CRANK-NICOLSON TO SOLVE THE TRANSIENT SOLID PHASE     OR-A3258
C     SOLUTE CONCENTRATION.  S(I,K+1)                                        OR-A3259
 780  S(I) = CNSTS(3)+SOLD2(I) *(CNSTS(2)/2.+1./DTK1)+CNSTS(1)*CIKH          OR-A3260
```

```
      S(I) = S(I)/(1./DTK1-CNSTS(2)/2.)                                 OR-A3261
      GO TO 940                                                         OR-A3262
C                  NON-EQUILIBRIUM .   BILINEAR ISOTHERM                OR-A3263
 800  S(I) = (CNSTS(1)*CIKH+CNSTS(4)+SOLD2(I) *(CNSTS(2)/2.+CNSTS(3)*  OR-A3264
     1CIKH/2.+1./DTK1))/(1./DTK1-CNSTS(2)/2.-CNSTS(3)*CIKH/2.)          OR-A3265
      GO TO 940                                                         OR-A3266
C                  NON-EQUILIBRIUM .  LANGMUIR ISOTHERM                 OR-A3267
 820  S(I) = (CNSTS(1)*CIKH/(1.+CNSTS(2)*CIKH)+SOLD2(I) *(CNSTS(3)/2.+1.OR-A3268
     1/DTK1)+CNSTS(4))/(1./DTK1-CNSTS(3)/2.)                            OR-A3269
      GO TO 940                                                         OR-A3270
C                  NON-EQUILIBRIUM .  FREUNDLICH                        OR-A3271
 840  S(I) = SOLD2(I) *(CNSTS(3)/2.+1./DTK1)+CNSTS(4)                   OR-A3272
      IF (CIKH.GT.0.) S(I) = S(I)+CNSTS(1)*(CIKH**CNSTS(2))             OR-A3273
      S(I) = S(I)/(1./DTK1-CNSTS(3)/2.)                                 OR-A3274
      GO TO 940                                                         OR-A3275
 860  CONTINUE                                                          OR-A3276
C                  NON-EQUILIBRIUM .  GENERAL NON-LINEAR ISOTHERM       OR-A3277
C                                                                       OR-A3278
C     SINCE THE ISOTHERM CAN BE NON-LINEAR IN BOTH S AND C, ONE MUST    OR-A3279
C     ITERATE ON S UNTIL THE ESTIMATED S AGREES WITH THE COMPUTED VALUE OR-A3280
      M9 = 0                                                            OR-A3281
 880  CONTINUE                                                          OR-A3282
      IF (M9.GT.ITRMAX) WRITE (OUT,900) K1,TIME,M9,I,RATIO,SRATIO       OR-A3283
 900  FORMAT (////////////,56X,14HERROR CODE  67,////,50X,27HERROR IN SUBROR-A3284
     1OUTINE  SOLUTE,//,10X,29HAT THE NEW TIME LEVEL   K1 = ,I3,        OR-A3285
     212H AND TIME = ,E12.4,56H THE SOLUTE EQUATION ( SOLID PHASE ) FAILOR-A3286
     3ED TO CONVERGE ,/,10X,13HAFTER   M9 = ,I3,26H ITERATIONS FOR NODE OR-A3287
     4 I = ,I3,18H  THE RATIO ON THE,/,10X,24HLAST ITERATION  RATIO = , OR-A3288
     5E13.6,40H BUT THE CONVERGENCE CRITERION SRATIO = ,E13.6)           OR-A3289
      IF (M9.GT.ITRMAX) STOP                                            OR-A3290
      M9 = M9+1                                                         OR-A3291
      S(I) = SGUESS(I)                                                  OR-A3292
      SIKH = (SGUESS(I)+SOLD2(I) )/2.                                   OR-A3293
C                                                                       OR-A3294
C                                                                       OR-A3295
C     INSERT THE FINITE-DIFFERENCE SOLUTION FOR S(I) BETWEEN            OR-A3296
C     CARDS NUMBERED  904-905 WHEN JSORB=9  AND THE ISOTHERM IS A       OR-A3297
C     NON-LINEAR FUNCTION OF S.                                         OR-A3298
C     IF THE ISOTHERM IS     A     LINEAR FUNCTION OF S,  INSERT THE    OR-A3299
C     FINITE-DIFFERENCE EQUATION OF S BETWEEN STATEMENTS 926 AND 927    OR-A3300
C                                                                       OR-A3301
C                                                                       OR-A3302
 904  CONTINUE                                                          OR-A3303
C                                                                       OR-A3304
 905  CONTINUE                                                          OR-A3305
C                                                                       OR-A3306
      IF (S(I).LT.0.) S(I) = 0.                                         OR-A3307
```

```
      IF(S(I).GT.SMAX) SMAX=S(I)                                        OR-A3308
      RATIO = ABS(SGUESS(I)-S(I))                                       OR-A3309
      IF (RATIO.LE.TLRNCE*SMAX) GO TO 920                               OR-A3310
      IF (SGUESS(I).NE.0.) RATIO = RATIO/ABS(SGUESS(I))                 OR-A3311
      IF (RATIO.LE.SRATIO) GO TO 920                                    OR-A3312
      SGUESS(I) = (SGUESS(I)+S(I))/2.                                   OR-A3313
      IF (SGUESS(I).LT.0.) SGUESS(I) = 0.                               OR-A3314
      GO TO 880                                                         OR-A3315
  920 CONTINUE                                                          OR-A3316
C                                                                       OR-A3317
C     INSERT    BETWEEN CARDS NUMBERED  926-927  THE CRANK-NICOLSON     OR-A3318
C     SOLUTION TO S(I) ONLY IF THE ISOTHERM IS A LINEAR FUNCTION OF S   OR-A3319
C     AND JSORB=9                                                       OR-A3320
C                                                                       OR-A3321
  926 CONTINUE                                                          OR-A3322
C                                                                       OR-A3323
  927 CONTINUE                                                          OR-A3324
C                                                                       OR-A3325
  940 IF (S(I).LT.0.) S(I) = 0.                                         OR-A3326
      IF(S(I).GT.SMAX) SMAX=S(I)                                        OR-A3327
  960 CONTINUE                                                          OR-A3328
      IF (INTL.EQ.1) GO TO 140                                          OR-A3329
      IF (JSORB.LE.1) GO TO 1200                                        OR-A3330
C      ITERATE UNTIL THE WORST SOLID  PHASE SOLUTE GUESS IS REDUCED     OR-A3331
C     TO WITHIN A PRESCRIBED LIMIT                                      OR-A3332
C     FIRST LOCATE THE WORST GUESS ON THE LAST RUN                      OR-A3333
      RWORST = 0.                                                       OR-A3334
      IWORST = 1                                                        OR-A3335
      DO 980 I=2,N1                                                     OR-A3336
      RATIO = ABS(SGUESS(I)-S(I))                                       OR-A3337
      IF (RATIO.LE.TLRNCE*SMAX) GO TO 980                               OR-A3338
      IF (S(I).LE.0.) GO TO 980                                         OR-A3339
      IF (SGUESS(I).NE.0.) RATIO = RATIO/ABS(SGUESS(I))                 OR-A3340
      IF (RATIO.LT.RWORST) GO TO 980                                    OR-A3341
      RWORST = RATIO                                                    OR-A3342
      IWORST = I                                                        OR-A3343
  980 CONTINUE                                                          OR-A3344
      IF(FAIL.EQ.1) WRITE(OUT,1000) ITR,IWORST,SGUESS(IWORST),          OR-A3345
     $ S(IWORST),RWORST,MS,MINIS,NITR                                   OR-A3346
 1000 FORMAT(13X, I3,11X,I3,11X,E11.4, 7X,E11.4,12X,E11.4, 7X,I3,3X,    OR-A3347
     $ I3,4X,I3)                                                        OR-A3348
      IF (FAIL.NE.0.AND.MS.GE.IFMAX) GO TO 180                          OR-A3349
      CGUESS(1) = C(1)                                                  OR-A3350
       DO 1100 I=2,NITR                                                 OR-A3351
      CGUESS(I) = C(I)                                                  OR-A3352
      SCOLD(I) = SCOLD(I)                                               OR-A3353
      SGOLD(I) = SGOLD(I)                                               OR-A3354
```

```
      SCOLD(I) = S(I)                                                    OR-A3355
      SGOLD(I) = SGUESS(I)                                               OR-A3356
      IF(ITR.LE.3) GO TO 1080                                            OR-A3357
C     NEW GUESS IS BASED ON A NEWTON-RAPHSON ITERATION SCHEME            OR-A3358
      DELG=SGOLD(I)-SGGOLD(I)                                            OR-A3359
      DELC=SCOLD(I)-SCCOLD(I)                                            OR-A3360
      IF(DELC.EQ.0..OR.DELG.EQ.0.) GO TO 1080                            OR-A3361
      H=SGOLD(I)-SCOLD(I)                                                OR-A3362
      DHDS=1.-DELC/DELG                                                  OR-A3363
      IF(DHDS.EQ.0.) GO TO 1080                                          OR-A3364
      DELS=-H/DHDS                                                       OR-A3365
      HOLD=SGGOLD(I)-SCCOLD(I)                                           OR-A3366
      IF(H.EQ.0.) GO TO 1060                                             OR-A3367
      IF(H.GE.0..AND.DHDS/DELG.GT.0..AND.HOLD/H.GT.0.) GO TO 1080        OR-A3368
      IF(H.LT.0..AND.DHDS/DELG.LT.0..AND.HOLD/H.GT.0.) GO TO 1080        OR-A3369
1060  SGUESS(I)=SGOLD(I)+DELS                                            OR-A3370
      GO TO 1100                                                         OR-A3371
 1080 SGUESS(I) = (SGOLD(I)+SCOLD(I))/2.                                 OR-A3372
 1100 CONTINUE                                                           OR-A3373
       DO 1140 I=2,NITR                                                  OR-A3374
      IF (SGUESS(I).LT.0.) SGUESS(I) = 0.                                OR-A3375
 1140 CONTINUE                                                           OR-A3376
      IF(RWORST.LE.SRATIO) GO TO 1150                                    OR-A3377
C                CONTINUE THE MINI-ITERATOR                            OR-A3378
      MINIS=MINIS-1                                                      OR-A3379
      NMINI=IWORST+20                                                    OR-A3380
      NITR=NMINI                                                         OR-A3381
      N1=NITR-1                                                          OR-A3382
      IF(NMINI.LT.N) GO TO 180                                           OR-A3383
1150  IF(MINIS.GE.0) GO TO 1160                                          OR-A3384
C            REVERT BACK TO THE MAXI-ITERATOR                          OR-A3385
      MINIS=0                                                            OR-A3386
      NMINI=N                                                            OR-A3387
      NITR=N                                                             OR-A3388
      N1=NITR-1                                                          OR-A3389
      GO TO 180                                                          OR-A3390
 1160 IF (FAIL.NE.0.OR.IFMAX.NE.ITRMAX) WRITE (OUT,1180)                 OR-A3391
 1180 FORMAT (//,50X,39HPROGRAM HAS RECOVERED AND WILL CONTINUE,///)     OR-A3392
 1200 TCR = 0.                                                           OR-A3393
      IF (TBLCG .EQ.-1                ) GO TO 1240                       OR-A3394
      DO 1220 I=2,N1                                                     OR-A3395
C     RATE OF SOLUTE UPTAKE BY THE ROOT SYSTEM AT TIME LEVEL K+1/2       OR-A3396
1220  TCR = TCR+G(I)*(Z(I+1)-Z(I-1))/2.                                  OR-A3397
1240  IF (BCTOPC.EQ.3) QCTOP = (C(1)*(THETA(1)/DTK1+T1C)+C(2)*T2C+COLD2(OR-A3398
     11) *(-WOLD2(1) /DTK1+T1C)+COLD2(2) *T2C)*(Z(2)-Z(1))               OR-A3399
      IF (BCBTMC.EQ.3) QCBTM = (C(N1)*(-T3C)+C(NITR)*(-THETA(NITR)/DTK1-OR-A3400
     1T4C)+COLD2(NITR) *(WOLD2(NITR) /DTK1-T4C)+COLD2(N1) *(-T3C))*(Z    OR-A3401
```

```
     2(NITR)-Z(N1))                                                     OR-A3402
      RETURN                                                            OR-A3403
      END                                                               OR-A3404


      SUBROUTINE ORDER (NUM,X,Y,NAME)                                   OR-A3405
C                                                                       OR-A3406
C                                                                       OR-A3407
C     THIS SUBROUTINE SCANS     ARRAY X TO MAKE SURE THAT ALL VALUES AREOR-A3408
C     IN ASCENDING ORDER                                                OR-A3409
C      IN ADDITION, PRINT OUT THE DATA SET ARRAYS                       OR-A3410
C                                                                       OR-A3411
C        NAME       THE NAME OF THE DATA SET, ANY 3 LETTER NAME, FED IN OR-A3412
C                    AS  3HABC                                          OR-A3413
C        NUM        NUMBER OF VALUES TO BE SCANNED IN ARRAY X          OR-A3414
C        X(I)       ARRAY TO BE SCANNED, VARIABLE TO FUNCTION Y        OR-A3415
C        Y(I)       VALUE OF FUNCTION CORRESPONDING TO VARIABLE X(I)   OR-A3416
C                                                                       OR-A3417
      INTEGER OUT,PNCH                                                  OR-A3418
      COMMON /IO/ IN,OUT,PNCH                                           OR-A3419
      DIMENSION X(NUM), Y(NUM)                                          OR-A3420
C                                                                       OR-A3421
C                                                                       OR-A3422
      WRITE (OUT,20) NAME                                               OR-A3423
   20 FORMAT (   ////,56X,11HDATA SET   ,A3,/ )                         OR-A3424
      IF (NUM.LT.2) GO TO 200                                           OR-A3425
      DO 40 I=2,NUM                                                     OR-A3426
      IJ = I-1                                                          OR-A3427
      IF (X(I).LE.X(IJ)) GO TO 120                                      OR-A3428
   40 CONTINUE                                                          OR-A3429
      WRITE (OUT,60) NAME,NAME,NAME,NAME,NAME,NAME,NAME,NAME            OR-A3430
   60 FORMAT (/,3X,1HI,5X,1HX,A3,5H(I  ),4X,1HY,A3,5H(I  ),8X,1HX,A3,   OR-A3431
     15H(I+1),4X,1HY,A3,5H(I+1),8X,1HX,A3,5H(I+2),4X,1HY,A3,5H(I+2),8X, OR-A3432
     21HX,A3,5H(I+3),4X,1HY,A3,5H(I+3),/)                               OR-A3433
      XN = NUM                                                          OR-A3434
      NM = XN/4.+.95                                                    OR-A3435
      DO 100 I=1,NM                                                     OR-A3436
      I0 = (I-1)*4+1                                                    OR-A3437
      I1 = I0+3                                                         OR-A3438
```

```
      IF (I1.GT.NUM) I1 = NUM                                           OR-A3439
      WRITE (OUT,80) I0,(X(J),Y(J),J=I0,I1)                             OR-A3440
   80 FORMAT (2X,I3,2X,4(E11.4,2X,E11.4,6X))                            OR-A3441
  100 CONTINUE                                                          OR-A3442
      RETURN                                                            OR-A3443
  120 WRITE (OUT,140) NAME,NAME,NAME,NAME,IJ,X(IJ),NAME,I,X(I),NAME,NUM,OR-A3444
     1NAME,NAME,NAME                                                    OR-A3445
  140 FORMAT (///////////,56X,14HERROR CODE  68,////,50X,26HERROR IN SUBROR-A3446
     1OUTINE  ORDER,/////,34X,1HX,A3,27H(I-1)  MUST BE LESS THAN  X,A3, OR-A3447
     224H(I)  FOR ALL VALUES OF I,//,33X,16HTHE FOLLOWING  X,A3,        OR-A3448
     341H ARRAY VALUES WERE NOT IN ASCENDING ORDER,//,40X,1HX,A3,1H(,I3,OR-A3449
     44H) = ,E11.4,10X,1HX,A3,1H(,I3,4H) = ,E11.4,///,11X,26HTHERE WERE OR-A3450
     5A TOTAL OF  NUM,A3,3H = ,I3,21H  ELEMENTS IN ARRAY X,A3,34H.  BELOOR-A3451
     6W IS A LISTING OF ARRAYS  X,A3,6H AND Y,A3,///)                   OR-A3452
      DO 180 J=1,NUM                                                    OR-A3453
      WRITE (OUT,160) NAME,J,X(J),NAME,J,Y(J)                           OR-A3454
  160 FORMAT (40X,1HX,A3,1H(,I3,4H) = ,E11.4,10X,1HY,A3,1H(,I3,4H) = ,  OR-A3455
     1E11.4)                                                            OR-A3456
  180 CONTINUE                                                          OR-A3457
      STOP                                                              OR-A3458
  200 WRITE (OUT,220) NAME,NAME,NAME,NUM                                OR-A3459
  220 FORMAT (///////////,56X,14HERROR CODE  69,////,50X,26HERROR IN SUBROR-A3460
     1OUTINE  ORDER,/////,20X,53HTHERE MUST BE AT LEAST TWO TABULAR VALUOR-A3461
     2ES IN ARRAYS X,A3,6H AND Y,A3,18H  BUT YOU SET  NUM,A3,3H = ,I3)  OR-A3462
      STOP                                                              OR-A3463
      END                                                               OR-A3464
```

```
      SUBROUTINE INTGRT (TYPE,NUM,VARBLE,FNCTN,RESULT,NAME)             OR-A3465
C                                                                       OR-A3466
C                  NUMERICAL INTEGRATION ROUTINE                        OR-A3467
C                                                                       OR-A3468
C                                                                       OR-A3469
C        TYPE      METHOD OF INTEGRATION                                OR-A3470
C                   = 1  PIECEWISE-CONSTANT INTEGRATION                 OR-A3471
C                         (I.E.  SUM OF  F(I)*(Z(I+1)-Z(I)) )           OR-A3472
C                   = 2  INTEGRATION OF A SECOND-ORDER TAYLOR SERIES    OR-A3473
C                          EXPANSION OF THE FUNCTION, ASSUMING IT IS    OR-A3474
C                          DEFINED AT UNEQUALLY OR EQUALLY SPACED NODES OR-A3475
```

```
C                       THE SCHEME IS FOURTH-ORDER ACCURATE          OR-A3476
C       NUM       TOTAL NUMBER OF ELEMENTS IN ARRAY  VARBLE AND FNCTN OR-A3477
C                                                                    OR-A3478
C       VARBLE(J) INDEPENDENT VARIABLE OF FUNCTION  FNCTN            OR-A3479
C                                                                    OR-A3480
C       FNCTN(J)  JTH VALUE OF FUNCTION  F  AT NODE J                OR-A3481
C                                                                    OR-A3482
C       RESULT    RESULTANT VALUE OF THE INTEGRATION OF FUNCTION     OR-A3483
C                   ARRAY  FNCTN VERSUS VARBLE                       OR-A3484
C                                                                    OR-A3485
      INTEGER OUT,PNCH,TYPE,ODD                                      OR-A3486
      COMMON /IO/ IN,OUT,PNCH                                        OR-A3487
      DIMENSION VARBLE(NUM), FNCTN(NUM)                              OR-A3488
C                                                                    OR-A3489
      RESULT = 0.                                                    OR-A3490
      IF (NUM.LE.1) GO TO 220                                        OR-A3491
      IF (TYPE.NE.1) GO TO 40                                        OR-A3492
C                     PIECEWISE-CONSTANT INTEGRATION                 OR-A3493
      N1 = NUM-1                                                     OR-A3494
      DO 20 I=1,N1                                                   OR-A3495
20    RESULT = RESULT+FNCTN(I)*(VARBLE(I+1)-VARBLE(I))               OR-A3496
      GO TO 260                                                      OR-A3497
 40   IF (TYPE.NE.2) GO TO 120                                       OR-A3498
C                                                                    OR-A3499
C                                                                    OR-A3500
C     INTEGRATION OF A TAYLOR SERIES EXPANSION OF THE FUNCTION, TO   OR-A3501
C     SECOND-ORDER OVER UNEQUALLY SPACED INTERVALS.  INTEGRATION IS DONEOR-A3502
C     OVER ONE INTERVAL AT A TIME AND THEN SUMMED.                   OR-A3503
C                                                                    OR-A3504
C                                                                    OR-A3505
C     IF THERE ARE ONLY TWO POINTS, USE THE TRAPEZOIDAL RULE         OR-A3506
      IF (NUM.EQ.2) RESULT = (FNCTN(1)+FNCTN(2))*(VARBLE(2)-VARBLE(1))/2OR-A3507
     1.                                                              OR-A3508
      IF (NUM.EQ.2) GO TO 260                                        OR-A3509
C        ODD = 0  IF NUM IS EVEN AND  ODD=1 IF NUM IS ODD            OR-A3510
      M1 = NUM/2                                                     OR-A3511
      ODD = NUM-M1*2                                                 OR-A3512
      JSUM = (NUM-1)/2                                               OR-A3513
      IF (ODD.EQ.0) JSUM = (NUM-2)/2                                 OR-A3514
      DO 60 J=1,JSUM                                                 OR-A3515
      I = 2*J                                                        OR-A3516
      H = VARBLE(I)-VARBLE(I-1)                                      OR-A3517
      IF (H.LE.0.) GO TO 80                                          OR-A3518
      A = (VARBLE(I+1)-VARBLE(I))/H                                  OR-A3519
      IF (A.LE.0.) GO TO 80                                          OR-A3520
      RESULT = RESULT+FNCTN(I-1)*H*(2.+3.*A-A*A*A)/6./(1.+A)+FNCTN(I)*H*OR-A3521
     1(1.+3.*A+3.*A*A+A*A*A)/6./A+FNCTN(I+1)*H*(2.*A*A*A+3.*A*A-1.)/6./AOR-A3522
```

```
     2/(1.+A)                                                          OR-A3523
 60   CONTINUE                                                          OR-A3524
      IF (ODD.EQ.1) GO TO 260                                           OR-A3525
      I = NUM-1                                                         OR-A3526
      RESULT = RESULT-FNCTN(I-1)*A*A*A*H/6./(1.+A)+FNCTN(I)*(3.+A)*A*H/6OR-A3527
     1.+FNCTN(I+1)*(3.+2.*A)*A*H/6./(1.+A)                              OR-A3528
      GO TO 260                                                         OR-A3529
 80   WRITE (OUT,100) NAME                                              OR-A3530
 100  FORMAT (////////////,56X,14HERROR CODE  72,////,50X,27HERROR IN SUBROR-A3531
     1OUTINE  INTGRT,//,31X,77HINTEGRATION IS ONLY VALID IF THE INDEPENDOR-A3532
     2ENT VARIABLE INCREASES MONOTONICALLY,/,34X,39HCHECK BELOW TO  SEE OR-A3533
     3IF ANY VALUES OF X(,A3,28H) ARE REPEATED OR DECREASING )          OR-A3534
      GO TO 160                                                         OR-A3535
 120  WRITE (OUT,140) TYPE ,NAME                                        OR-A3536
 140  FORMAT (////////////,56X,14HERROR CODE  73,////,50X,27HERROR IN SUBROR-A3537
     1OUTINE  INTGRT,//,40X,58HONLY TWO METHODS OF INTEGRATION ARE ALLOWOR-A3538
     2ED,  TYPE=1 AND 2,/,40X,20HBUT YOU SET  TYPE = ,I3,//,47X,        OR-A3539
     351HGIVEN BELOW IS A LIST OF THE DATA USED IN DATA SET  ,A3,///)   OR-A3540
 160  DO 200 I=1,NUM                                                    OR-A3541
      WRITE(OUT,180) NAME,I,VARBLE(I),NAME,I,FNCTN(I)                   OR-A3542
 180  FORMAT (40X,1HX,A3,1H(,I3, 4H) = ,E11.4,10X,1HY,A3, 1H(,I3,4H) = ,OR-A3543
     1 E11.4)                                                           OR-A3544
 200  CONTINUE                                                          OR-A3545
      STOP                                                              OR-A3546
 220  WRITE (OUT,240) TYPE,NUM,NUM,NAME                                 OR-A3547
 240  FORMAT (////////////,56X,14HERROR CODE  74,////,50X,27HERROR IN SUBROR-A3548
     1OUTINE  INTGRT,//,66X,7HYOU SET,//,64X,7HTYPE = ,I3,/,65X,6HNUM = OR-A3549
     2,I3,//,31X,70HTHERE MUST BE AT LEAST TWO POINTS TO BE INTEGRATED BOR-A3550
     3UT YOU SET  NUM = ,I3,1X,12HIN DATA SET ,A3)                      OR-A3551
      STOP                                                              OR-A3552
 260  RETURN                                                            OR-A3553
      END                                                               OR-A3554
```

```
      SUBROUTINE INTRP (NUM,TBL,X,Y,XI,YI,DYDX,NAME)                    OR-A3555
C                                                                       OR-A3556
C     FOR A GIVEN VALUE OF  XI, FIND YI BY INTERPOLATING THE KNOWN      OR-A3557
C     TABLE OF  Y VERSUS Y                                              OR-A3558
C     IN ADDITION, DETERMINE THE SLOPE  DY/DX  AT POINT (XI,YI)         OR-A3559
```

```
C                                                                       OR-A3560
C                                                                       OR-A3561
C                                                                       OR-A3562
C       TBL       TYPE OF INTERPOLATION SCHEME TO BE USED ON TABULAR    OR-A3563
C                   VALUES OF X AND Y                                   OR-A3564
C                  -1       (FUNCTION IS NOT TO BE USED)               OR-A3565
C                   0       (EMPIRICAL  EQUATION IS TO BE USED)        OR-A3566
C       TBL =       1       (LINEAR INTERPOLATION OF  Y VERSUS X )     OR-A3567
C                   2       (QUADRATIC INTERPOLATION OF Y VERSUS X)    OR-A3568
C                   3       (CUBIC SPLINE INTERPOLATION OF  Y VERSUS X)OR-A3569
C                   4       (LINEAR INTERPOLATION OF  LN(Y) VERSUS X ) OR-A3570
C                   5       (CUBIC SPLINE INTERPOLATION OF LN(Y) VS X )OR-A3571
C                   6       (LINEAR INTERPOLATION OF  Y VS LN(X) )     OR-A3572
C                   7       (CUBIC SPLINE INTERPOLATION OF Y VS LN(X) )OR-A3573
C                   8       (LINEAR INTERPOLATION OF  LN(Y) VS LN(X) ) OR-A3574
C                   9       (CUBIC SPLINE INTERPOLATION                OR-A3575
C                             OF  LN(Y) VERSUS LN(X) )                 OR-A3576
C                  10       (PIECEWISE-CONSTANT VALUES BETWEEN NODES)  OR-A3577
C                                                                       OR-A3578
C       NAME      THE NAME OF THE DATA SET, ANY 3 LETTER NAME,          OR-A3579
C                   SPECIFIED AS 3HABC                                  OR-A3580
C       NUM       NUMBER OF TABULAR VALUES IN ARRAYS X AND Y            OR-A3581
C       X(J)      ARRAY VALUES OF FUNCTION X                            OR-A3582
C       Y(J)      ARRAY VALUES OF FUNCTION Y CORRESPONDING TO X(J)      OR-A3583
C       Z(J)      INTERPOLATION COEFFICIENT , THE TYPE OF COEFFICIENT   OR-A3584
C                   DEPENDS ON THE TYPE OF INTERPOLATION SCHEME USED    OR-A3585
C                                                                       OR-A3586
C                                                                       OR-A3587
      INTEGER OUT,TBL,PNCH                                              OR-A3588
      COMMON /IO/ IN,OUT,PNCH                                           OR-A3589
      DIMENSION X(NUM), Y(NUM)                                          OR-A3590
C                                                                       OR-A3591
C                                                                       OR-A3592
      IF (TBL.LE.0.OR.TBL.GT.10) GO TO 140                              OR-A3593
C        EXTRAPOLATION IS NOT PERMITTED                                 OR-A3594
      IF (XI.LE.X(NUM).AND.XI.GE.X(1)) GO TO 40                         OR-A3595
C     CHECK IF THE FAILURE TO BE WITHIN THE ALLOWED RANGE IS DUE TO     OR-A3596
C     MACHINE TOLERANCE, ASSUMED TO BE 1.E-3                            OR-A3597
C     (I.E., .99999 INSTEAD OF 1.00000)                                 OR-A3598
      TLRNCE = 1.E-03                                                   OR-A3599
      XD1 = ABS((XI-X(1))/(X(NUM)-X(1)))                                OR-A3600
      XDN = ABS((XI-X(NUM))/(X(NUM)-X(1)))                              OR-A3601
      IF (XD1.LE.TLRNCE) XI = X(1)                                      OR-A3602
      IF (XD1.LE.TLRNCE) GO TO 40                                       OR-A3603
      IF (XDN.LE.TLRNCE) XI = X(NUM)                                    OR-A3604
      IF (XDN.LE.TLRNCE) GO TO 40                                       OR-A3605
      WRITE (OUT,20) TBL,NAME,XI,NAME,X(1),NAME,NUM,X(NUM),NAME         OR-A3606
   20 FORMAT(1H1,///////,56X,14HERROR CODE  75,////,50X,34HERROR FLAG FR
```

```
     10H SUBROUTINE  INTRP ,///,40X,41HUSING THE INTERPOLATION SCHEME OFOR-A3607
     2  TBL = ,I3,15H WITH DATA SET ,A3,//,20X,84HYOU TRIED TO EXTRAPOLAOR-A3608
     3TE OUTSIDE OF THE GIVEN RANGE OF FUNCTION  Y VERSUS VARIABLE X,/, OR-A3609
     420X,31HONLY INTERPOLATION IS PERMITTED,//,17X,41HYOU WANTED TO EVAOR-A3610
     5LUATE AT VARIABLE  XI = ,E12.5,52H BUT TABULAR DATA OF VARIABLE X OR-A3611
     6IS LIMITED TO VALUES,//,37X,9HBETWEEN X,A3,8H(  1) = ,E11.4,      OR-A3612
     77H AND  X,A3,1H(,I3,4H) = ,E11.4,///,33X,59HRESUBMIT THE PROGRAM AOR-A3613
     8FTER EXTENDING THE RANGE OF DATA SET ,A3,///)                     OR-A3614
      GO TO 220                                                         OR-A3615
 40   GO TO (60,120,100,60,100,60,100,60,100,80), TBL                   OR-A3616
 60   IF (NUM.LT.2) GO TO 300                                           OR-A3617
      CALL LINEAR (NUM,TBL,X,Y,XI,YI,DYDX,NAME)                         OR-A3618
      GO TO 420                                                         OR-A3619
 80   IF (NUM.LT.2) GO TO 300                                           OR-A3620
      CALL PIECE (NUM,X,Y,XI,YI,NAME)                                   OR-A3621
C             SLOPE                                                     OR-A3622
      DYDX = 0.                                                         OR-A3623
      GO TO 420                                                         OR-A3624
 100  IF (NUM.LT.3) GO TO 340                                           OR-A3625
      CALL CUBIC (NUM,TBL,X,Y,XI,YI,DYDX,NAME)                          OR-A3626
      GO TO 420                                                         OR-A3627
 120  IF (NUM.LT.3) GO TO 380                                           OR-A3628
      CALL QUAD (NUM,X,Y,XI,YI,DYDX,NAME)                               OR-A3629
      GO TO 420                                                         OR-A3630
 140  IF (TBL.EQ.0) WRITE (OUT,160)                                     OR-A3631
 160  FORMAT (////////////,56X,14HERROR CODE  76,////,50X,26HERROR IN SUBROR-A3632
     1OUTINE  INTRP,//,20X,77HYOU CALLED SUBROUTINE INTRP TO COMPUTE AN OR-A3633
     2INTERPOLATION WHEN IN FACT  TBL = 0,/,20X,63HWHICH INDICATES THAT OR-A3634
     3AN EMPIRICAL FORMULA WAS TO HAVE BEEN USED)                       OR-A3635
      IF (TBL.EQ.0) GO TO 220                                           OR-A3636
      IF (TBL.EQ.-1) WRITE (OUT,180)                                    OR-A3637
 180  FORMAT (////////////,56X,14HERROR CODE  77,////,50X,26HERROR IN SUBROR-A3638
     1OUTINE  INTRP,//,20X,74HWHY DID YOU CALL SUBROUTINE INTRP WHEN IN OR-A3639
     2FACT  TBL = -1, WHICH MEANS THAT,/,20X,38HARRAYS X AND Y ARE NOT TOR-A3640
     30 BE EVEN USED)                                                   OR-A3641
      IF (TBL.EQ.-1) GO TO 220                                          OR-A3642
      WRITE (OUT,200) TBL                                               OR-A3643
 200  FORMAT (////////////,56X,14HERROR CODE  78,////,50X,27HERROR IN SUBROR-A3644
     1OUTINE  INTRP ,//,20X,31HINTERPOLATION TECHNIQUE  TBL = ,I3,      OR-A3645
     242H IS NOT PROVIDED FOR IN SUBROUTINE  INTRP ,/,20X,38HPROBABLE REOR-A3646
     3ASON,  MISPUNCHED DATA CARD)                                      OR-A3647
 220  WRITE (OUT,240) NAME,NUM,NAME,TBL,NAME                            OR-A3648
 240  FORMAT (/////,50X,39HDATA VARIABLES AT TIME OF ERROR MESSAGE,//,  OR-A3649
     164X,3HNUM,A3,3H = ,I3,/,64X,3HTBL,A3,3H = ,I3,//,38X,60HTHE FOLLOWOR-A3650
     2ING IS A LIST OF THE X AND Y VALUES FROM DATA SET ,A3,////)       OR-A3651
C             PRINT OUT TABLE FOR ERROR ANALYSIS                        OR-A3652
      DO 280 J=1,NUM                                                    OR-A3653
```

```
      WRITE (OUT,260) NAME,J,X(J),NAME,J,Y(J)                          OR-A3654
  260 FORMAT (41X,1HX,A3,1H(,I3,4H) = ,E11.4,10X,1HY,A3,1H(,I3,4H) = ,  OR-A3655
     1E11.4)                                                           OR-A3656
  280 CONTINUE                                                         OR-A3657
      STOP                                                             OR-A3658
  300 WRITE (OUT,320) NUM,TBL                                          OR-A3659
  320 FORMAT (////////////,56X,14HERROR CODE  79,////,50X,27HERROR IN SUBROR-A3660
     1OUTINE  INTRP ,//,20X,57HA LINEAR INTERPOLATION SCHEME WAS CALLED OR-A3661
     2BUT ONLY  NUM = ,I3,30H ARRAY   VALUES WERE AVAILABLE,/,20X,     OR-A3662
     363HAT LEAST TWO ARRAY   VALUES ARE NEEDED FOR LINEAR INTERPOLATIONOR-A3663
     4,/,20X,33HIN ADDITION YOU SPECIFIED  TBL = ,I3)                  OR-A3664
      IF (NUM.GT.0) GO TO 220                                          OR-A3665
      STOP                                                             OR-A3666
  340 WRITE (OUT,360) NUM,TBL                                          OR-A3667
  360 FORMAT (////////////,56X,14HERROR CODE  80,////,50X,27HERROR IN SUBROR-A3668
     1OUTINE  INTRP ,//,20X,63HA CUBIC SPLINE INTERPOLATION SCHEME WAS COR-A3669
     2ALLED BUT ONLY  NUM = ,I3,28H ARRAY VALUES WERE AVAILABLE,/,20X,  OR-A3670
     371HAT LEAST THREE ARRAY   VALUES ARE NEEDED FOR CUBIC SPLINE INTERORR-A3671
     4POLATION,/,20X,33HIN ADDITION YOU SPECIFIED  TBL = ,I3)          OR-A3672
      IF (NUM.GT.0) GO TO 220                                          OR-A3673
      STOP                                                             OR-A3674
  380 WRITE (OUT,400) NUM,TBL                                          OR-A3675
  400 FORMAT (////////////,56X,14HERROR CODE  81,////,50X,26HERROR IN SUBROR-A3676
     1OUTINE INTRP ,//,20X,60HA QUADRATIC INTERPOLATION SCHEME WAS CALLEOR-A3677
     2D BUT ONLY  NUM = ,I3,30H ARRAY   VALUES WERE AVAILABLE,/,20X,    OR-A3678
     368HAT LEAST THREE ARRAY   VALUES ARE NEEDED FOR QUADRATIC INTERPOLOR-A3679
     4ATION,/,20X,33HIN ADDITION YOU SPECIFIED  TBL = ,I3)             OR-A3680
      IF (NUM.GT.0) GO TO 220                                          OR-A3681
      STOP                                                             OR-A3682
  420 RETURN                                                           OR-A3683
      END                                                              OR-A3684
```

```
      SUBROUTINE PIECE (NUM,X,Y,XI,YI,NAME)                            OR-A3685
                                                                       OR-A3686
C                                                                      OR-A3687
C             PIECEWISE-CONSTANT INTERPOLATION                         OR-A3688
C     WHEN TBL=10                                                      OR-A3689
C                                                                      OR-A3690
C        NAME      THE NAME OF THE DATA SET, ANY 3 LETTER NAME,
```

```
C                    SPECIFIED FROM THE CALLING SUBROUTINE AS 3HABC      OR-A3691
C        XI        SPECIFIED VALUE OF VARIABLE X                         OR-A3692
C        YI        UNKNOWN VALUE OF FUNCTION Y THAT IS TO BE FOUND FOR   OR-A3693
C                    GIVEN VARIABLE X                                    OR-A3694
C                                                                        OR-A3695
      DIMENSION X(NUM), Y(NUM)                                           OR-A3696
C                                                                        OR-A3697
C     NOTE.        YI = Y(I)  FOR ALL VALUES OF XI GREATER               OR-A3698
C                    OR EQUAL TO X(I) BUT LESS THEN X(I+1)               OR-A3699
C                                                                        OR-A3700
      DO 20 I=2,NUM                                                      OR-A3701
      IF (XI.GE.X(I)) GO TO 20                                           OR-A3702
      YI = Y(I-1)                                                        OR-A3703
      GO TO 40                                                           OR-A3704
   20 CONTINUE                                                           OR-A3705
      YI = Y(NUM)                                                        OR-A3706
   40 RETURN                                                             OR-A3707
      END                                                                OR-A3708
```

```
      SUBROUTINE LINEAR (NUM,TBL,X,Y,XI,YI,DYDX,NAME)                    OR-A3709
C                                                                        OR-A3710
C             LINEAR INTERPOLATION SCHEME                                OR-A3711
C                                                                        OR-A3712
      INTEGER TBL,OUT,PNCH                                               OR-A3713
      COMMON /IO/ IN,OUT,PNCH                                            OR-A3714
      DIMENSION X(NUM), Y(NUM)                                           OR-A3715
C        NAME      THE NAME OF THE DATA SET, ANY 3 LETTER NAME,          OR-A3716
C                    SPECIFIED FROM THE CALLING SUBROUTINE AS 3HABC      OR-A3717
C        XI        SPECIFIED VALUE OF VARIABLE X                         OR-A3718
C        YI        UNKNOWN VALUE OF FUNCTION Y THAT IS TO BE FOUND FOR   OR-A3719
C                    GIVEN VALUE OF VARIABLE X BY A LINEAR INTERPOLATIONOR-A3720
C                    SCHEME OF EITHER  Y VS X  OR  LN(Y) VS X           OR-A3721
C                    OR  Y VS LN(X)  OR  LN(Y) VS LN(X)                 OR-A3722
C        DYDX      THE DERIVATIVE OF FUNCTION Y WITH RESPECT TO VARIABLEOR-A3723
C                    X AT POINT (XI,YI)                                  OR-A3724
      I = 0                                                              OR-A3725
      IF (NUM.GE.24) GO TO 20                                            OR-A3726
      NH = NUM/2                                                         OR-A3727
```

```
      IF (XI.GT.X(NH)) I = NH                                                  OR-A3728
      GO TO 40                                                                 OR-A3729
20    NH = NUM/4                                                               OR-A3730
      IF (XI.GT.X(NH)) I = NH                                                  OR-A3731
      IF (XI.GT.X(2*NH)) I = 2*NH                                              OR-A3732
      IF (XI.GT.X(3*NH)) I = 3*NH                                              OR-A3733
40    I = I+1                                                                  OR-A3734
      IF (I.GT.NUM) GO TO 540                                                  OR-A3735
      IF (XI-X(I)) 160,60,40                                                   OR-A3736
60    YI = Y(I)                                                                OR-A3737
      IP = I                                                                   OR-A3738
      IF (I.LT.NUM) IP = I+1                                                   OR-A3739
      IL = I                                                                   OR-A3740
      IF (I.GT.1) IL = I-1                                                     OR-A3741
      DX = X(IP)-X(IL)                                                         OR-A3742
      IF (DX.LE.0.) GO TO 260                                                  OR-A3743
      IF (TBL.EQ.1) GO TO 80                                                   OR-A3744
      IF (TBL.EQ.4) GO TO 100                                                  OR-A3745
      IF (XI.EQ.0.) GO TO 300                                                  OR-A3746
      IF (TBL.EQ.6) GO TO 120                                                  OR-A3747
      IF (TBL.EQ.8) GO TO 140                                                  OR-A3748
 80   DYDX = (Y(IP)-Y(IL))/(X(IP)-X(IL))                                       OR-A3749
      RETURN                                                                   OR-A3750
 100  DYDX = YI*(ALOG(ABS(Y(IP)))-ALOG(ABS(Y(IL))))/(X(IP)-X(IL))             OR-A3751
      RETURN                                                                   OR-A3752
 120  DYDX = (Y(IP)-Y(IL))/XI/(ALOG(ABS(X(IP)))-ALOG(ABS(X(IL))))             OR-A3753
      RETURN                                                                   OR-A3754
 140  DYDX = YI/XI*(ALOG(ABS(Y(IP)))-ALOG(ABS(Y(IL))))/(ALOG(ABS(X(IP)))OR-A3755
     1-ALOG(ABS(X(IL))))                                                       OR-A3756
      RETURN                                                                   OR-A3757
 160  IP = I                                                                   OR-A3758
      IL = I-1                                                                 OR-A3759
      DX = X(IP)-X(IL)                                                         OR-A3760
      IF (DX.LE.0.) GO TO 260                                                  OR-A3761
      IF (TBL.EQ.1) GO TO 180                                                  OR-A3762
      IF (TBL.EQ.4) GO TO 200                                                  OR-A3763
      IF (XI.EQ.0.) GO TO 300                                                  OR-A3764
      IF (TBL.EQ.6) GO TO 220                                                  OR-A3765
      IF (TBL.EQ.8) GO TO 240                                                  OR-A3766
C                        Y  VERSUS  X                                          OR-A3767
 180  DYDX = (Y(I)-Y(I-1))/(X(I)-X(I-1))                                       OR-A3768
      YI = Y(I-1)+DYDX*(XI-X(I-1))                                             OR-A3769
      RETURN                                                                   OR-A3770
C                        LN(Y)  VERSUS  X                                      OR-A3771
 200  IF (Y(I).EQ.0.) GO TO 360                                                OR-A3772
      IF (Y(I-1).EQ.0.) GO TO 340                                              OR-A3773
      Z = (ALOG(ABS(Y(I)))-ALOG(ABS(Y(I-1))))/(X(I)-X(I-1))                    OR-A3774
```

```
      YILN = ALOG(ABS(Y(I-1)))+(XI-X(I-1))*Z                                  OR-A3775
      YI = EXP(YILN)                                                          OR-A3776
      IF (Y(I).LT.0.) YI = -YI                                                OR-A3777
      DYDX = YI*Z                                                             OR-A3778
      RETURN                                                                  OR-A3779
C                             Y  VERSUS  LN(X)                              OR-A3780
 220  IF (X(I).EQ.0.) GO TO 420                                               OR-A3781
      IF (X(I-1).EQ.0.) GO TO 400                                             OR-A3782
      Z = (Y(I)-Y(I-1))/(ALOG(ABS(X(I)))-ALOG(ABS(X(I-1))))                   OR-A3783
      YI = Y(I-1)+(ALOG(ABS(XI))-ALOG(ABS(X(I-1))))*Z                         OR-A3784
      DYDX = Z/XI                                                             OR-A3785
      RETURN                                                                  OR-A3786
C                              LN(Y)  VERSUS  LN(X)                         OR-A3787
 240  IF (X(I).EQ.0.) GO TO 420                                               OR-A3788
      IF (X(I-1).EQ.0.) GO TO 400                                             OR-A3789
      IF (Y(I-1).EQ.0.) GO TO 340                                             OR-A3790
      IF (Y(I).EQ.0.) GO TO 360                                               OR-A3791
      Z = (ALOG(ABS(Y(I)))-ALOG(ABS(Y(I-1))))/(ALOG(ABS(X(I)))-ALOG(ABS       OR-A3792
     1(X(I-1))))                                                              OR-A3793
      YILN = ALOG(ABS(Y(I-1)))+(ALOG(ABS(XI))-ALOG(ABS(X(I-1))))*Z            OR-A3794
      YI = EXP(YILN)                                                          OR-A3795
      IF (Y(I).LT.0.) YI = -YI                                                OR-A3796
      DYDX = YI*Z/XI                                                          OR-A3797
      GO TO 580                                                               OR-A3798
 260  WRITE (OUT,280) NAME,IL,NAME,IP                                         OR-A3799
 280  FORMAT (////////////,56X,14HERROR CODE  90,////,50X,26HERROR IN SUBROR-A3800
     1OUTINE LINEAR,//,18X,90HTHIS INTERPOLATION ROUTINE REQUIRES THAT TOR-A3801
     2HE DATA OF THE X ARRAY (INDEPENDENT VARIABLE) TO,/,18X,88HBE UNIQUOR-A3802
     3E AND TO MONOTONICALLY INCREASE IN VALUE (I.E., X(2) IS GREATER THOR-A3803
     4AN X(1), ETC.),//,27X,48HCHECK THE DATA LIST BELOW AND LOOK AT ELEOR-A3804
     5MENTS X,A3,1H(,I3,7H) AND X,A3,1H(,I3,1H))                             OR-A3805
      GO TO 460                                                              OR-A3806
 300  WRITE (OUT,320)                                                        OR-A3807
 320  FORMAT (////////////,56X,14HERROR CODE  82,////,50X,26HERROR IN SUBROR-A3808
     1OUTINE LINEAR,///,20X,84HYOU CAN NOT SPECIFY A LOG DATA TRANSFORMAOR-A3809
     2TION AND INTERPOLATION SCHEME WHEN   XI =0.,//,10X,106HXI IS THE SOR-A3810
     3PECIFIED VALUE OF VARIABLE  X  AT WHICH YOU ATTEMPTED TO INTERPOLAOR-A3811
     4TE THE  Y FUNCTION TO FIND YI,///,20X,80HSWITCH TO A NON-LOG DATA OR-A3812
     5TRANSFORMATION SCHEME FOR THIS PARTICULAR  X,Y DATA SET)                OR-A3813
      GO TO 460                                                              OR-A3814
 340  I = I-1                                                                OR-A3815
 360  WRITE (OUT,380) NAME,I,Y(I),NAME,I,NAME,I                              OR-A3816
 380  FORMAT (////////////,56X,14HERROR CODE  83,////,50X,27HERROR IN SUBROR-A3817
     1OUTINE  LINEAR,///,16X,105HYOU CAN NOT SPECIFY A LOG DATA TRANSFOROR-A3818
     2M AND INTERPOLATION SCHEME WHEN ONE OF THE  Y ARRAY VALUES IS ZEROOR-A3819
     3,//,50X,1HY,A3,1H(,I3,4H) = ,E11.4,///,23X,32HELIMINATE THIS PARTIOR-A3820
     4CULAR SET  X,A3,1H(,I3,3H),Y,A3,1H(,I3,31H)  FROM THE ARRAY  AND ROR-A3821
```

```
     5ESUBMIT)                                                          OR-A3822
      GO TO 460                                                         OR-A3823
400   I = I-1                                                           OR-A3824
420   WRITE (OUT,440) NAME,I,X(I),NAME,I,NAME,I                         OR-A3825
440   FORMAT (//////////,56X,14HERROR CODE  84,////,50X,27HERROR IN SUBROR-A3826
     1OUTINE  LINEAR,///,16X,106HYOU CAN NOT  SPECIFY A LOG DATA TRANSFOOR-A3827
     2RM AND INTERPOLATION SCHEME WHEN ONE OF THE  X ARRAY VALUES IS ZERROR-A3828
     30,//,50X,1HX,A3,1H(,I3,4H) = ,E11.4,///,23X,32HELIMINATE THIS PARTOR-A3829
     4ICULAR SET  X,A3,1H(,I3,3H),Y,A3,1H(,I3,30H)  FROM THE ARRAY AND ROR-A3830
     5ESUBMIT)                                                          OR-A3831
460   WRITE (OUT,480) NUM,TBL,NAME,NAME                                 OR-A3832
480   FORMAT (/////,44X,39HDATA VARIABLES AT TIME OF ERROR MESSAGE,//,//OR-A3833
     1,59X,6HNUM = ,I3,/,59X,6HTBL = ,I3,/,58X,7HNAME = ,A3,////,18X,   OR-A3834
     253HTHE FOLLOWING LIST SHOWS THE X AND Y ARRAYS OF THE   ,A3,       OR-A3835
     340H   DATA SET IN WHICH THIS ERROR OCCURRED,////)                  OR-A3836
      DO 520 J=1,NUM                                                    OR-A3837
      WRITE (OUT,500) NAME,J,X(J),NAME,J,Y(J)                           OR-A3838
500   FORMAT (36X,1HX,A3,1H(,I3,4H) = ,E11.4,10X,1HY,A3,1H(,I3,4H) = ,   OR-A3839
     1E11.4)                                                            OR-A3840
520   CONTINUE                                                          OR-A3841
      STOP                                                              OR-A3842
540   WRITE (OUT,560)                                                   OR-A3843
560   FORMAT (//////////,56X,14HERROR CODE  98,////,50X,27HERROR IN SUBROR-A3844
     1OUTINE  LINEAR,///,20X,79HTHE VALUES OF THE X ARRAY DO NOT MONOTONOR-A3845
     2ICALLY INCREASE IN VALUE AS IS REQUIRED,//,20X,67HREARRANGE THE X OR-A3846
     3AND Y DATA SETS SO THAT THIS CONDITION IS SATISFIED)              OR-A3847
      GO TO 460                                                         OR-A3848
580   RETURN                                                            OR-A3849
      END                                                               OR-A3850
```

```
      SUBROUTINE QUAD (NUM,X,Y,XI,YI,DYDX,NAME)                         OR-A3851
C                                                                       OR-A3852
C        QUADRATIC INTERPOLATION ROUTINE                                OR-A3853
C     BASED ON A SECOND-ORDER TAYLOR SERIES EXPANSION OF A FUNCTION     OR-A3854
C        WITH UNEQUAL SPACING OF PIVOTAL POINTS                         OR-A3855
C                                                                       OR-A3856
C                                                                       OR-A3857
C        M.G. SALVADORI  AND M.L. BARON                                 OR-A3858
```

```
C       NUMERICAL METHODS IN FORTRAN                                    OR-A3859
C       PRENTICE-HALL, INC.                                             OR-A3860
C       2ND EDITION, 1961, PAGES 67-70. 302 P.                          OR-A3861
C                                                                       OR-A3862
      INTEGER OUT,PNCH                                                  OR-A3863
      COMMON /IO/ IN,OUT,PNCH                                           OR-A3864
      DIMENSION X(NUM), Y(NUM)                                          OR-A3865
C       NAME      THE NAME OF THE DATA SET, ANY 3 LETTER NAME,          OR-A3866
C                   SPECIFIED FROM THE CALLING SUBROUTINE AS 3HABC.     OR-A3867
C       XI        SPECIFIED VALUE OF VARIABLE X                         OR-A3868
C       YI        UNKNOWN VALUE OF FUNCTION Y THAT IS TO BE FOUND       OR-A3869
C                   FOR THE GIVEN VALUE OF XI                           OR-A3870
C       DYDX      THE DERIVATIVE OF FUNCTION Y WITH RESPECT TO          OR-A3871
C                   VARIABLE X AT POINT (XI,YI)                         OR-A3872
C                                                                       OR-A3873
      IF (NUM.LE.2) GO TO 160                                           OR-A3874
      I = 1                                                             OR-A3875
      IF (NUM.GE.24) GO TO 20                                           OR-A3876
      NH = NUM/2                                                        OR-A3877
      IF (XI.GT.X(NH)) I = NH                                           OR-A3878
      GO TO 40                                                          OR-A3879
 20   NH = NUM/4                                                        OR-A3880
      IF (XI.GT.X(NH)) I = NH                                           OR-A3881
      IF (XI.GT.X(2*NH)) I = 2*NH                                       OR-A3882
      IF (XI.GT.X(3*NH)) I = 3*NH                                       OR-A3883
C       LOCATE THE FIRST NODE GREATER OR EQUAL TO XI                    OR-A3884
 40   I = I+1                                                           OR-A3885
      IF (I.GT.NUM) GO TO 200                                           OR-A3886
      IF (XI.GT.X(I)) GO TO 40                                          OR-A3887
      IF (I.EQ.NUM) I = NUM-1                                           OR-A3888
      H = X(I)-X(I-1)                                                   OR-A3889
      I1 = I-1                                                          OR-A3890
      IF (H.LE.0.) GO TO 60                                             OR-A3891
      ALPHA = (X(I+1)-X(I))/H                                           OR-A3892
      ETA = (XI-X(I))/H                                                 OR-A3893
      YI = Y(I-1)*ETA*(ETA-ALPHA)/(1.+ALPHA)+Y(I)*(-ETA*ETA-ETA*(1.-    OR-A3894
     1ALPHA)+ALPHA)/ALPHA+Y(I+1)*ETA*(ETA+1.)/ALPHA/(1.+ALPHA)          OR-A3895
      DYDX = Y(I-1)*(2.*ETA-ALPHA)/H/(1.+ALPHA)+Y(I)*(-2.*ETA-1.+ALPHA)/OR-A3896
     1H/ALPHA+Y(I+1)*(2.*ETA+1.)/H/ALPHA/(1.+ALPHA)                     OR-A3897
      GO TO 240                                                         OR-A3898
 60   WRITE (OUT,80) NAME,NAME,I1,NAME,I                                OR-A3899
 80   FORMAT (////////////,56X,14HERROR CODE  85,////,50X,24HERROR IN SUBROR-A3900
     1OUTINE QUAD,//,18X,89HTHIS INTERPOLATION ROUTINE REQUIRES THAT THEOR-A3901
     2 DATA OF THE X ARRAY(INDEPENDENT VARIABLE) TO,/,18X,87HBE UNIQUE AOR-A3902
     3ND TO MONOTONICALLY INCREASE IN VALUE (I.E., X(2) IS GREATER THAN OR-A3903
     4X(1) ,ETC),////,17X,55HTHE FOLLOWING LIST SHOWS THAT X AND Y ARRAYOR-A3904
     5S  OF THE   ,A3,40H   DATA SET IN WHICH THIS ERROR OCCURRED,/,17X,OR-A3905
```

```
    624HLOOK AT ARRAY ELEMENTS X,A3,1H(,I3,8H) AND  X,A3,1H(,I3,1H),///OR-A3906
    7/)                                                                 OR-A3907
100  DO 140 I=1,NUM                                                     OR-A3908
     WRITE (OUT,120) NAME,I,X(I),NAME,I,Y(I)                            OR-A3909
120  FORMAT (37X,1HX,A3,1H(,I3,4H) = ,E11.4,10X,1HY,A3,1H(,I3,4H) = ,   OR-A3910
    1E11.4)                                                             OR-A3911
140  CONTINUE                                                           OR-A3912
     STOP                                                               OR-A3913
160  WRITE (OUT,180) NAME,NAME,NAME,NUM                                 OR-A3914
180  FORMAT (////////////,56X,14HERROR CODE  86,////,50X,24HERROR IN SUBROR-A3915
    1OUTINE QUAD,////,32X,65HTHIS INTERPOLATION ROUTINE REQUIRES AT  LEOR-A3916
    2AST 3 NODES IN ARRAYS X,A3,6H AND Y,A3,/,32X,15HBUT YOU SET NUM,A3OR-A3917
    3,3H = ,I3)                                                        OR-A3918
     IF (NUM.LE.0) STOP                                                OR-A3919
     GO TO 100                                                         OR-A3920
200  WRITE (OUT,220)                                                   OR-A3921
220  FORMAT (////////////,56X,14HERROR CODE  99,////,50X,25HERROR IN SUBROR-A3922
    1OUTINE  QUAD,///,20X,79HTHE VALUES OF THE X ARRAY DO NOT MONOTONICOR-A3923
    2ALLY INCREASE IN VALUE AS IS REQUIRED,//,20X,67HREARRANGE THE X ANOR-A3924
    3D Y DATA SETS SO THAT THIS CONDITION IS SATISFIED)                 OR-A3925
     GO TO 100                                                         OR-A3926
240  RETURN                                                            OR-A3927
     END                                                               OR-A3928
```

```
      SUBROUTINE CUBIC (NUM,TBL,X,Y,XI,YI,DYDX,NAME)                    OR-A3929
                                                                        OR-A3930
C
C     COMPUTE THE NATURAL CUBIC INTERPOLATORY SPLINE COEFFICIENTS BASED  OR-A3931
C     ON THE WORK IN                                                    OR-A3932
C             NUMERICAL COMPUTING. AN INTRODUCTION                      OR-A3933
C                  BY. L.F.SHAMPINE AND R.C.ALLEN                       OR-A3934
C                  W.B.SAUNDERS CO., 1973, SEE PAGE 238. 258 PAGES.     OR-A3935
      INTEGER TBL,OUT,PNCH                                              OR-A3936
      COMMON /IO/ IN,OUT,PNCH                                           OR-A3937
      DIMENSION X(NUM), Y(NUM)                                          OR-A3938
      DIMENSION Z(200), RHO(200), TAU(200)                              OR-A3939
                                                                        OR-A3940
C
C        NOTE.  ARRAYS Z(.),RHO(.) AND TAU(.) MUST BE DIMENSIONED AS    OR-A3941
C     LARGE AS NUM, WHERE NUM COULD BE AS LARGE AS NUMMAX(SEE    PROGRAMOR-A3942
```

```
C     NATURE)                                                          OR-A3943
C                                                                      OR-A3944
C                                                                      OR-A3945
C        NAME      THE NAME OF THE DATA SET, ANY 3 LETTER NAME,        OR-A3946
C                    SPECIFIED FROM THE CALLING SUBROUTINE AS 3HABC    OR-A3947
C        XI        SPECIFIED VALUE OF VARIABLE X                       OR-A3948
C        YI        UNKNOWN VALUE    OF FUNCTION Y THAT IS TO BE FOUND  OR-A3949
C                    FOR A GIVEN VALUE OF VARIABLE X  BY A NATURAL CUBICOR-A3950
C                    SPLINE INTERPOLATION SCHEME OF EITHER Y VS X      OR-A3951
C                    OR LN(Y) VS X  OR  Y VS LN(X)  OR  LN(Y) VS LN(X) OR-A3952
C        DYDX      THE DERIVATIVE OF FUNCTION Y WITH RESPECT TO VARIABLEOR-A3953
C                    X AT POINT (XI,YI)                                OR-A3954
C                                                                      OR-A3955
C       CURRENT DIMENSION OF ARRAYS Z,RHO, AND TAU                     OR-A3956
      NUMSET = 200                                                     OR-A3957
C                                                                      OR-A3958
C                                                                      OR-A3959
      IF (NUM.GT.NUMSET) WRITE (OUT,20) NUMSET,NUMSET,NUMSET,NAME,NUM, OR-A3960
     1NUM,NUM,NUM,NUMSET                                               OR-A3961
   20 FORMAT (///////////,56X,14HERROR CODE  97,////,50X,25HERROR IN SUBROR-A3962
     1OUTINE CUBIC,//,26X,86HTHE DIMENSIONS OF ARRAYS Z,RHO, AND TAU IN OR-A3963
     2SUBROUTINE CUBIC ARE CURRENTLY SPECIFIED AS,//,42X,12HDIMENSION Z(OR-A3964
     3,I4,7H), RHO(,I4,7H), TAU(,I4,1H),//,24X,84HHOWEVER, ONE OF THE CAOR-A3965
     4LLING ARGUMENTS TO THIS SUBROUTINE NEEDS AN ARRAY OF SIZE  NUM,A3,OR-A3966
     53H = ,I3,/////,42X,54HIN SUBROUTINE CUBIC, SUBSTITUTE IN THE FOLLOOR-A3967
     6WING CARDS,//,50X,12HDIMENSION Z(,I4,7H), RHO(,I4,7H), TAU(,I4,1H)OR-A3968
     7,//,63X,9HNUMSET = ,I4)                                          OR-A3969
      IF (NUM.GT.NUMSET) STOP                                          OR-A3970
C                                                                      OR-A3971
      RHO(2) = 0.                                                      OR-A3972
      TAU(2) = 0.                                                      OR-A3973
      N1 = NUM-1                                                       OR-A3974
      N2 = NUM-2                                                       OR-A3975
      I = 1                                                            OR-A3976
      IF (Y(1).EQ.0..AND.TBL.EQ.5) GO TO 400                           OR-A3977
      IF (Y(1).EQ.0..AND.TBL.EQ.9) GO TO 400                           OR-A3978
      IF (X(1).EQ.0..AND.TBL.EQ.7) GO TO 440                           OR-A3979
      IF (X(1).EQ.0..AND.TBL.EQ.9) GO TO 440                           OR-A3980
      DO 120 I=2,N1                                                    OR-A3981
      DXN = X(I)-X(I-1)                                                OR-A3982
      DXP = X(I+1)-X(I)                                                OR-A3983
      I1 = I-1                                                         OR-A3984
      IF (DXN.LE.0..OR.DXP.LE.0.) GO TO 360                            OR-A3985
      IF (TBL.EQ.7.OR.TBL.EQ.9) GO TO 40                               OR-A3986
      GO TO 60                                                         OR-A3987
   40 DXN = ALOG(ABS(X(I)))-ALOG(ABS(X(I-1)))                          OR-A3988
      DXP = ALOG(ABS(X(I+1)))-ALOG(ABS(X(I)))                          OR-A3989
```

```
 60   TEMP = DXN/DXP*(RHO(I)+2.)+2.                                          OR-A3990
      RHO(I+1) = -1./TEMP                                                    OR-A3991
      IF (TBL.EQ.5.OR.TBL.EQ.9) GO TO 80                                     OR-A3992
      YYIN = Y(I-1)                                                          OR-A3993
      YYI = Y(I)                                                             OR-A3994
      YYIP = Y(I+1)                                                          OR-A3995
      GO TO 100                                                              OR-A3996
 80   IF (Y(I).EQ.0.) GO TO 400                                              OR-A3997
      YYIN = ALOG(ABS(Y(I-1)))                                               OR-A3998
      YYI = ALOG(ABS(Y(I)))                                                  OR-A3999
      YYIP = ALOG(ABS(Y(I+1)))                                               OR-A4000
 100  D = 6.*((YYIP-YYI)/DXP-(YYI-YYIN)/DXN)/DXP                             OR-A4001
120   TAU(I+1) = (D-DXN*TAU(I)/DXP)/TEMP                                     OR-A4002
C     NOTE   Z(I) =DDY/DDX IF TBL=3                                          OR-A4003
C            Z(I) = DD(LN(Y))/DDX IF TBL=5                                   OR-A4004
C            Z(I) = DDY/DD(LN(X)) IF TBL=7                                   OR-A4005
C            Z(I) = DD(LN(Y))/DD(LN(X)) IF TBL=9                             OR-A4006
C     COMPUTE THE SECOND DERIVATIVE, Z, FOR THE NATURAL CUBIC SPLINE         OR-A4007
      Z(1) = 0.                                                              OR-A4008
      Z(NUM) = 0.                                                            OR-A4009
      DO 140 I=1,N2                                                          OR-A4010
      IB = NUM-I                                                             OR-A4011
140   Z(IB) = RHO(IB+1)*Z(IB+1)+TAU(IB+1)                                    OR-A4012
      DYDX = 0.                                                              OR-A4013
      YI = 1.E-70                                                            OR-A4014
      I = 1                                                                  OR-A4015
      IF (NUM.GE.24) GO TO 160                                               OR-A4016
      NH = NUM/2                                                             OR-A4017
      IF (XI.GT.X(NH)) I = NH                                                OR-A4018
      GO TO 180                                                              OR-A4019
 160  NH = NUM/4                                                             OR-A4020
      IF (XI.GT.X(NH)) I = NH                                                OR-A4021
      IF (XI.GT.X(2*NH)) I = 2*NH                                            OR-A4022
      IF (XI.GT.X(3*NH)) I = 3*NH                                            OR-A4023
 180  I = I+1                                                                OR-A4024
      IF (I.GT.NUM) GO TO 560                                                OR-A4025
      IF (XI.GT.X(I)) GO TO 180                                              OR-A4026
      IF (TBL.EQ.7.OR.TBL.EQ.9) GO TO 260                                    OR-A4027
      DXA = X(I)-XI                                                          OR-A4028
      DXB = XI-X(I-1)                                                        OR-A4029
      DX = X(I)-X(I-1)                                                       OR-A4030
      IF (TBL.EQ.3) GO TO 200                                                OR-A4031
      IF (TBL.EQ.5) GO TO 220                                                OR-A4032
C                        Y  VERSUS  X                                        OR-A4033
 200  YI = DXA*Z(I-1)*(DXA*DXA/DX-DX)/6.+DXB*Z(I)*(DXB*DXB/DX-DX)/6.+        OR-A4034
     1(DXA*Y(I-1)+DXB*Y(I))/DX                                               OR-A4035
C      DERIVATIVE  DY/DX AT  (XI,YI)                                         OR-A4036
```

```
      DYDX = -Z(I-1)*DXA*DXA/2./DX+Z(I)*DXB*DXB/2./DX+(Y(I)-Y(I-1))/DX- OR-A4037
     1DX*(Z(I)-Z(I-1))/6.                                              OR-A4038
      RETURN                                                           OR-A4039
C                        LN(Y)  VERSUS  X                              OR-A4040
  220 YILN = DXA*Z(I-1)*(DXA*DXA/DX-DX)/6.+DXB*Z(I)*(DXB*DXB/DX-DX)/6.+ OR-A4041
     1(DXA*ALOG(ABS(Y(I-1)))+DXB*ALOG(ABS(Y(I))))/DX                   OR-A4042
      IF (YILN.LT.-174.) GO TO 240                                     OR-A4043
      YI = 1.E+70                                                      OR-A4044
      IF (YILN.GT.174.) GO TO 240                                      OR-A4045
      YI = EXP(YILN)                                                   OR-A4046
  240 IF (Y(I).LT.0.) YI = -YI                                         OR-A4047
C                                                                      OR-A4048
C        DERIVATIVE  DY/DX AT (XI,YI)                                  OR-A4049
C     FIRST FIND  D(LN(Y))/DX                                          OR-A4050
      DLNYDX = -Z(I-1)*DXA*DXA/2./DX+Z(I)*DXB*DXB/2./DX+(ALOG(ABS(Y(I)))OR-A4051
     1-ALOG(ABS(Y(I-1))))/DX-DX*(Z(I)-Z(I-1))/6.                       OR-A4052
      DYDX = YI*DLNYDX                                                 OR-A4053
      GO TO 600                                                        OR-A4054
  260 DXA = ALOG(ABS(X(I)))-ALOG(ABS(XI))                              OR-A4055
      DXB = ALOG(ABS(XI))-ALOG(ABS(X(I-1)))                            OR-A4056
      DX = ALOG(ABS(X(I)))-ALOG(ABS(X(I-1)))                           OR-A4057
      IF (TBL.EQ.9) GO TO 280                                          OR-A4058
      YYIN = Y(I-1)                                                    OR-A4059
      YYI = Y(I)                                                       OR-A4060
      GO TO 300                                                        OR-A4061
  280 YYIN = ALOG(ABS(Y(I-1)))                                         OR-A4062
      YYI = ALOG(ABS(Y(I)))                                            OR-A4063
      GO TO 320                                                        OR-A4064
C                                 Y  VERSUS  LN(X)                     OR-A4065
  300 YI = DXA*Z(I-1)*(DXA*DXA/DX-DX)/6.+DXB*Z(I)*(DXB*DXB/DX-DX)/6.+  OR-A4066
     1(DXA*YYIN+DXB*YYI)/DX                                            OR-A4067
C                 DERIVATIVE  DY/D(LN(X))  AT (XI,YI)                  OR-A4068
      DYDLNX = -Z(I-1)*DXA*DXA/2./DX+Z(I)*DXB*DXB/2./DX+(YYI-YYIN)/DX-DXOR-A4069
     1*(Z(I)-Z(I-1))/6.                                                OR-A4070
C     NOTE.    DY/D(LNX) = X*DY/DX                                     OR-A4071
      DYDX = DYDLNX/XI                                                 OR-A4072
      RETURN                                                           OR-A4073
C                           LN(Y)  VERSUS  LN(X)                       OR-A4074
  320 YILN = DXA*Z(I-1)*(DXA*DXA/DX-DX)/6.+DXB*Z(I)*(DXB*DXB/DX-DX)/6.+ OR-A4075
     1(DXA*YYIN+DXB*YYI)/DX                                            OR-A4076
      IF (YILN.LT.-174.) GO TO 340                                     OR-A4077
      YI = 1.E+70                                                      OR-A4078
      IF (YILN.GT.174.) GO TO 340                                      OR-A4079
      YI = EXP(YILN)                                                   OR-A4080
  340 IF (Y(I).LT.0.) YI = -YI                                         OR-A4081
C              DERIVATIVE   D(LNY)/D(LNX)  AT (XI,YI)                  OR-A4082
      DLYDLX = -Z(I-1)*DXA*DXA/2./DX+Z(I)*DXB*DXB/2./DX+(YYI-YYIN)/DX-DXOR-A4083
```

```
     1*(Z(I)-Z(I-1))/6.                                                 OR-A4084
C         NOTE.   D(LNY)/D(LNX) = D(LNY)/DY*DY/DX*DX/D(LNX)             OR-A4085
      DYDX = YI*DLYDLX/XI                                               OR-A4086
      RETURN                                                            OR-A4087
  360 WRITE (OUT,380) NAME,I1,NAME,I                                    OR-A4088
  380 FORMAT (///////////,56X,14HERROR CODE  87,////,50X,25HERROR IN SUBROR-A4089
     1OUTINE CUBIC,//,18X,90HTHIS INTERPOLATION ROUTINE REQUIRES THAT THOR-A4090
     2E DATA OF THE X ARRAY(INDEPENDENT VARIABLE)  TO,/,18X,90HBE UNIQUEOR-A4091
     3 AND MUST MONOTONICALLY INCREASE IN VALUE (I.E., X(2) IS GREATER TOR-A4092
     4HAN X(1), ETC.),//,50X,25HCHECK THE DATA LIST BELOW,/,/,44X,      OR-A4093
     522HIN PARTICULAR, CHECK X,A3,1H(,I3,7H) AND X,A3,1H(,I3,1H))      OR-A4094
      GO TO 480                                                         OR-A4095
  400 WRITE (OUT,420) NAME,I,Y(I),NAME,I,NAME,I                         OR-A4096
  420 FORMAT (/////////,56X,14HERROR CODE  88,////,50X,25HERROR IN SUBROOR-A4097
     1UTINE CUBIC,///,14X,111HYOU CAN NOT SPECIFY A LOG DATA TRANSFORM AOR-A4098
     2ND CUBIC INTERPOLATION SCHEME WHEN ONE OF THE  Y ARRAY VALUES IS ZOR-A4099
     3ERO,//,50X,1HY,A3,1H(,I3,4H) = ,E11.4,///,24X,36HELIMINATE THIS PAOR-A4100
     4RTICULAR PAIR OF  X,A3,1H(,I3,4H), Y,A3,1H(,I3,30H)  FROM THE ARRAOR-A4101
     5Y AND RESUBMIT)                                                   OR-A4102
      GO TO 480                                                         OR-A4103
  440 WRITE (OUT,460) NAME,I,X(I),NAME,I,NAME,I                         OR-A4104
  460 FORMAT (///////////,56X,14HERROR CODE  89,////,50X,25HERROR IN SUBROR-A4105
     1OUTINE CUBIC,///,14X,112HYOU CAN NOT SPECIFY A LOG DATA TRANSFORM OR-A4106
     2AND CUBIC INTERPOLATION SCHEME  WHEN ONE OF THE  X ARRAY VALUES ISOR-A4107
     3 ZERO,//,50X,1HX,A3,1H(,I3,4H) = ,E11.4,///,24X,36HELIMINATE THIS OR-A4108
     4PARTICULAR PAIR OF  X,A3,1H(,I3,4H), Y,A3,1H(,I3,30H)  FROM THE ARROR-A4109
     5RAY AND RESUBMIT)                                                 OR-A4110
  480 WRITE (OUT,500) NUM,TBL,NAME,NAME                                 OR-A4111
  500 FORMAT (///////,44X,39HDATA VARIABLES AT TIME OF ERROR MESSAGE,//,/OR-A4112
     1/,59X,6HNUM = ,I3,/,59X,6HTBL = ,I3,/,58X,7HNAME = ,A3,////,18X,  OR-A4113
     258HTHE FOLLOWING LIST SHOWS THAT X AND Y ARRAYS OF DATA SET  ,A3, OR-A4114
     330H  IN WHICH THIS ERROR OCCURRED,////)                           OR-A4115
      DO 540 J=1,NUM                                                    OR-A4116
      WRITE (OUT,520) NAME,J,X(J),NAME,J,Y(J)                           OR-A4117
  520 FORMAT (36X,1HX,A3,1H(,I3,4H) = ,E11.4,10X,1HY,A3,1H(,I3,4H) = ,  OR-A4118
     1E11.4)                                                            OR-A4119
  540 CONTINUE                                                          OR-A4120
      STOP                                                              OR-A4121
  560 WRITE (OUT,580)                                                   OR-A4122
  580 FORMAT (///////////,56X,14HERROR CODE 100,////,50X,26HERROR IN SUBROR-A4123
     1OUTINE  CUBIC,///,20X,79HTHE VALUES OF THE X ARRAY DO NOT MONOTONIOR-A4124
     2CALLY INCREASE IN VALUE AS IS REQUIRED,//,20X,67HREARRANGE THE X AOR-A4125
     3ND Y DATA SETS SO THAT THIS CONDITION IS SATISFIED)               OR-A4126
      GO TO 480                                                         OR-A4127
  600 RETURN                                                            OR-A4128
      END                                                               OR-A4129
```

```
      SUBROUTINE TABLED (NUM,X,Y,NAME)                                  OR-A4130
C                                                                       OR-A4131
C                                                                       OR-A4132
C     INSERT THREE ADDITIONAL XI DATA VALUES INTO ARRAY X AND APPLY     OR-A4133
C     ALL  TEN  TYPES OF INTERPOLATION METHODS TO DETERMINE THE         OR-A4134
C     CORRESPONDING YI VALUE AND ITS DERIVATIVE                         OR-A4135
C                                                                       OR-A4136
C        NAME      THE NAME OF THE DATA SET, ANY 3 LETTER NAME, FED     OR-A4137
C                    IN AS 3HABC                                        OR-A4138
C                                                                       OR-A4139
C                                                                       OR-A4140
      INTEGER OUT,PNCH                                                  OR-A4141
      COMMON Z1(200),Z2(200),Z3(200),Z4(200),Z5(200),XT(200),DUMMYG(200)OR-A4142
     1,DUMMYH(200),DUMMYI(200),DUMMYJ(200),DUMMYK(200)                  OR-A4143
      COMMON /IO/ IN,OUT,PNCH                                           OR-A4144
      DIMENSION X(NUM), Y(NUM)                                          OR-A4145
      DIMENSION YT(5), D(5), QICK(4)                                    OR-A4146
C                                                                       OR-A4147
C        NOTE.  ARRAYS  YT(5),D(5) AND QICK(4) MUST ALWAYS BE           OR-A4148
C     DIMENSIONED AS THEY ARE NOW                                       OR-A4149
C     GENERATE 3 INTERNODAL POINTS OF INTERPOLATION FOR EACH SPECIFIED  OR-A4150
C     DATA POINT                                                        OR-A4151
      QICK(1) = 0.                                                      OR-A4152
      QICK(2) = .25                                                     OR-A4153
      QICK(3) = .5                                                      OR-A4154
      QICK(4) = .75                                                     OR-A4155
      WRITE (OUT,20) NAME                                               OR-A4156
   20 FORMAT (///////,59X,10HDATA SET  ,A3,////)                        OR-A4157
      I = 1                                                             OR-A4158
      IF (X(1).EQ.0..AND.X(2).LT.0.) X(1)=-X(2)*1.E-10                  OR-A4159
      IF (X(1).EQ.0..AND.X(2).GT.0.) X(1)=X(2)*1.E-10                   OR-A4160
      IF (Y(1).EQ.0..AND.Y(2).LT.0.) Y(1)=-Y(2)*1.E-10                  OR-A4161
      IF (Y(1).EQ.0..AND.Y(2).GT.0.) Y(1)=Y(2)*1.E-10                   OR-A4162
      J = 0                                                             OR-A4163
      N1 = NUM-1                                                        OR-A4164
      DO 60 I=1,N1                                                      OR-A4165
      IF (X(I).EQ.0.) GO TO 220                                         OR-A4166
      IF (Y(I).EQ.0.) GO TO 260                                         OR-A4167
```

```
      DO 40 JJ=1,4                                                      OR-A4168
      JJJ = J+JJ                                                        OR-A4169
40    XT(JJJ) = X(I)+(X(I+1)-X(I))*QICK(JJ)                             OR-A4170
60    J = J+4                                                           OR-A4171
      JM = J+1                                                          OR-A4172
      XT(JM) = X(NUM)                                                   OR-A4173
      WRITE (OUT,80)                                                    OR-A4174
 80   FORMAT (17X,8X,7HTBL = 1,15X,7HTBL = 2,15X,7HTBL = 3,15X,7HTBL = 4OR-A4175
     1,15X,7HTBL = 5,/,17X,8X,6HLINEAR,15X,9HQUADRATIC,15X,5HCUBIC,17X, OR-A4176
     26HLINEAR,16X,5HCUBIC,/,25X,6HY VS X,16X,6HY VS X,16X,6HY VS X,16X,OR-A4177
     38HLNY VS X,14X,8HLNY VS X,//,11X,1HX,11X,1HY,7X,5HDY/DX,9X,1HY,7X,OR-A4178
     45HDY/DX,9X,1HY,7X,5HDY/DX,10X,1HY,7X,5HDY/DX,9X,1HY,8X,5HDY/DX,///OR-A4179
     5)                                                                 OR-A4180
      DO 140 I=1,JM                                                     OR-A4181
      CALL INTRP (NUM,1,X,Y,XT(I),YT(1),D(1),3HT1 )                     OR-A4182
      CALL INTRP (NUM,2,X,Y,XT(I),YT(2),D(2),3HT2 )                     OR-A4183
      CALL INTRP (NUM,3,X,Y,XT(I),YT(3),D(3),3HT3 )                     OR-A4184
      CALL INTRP (NUM,4,X,Y,XT(I),YT(4),D(4),3HT4 )                     OR-A4185
      CALL INTRP (NUM,5,X,Y,XT(I),YT(5),D(5),3HT5 )                     OR-A4186
      IF (I.EQ.1) WRITE (OUT,100) I,XT(I),(YT(J),D(J),J=1,5)            OR-A4187
 100  FORMAT (2X,I3,2H**,E10.3,10(1X,E10.3))                            OR-A4188
      IF (I.EQ.1) GO TO 140                                             OR-A4189
      I1 = I-1                                                          OR-A4190
      M1 = I1/4                                                         OR-A4191
      MOD1 = I1-M1*4                                                    OR-A4192
      IF (MOD1.EQ.0) WRITE (OUT,100) I,XT(I),(YT(J),D(J),J=1,5)         OR-A4193
      IF (MOD1.NE.0) WRITE (OUT,120) I,XT(I),(YT(J),D(J),J=1,5)         OR-A4194
 120  FORMAT (2X,I3,1X,11(1X,E10.3))                                    OR-A4195
 140  CONTINUE                                                          OR-A4196
      WRITE (OUT,160)                                                   OR-A4197
 160  FORMAT (/////)                                                    OR-A4198
      WRITE (OUT,180)                                                   OR-A4199
 180  FORMAT (17X,8X,7HTBL = 6,15X,7HTBL = 7,15X,7HTBL = 8,15X,7HTBL = 9OR-A4200
     1,15X,8HTBL = 10,/,17X,8X,6HLINEAR,17X,5HCUBIC,17X,6HLINEAR,16X,  OR-A4201
     25HCUBIC,16X,5HPIECE,/,24X,8HY VS LNX,14X,8HY VS LNX,14X,10HLNY VS OR-A4202
     3LNX,12X,10HLNY VS LNX,16X,6HY VS X,//,12X,1HX,10X,1HY,8X,5HDY/DX, OR-A4203
     48X,1HY,8X,5HDY/DX,9X,1HY,7X,5HDY/DX,9X,1HY,7X,5HDY/DX,9X,1HY,7X,  OR-A4204
     55HDY/DX,///)                                                      OR-A4205
      DO 200 I=1,JM                                                     OR-A4206
      CALL INTRP (NUM,6,X,Y,XT(I),YT(1),D(1),3HT6 )                     OR-A4207
      CALL INTRP (NUM,7,X,Y,XT(I),YT(2),D(2),3HT7 )                     OR-A4208
      CALL INTRP (NUM,8,X,Y,XT(I),YT(3),D(3),3HT8 )                     OR-A4209
      CALL INTRP (NUM,9,X,Y,XT(I),YT(4),D(4),3HT9 )                     OR-A4210
      CALL INTRP (NUM,10,X,Y,XT(I),YT(5),D(5),3HT10)                    OR-A4211
      IF (I.EQ.1) WRITE (OUT,100) I,XT(I),(YT(J),D(J),J=1,5)            OR-A4212
      IF (I.EQ.1) GO TO 200                                             OR-A4213
      I1 = I-1                                                          OR-A4214
```

```
      M1 = I1/4                                                          OR-A4215
      MOD1 = I1-M1*4                                                     OR-A4216
      IF (MOD1.EQ.0) WRITE (OUT,100) I,XT(I),(YT(J),D(J),J=1,5)          OR-A4217
      IF (MOD1.NE.0) WRITE (OUT,120) I,XT(I),(YT(J),D(J),J=1,5)          OR-A4218
  200 CONTINUE                                                           OR-A4219
      RETURN                                                             OR-A4220
  220 WRITE (OUT,240) NAME,I                                             OR-A4221
  240 FORMAT (//,29X,58HTHIS DATA SET CAN NOT BE REVIEWED BECAUSE THE X  OR-A4222
     1VALUE OF X,A3,1H(,I3,6H) = 0.,/,45X,43HSOME OF THE INTERPOLATION M OR-A4223
     2ETHODS USE LN(X),/,54X,25HSKIP TO THE NEXT DATA SET)               OR-A4224
      RETURN                                                             OR-A4225
  260 WRITE (OUT,280) NAME,I                                             OR-A4226
  280 FORMAT (//,29X,58HTHIS DATA SET CAN NOT BE REVIEWED BECAUSE THE Y  OR-A4227
     1VALUE OF Y,A3,1H(,I3,6H) = 0.,/,45X,43HSOME OF THE INTERPOLATION M OR-A4228
     2ETHODS USE LN(Y),/,54X,25HSKIP TO THE NEXT DATA SET)               OR-A4229
      RETURN                                                             OR-A4230
      END                                                                OR-A4231
```

```
      SUBROUTINE RAF (C,THETA,Z,TIME,RAFI)                               OR-A4232
C                                                                        OR-A4233
C                                                                        OR-A4234
C             ROOT ABSORPTION FUNCTION                                   OR-A4235
C                                                                        OR-A4236
C                                                                        OR-A4237
C        ROOT ABSORPTION FUNCTION = ROOT DENSITY*ROOT UPTAKE ACTIVITY    OR-A4238
C                                                                        OR-A4239
C                    RAFI = B*RD*RAC*RAW                                 OR-A4240
C                                                                        OR-A4241
      INTEGER WILTED                                                     OR-A4242
      COMMON /ROOTS/ CNVRSN,TCR,PPSURF(3),PWILT,RR,TR,WILTED             OR-A4243
      PI = 3.141593                                                      OR-A4244
      CALL RDNSTY (Z,TIME,RD)                                            OR-A4245
      CALL RACTYC (C,RAC)                                                OR-A4246
      CALL RACTYW (THETA,RAW)                                            OR-A4247
C                                                                        OR-A4248
      B = 0.                                                             OR-A4249
      IF (RD.LE.0..OR.RR.LE.0.) GO TO 20                                 OR-A4250
      RCYL = 1./SQRT(ABS(4.*RD))                                         OR-A4251
```

```
      RSTELE = .666*RR                                                  OR-A4252
      B = 2.*PI/ALOG(RCYL/RSTELE)                                       OR-A4253
   20 CONTINUE                                                          OR-A4254
      RAFI = B*RD*RAC*RAW                                               OR-A4255
      RETURN                                                            OR-A4256
      END                                                               OR-A4257


      SUBROUTINE SINKW (NUM,CSOIL,WSOIL,PSOIL,PSP,SUM,SUMZFP,TIME)      OR-A4258
                                                                        OR-A4259
C                                                                       OR-A4260
C                                                                       OR-A4261
C     COMPUTE THE   WATER  UPTAKE BY THE ROOT SYSTEM                    OR-A4262
C     AT TIME LEVEL K+1/2                                               OR-A4263
C                                                                       OR-A4264
C                                                                       OR-A4265
      INTEGER WILTED                                                    OR-A4266
      REAL KSOIL,KCRTX,KSYS,KSUM                                        OR-A4267
      COMMON /DEPTH/ N,Z(200)                                           OR-A4268
      COMMON /FLUX/ A(200),G(200),QZ(200)                               OR-A4269
      COMMON /ROOTS/ CNVRSN,TCR,PPSURF(3),PWILT,RR,TR,WILTED            OR-A4270
      DIMENSION WSOIL(NUM), PSOIL(NUM), CSOIL(NUM)                      OR-A4271
C                                                                       OR-A4272
C                                                                       OR-A4273
C     A(I)      RATE OF WATER UPTAKE BY ROOTS AT NODE I,                OR-A4274
C                 TIME LEVEL  K+1/2, WITH UNITS                         OR-A4275
C                 OF (L**3 FLUID/L**3 GROSS/T).                         OR-A4276
C                 NOTE THAT FOR ROOT UPTAKE, A(I) MUST BE A NEGATIVE    OR-A4277
C                 QUANTITY                                              OR-A4278
C     CSOIL(I)  ITH VALUE OF LIQUID PHASE SOLUTE CONCENTRATION IN THE   OR-A4279
C                    SOIL AT TIME LEVEL K+1/2                           OR-A4280
C     N         TOTAL NUMBER OF NODES                                   OR-A4281
C     NUM       NUMBER OF SPATIAL NODES (I.E. NUM=N)                    OR-A4282
C     PSOIL(I)  ITH VALUE OF MATRIC POTENTIAL OF SOIL                   OR-A4283
C                 AT TIME LEVEL K+1/2                                   OR-A4284
C     PSP       PLANT SURFACE POTENTIAL AT TIME LEVEL K+1/2             OR-A4285
C     SUM       THE SUM OF KSYS(I)*RAF(I)*(Z(I+1)-Z(I-1))/2*CNVRSN      OR-A4286
C                 FOR I=2,...,N-1                                       OR-A4287
C     SUMZFP    THE SUM OF KSYS(I)*RAF(I)*(Z(I)+RPF(I)-P(I)*CNVRSN)     OR-A4288
C                 *(Z(I+1)-Z(I-1))/2  FOR I=2,...,N-1
```

```
C        TIME      TIME AT TIME LEVEL K+1/2                                    OR-A4289
C                                                                              OR-A4290
C        WSOIL(I)  ITH VALUE OF VOLUMETRIC   WATER  CONTENT OF SOIL           OR-A4291
C                    AT TIME LEVEL K+1/2                                       OR-A4292
C                                                                              OR-A4293
C                                                                              OR-A4294
C      THE FIRST AND LAST NODES DO NOT HAVE ROOT SINKS                         OR-A4295
       A(1) = 0.                                                               OR-A4296
       A(N) = 0.                                                               OR-A4297
       SUM = 0.                                                                OR-A4298
       SUMZFP = 0.                                                             OR-A4299
       N1 = N-1                                                                OR-A4300
       DO 20 I=2,N1                                                            OR-A4301
       A(I) = 0.                                                               OR-A4302
       CALL RAF (CSOIL(I),WSOIL(I),Z(I),TIME,RAFI)                             OR-A4303
       IF (RAFI.LE.0.) GO TO 20                                                OR-A4304
       CALL KWZ (WSOIL(I),KSOIL)                                               OR-A4305
       CALL KWCRTX (WSOIL(I),KCRTX)                                            OR-A4306
       KSYS = 0.                                                               OR-A4307
       KSUM = KCRTX+KSOIL                                                      OR-A4308
       IF (KSUM.GT.0.) KSYS = ABS(KCRTX*KSOIL/KSUM)                            OR-A4309
       CALL RPF (WSOIL(I),Z(I),RPFI)                                           OR-A4310
C                          ROOT POTENTIAL (L POTENTIAL)                        OR-A4311
       PROOT = PSP+(Z(I)+RPFI)/CNVRSN                                          OR-A4312
       A(I) = KSYS*RAFI*(PROOT-PSOIL(I))*CNVRSN                                OR-A4313
C                                                                              OR-A4314
C                                                                              OR-A4315
C      AS IT IS WRITTEN, ROOTS CAN ONLY WITHDRAW WATER FROM THE SOIL.          OR-A4316
C     HOWEVER, IF YOU WANT ROOTS TO HAVE THE ABILITY TO TRANSFER WATER         OR-A4317
C     BACK INTO THE SOIL, REMOVE THE FOLLOWING CARD (STATEMENT 5  )            OR-A4318
C                                                                              OR-A4319
    5  IF (A(I).GT.0.) A(I) = 0.                                               OR-A4320
C                                                                              OR-A4321
C                                                                              OR-A4322
       IF (A(I).EQ.0.) GO TO 20                                                OR-A4323
       SUM = SUM+KSYS*RAFI*(Z(I+1)-Z(I-1))/2.*CNVRSN                           OR-A4324
       SUMZFP = SUMZFP+KSYS*RAFI*(Z(I)+RPFI-PSOIL(I)*CNVRSN)*(Z(I+1)-Z(I-      OR-A4325
      11))/2.                                                                  OR-A4326
   20  CONTINUE                                                                OR-A4327
       RETURN                                                                  OR-A4328
       END                                                                     OR-A4329
```

```
      SUBROUTINE REGRID                                                 OR-A4330
                                                                        OR-A4331
C
C        REGRID ALL OF THE   WATER /PRESSURE/SOLUTE ARRAYS FROM THE     OR-A4332
C     OLD Z0 TO THE NEW  ZF  SPATIAL NODE GRID SYSTEM USING A           OR-A4333
C          LINEAR INTERPOLATION SCHEME                                  OR-A4334
C                                                                       OR-A4335
      INTEGER TBLZ0,TBLZF,OUT,PNCH,TBL                                  OR-A4336
      COMMON DUMX(200),DUMY(200),DUMZ(200),DUMMYD(200),DUMMYE(200),     OR-A4337
     1DUMMYF(200),DUMMYG(200),DUMMYH(200),DUMMYI(200),DUMMYJ(200),DUMMYKOR-A4338
     2(200)                                                             OR-A4339
      COMMON /BEAR/ FGUESS(200),FOLD1(200),FOLD2(200),F(200)            OR-A4340
      COMMON /DEPTH/ N,Z(200)                                           OR-A4341
      COMMON /FLUX/ A(200),G(200),QZ(200)                               OR-A4342
      COMMON /IO/ IN,OUT,PNCH                                           OR-A4343
      COMMON /LIQUID/ CGUESS(200),COLD1(200),COLD2(200),C(200)          OR-A4344
      COMMON /MATRIC/ PGUESS(200),POLD1(200),POLD2(200),PSI(200)        OR-A4345
      COMMON /MOIST/ WGUESS(200),WOLD1(200),WOLD2(200),THETA(200)       OR-A4346
      COMMON /SOLID/ SGUESS(200),SOLD1(200),SOLD2(200),S(200)           OR-A4347
      COMMON /TABZ0/ NUMZ0,TBLZ0,Z0(200)                                OR-A4348
      COMMON /TABZF/ NUMZF,TBLZF,ZF(200)                                OR-A4349
                                                                        OR-A4350
C
C        N          NUMBER OF NODES TO BE USED IN THE PROGRAM          OR-A4351
C        NUMZ0      TOTAL NUMBER OF NODES IN THE OLD GRID NETWORK      OR-A4352
C        NUMZF      TOTAL NUMBER OF NODES IN THE NEW GRID NETWORK      OR-A4353
C        Z          ARRAY CONTAINING THE GRID  SPACING TO BE USED IN THE OR-A4354
C                     PROGRAM   ( L GROSS )                             OR-A4355
C        Z0         ORIGINAL GRID SPACING    ( L GROSS )              OR-A4356
C        ZF         NEW GRID SPACING    ( L GROSS )                   OR-A4357
C                                                                       OR-A4358
C     NOTE.  NUMZ0 AND NUMZF DO NOT HAVE TO BE THE SAME BUT Z0(NUMZ0)   OR-A4359
C     MUST EQUAL  ZF(NUMZF) I.E., THE LENGTH OF THE SOIL COLUMN IS      OR-A4360
C     FIXED                                                             OR-A4361
C                                                                       OR-A4362
C     NOTE.  AT ALL TIMES  Z0(1) = ZF(1) = Z(1) = 0                     OR-A4363
C        I.E., FIRST NODE LIES ON THE SURFACE                           OR-A4364
C                                                                       OR-A4365
      IF (NUMZF.LE.4) WRITE (OUT,20) NUMZF                              OR-A4366
   20 FORMAT (//////////,56X,14HERROR CODE  70,////,50X,26HERROR IN SUBROR-A4367
     1OUTINE REGRID,//,20X,69HYOU FAILED TO CORRECTLY SPECIFY THE PARAMEOR-A4368
     2TER  NUMZF   IN DATA SET ZF,/,20X,17HYOU SET  NUMZF = ,I3,        OR-A4369
     356H  BUT THE SOIL COLUMN MUST HAVE AT LEAST  5 TO 10  NODES)      OR-A4370
      IF (NUMZF.LE.4) STOP                                              OR-A4371
      TLRNCE=1.E-03                                                     OR-A4372
```

```
      DELZ=ABS((Z0(NUMZ0)-ZF(NUMZF))/Z0(NUMZ0))                          OR-A4373
      IF(DELZ.GT.TLRNCE) WRITE(OUT,40) NUMZ0,Z0(NUMZ0),NUMZF,            OR-A4374
     $ ZF(NUMZF)                                                         OR-A4375
 40   FORMAT (//////////,56X,14HERROR CODE  71,////,50X,26HERROR IN SUBROR-A4376
     1OUTINE REGRID,///,20X,95HDURING REGRIDDING,THE SOIL COLUMN MUST REOR-A4377
     2MAIN THE SAME LENGTH, BUT YOU SET THE DEEPEST NODES AS,//,40X,     OR-A4378
     33HZ0(,I3,4H) = ,E13.6,/,40X,3HZF(,I3,4H) = ,E13.6,///,20X,         OR-A4379
     469HTHE NUMBER OF NODES DOES NOT HAVE TO AGREE BUT THE COLUMN LENGTOR-A4380
     5H MUST)                                                            OR-A4381
      IF(DELZ.GT.TLRNCE) STOP                                            OR-A4382
      TBL = 1                                                            OR-A4383
      DO 60 I=1,NUMZF                                                    OR-A4384
60    CALL INTRP (NUMZ0,TBL,Z0,CGUESS,ZF(I),DUMY(I),DUM,3HR1 )           OR-A4385
      DO 80 I=1,NUMZF                                                    OR-A4386
80    CGUESS(I) = DUMY(I)                                                OR-A4387
      DO 100 I=1,NUMZF                                                   OR-A4388
100   CALL INTRP (NUMZ0,TBL,Z0,PGUESS,ZF(I),DUMY(I),DUM,3HR2 )           OR-A4389
      DO 120 I=1,NUMZF                                                   OR-A4390
120   PGUESS(I) = DUMY(I)                                                OR-A4391
      DO 140 I=1,NUMZF                                                   OR-A4392
140   CALL INTRP (NUMZ0,TBL,Z0,SGUESS,ZF(I),DUMY(I),DUM,3HR3 )           OR-A4393
      DO 160 I=1,NUMZF                                                   OR-A4394
160   SGUESS(I) = DUMY(I)                                                OR-A4395
      DO 180 I=1,NUMZF                                                   OR-A4396
180   CALL INTRP (NUMZ0,TBL,Z0,WGUESS,ZF(I),DUMY(I),DUM,3HR4 )           OR-A4397
      DO 200 I=1,NUMZF                                                   OR-A4398
200   WGUESS(I) = DUMY(I)                                                OR-A4399
      DO 220 I=1,NUMZF                                                   OR-A4400
220   CALL INTRP (NUMZ0,TBL,Z0,C,ZF(I),DUMY(I),DUM,3HR5 )                OR-A4401
      DO 240 I=1,NUMZF                                                   OR-A4402
240   C(I) = DUMY(I)                                                     OR-A4403
      DO 260 I=1,NUMZ0                                                   OR-A4404
260   DUMX(I) = COLD1(I)                                                 OR-A4405
      DO 280 I=1,NUMZF                                                   OR-A4406
280   CALL INTRP (NUMZ0,TBL,Z0,DUMX,ZF(I),COLD1(I) ,DUM,3HR6 )           OR-A4407
      DO 300 I=1,NUMZ0                                                   OR-A4408
300   DUMX(I) = COLD2(I)                                                 OR-A4409
      DO 320 I=1,NUMZF                                                   OR-A4410
320   CALL INTRP (NUMZ0,TBL,Z0,DUMX,ZF(I),COLD2(I) ,DUM,3HR7 )           OR-A4411
      DO 340 I=1,NUMZ0                                                   OR-A4412
340   DUMX(I) = POLD1(I)                                                 OR-A4413
      DO 360 I=1,NUMZF                                                   OR-A4414
360   CALL INTRP (NUMZ0,TBL,Z0,DUMX,ZF(I),POLD1(I) ,DUM,3HR8 )           OR-A4415
      DO 380 I=1,NUMZ0                                                   OR-A4416
380   DUMX(I) = POLD2(I)                                                 OR-A4417
      DO 400 I=1,NUMZF                                                   OR-A4418
400   CALL INTRP (NUMZ0,TBL,Z0,DUMX,ZF(I),POLD2(I) ,DUM,3HR8B)           OR-A4419
```

```
      DO 420 I=1,NUMZ0                                                    OR-A4420
420   DUMX(I) = SOLD1(I)                                                  OR-A4421
      DO 440 I=1,NUMZF                                                    OR-A4422
440   CALL INTRP (NUMZ0,TBL,Z0,DUMX,ZF(I),SOLD1(I) ,DUM,3HR9 )            OR-A4423
      DO 460 I=1,NUMZ0                                                    OR-A4424
460   DUMX(I) = SOLD2(I)                                                  OR-A4425
      DO 480 I=1,NUMZF                                                    OR-A4426
480   CALL INTRP (NUMZ0,TBL,Z0,DUMX,ZF(I),SOLD2(I) ,DUM,3HR10)            OR-A4427
      DO 500 I=1,NUMZF                                                    OR-A4428
500   CALL INTRP (NUMZ0,TBL,Z0,THETA,ZF(I),DUMY(I),DUM,3HR11)             OR-A4429
      DO 520 I=1,NUMZF                                                    OR-A4430
520   THETA(I) = DUMY(I)                                                  OR-A4431
      DO 540 I=1,NUMZ0                                                    OR-A4432
540   DUMX(I) = WOLD1(I)                                                  OR-A4433
      DO 560 I=1,NUMZF                                                    OR-A4434
560   CALL INTRP (NUMZ0,TBL,Z0,DUMX,ZF(I),WOLD1(I) ,DUM,3HR12)            OR-A4435
      DO 580 I=1,NUMZ0                                                    OR-A4436
580   DUMX(I) = WOLD2(I)                                                  OR-A4437
      DO 600 I=1,NUMZF                                                    OR-A4438
600   CALL INTRP (NUMZ0,TBL,Z0,DUMX,ZF(I),WOLD2(I) ,DUM,3HR13)            OR-A4439
      DO 620 I=1,NUMZF                                                    OR-A4440
620   CALL INTRP (NUMZ0,TBL,Z0,FGUESS,ZF(I),DUMY(I),DUM,3HR14)            OR-A4441
      DO 640 I=1,NUMZF                                                    OR-A4442
640   FGUESS(I) = DUMY(I)                                                 OR-A4443
      DO 660 I=1,NUMZ0                                                    OR-A4444
660   DUMX(I) = FOLD1(I)                                                  OR-A4445
      DO 680 I=1,NUMZF                                                    OR-A4446
680   CALL INTRP (NUMZ0,TBL,Z0,DUMX,ZF(I),FOLD1(I) ,DUM,3HR15)            OR-A4447
      DO 700 I=1,NUMZ0                                                    OR-A4448
700   DUMX(I) = FOLD2(I)                                                  OR-A4449
      DO 720 I=1,NUMZF                                                    OR-A4450
720   CALL INTRP (NUMZ0,TBL,Z0,DUMX,ZF(I),FOLD2(I) ,DUM,3HR16)            OR-A4451
      DO 740 I=1,NUMZF                                                    OR-A4452
740   CALL INTRP (NUMZ0,TBL,Z0,QZ,ZF(I),DUMY(I),DUM,3HR17)                OR-A4453
      DO 760 I=1,NUMZF                                                    OR-A4454
760   QZ(I) = DUMY(I)                                                     OR-A4455
      N = NUMZF                                                           OR-A4456
      DO 780 I=1,NUMZF                                                    OR-A4457
780   Z(I) = ZF(I)                                                        OR-A4458
      RETURN                                                              OR-A4459
      END                                                                 OR-A4460
```

```
      SUBROUTINE TRNSFM                                                 OR-A4461
C                                                                       OR-A4462
C     GENERATE THE DIFFUSIVITY POTENTIAL BY MEANS OF THE KIRCHHOFF      OR-A4463
C     TRANSFORM                                                         OR-A4464
C                                                                       OR-A4465
C                                                                       OR-A4466
      REAL KWZSAT,KWZDRY                                                OR-A4467
      INTEGER TBLDFZ,TBLDWF,TBLFP,TBLFW,TBLKFZ,TBLKPZ,TBLPF,TBLWF       OR-A4468
      INTEGER BCTOPC,BCTOPW,BCBTMC,BCBTMW,WILTED,OUT,PNCH               OR-A4469
      COMMON XDUM(200),DUMMYB(200),YDUM(200),DUMMYD(200),DUMMYE(200),   OR-A4470
     1DUMMYF(200),DUMMYG(200),DUMMYH(200),DUMMYI(200),DUMMYJ(200),DUMMYKOR-A4471
     2(200)                                                             OR-A4472
      COMMON /BEAR/ FGUESS(200),FOLD1(200),FOLD2(200),F(200)            OR-A4473
      COMMON /DATA/ BCTOPC,BCTOPW,BCBTMC,BCBTMW,JWORH,MODE,JSORB        OR-A4474
      COMMON /DEPTH/ N,Z(200)                                           OR-A4475
      COMMON /IO/ IN,OUT,PNCH                                           OR-A4476
      COMMON /MATRIC/ PGUESS(200),POLD1(200),POLD2(200),PSI(200)        OR-A4477
      COMMON /MOIST/ WGUESS(200),WOLD1(200),WOLD2(200),THETA(200)       OR-A4478
      COMMON /ROOTS/ CNVRSN,TCR,PPSURF(3),PWILT,RR,TR,WILTED            OR-A4479
      COMMON /SLIDER/ FDRY,FSAT,PICK(50),NUMPCK,JWHS                    OR-A4480
      COMMON /TABDFZ/ NUMDFZ,TBLDFZ,XDFZ(50),YDFZ(50)                   OR-A4481
      COMMON /TABDWF/ NUMDWF,TBLDWF,XDWF(50),YDWF(50)                   OR-A4482
      COMMON /TABFP/ NUMFP,TBLFP,XFP(50),YFP(50)                        OR-A4483
      COMMON /TABFW/ NUMFW,TBLFW,XFW(50),YFW(50)                        OR-A4484
      COMMON /TABKFZ/ NUMKFZ,TBLKFZ,XKFZ(50),YKFZ(50)                   OR-A4485
      COMMON /TABKPZ/ NUMKPZ,TBLKPZ,XKPZ(50),YKPZ(50)                   OR-A4486
      COMMON /TABPF/ NUMPF,TBLPF,XPF(50),YPF(50)                        OR-A4487
      COMMON /TABWF/ NUMWF,TBLWF,XWF(50),YWF(50)                        OR-A4488
      COMMON /WDATA/ GRAV,KWZDRY,KWZSAT,PDRY,PSAT,WDRY,WSAT             OR-A4489
C                                                                       OR-A4490
C                                                                       OR-A4491
      TBLDFZ = 1                                                        OR-A4492
      TBLDWF = 1                                                        OR-A4493
      TBLFP = 1                                                         OR-A4494
      TBLFW = 1                                                         OR-A4495
      TBLKFZ = 1                                                        OR-A4496
      TBLPF = 1                                                         OR-A4497
      TBLWF = 1                                                         OR-A4498
      NUM = 40                                                          OR-A4499
      IF (JWHS.EQ.0) NUM = NUMPCK                                       OR-A4500
      NUMI = 40                                                         OR-A4501
      NUMDFZ = NUM                                                      OR-A4502
      NUMFW = NUM                                                       OR-A4503
```

```
      NUMKFZ = NUM                                                      OR-A4504
      NUMPF = NUM                                                       OR-A4505
      NUMWF = NUM                                                       OR-A4506
      NN1 = NUM-1                                                       OR-A4507
      XN1 = NUM-1                                                       OR-A4508
      NNI1 = NUMI-1                                                     OR-A4509
      XNI = NUMI-1                                                      OR-A4510
      IF (JWHS.EQ.1) GO TO 200                                          OR-A4511
C                                                                       OR-A4512
C                                                                       OR-A4513
C                     F AS A FUNCTION OF WATER CONTENT                  OR-A4514
C                                                                       OR-A4515
C                                                                       OR-A4516
      XFW(1) = WDRY                                                     OR-A4517
      XFW(NUM) = WSAT                                                   OR-A4518
      DELW = WSAT-WDRY                                                  OR-A4519
      DO 20 I=2,NN1                                                     OR-A4520
20    XFW(I) = WDRY+DELW*PICK(I)                                        OR-A4521
C                                                                       OR-A4522
C        GENERATE THE  F(THETA) TABLE                                   OR-A4523
      XDUM(1) = WDRY                                                    OR-A4524
      DO 80 I=2,NUM                                                     OR-A4525
      DO 40 J=2,NNI1                                                    OR-A4526
40    XDUM(J) = XDUM(J-1)+(XFW(I)-WDRY)/XNI                             OR-A4527
      XDUM(NUMI) = XFW(I)                                               OR-A4528
C     GENERATE VALUES OF DWZ(THETA)                                     OR-A4529
      DO 60 J=1,NUMI                                                    OR-A4530
60    CALL DWZ (XDUM(J),YDUM(J))                                        OR-A4531
C     INTEGRATE  D  OVER THETA                                          OR-A4532
C     INTEGRATE BETWEEN WDRY AND XFW(I)                                 OR-A4533
C     USE NUMI MIDPOINTS                                                OR-A4534
C                     THE KIRCHHOFF TRANSFORM                           OR-A4535
80    CALL INTGRT (2,NUMI,XDUM,YDUM,YFW(I),3HFW2)                       OR-A4536
C                                  F(DRY)                               OR-A4537
      YFW(1) = 0.                                                       OR-A4538
      FDRY = YFW(1)                                                     OR-A4539
      FSAT = YFW(NUM)                                                   OR-A4540
C     FLIP OVER TO GET THETA(F)                                         OR-A4541
      DO 100 I=1,NUM                                                    OR-A4542
      XWF(I) = YFW(I)                                                   OR-A4543
100   YWF(I) = XFW(I)                                                   OR-A4544
      YWF(1) = WDRY                                                     OR-A4545
      YWF(NUM) = WSAT                                                   OR-A4546
C                                                                       OR-A4547
C                                    K(F)                               OR-A4548
C     CONDUCTIVITY AS A FUNCTION OF DIFFUSIVITY POTENTIAL               OR-A4549
      DO 120 I=1,NUM                                                    OR-A4550
```

```
C     THE F VALUE IS TAKEN FROM ABOVE                                    OR-A4551
      XKFZ(I) = XWF(I)                                                   OR-A4552
C     THE THETA CORRESPONDING TO  F  IS TAKEN FROM ABOVE                 OR-A4553
C     COMPUTE   K(THETA)                                                 OR-A4554
120   CALL KWZ (YWF(I),YKFZ(I))                                          OR-A4555
      YKFZ(1) = KWZDRY                                                   OR-A4556
      YKFZ(NUM) = KWZSAT                                                 OR-A4557
C              GENERATE   D(F)                                           OR-A4558
C     DIFFUSIVITY AS A FUNCTION OF DIFFUSIVITY POTENTIAL                 OR-A4559
C     USE THE  F  AND THETA VALUES FROM ABOVE                            OR-A4560
      DO 140 I=1,NUM                                                     OR-A4561
      XDFZ(I) = XWF(I)                                                   OR-A4562
140   CALL DWZ (YWF(I),YDFZ(I))                                          OR-A4563
C                                                                        OR-A4564
C                              PSI(F)                                    OR-A4565
C     MATRIC POTENTIAL AS A FUNCTION OF DIFFUSIVITY POTENTIAL            OR-A4566
C                                                                        OR-A4567
      DO 160 I=1,NUM                                                     OR-A4568
      XPF(I) = YFW(I)                                                    OR-A4569
      IF (I.NE.1.AND.I.NE.NUM) CALL PSIW (XFW(I),YPF(I),DUM)             OR-A4570
 160  CONTINUE                                                           OR-A4571
      YPF(1) = PDRY                                                      OR-A4572
      YPF(NUM) = PSAT                                                    OR-A4573
C            GENERATE THE INITIAL F                                      OR-A4574
      DO 180 I=1,N                                                       OR-A4575
      CALL INTRP (NUMFW,TBLFW,XFW,YFW,THETA(I),F(I),DUM,3HFW3)           OR-A4576
      CALL INTRP (NUMFW,TBLFW,XFW,YFW,WGUESS(I),FGUESS(I),DUM,3HFW4)     OR-A4577
      CALL INTRP (NUMFW,TBLFW,XFW,YFW,WOLD1(I) ,FOLD1(I) ,DUM,3HFW5)     OR-A4578
180   CALL INTRP (NUMFW,TBLFW,XFW,YFW,WOLD2(I) ,FOLD2(I) ,DUM,3HFW6)     OR-A4579
      RETURN                                                             OR-A4580
C                                                                        OR-A4581
C                     MATRIC POTENTIAL-BASED                             OR-A4582
C                                                                        OR-A4583
C                                                                        OR-A4584
C                       F AS A FUNCTION OF MATRIC POTENTIAL              OR-A4585
C                                                                        OR-A4586
C                                                                        OR-A4587
 200  XFP(1) = PDRY                                                      OR-A4588
      XFP(NUM) = PSAT                                                    OR-A4589
      XLDRY = ALOG(ABS(PDRY))                                            OR-A4590
      WI = WDRY                                                          OR-A4591
      DO 220 I=2,NN1                                                     OR-A4592
      WI = WI+(WSAT-WDRY)/XN1                                            OR-A4593
220   CALL PSIW (WI,XFP(I),DUM)                                          OR-A4594
C     GENERATE THE     F(PSI)  TABLE                                     OR-A4595
      XDUM(1) = XFP(1)                                                   OR-A4596
      YDUM(1) = KWZDRY                                                   OR-A4597
```

```
      IF (XFP(NUM).EQ.0.) XLZERO = XFP(NN1)/100.                        OR-A4598
      DO 320 J=2,NUM                                                    OR-A4599
      IF (J.LT.NUM) GO TO 240                                           OR-A4600
      IF (XFP(J).NE.0.) GO TO 240                                       OR-A4601
      IF (XFP(J).EQ.0.) XLJ = ALOG(ABS(XLZERO))                         OR-A4602
      GO TO 260                                                         OR-A4603
  240 XLJ = ALOG(ABS(XFP(J)))                                           OR-A4604
  260 DO 280 L=2,NNI1                                                   OR-A4605
      XLL = ALOG(ABS(XDUM(L-1)))+(XLJ-XLDRY)/XNI                        OR-A4606
      XDUM(L) = EXP(XLL)                                                OR-A4607
      IF (XFP(J).LE.0.) XDUM(L) = -XDUM(L)                              OR-A4608
  280 CONTINUE                                                          OR-A4609
      XDUM(NUMI) = XFP(J)                                               OR-A4610
C          GENERATE VALUES OF  KPZ(PSI)                                 OR-A4611
      DO 300 L=2,NUMI                                                   OR-A4612
  300 CALL INTRP (NUMKPZ,TBLKPZ,XKPZ,YKPZ,XDUM(L),YDUM(L),DUM,3HKP8)    OR-A4613
C               INTEGRATE  K  OVER PSI                                  OR-A4614
C        INTEGRATE BETWEEN  PDRY AND XFP(I) USING  NUMI MIDPOINTS       OR-A4615
C                        THE KIRCHHOFF TRANSFORM                        OR-A4616
      CALL INTGRT (2,NUMI,XDUM,YDUM,FPI,3HFP2)                          OR-A4617
  320 YFP(J) = FPI*CNVRSN                                               OR-A4618
C                                       F(DRY)                          OR-A4619
      YFP(1) = 0.                                                       OR-A4620
      FDRY = YFP(1)                                                     OR-A4621
      FSAT = YFP(NUM)                                                   OR-A4622
C     EXTEND THE TABLE TO INCLUDE POSITIVE POTENTIAL                    OR-A4623
      NUMFP = NUM+1                                                     OR-A4624
      XFP(NUMFP)=(ABS(PDRY)+ABS(PSAT))*10.                              OR-A4625
      YFP(NUMFP) = FSAT+KWZSAT*CNVRSN*(XFP(NUMFP)-PSAT)                 OR-A4626
C         FLIP OVER TO GET   PSI(F)                                     OR-A4627
      NUMPF = NUM+1                                                     OR-A4628
      DO 340 I=1,NUMPF                                                  OR-A4629
      XPF(I) = YFP(I)                                                   OR-A4630
  340 YPF(I) = XFP(I)                                                   OR-A4631
C                                                                       OR-A4632
C                       GENERATE   THETA(F)                             OR-A4633
C                                                                       OR-A4634
C     USE THE  F  VALUES FROM ABOVE                                     OR-A4635
      DO 360 I=1,NUM                                                    OR-A4636
      XWF(I) = XPF(I)                                                   OR-A4637
  360 CALL WPSI (YPF(I),YWF(I),DUM)                                     OR-A4638
      YWF(1) = WDRY                                                     OR-A4639
      YWF(NUM) = WSAT                                                   OR-A4640
      NUMWF = NUM+1                                                     OR-A4641
      XWF(NUMWF) = XPF(NUMWF)                                           OR-A4642
      YWF(NUMWF) = WSAT                                                 OR-A4643
C                                                                       OR-A4644
```

```
C                       GENERATE   D(THETA)/D(F)                          OR-A4645
C                                                                         OR-A4646
C                                                                         OR-A4647
      DO 380 I=1,NN1                                                      OR-A4648
      XDWF(I) = XWF(I)                                                    OR-A4649
380   CALL INTRP (NUMWF,TBLWF,XWF,YWF,XDWF(I),DUM,YDWF(I),3HWF3)          OR-A4650
      XDWF(NUM) = XWF(NUM)                                                OR-A4651
      YDWF(NUM) = 0.                                                      OR-A4652
      NUMDWF = NUM+1                                                      OR-A4653
      XDWF(NUMDWF) = XWF(NUMDWF)                                          OR-A4654
      YDWF(NUMDWF) = 0.                                                   OR-A4655
C                                                                         OR-A4656
C                                F(THETA)                                 OR-A4657
C                                                                         OR-A4658
C         FLIP WF OVER                                                    OR-A4659
      DO 400 I=1,NUM                                                      OR-A4660
      XFW(I) = YWF(I)                                                     OR-A4661
400   YFW(I) = XWF(I)                                                     OR-A4662
      NUMFW = NUM                                                         OR-A4663
C                                                                         OR-A4664
C                                    K(F)                                 OR-A4665
C                                                                         OR-A4666
C     CONDUCTIVITY AS A FUNCTION OF THE DIFFUSIVITY POTENTIAL             OR-A4667
      DO 420 I=1,NUM                                                      OR-A4668
      XKFZ(I) = XPF(I)                                                    OR-A4669
420   CALL INTRP (NUMKPZ,TBLKPZ,XKPZ,YKPZ,YPF(I),YKFZ(I),DUM,3HKP9)      OR-A4670
      YKFZ(1) = KWZDRY                                                    OR-A4671
      YKFZ(NUM) = KWZSAT                                                  OR-A4672
      NUMKFZ = NUM+1                                                      OR-A4673
      XKFZ(NUMKFZ) = XWF(NUMKFZ)                                          OR-A4674
      YKFZ(NUMKFZ) = KWZSAT                                               OR-A4675
C     GENERATE THE INITIAL  F                                             OR-A4676
      DO 440 I=1,N                                                        OR-A4677
      CALL INTRP (NUMFP,TBLFP,XFP,YFP,PSI(I),F(I),DUM,3HFP3)              OR-A4678
      CALL INTRP (NUMFP,TBLFP,XFP,YFP,PGUESS(I),FGUESS(I),DUM,3HFP4)      OR-A4679
      CALL INTRP (NUMFP,TBLFP,XFP,YFP,POLD1(I) ,FOLD1(I) ,DUM,3HFP5)      OR-A4680
440   CALL INTRP (NUMFP,TBLFP,XFP,YFP,POLD2(I) ,FOLD2(I) ,DUM,3HFP6)      OR-A4681
      RETURN                                                              OR-A4682
      END                                                                 OR-A4683
```

```
      SUBROUTINE DUMP (TIME)                                                    OR-A4684
                                                                                OR-A4685
C                                                                               OR-A4686
C        PUNCH OUT THE FINAL VALUES OF THE STATE VARIABLES                      OR-A4687
C                                                                               OR-A4688
C                                                                               OR-A4689
C     NOTE.  THE DATA IS PUNCHED OUT IN THE SAME FORMAT AS THAT                 OR-A4690
C        NEEDED FOR DATA INPUT.  HENCE, THE PUNCHED OUTPUT DATA CAN             OR-A4691
C        BE USED FOR RESTART PROBLEMS                                           OR-A4692
      INTEGER OUT,PNCH,TBL                                                      OR-A4693
      INTEGER TBLCO,TBLPO,TBLSO,TBLWO,BCTOPC,BCTOPW,BCBTMC,BCBTMW               OR-A4694
      COMMON /DATA/ BCTOPC,BCTOPW,BCBTMC,BCBTMW,JWORH,MODE,JSORB                OR-A4695
      COMMON /DEPTH/ N,Z(200)                                                   OR-A4696
      COMMON /IO/ IN,OUT,PNCH                                                   OR-A4697
      COMMON /LIQUID/ CGUESS(200),COLD1(200),COLD2(200),C(200)                  OR-A4698
      COMMON /MATRIC/ PGUESS(200),POLD1(200),POLD2(200),PSI(200)                OR-A4699
      COMMON /MOIST/ WGUESS(200),WOLD1(200),WOLD2(200),THETA(200)               OR-A4700
      COMMON /SLIDER/ FDRY,FSAT,PICK(50),NUMPCK,JWHS                            OR-A4701
      COMMON /SOLID/ SGUESS(200),SOLD1(200),SOLD2(200),S(200)                   OR-A4702
      COMMON /TABCO/ NUMCO,TBLCO,XCO(200),YCO(200)                              OR-A4703
      COMMON /TABPO/ NUMPO,TBLPO,XPO(200),YPO(200)                              OR-A4704
      COMMON /TABSO/ NUMSO,TBLSO,XSO(200),YSO(200)                              OR-A4705
      COMMON /TABWO/ NUMWO,TBLWO,XWO(200),YWO(200)                              OR-A4706
C                                                                               OR-A4707
C                                                                               OR-A4708
      NUM = N                                                                   OR-A4709
      NUMO = 0                                                                  OR-A4710
      IF (MODE.EQ.2) TBLPO = -1                                                 OR-A4711
      IF (JSORB.LE.-1.OR.MODE.EQ.1) TBLSO = -1                                  OR-A4712
      IF (MODE.EQ.1) TBLCO = -1                                                 OR-A4713
   20 FORMAT (8E10.4)                                                           OR-A4714
      TBL = 1                                                                   OR-A4715
C     PUNCH OUT THE SPATIAL NODE DISTRIBUTION                                   OR-A4716
      WRITE (PNCH,40) TIME,NUM,TBL                                              OR-A4717
   40 FORMAT (2X,36HSPATIAL NODE DISTRIBUTION AT TIME = ,E11.4,/,2I5,62XOR-A4718
     1,2HZO)                                                                    OR-A4719
      WRITE (PNCH,20) (Z(I),I=1,NUM)                                            OR-A4720
C     PUNCH OUT LIQUID PHASE SOLUTE CONCENTRATION                               OR-A4721
      WRITE (PNCH,60) TIME                                                      OR-A4722
   60 FORMAT (2X,44HLIQUID PHASE SOLUTE CONCENTRATION AT TIME = ,E11.4)         OR-A4723
      IF (TBLCO.LE.-1) WRITE (PNCH,80) NUMO,TBLCO                               OR-A4724
   80 FORMAT (2I5,62X,2HCO)                                                     OR-A4725
      IF (TBLCO.GE.0) WRITE (PNCH,80) NUM,TBL                                   OR-A4726
      IF (TBLCO.GE.0) WRITE (PNCH,20) (Z(I),C(I),I=1,NUM)                       OR-A4727
C     PUNCH OUT MATRIC POTENTIAL                                                OR-A4728
      WRITE (PNCH,100) TIME
```

```
  100  FORMAT (2X,27HMATRIC POTENTIAL AT TIME = ,E11.4)                    OR-A4729
       IF (TBLP0.LE.-1) WRITE (PNCH,120) NUM0,TBLP0                        OR-A4730
  120  FORMAT (2I5,62X,2HP0)                                               OR-A4731
       IF (TBLP0.GE.0) WRITE (PNCH,120) NUM,TBL                            OR-A4732
       IF (TBLP0.GE.0) WRITE (PNCH,20) (Z(I),PSI(I),I=1,NUM)               OR-A4733
C      PUNCH OUT SOLID PHASE SOLUTE CONCENTRATION                          OR-A4734
       WRITE (PNCH,140) TIME                                               OR-A4735
  140  FORMAT (2X,43HSOLID PHASE SOLUTE CONCENTRATION AT TIME = ,E11.4)    OR-A4736
       IF (TBLS0.LE.-1) WRITE (PNCH,160) NUM0,TBLS0                        OR-A4737
  160  FORMAT (2I5,62X,2HS0)                                               OR-A4738
       IF (TBLS0.GE.0) WRITE (PNCH,160) NUM,TBL                            OR-A4739
       IF (TBLS0.GE.0) WRITE (PNCH,20) (Z(I),S(I),I=1,NUM)                 OR-A4740
C      PUNCH OUT VOLUMETRIC WATER CONTENT                                  OR-A4741
       WRITE (PNCH,180) TIME                                               OR-A4742
  180  FORMAT (2X,35HVOLUMETRIC WATER CONTENT AT TIME = ,E10.4)            OR-A4743
       IF (TBLW0.LE.-1) WRITE (PNCH,200) NUM0,TBLW0                        OR-A4744
  200  FORMAT (2I5,62X,2HW0)                                               OR-A4745
       IF (TBLW0.GE.0) WRITE (PNCH,200) NUM,TBL                            OR-A4746
       IF (TBLW0.GE.0) WRITE (PNCH,20) (Z(I),THETA(I),I=1,NUM)             OR-A4747
       WRITE (PNCH,220)                                                    OR-A4748
  220  FORMAT (25X,30H*****  END OF DATA SETS  *****)                      OR-A4749
       RETURN                                                              OR-A4750
       END                                                                 OR-A4751
```

```
       SUBROUTINE STEP (TIME)                                              OR-A4752
C                                                                          OR-A4753
C                                                                          OR-A4754
C        SPECIFY THE TIME STEP-SIZE (DTK1) AND/OR THE PRINTOUT STEP-       OR-A4755
C          SIZE (NSKIP)                                                    OR-A4756
C                                                                          OR-A4757
C                                                                          OR-A4758
C      HENCE,   (FUTURE TIME) = TIME + DTK1                                OR-A4759
C         AND (FUTURE PRINTOUT) = TIME + DTK1*NSKIP                        OR-A4760
C                                                                          OR-A4761
C                                                                          OR-A4762
       INTEGER OUTPUT                                                      OR-A4763
       COMMON /DELTA/ ATCOEF,BTCOEF,CTCOEF,DTK,DTK1,DTMAX,DTMIN,K1DELT     OR-A4764
       COMMON /DEPTH/ N,Z(200)                                             OR-A4765
```

```
      COMMON /FLUX/ A(200),G(200),QZ(200)                                   OR-A4766
      COMMON /MOIST/ WGUESS(200),WOLD1(200),WOLD2(200),THETA(200)           OR-A4767
      COMMON /PRNT/ NSKIP,NPRINT,OUTPUT                                     OR-A4768
C                                                                           OR-A4769
CC                                                                          OR-A4770
C       ATCOEF,BTCOEF,CTCOEF     COEFFICIENTS USED IN THE GENERAL TIME      OR-A4771
C                                  STEP FUNCTION  WHEN K1DELT=1.  MUST      OR-A4772
C                                  BE NON-NEGATIVE IN VALUE                 OR-A4773
C       DTMAX      SPECIFIED MAXIMUM TIME STEP (T)                          OR-A4774
C       DTMIN      SPECIFIED MINIMUM TIME STEP (T)                          OR-A4775
C       DTK        CURRENT TIME STEP-SIZE, AT LEVEL K (T)                   OR-A4776
C       DTK1       FUTURE TIME STEP-SIZE, AT LEVEL K+1 (T)                  OR-A4777
C       K1DELT     DECISION VARIABLE THAT SPECIFIES WHICH METHOD WILL       OR-A4778
C                    BE USED TO COMPUTE THE TIME STEP-SIZE                  OR-A4779
C                    =  0     METHOD OF HANKS AND BOWERS(1969)              OR-A4780
C                    =  1     GENERAL FORM                                  OR-A4781
C                              DT(K+1)=ATCOEF+BTCOEF*DT(K)+CTCOEF*T(K)      OR-A4782
C                    =  2     THE USER CAN SPECIFY ANY PROCEDURE DESIRED    OR-A4783
C                               BY WRITING THE STEP-SIZE FUNCTION           OR-A4784
C                               BETWEEN STATEMENTS 80 AND 100 BELOW.        OR-A4785
C       N          TOTAL NUMBER OF SPACE NODES                              OR-A4786
C       NSKIP      PRINTOUT  SKIPPER.  PROGRAM WILL PRINT AND               OR-A4787
C                    PUNCH(WHEN OUTPUT=1) THE COMPUTED VALUES OF WATER      OR-A4788
C                    CONTENT , POTENTIAL, AND SOLUTE CONCENTRATION          OR-A4789
C                    EVERY NSKIP TIME STEPS . IF DESIRED, ONE CAN WRITE     OR-A4790
C                    A FORTRAN PROGRAM TO SPECIFY  NSKIP  AS A              OR-A4791
C                    FUNCTION OF TIME.  WRITE THIS PROGRAM BELOW            OR-A4792
C                   THE "100 CONTINUE" STATEMENT                            OR-A4793
C       TIME       CURRENT TIME AT WHICH EVERY THING HAS ALREADY BEEN        OR-A4794
C                    SOLVED FOR (T)                                         OR-A4795
C                                                                           OR-A4796
C                                                                           OR-A4797
      DTK1 = DTMAX                                                          OR-A4798
      IF (K1DELT-1) 20,60,80                                                OR-A4799
   20 CONTINUE                                                              OR-A4800
C                                                                           OR-A4801
CC       THE METHOD OF HANKS AND BOWERS(1969)                               OR-A4802
C                                                                           OR-A4803
C     THE TIME STEP IS COMPUTED AS THE TIME THAT IT TAKES FOR THE           OR-A4804
C     LARGEST   WATER FLUX TO FLOW FROM ONE NODE TO THE NEXT                OR-A4805
      N1 = N-1                                                              OR-A4806
      DO 40 I=1,N1                                                          OR-A4807
C     EVERYTHING IS DEFINED AT  (I+1/2,K+1/2)                               OR-A4808
      IF (QZ(I).EQ.0.) GO TO 40                                             OR-A4809
      WIHKH = (THETA(I+1)+THETA(I)+WOLD2(I+1) +WOLD2(I) )/4.                OR-A4810
      DT=ABS(WIHKH*(Z(I+1)-Z(I))/QZ(I))                                     OR-A4811
      IF(DT.LT.DTK1) DTK1=DT                                                OR-A4812
```

```
 40   CONTINUE                                                          OR-A4813
      GO TO 100                                                         OR-A4814
 60   CONTINUE                                                          OR-A4815
C                                                                       OR-A4816
C       THE GENERAL FORMULA  FOR THE TIME INCREMENT IS AS FOLLOWS       OR-A4817
C             DT(K+1) = ATCOEF + BTCOEF*DT(K) + CTCOEF*T(K)             OR-A4818
C                                                                       OR-A4819
C       WHERE, UNDER ALL CIRCUMSTANCES DT(K+1) MUST BE BETWEEN OR       OR-A4820
C     EQUAL TO THE LIMITS (DTMIN,DTMAX)                                 OR-A4821
C                                                                       OR-A4822
C       SPECIAL CASES                                                   OR-A4823
C            1)CONSTANT TIME STEP-SIZE                                  OR-A4824
C                      THUS  DTK1 = ATCOEF                              OR-A4825
C                      SET THE COEFFICIENTS  BTCOEF=0 AND CTCOEF=0      OR-A4826
C            II)LOGARITHMIC INCREASE IN TIME STEP-SIZE                  OR-A4827
C                      DTK1=ATCOEF+BTCOEF*DTK+CTCOEF*TIME               OR-A4828
C       WHERE EITHER COEFFICIENT BTCOEF OR CTCOEF CAN BE ZERO, BUT NOT  OR-A4829
C       SIMULATANEOUSLY.  COEFFICIENT  ATCOEF CAN ALSO BE ZERO.         OR-A4830
C       NOTE  ON THE FIRST TIME STEP    DTK=DTMIN                       OR-A4831
C                                                                       OR-A4832
      DTK1 = ATCOEF+BTCOEF*DTK+CTCOEF*TIME                              OR-A4833
      GO TO 100                                                         OR-A4834
 80   CONTINUE                                                          OR-A4835
C                                                                       OR-A4836
C                                                                       OR-A4837
C       WRITE A FORTRAN PROGRAM(IF K1DELT=2) SPECIFYING DTK1 AS A       OR-A4838
C       FUNCTION OF TIME                                                OR-A4839
C                                                                       OR-A4840
 100  CONTINUE                                                          OR-A4841
C                                                                       OR-A4842
C                                                                       OR-A4843
C     WRITE A FORTRAN PROGRAM(IF ANY) SPECIFYING NSKIP AS A FUNCTION    OR-A4844
C     OF TIME                                                           OR-A4845
C     NOTE.  NSKIP IS SPECIFIED BY DATA CARD 1  BUT AS WRITTEN, NSKIP   OR-A4846
C     REMAINS THE SAME THROUGHOUT THE PROGRAM.  IF YOU WISH NSKIP TO    OR-A4847
C     VARY WITH TIME, WRITE THE APPROPRIATE FORTRAN STATEMENTS BELOW.   OR-A4848
C                                                                       OR-A4849
C                                                                       OR-A4850
      RETURN                                                            OR-A4851
      END                                                               OR-A4852
```

```
      SUBROUTINE INTLZ                                                  OR-A4853
C                                                                       OR-A4854
C           INITIAL SPATIAL NODE DISTRIBUTION                           OR-A4855
C                                                                       OR-A4856
C       NUMZ0     INITIAL NUMBER OF SPATIAL NODES TO BE USED            OR-A4857
C       Z0(I)     ARRAY CONTAINING THE INITIAL DISTANCES                OR-A4858
C                   FROM THE SURFACE TO NODE I ( L GROSS )              OR-A4859
C                                                                       OR-A4860
      INTEGER TBLZ0                                                     OR-A4861
      COMMON /TABZ0/ NUMZ0,TBLZ0,Z0(200)                                OR-A4862
      Z0(1) = 0.                                                        OR-A4863
      IF (TBLZ0.EQ.0) GO TO 500                                         OR-A4864
      RETURN                                                            OR-A4865
500   CONTINUE                                                          OR-A4866
C                                                                       OR-A4867
C                 EMPIRICAL FORMULAE                                    OR-A4868
      RETURN                                                            OR-A4869
      END                                                               OR-A4870
```

```
      SUBROUTINE FNLZ                                                   OR-A4871
C                                                                       OR-A4872
C                                                                       OR-A4873
C     SPATIAL  NODE DISTRIBUTION TO BE USED THROUGHOUT THE REMAINDER    OR-A4874
C   OF THE PROGRAM, I.E., AFTER TIME  TGRID                             OR-A4875
C                                                                       OR-A4876
C     NUMZF     FINAL NUMBER OF SPATIAL NODES TO BE USED                OR-A4877
C     ZF(I)     ARRAY CONTAINING THE FINAL          DISTANCES FROM      OR-A4878
C                 THE SURFACE TO NODE I ( L GROSS )                     OR-A4879
C                                                                       OR-A4880
      INTEGER TBLZF                                                     OR-A4881
      COMMON /TABZF/ NUMZF,TBLZF,ZF(200)                                OR-A4882
      ZF(1) = 0.                                                        OR-A4883
      IF (TBLZF.LE.-1) RETURN                                           OR-A4884
      IF (TBLZF.EQ.0) GO TO 500                                         OR-A4885
C      THE TABLE HAS ALREADY BEEN FED IN AS  ZF IF TBLZF IS GREATER THANOR-A4886
```

```
C     ZERO                                                              OR-A4887
      RETURN                                                            OR-A4888
500   CONTINUE                                                          OR-A4889
C                                                                       OR-A4890
C             EMPIRICAL FORMULAE                                        OR-A4891
      RETURN                                                            OR-A4892
      END                                                               OR-A4893
```

```
      SUBROUTINE INTLC                                                  OR-A4894
C                                                                       OR-A4895
C     DEFINE THE INITIAL LIQUID PHASE SOLUTE CONCENTRATION              OR-A4896
C                                                                       OR-A4897
C        C0(J)      INITIAL LIQUID PHASE SOLUTE CONCENTRATION AT NODE J OR-A4898
C                     WITH UNITS OF ( M/L**3 FLUID )                    OR-A4899
C        N          TOTAL NUMBER OF SPATIAL NODES                     OR-A4900
C        Z(J)       DISTANCE FROM THE SURFACE TO NODE J               OR-A4901
C                     WITH UNITS OF  ( L GROSS )                      OR-A4902
C                                                                       OR-A4903
      INTEGER TBLC0                                                     OR-A4904
      COMMON /DEPTH/ N,Z(200)                                           OR-A4905
      COMMON /LIQUID/ CGUESS(200),COLD1(200),COLD2(200),C0(200)         OR-A4906
      COMMON /TABC0/ NUMC0,TBLC0,XC0(200),YC0(200)                      OR-A4907
      IF (TBLC0.LE.-1) RETURN                                           OR-A4908
      IF (TBLC0.EQ.0) GO TO 500                                         OR-A4909
C     CALL THE INTERPOLATION SCHEME                                     OR-A4910
      DO 10 I=1,N                                                       OR-A4911
      CALL INTRP (NUMC0,TBLC0,XC0,YC0,Z(I),C0(I),DYDX,3HC0 )            OR-A4912
 10   CONTINUE                                                          OR-A4913
      RETURN                                                            OR-A4914
500   CONTINUE                                                          OR-A4915
C     WITH A FORTRAN PROGRAM TO SPECIFY  C0(J) AS A FUNCTION OF  Z(J)   OR-A4916
C     WHEN TBLC0 EQUALS ZERO                                            OR-A4917
C                           EMPIRICAL FORMULAE                          OR-A4918
      RETURN                                                            OR-A4919
      END                                                               OR-A4920
```

```
      SUBROUTINE INTLP                                                      OR-A4921
                                                                            OR-A4922
C                                                                           OR-A4923
C        DEFINE THE INITIAL SOIL MATRIC POTENTIAL  PSI                      OR-A4924
C                                                                           OR-A4925
C                                                                           OR-A4926
C        N          TOTAL NUMBER OF SPATIAL NODES                           OR-A4927
C        P0(J)      INITIAL SOIL MATRIC POTENTIAL AT NODE J                 OR-A4928
C                     WITH UNITS OF (L POTENTIAL)                           OR-A4929
C        Z(J)       DISTANCE FROM THE SURFACE TO NODE J                     OR-A4930
C                                                                           OR-A4931
C                                                                           OR-A4932
      INTEGER TBLP0                                                         OR-A4933
      COMMON /DEPTH/ N,Z(200)                                               OR-A4934
      COMMON /MATRIC/ PGUESS(200),POLD1(200),POLD2(200),P0(200)             OR-A4935
      COMMON /TABP0/ NUMP0,TBLP0,XP0(200),YP0(200)                          OR-A4936
      IF (TBLP0.LE.-1) RETURN                                               OR-A4937
      IF (TBLP0.EQ.0) GO TO 500                                             OR-A4938
C      CALL THE INTERPOLATION SCHEME                                        OR-A4939
      DO 10 I=1,N                                                           OR-A4940
      CALL INTRP (NUMP0,TBLP0,XP0,YP0,Z(I),P0(I),DYDX,3HP0 )                OR-A4941
   10 CONTINUE                                                              OR-A4942
      RETURN                                                                OR-A4943
  500 CONTINUE                                                              OR-A4944
C     WRITE A FORTRAN PROGRAM TO SPECIFY  P0(J) AS FUNCTION OF  Z(J)        OR-A4945
C     WHEN TBLP0 EQUALS ZERO                                                OR-A4946
C             EMPIRICAL FORMULAE                                            OR-A4947
      RETURN                                                                OR-A4948
      END


      SUBROUTINE INTLS                                                      OR-A4949
C                                                                           OR-A4950
```

```
C     DEFINE THE INITIAL SOLID PHASE SOLUTE CONCENTRATION                OR-A4951
C                                                                        OR-A4952
C                                                                        OR-A4953
C        N          TOTAL NUMBER OF SPATIAL NODES                        OR-A4954
C        S0(J)      INITIAL SOLID PHASE SOLUTE CONCENTRATION             OR-A4955
C                     AT NODE J  WITH UNITS OF ( M/L**3 GROSS )          OR-A4956
C        Z(J)       DISTANCE FROM THE SURFACE TO NODE J                  OR-A4957
C                                                                        OR-A4958
      INTEGER TBLS0                                                      OR-A4959
      COMMON /DEPTH/ N,Z(200)                                            OR-A4960
      COMMON /SOLID/ SGUESS(200),SOLD1(200),SOLD2(200),S0(200)           OR-A4961
      COMMON /TABS0/ NUMS0,TBLS0,XS0(200),YS0(200)                       OR-A4962
      IF (TBLS0.LE.-1) RETURN                                            OR-A4963
      IF (TBLS0.EQ.0) GO TO 500                                          OR-A4964
C      CALL THE INTERPOLATION SCHEME                                     OR-A4965
      DO 10 I=1,N                                                        OR-A4966
      CALL INTRP (NUMS0,TBLS0,XS0,YS0,Z(I),S0(I),DYDX,3HS0 )             OR-A4967
 10   CONTINUE                                                           OR-A4968
      RETURN                                                             OR-A4969
500   CONTINUE                                                           OR-A4970
C     WRITE A FORTRAN PROGRAM TO SPECIFY  S0(J)  AS A FUNCTION OF  Z(J)  OR-A4971
C     WHEN  TBLS0 EQUALS ZERO                                            OR-A4972
C                 EMPIRICAL FORMULAE                                     OR-A4973
      RETURN                                                             OR-A4974
      END                                                                OR-A4975
```

```
      SUBROUTINE INTLW                                                   OR-A4976
C                                                                        OR-A4977
C                                                                        OR-A4978
C        DEFINE THE INITIAL VOLUMETRIC WATER CONTENT - THETA-            OR-A4979
C                                                                        OR-A4980
C        N          TOTAL NUMBER OF SPATIAL NODES                        OR-A4981
C        W0(J)      INITIAL VOLUMETRIC WATER CONTENT AT NODE J           OR-A4982
C                     WITH UNITS OF ( L**3 FLUID/L**3 GROSS )            OR-A4983
C        Z(J)       DISTANCE FROM THE SURFACE TO NODE J                  OR-A4984
C                                                                        OR-A4985
      INTEGER TBLW0                                                      OR-A4986
      COMMON /DEPTH/ N,Z(200)                                            OR-A4987
```

```
      COMMON /MOIST/ WGUESS(200),WOLD1(200),WOLD2(200),W0(200)          OR-A4988
      COMMON /TABW0/ NUMW0,TBLW0,XW0(200),YW0(200)                      OR-A4989
      IF (TBLW0.LE.-1) RETURN                                           OR-A4990
      IF (TBLW0.EQ.0) GO TO 500                                         OR-A4991
C        CALL THE INTERPOLATION SCHEME                                  OR-A4992
      DO 10 I=1,N                                                       OR-A4993
      CALL INTRP (NUMW0,TBLW0,XW0,YW0,Z(I),W0(I),DYDX,3HW0 )            OR-A4994
 10   CONTINUE                                                          OR-A4995
      RETURN                                                            OR-A4996
500   CONTINUE                                                          OR-A4997
C     WRITE A FORTRAN PROGRAM TO SPECIFY  W0(J) AS A FUNCTION OF  Z(J)  OR-A4998
C     WHEN  TBLW0 EQUALS ZERO                                           OR-A4999
C                  EMPIRICAL FORMULAE                                   OR-A5000
      RETURN                                                            OR-A5001
      END                                                               OR-A5002
```

```
      SUBROUTINE BCCBTM (TIME,FBTMC)                                    OR-A5003
                                                                        OR-A5004
C                                                                       OR-A5005
C     DEFINE THE TYPE OF BOUNDARY CONDITION AND THE RIGHT-HAND SIDE     OR-A5006
C     VALUE OF THE BOTTOM BOUNDARY CONDITION FOR THE LIQUID PHASE SOLUTE OR-A5007
C     EQUATION                                                          OR-A5008
C                                                                       OR-A5009
C        BCBTMC    = 0  NO BOUNDARY CONDITION IS ASSIGNED               OR-A5010
C                  = 1  1ST TYPE  B.C.                                  OR-A5011
C                            C = FBTMC                                  OR-A5012
C                                                                       OR-A5013
C                  = 2  2ND TYPE  B.C.                                  OR-A5014
C                            DC/DZ = FBTMC                              OR-A5015
C                                                                       OR-A5016
C                  = 3  3RD TYPE  B.C.                                  OR-A5017
C                            -DSZ*THETA*DC/DZ + QZ*C = FBTMC            OR-A5018
C                                                                       OR-A5019
C        FBTMC     RIGHT-HAND SIDE VALUE    OF THE BOTTOM BOUNDARY     OR-A5020
C                    CONDITION OF THE LIQUID PHASE SOLUTE EQUATION      OR-A5021
C        TIME      TIME AT WHICH BOUNDARY CONDITION IS TO BE EVALUATED  OR-A5022
C                                                                       OR-A5023
      INTEGER BCTOPC,BCTOPW,BCBTMC,BCBTMW,TBLBCB,TBLFCB                 OR-A5024
      COMMON /DATA/ BCTOPC,BCTOPW,BCBTMC,BCBTMW,JWORH,MODE,JSORB
```

```
      COMMON /TABBCB/ NUMBCB,TBLBCB,XBCB(50),YBCB(50)                    OR-A5025
      COMMON /TABFCB/ NUMFCB,TBLFCB,XFCB(50),YFCB(50)                    OR-A5026
      BCBTMC = 0                                                         OR-A5027
      FBTMC = 0.                                                         OR-A5028
      IF (TBLFCB.LE.-1) RETURN                                           OR-A5029
      IF (TBLBCB.EQ.0) GO TO 10                                          OR-A5030
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  BCBTMC AT THE GIVEN TIMEOR-A5031
      CALL INTRP (NUMBCB,TBLBCB,XBCB,YBCB,TIME,BC,DYDX,3HBCB)            OR-A5032
C     MAKE SURE THAT THE SPECIFIED VALUE OF BC IS ACTUALLY AN INTEGER    OR-A5033
      BCBTMC = BC+.01                                                    OR-A5034
 10   IF (TBLFCB.EQ.0) GO TO 500                                         OR-A5035
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  FBTMC  AT THE GIVEN TIMEOR-A5036
      CALL INTRP (NUMFCB,TBLFCB,XFCB,YFCB,TIME,FBTMC,DYDX,3HFCB)         OR-A5037
C                                                                        OR-A5038
500   IF (TBLBCB.NE.0) GO TO 1000                                        OR-A5039
C     WRITE A FORTRAN PROGRAM SPECIFYING  BCBTMC  AS A FUNCTION OF TIME  OR-A5040
C     WHEN  TBLBCB IS ZERO                                               OR-A5041
C                 EMPIRICAL FORMULAE FOR  BCBTMC                         OR-A5042
C                                                                        OR-A5043
1000  IF (TBLFCB.NE.0) RETURN                                            OR-A5044
C     WRITE A FORTRAN PROGRAM SPECIFYING  FBTMC  AS A FUNCTION OF TIME   OR-A5045
C     WHEN  TBLFCB  IS ZERO                                              OR-A5046
C                 EMPIRICAL FORMULAE FOR  FBTMC                          OR-A5047
      RETURN                                                             OR-A5048
      END                                                                OR-A5049
```

```
      SUBROUTINE BCCTOP (TIME,FTOPC)                                     OR-A5050
C                                                                        OR-A5051
C     DEFINE THE TYPE OF BOUNDARY CONDITION AND THE RIGHT-HAND SIDE      OR-A5052
C     VALUE OF THE TOP BOUNDARY CONDITION FOR THE LIQUID PHASE           OR-A5053
C     SOLUTE EQUATION                                                    OR-A5054
C                                                                        OR-A5055
C                                                                        OR-A5056
C        BCTOPC    = 0       NO BOUNDARY CONDITION IS ASSIGNED           OR-A5057
C                  = 1  1ST TYPE  B.C.                                   OR-A5058
C                            C = FTOPC                                   OR-A5059
C                  = 2  2ND TYPE  B.C.                                   OR-A5060
C                           DC/DZ = FTOPC                                OR-A5061
```

```
C                                                                       OR-A5062
C                                                                       OR-A5063
C                                                                       OR-A5064
C                = 3  3RD TYPE  B.C.                                    OR-A5065
C                           -DSZ*THETA*DC/DZ + QZ*C = FTOPC             OR-A5066
C     DURING INFILTRATION, THE SURFACE FLUX CONDITION MUST BE DEFINED AS OR-A5067
C                               FTOPC = QWTOP*CTOP                      OR-A5068
C     WHERE  CTOP  IS THE SPECIFIED SURFACE SOLUTE                      OR-A5069
C     CONCENTRATION(M/L**3 FLUID) AND  QWTOP   IS THE ACTUAL SURFACE    OR-A5070
C     FLUX OF WATER.                                                    OR-A5071
C     THE USER MUST SUPPLY THE VALUE OF  CTOP WHEREAS THE COMPUTER      OR-A5072
C     PROGRAM WILL GENERATE THE VALUE OF QWTOP                          OR-A5073
C                                                                       OR-A5074
C        CTOP      SPECIFIED SURFACE SOLUTE CONCENTRATION WITH UNITS    OR-A5075
C                    OF (M/L**3 FLUID)                                  OR-A5076
C        FTOPC     RIGHT-HAND SIDE VALUE    OF THE TOP BOUNDARY       OR-A5077
C                    CONDITION OF THE LIQUID PHASE SOLUTE EQUATION      OR-A5078
C        QWTOP     ACTUAL SURFACE FLUX OF WATER THROUGH THE UPPER      OR-A5079
C                    SURFACE AT NODE 1/2 AND AT TIME LEVEL K+1/2, WITH OR-A5080
C                    UNITS OF (L**3 FLUID/L**2 GROSS/T)                 OR-A5081
C        TIME      TIME AT WHICH BOUNDARY CONDITION IS TO BE EVALUATED  OR-A5082
C                                                                       OR-A5083
      INTEGER BCTOPC,BCTOPW,BCBTMC,BCBTMW,TBLBCT,TBLFCT                 OR-A5084
      COMMON /DATA/ BCTOPC,BCTOPW,BCBTMC,BCBTMW,JWORH,MODE,JSORB        OR-A5085
      COMMON /DEPTH/ N,Z(200)                                           OR-A5086
      COMMON /LIQUID/ CGUESS(200),COLD1(200),COLD2(200),C(200)          OR-A5087
      COMMON /QFLUX/ QWBTM,QWTOP,QCBTM,QCTOP                            OR-A5088
      COMMON /QITR/ QCOLD(2),QPOLD(2),QMIN                              OR-A5089
      COMMON /TABBCT/ NUMBCT,TBLBCT,XBCT(50),YBCT(50)                   OR-A5090
      COMMON /TABFCT/ NUMFCT,TBLFCT,XFCT(200),YFCT(200)                 OR-A5091
      BCTOPC = 0                                                        OR-A5092
      FTOPC = 0.                                                        OR-A5093
      IF (TBLFCT.LE.-1) RETURN                                          OR-A5094
      IF (TBLBCT.EQ.0) GO TO 10                                         OR-A5095
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  BCTOPC  AT THE GIVEN    OR-A5096
C     TIME                                                              OR-A5097
      CALL INTRP (NUMBCT,TBLBCT,XBCT,YBCT,TIME,BC,DYDX,3HBCT)           OR-A5098
C     CONVERT BC TO AN INTEGER                                          OR-A5099
      BCTOPC = BC+.01                                                   OR-A5100
   10 IF (TBLFCT.EQ.0) GO TO 500                                        OR-A5101
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  FTOPC  AT THE GIVEN     OR-A5102
C     TIME                                                              OR-A5103
      IF(BCTOPC.NE.3) CALL INTRP(NUMFCT,TBLFCT,XFCT,YFCT,TIME,FTOPC,DYDXOR-A5104
     2 ,3HFCT)                                                          OR-A5105
      IF(BCTOPC.NE.3) GO TO 500                                         OR-A5106
C     NOTE THAT DURING INFILTRATION THAT DATA SET FCT DEFINES  XFCT AS  OR-A5107
C     THE TIME AND  YFCT AS THE SPECIFIED SURFACE CONCENTRATION(CTOP)   OR-A5108
      CALL INTRP(NUMFCT,TBLFCT,XFCT,YFCT,TIME,CTOP,DYDX,3HFC1)
```

```
      FTOPC=0.                                                          OR-A5109
      IF (QWTOP.GT.0.) FTOPC = QWTOP*CTOP                               OR-A5110
C                                                                       OR-A5111
500   IF (TBLBCT.NE.0) GO TO 1000                                       OR-A5112
C                                                                       OR-A5113
C     WRITE A FORTRAN PROGRAM SPECIFYING  BCTOPC  AS A FUNCTION OF TIME OR-A5114
C     WHEN  TBLBCT  IS ZERO                                             OR-A5115
C                 EMPIRICAL FORMULAE FOR  BCTOPC                      OR-A5116
C                                                                       OR-A5117
1000  IF (TBLFCT.NE.0) RETURN                                           OR-A5118
C                                                                       OR-A5119
C     WRITE A FORTRAN PROGRAM SPECIFYING  FTOPC  AS A FUNCTION OF TIME  OR-A5120
C     WHEN  TBLFCT  IS ZERO                                             OR-A5121
C                 EMPIRICAL FORMULAE FOR  FTOPC                       OR-A5122
      RETURN                                                            OR-A5123
      END                                                               OR-A5124
```

```
      SUBROUTINE BCWBTM (TIME,FBTMW)                                    OR-A5125
C                                                                       OR-A5126
C     DEFINE THE TYPE OF BOUNDARY CONDITION AND THE RIGHT-HAND SIDE     OR-A5127
C     VALUE OF THE BOTTOM BOUNDARY CONDITION FOR THE WATER FLOW EQUATIONOR-A5128
C     BASED ON EITHER WATER CONTENT OR MATRIC POTENTIAL                 OR-A5129
C                                                                       OR-A5130
C        BCBTMW    = 0  NO BOUNDARY CONDITION IS ASSIGNED               OR-A5131
C                  = 1  1ST TYPE  B.C.                                  OR-A5132
C                            THETA = FBTMW                              OR-A5133
C                       OR    PSI  = FBTMW                             OR-A5134
C                                                                       OR-A5135
C                  = 2  2ND TYPE  B.C.                                  OR-A5136
C                            D(THETA)/DZ = FBTMW                        OR-A5137
C                       OR    D(PSI)/DZ  = FBTMW                       OR-A5138
C                                                                       OR-A5139
C                  = 4  4TH TYPE  B.C.                                  OR-A5140
C                            - DWZ*D(THETA)/DZ + KWZ = FBTMW            OR-A5141
C                       OR   - KWZ*D( PSI )/DZ + KWZ = FBTMW            OR-A5142
C        FBTMW     RIGHT-HAND SIDE VALUE    OF THE BOTTOM BOUNDARY     OR-A5143
C                    CONDITION OF THE WATER FLOW EQUATION               OR-A5144
C        TIME      TIME AT WHICH THE BOUNDARY CONDITION IS TO BE        OR-A5145
```

```
C                    EVALUATED                                          OR-A5146
C                                                                       OR-A5147
C                                                                       OR-A5148
C                                                                       OR-A5149
      INTEGER BCTOPC,BCTOPW,BCBTMC,BCBTMW,TBLBWB,TBLFWB                 OR-A5150
      INTEGER WILTED                                                    OR-A5151
      COMMON /DATA/ BCTOPC,BCTOPW,BCBTMC,BCBTMW,JWORH,MODE,JSORB        OR-A5152
      COMMON /DELTA/ ATCOEF,BTCOEF,CTCOEF,DTK,DTK1,DTMAX,DTMIN,K1DELT   OR-A5153
      COMMON /QFLUX/ QWBTM,QWTOP,QCBTM,QCTOP                            OR-A5154
      COMMON /ROOTS/ CNVRSN,TCR,PPSURF(3),PWILT,RR,TR,WILTED            OR-A5155
      COMMON /TABBWB/ NUMBWB,TBLBWB,XBWB(50),YBWB(50)                   OR-A5156
      COMMON /TABFWB/ NUMFWB,TBLFWB,XFWB(50),YFWB(50)                   OR-A5157
      BCBTMW = 0                                                        OR-A5158
      FBTMW = 0.                                                        OR-A5159
      IF (TBLFWB.LE.-1) RETURN                                          OR-A5160
      IF (TBLBWB.EQ.0) GO TO 10                                         OR-A5161
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  BCBTMW AT THE GIVEN TIME OR-A5162
C        CONVERT BC TO AN INTEGER                                       OR-A5163
      CALL INTRP (NUMBWB,TBLBWB,XBWB,YBWB,TIME,BC,DYDX,3HBWB)           OR-A5164
      BCBTMW = BC+.01                                                   OR-A5165
 10   IF (TBLFWB.EQ.0) GO TO 500                                        OR-A5166
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  FBTMW AT THE GIVEN TIME OR-A5167
      CALL INTRP (NUMFWB,TBLFWB,XFWB,YFWB,TIME,FBTMW,DYDX,3HFWB)        OR-A5168
C                                                                       OR-A5169
500   IF (TBLBWB.NE.0) GO TO 1000                                       OR-A5170
C                                                                       OR-A5171
C     WRITE A FORTRAN PROGRAM SPECIFYING  BCBTMW  AS A FUNCTION OF TIME OR-A5172
C     WHEN  TBLBWB IS ZERO                                              OR-A5173
C                 EMPIRICAL FORMULAE FOR  BCBTMW                        OR-A5174
C                                                                       OR-A5175
1000  IF (TBLFWB.NE.0) RETURN                                           OR-A5176
C                                                                       OR-A5177
C     WRITE A FORTRAN PROGRAM SPECIFYING  FBTMW  AS A FUNCTION OF TIME  OR-A5178
C     WHEN  TBLFWB  IS ZERO                                             OR-A5179
C                 EMPIRICAL FORMULAE FOR  FBTMW                         OR-A5180
      RETURN                                                            OR-A5181
      END


      SUBROUTINE BCWTOP (TIME,FTOPW)                                    OR-A5182
```

```
C                                                                       OR-A5183
C     DEFINE THE TYPE OF BOUNDARY CONDITION AND THE RIGHT-HAND SIDE     OR-A5184
C     VALUE OF THE TOP BOUNDARY CONDITION FOR THE WATER FLOW EQUATION   OR-A5185
C     BASED ON EITHER WATER CONTENT OR MATRIC POTENTIAL                 OR-A5186
C                                                                       OR-A5187
C                                                                       OR-A5188
C        BCTOPW    = 0  NO BOUNDARY CONDITION IS ASSIGNED               OR-A5189
C                  = 1  1ST TYPE  B.C.                                  OR-A5190
C                            THETA = FTOPW                              OR-A5191
C                       OR    PSI  = FTOPW                             OR-A5192
C                                                                       OR-A5193
C                  = 2  2ND TYPE  B.C.                                  OR-A5194
C                            D(THETA)/DZ = FTOPW                        OR-A5195
C                       OR   D( PSI )/DZ = FTOPW                        OR-A5196
C                                                                       OR-A5197
C                  = 4  4TH TYPE  B.C.                                  OR-A5198
C                            - DWZ*D(THETA)/DZ + KWZ = FTOPW            OR-A5199
C                       OR   - KWZ*D( PSI )/DZ + KWZ = FTOPW            OR-A5200
C                                                                       OR-A5201
C                                                                       OR-A5202
C        FTOPW     RIGHT-HAND SIDE VALUE OF THE TOP BOUNDARY CONDITION  OR-A5203
C                    OF THE WATER FLOW EQUATION                         OR-A5204
C        TIME      TIME AT WHICH BOUNDARY CONDITION IS TO BE EVALUATED  OR-A5205
C                                                                       OR-A5206
      INTEGER BCTOPC,BCTOPW,BCBTMC,BCBTMW,TBLBWT,TBLFWT                 OR-A5207
      INTEGER WILTED                                                    OR-A5208
      COMMON /DATA/ BCTOPC,BCTOPW,BCBTMC,BCBTMW,JWORH,MODE,JSORB        OR-A5209
      COMMON /DELTA/ ATCOEF,BTCOEF,CTCOEF,DTK,DTK1,DTMAX,DTMIN,K1DELT   OR-A5210
      COMMON /QFLUX/ QWBTM,QWTOP,QCBTM,QCTOP                            OR-A5211
      COMMON /ROOTS/ CNVRSN,TCR,PPSURF(3),PWILT,RR,TR,WILTED            OR-A5212
      COMMON /TABBWT/ NUMBWT,TBLBWT,XBWT(50),YBWT(50)                   OR-A5213
      COMMON /TABFWT/ NUMFWT,TBLFWT,XFWT(200),YFWT(200)                 OR-A5214
      BCTOPW = 0                                                        OR-A5215
      FTOPW = 0.                                                        OR-A5216
      IF (TBLFWT.LE.-1) RETURN                                          OR-A5217
      IF (TBLBWT.EQ.0) GO TO 10                                         OR-A5218
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  BCTOPW AT THE GIVEN TIMEOR-A5219
      CALL INTRP (NUMBWT,TBLBWT,XBWT,YBWT,TIME,BC,DYDX,3HBWT)           OR-A5220
C     CONVERT  BC  TO AN INTEGER                                        OR-A5221
      BCTOPW = BC+.01                                                   OR-A5222
   10 IF (TBLFWT.EQ.0) GO TO 500                                        OR-A5223
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  FTOPW  AT THE GIVEN TIMEOR-A5224
      CALL INTRP (NUMFWT,TBLFWT,XFWT,YFWT,TIME,FTOPW,DYDX,3HFWT)        OR-A5225
C                                                                       OR-A5226
  500 IF (TBLBWT.NE.0) GO TO 1000                                       OR-A5227
C                                                                       OR-A5228
C                                                                       OR-A5229
```

```
C     WRITE A FORTRAN PROGRAM SPECIFYING  BCTOPW  AS A FUNCTION OF TIME OR-A5230
C     WHEN  TBLBWT  IS ZERO                                             OR-A5231
C                EMPIRICAL FORMULAE FOR  BCTOPW                         OR-A5232
C                                                                       OR-A5233
C                                                                       OR-A5234
C                                                                       OR-A5235
1000  IF (TBLFWT.NE.0) RETURN                                           OR-A5236
C
C     WRITE A FORTRAN PROGRAM SPECIFYING  FTOPW  AS A FUNCTION OF TIME  OR-A5237
C     WHEN  TBLFWT  IS ZERO                                             OR-A5238
C                EMPIRICAL FORMULAE FOR  FTOPW                          OR-A5239
                                                                        OR-A5240
      RETURN                                                            OR-A5241
      END
```

```
      SUBROUTINE SINKC(C,THETA,T,Z,I,A,G)                               OR-A5242
                                                                        OR-A5243
C                                                                       OR-A5244
C           COMPUTE THE SOLUTE ROOT UPTAKE TERM G                       OR-A5245
C                                                                       OR-A5246
      INTEGER TBLCG                                                     OR-A5247
      REAL K1,K2                                                        OR-A5248
      COMMON /TABCG/ NUMCG,TBLCG,XCG(50),YCG(50)                        OR-A5249
C                                                                       OR-A5250
C     ACTIVE SOLUTE ROOT UPTAKE MODEL   G = GCOEF                       OR-A5251
C     PASSIVE SOLUTE ROOT UPTAKE MODEL  G = GCOEF*A                     OR-A5252
C                                                                       OR-A5253
C        A         ROOT SINK UPTAKE OF WATER ( L**3 FLUID/L**3 GROSS/T )OR-A5254
C                    AT (I,K+1/2)                                       OR-A5255
C        C         LIQUID PHASE SOLUTE CONCENTRATION AT NODE I AND     OR-A5256
C                    TIME LEVEL  K+1/2 WITH UNITS OF ( M/L**3 FLUID )   OR-A5257
C        G         ROOT SINK UPTAKE OF SOLUTE ( M/L**3 FLUID/T )       OR-A5258
C        GCOEF     COEFFICIENT  TO  THE SOLUTE SOURCE/SINK TERM.       OR-A5259
C                    IT IS ASSUMED TO BE A FUNCTION OF SOLUTE          OR-A5260
C                    CONCENTRATION WITH UNITS OF (M/L**3 FLUID).       OR-A5261
C                    NOTE THAT GCOEF IS A POSITIVE QUANTITY.           OR-A5262
C        I         ITH NODE OF ROOT UPTAKE, I=2,...,N-1                OR-A5263
C        T         THE K+1/2 TIME LEVEL (T) AT WHICH THE COEFFICIENT   OR-A5264
C                    IS TO BE EVALUATED AT                             OR-A5265
C        THETA     VOLUMETRIC   WATER  CONTENT AT NODE I AND TIME      OR-A5266
C                    LEVEL K+1/2 WITH UNITS OF(L**3 FLUID/L**3 GROSS)
```

```
C        Z         DEPTH OF THE ITH NODE AT WHICH ROOT UPTAKE OCCURS    OR-A5267
C                    ( L GROSS )                                       OR-A5268
C                                                                      OR-A5269
C           MODELS OF SOLUTE UPTAKE CAN BE WRITTEN BY THE              OR-A5270
C     USER BELOW THE "500 CONTINUE" STATEMENT, SUCH AS                 OR-A5271
C                                                                      OR-A5272
C        CONSTANT             GCOEF = K1                             OR-A5273
C                                                                      OR-A5274
C        LINEAR               GCOEF = K1*C                           OR-A5275
C                                                                      OR-A5276
C        MICHAELIS-MENTEN     GCOEF = K1*C/(1.+K2*C)                 OR-A5277
C                                                                      OR-A5278
C     WHERE K1 AND K2 ARE SPECIFIED BY THE USER AND WHERE GCOEF        OR-A5279
C        SHOULD ALWAYS BE A POSITIVE QUANTITY                          OR-A5280
      GCOEF = 0.                                                       OR-A5281
      K1 = 0.                                                          OR-A5282
      K2 = 0.                                                          OR-A5283
      G = 0.                                                           OR-A5284
      IF (TBLCG.LE.-1) RETURN                                          OR-A5285
      IF (TBLCG.EQ.0) GO TO 500                                        OR-A5286
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  GCOEF  FOR A GIVEN     OR-A5287
C     VALUE OF  C                                                      OR-A5288
      CALL INTRP (NUMCG,TBLCG,XCG,YCG,C,GCOEF,DYDX,3HCG )              OR-A5289
      G = GCOEF*A                                                      OR-A5290
      RETURN                                                           OR-A5291
500   CONTINUE                                                         OR-A5292
C     WRITE A FORTRAN PROGRAM SPECIFYING  GCOEF  AS A FUNCTION OF      OR-A5293
C     EITHER THETA,C,Z OR I WHEN TBLCG IS ZERO                         OR-A5294
C                              EMPIRICAL FORMULAE                      OR-A5295
      G = GCOEF*A                                                      OR-A5296
      RETURN                                                           OR-A5297
      END                                                              OR-A5298
```

```
      SUBROUTINE STMATA (PSURF,CST,DCSTDP)                             OR-A5299
C                                                                      OR-A5300
C        COMPUTE THE STOMATAL EFFICIENCY COEFFICIENT                   OR-A5301
C                                                                      OR-A5302
C        CST       STOMATAL EFFICIENCY (DECIMAL PERCENT)               OR-A5303
```

```
C       DCSTDP    D(CST)/D(PSP)  DERIVATIVE OF CST WITH RESPECT TO      OR-A5304
C                      PLANT SURFACE POTENTIAL ( 1/L POTENTIAL )        OR-A5305
C       PSURF     PRESSURE POTENTIAL IN THE PLANT AT THE SURFACE        OR-A5306
C                   (L POTENTIAL).  IT IS A NEGATIVE QUANTITY.          OR-A5307
C                                                                       OR-A5308
C                                                                       OR-A5309
      INTEGER TBLCST                                                    OR-A5310
      COMMON /TABCST/ NUMCST,TBLCST,XCST(50),YCST(50)                   OR-A5311
      CST = 1.                                                          OR-A5312
      DCSTDP=0.                                                         OR-A5313
      IF (TBLCST.LE.-1) RETURN                                          OR-A5314
      IF (TBLCST.EQ.0) GO TO 500                                        OR-A5315
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  CST FOR A GIVEN PLANT   OR-A5316
C     SURFACE POTENTIAL                                                 OR-A5317
      CALL INTRP (NUMCST,TBLCST,XCST,YCST,PSURF,CST,DCSTDP,3HCST)       OR-A5318
      RETURN                                                            OR-A5319
C                                                                       OR-A5320
C                                                                       OR-A5321
500   CONTINUE                                                          OR-A5322
C     WRITE A FORTRAN PROGRAM SPECIFYING  CST  AND  DCSTDP  AS FUNCTIONSOR-A5323
C     OF PLANT SURFACE POTENTIAL WHEN  TBLCST IS ZERO                   OR-A5324
C                 EMPIRICAL FORMULAE                                    OR-A5325
C                                                                       OR-A5326
C                                                                       OR-A5327
C     THE DERIVATIVE WITH RESPECT TO PLANT SURFACE POTENTIAL            OR-A5328
C                                                                       OR-A5329
C                 D(CST)/D(PSP)                                         OR-A5330
C                                                                       OR-A5331
      RETURN                                                            OR-A5332
      END                                                               OR-A5333
```

```
      SUBROUTINE KWCRTX (THETA,CTX)                                     OR-A5334
                                                                        OR-A5335
C                                                                       OR-A5336
C       CONDUCTIVITY OF THE ROOT CORTEX                                 OR-A5337
C                                                                       OR-A5338
C       CTX       CONDUCTIVITY OF THE ROOT CORTEX                       OR-A5339
C                      WITH UNITS OF (L**3 FLUID/L**2 GROSS/T)          OR-A5340
C       THETA     VOLUMETRIC   WATER  CONTENT (L**3 FLUID/L**3 GROSS)
```

```
C                                                                       OR-A5341
C                                                                       OR-A5342
C                                                                       OR-A5343
      INTEGER TBLCTX                                                    OR-A5344
      COMMON /TABCTX/ NUMCTX,TBLCTX,XCTX(50),YCTX(50)                   OR-A5345
      CTX = 1.                                                          OR-A5346
      IF (TBLCTX.LE.-1) RETURN                                          OR-A5347
      IF (TBLCTX.EQ.0) GO TO 500                                        OR-A5348
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  CTX  AS A FUNCTION OF   OR-A5349
C     VOLUMETRIC   WATER  CONTENT                                       OR-A5350
      CALL INTRP (NUMCTX,TBLCTX,XCTX,YCTX,THETA,CTX,DYDX,3HCTX)         OR-A5351
      RETURN                                                            OR-A5352
C                                                                       OR-A5353
C                                                                       OR-A5354
500   CONTINUE                                                          OR-A5355
C     WRITE A FORTRAN PROGRAM SPECIFYING  CTX  AS A FUNCTION OF         OR-A5356
C     VOLUMETRIC   WATER  CONTENT  WHEN  TBLCTX  IS ZERO                OR-A5357
C                                 EMPIRICAL FORMULAE                    OR-A5358
      RETURN                                                            OR-A5359
      END                                                               OR-A5360
```

```
      SUBROUTINE DSZ (THETA,QZ,DSZI)                                    OR-A5361
C                                                                       OR-A5362
C     COMPUTE THE MAGNITUDE OF THE APPARENT DIFFUSION COEFFICIENT FOR   OR-A5363
C      THE SOLUTE TRANSPORT EQUATION                                    OR-A5364
C                                                                       OR-A5365
C        DSZI       APPARENT SOLUTE DIFFUSION COEFFICIENT               OR-A5366
C                     WHICH HAS UNITS OF ( L**2 GROSS/T )               OR-A5367
C                     AND IS A FUNCTION OF PORE VELOCITY                OR-A5368
C                                                                       OR-A5369
C        QZ         DARCIAN FLUX IN THE SOIL                           OR-A5370
C                     WITH UNITS OF ( L**3 FLUID/L**2 GROSS/T )         OR-A5371
C                     EVALUATED AT (I+1/2,K+1/2)                        OR-A5372
C        THETA      VOLUMETRIC   WATER  CONTENT                        OR-A5373
C                     WITH UNITS OF ( L**3 FLUID/L**3 GROSS )           OR-A5374
C                     EVALUATED AT (I+1/2,K+1/2)                        OR-A5375
C                                                                       OR-A5376
C                                                                       OR-A5377
```

```
C      NOTE. THE MAGNITUDE OF THE PORE-WATER VELOCITY  V = ABS(QZ/THETA)OR-A5378
C                                                                      OR-A5379
      INTEGER TBLDSZ                                                   OR-A5380
      COMMON /TABDSZ/ NUMDSZ,TBLDSZ,XDSZ(50),YDSZ(50)                  OR-A5381
      DSZI = 0.                                                        OR-A5382
C           MAGNITUDE OF THE PORE-WATER VELOCITY                       OR-A5383
      V = 0.                                                           OR-A5384
      IF (THETA.GT.0.) V = ABS(QZ/THETA)                               OR-A5385
      IF (TBLDSZ.LE.-1) RETURN                                         OR-A5386
      IF (TBLDSZ.EQ.0) GO TO 500                                       OR-A5387
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  DSZI  FOR A GIVEN      OR-A5388
C     PORE-WATER VELOCITY                                              OR-A5389
      CALL INTRP (NUMDSZ,TBLDSZ,XDSZ,YDSZ,V,DSZI,DYDX,3HDSZ)           OR-A5390
      RETURN                                                           OR-A5391
500   CONTINUE                                                         OR-A5392
C                                                                      OR-A5393
C     WRITE A FORTRAN PROGRAM SPECIFYING  DSZI  AS A FUNCTION OF       OR-A5394
C     PORE-WATER VELOCITY WHEN TBLDSZ IS ZERO                          OR-A5395
C                 EMPIRICAL FORMULAE                                   OR-A5396
C                                                                      OR-A5397
      RETURN                                                           OR-A5398
      END                                                              OR-A5399
```

```
      SUBROUTINE DWZ (THETA,DWZI)                                      OR-A5400
                                                                       OR-A5401
C                                                                      OR-A5402
C                                                                      OR-A5403
C        COMPUTE SOIL WATER DIFFUSIVITY                                OR-A5404
C                                                                      OR-A5405
C                                                                      OR-A5406
      INTEGER TBLDWZ,WILTED                                            OR-A5407
      COMMON /ROOTS/ CNVRSN,TCR,PPSURF(3),PWILT,RR,TR,WILTED           OR-A5408
      COMMON /TABDWZ/ NUMDWZ,TBLDWZ,XDWZ(50),YDWZ(50)                  OR-A5409
C        DWZI              SOIL WATER DIFFUSIVITY ( L**2 GROSS/T )     OR-A5410
C                    AS A FUNCTION OF VOLUMETRIC   WATER  CONTENT      OR-A5411
C        THETA     VOLUMETRIC   WATER  CONTENT ( L**3 FLUID/L**3 GROSS )OR-A5412
C                                                                      OR-A5413
C                                                                      OR-A5414
      DWZI = 0.
```

```
      IF (TBLDWZ.LE.-1) RETURN                                          OR-A5415
      IF (TBLDWZ.EQ.0) GO TO 500                                        OR-A5416
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  DWZI  FOR THE GIVEN     OR-A5417
C     VALUE OF THETA                                                    OR-A5418
      CALL INTRP (NUMDWZ,TBLDWZ,XDWZ,YDWZ,THETA,DWZI,DYDX,3HDWZ)        OR-A5419
      RETURN                                                            OR-A5420
500   CONTINUE                                                          OR-A5421
C                                                                       OR-A5422
C     WRITE A FORTRAN PROGRAM SPECIFYING  DWZI  AS A FUNCTION OF        OR-A5423
C     VOLUMETRIC   WATER  CONTENT WHEN  TBLDWZ  IS ZERO                 OR-A5424
C                  EMPIRICAL FORMULAE                                   OR-A5425
C                                                                       OR-A5426
      RETURN                                                            OR-A5427
      END                                                               OR-A5428
```

```
      SUBROUTINE KWZ (THETA,KWZI)                                       OR-A5429
C                                                                       OR-A5430
C                                                                       OR-A5431
C     COMPUTE THE UNSATURATED SOIL HYDRAULIC CONDUCTIVITY               OR-A5432
C                                                                       OR-A5433
C                                                                       OR-A5434
      REAL KWZI                                                         OR-A5435
      INTEGER TBLKWZ                                                    OR-A5436
      COMMON /TABKWZ/ NUMKWZ,TBLKWZ,XKWZ(50),YKWZ(50)                   OR-A5437
C                                                                       OR-A5438
C        KWZI              UNSATURATED SOIL HYDRAULIC CONDUCTIVITY      OR-A5439
C                    AS A FUNCTION OF VOLUMETRIC   WATER  CONTENT       OR-A5440
C                    KWZI HAS UNITS OF ( L**3 FLUID/L**2 GROSS/T )      OR-A5441
C                                                                       OR-A5442
C        THETA     VOLUMETRIC   WATER  CONTENT ( L**3 FLUID/L**3 GROSS )OR-A5443
C                                                                       OR-A5444
C                                                                       OR-A5445
      KWZI = 0.                                                         OR-A5446
      IF (TBLKWZ.LE.-1) RETURN                                          OR-A5447
      IF (TBLKWZ.EQ.0) GO TO 500                                        OR-A5448
C        CALL THE INTERPOLATION SCHEME TO COMPUTE  KWZI FOR A           OR-A5449
C     GIVEN VALUE OF  THETA                                             OR-A5450
      CALL INTRP (NUMKWZ,TBLKWZ,XKWZ,YKWZ,THETA,KWZI,DYDX,3HKWZ)        OR-A5451
```

```
      RETURN                                                            OR-A5452
C                                                                       OR-A5453
500   CONTINUE                                                          OR-A5454
C     WRITE A FORTRAN PROGRAM SPECIFYING  KWZI AS                       OR-A5455
C     FUNCTIONS OF VOLUMETRIC   WATER  CONTENT WHEN  TBLKWZ  IS ZERO    OR-A5456
C                 EMPIRICAL FORMULAE                                    OR-A5457
C                                                                       OR-A5458
      RETURN                                                            OR-A5459
      END                                                               OR-A5460
```

```
      SUBROUTINE PSIW (THETA,PSI,DPDW)                                  OR-A5461
C                                                                       OR-A5462
C     CONVERT VOLUMETRIC   WATER  CONTENT TO MATRIC POTENTIAL BY USING  OR-A5463
C     A RELATION OF  PSI(THETA)                                         OR-A5464
C                                                                       OR-A5465
C                                                                       OR-A5466
C        DPDW      DERIVATIVE  D(PSI)/D(THETA)                        OR-A5467
C                    WITH UNITS OF (L POTENTIAL*L**3 GROSS/L**3 FLUID)  OR-A5468
C                                                                       OR-A5469
C        PSI       SOIL MATRIC POTENTIAL  ( L POTENTIAL )             OR-A5470
C                                                                       OR-A5471
C        THETA     VOLUMETRIC   WATER  CONTENT OF SOIL                OR-A5472
C                       WITH UNITS OF ( L**3 FLUID/L**3 GROSS )         OR-A5473
C                                                                       OR-A5474
      INTEGER TBLPW                                                     OR-A5475
      COMMON /TABPW/ NUMPW,TBLPW,XPW(50),YPW(50)                        OR-A5476
      PSI=0.                                                            OR-A5477
      DPDW = 0.                                                         OR-A5478
      IF (TBLPW.LE.-1) RETURN                                           OR-A5479
      IF (TBLPW.EQ.0) GO TO 500                                         OR-A5480
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  PSI  AT SPECIFIED       OR-A5481
C     VALUE OF  THETA                                                   OR-A5482
      CALL INTRP (NUMPW,TBLPW,XPW,YPW,THETA,PSI,DPDW,3HPW1)             OR-A5483
      RETURN                                                            OR-A5484
500   CONTINUE                                                          OR-A5485
C                                                                       OR-A5486
C     WRITE A FORTRAN PROGRAM SPECIFYING  PSI  AND  DPDW  AS A FUNCTION OR-A5487
C     OF THE VOLUMETRIC WATER CONTENT WHEN TBLPW IS ZERO                OR-A5488
```

```
C                EMPIRICAL FORMULAE                                     OR-A5489
C                                                                       OR-A5490
C                                                                       OR-A5491
      RETURN                                                            OR-A5492
      END                                                               OR-A5493


      SUBROUTINE PTRNS (TIME,QPS)                                       OR-A5494
C                                                                       OR-A5495
C        COMPUTE THE POTENTIAL TRANSPIRATION DEMAND                     OR-A5496
C                                                                       OR-A5497
C        QPS       POTENTIAL TRANSPIRATION DEMAND                       OR-A5498
C                    WITH UNITS OF (L**3 FLUID/L**2 GROSS/T)            OR-A5499
C                    (A NEGATIVE QUANTITY)                              OR-A5500
C        TIME      TIME   ( T )                                        OR-A5501
C                                                                       OR-A5502
      INTEGER TBLQPS                                                    OR-A5503
      COMMON /TABQPS/ NUMQPS,TBLQPS,XQPS(200),YQPS(200)                 OR-A5504
      QPS = 0.                                                          OR-A5505
      IF (TBLQPS.LE.-1) RETURN                                          OR-A5506
      IF (TBLQPS.EQ.0) GO TO 500                                        OR-A5507
C        CALL THE INTERPOLATION SCHEME TO COMPUTE  QPS  AT THE GIVEN    OR-A5508
C     TIME                                                              OR-A5509
      CALL INTRP (NUMQPS,TBLQPS,XQPS,YQPS,TIME,QPS,DYDX,3HQPS)          OR-A5510
      RETURN                                                            OR-A5511
C                                                                       OR-A5512
C                                                                       OR-A5513
500   CONTINUE                                                          OR-A5514
C     WRITE A FORTRAN PROGRAM SPECIFYING  QPS  AS A FUNCTION OF TIME    OR-A5515
C     WHEN  TBLQPS  IS ZERO                                             OR-A5516
C                EMPIRICAL FORMULAE                                     OR-A5517
C                                                                       OR-A5518
      RETURN                                                            OR-A5519
      END                                                               OR-A5520
```

```
      SUBROUTINE RACTYC (C,RAC)                                          OR-A5521
                                                                         OR-A5522
C                                                                        OR-A5523
C                 ROOT ACTIVITY DUE TO SOLUTE CONTENT                    OR-A5524
C                                                                        OR-A5525
C                                                                        OR-A5526
C        C        LIQUID PHASE SOLUTE CONCENTRATION (M/L**3 FLUID)       OR-A5527
C                                                                        OR-A5528
C        RAC      ROOT ACTIVITY (IN DECIMAL PERCENT) DUE TO THE LIQUID   OR-A5529
C                   PHASE SOLUTE CONCENTRATION.  IT IS A COEFFICIENT     OR-A5530
C                   DESCRIBING THE RELATIVE ACTIVITY OF THE ROOTS AT     OR-A5531
C                   A PARTICULAR NODE DUE TO SOLUTE CONCENTRATION.       OR-A5532
C                                                                        OR-A5533
      INTEGER TBLRAC                                                     OR-A5534
      COMMON /TABRAC/ NUMRAC,TBLRAC,XRAC(50),YRAC(50)                    OR-A5535
      RAC = 1.                                                           OR-A5536
      IF (TBLRAC.LE.-1) RETURN                                           OR-A5537
      IF (TBLRAC.EQ.0) GO TO 500                                         OR-A5538
C      CALL THE INTERPOLATION SCHEME TO COMPUTE  RAC  FOR A GIVEN        OR-A5539
C     VALUE OF LIQUID PHASE SOLUTE CONCENTRATION                         OR-A5540
      CALL INTRP (NUMRAC,TBLRAC,XRAC,YRAC,C,RAC,DYDX,3HRAC)              OR-A5541
      RETURN                                                             OR-A5542
500   CONTINUE                                                           OR-A5543
C                                                                        OR-A5544
C      WRITE A FORTRAN PROGRAM SPECIFYING  RAC  AS A FUNCTION OF LIQUID  OR-A5545
C     PHASE SOLUTE CONCENTRATION WHEN  TBLRAC = 0                        OR-A5546
C                              EMPIRICAL FORMULAE                        OR-A5547
      RETURN                                                             OR-A5548
      END
```

```
      SUBROUTINE RACTYW (THETA,RAW)                                      OR-A5549
                                                                         OR-A5550
C                                                                        OR-A5551
C                 ROOT ACTIVITY DUE TO   WATER  CONTENT                  OR-A5552
C
```

```
C                                                                       OR-A5553
C       RAW       ROOT ACTIVITY (IN DECIMAL PERCENT)                    OR-A5554
C                    DUE TO   WATER  CONTENT                            OR-A5555
C       THETA     VOLUMETRIC   WATER  CONTENT(L**3 FLUID/L**3 GROSS)    OR-A5556
C                                                                       OR-A5557
C                                                                       OR-A5558
      INTEGER TBLRAW                                                    OR-A5559
      COMMON /TABRAW/ NUMRAW,TBLRAW,XRAW(50),YRAW(50)                   OR-A5560
      RAW = 1.                                                          OR-A5561
      IF (TBLRAW.LE.-1) RETURN                                          OR-A5562
      IF (TBLRAW.EQ.0) GO TO 500                                        OR-A5563
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  RAW  FOR A GIVEN VALUE  OR-A5564
C     OF   WATER  CONTENT                                               OR-A5565
      CALL INTRP (NUMRAW,TBLRAW,XRAW,YRAW,THETA,RAW,DYDX,3HRAW)         OR-A5566
      RETURN                                                            OR-A5567
C                                                                       OR-A5568
C                                                                       OR-A5569
500   CONTINUE                                                          OR-A5570
C     WRITE A COMPUTER PROGRAM SPECIFYING  RAW  AS A FUNCTION OF THE    OR-A5571
C     VOLUMETRIC   WATER  CONTENT WHEN  TBLRAW  IS ZERO                 OR-A5572
C                  EMPIRICAL FORMULAE                                   OR-A5573
C                                                                       OR-A5574
      RETURN                                                            OR-A5575
      END                                                               OR-A5576
```

```
      SUBROUTINE RDNSTY (Z,TIME,RD)                                     OR-A5577
C                                                                       OR-A5578
C                                                                       OR-A5579
C     COMPUTE THE ROOT DENSITY AS A FUNCTION OF DEPTH AND TIME          OR-A5580
C                                                                       OR-A5581
C                                                                       OR-A5582
C       RD        ROOT DENSITY (L ROOT/L**3 GROSS) AS A FUNCTION OF     OR-A5583
C                   TIME AND DEPTH                                      OR-A5584
C       TIME      TIME AT WHICH ROOT DENSITY IS TO BE EVALUATED ( T )   OR-A5585
C       Z         DEPTH AT WHICH ROOT DENSITY IS TO BE EVALUATED        OR-A5586
C                   ( L GROSS )                                         OR-A5587
C                                                                       OR-A5588
      INTEGER TBLRD                                                     OR-A5589
```

```
      COMMON /TABRD/ NUMRD,TBLRD,XRD(50),YRD(50)                        OR-A5590
      RD = 0.                                                           OR-A5591
      IF (TBLRD.LE.-1) RETURN                                           OR-A5592
      IF (TBLRD.EQ.0) GO TO 500                                         OR-A5593
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  RD  FOR A GIVEN DEPTH   OR-A5594
C         AND A SPECIFIED TIME                                          OR-A5595
      CALL INTRP (NUMRD,TBLRD,XRD,YRD,Z,RD,DYDX,3HRD )                  OR-A5596
      RETURN                                                            OR-A5597
C                                                                       OR-A5598
C                                                                       OR-A5599
500   CONTINUE                                                          OR-A5600
C     WRITE A FORTRAN PROGRAM SPECIFYING  RD  AS A FUNCTION OF EITHER   OR-A5601
C     TIME AND/OR DEPTH WHEN  TBLRD  IS ZERO                            OR-A5602
C                  EMPIRICAL FORMULAE                                   OR-A5603
      RETURN                                                            OR-A5604
      END                                                               OR-A5605
```

```
      SUBROUTINE RPF (THETA,Z,RPFI)                                     OR-A5606
                                                                        OR-A5607
C                                                                       
C     THE ROOT PRESSURE  FUNCTION EXPRESSES THE LOSS OF POTENTIAL       OR-A5608
C     DUE TO THE RESISTANCE OF THE WATER MOVING UP THE ROOT XYLEM       OR-A5609
C                                                                       OR-A5610
C                                                                       OR-A5611
C        RPFI       THE VALUE OF THE ROOT PRESSURE FUNCTION (L GROSS)   OR-A5612
C                        ( A POSITIVE QUANTITY)                         OR-A5613
C                                                                       OR-A5614
C        THETA      VOLUMETRIC   WATER  CONTENT(L**3 FLUID/L**3 GROSS) OR-A5615
C                                                                       OR-A5616
C        Z          DEPTH(L GROSS)                                      OR-A5617
C                                                                       OR-A5618
      INTEGER TBLRPF                                                    OR-A5619
      COMMON /TABRPF/ NUMRPF,TBLRPF,XRPF(50),YRPF(50)                   OR-A5620
      RPFI = 0.                                                         OR-A5621
      IF (TBLRPF.LE.-1) RETURN                                          OR-A5622
      IF (TBLRPF.EQ.0) GO TO 500                                        OR-A5623
C     CALL THE INTERPOLATION SCHEME TO COMPUTE  RPFI  FOR A GIVEN  DEPTHOR-A5624
      CALL INTRP (NUMRPF,TBLRPF,XRPF,YRPF,Z,RPFI,DYDX,3HRPF)            OR-A5625
      RETURN                                                            OR-A5626
```

```
C                                                                       OR-A5627
C                                                                       OR-A5628
500   CONTINUE                                                          OR-A5629
C        WRITE A FORTRAN PROGRAM SPECIFYING  RPFI  AS A FUNCTION        OR-A5630
C     OF DEPTH WHEN  TBLRPF  IS ZERO                                    OR-A5631
C                              EMPIRICAL FORMULAE                       OR-A5632
      RETURN                                                            OR-A5633
      END                                                               OR-A5634
```

```
      SUBROUTINE WPSI (PSI,THETA,DWDP)                                  OR-A5635
C                                                                       OR-A5636
C                                                                       OR-A5637
C        CONVERT MATRIC TO VOLUMETRIC   WATER  CONTENT BY USING A       OR-A5638
C     RELATION OF  THETA(PSI)                                           OR-A5639
C                                                                       OR-A5640
C        DWDP       DERIVATIVE  D(THETA)/D(PSI)                       OR-A5641
C                     WITH UNITS OF(L**3 FLUID/L**3 GROSS/L POTENTIAL)  OR-A5642
C        PSI        SOIL MATRIC POTENTIAL  ( L POTENTIAL )            OR-A5643
C        THETA      VOLUMETRIC   WATER  CONTENT OF SOIL               OR-A5644
C                     WITH UNITS OF  ( L**3 FLUID/L**3 GROSS )        OR-A5645
C                                                                       OR-A5646
C                                                                       OR-A5647
      REAL KWZDRY,KWZSAT                                                OR-A5648
      INTEGER TBLWP                                                     OR-A5649
      COMMON /TABWP/ NUMWP,TBLWP,XWP(50),YWP(50)                        OR-A5650
      COMMON /WDATA/ GRAV,KWZDRY,KWZSAT,PDRY,PSAT,WDRY,WSAT             OR-A5651
      THETA=0.                                                          OR-A5652
      DWDP = 0.                                                         OR-A5653
      IF (PSI.GT.0.) THETA = WSAT                                       OR-A5654
      IF (PSI.GT.0.) RETURN                                             OR-A5655
      IF (TBLWP.LE.-1) RETURN                                           OR-A5656
      IF (TBLWP.EQ.0) GO TO 500                                         OR-A5657
C        CALL THE INTERPOLATION SCHEME TO COMPUTE  THETA AT THE         OR-A5658
C     SPECIFIED VALUE OF  PSI                                           OR-A5659
      CALL INTRP (NUMWP,TBLWP,XWP,YWP,PSI,THETA,DWDP,3HWP1)             OR-A5660
      RETURN                                                            OR-A5661
500   CONTINUE                                                          OR-A5662
C                                                                       OR-A5663
```

```
C     WRITE A FORTRAN PROGRAM SPECIFYING  THETA  AND  DWDP  AS FUNCTIONSOR-A5664
C     OF THE SOIL MATRIC POTENTIAL WHEN  TBLWP  IS ZERO                 OR-A5665
C                  EMPIRICAL FORMULAE                                   OR-A5666
      RETURN                                                            OR-A5667
      END                                                               OR-A5668
```