Integrated Water Flow Model
IWFM v4.0
Revision 318

User's Manual

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1. Introduction

The purpose of the IWFM user's manual is to serve as a guide for populating input files, running IWFM and understanding the model results. This chapter briefly describes IWFM and the development of the model. A summary of this manual is included in this chapter to help guide the user when working with IWFM.

1.1. IWFM Description

IWFM is a Fortran code written using a mixture of Fortran 95 and Fortran 2003 languages. The model is comprised of a pre-processor, simulation component and post-processors (Figure 1.1). IWFM must be run sequentially and the output generated from one program must be transferred to the next before beginning a model run.

1.2. Summary of IWFM User's Manual

Chapter 1	Introduction
Chapter 2	Discusses general topics related to time-tracking simulation option, preparation of time series input data and file formats recognized by IWFM
Chapter 3	Descriptions of the pre-processor input and output files
Chapter 4	Descriptions of the simulation input data files and output files generated

Chapter 5	Descriptions of the budget tables and the required input needed to tabulate simulation results
Chapter 6	Step-by-step guide of how to run IWFM, which includes running the pre-processor, simulation and budget portions of the program

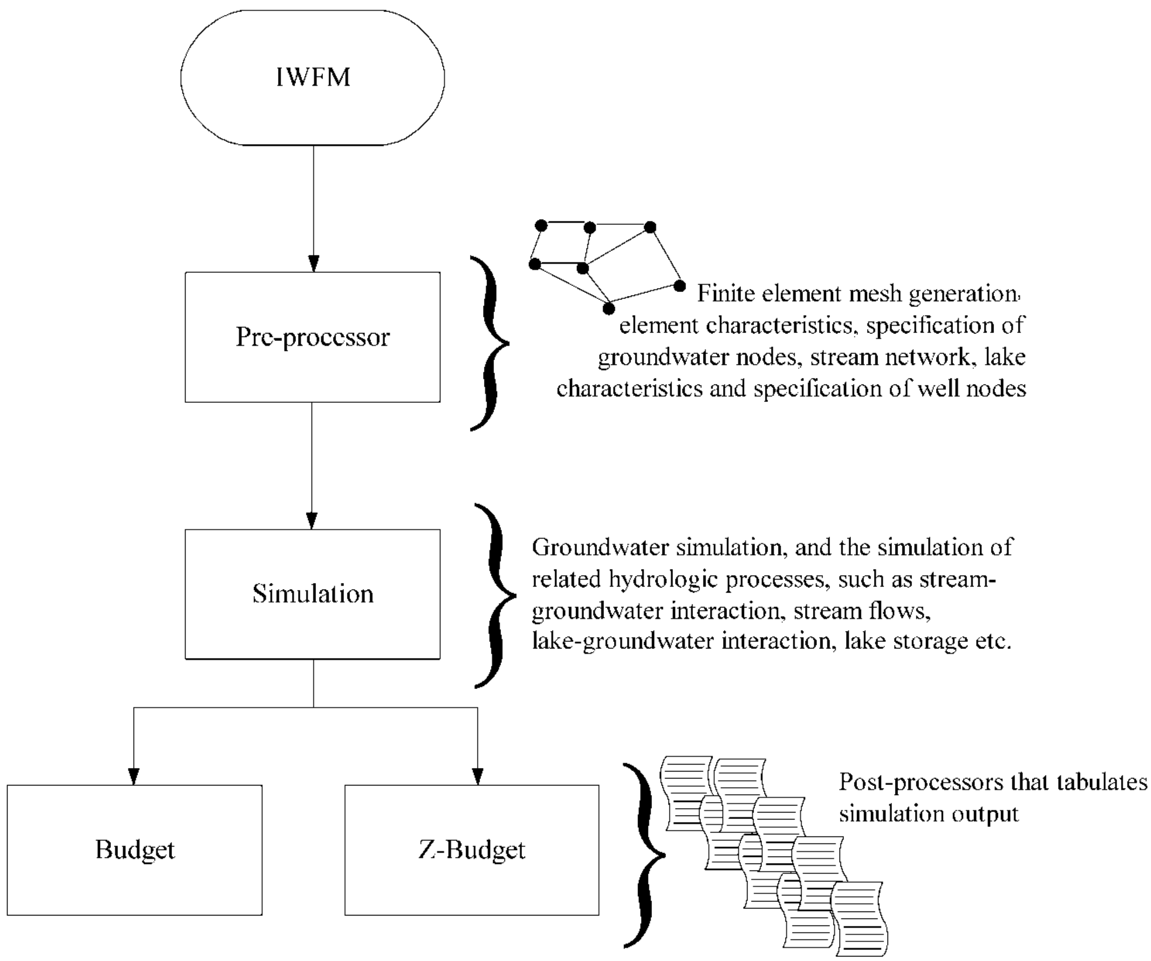


Figure 1.1 IWFM program structure

2. General Topics

2.1. Simulation Time Tracking

IWFM offers two simulation options, namely *time tracking* and *non-time tracking* simulations. In a time tracking simulation, IWFM is aware of the actual dates and times of the start and end of the simulation period. In a non-time tracking simulation, the start of the simulation period is always tagged as time zero and the simulation time is referenced simply by the number of time steps elapsed.

i. Time Tracking Simulation

During a time tracking simulation IWFM keeps track of the date and time of each time step. In such simulations, each data entry in input time series data files is required to have a date and time stamp which allows IWFM to retrieve time series data correctly. This, in return, allows the user to maintain a single set of time series input data files for applications where the starting and ending date and time of the simulation may change. For example, during the calibration stage of a project, the simulation is run for two periods: calibration period and the verification period. In a time tracking simulation, time series input data files can be prepared so that the data covers both the calibration and verification periods. Then the same time series data files can be used for both calibration and verification runs without the need for modification. Since a time tracking simulation keeps track of actual date and time of each of the simulation time steps, IWFM can retrieve the correct data from the time series data files.

Time tracking simulations allow usage of HEC-DSS files as well as ASCII text files for time series data input and output. HEC-DSS is a database format designed by Hydrologic Engineering Center (HEC) of U.S. Army Corps of Engineers specifically for time-series data encountered in hydrologic applications. These files allow efficient storage and retrieval of hydrologic time series data, and HEC offers free utilities (HEC-DSSVue and DSS Excel add-in) for manipulation, visualization and analysis of data stored in DSS files. These utilities and instructions on how to use DSS files can be downloaded from HEC web site at www.hec.usace.army.mil.

Another advantage of time tracking simulations is that results that are printed to output files have date and time stamps associated with them. This allows easy comparison of simulation results to observed values which generally come with the date and time of observation.

It is anticipated that most IWFM applications will use the time tracking simulation option.

ii. Non-time Tracking Simulation

In this simulation option, IWFM is not aware of the actual date and time for the start and end of the simulation period. The start of the simulation period is always zero, and the time during the simulation period is referred to by the elapsed time steps. For instance, assuming length of simulation time step is a month, elapsed simulation time will be referred as month 1, month 2, month 3, etc.

Since IWFM has no means to keep track of actual date and time in a non-time tracking simulation, it is up to the user to arrange the time series input data for proper data reading. For instance, in the calibration stage of a project where the simulation is run for a calibration period and for a verification period, the user will have to maintain two sets of time series input data files. One of these sets will be for the calibration period where the first data corresponds to the first time step in the calibration period, and the other set will be for the verification period where the first data corresponds to the first time step in the verification period.

In non-time tracking simulations, the results will be printed to the output files for each time step without a specific date and time. It is up to the user to convert absolute time steps to actual dates and times to compare them to observed values which generally come with the actual date and time of the observation. Furthermore, in such simulations only the usage of ASCII text files are allowed and the DSS files cannot be used for input or output of time series data.

It is anticipated that non-time tracking simulation option will be used mainly for theoretical problems such as the validation of numerical methods used in IWFM.

2.1.1. Length of Simulation Time Step

i. Time Tracking Simulation

In order to be consistent with the standards of HEC-DSS database files, IWFM restricts the length of simulation time step that can be used in an application. The allowable time step lengths are listed in Table 2.1.

ii. Non-time Tracking Simulation

The length of the simulation time step can be any number that is greater than zero. The user specifies a "tag" for the length of time step but IWFM does not recognize this tag. For example, the length of the time step can be 0.25 and the tag can be “month” IWFM uses the value 0.25 when the numerical methods require a value for Δt (see IWFM Theoretical Documentation), but the “month” tag does not represent anything for IWFM;

Time Step Length	**IWFM Notation**
1 minute	1MIN
2 minutes	2MIN
3 minutes	3MIN
4 minutes	4MIN
5 minutes	5MIN
10 minutes	10MIN
15 minutes	15MIN
20 minutes	20MIN
30 minutes	30MIN
1 hour	1HOUR
2 hours	2HOUR
3 hours	3HOUR
4 hours	4HOUR
6 hours	6HOUR
8 hours	8HOUR
12 hours	12HOUR
1 day	1DAY
1 week	1WEEK
1 month	1MON
1 year	1YEAR

Table 2.1 List of allowable time step lengths in time tracking simulations

it does not know that 0.25 month represents 7.75 days in March, and 7.5 days in April.

2.1.2. Time Stamp Format

In time tracking simulations, start and end date and time of simulation period as well as the date and time of each data entry in time series data input files are required to be specified by using a time stamp. The format of the time stamp is as follows:

MM/DD/YYYY_hh:mm

where

MM	=	two digit month index;
DD	=	two digit day index;
YYYY	=	four digit year;
hh	=	two digit hour in terms of military time (e.g. 1:00pm is represented as 13:00);
mm	=	two digit minute.

The time is represented in military time and midnight is referred to as 24:00. For instance, 05/28/1973_24:00 represents the midnight on the night of May 28, 1973. Another example is the starting date and time of a simulation period: if the initial conditions for a monthly simulation is given for the end of September 30, 1975, then the time stamp for the starting date and time of the simulation will be 09/30/1975_24:00. The first simulation result will be printed for October 31, 1975 at midnight with the time stamp 10/31/1975_24:00.

2.1.3. Preparation of Time Series Data Input Files

i. Time Tracking Simulation

In time tracking simulations, the user is allowed to use a mixture of ASCII text and DSS files for time series input data. In preparing these files, the user should follow the rules listed below:

1. The data should have a regular interval. Gaps in the data are not allowed. For instance, if the data is monthly a value for every month should be entered.
2. The time stamp of the data represents the end of the interval for which the data is valid. For instance, in monthly time series stream inflow data, a data point time stamped with 08/31/1995_24:00 represents the inflow that occurred in August of 1995. As another example, if the starting date and time of the simulation period is 12/31/1970_24:00 (i.e. initial conditions are given at the midnight of December 31, 1970) in a monthly simulation, then IWFM will search for the time series data time stamped as 01/31/1971_24:00 (data for the month of January in 1971) in the time series input files.
3. The smallest interval that can be used for time series data is 1 minute.
4. A time series input data can be constant throughout the simulation period. If an ASCII text file is used for data input, the time stamp for the constant value can be set to a date and time that is greater than the ending date and time of the simulation period. For instance, if the simulation period ends at 06/15/2003_18:00 (6:00pm on June 15, 2003), then the constant value can

have a time stamp 12/31/2100_24:00 (midnight on the night of December 31, 2100). IWFM reads the constant value for the midnight of December 31, 2100 and uses this value for all simulation times before this date and time. Generally, time series input files include conversion factors to convert only the "spatial" component of the input data unit. The temporal unit is deduced from the time interval of the input data. In the case of constant time series data, IWFM is not able to obtain the time interval and, hence, the temporal unit. If a constant value for time series data is used, the user should make sure that appropriate conversion factors are supplied so that the temporal and spatial units of the input data are consistent with those used internally in Simulation. Time series data that is constant can also be represented in DSS files but this is not suggested.

5. For rate-type time series data (e.g. stream inflow data), the time unit is assumed to be the interval of data. For instance, if the stream inflow data is entered monthly, IWFM assumes that the time unit of the flow rates is 1 month. When time series data is a constant value for the entire simulation period IWFM has no way to figure out the time unit of the input data. In this case the user should make sure that the time unit of data is the same as the consistent time unit of simulation

6. For recycled time series data (e.g. fraction of total urban water that is used indoors given for each month but do not change from one year to the other), the year of the time stamp can be set to 4000. Year 4000 is a special flag for IWFM such that it replaces year 4000 with the simulation year to retrieve

the appropriate data from the input file. As an example consider the time series data in Table 2.2 for the fraction of total urban water that is used indoors. This data set represents that for the first third of each simulation year the urban water indoors usage fraction is 0.7, for the second third it is 0.5 and for the last third it is 0.35. Recycled time series data can be used in both ASCII text and DSS files. If a monthly time series data is to be recycled the user should enter the time stamp for the last day of February as 02/29/4000_24:00 to address both the leap and non-leap years.

7. The interval of time series data is required to be synchronized with the simulation time step. Table 2.3 shows examples of accepted and unaccepted situations. It should be noted that IWFM will continue to read data from the input files even if the data interval is not properly synchronized with the simulation time step. However, in such cases there is no guarantee that the correct data will be retrieved from the input file. Therefore, it is up to the user to ensure correct synchronization between the input data and the simulation time step.

Time Stamp	Fraction of Urban Indoors Water
04/30/4000_24:00	0.70
08/31/4000_24:00	0.50
12/31/4000_24:00	0.35

Table 2.2 Example for representation of recycled time series data

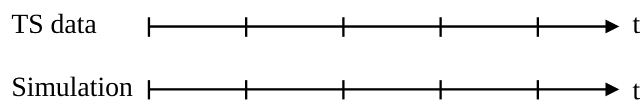
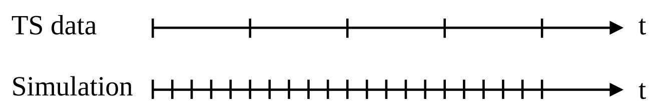
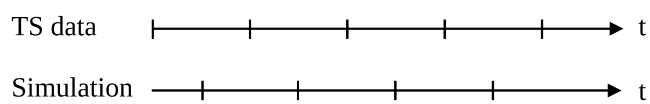
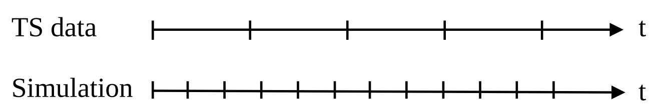
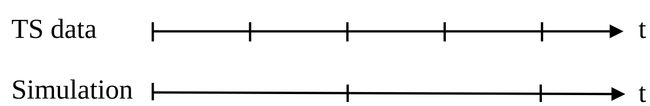
Situation	Graphical Representation	Accepted
Monthly time series data, monthly simulation		Yes
Monthly time series data, daily simulation		Yes
Monthly time series data, monthly simulation (TS data times don't match simulation times)		No
Monthly time series data, weekly simulation		No
Monthly time series data, yearly simulation		No

Table 2.3 Examples for acceptable and unacceptable cases for the syncronization of time series data interval and the simulation time step

ii. Non-time Tracking Simulation

In this case, the first data entry in the input data file should always correspond to the first time step in the simulation. Recycled time series data as well as data that is constant throughout the simulation period can be represented using NSP_ and NFQ_ variables (see the chapter on Simulation for more details). The time tag for each entry in the data file should be an integer number. This number is simply for the user to track the time series data; IWFM does not use it for any purposes.

2.2. Input and Output Data File Types

IWFM can access multiple file formats: (i) ASCII text, (ii) Fortran binary, and (iii) HEC-DSS files. The user can use several file formats in a single application. For instance, some of the input time series data can be read from HEC-DSS files whereas the rest can be read from ASCII text files. Some of the time series simulation results can be printed out to ASCII text files and the others can be printed out to HEC-DSS files.

Although IWFM allows usage of several file formats in a single application, some of the input and output files are required to be in specific formats. For instance, all budget output files generated by Simulation and read in by Budget or Z-Budget post-processors are required to be in Fortran binary format. Another example is the main control input files for all IWFM components; these files are all required to be in ASCII text file format.

IWFM recognizes the file formats from the file name extensions. Table 2.4 lists the file name extensions that are recognized by IWFM for each of the file formats.

File Type	Recognized File Name Extensions
ASCII	.DAT .TXT .OUT .IN .IN1 .IN2 .BUD
Fortran binary	.BIN
HEC-DSS	.DSS

Table 2.4 File name extensions recognized by IWFM

3. Pre-Processor

The pre-processor is the first part of IWFM that is executed when running the model. The program compiles time-independent data such as the spatial, hydrologic, and stratigraphic characteristics specific to a simulation project. Specification of the finite element mesh, stratigraphy, stream network and lakes within the model domain are processed in this part of IWFM. This chapter gives a description of the pre-processor input and output files.

3.1. Input Files

This section consists of input file explanations, the description of variables in each pre-processing input file and sample input files. The user should not judge input file spacing based on the sample input files provided in this documentation, instead refer to the input files from a copy of IWFM.

Table 3.1 specifies the input files that contain required and optional data to run the pre-processing portion of IWFM. The status is based on the input files required to simulate groundwater flow with IWFM, versus groundwater flow simulation in conjunction with other model features, such as stream flows, and lakes.

Pre-Processor Main Input File

The main input file allows a maximum of three lines for a title that is printed to the Pre-processor Standard Output File (PreprocessorMessages.out). ‘C’, ‘c’, or ‘*’

Description	Status
Element configuration	Required
Spatial location of all nodes	Required
Aquifer stratigraphy data	Required
Stream configuration	Optional
Lake configuration	Optional

Table 3.1 List of IWFM pre-processor input files

should not be in the first column of any of the title lines since IWFM treats these lines comments and skips them. All pre-processor input file names are read from the main input file. File names can include relative or absolute paths but must be no more than 500 characters long. Simply leave any file name specification columns blank if an input file is not used. Groundwater simulation requires element configuration data, nodal coordinates, and stratigraphy data. The pre-processor can output all units of length and area, given that the user specifies the conversion factor from simulation units to output units of length and area. The following list represents each input variable specified in the Pre-Processor Main Input File:

KOUT — Option to print time-independent data read by the pre-processor program

KDEB — This print option allows the user to print program messages on the screen during execution of the pre-processor or print the non-zero finite element stiffness matrix components

FACTLTOU — Factor to convert simulation unit of length to the user specified output unit of length

UNITLTOU	The output unit of length, described in maximum of 10 characters
FACTAROU	Factor to convert simulation unit of area to the user specified output unit of area
UNITAROU	The output unit of area, described in a maximum of 10 characters

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                       *** Version ### ***
C
C*******************************************************************************
C
C                            MAIN INPUT FILE
C                        for IWFM Pre-Processing
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: PreProcessor_MAIN.DAT
C
C*****************************************************************************
C                      Titles Printed in the Output
C
C   *A Maximum of 3 title lines can be printed.
C   *Do not use '*' , 'c' or 'C' in the first column.
C
C                          **********************
                                 IWFM
                           Version ### Release
                                  DWR
C                          **********************
C*****************************************************************************
C                             File Description
C
C  *Listed below are all input and output file names used when running the
C   pre-processor for IWFM simulation.
C
C  *Each file name has a maximum length of 500 characters
C
C  *If a file does not exist for a project, leave the filename blank
C   For example, if lakes are not modeled in the project, the file name and
C   description columns for lake configuration file will appear as:
C
C   FILE NAME                                       DESCRIPTION
C                                                   / 6: LAKE DATA FILE
C-----------------------------------------------------------------------------
C   FILE NAME                                       DESCRIPTION
C-----------------------------------------------------------------------------
    OUTPUT1.BIN                                     / 1: BINARY OUTPUT FOR SIMULATION (OUTPUT, REQUIRED)
    ELEMENT.DAT                                     / 2: ELEMENT CONFIGURATION FILE (INPUT, REQUIRED)
    NODEXY.DAT                                      / 3: NODE X-Y COORDINATE FILE (INPUT, REQUIRED))
    STRATA.DAT                                      / 4: STRATIGRAPHIC DATA FILE (INPUT, REQUIRED))
    STREAM.DAT                                      / 5: STREAM GEOMETRIC DATA FILE (INPUT, OPTIONAL)
                                                    / 6: LAKE DATA FILE (INPUT, OPTIONAL)
C------------------------------------------------------------------------------
C******************************************************************************
C                     Pre-Processor Output Specifications
C
C    KOUT; Enter 1 - Print geometric and stratigraphic information
C          Enter 0 - Otherwise
C
C    KDEB; Enter 2 - Print messages on the screen during program execution
C          Enter 1 - Print non-zero Finite Element Stiffness Matrix Components
C          Enter 0 - Otherwise
C-----------------------------------------------------------------------------
C  VALUE                         DESCRIPTION
C-----------------------------------------------------------------------------
     1                           / KOUT
     1                           / KDEB
C-----------------------------------------------------------------------------
C*****************************************************************************
C                  Unit Specifications of Pre-Processor Output
C
C    FACTLTOU; Factor to convert simulation unit of length to specified output unit of length
C    UNITLTOU; The output unit of length (maximum of 10 characters)
C    FACTAROU; Factor to convert simulation unit of area to specified output unit of area
C    UNITAROU; The output unit of area (maximum of 10 characters)
C
C-----------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-----------------------------------------------------------------------------
    1.0                         /FACTLTOU  (ft -> ft)
    FEET                        /UNITLTOU
    0.000022957                 /FACTAROU  (sq.ft. -> acres)
    ACRES                       /UNITAROU
```

Element Configuration File

Element Configuration File details the element configuration for each element represented in the finite element mesh, number of subregions that the model domain is divided into, the name of the subregions and the subregion number that each element belongs to. Each element is configured using three or four nodal points. All elements that represent the model domain are either triangular or quadrilateral. A zero value for IDE(4) indicates that the element is triangular. Nodes corresponding to each element are specified in a counterclockwise manner. Element size should be based on observed or predicted groundwater head gradients throughout the model domain. Therefore, in areas where the flux is large, the size of the elements should be smaller than those located in areas of relatively small flow gradients. IWFM Mesh Generator that is available for download from the IWFM web site can be used to quickly generate the finite element grid. The following variables are required as input in Element Configuration File:

NE	Number of elements within the model domain
NREGN	Number of subregions the model domain is divided into
RNAME	Name of each subregion (maximum 50 characters long)
IE	Element number
IDE	Nodes corresponding to each element number; 3 nodes are associated with each triangular element (4^{th} node should be set to zero) and 4 nodes are associated with each quadrilateral element
IRGE	Subregion number that element IE belongs to

```
C*****************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*****************************************************************************
C
C                         ELEMENT CONFIGURATION FILE
C                          Discretization Component
C                            *** Version 4.0 ***
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: ELEMENT.DAT
C
C*****************************************************************************
C                              File Description
C
C   This file  contains the element configuration for each element.
C   The nodes that make a finite element are listed for each element in
C   a counter-clock wise fashion starting with any node. For triangular elements,
C   the fourth node is specified as zero.
C
C
C   For example,
C
C                    13-------------14----------17
C                     I              I         I
C                     I      2       I   3   I
C                     I              I     I
C                     I              I   I
C                    15------------- 16
C
C
C   The configuration for elements 2 and 3 will be listed as,
C
C            element   node 1    node 2    node 3   node 4
C               2        13        15        16       14
C               3        14        16        17        0
C
C*****************************************************************************
C                          Element Configuration Data
C
C    NE    ;   Number of elements within the model domain
C    NREGN ;   Number of subregions
C
C-----------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-----------------------------------------------------------------------------
    400                           / NE
    4                             / NREGN
C*****************************************************************************
C                              Sub-region Names
C
C   The following lists the names for each sub-region in a sequential order.
C
C------------------------------------------------------------------------------
C
C   RNAME; Sub-region name (max. 50 characters)
C
C------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C------------------------------------------------------------------------------
    Region1                      / RNAME1
    Region2                      / RNAME2
    Region3                      / RNAME3
    Region4                      / RNAME4
C*****************************************************************************
C
C   The data listed below represents all elements and corresponding nodes
C   within the model domain.
C
C   IE;      Element number
C   IDE;     Nodes corresponding to each element
C            *Note* IDE(4) is zero for all triangular elements
C   IRGE;    Subregion number to which element IE belongs to
C
C-----------------------------------------------------------------------------
C   Element     ------------Corresponding Nodes------------------      Subregion
C   IE          IDE(1)        IDE(2)       IDE(3)       IDE(4)          IRGE
C-----------------------------------------------------------------------------
     1           1             2            23           22              1
     2           2             3            24           23              1
     3           3             4            25           24              1
     4           4             5            26           25              1
     5           5             6            27           26              1
     .           .             .            .            .               .
     .           .             .            .            .               .
     .           .             .            .            .               ,
     397         416           417          438          437             4
     398         417           418          439          438             4
     399         418           419          440          439             4
     400         419           420          441          440             4
```

Nodal X-Y Coordinate File

The nodal coordinate file contains node numbers and corresponding x and y coordinates (in relation to a specific origin). Any coordinate units may be used as long as the appropriate conversion factor is given. This file sets up the spatial orientation of the groundwater nodes in the model domain. The finite element mesh is generated from the nodal coordinates, as well as relationship between elements and corresponding groundwater nodes (refer to the Element Configuration File).

ND	Number of groundwater nodes
FACT	Factor to convert nodal coordinates to simulation unit of length
ID	Groundwater node identification number
X	x-coordinate of groundwater node location
Y	y-coordinate of groundwater node location

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                         NODAL X-Y COORDINATE FILE
C                          Discretization Component
C                            *** Version 4.0 ***
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: NODEXY.DAT
C
C*******************************************************************************
C                             File Description
C
C   *This file includes all groundwater nodes that represent the model domain,
C    as well as the x and y coordinates that correspond with each node.
C
C   *The coordinates can be specified for any reference point and coordinate
C    system
C
C*******************************************************************************
C                     Groundwater Node Specifications
C
C   ND;    Number of groundwater nodes
C   FACT;  Conversion factor for nodal coordinates
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
    441                           /ND
    1.0                           /FACT
C-------------------------------------------------------------------------------
C*******************************************************************************
C                       Groundwater Node Locations
C   The following lists the node number and x & y coordinate of each node
C
C   ID;   Groundwater node number
C   X,Y;  Coordinates of groundwater node location; [L]
C
C-------------------------------------------------------------------------------
C   Node     ----------Coordinates----------
C    ID           X                  Y
C-------------------------------------------------------------------------------
      1        0.0                0.0
      2        2000.0             0.0
      3        4000.0             0.0
      4        6000.0             0.0
      5        8000.0             0.0
      .        .                  .
      .        .                  .
      .        .                  .
    437        32000.0            40000.0
    438        34000.0            40000.0
    439        36000.0            40000.0
    440        38000.0            40000.0
    441        40000.0            40000.0
```

Stratigraphy File

The stratigraphy data represents the composition, distribution, and succession of aquifer layers. Each aquifer layer can be classified as confined or unconfined. For a confined layer, information must be provided about confining layer (aquiclude or aquitard). The data file specifies each aquifer layer. The conversion factor in the data file converts elevations and thicknesses to simulation unit of length. The ground surface elevation and the thickness of each layer (and corresponding confining layer) at each node are required stratigraphy input data.

If the thickness of the aquiclude or aquitard is set to zero, there is no separating confining layer that distinguishes an aquifer layer from the adjacent layer. If thickness of an aquifer layer is set to zero, this implies that the groundwater node at that aquifer layer is an inactive node and the aquifer layer does not exist at that location. The following input is required in the stratigraphy data file:

NL	Number of aquifer layers modeled in IWFM; each layer consists of an aquifer and aquiclude or aquitard
FACT	Factor to convert stratigraphic data from user input units to the simulation unit of length
ID	Groundwater node
ELV	Ground surface elevation relative to a common datum, [L]
W	Thickness of the aquifer layer, and its confining layer (if the layer is confined). If the layer is unconfined, specify the aquitard thickness as zero

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C
C*******************************************************************************
C
C                           STRATIGRAPHY FILE
C                         Discretization Component
C                           *** Version 4.0 ***
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: STRATA.DAT
C
C*******************************************************************************
C                          File Description
C
C   This data file contains:
C   *the ground surface elevation,
C   *the number of aquifer layers to be modeled, and
C   *the thickness of each aquifer and corresponding confining layer (if any)
C   at each groundwater node within the model domain.
C
C*******************************************************************************
C                   Stratigraphy Specification Data
C
C   NL;    Number of layers to be modeled
C   FACT;  Conversion factor for elevations and thicknesses in the
C          stratigraphic data
C-------------------------------------------------------------------------------
C   VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
    2                           /NL
    1.0                         /FACT
C-------------------------------------------------------------------------------
C*******************************************************************************
C                         Stratigraphy Data
C
C  *The stratigraphy data represents the geology that deals with the origin,
C   composition, distribution and succession of groundwater layers.
C
C  *Each groundwater layer is specified as an aquifer and aquiclude or aquitard.
C   If there is no aquiclude or aquitard within the layer, specify a thickness
C   of zero
C
C  *The stratigraphy data includes the ground surface elevation, as well as the
C   thickness of the aquifer, aquitard, or aquiclude at each groundwater node
C
C   ID;      Groundwater node
C   ELV;     Ground surface elevation with respect to a common datum; [L]
C   W(1);    Thickness of aquiclude in Layer 1; [L]
C   W(2);    Thickness of aquifer in Layer 1; [L]
C   W(3);    Thickness of aquiclude in Layer 2; [L]
C   W(4);    Thickness of aquifer in Layer 2; [L]
C   W(5);    Thickness of aquiclude in Layer 3; [L]
C   W(6);    Thickness of aquifer in Layer 3; [L]
C
C------------------------------------------------------------------------------
C    Node  Elevation   --Layer #1--     --Layer #2--     --Layer #3--   ...
C     ID     ELV        W(1)   W(2)     W(3)    W(4)      W(5)    W(6)  ...
C------------------------------------------------------------------------------
       1    500.0       0.0    500.0    10.0    100.0
       2    500.0       0.0    500.0    10.0    100.0
       3    500.0       0.0    500.0    10.0    100.0
       4    500.0       0.0    500.0    10.0    100.0
       5    500.0       0.0    500.0    10.0    100.0
       .    .           .      .         .      .
       .    .           .      .         .      .
       .    .           .      .         .      .
     436    500.0       0.0    500.0     0.0    100.0
     437    500.0       0.0    500.0     0.0    100.0
     438    500.0       0.0    500.0     0.0    100.0
     439    500.0       0.0    500.0     0.0    100.0
     440    500.0       0.0    500.0     0.0    100.0
     441    500.0       0.0    500.0     0.0    100.0
```

Stream Configuration File

Stream flow is modeled using one-dimensional line segments. The Stream Configuration File contains all of the stream nodes and their spatial orientation. The first line of the data file lists the version number of the IWFM stream component preceded by a # sign. IWFM checks this version number for consistency; therefore, this line must not be deleted or modified. The Stream Configuration File includes the stream network configuration, which is specified for each reach. Following the stream reach data is the rating table for each of the stream nodes. Based on the rating table values, interpolation is used to determine the stream flow for a specific stream elevation. The following parameters must be specified at the beginning of the stream configuration file for the simulation of stream flows:

NRH	Number of stream reaches modeled
NR	Number of stream nodes modeled
NRTB	Number of data points in each rating table. A rating table is given for each stream node specified within the model domain

Stream Reaches

For each reach of a river, the following items are specified: reach identification number (ID), first upstream node of reach ID, last downstream node of reach ID, and the stream node that reach ID flows into. The stream nodes are then listed, followed by the groundwater node that the stream node corresponds to.

If flow from a stream reach contributes to a lake, then the lake number preceded by a negative sign should be entered instead of the stream node number that reach ID flows into. The lake numbers are listed in the lake data file. The following parameters are specified in the stream reach specification portion of the Stream Configuration File:

ID	Reach identification number
IBUR	First upstream node of reach ID
IBDR	Last downstream node of reach ID
IDWN	Stream node that reach ID flows into (enter zero if stream flow leaves the modeled area; enter –*nlk* if stream flow enters lake number *nlk*)
NAME	Name of the stream reach (maximum 20 characters long)
IRV	Stream node number
IGW	Groundwater node that the stream node IRV corresponds to

Rating Table

Each stream node and corresponding stream bottom elevation are specified in this file, along with a rating table for each stream node that specifies the flow rate for various stream elevations. The purpose of a rating table is to determine stream flow rate, given a specific stream elevation. Factors to convert stream depths and stream bottom elevations to simulation unit of length and stream flows to simulation unit of flow rate are required.

FACTLT	Factor to convert stream bottom elevation and depth to simulation unit of length
FACTQ	Factor to convert the spatial component of the rating table flow rates into simulation unit of volume. For instance, if the rating table flow rates are given in ac.ft./month and the consistent

simulation units for volume and time are cu.ft. and day, respectively, then this variable should be set to 2.29568E-05 (to convert ac.ft./month to cu.ft./month). The conversion of cu.ft./month to cu.ft./day is performed dynamically in the Simulation part since each month has a different number of days. This variable can also be used to convert flow rate units that are not recognized by IWFM to units that are recognized. For instance, if the flow rates are given in units of cfs (IWFM doesn't recognize second as a unit of time), this variable can be set to 60 to convert cfs into cu.ft./min and variable TUNIT can be set to 1MIN.

TUNIT	Time unit of the rating table flow rates
ID	Stream node number
BOTR	Stream bottom elevation relative to a common datum, [L]
HRTB	Stream depth, [L]
QRTB	Flow rate at stream depth HRTB, [L^3/T]

```
#4.0
C *** DO NOT DELETE ABOVE LINE ***
C
C*******************************************************************************
C
C                    INTEGRATED WATER FLOW MODEL (IWFM)
C                           *** Version ### ***
C
C*******************************************************************************
C
C                       STREAM SPECIFICATION FILE
C                        for IWFM Pre-Processing
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: STREAM.DAT
C
C*******************************************************************************
C                             File Description
C
C   *All stream/river nodes modeled in IWFM are specified with respect to their
C    corresponding groundwater nodes
C
C   *A flow versus depth rating table is specified for each stream node
C
C*******************************************************************************
C                     Stream Reach Specifications
C
C   NRH;   Number of stream reaches modeled
C   NR;    Number of stream nodes modeled
C   NRTB;  Number of data points in stream rating tables
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    3                           / NRH
    23                          / NR
    5                           / NRTB
C-------------------------------------------------------------------------------
C*******************************************************************************
C                      Description of Stream Reaches
C
C   The following lists the stream nodes and corresponding groundwater
C   nodes for each stream reach modeled in IWFM.
C
C   ID;    Reach number
C   IBUR;  First upstream stream node of the reach
C   IBDR;  Last downstream node of the reach
C   IDWN;  Stream node into which the reach flows into
C              0: If stream flow leaves the modeled area
C           -nlk: If stream flows into lake number nlk
C   NAME;  Name of the reach (maximum 20 characters)
C
C   Additionally, for each stream node within the reach the corresponding
C   groundwater node number is listed.
C
C   IRV;   Stream node
C   IGW;   Corresponding groundwater node
C
C-------------------------------------------------------------------------------
C     REACH  1
C   Reach  Upstream  Downstream  Outflow   Reach
C           Node       Node       Node      Name
C   ID      IBUR       IBDR       IDWN      NAME
C-------------------------------------------------------------------------------
     1        1          10        -1       Reach1
C-------------------------------------------------------------------------------
C   Stream    Groundwater
C   node         node
C   IRV          IGW
C-------------------------------------------------------------------------------
     1          433
     2          412
     .           .
     .           .
     .           .
     9          265
    10          264
C-------------------------------------------------------------------------------
C     REACH 2
C   Reach  Upstream  Downstream  Outflow   Reach
C           Node       Node       Node      Name
C   ID      IBUR       IBDR       IDWN      NAME
C-------------------------------------------------------------------------------
     2       11         16         17       Reach2
C-------------------------------------------------------------------------------
C   Stream    Groundwater
C   node         node
C   IRV          IGW
C-------------------------------------------------------------------------------
    11          222
     .           .
     .           .
    16          139
C-------------------------------------------------------------------------------
C     REACH  3
C   Reach  Upstream  Downstream  Outflow   Reach
C           Node       Node       Node      Name
C   ID      IBUR       IBDR       IDWN      NAME
C-------------------------------------------------------------------------------
     3       17         23          0       Reach3
C-------------------------------------------------------------------------------
C   Stream    Groundwater
C   node         node
C   IRV          IGW
C-------------------------------------------------------------------------------
    17          139
     .           .
     .           .
     .           .
    23          13
```

```
C*******************************************************************************
C                              Stream rating tables
C
C   FACTLT; Conversion factor for stream bottom elevation and stream depth
C   FACTQ;  Conversion factor for rating table flow rates
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of flow rate listed in this file      = AC.FT./MONTH
C                    Consistent unit used in simulation         = CU.FT/DAY
C                    Enter FACTQ (AC.FT./MONTH -> CU.FT./MONTH) = 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   TUNIT;  Time unit of flow rate.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Simulation Main
C             Control File.
C
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
      1.0                         / FACTLT
      60.0                        / FACTQ  (cfs -> cu.ft/min since seconds cannot be represented in Simulation)
      1MIN                        / TUNIT
C-------------------------------------------------------------------------------
C   The following lists a stream rating table for each of the stream nodes
C   *Note* In order to define a specified stream depth, enter all HRTB values
C           as equal to the specified depth value
C
C   ID;    Stream node number
C   BOTR;  Stream bottom elevation relative to a common datum [L]
C   HRTB;  Stream depth [L]
C   QRTB;  Flow rate at stream depth HRTB [L^3/T]
C
C------------------------------------------------------------
C   Stream    Bottom    Stream     Flow
C   node     elevation  depth      rate
C   ID         BOTR     HRTB       QRTB
C------------------------------------------------------------
     1         300.0     0.0       0.00
                         2.0       734.94
                         5.0       3299.29
                         15.0      19033.60
                         25.0      41568.45
     2         298.0     0.0       0.00
                         2.0       734.94
                         5.0       3299.29
                         15.0      19033.60
                         25.0      41568.45
     3         296.0     0.0       0.00
                         2.0       734.94
                         5.0       3299.29
                         15.0      19033.60
                         25.0      41568.45
     .          .        .         .
                         .         .
                         .         .
     .          .        .         .
                         .         .
                         .         .
    23         260.0     0.0       0.00
                         2.0       734.94
                         5.0       3299.29
                         15.0      19033.60
                         25.0      41568.45
```

Lake Configuration File

The Lake Configuration File specifies the number of lakes modeled and the elements that make up each lake. The first line of the data file lists the version number of the IWFM lake component preceded by a # sign. IWFM checks this version number for consistency; therefore, this line must not be deleted or modified. Each lake is specified by an identification number. The destination for the outflow from each lake is required, followed by the number of elements that each lake encompasses and the element numbers that correspond to the lake region. The following lists the lake input:

NLAKE	Number of lakes modeled
ID	Lake identification number
TYPDST	Destination type for lake outflow (0 if lake outflow goes outside the model domain, 1 if lake outflow contributes to a stream node, or 3 if lake outflow contributes to a downstream lake)
DST	Destination number for lake outflow (any value if TYPDST is set to 0, stream node number if TYPDST is set to 1, and lake number if TYPDST is set to 3)
NELAKE	Number of elements that a lake encompasses
IELAKE	Element number over which the lake is located

```
#4.0
C *** DO NOT DELETE ABOVE LINE ***
C
C*****************************************************************************
C
C                    INTEGRATED WATER FLOW MODEL (IWFM)
C                           *** Version ### ***
C
C*****************************************************************************
C
C                   LAKE CONFIGURATION DATA FILE
C                     for IWFM Pre-Processing
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: LAKE.DAT
C
C*****************************************************************************
C
C                             File Description:
C
C   This data file contains the number of lakes being modeled,
C   destination for lake outflow and the finite elements included in each lake.
C
C*****************************************************************************
C                  Lake Configuration Data
C
C   NLAKE  ; Number of lakes that are being modeled
C
C-----------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-----------------------------------------------------------------------------
      1                        / NLAKE
C-----------------------------------------------------------------------------
C
C   The following lists the area and elevation for the NLAKE number of lakes
C
C   ID    ;  Sequential number for the lakes
C   TYPDST;  Destination type for lake outflow
C              0 = Lake outflow goes outside the model domain
C              1 = Lake outflow goes to stream node DST (see below)
C              3 = Lake outflow goes to downstream lake DST (see below)
C   DST   ;  Destination number for lake outflow
C              * Note: Enter any number if TYPDST is 0
C   NELAKE;  Number of lake elements where lake lies
C   IELAKE;  Element in which the lake is located
C
C--------------------------------------------------------------------
C     ID    TYPDST      DST       NELAKE        IELAKE
C--------------------------------------------------------------------
      1       1         11         10            169
                                                 170
                                                 171
                                                 188
                                                 189
                                                 190
                                                 207
                                                 208
                                                 209
                                                 210
```

3.2. Output Files

Binary Output File

The Binary Output File contains the pre-processing information used in the simulation portion of IWFM. This file must be copied to the folder with the IWFM simulation executable program.

Pre-processor Standard Output File (PreprocessorMessages.out)

The Pre-processor Standard Output File provides the user with data that was processed in the pre-processor portion of IWFM. The following list indicates the information available in this output file:

- Project title (specified in the Pre-Processor Main Input File)
- Date and time of run, which is determined internally within the program
- List of input files read in the pre-processing program
- Various warning and/or error messages
- Subregional areas
- Number of nodes, triangular elements, quadrilateral elements and groundwater layers
- Nodal x-y coordinates and areas associated with each node
- Elements, corresponding nodes, and elemental areas
- Top and bottom elevations of aquifer layers
- IUD variable at a node of an aquifer layer

IUD = 1 : the node is active; i.e. the aquifer layer exists at the particular node

IUD = –99 : the node is inactive; i.e. the aquifer layer thickness is zero and the layer does not exist at the particular node

- Stream reach information
- Number of active layers at each node
- Node numbers surrounding each groundwater node
- Non-zero components of conductance matrix
- Execution time for the pre-processor program

```
*************************************************************************************************************************************
                                                         IWFM
                                                  Version ### Release
                                                          DWR
*************************************************************************************************************************************

THIS RUN IS MADE ON 04/25/2012 AT 15:41:32

THE FOLLOWING FILES ARE USED IN THIS SIMULATION:
 1                                 ..\Simulation\OUTPUT1.BIN
 2                                 ELEMENT.DAT
 3                                 NODEXY.DAT
 4                                 STRATA.DAT
 5                                 STREAM.DAT
 6                                 LAKE.DAT

REGION =   1   197680.87  ACRES
REGION =   2   197680.87  ACRES
      TOTAL    395361.73  ACRES

NO. OF NODES                            ( ND): 441
NO. OF TRIANGULAR ELEMENTS              (NET): 0
NO. OF QUADRILATERAL ELEMENTS           (NEQ): 400
NO. OF TOTAL ELEMENTS                   ( NE): 400
NO. OF LAYERS                           ( NL): 2
SUM OF CONNECTING NODES FOR EACH NODE ( NJ): 9335


    NODE           X             Y      AREA(ACRES)
       1    1804440.00   14435520.00       247.10
       .             .             .            .
       .             .             .            .
       .             .             .            .
     441    1935672.00   14566752.00       247.10


   ELEMENT            NODE           AREA(ACRES)
        1       1     2    23    22       988.40
        .       .     .     .     .            .
        .       .     .     .     .            .
        .       .     .     .     .            .
      400     419   420   441   440       988.40


    *** TOP AND BOTTOM ELEVATIONS OF AQUIFER LAYERS (FEET) ***
  NODE  GRND.SURF.          LAYER  1                      LAYER  2
                    IUD        TOP     BOTTOM    IUD        TOP     BOTTOM
     1      500.00    1     500.00       0.00      1     -10.00    -110.00
     .           .    .          .          .      .          .          .
     .           .    .          .          .      .          .          .
     .           .    .          .          .      .          .          .
   441      500.00    1     500.00       0.00      1       0.00    -100.00

REACH STREAM GRID     GROUND   INVERT             AQUIFER   ALLUVIAL    UPSTREAM
  NO.   NO.   NO.     ELEV.    ELEV.     DEPTH    BOTTOM  THICKNESS      NODES
                         (ALL UNITS ARE IN FEET)
     1     1   433     500.0    300.0     200.0       0.0     300.0
     1     2   412     500.0    298.0     202.0       0.0     298.0        1
     .     .     .         .        .         .         .         .        .
     .     .     .         .        .         .         .         .        .
     .     .     .         .        .         .         .         .        .
     3    22    34     500.0    262.0     238.0       0.0     262.0       21
     3    23    13     500.0    260.0     240.0       0.0     260.0       22


 NODE   # OF ACTIVE LAYERS   TOP ACTIVE LAYER   SURROUNDING GW NODES
    1                    2                  1        2    22    23
    .                    .                  .        .     .     .
    .                    .                  .        .     .     .
    .                    .                  .        .     .     .
  441                    2                  1      419   420   440


 ELEMENT              ELEMENT MATRIX COMPONENTS
     1        -0.17     -0.33     -0.17     -0.17     -0.33     -0.17
     .            .         .         .         .         .         .
     .            .         .         .         .         .         .
     .            .         .         .         .         .         .
   400        -0.17     -0.33     -0.17     -0.17     -0.33     -0.17

**************************************************
TOTAL RUN TIME:  0.220 SECONDS
**************************************************
```

4. Simulation

The simulation portion of IWFM models the groundwater flow and related processes within the project domain for a simulation time period. This chapter details the input and output files associated with this portion of the program.

4.1. Input Files

This section consists of input file explanations, the description of variables in each simulation input file and a sample of each input file.

In setting the spatial and temporal input data to be used in IWFM runs, the user is free to specify data with any units as long as the correct conversion factors are specified. IWFM does not use a particular set of units internally. Instead, the user decides on the units to be used and it is the user's responsibility to specify appropriate conversion factors in the input data files to convert a particular data unit to the unit used during simulation. Preparation of each data file includes the entry of relevant conversion factors that need to be specified by the user.

All time series data files require specifying the NSP_ and NFQ_ variables. For instance, in the Stream Inflow Data File these variables appear as NSPSTRM and NFQSTRM, respectively. These variables are included in time-series data files in order to make the entry of repetitive data more convenient. NSP_ variable is the number of time steps before a particular time-series data is updated. NFQ_ variable is the repetition frequency of the particular data file. As an example, consider irrigation months (i.e.

growing period) for a specific crop. The irrigation month (specified as 1 if the crop is grown in a given month, or 0 if it is not) will change in a given water year but will likely stay the same from one year to another. Therefore, generally one value of irrigation period flag is defined for each month of the year and these values are used for the corresponding months of all simulation years. The repetitive irrigation period data entry can be avoided by the use of NSP_ and NFQ_ variables. If IWFM is run on a monthly time step, then NSPIP in the Irrigation Period Data File can be set as 1, NFQIP as 12 and the 12 monthly irrigation period flags can be listed afterwards with the first irrigation period flag corresponding to the first simulation month. This means that IWFM will read an irrigation period flag at the beginning of every time step (NSPIP = 1) and when it reads in 12 values (NFQIP = 12) it will rewind the data file and start reading irrigation period flags from the beginning of the file.

As another example, consider using the same monthly irrigation period flags with a daily IWFM run. Assuming that there are 30 days in each month (IWFM does not make such assumptions internally. It is up to the user to make and defend such assumptions) the same 12-value irrigation period data can be used by setting NSPIP to 30 and NFQIP to 12. This time IWFM will read an irrigation period flag and use it for 30 time steps (NSPIP = 30), i.e. 30 days. At the beginning of the 31^{st} time step, i.e. 31^{st} day, it will read in the next irrigation period flag and use it for another 30 time steps. When a total of 12 readings from the Irrigation Period Data File is made (NFQIP = 12), IWFM will rewind the data file and continue reading values from the start of the file. If, on the other hand, the full time series data for the entire simulation period is supplied then NFQ_ variable should be set to zero.

Although NSP_ and NFQ_ values are used only in non-time tracking simulations, the user is required to input a value for these variables in time tracking simulations as well. The following sections give detailed descriptions of each input and output data file involved in simulation part of IWFM.

Simulation Main Input File

The main input file for IWFM simulation is similar to the Pre-processor Main Input File, in that it contains the file names for all data files, output files, and binary files as well as unit output specifications. The character 'c', 'C', or '*', in the first column indicates a comment line in the data file. These characters cannot be placed in the first column to be read as input. The title of the model run is specified in this file and is printed to the Simulation Standard Output File (SimulationMessages.out). The program accepts a maximum of three title lines. The input and output file names are included in this file. The simulation period start and time as well as time step length are also specified. The simulation option as time tracking or non-time tracking is specified with the format of the time for the start of the simulation period.

Four output and debugging options are available in IWFM. A value of 2 directs the program to print messages regarding the program execution to the screen. A value of 1 prints aquifer parameter data to Simulation Standard Output File. Printing the aquifer parameter data is useful during model calibration. Above options can be turned off by specifying KDEB as zero. Finally, setting KDEB to -1 turns off all screen output. This option may decrease program execution times on some operating systems.

Some simulation results can be written to text output files. The information in the output files is displayed based on the unit conversion factors and unit names specified in this input file. The output unit control parameters are used to display the output files in the units specified by the user.

Solution scheme control parameters (namely the solution method, the relaxation parameter, maximum number of iterations and convergence criteria for the solution of equation system, non-linear soil moisture and the supply adjustment) are also specified in this file. The user can choose between two matrix inversion methods, namely the successive overrelaxation (SOR) and the generalized preconditioned conjugate gradient (GMRES) methods. If SOR method is used then the overrelaxation parameter should be set to a value between 1.0 and 2.0. For GMRES method this parameter is not used even though some value has to be entered to avoid immature stopping of the Simulation program. It should be noted that the convergence criteria and the maximum number of iterations specified for soil moisture routing in this file are only used in the simulation of small watersheds and the unsaturated zone. These parameters for the routing of the moisture in the root zone are specified separately in a different file (discussed later). In the situation that the solution of the system of equations or the non-linear conservation equation for soil moisture does not satisfy the specified convergence criteria within the maximum number of iterations set, the user should re-evaluate the convergence criteria and/or maximum number of iterations set. The convergence criteria and the maximum iteration number for the supply adjustment are used if automated supply adjustment is turned on.

The functionality of adjusting surface water diversions and/or pumping internally can be activated by setting KOPTDV to a value other than 00.

The following is a list of the variables used in this data file:

BDT	Beginning date and time for the simulation. If it is a time tracking simulation , it should have a MM/DD/YYYY_hh:mm format. If it is a non-time tracking simulation, it should be a real number.
DELTAT	Time step used in the simulation of hydrologic processes. This variable is used only for non-time tracking simulations. At this point, this value is hard coded as 1.0.
UNITT	For time tracking simulation, this is the time step length and unit. The user is expected to choose one of the options listed in the Simulation Main Input File. If non-time tracking simulation, then this is the unit of time step DELTAT with a maximum of 10 characters.
EDT	Ending time of simulation period. If it is a time tracking simulation, it should have the MM/DD/YYYY_hh:mm format. In non-time tracking simulations it is a real number. For instance, assume that BDT is set to 5.0 and DELTAT to 1.0 in a non-time tracking simulation. If the length of simulation period is 100.0 then this variable should be set to 105.0.
KDEB	Switch for output and debugging options (2 = print messages on the screen to monitor execution; 1 = print aquifer parameter data to the Simulation Standard Output File; 0 = turn off output and

	debugging options; -1 = suppress printing of simulation timesteps on the screen)
CACHE	This is the minimum number of simulation results for each time series output data that is stored in the computer memory before saved onto the hard disk. The actual number is specified internally in IWFM based on the characteristics of the output data. For instance, if a model domain has a total of 200 groundwater nodes and if CACHE is set to 2000, then 10 time step worth of groundwater head values will be stored in the memory before being saved onto the hard disk. If CACHE is set to 200, only 1 time step worth of groundwater head values will be stored in the memory. If it is set to 20, still 1 time step worth of head values will be stored in the memory. The value set for the CACHE variable can have a substantial effect on the speed of the simulation especially if DSS files are being used for output.
FACTLTOU	Factor to convert simulation unit of length to output unit of length
UNITLTOU	Output unit of length (maximum 10 characters long)
FACTAROU	Factor to convert simulation unit of area to output unit of area
UNITAROU	Output unit of area (maximum 10 characters long)
FACTVLOU	Factor to convert simulation unit of volume to output unit of volume
UNITVLOU	Output unit of volume (maximum 10 characters long)

FACTVROU	Factor to convert simulation unit of volumetric flow rate into intended output unit of volumetric flow rate
UNITVROU	Output unit of volumetric flow rate (maximum 10 characters long)
MSOLVE	Matrix solution method. Enter 1 to use the successive overrelaxation (SOR) method, or enter 2 to use the generalized preconditioned conjugate gradient method
RELAX	Relaxation parameter for the successive overrelaxation method used in solving the system of equations (value should be between 1.0 and 2.0). A value must still be supplied even if generalized preconditioned conjugate gradient method (MSOLVE = 2) is chosen to invert the coefficient matrix.
MXITER	Maximum number of iterations for the solution of system of equations that represent the mass conservation for streams, lakes and groundwater
MXITERSM	Maximum number of iterations for the nonlinear soil moisture accounting. This parameter is used only for the simulation of small watersheds and the unsaturated zone
MXITERSP	Maximum number of iterations for supply adjustment
STOPC	Convergence criteria for groundwater, stream and lake head difference, [L]
STOPCSM	Convergence criteria for soil moisture, [L]. This parameter is used only for the simulation of small watersheds and the unsaturated zone

STOPCSP	Fraction of water demand to be used as a convergence criteria for iterative supply adjustment. If the difference between the water supply and water demand at agricultural and/or urban lands in a grid cell is less than this convergence criteria, then supply adjustment is skipped.
KOPTDV	Switch to turn on or off the automated water supply adjustment functionality of IWFM. It is specified as a two digit number. First digit from left turns on or off the adjustment of groundwater pumping (0 = no adjustment; 1 = adjust groundwater pumping). Second digit from left turns on or off the adjustment of surface water diversions (0 = no adjustment for diversions; 1 = adjust diversions so that diversions meet the total water demand less the groundwater pumping). If both diversions and pumping are specified to be adjusted, then diversions are adjusted first and pumping is adjusted second. If KOPTDV is set to a value other than 00, then the Supply Adjustment Specification File should also be supplied.

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                            MAIN INPUT FILE
C                          for IWFM Simulation
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: Simulation_MAIN.IN
C
C*******************************************************************************
C                              File Description
C
C    This file contains the title of the run to be printed in the output,
C    the names and descriptions of all simulation input files, conversion
C    factors and output control options for running the simulation model.
C
C*******************************************************************************
C                        Titles Printed in the Output
C
C   *A maximum of 3 title lines can be printed.
C   *Do not use '*' , 'c' or 'C' in the first column of the title lines.
C
C                          **********************
                                  IWFM
                           Version ### Release
                                   DWR
C                          **********************
C******************************************************************************
C                            File Description
C
C  *Listed below are all input and output file names used when running the
C   IWFM simulation.
C
C  *Each file name has a maximum length of 1000 characters
C
C  *If a file does not exist for a project, leave the filename blank
C   For example, if tile drains are not modeled in the project, the file name and
C   description columns for unit 14 will appear as:
C
C   FILE NAME                                 DESCRIPTION
C                                             /14: TILE DRAINS PARAMETER DATA FILE
C-----------------------------------------------------------------------------------------
C    FILE NAME                                DESCRIPTION
C-----------------------------------------------------------------------------------------
     PreProcessor.bin                         / 1: BINARY INPUT GENERATED BY PRE-PROCESSOR (INPUT, REQUIRED)
     Parameter.dat                            / 2: PARAMETER DATA FILE (INPUT, REQUIRED)
     RootZone\RootZone_MAIN.dat               / 3: ROOT ZONE COMPONENT MAIN FILE (INPUT, OPTIONAL)
     Stream\Stream_MAIN.dat                   / 4: STREAM COMPONENT MAIN FILE (INPUT, OPTIONAL)
     Lake\Lake_MAIN.dat                       / 5: LAKE COMPONENT MAIN FILE (INPUT, OPTIONAL)
     Bound.dat                                / 6: BOUNDARY CONDITION DATA FILE (INPUT, REQUIRED)
     BoundTSD.dat                             / 7: TIME SERIES BOUNDARY CONDITIONS (INPUT, OPTIONAL)
     Print.dat                                / 8: PRINT CONTROL FILE (INPUT, OPTIONAL)
     Init.dat                                 / 9: INITIAL CONDITION DATA FILE (INPUT, REQUIRED)
     IrigFrac.dat                             /10: IRRIGATION FRACTIONS DATA FILE (INPUT, OPTIONAL)
     SupplyAdjust.dat                         /11: SUPPLY ADJUSTMENT SPECIFICATION DATA FILE (INPUT, OPTIONAL)
     Precip.dat                               /12: PRECIPITATION DATA FILE (INPUT, OPTIONAL)
     ET.dat                                   /13: EVAPOTRANSPIRATION DATA FILE (INPUT, OPTIONAL)
     TileDrain.dat                            /14: TILE DRAINS PARAMETER DATA FILE (INPUT, OPTIONAL)
     Pumping\Pump_MAIN.dat                    /15: PUMPING COMPONENT MAIN FILE (INPUT, OPTIONAL)
                                              /16: AQUIFER PARAMETER OVER-WRITE DATA FILE (INPUT, OPTIONAL)
     ..\ZBudget\ZBudget.bin                   /17: BINARY OUTPUT FOR GROUNDWATER ZONE BUDGET (OUTPUT,OPTIONAL)
     ..\Budget\SWShed.bin                     /18: BINARY OUTPUT FOR SMALL WATERSHED FLOW COMPONENTS (OUTPUT, OPTIONAL)
     ..\Budget\GW.bin                         /19: BINARY OUTPUT FOR GROUNDWATER BUDGET (OUTPUT, OPTIONAL)
                                              /20: SUBSIDENCE OUTPUT FILE (OUTPUT, OPTIONAL)
     FaceFlow.out                             /21: ELEMENT FACE FLOW OUTPUT FILE (OUTPUT, OPTIONAL)
     BoundaryFlow.out                         /22: BOUNDARY FLOW OUTPUT FILE (OUTPUT, OPTIONAL)
     GWHyd.out                                /23: GW LEVEL HYDROGRAPH OUTPUT FILE (OUTPUT, OPTIONAL)
     GWHeadAll.out                            /24: GW LEVEL OUTPUT AT EVERY MODEL NODE (OUTPUT, OPTIONAL)
     VerticalFlow.out                         /25: LAYER VERTICAL FLOW OUTPUT (OUTPUT, OPTIONAL)
                                              /26: GROUNDWATER HEADS FOR TECPLOT (OUTPUT, OPTIONAL)
                                              /27: SUBSIDENCE OUTPUT FOR TECPLOT (OUTPUT, OPTIONAL)
     FinResults.out                           /28: FINAL SIMULATION RESULTS (OUTPUT, REQUIRED)
C*******************************************************************************
C                         Model Simulation Period
C
C   The following lists the simulation beginning time, ending time and time step length.
C   Based on the entry for BDT below, the actual simulation date and time can be tracked.
C
C   BDT    ; Beginning date and time for the simulation.  Use one of the following formats:
C              MM/DD/YYYY_hh:mm  = Simulation date and time will be tracked
C                                    (Midnight is 24:00);
C              #.##              = Simulation date and time will NOT be tracked
C                                    (any real number greater than or equal to zero can be entered).
C
C-------------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-------------------------------------------------------------------------------
        09/30/1990_24:00            / BDT
C-------------------------------------------------------------------------------
C                        Simulation Date and Time Tracked
C
C   If the simulation date and time will be tracked (i.e. BDT above is entered in
```

```
C   MM/DD/YYYY_hh:mm format) enter values for parameters below.  Otherwise, comment
C   out the value entry lines below and use the "Simulation Date and Time NOT Tracked"
C   option below.
C
C   UNITT  ; Time step length and unit. Choose one of the following:
C                  1MIN
C                  2MIN
C                  3MIN
C                  4MIN
C                  5MIN
C                  10MIN
C                  15MIN
C                  20MIN
C                  30MIN
C                  1HOUR
C                  2HOUR
C                  3HOUR
C                  4HOUR
C                  6HOUR
C                  8HOUR
C                  12HOUR
C                  1DAY
C                  1WEEK
C                  1MON
C                  1YEAR
C   EDT   ; Ending simulation date and time.  Use MM/DD/YYYY_hh:mm format
C             (midnight is 24:00).
C
C-------------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-------------------------------------------------------------------------------
        1DAY                    / UNITT
        09/30/2000_24:00        / EDT
C-------------------------------------------------------------------------------
C                         Simulation Date and Time NOT Tracked
C
C   If the simulation date and time will not be tracked (i.e. BDT above is entered in
C   #.## format) enter values for parameters below.  Otherwise, comment
C   out the value entry lines below and use the above "Simulation Date and Time Tracked"
C   option.
C
C   DELTAT ; Time step to be used in the simulation of hydrologic processes;
C              any entry that is greater than zero is acceptable.
C   UNITT  ; Unit of time step DELTAT (maximum 10 characters);
C              any entry is acceptable.
C   EDT    ; Ending simulation date and time.  Use #.## format.
C
C-------------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-------------------------------------------------------------------------------
*                               / DELTAT
*                               / UNITT
*                               / EDT
C***********************************************************************************
C                       Processing, Output and Debugging Options
C
C   The following lists the options for parallel processing, detailed output and debugging.
C   KDEB;    Enter  2 - to print messages on the screen to monitor execution
C            Enter  1 - to print aquifer parameter data
C            Enter  0 - otherwise
C            Enter -1 - to suppress printing of timestep on the screen
C   CACHE;   Cache size in terms of number of values stored for time series data output
C
C-----------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
     0                          / KDEB
     50000                      / CACHE
C******************************************************************************
C                    Output Unit Control
C
C    FACTLTOU; Factor to convert simulation unit of length into intented output unit of length
C    UNITLTOU; Output unit of length (max. 10 characters long)
C    FACTAROU; Factor to convert simulation unit of area into intended output unit of area
C    UNITAROU; Output unit of area (max. 10 characters long)
C    FACTVLOU; Factor to convert simulation unit of volume into intended output unit of volume
C    UNITVLOU; Output unit of volume (max. 10 characters long)
C    FACTVROU; Factor to convert simulation unit of volumetric flow rate into intended output
C               unit of volumetric flow rate
C    UNITVROU; Output unit of volumetric flow rate (max. 10 characters long)
C
C-----------------------------------------------------------------------------
C    VALUE                      DESCRIPTION
C-----------------------------------------------------------------------------
     1.0                       / FACTLTOU     (ft -> ft)
     FEET                      / UNITLTOU
     0.000022957               / FACTAROU     (sq.ft. -> ac)
     ACRES                     / UNITAROU
     0.000022957               / FACTVLOU     (cu.ft. -> ac.ft)
     AC.FT.                    / UNITVLOU
     0.000022957               / FACTVROU     (cu.ft./day -> ac.ft./day)
     AF/DAY                    / UNITVROU
C*******************************************************************************
C                            Solution Scheme Control
C
C   The following lists the solution scheme control parameters used in SIMULATION
C
C   MSOLVE  ; Matrix solution method
```

```
C              1 = SOR method
C              2 = Generalized preconditioned conjugate method
C   RELAX   ; Relaxation parameter for SOR (value should be between 1.0 and 2.0)
C   MXITER  ; Maximum number of iterations for the solution of system of equations
C   MXITERSM; Maximum number of iterations for the nonlinear moisture accounting
C             * Note: Used only for small watresheds and unsaturated zone
C   MXITERSP; Maximum number of iterations for pumping adjustment
C   STOPC   ; Convergence criteria for groundwater, stream and lake head difference; [L]
C   STOPCSM ; Convergence criteria as a fraction of total porosity for soil
C              moisture routing; [L/L]
C             * Note: Used only for small watresheds and unsaturated zone
C   STOPCSP ; Fraction of water demand to be used as convergence criteria for
C              iterative supply adjustment
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    2                           / MSOLVE
    1.0                         / RELAX
    1500                        / MXITER
    150                         / MXITERSM
    50                          / MXITERSP
    0.0001                      / STOPC
    0.001                       / STOPCSM
    0.001                       / STOPCSP
C*******************************************************************************
C                   Supply Adjustment Control Options
C
C   KOPTDV;  Enter two digits as follows:
C            1st digit(from left):
C                       0 = No adjustment for groundwater pumping
C                       1 = YES: Adjust groundwater pumping
C
C            2nd digit(from left):
C                       0 = No adjustment for streamflow diversion
C                       1 = YES: Adjust surface water diversions
C            ** Note: When this flag is set to a value other than 00, SupplyAdjustment
C                     Specifications Data File is required.
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    11                         / KOPTDV
```

Parameter Data File

The Parameter Data File contains multiple data types that include parameters for all groundwater nodes and layers. Data may be by parametric grids, or by node-by-node values. Parameters are also set for the unsaturated zone and small stream watersheds. The file is broken into the following sections:

Aquifer Parameters

Aquifer parameters can be specified using parametric grids (NGROUP > 0) or for each groundwater node (NGROUP = 0). The NGROUP value indicates the number of parametric grids used to define aquifer parameters. Regardless of the value specified for NGROUP, the following list specifies the variables that must be defined in the Parameter Data File:

NGROUP	Number of parametric grid groups
FX	Conversion factor for parametric grid coordinates
FKH	Conversion factor for the spatial component for the unit of aquifer horizontal hydraulic conductivity
FS	Conversion factor for specific storage coefficient
FN	Factor to weight specific yield value
FV	Conversion factor for the spatial component for the unit of aquitard vertical hydraulic conductivity
FL	Conversion factor for the spatial component for the unit of aquifer vertical hydraulic conductivity

FSCE	Conversion factor for elastic storage coefficient
FSCI	Conversion factor for inelastic storage coefficient
FDC	Conversion factor for interbed thickness
FDCMIN	Conversion factor for minimum interbed thickness
FHC	Conversion factor for pre-compaction hydraulic head
TUNITKH	Time unit of horizontal hydraulic conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
TUNITV	Time unit of aquitard vertical conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
TUNITL	Time unit of aquifer vertical conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File

From the parametric grid information, aquifer parameters at parametric nodes are interpolated to obtain parameter values at finite element nodes within the model domain. A parametric grid group may zoom in closer on groundwater nodes associated with the group and overwrite values given in the previous group. A value of –1 for any parameter specified for a node within a parametric grid group indicates that the parameter value specified in the previous group for the parametric node remains the same value. For NGROUP value greater than zero, the following information must be defined for each parametric grid group:

NDP	Number of parametric nodes in the parametric grid

NEP	Number of parametric elements in the parametric grid
IE	Parametric element number
NODE	Corresponding parametric node
ID	Parametric node number
PX, PY	Parametric node coordinates, [L]
PKH	Aquifer horizontal hydraulic conductivity, [L/T]
PS	Specific storage, [1/L]
PN	Specific yield, [L/L]
PV	Aquitard vertical hydraulic conductivity, [L/T]
PL	Aquifer vertical hydraulic conductivity, [L/T]
SCE	Elastic storage coefficient (Use SCE*DC if DC=0), [1/L]
SCI	Inelastic storage coefficient (Use SCI*DC if DC=0), [1/L]
DC	Interbed thickness, [L]
DCMIN	Minimum interbed thickness, [L]
HC	Pre-compaction hydraulic head (set to 99999.0 to use the initial heads for the value of HC), [L]

The values of SCE, SCI, DC, DCMIN and HC are specified only for interbed layers.

In order to set parameters at specified finite element nodes to values defined at an individual parametric node, the number of parametric nodes, NDP, should be given as 1 and number of parametric elements, NEP, should be given as 0. This is useful when a portion or the entire model domain is homogeneous, and parameters at specified finite element nodes are required to be set to the same values. If this feature is utilized (i.e.

NDP is set to 1 and NEP is set to 0) then the construction of parametric elements needs to be skipped (i.e. specification of IE and NODE).

If no parametric grids are specified, advance to the point in the data file where aquifer parameters are specified by each groundwater node (Option 2). In this case, the above parameter values are specified for each finite element node. The conversion factors specified above are used to convert input data units to the units that are used in the simulation.

Anomaly in Hydraulic Conductivity

If there are hydraulic conductivity values defined in the previous section that need to be overwritten, the following parameters in this file must be defined:

NEBK	Number of elements where hydraulic conductivity values will be overwritten
FACT	Conversion factor for the spatial component for the unit of anomaly hydraulic conductivity values
TUNITH	Time unit of anomaly hydraulic conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File.
IC	Identification number of the element for which anomaly hydraulic conductivity is defined
IEBK	Element number corresponding to counter IC
BK	Hydraulic conductivity at the specified element; this value should be given for each aquifer layer modeled in IWFM, [L]

Unsaturated Zone Parameters

This section is skipped if soil moisture in the unsaturated zone is not modeled, i.e. no rain gages are specified in the Pre-processor. Similar to aquifer parameters, the unsaturated zone parameters can be defined for each element, or by parametric grids. Regardless of how unsaturated zone parameters are defined, the number of layers, parametric groups and conversion factors must be specified:

NUNSAT	Number of layers in the unsaturated zone
NGROUP	Number of parametric groups that define the unsaturated zone parameters
FX	Conversion factor for parametric grid coordinates (it should be specified even if parametric grids are not being used and unsaturated zone parameters are specified for each element)
FD	Conversion factor for the thickness of the unsaturated layer
FK	Conversion factor for the spatial component of the unit of unsaturated zone hydraulic conductivity
TUNITZ	Time unit of hydraulic conductivity. This should be one of the unitsrecognized by HEC-DSS that are listed in the Simulation Main Input File.

If the option to use parametric grids is selected (Option 1), the following procedure occurs: the grid must first be defined by number of nodes and elements, then the makeup of the elements by nodes, and finally the specific characteristics of those nodes with respect to the unsaturated zone parameters:

NDP	Number of nodes in the parametric grid

NEP	Number of elements in the parametric grid
IE	Parametric element number
NODE	Corresponding parametric nodes (4 nodes should entered for each parametric element. For triangular elements 4th node must be set to zero)
ID	Parametric node number
PX	x-coordinate of the parametric node, [L]
PY	y-coordinate of the parametric node, [L]
PD	Thickness of unsaturated layer (if thickness for the last unsaturated layer is entered as zero, the program will compute the thickness of the last unsaturated layer), [L]
PN	Total porosity of unsaturated zone, [L/L]
PI	Pore size distribution index for the unsaturated zone
PK	Hydraulic conductivity of unsaturated zone, [L/T]
PRHC	Method to represent the unsaturated hydraulic conductivity versus moisture content in routing the moisture through the unsaturated zone (1 = Campbell's equation, 2 = van Genuchten-Mualem equation; see the *IDC v4.0 Theoretical Documentation and User's Manual* for the details of these methods)

If no parametric grids are specified, advance to the point in the data file where unsaturated zone parameters are specified by each element (Option 2). In this case, the above parameter values are specified for each finite element. The conversion factors specified above are used to convert input data units to the units that are used in the simulation.

Small Stream Watershed Groups

The small stream watershed data specified in this file is related to each small stream watershed group defined. Each group can correspond to several small stream watersheds that have the same characteristics. In the Boundary Conditions Data File, individual small stream watersheds are specified with respect to the groundwater nodes they are connected to and the small stream watershed group they correspond to. The values listed below are necessary to define the impacts of small watersheds at the model boundary:

NSW	Number of small watershed groups
FACTL	Conversion factor for small stream watershed root zone depth and groundwater threshold value
FACTK	Conversion factor for the spatial component of the unit for the small stream watershed hydraulic conductivity
TUNITK	Time unit of hydraulic conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File.
FACTT	Conversion factor for recession coefficients
TUNITT	Time unit of recession coefficients. This should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File.

FACTCN	Factor to convert inches to the unit of length used in the simulation
IS	Small watershed group identification number
IRNS	Precipitation rate at the small watershed; this number corresponds to the appropriate data column in the Precipitation File
ICETS	Evapotranspiration rate for the small watershed; this number corresponds to the appropriate data column in the Evapotranspiration File
FLDCAS	Field capacity (multiplied by the root zone depth in IWFM to be converted to a unit of depth), [L/L]
TPOROS	Total porosity (multiplied by the root zone depth in IWFM to be converted to a unit of depth), [L/L]
LAMBDAS	Pore size distribution index
CROOT	Root zone depth of native vegetation in the small watershed, [L]
SOILKS	Hydraulic conductivity of the root zone, [L/T]
RHCS	Method to represent the unsaturated hydraulic conductivity versus moisture content in routing the moisture through the small watershed (1 = Campbell's equation, 2 = van Genuchten-Mualem equation; see the *IDC v4.0 Theoretical Documentation and User's Manual* for the details of these methods)
CN	Curve number for small watershed area
GWSOS	Threshold value above which groundwater storage of small watershed contributes to surface runoff, [L]
SWKS	Recession coefficient for surface outflow, [1/T]

GWKS	Recession coefficient for base flow, [1/T]

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                            PARAMETER DATA FILE
C                            for IWFM Simulation
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  Parameter.dat
C
C*******************************************************************************
C                             File Description:
C
C   This data file contains the aquifer parameters for each groundwater node
C   and each layer. The parameters may be set by using a parametric
C   grid to interpolate values or by listing values for each node
C   individually. In addition, this file contains the parameters for the
C   unsaturated zone and small watersheds.
C
C*******************************************************************************
C                           AQUIFER PARAMETERS
C
C-------------------------------------------------------------------------------
C   Option 1 - Set aquifer parameters by use of a parametric grid(NGROUP > 0)
C   Option 2 - Set aquifer parameters at every groundwater node  (NGROUP = 0)
C
C   NGROUP;  Number of parametric grid groups
C
C-------------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-------------------------------------------------------------------------------
        6                       / NGROUP
C------------------------------------------------------------------------------
C   OPTIONS 1 & 2 : The following lists the factors to convert the aquifer
C   parameters and grid coordinates to the appropriate units
C
C   FX     ;  Conversion factor for parametric grid coordinates
C   FKH    ;  Conversion factor for horizontal hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                = IN/DAY
C                     Enter FKH (FT/MONTH -> IN/MONTH)                  = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FS     ;  Conversion factor for specific storage coefficient
C   FN     ;  Weighting factor for specific yield value
C   FV     ;  Conversion factor for aquitard vertical hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file  = FT/MONTH
C                     Consistent unit used in simulation                = IN/DAY
C                     Enter FV (FT/MONTH -> IN/MONTH)                   = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FL     ;  Conversion factor for aquifer vertical hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                = IN/DAY
C                     Enter FL (FT/MONTH -> IN/MONTH)                   = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FSCE   ;  Conversion factor for elastic storage coefficient
C   FSCI   ;  Conversion factor for inelastic storage coefficient
C   FDC    ;  Conversion factor for interbed thickness
C   FDCMIN ;  Conversion factor for minimum interbed thickness
C   FHC    ;  Conversion factor for pre-compaction hydraulic head
C   TUNITKH;  Time unit of horizontal hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   TUNITV ;  Time unit of aquitard vertical conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   TUNITL ;  Time unit of aquifer vertical conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C
C-------------------------------------------------------------------------------------------------------------------
C  FX       FKH         FS          FN          FV         FL        FSCE        FSCI        FDC        FDCMIN       FHC
C--------------------------------------------------------------------------------------------------------------------
  3.281     1.0      0.000001       1.0         1.0        1.0     0.000001     0.002       1.0          1.0         1.0
C-------------------------------------------------------------------------------------------------------------------
C   VALUE              DESCRIPTION
C-------------------------------------------------------------------------------------------------------------------
    1MON               / TUNITKH
    1MON               / TUNITV
    1MON               / TUNITL
C*******************************************************************************
C                  OPTION 1 (for Aquifer Parameter Definition)
C*******************************************************************************
C-------------------------------------------------------------------------------
C   *** GROUP 1 ***
C-------------------------------------------------------------------------------
C   Enter node numbers from FE grid for the 1st parametric group
C     (e.g. 1-100,101,301-359,567)
C     * Enter 0 if no nodes will be affected with this parametric grid
C-------------------------------------------------------------------------------
     1-1393
```

```
C-------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 1st parametric grid
C   NEP;     Number of elements in the 1st parametric grid
C
C-------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
     33                        / NDP
     20                        / NEP
C-------------------------------------------------------------------------------
C
C   The following is a list of the parametric elements and
C   corresponding parametric nodes for the 1st parametric group
C   (to be used only when NEP > 0)
C
C   IE  ;    Parametric element number
C   NODE;    Corresponding parametric node
C
C-------------------------------------------------------------------------------
C           Node 1    Node 2    Node 3     Node 4
C    IE      NODE      NODE      NODE       NODE
C------------------------------------------------------------------------------
      1        1         3         4          2
      2        3         5         6          4
      .        .         .         .          .
      .        .         .         .          .
      .        .         .         .          .
     19       28        31        32         29
     20       29        32        33         30
C-------------------------------------------------------------------------------
C
C   List the paramatric nodes, nodal coordinates and aquifer
C   parameters for each layer of the 1st parametric group
C   (enter -1.0 not to overwrite the previously set values)
C
C   ID   ;   Parametric node number
C   PX,PY;   Parametric node coordinates; [L]
C   PKH  ;   Hydraulic conductivity; [L/T]
C   PS   ;   Specific storage; [1/L]
C   PN   ;   Specific yield; [L/L]
C   PV   ;   Aquitard vertical hydraulic conductivity; [L/T]
C   PL   ;   Aquifer vertical hydraulic conductivity; [L/T]
C   SCE  ;   Elastic storage coefficient (Use SCE*DC if DC=0); [1/L]
C   SCI  ;   Inelastic storage coefficient (Use SCI*DC if DC=0); [1/L]
C   DC   ;   Interbed thickness;[L]
C   DCMIN;   Minimum interbed thickness; [L]
C   HC   ;   Pre-compaction hydraulic head (use 99999. to use initial heads); [L]
C            *Note* The above land subsidence parameters are only for interbed layers (i.e. clay layers)
C-----------------------------------------------------------------------------------------------------------------
C  ID         PX         PY         PKH       PS        PN     PV        PL       SCE      SCI       DC        DCMIN   HC
C-----------------------------------------------------------------------------------------------------------------
    1       526411   4488044     100.00     1.0       0.08   0.20      1.0      4.5    0.050      -1         2        99999.
                                  60.00     5.0       0.05   1.00      1.0      4.5    0.050      -1         2        99999.
                                  60.00     5.0       0.05   0.60      0.6      4.5    0.050      -1         2        99999.
    2       576022   4510977      80.00     1.0       0.09   0.20      1.0      4.5    0.050      -1         2        99999.
                                  40.00     5.0       0.05   1.00      1.0      4.5    0.050      -1         2        99999.
                                  40.00     5.0       0.05   0.60      0.6      4.5    0.050      -1         2        99999.
    .          .         .          .       .         .      .         .        .        .         .         .            .
                                    .       .         .      .         .        .        .         .         .            .
                                    .       .         .      .         .        .        .         .         .            .
    .          .         .          .       .         .      .         .        .        .         .         .            .
                                    .       .         .      .         .        .        .         .         .            .
                                    .       .         .      .         .        .        .         .         .            .
   33       899721   3868499      80.00     1.0       0.12   0.20      1.0      4.5     1.00      -1         2        99999.
                                  50.00     2.0       0.07   0.0001    0.1      4.5     1.00      -1         3        99999.
                                  20.00     3.0       0.07   0.60      0.6      4.5     1.00      -1         3        99999.
C-----------------------------------------------------------------------------------------------------------------
C    *** GROUP 2 ***
C--------------------------------------------------------------------------------
C   Enter node numbers from the FE grid for the 2nd parametric group
C     (e.g. 1-100,101,301-359,567)
C--------------------------------------------------------------------------------
    1318-1321,1325,1329-1336,1339-1347,1349-1358,1360-1393
C-------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 2nd parametric grid
C   NEP;     Number of elements in the 2nd parametric grid
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C--------------------------------------------------------------------------------
     6                           / NDP
     2                           / NEP
C--------------------------------------------------------------------------------
C   Element   Node 1    Node 2    Node 3     Node 4
C    IE        NODE      NODE      NODE       NODE
C--------------------------------------------------------------------------------
      1        34        37        38         35
      2        35        38        39         36
C-------------------------------------------------------------------------------
C
C   List the paramatric nodes, nodal coordinates and aquifer
C   parameters for each layer of the 2nd parametric group
C   (enter -1.0 not to overwrite the previously set values)
C
C   ID   ;   Parametric node number
C   PX,PY;   Parametric node coordinates; [L]
```

```
C   PKH  ;   Hydraulic conductivity; [L/T]
C   PS   ;   Specific storage; [1/L]
C   PN   ;   Specific yield; [L/L]
C   PV   ;   Aquitard vertical hydraulic conductivity; [L/T]
C   PL   ;   Aquifer vertical hydraulic conductivity; [L/T]
C   SCE  ;   Elastic storage coefficient (Use SCE*DC if DC=0); [1/L]
C   SCI  ;   Inelastic storage coefficient (Use SCI*DC if DC=0); [1/L]
C   DC   ;   Interbed thickness;[L]
C   DCMIN;   Minimum interbed thickness; [L]
C   HC   ;   Pre-compaction hydraulic head (use 99999. to use initial heads); [L]
C            *Note* The above land subsidence parameters are only for interbed layers (i.e. clay layers)
C-----------------------------------------------------------------------------------------------------------------------
C  ID         PX         PY         PKH       PS        PN     PV        PL        SCE      SCI       DC        DCMIN    HC
C-----------------------------------------------------------------------------------------------------------------------
   34       795918   3906758     100.      1.      .12      .2       1.0        -1      -1       -1      -1        -1
                                  80.      5.      .07      .002      .5        -1      -1       -1      -1        -1
                                  20.      3.      .07      .6        .6        -1      -1       -1      -1        -1
    .          .         .         .       .        .        .         .         .       .        .       .         .
                                   .       .        .        .         .         .       .        .       .         .
                                   .       .        .        .         .         .       .        .       .         .
    .          .         .         .       .        .        .         .         .       .        .       .         .
                                   .       .        .        .         .         .       .        .       .         .
                                   .       .        .        .         .         .       .        .       .         .
   39       905818   3868499      80.      1.      .12      .2       1.0        -1      -1       -1      -1        -1
                                  50.     10.      .07      .0015     .4        -1      -1       -1      -1        -1
                                   5.      8.      .07      .6        .6        -1      -1       -1      -1        -1
C------------------------------------------------------------------------------------------------------------------------
C    *** GROUP 3 ***
C-------------------------------------------------------------------------------
   .           .
   .           .
   .           .
C--------------------------------------------------------------------------------------------
C    *** GROUP 6 ***
C-------------------------------------------------------------------------------
C   Enter node numbers from the FE grid for the 6th parametric group
C     (e.g. 1-100,101,301-359,567)
C-------------------------------------------------------------------------------
 792  791  790  789  788  787  786  785
 784  769  768
 757  756  755  754  753  752  751  750
 749  728
 741  740  739  738  737  736  729
 715  702
 701  700  699  698  697  696  695  694
 693  683
 681  682
 671  660  649
 657  656  655  654  653  652  651  650  633
 623  622  621  620  619  618  617  616
 615  605  592  576  567  558
C------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 6th parametric grid
C   NEP;     Number of elements in the 6th parametric grid
C
C------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
     1                            / NDP
     0                            / NEP
C-------------------------------------------------------------------------------
C   Element   Node 1    Node 2    Node 3     Node 4
C    IE        NODE      NODE      NODE       NODE
C-------------------------------------------------------------------------------
*
*
C------------------------------------------------------------------------------
C
C   List the paramatric nodes, nodal coordinates and aquifer
C   parameters for each layer of the 6th parametric group
C
C   ID;      Parametric node number
C   PX,PY;   Parametric node coordinates [L]
C   PKH;     Hydraulic conductivity [L/T]
C   PS;      Specific storage [1/L]
C   PN;      Specific yield [FT/FT]
C   PV;      Aquitard vertical hydraulic conductivity [L/T]
C   PL;      Aquifer vertical hydraulic conductivity [L/T]
C   SCE;     Elastic storage coefficient (Use SCE*DC if DC=0) [1/L]
C   SCI;     Inelastic storage coefficient (Use SCI*DC if DC=0) [1/L]
C   DC;      Interbed thickness
C   DCMIN;   Minimum interbed thickness
C   HC;      Pre-compaction hydraulic head (use 99999. to use initial heads) [L]
C            *Note* The above land subsidence parameters are only for interbed layers (i.e. clay layers)
C----------------------------------------------------------------------------------------------------------------------
C  ID         PX        PY          PKH      PS        PN     PV        PL        SCE      SCI        DC      DCMIN      HC
C----------------------------------------------------------------------------------------------------------------------
   43     742369.0  3867036.0       40.    -1        -1     -1        -1        -1       -1         -1      -1         -1
                                    -1     -1        -1     -1        -1        -1       -1         -1      -1         -1
                                    -1     -1        -1     -1        -1        -1       -1         -1      -1         -1
C******************************************************************************
C                  OPTION 2 (for Aquifer Parameter Definition)
C******************************************************************************
C
C    List the groundwater nodes, and aquifer parameters for
C    each layer (skip if option 1 is used)
C
```

```
C   ID   ;   Groundwater node number
C   PKH  ;   Hydraulic conductivity; [L/T]
C   PS   ;   Specific storage; [1/L]
C   PN   ;   Specific yield; [L/L]
C   PV   ;   Aquitard vertical hydraulic conductivity; [L/T]
C   PL   ;   Aquifer vertical hydraulic conductivity; [L/T]
C   SCE  ;   Elastic storage coefficient (Use SCE*DC if DC=0); [1/L]
C   SCI  ;   Inelastic storage coefficient (Use SCI*DC if DC=0); [1/L]
C   DC   ;   Interbed thickness; [L]
C   DCMIN;   Minimum interbed thickness; [L]
C   HC   ;   Pre-compaction hydraulic head (use 99999. to use initial heads); [L]
C            *Note* The above land subsidence parameters are only for interbed layers (i.e. clay layers)
C
C-------------------------------------------------------------------------------
C                         Layer  1
C                         Layer  2
C                            .
C                            .
C
C        Hydr.   Spec.    Spec.  Aquitard  Aquifer   Elastic   Inelastic   Interbed   Min. Intrbd   Precompc
C        cond.   Stor.    Yld.    Vert. K  Vert. K  Stg. Coef. Stg. Coef.  Thickness   Thickness    Hyd. Head
C  ID     PKH     PS       PN       PV       PL        SCE        SCI         DC        DCMIN          HC
C--------------------------------------------------------------------------------------------------------------
*
C******************************************************************************
C                      ANOMALY IN HYDRAULIC CONDUCTIVITY
C
C   List the groundwater elements and corresponding aquifer
C   parameters for nodes that will overwrite the above aquifer data
C
C   NEBK;   Number of elements where hydraulic conductivity
C             values will be overwritten
C   FACT;   Conversion factor for the anomaly hydraulic conductivity
C            It is used to convert only the spatial component of the unit;
C            DO NOT include the conversion factor for time component of the unit.
C            * e.g. Unit of anomaly hydraulic conductivity listed in this file = FT/MONTH
C                   Consistent unit used in simulation                        = IN/DAY
C                   Enter FACT (FT/MONTH -> IN/MONTH)                         = 8.33333E-02
C                    (conversion of MONTH -> DAY is performed automatically)
C   TUNITH; Time unit of anomaly hydraulic conductivity.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Main Control File.
C------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C------------------------------------------------------------------------------
     7                          / NEBK
     1.0                        / FACT
     1MON                       / TUNITH
C--------------------------------------------------------------------------------------------------------------
C
C   IC  ;    Counter for number of overwrite options
C   IEBK;    Element number corresponding to counter IC
C   BK  ;    Hydraulic conductivity at the specified node; [L/T]
C----------------------------------------------------------------------------
C                             LAYER 1   LAYER 2   LAYER 3
C     IC          IEBK        BK         BK        BK
C------------------------------------------------------------------------------
      1           55        .2         .2        .2
      2           56        .2         .2        .2
      3           57        .2         .2        .2
      4           58        .2         .2        .2
      5         1383        .001       .001      .001
      6         1384        .001       .001      .001
      7         1385        .001       .001      .001
C******************************************************************************
C                         UNSATURATED ZONE PARAMETERS
C
C   NUNSAT;  Number of layers in the unsaturated zone
C             * Enter 0 if unsaturated zone is not simulated
C
C------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C------------------------------------------------------------------------------
    2                           / NUNSAT
C------------------------------------------------------------------------------
C   Option 1 - Set unsaturated zone parameters by use of a parametric grid(NGROUP > 0)
C   Option 2 - Set unsaturated zone parameters at every groundwater node  (NGROUP = 0)
C
C   NGROUP;  Number of parametric grid groups
C------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C------------------------------------------------------------------------------
    0                           / NGROUP
C-----------------------------------------------------------------------------
C   OPTIONS 1 & 2 : The following lists the factors to convert the unsaturated
C                  zone parameters and grid coordinates to the appropriate units
C
C
C   FX;      Conversion factor for grid coordinates
C   FD;      Conversion factor for the thickness of the unsaturated layer
C   FK;      Conversion factor for hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                 = IN/DAY
C                     Enter FACT (FT/MONTH -> IN/MONTH)                  = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITZ;  Time unit of hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
```

```
C
C-------------------------------------------------------------------------------
C    FX             FD            FK
C-------------------------------------------------------------------------------
     1.0           1.0            1.0
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
    1mon                         / TUNITZ
C*******************************************************************************
C            OPTION 1 (for Unsaturated Zone Parameter Definition)
C*******************************************************************************
C-------------------------------------------------------------------------------
C   *** GROUP 1 ***
C-------------------------------------------------------------------------------
C   Enter element numbers from FE grid for the 1st parametric group
C     (e.g. 1-100,101,301-359,567)
C-------------------------------------------------------------------------------
*
C-------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 1st parametric grid
C   NEP;     Number of elements in the 1st parametric grid
C
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
*                                 / NDP
*                                 / NEP
C-------------------------------------------------------------------------------
C
C   The following is a list of the parametric elements and
C   corresponding parametric nodes for the 1st parametric group
C   (to be used only when parametric option is used, ie. NDP > 0)
C
C   IE  ;    Parametric element number
C   NODE;    Corresponding parametric node
C
C-------------------------------------------------------------------------------
C             Node 1    Node 2    Node 3     Node 4
C    IE        NODE      NODE      NODE       NODE
C------------------------------------------------------------------------------
*
C-------------------------------------------------------------------------------
C    List the parametric nodes,coordinates, and unsaturated zone parameters for
C    each layer of the 1st parametric group (skip if option 2 is used)
C
C   ID   ;   Parametric node number
C   PX   ;   x-coordinate of the parametric node; [L]
C   PY   ;   y-coordinate of the parametric node; [L]
C   PD   ;   Thickness of unsaturated layer; [L]
C   PN   ;   Total porosity; [L/L]
C   PI   ;   Pore size distribution index [dimensionless]
C   PK   ;   Hydraulic conductivity; [L/T]
C   PRHC ;   Method to represent hydraulic conductivity vs. moisture content curve
C               1 = Campbell's equation
C               2 = van Genucten-Mualem equation
C----------------------------------------------------------------------------------------------------
C          NODAL COORDINATES     Thickness     Porosity    Pore Size Dist.In.   Hyd. Cond.    Method
C   ID       PX      PY             PD            PN            PI                 PK          PRHC
C----------------------------------------------------------------------------------------------------
*
C---------------------------------------------------------------------------------------------
C    *** GROUP 2 ***
C--------------------------------------------------------------------------------
C   Enter element numbers from FE grid for the 2nd parametric group
C     (e.g. 1-100,101,301-359,567)
C--------------------------------------------------------------------------------
*
C-------------------------------------------------------------------------------
C
C   NDP;     Number of nodes in the 2nd parametric grid
C   NEP;     Number of elements in the 2nd parametric grid
C
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C--------------------------------------------------------------------------------
*                                  / NDP
*                                  / NEP
C--------------------------------------------------------------------------------
C   Element   Node 1    Node 2    Node 3     Node 4
C    IE        NODE      NODE      NODE       NODE
C--------------------------------------------------------------------------------
*
C--------------------------------------------------------------------------------
C    List the parametric nodes,coordinates, and unsaturated zone parameters for
C    each layer of the 2nd parametric group (skip if option 2 is used)
C
C   ID   ;   Parametric node number
C   PX   ;   x-coordinate of the parametric node; [L]
C   PY   ;   y-coordinate of the parametric node; [L]
C   PD   ;   Thickness of unsaturated layer; [L]
C   PN   ;   Total porosity; [L/L]
C   PI   ;   Pore size distribution index [dimensionless]
C   PK   ;   Hydraulic conductivity; [L/T]
C   PRHC ;   Method to represent hydraulic conductivity vs. moisture content curve
C               1 = Campbell's equation
C               2 = van Genucten-Mualem equation
```

```
C-----------------------------------------------------------------------------------------------------
C          NODAL COORDINATES     Thickness     Porosity    Pore Size Dist.In.   Hyd. Cond.    Method
C   ID       PX      PY              PD            PN            PI                  PK          PRHC
C-----------------------------------------------------------------------------------------------------
*
C*******************************************************************************
C            OPTION 2 (for Unsaturated Zone Parameter Definition)
C*******************************************************************************
C
C   List the groundwater elements and unsaturated zone parameters for
C   each layer (skip if option 1 is used)
C
C   IE   ;   Element number
C   PD   ;   Thickness of unsaturated layer; [L]
C   PN   ;   Total porosity; [L/L]
C   PI   ;   Pore size distribution index; [dimensionless]
C   PK   ;   Hydraulic conductivity; [L/T]
C   PRHC ;   Method to represent hydraulic conductivity vs. moisture content curve
C               1 = Campbell's equation
C               2 = van Genucten-Mualem equation
C-----------------------------------------------------------------------------------------
C                         LAYER 1                                  LAYER 2
C             ----------------------------------      ---------------------------------
C   IE          PD        PN      PI      PK     PRHC      PD     PN      PI      PK     PRHC
C-----------------------------------------------------------------------------------------
    1           20.0      0.3     0.35    10.0    2        20.0   0.3     0.35    10.0     2
    2           20.0      0.3     0.35    10.0    2        20.0   0.3     0.35    10.0     2
    .           .         .       .       .       .        .      .       .       .        .
    .           .         .       .       .       .        .      .       .       .        .
    .           .         .       .       .       .        .      .       .       .        .
    1392        20.0      0.3     0.35    10.0    2        20.0   0.3     0.35    10.0     2
    1393        20.0      0.3     0.35    10.0    2        20.0   0.3     0.35    10.0     2
C--------------------------------------------------------------------------------
C*********************************************************************************************************
C                         SMALL STREAM WATERSHED DATA
C
C   The following  lists the small watershed parameters that are used in the
C   computation of runoff from the tributary watersheds outside the model boundary.
C
C
C   NSW    ;   Number of small watershed groups
C   FACTL  ;   Conversion factor for root zone depth and groundwater threshold value
C   FACTK  ;   Conversion factor for hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                = IN/DAY
C                     Enter FACT (FT/MONTH -> IN/MONTH)                 = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITK ;   Time unit of hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   FACTT  ;   Conversion factor for recession coefficients
C   TUNITT ;   Time unit of recession coefficients.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   FACTCN ;   Conversion factor to convert inches to the simulation unit of length.
C
C-----------------------------------------------------------------------------
C   VALUE                 DESCRIPTION
C-----------------------------------------------------------------------------
      15                   / NSW
      1.0                 / FACTL
      1.0                 / FACTK
      1mon                / TUNITK
      1.0                 / FACTT
      1mon                / TUNITT
      0.083333            / FACTCN  (in -> ft)
C-----------------------------------------------------------------------------
C
C   IS     ;   Small watershed group identification number
C   IRNS   ;   Rainfall station number associated with the small watershed - this number
C               corresponds to the appropriate data column in the Precipitation Data File
C   ICETS  ;   Evapotranspiration rate for the small watershed - this number corresponds
C               to the appropriate data column in the ET Data File
C   FLDCAS ;   Field capacity; [L/L]
C   TPOROS ;   Total porosity; [L/L]
C   LAMBDAS;   Pore size distribution index; [dimensionless]
C   CROOT  ;   Root zone depth of native vegetation in the small watershed; [L]
C   SOILKS ;   Hydraulic conductivity of the root zone; [L/T]
C   RHCS   ;   Method to represent hydraulic conductivity vs. moisture content curve
C               1 = Campbell's equation
C               2 = van Genucten-Mualem equation
C   CN     ;   Curve number for small watershed area
C              (Reference: USDA, 1985)
C   GWSOS  ;   Threshold value of groundwater depth above which groundwater
C                storage of small watershed contributes to surface runoff; [L]
C   SWKS   ;   Recession coefficient for surface outflow; [1/T]
C   GWKS   ;   Recession coefficient for base flow; [1/T]
C
C--------------------------------------------------------------------------------------------------------------
C IS   IRNS    ICETS   FLDCAS    TPOROS    LAMBDAS    CROOT    SOILKS    RHCS   CN    GWSOS    SWKS    GWKS
C--------------------------------------------------------------------------------------------------------------
  1     2        6       0.08      0.10      0.18       3.0       5.0       2     80    10.0     0.4     0.002
  .     .        .       .         .         .          .         .         .     .     .        .       .
  .     .        .       .         .         .          .         .         .     .     .        .       .
  .     .        .       .         .         .          .         .         .     .     .        .       .
  15    2        6       0.08      0.08      0.33       3.0       7.0       2     83    10.00    0.4     0.005
```

Root Zone Component Files

Simulation Main Input File points to the Root Zone Component Main File which is the gateway to additional data files that are used in simulating land surface and root zone flow processes at agricultural, urban, native vegetation and riparian vegetation lands. Agricultural and urban water demands are also computed in the root zone component. The input and output files used in the root zone component are described in detail in the document titled *IDC v4.0 Theoretical Documentation and User's Manual*. To turn off the simulation of the land surface and root zone flow processes as well as the computation of water demands, one can leave the filename for the Root Zone Component Main File in the Simulation Main Input File blank.

Stream Component Files

Simulation Main Input File points to the Stream Component Main File which is the gateway for all other data files that are needed to simulate stream flows, diversions and bypasses. Data input files that are used in simulating stream flows, diversions and bypasses are described in the following sections.

Stream Component Main File

Stream Component Main File is the gateway to additional data files that are used in routing stream flows as well as simulating diversions and bypasses. The names of the data files that are used in simulating stream related flow processes as well as the names of the output files are listed in this file. Stream bed parameters are also specified in this file.

All stream-component related input and output files are optional. For instance, if a particular output is not required, then the user simply does not specify the output file name, or if the stream diversions are not modeled then the use does not need to specify the names of the diversion specifications and time-series diversion rates data files.

The Stream Component Main File is divided into multiple sections:

General Input and Output Filenames

This section lists the input filenames that stream component uses to retrieve data to simulate diversions, bypasses as well as to define inflows at specified stream nodes. If desired, filenames for stream reach budget and diversion details output can also be specified. The following variables are used in this section:

INFLOWFL	Stream inflow data file (maximum 1000 characters); leave this file name blank if there are no stream inflows defined
DIVSPECFL	Diversion specifications data file (maximum 1000 characters); leave this file name blank if there are no diversions modeled
BYPSPECFL	Bypass specifications data file (maximum 1000 characters); leave this file name blank if there are no bypasses modeled
DIVFL	Diversion rate data file (maximum 1000 characters); leave this file name blank if there are no diversions modeled
STRMRCHBUDFL	Binary output file for detailed stream flow budget at each stream reach (maximum 1000 characters); leave this file name blank if this output is not required
DIVDTLBUDFL	Binary output file for diversion details (maximum 1000 characters); leave this file name blank if this output is not required

Stream Flow Hydrograph Output Data

In this section, information for IWFM is supplied to print-out hydrograhs at specified stream nodes:

NOUTR	Total number of hydrographs to be printed; enter 0 if no stream hydrograph data is to be printed
IHSQR	Switch for the output of stream surface elevations or stream flows (0 = print-out stream flows, 1= print-out stream surface elevations; a value must still be specified even if NOUTR is set to zero)

FACTVROU	Factor to convert simulation unit of stream flows into intended output unit (a value must still be specified even if NOUTR is set to zero)
UNITVROU	Output unit of stream flow (maximum 10 characters long; a value must still be specified even if NOUTR is set to zero)
FACTLTOU	Factor to convert simulation unit of stream surface elevations into intended output unit (a value must still be specified even if NOUTR is set to zero)
UNITLTOU	Output unit of stream surface elevation (maximum 10 characters long; a value must still be specified even if NOUTR is set to zero)
STHYDOUTFL	File name for stream hydrograph output (maximum 1000 characters; leave blank if NOUTR is set to zero)
IOUTR	Stream node number for printing hydrograph output; list NOUTR stream nodes for which hydrographs will be printed

Stream Flow Budget at Selected Nodes

In this section the user can list stream nodes for which detailed water budget terms will be printed out to a binary file specified by the user. These water budgets are similar to those printed out to file STRMRCHBUDFL as described above, except that values printed out to STRMRCHBUDFL file are for stream reaches (i.e. collection of stream nodes specified by the user in Pre-processor). The following variables are used:

NBUDR	Total number of stream nodes for which budget output is desired; enter 0 if no stream node budget is required

STNDBUDFL	Binary output file for stream node budget (maximum 1000 characters; leave blank if stream node water budget output is not required)
IBUDR	Stream node for budget output; list NBUDR stream nodes for which water budget will be printed out

Stream Bed Parameters

In this section, stream bed characteristics for each node are specified. These parameters are used in computing stream-aquifer interaction.

FACTK	Conversion factor for spatial component of stream bed conductivity
TUNITSK	Time unit of conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
FACTL	Conversion factor for stream bed thickness and wetted perimeter
IR	Stream node number
CSTRM	Hydraulic conductivity of stream bed; [L/T]
DSTRM	Thickness of stream bed; [L]
WETPR	Wetted perimeter; [L]

```
#4.0
C *** DO NOT DELETE ABOVE LINE ***
C
C*****************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*****************************************************************************
C
C                       STREAM PARAMETERS DATA FILE
C                            Stream Component
C                           for IWFM Simulation
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: Stream_MAIN.dat
C
C*****************************************************************************
C                               File Description
C
C     This file contains parameters and data file names for the simulation
C     of stream flows.
C
C*****************************************************************************
C
C                         Input and Output Data File Names
C
C  INFLOWFL    ; Stream inflow data file (max. 1000 characters)
C                 * Leave blank if no stream inflow data exists
C  DIVSPECFL   ; Diversion specifications data file (max. 1000 characters)
C                 * Leave blank if diversions are not simulated
C  BYPSPECFL   ; Bypass specifications data file (max. 1000 characters)
C                 * Leave blank if bypasses are not simulated
C  DIVFL       ; Diversion data file (max. 1000 characters)
C                 * Leave blank if diversions are not simulated
C  STRMRCHBUDFL; Binary output file for stream flow budget at each
C                 stream reach (max. 1000 characters)
C                 * Leave blank if this output is not required
C  DIVDTLBUDFL ; Binary output file for diversion details (max. 1000 characters)
C                 * Leave blank if this output is not required
C----------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C----------------------------------------------------------------------------
    Stream\StreamInflow.dat       / INFLOWFL
    Stream\DiverSpecs.dat         / DIVSPECFL
    Stream\BypassSpecs.dat        / BYPSPECFL
    Stream\Diversions.dat         / DIVFL
    ..\Budget\StrmBud.bin         / STRMRCHBUDFL
    ..\Budget\DiverDetail.bin     / DIVDTLBUDFL
C*****************************************************************************
C                        Stream Flow Hydrograph Output Data
C
C  NOUTR      ; Total number of hydrographs to be printed
C                (NOUTR = 0 if no stream hydrograph data is to be printed)
C  IHSQR      ; Switch for the output of stream surface elevations or stream flows;
C                IHSQR = 0 if output of stream flows is desired,
C                IHSQR = 1 if output of stream surface elevations is desired
C  FACTVROU   ; Factor to convert simulation unit of stream flows into
C                intented output unit
C  UNITVROU   ; Output unit of stream flow (max. 10 characters long)
C  FACTLTOU   ; Factor to convert simulation unit of stream surface
C                elevations into intented output unit
C  UNITLTOU   ; Output unit of stream surface elevation (max. 10 characters long)
C  STHYDOUTFL ; File name for stream hydrograph output (max. 1000 characters)
C                 * Leave blank if this output is not required
C
C----------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C----------------------------------------------------------------------------
    23                            / NOUTR
    0                             / IHSQR
    0.000022957                   / FACTVROU     (cu.ft./day -> ac.ft./day)
    ac.ft./day                    / UNITVROU
    1.0                           / FACTLTOU
    ft                            / UNITLTOU
    StrmHyd.out                   / STHYDOUTFL
C-----------------------------------------------------------------------------
C
C   The following lists the stream node number for hydrograph to be printed
C   (skip if no hydrographs are to be printed, ie. NOUTR = 0)
C
C   IOUTR;   Stream node number for printing hydrograph output
C-----------------------------------------------------------------------------
C    IOUTR
C-----------------------------------------------------------------------------
       1
       2
       .
       .
       .
       22
       23
C*****************************************************************************
C                        Stream Flow Budget at Selected Nodes
C
C  NBUDR      ; Total number of stream nodes for which budget output is desired
```

```
C                (NBUDR = 0 if no stream node budget is required)
C  STNDBUDFL  ; Binary output file for stream node budget (max. 1000 characters)
C                 * Leave blank if this output is not required
C
C-----------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-----------------------------------------------------------------------------
     3                            / NBUDR
     ..\Budget\StrmNodeBud.bin    / STNDBUDFL
C------------------------------------------------------------------------------
C
C   The following lists the stream nodes for budget output
C   (skip if no budget output is required, ie. NBUDR = 0)
C
C   IBUDR;   Stream node for budget output
C------------------------------------------------------------------------------
C    IBUDR
C------------------------------------------------------------------------------
       1
       8
       19
C******************************************************************************
C                       STREAM BED PARAMETERS
C
C     The following lists the parameters to model streams.
C
C   FACTK ;   Conversion factor for stream bed conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation       = IN/DAY
C                     Enter FACTK (FT/MONTH -> IN/MONTH)       = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITSK;  Time unit of conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   FACTL ;   Conversion factor for stream bed thickness and wetted perimeter
C   IR    ;   Stream node number
C   CSTRM ;   Hydraulic conductivity of stream bed; [L/T]
C   DSTRM ;   Thickness of stream bed; [L]
C   WETPR ;   Wetted perimeter; [L]
C
C-----------------------------------------------------------------------------
C   VALUE                 DESCRIPTION
C-----------------------------------------------------------------------------
    1.0                   / FACTK
    1day                  / TUNITSK
    1.0                   / FACTL
C-----------------------------------------------------------------------------
C    IR       CSTRM       DSTRM      WETPR
C-----------------------------------------------------------------------------
     1         10.0        1.0       150.0
     2         10.0        1.0       150.0
     .         .           .         .
     .         .           .         .
     .         .           .         .
     22        10.0        1.0       150.0
     23        10.0        1.0       150.0
```

Stream Inflow File

The Stream Inflow File contains the time series for all inflows into the modeled streams. Number of time steps to update the inflow data and repetition frequency are both set by the user. Stream nodes that receive inflow from outside the modeled area are specified, as well as the columns containing the values of stream inflow data to each of the listed stream nodes. If there is a zero for any given stream flow, then that column is not used in the simulation. To help identify the nodes, a description preceded by a back slash ("/") following the stream node number can be used. In time tracking simulations the time series stream inflow data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following variables are specified in this file:

NCOLSTRM	Total number of stream inflows
FACTSTRM	Conversion factor for the spatial component of the unit for the stream inflows
NSPSTRM	Number of time steps to update the stream inflows; if time tracking simulation enter any number
NFQSTRM	Repetition frequency of the stream inflow data; if time tracking simulation enter any number
DSSFL	If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Stream Inflow File

IRST	Stream node where inflow occurs; a value of zero in this column indicates that the corresponding data set is not used, and the stream inflow is taken to be zero

Data Input from Stream Inflow File

If the time series data is listed in the same file, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

ITST	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
ASTRM	Stream inflow at the specified stream node

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                   STREAM INFLOW DATA FILE
C                     Stream Component
C                    for IWFM Simulation
C
C
C              Project : IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: StreamInflow.dat
C
C*******************************************************************************
C                            File Description
C
C   This data file contains the inflows to the stream nodes that are modeled.
C
C*******************************************************************************
C                        Stream Inflow Data Specifications
C
C   NCOLSTRM; Total number of stream inflows (or pathnames if DSS files are used)
C   FACTSTRM; Conversion factor for stream inflow
C               It is used to convert only the spatial component of the unit;
C               DO NOT include the conversion factor for time component of the unit.
C               * e.g. Unit of flow listed in this file            = AC-FT/MONTH
C                      Consistent unit used in simulation          = CU.FT/DAY
C                      Enter FACTSTRM (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                       (conversion of MONTH -> DAY is performed automatically)
C   NSPSTRM ; Number of time steps to update the stream inflows
C               * Enter any number if time-tracking option is on
C   NFQSTRM ; Repetition frequency of the stream inflow data
C               * Enter 0 if full time series data is supplied
C               * Enter any number if time-tracking option is on
C   DSSFL   ; The name of the DSS file for data input (maximum 50 characters);
C               * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C    VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    58                          /NCOLSTRM
    86400.0                     /FACTSTRM    (cfs -> cu.ft./day)
    1                           /NSPSTRM
    0                           /NFQSTRM
                                /DSSFL
C-------------------------------------------------------------------------------
C                        Stream Inflow Location Information
C
C   List the list nodes below where the inflow occurs.
C
C   IRST;    Stream node where inflow occurs
C              * Enter '0' if the corresponding data set is not used
C
C-------------------------------------------------------------------------------
C   IRST
C-------------------------------------------------------------------------------
    205                         / 1:
    211                         / 2:
    220                         / 3:
      .                            .
      .                            .
      .                            .
      0                         /53:
      0                         /54:
     11                         /55:
    424                         /56:
     69                         /57:
     80                         /58:
C-------------------------------------------------------------------------------
C                            Stream Inflow Data
C                           (READ FROM THIS FILE)
C
C   List the stream inflow data below, if it will not be read from a DSS
C   file (i.e. DSSFL is left blank above).
C
C   ITST ;   Time
C   ASTRM;   Stream inflow at the stream node specified above; [L^3/T]
C
C-------------------------------------------------------------------------------
C   ITST            ASTRM(1)  ASTRM(2)  ASTRM(3) ...
C-------------------------------------------------------------------------------
C                      1         2         3      ......   56      57      58
10/31/1921_24:00    232.00     7.50     15.70    ......   0.00    0.00    0.00
11/30/1921_24:00    237.00    22.50     19.50    ......   0.00    0.00    0.00
12/31/1921_24:00    335.00    49.60     29.10    ......   0.00    0.00    0.00
        .              .         .         .     ......    .       .       .
        .              .         .         .     ......    .       .       .
        .              .         .         .     ......    .       .       .
07/31/1998_24:00    912.60    19.92     50.24    ......   4.90    1.20    6.00
08/31/1998_24:00    903.68     9.10     33.20    ......   7.00    0.00    0.00
09/30/1998_24:00    660.97     7.14     26.72    ......   0.00    0.00    0.00
C-------------------------------------------------------------------------------
C                     Pathnames for Stream Inflow Data
C                          (READ FROM DSS FILE)
C
C   List the pathnames for the stream inflow data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C-----------------------------------------------------------------------------------
C   REC       PATH
C-----------------------------------------------------------------------------------
*
*
```

Diversion Specifications File

This data file specifies the surface water diversion locations and the recharge zones for the recoverable losses from all modeled diversions. Deliveries, recoverable losses, non-recoverable losses, maximum diversion rates, diversion adjustment specifications and the percentage of each diversion that is used for agricultural purposes are specified in this file.

Surface Water Diversion Specifications

The first portion of the data file includes the number of surface water diversions modeled and the diversion specifications for each diversion modeled.

NRDV	Number of surface water diversions in the model
ID	Surface water diversion identification number
IRDV	Stream node from where the diversion takes place. Enter '0' if the stream node is not within the model domain
ICDVMAX	Maximum diversion amount; this number corresponds to the data column in the Diversion Data File; enter 0 if there is no maximum diversion rate
FDVMAX	Fraction of data value specified in column ICDVMAX to be used as maximum diversion amount
ICOLRL	Column number in the Diversion Data File used to define the recoverable loss corresponding to diversion number ID
FRACRL	Relative proportion of the data value that is specified by ICOLRL to be used as recoverable loss

ICOLNL	Column number in the Diversion Data File that corresponds to the non-recoverable loss from diversion number ID
FRACNL	Relative proportion of the data value that is specified by ICOLNL to be used as non-recoverable loss
TYPDSTDL	Diversion destination type (0 = diversion goes outside the model domain, 2 = diversion goes to element DSTDL, 4 = diversion goes to subregion DSTDL, 6 = diversion goes to a group of elements with ID DSTDL where element groups are listed later in this file)
DSTDL	Destination ID for diversion (enter any number if TYPDSTDL is 0, i.e. diversion is delivered to outside the model area)
ICOLDL	Delivery to destination DSTDL; this number corresponds to the appropriate data column in the Diversion Data File
FRACDL	Relative proportion of the data value that is specified by ICOLDL to be used as delivery to destination DSTDL
ICFSIRIG	Fraction of the delivery that is used for irrigation purposes (remaining amount will be used to supply the user specified urban demand); this number corresponds to the appropriate data column in the Irrigation Fractions Data File
ICADJ	Supply adjustment specification; this number corresponds to the appropriate data column in the Supply Adjustment Specifications File
NAME	Name of the diversion (maximum 20 characters); this name is later used in reporting the diversion details

Element Groups for Diversion Deliveries

Diversions can be delivered to user specified groups of elements. The following variables are used to describe the element groups:

NGRP	Number of element groups; enter 0 if there are no element groups where diversions are delivered
ID	Element group ID entered sequentially
NELEM	Number of elements in element group ID
IELEM	Element numbers that are in group ID

Recharge Zone for Each Diversion Point

Each diversion point must have a related recharge zone where the recoverable loss specified above becomes groundwater recharge. The following list describes the variables used to indicate a recharge zone for each diversion point:

ID	Recharge zone identification number; recharge zone ID should be the same as diversion identification number
NERELS	Total number of elements through which recharge occurs
IERELS	Element number through which recharge occurs
FERELS	Relative proportion of the recoverable loss to be applied to element IERELS as recharge

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C              SURFACE WATER DIVERSION SPECIFICATION DATA FILE
C                           Stream Component
C                          for IWFM Simulation
C
C
C              Project : IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: DiversionSpecs.dat
C
C*******************************************************************************
C                           File Description
C
C  This data file contains the specification data for surface water diversions.
C
C*******************************************************************************
C                  Surface Water Diversion Specifications
C
C   The following lists the number of surface water diversions and
C   specifications for each diversion that is included in the model.
C
C   NRDV;    Number of surface water diversions included in the model.
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
      5                          / NRDV
C-------------------------------------------------------------------------------
C
C   The following lists the specifications for each surface water diversion
C   (skip if no diversions are modeled, i.e. NRDV = 0)
C
C   ID      ; Surface water diversion identification number
C   IRDV    ; Stream node from where the diversion takes place. Enter '0' if
C              the stream node is outside the model area.
C   ICDVMAX ; Maximum diversion amount - this number corresponds to the
C              appropriate data column in the Diversion Data File
C             * Enter 0 if a maximum diversion amount does not apply.
C   FDVMAX  ; Fraction of data value specified in column ICDVMAX to be used as
C              maximum diversion amount
C   ICOLRL  ; Recoverable loss -  this number corresponds to the appropriate
C              data column in the Diversion Data File
C   FRACRL  ; Fraction of the data value that is specified by ICOLRL
C              to be used as recoverable loss
C   ICOLNL  ; Non-recoverable loss - this number corresponds to the appropriate
C              data column in the Diversion Data File
C   FRACNL  ; Fraction of the data value that is specified by ICOLNL
C              to be used as non-recoverable loss
C   TYPDSTDL; Diversion destination type
C               0 = Diversion goes outside the model domain
C               2 = Diversion goes to element DSTDL (see below)
C               4 = Diversion goes to subregion DSTDL (see below)
C               6 = Diversion goes to a group of elements with ID DSTDL
C                    (element groups are listed after this section)
C   DSTDL   ; Destination ID for diversion
C             * Note: Enter any number if TYPDSTDL is 0
C   ICOLDL  ; Delivery to destination DSTDL - this number corresponds to the
C              appropriate data column in the Diversion Data File
C   FRACDL  ; Fraction of the data value that is specified by ICOLDL
C              to be used as delivery to destination DSTDL
C   ICFSIRIG; Fraction of the delivery that is used for irrigation purposes -
C              this number corresponds to the appropriate data column in the
C              Irrigation Fractions Data File (remaining amount will be used to
C              supply the user specified urban demand)
C   ICADJ   ; Supply adjustment specification - this number corresponds to the appropriate
C              data column in the Supply Adjustment Specifications Data File
C   NAME    ; Name of the diversion (maximum 20 characters)
C
C---- -------------------------------------------------------------------------------------------------
C ID  IRDV  ICDVMAX  FDVMAX  ICOLRL  FRACRL  ICOLNL  FRACNL  TYPDSTDL  DSTDL  ICOLDL  FRACDL  ICFSIRIG  ICADJ  NAME
C---- -------------------------------------------------------------------------------------------------
  1    9     0        0.0     1       0.01    1       0.01    4         2      1       0.98    1         2      UrbDiv1
  2    12    0        0.0     2       0.02    2       0.02    4         2      2       0.96    1         2      UrbDiv2
  3    12    0        0.0     3       0.01    3       0.02    4         1      3       0.97    2         1      AgDiv1
  4    22    0        0.0     4       0.00    4       0.01    0         0      4       0.99    2         3      DivOut
  5    0     0        0.0     5       0.00    5       0.01    6         1      5       0.99    2         1      RiceDiv
C-----------------------------------------------------------------------------------------------------------
C
C                   Element Groups for Diversion Deliveries
C
C   List the elements in each group where selected diversions above are delivered to. All
C   elements in each group must belong to the same subregion.
C
C   NGRP  ; Number of element groups
C            * Enter 0 if there are no element groups where diversions
C              are delivered.
C   ID    ; Element group ID entered sequentially
C   NELEM ; Number of elements in element group ID
C   IELEM ; Element numbers that are in group ID
C
C-------------------------------------------------------------------------------
     1                  / NGRP
C-------------------------------------------------------------------------------
```

```
C    ID         NELEM      IELEM
C-------------------------------------------------------------------------------
     1           50         211
                            212
                            213
                            .
                            .
                            .
                            298
                            299
                            300
C-------------------------------------------------------------------------------
C
C                  Recharge zone for each diversion point
C       (Skip if no diversions are being modeled, i.e. NRDV = 0)
C
C   ID    ;  Recharge zone identification number
C             (*Note* Recharge zone ID's should match river diversion ID numbers)
C   NERELS;  Total number of elements through which recharge occurs
C   IERELS;  Element number through which recharge occurs
C   FERELS;  Relative proportion of the recoverable loss to be applied to
C               element IERELS as recharge
C
C-------------------------------------------------------------------------------
C    ID         NERELS      IERELS     FERELS
C-------------------------------------------------------------------------------
     1            2           251        1.0
                              270        1.0
     2            1           191        1.0
     3            3           193        1.0
                              174        1.0
                              155        1.0
     4            0           0          0.0
     5            0           0          0.0
```

Bypass Specifications File

This data file specifies the stream nodes where bypasses are taken from and streams node where they are returned, as well as the recharge zones for the recoverable losses from all modeled bypasses.

Bypass Configuration Specifications

This part of the data file describes the configuration of the modeled bypasses

NDIVS	Number of bypasses
FACTX	Conversion factor for the spatial component of the variable DIVX (the stream flow in the bypass rating table if the bypass amount is specified using a rating table)
TUNITX	Time unit of stream flow; his should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File.
FACTY	Conversion factor for the spatial component of the variable DIVY (the bypass rate in the bypass rating table if the bypass amount is specified using a rating table)
TUNITY	Time unit of bypass rate; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File.
ID	Bypass identification number
IA	Stream node number where bypass is exported from
TYPEDEST	Destination type for the bypass (0 = bypass is taken to outside the model boundary, 1 = bypass goes to a downstream node, 3 = bypass goes to a lake)

DEST	Destination for the bypass; enter any number if TYPEDEST is set to 0
IDIVC	If positive, IDIVC is the column number in the Diversion Data File for bypass flow; if negative, IDIVC is the number of points in the diversion rating table
DIVRL	Fraction of the diversion assigned as recoverable loss
DIVNL	Fraction of the diversion assigned as non-recoverable loss
DIVX	Stream flow available at stream node IA; [L^3/T]; enter only if IDIVC is less than zero. If IDIVC is less than zero then –IDVC values of DIVX must be entered
DIVY	Bypass rate amount corresponding to DIVX; [L^3/T]; enter only if IDIVC is less than zero. If IDIVC is less than zero then –IDVC values of DIVY must be entered
NAME	Name of the bypass (maximum 20 characters)

Seepage Locations for Bypass Canals

In this section elements that receive the recoverable losses from each bypass are listed. Recoverable losses from bypasses become recharge to groundwater at the designated elements. The following variables are used to specify the seepage locations for bypasses:

ID	Bypass identification number
NERELS	Total number of elements that receive the bypass recoverable loss
IERELS	Element number that receives the bypass recoverable loss

FERELS	Relative proportion of the recoverable loss to be applied to element IERELS as recharge

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                  STREAM BYPASS SPECIFICATION DATA FILE
C                           Stream Component
C                          for IWFM Simulation
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: BypassSpecs.dat
C
C*******************************************************************************
C                           File Description
C
C  This data file contains the specification data for stream bypasses.
C
C*******************************************************************************
C
C                  Bypass Configuration Specifications
C
C   NDIVS   ; Number of bypasses
C   FACTX   ; Conversion factor for DIVX
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of stream flow listed in this file   = AC-FT/MONTH
C                     Consistent unit used in simulation        = CU.FT/DAY
C                     Enter FACTX (AC-FT/MONTH -> CU.FT/MONTH)  = 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITX  ; Time unit of stream flow.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   FACTY   ; Conversion factor for DIVY
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of diversion listed in this file     = AC-FT/MONTH
C                     Consistent unit used in simulation        = CU.FT/DAY
C                     Enter FACTY (AC-FT/MONTH -> CU.FT/MONTH)  = 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITY  ; Time unit of diversion.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   ID      ; Bypass identification number
C   IA      ; Stream node number where bypass is exported from
C   TYPEDEST; Destination type for the bypass
C               0 = bypass goes to outside the model boundary
C               1 = bypass goes to a downstream node
C               3 = bypass goes to a lake
C   DEST    ; Destination for the bypass
C               * Note: Enter any number if TYPEDEST is set to 0
C   IDIVC   ; If positive, IDIVC is the column number in the Diversion Data File  for bypass flow
C             If negative, IDIVC is the number of points in the diversion rating table
C               * Note: A rating table cannot be specified if the bypass originates outside the model area
C   DIVRL   ; Fraction of the diversion assigned as recoverable loss
C   DIVNL   ; Fraction of the diversion assigned as non-recoverable loss
C   DIVX    ; Stream flow available at stream node IA; [L^3/T]
C               * Note: Enter only if IDIVC is less than zero
C   DIVY    ; Diversion amount corresponding to DIVX; [L^3/T]
C               * Note: Enter only if IDIVC is less than zero
C   NAME    ; Name of the bypass (maximum 20 characters)
C
C-------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    2                          / NDIVS
    43560.0                    / FACTX      (ac.ft. -> cu.ft.)
    1DAY                       / TUNITX
    43560.0                    / FACTY      (ac.ft. -> cu.ft.)
    1DAY                       / TUNITY
C----------------------------------------------------------------------------------
C  ID   IA   TYPEDEST  DEST   IDIVC   DIVRL  DIVNL    NAME
C                                     DIVX   DIVY
C----------------------------------------------------------------------------------
   1    13      0        0     6      0.0     0.0     Bypass1
   2    17      1       22    -4      0.0     0.1     Bypass2
                                      0.0     0.0
                                      1.0     0.5
                                     18.0     9.0
                                   8000.0  4000.0
C----------------------------------------------------------------------------------
C
C               Seepage locations for bypass canals
C
C       The following information specifies the recharge zone for each bypass.
C       (Skip if no bypass is being modeled, i.e. NDIVS = 0)
C
C   ID    ;  Recharge zone identification number
C              (* Note: Recharge zone ID's should match bypass ID numbers)
C   NERELS;  Total number of elements through which recharge occurs
C   IERELS;  Element number through which recharge occurs
C   FERELS;  Relative proportion of the recoverable loss to be applied to
C             element IERELS as recharge.
C
C-------------------------------------------------------------------------------
C    ID         NERELS      IERELS     FERELS
C-------------------------------------------------------------------------------
   1             0            0         0
   2             0            0         0
```

Diversion Data File

The Diversion Data File contains the diversion and bypass amounts as well as the maximum diversion rates. This data file is used in conjunction with the Diversion Specification File and the Bypass Specification File to route the water to delivery points, indicate bypass flows, the recoverable losses with respect to recharge zone and the non-recoverable losses. In time tracking simulations the time series diversions data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NCOLDV	Number of data columns included in this file
FACTDV	Conversion factor for the spatial component of the unit for the diversion data
NSPDV	Number of time steps to update the surface water diversion data; if time tracking simulation, enter any number
NFQDV	Repetition frequency of the surface water diversion data; a value of zero indicates that a full time series data set is supplied. If time tracking simulation, enter any number.
DSSFL	If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in this file

Data Input from Diversion Data File

If the time series data is listed in the Diversion Data File, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITDV	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
ADIVS	Diversion or bypass rate corresponding to the stream node specified in Diversion Specification File or the Bypass Specification File, [L^3/T]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                  SURFACE WATER DIVERSION DATA FILE
C                         Stream Component
C                        for IWFM Simulation
C
C
C             Project : IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: Diversions.dat
C
C*******************************************************************************
C                             File Description
C
C   This data file contains the surface water diversion and bypass data
C   for the stream nodes that have been specified in the surface water
C   diversion specification data file. Maximum diversion rates to be used
C   in supply adjutment computations are also listed in this file.
C
C*******************************************************************************
C                    Surface Water Diversion Data Specifications
C
C   The following lists the time-series surface water diversions for
C   each of the stream nodes where surface diversions have been specified.
C
C   NCOLDV;  Number of surface water diversions (or pathnames if DSS files are used)
C   FACTDV;  Conversion factor for surface water diversions
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of diversion listed in this file    = AC-FT/MONTH
C                    Consistent unit used in simulation       = CU.FT/DAY
C                    Enter FACTDV (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   NSPDV ;  Number of time steps to update the surface water diversion data
C             * Enter any number if time-tracking option is on
C   NFQDV ;  Repetition frequency of the surface water diversion data
C             * Enter 0 if full time series data is supplied
C             * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C             * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C    VALUE                     DESCRIPTION
C-------------------------------------------------------------------------------
     6                         / NCOLDV
     43560000.0                / FACTDV     (taf -> cu.ft.)
     1                         / NSPDV
     0                         / NFQDV
     TSDATA IN.DSS             / DSSFL
C*******************************************************************************
C                      Surface Water Diversion Data
C                         (READ FROM THIS FILE)
C
C   List the diversion data below, if it will not be read from a DSS file (i.e.
C   DSSFL is left blank above).
C
C   ITDV ;  Time
C   ADIVS;  Diversion rate and maximum diversion rates (if any) corresponding to
C            the stream node specified in diversion specification file; [L^3/T]
C
C-------------------------------------------------------------------------------
C   ITDV   ADIVS(1)  ADIVS(2)  ADIVS(3) ...
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C                Pathnames for Surface Water Diversion Data
C                         (READ FROM DSS FILE)
C
C   List the pathnames for diversion data below, if it will be read from a DSS file
C   (i.e. DSSFL is specified above).
C
C   REC  ;   Time series record number
C   PATH ;   Pathname for the time series record
C
C-------------------------------------------------------------------------------
C   REC       PATH
C-------------------------------------------------------------------------------
     1        /IWFM/DIV1/FLOW//1DAY/DIVERSION/
     2        /IWFM/DIV2/FLOW//1DAY/DIVERSION/
     3        /IWFM/DIV3/FLOW//1DAY/DIVERSION/
     4        /IWFM/DIV4/FLOW//1DAY/DIVERSION/
     5        /IWFM/DIV5/FLOW//1DAY/DIVERSION/
     6        /IWFM/BYPASS1/FLOW//1DAY/BYPASS/
```

Lake Component Files

Simulation Main Input File points to the Lake Component Main File which is the gateway for all other data files that are needed to simulate lake storages and lake-aquifer interaction. Data input files that are used in simulating lakes are described in the following sections.

Lake Component Main File

Lake Component Main File is the gateway to additional data files that are used in simulating lake storages and the lake-aquifer interaction. The names of the input and output files are listed in this file. Lake bed parameters and initial lake surface elevations are also specified.

The Lake Component Main File is divided into multiple sections:

Input and Output Filenames

This section lists the data file that lists the time series maximum lake elevations and the optional output file for detailed lake water budgets. The following variables are used in this section:

MXLKELVFL	File name that lists the time series maximum lake elevations (maximum 1000 characters)
LKBUDFL	Binary output file for lake water budget (maximum 1000 characters); leave blank if this output is not required

Lake Parameters

In this section lake bed parameters, lake evaporation and precipitation data are listed:

FACTK	Conversion factor for the spatial component of the lake bed hydraulic conductivity
TUNITK	Time unit of hydraulic conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
FACTL	Conversion factor for thickness of lake bed
IL	Lake number
CLAKE	Hydraulic conductivity of the lake bed; [L/T]
DLAKE	Thickness of the lake bed; [L]
ICHLMAX	Column number in MXLKELVFL file that lists the time series maximum lake elevation
ICETLK	Lake evapotranspiration rate; this number corresponds to the appropriate data column in the Evapotranspiration Data File listed in the Simulation Main Input File.
ICPCPLK	Lake precipitation rate; this number corresponds to the appropriate data column in the Precipitation Data File listed in the Simulation Main Input File.
NAMELK	Name of the lake; maximum 1000 characters

Initial Lake Elevations

In this section, initial conditions for the modeled lakes are specified:

FACT	Conversion factor for initial lake elevations
ILAKE	Lake identification number
HLAKE	Initial lake elevation; [L]

```
#4.0
C***  DO NOT DELETE ABOVE LINE ***
C
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                        LAKE PARAMETERS DATA FILE
C                           for IWFM Simulation
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: Lake_MAIN.dat
C
C*******************************************************************************
C                           File Description
C
C   This data file contains the parameters and data file names for the simulation
C   of lakes.
C
C*******************************************************************************
C                           Lake Data File Names
C
C   MXLKELVFL;  File name that lists the maximum lake elevations (max. 1000 characters)
C   LKBUDFL  ;  Binary output file for lake budget (max. 1000 characters)
C                 * Leave blank if this output is not required
C
C-----------------------------------------------------------------------------------------
C         VALUE                                       DESCRIPTION
C-----------------------------------------------------------------------------------------
          Lake\MaxLakeElev.dat                        / MXLKELVFL
          ..\Budget\LakeBud.bin                       / LKBUDFL
C*******************************************************************************
C                            Lake Parameters
C
C     The parameters required to model lakes are listed below.
C
C   FACTK  ;   Conversion factor for lake bed hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                 = IN/DAY
C                     Enter FACT (FT/MONTH -> IN/MONTH)                  = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNITK ;   Time unit of hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   FACTL  ;   Conversion factor for thickness of lake bed
C   IL     ;   Lake number
C   CLAKE  ;   Hydraulic conductivity of the lake bed; [L/T]
C   DLAKE  ;   Thickness of the lake bed; [L]
C   ICHLMAX;   Column number in MXLKELVFL file that gives maximum lake elevation
C   ICETLK ;   Evapotranspiration - this number corresponds to the appropriate data
C               column in the ET data file listed in the Main Control Data file.
C   ICPCPLK;   Precipitation - this number corresponds to the appropriate data column
C               in the Precipitation data file listed in the Main Control Data file.
C   NAMELK ;   Name of the lake (max. 1000 characters)
C
C-------------------------------------------------------------------------------
C   VALUE                 DESCRIPTION
C-------------------------------------------------------------------------------
    1.0                   / FACTK
    1day                  / TUNITK
    1.0                   / FACTL
C-------------------------------------------------------------------------------
C   IL       CLAKE      DLAKE      ICHLMAX    ICETLK   ICPCPLK   NAMELK
C-------------------------------------------------------------------------------
    1        10.0       1.0          1          7        2       Lake1
C*******************************************************************************
C                            Initial Lake Elevations
C
C     Initial lake surface elevations are listed below.
C
C   FACT  ;  Conversion factor for initial lake elevations
C   ILAKE ;  Sequential lake number
C   HLAKE ;  Initial lake elevations; [L]
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    1.0                         / FACT
C-------------------------------------------------------------------------------
C    ILAKE     HLAKE
C-------------------------------------------------------------------------------
      1        280.0
```

Maximum Lake Elevation Data File

This data file contains the time series data for the maximum lake elevations at the modeled lakes. The time-dependent maximum lake elevations at the modeled lakes are associated with each of the data columns through the ICHLMAX variable specified in the Lake Component Main File. In time tracking simulations the time series maximum lake elevation data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NCOLHLMX	Total number of time series data columns for maximum lake elevations
FACTHLMX	Conversion factor for maximum lake elevations
NSPHLMX	Number of time steps to update the maximum lake elevations; if time tracking simulation, enter any number
NFQHLMX	Repetition frequency of the maximum lake elevation data; if time tracking simulation, enter any number
DSSFL	If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Maximum Lake Elevation Data File

Data Input from Maximum Lake Elevation Data File

If the time series data is listed in the Maximum Lake Elevation Data File, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITHLMX	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
HLMAX	Maximum lake elevation; [L]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                   MAXIMUM LAKE ELEVATION DATA FILE
C                           Lake Component
C                         for IWFM Simulation
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: MaxLakeElev.dat
C
C*******************************************************************************
C                            File Description
C
C   This data file contains the time series data for the maximum lake elevations
C   at the modeled lakes.
C
C*******************************************************************************
C                        Maximum Lake Elevation Data Specifications
C
C   NCOLHLMX; Total number of time series data columns (or pathanmes if DSS files
C              are used)for maximum lake elevations
C   FACTHLMX; Conversion factor for maximum lake elevations
C   NSPHLMX ; Number of time steps to update the maximum lake elevations
C              * Enter any number if time-tracking option is on
C   NFQHLMX ; Repetition frequency of the maximum lake elevation data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL  ;  The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C     VALUE                    DESCRIPTION
C-------------------------------------------------------------------------------
      1                        / NCOLHLMX
      1.0                      / FACTHLMX
      1                        / NSPHLMX
      1                        / NFQHLMX
                               / DSSFL
C-------------------------------------------------------------------------------
C                        Maximum Lake Elevations Data
C                           (READ FROM THIS FILE)
C
C   List the maximum lake elevations data below, if it will not be read from
C   a DSS file (i.e. DSSFL is left blank above).
C
C   ITHLMX ;   Time
C   HLMAX  ;   Maximum lake elevation; [L]
C
C-------------------------------------------------------------------------------
C   ITHLMX          HLMAX(1)  HLMAX(2)  HLMAX(3) ...
C-------------------------------------------------------------------------------
09/30/2100_24:00    285.0
*
C-------------------------------------------------------------------------------
C                       Pathnames for Maximum Lake Elevations Data
C                                (READ FROM DSS FILE)
C
C   List the pathnames for maximum lake elevations data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C---------------------------------------------------------------------------------
C   REC       PATH
C---------------------------------------------------------------------------------
*
*
```

Boundary Conditions File

The following types of boundary conditions can be input into the boundary data file for each aquifer layer modeled:

1. Specified flow
2. Specified head
3. General head

Small stream watersheds are also listed in this file. For each aquifer layer, boundary conditions 1-3 are specified, followed by the small stream watershed boundary conditions. The number of boundary condition nodes for a layer must be specified as zero for the conditions not used in the simulation.

Specified Flow

Specified flow boundary conditions are defined when the flow is known across surfaces bounding the domain. The number of nodes with a specified flow, the conversion factor, followed by the list of nodes and associated flow terms are required input for specified flow boundary conditions. The variables used to describe the input data are as follows:

NQB	Number of nodes with specified flow; enter 0 if there are no specified-flow type boundary conditions (it should be noted that IWFM assumes zero flow at the boundaries by default so zero-flow boundary conditions need not be specified)
FACT	Conversion factor for the spatial component of the unit for the specified flow data

TUNIT	Time unit of flow boundary conditions; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
INODE	Groundwater node with a specified flow
BQ	Specified flow value at groundwater node INODE; if BQ is less than −10000, then –BQ−10000 indicates the corresponding column number in the Time Series Boundary Conditions Data File, [L^3/T]

Specified Head

Specified head boundary conditions are defined when the hydraulic head is known for surfaces bounding the domain. The number of boundary nodes with specified head values, conversion factor and each node and the related hydraulic head are defined in the input file in the following terms:

NHB	Number of groundwater nodes with specified head, enter 0 if there are no specified-head type boundary conditions
FACT	Conversion factor for specified head
INODE	Groundwater node with a specified head
BH	Specified head value for node INODE; if less than −10000.0, then –BH−10000.0 indicates the corresponding column number in the Time Series Boundary Conditions Data File, [L]

General Head

General head boundary condition is defined when head values at a specified distance from a boundary node is known. The number of general head boundary nodes is listed, followed by the conversion factors. This information is followed by the node numbers with a general head boundary condition and the related hydraulic head, area of influence and distance from each node. The following must be specified in this input to declare general head boundary conditions:

NGB	Number of groundwater nodes with general head boundary conditions, enter 0 if there are no general head boundary conditions
FACTH	Conversion factor for the head value
FACTAR	Conversion factor for area
INODE	Node number corresponding to the general head boundary condition
BH	Fixed head at distance BD (defined below) from the groundwater node INODE; if less than –10000.0, then –BH–10000.0 indicates the column number in the Time Series Boundary Condition Data File, [L]
BA	Area of influence surrounding groundwater node INODE, $[L^2]$
BD	Distance from the groundwater node INODE to the source of the fixed head BH, [L]

Small Stream Watersheds

To account for the inflows from small stream watersheds into the model domain, surface and subsurface flows leaving the small stream watershed and entering the model domain are simulated with an approximate method. The boundary condition values are implemented in the groundwater equation based on the computation of surface and subsurface flows using parameters defined in this file.

The surface runoff and groundwater recharge characteristics are specified for each small stream watershed modeled. Defined in this file are the number of small stream watersheds and related conversion factors. The following input includes each small watershed identification number and the related surface and subsurface information. The drainage area of the small watershed must be specified, followed by the stream node within the model where surface runoff contributes. The number of groundwater nodes that receive inflows from the small watershed is followed by a list that defines each groundwater identification number and the maximum recharge rate to that groundwater node. A negative value for the maximum recharge rate indicates that subsurface flow from the small watershed will directly contribute to groundwater node, whereas a positive value indicates the maximum amount of water that can percolate to the groundwater when routed from the small watershed to stream node IWBTS. The following variables are used in this section:

NTWB	Number of small watersheds that are modeled
FACTA	Conversion factor for small watershed drainage area
FACTQ	Conversion factor for the spatial component of the unit for the maximum recharge rate
TUNIT	Time unit of maximum recharge rate; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File

ID	Small watershed identification number
IWBS	Watershed group number corresponding to the parameters specified for watersheds in the Parameter Data File
AREAS	Drainage area of the small watershed, [L^2]
IWBTS	Stream node that receives small watershed surface runoff
NWB	Number of groundwater nodes that receive either direct subsurface inflow of percolation of the surface flow from the small watershed
IWB	Groundwater node numbers that receive direct subsurface flow or percolation of the surface flow from the small watershed
QMAXWB	Maximum recharge rate for each node [L^3/T]; a negative value indicates that the groundwater node receives baseflow from the small watershed at layer −QMAXWB (e.g. −2 means the groundwater node at aquifer layer 2 will receive the baseflow), whereas a positive value indicates the amount of water that can percolate through the small stream to the groundwater

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                   BOUNDARY CONDITIONS DATA FILE
C                       for IWFM Simulation
C
C
C              Project : IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: Bound.dat
C
C*******************************************************************************
C                          File Description:
C
C   This data file contains five types of boundary conditions for each layer.
C   The boundary conditions are set as constant head, prescribed flux and
C   general head for each layer which is to be followed by boundary conditions
C   for small watershed inflow computation.
C
C*******************************************************************************
C
C                       Layer 1  Boundary Conditions
C
C   The following lists the specified flux, constant head and general
C   head boundary conditions for Layer 1
C
C-------------------------------------------------------------------------------
C             Specified flux boundary conditions specifications (Layer 1)
C
C   NQB  ;    Number of nodes with specified flux
C   FACT ;    Conversion factor for specified flux data
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of flux listed in this file        = AC-FT/MONTH
C                     Consistent unit used in simulation      = CU.FT/DAY
C                     Enter FACT (AC-FT/MONTH -> CU.FT/MONTH) = 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNIT;    Time unit of flux boundary conditions.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Main Control File.
C
C  *Note* If the specified flux is zero, the nodes do not need to be specified
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
     0                           / NQB
     1.0                         / FACT
     1day                        / TUNIT
C-------------------------------------------------------------------------------
C
C               Specified flux boundary condition data (Layer 1)
C      (Skip if there are no nodes with a specified flux, i.e. NQB = 0)
C
C   INODE;   Groundwater node with a specified flux
C   BQ   ;   Specified flux value at groundwater node INODE; [L^3/T]
C              (If less than -10000.0, then -(BQ+10000.0) indicates the column
C               number in the Time Series Boundary Conditions Data File)
C-------------------------------------------------------------------------------
C     INODE     BQ
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C*******************************************************************************
C
C           Specified head boundary conditions specifications (Layer 1)
C
C   NHB ;    Number of groundwater nodes with specified head
C   FACT;    Conversion factor for specified head data
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
     42                          / NHB
     1.0                         / FACT
C-------------------------------------------------------------------------------
C
C               Specified head boundary condition data (Layer 1)
C   (Skip if there are no nodes with a specified head, i.e. NHB = 0)
C
C   INODE;   Groundwater node with a specified head
C   BH   ;   Specified head value for node INODE relative to a common datum; [L]
C              (If less than -10000.0, then -(BH+10000.0) indicates the column
C               number in the Time Series Boundary Conditions Data File)
C-------------------------------------------------------------------------------
C    INODE     BH
C-------------------------------------------------------------------------------
      1        290.0
      22       290.0
      43       290.0
      64       290.0
      .        .
      .        .
      .        .
      378      -10001
      399      -10001
```

```
      420      -10001
      441      -10001
C-------------------------------------------------------------------------------
C*******************************************************************************
C
C            General head boundary conditions specifications (Layer 1)
C
C   NGB   ;  Number of groundwater nodes with general head boundary conditions
C   FACTH ;  Conversion factor for head
C   FACTAR;  Conversion factor for area
C-------------------------------------------------------------------------------
C       VALUE                  DESCRIPTION
C-------------------------------------------------------------------------------
        0                      / NGB
        1.0                    / FACTH
        1.0                    / FACTAR
C-------------------------------------------------------------------------------
C
C             General head boundary conditions data (Layer 1)
C  (Skip if there are no nodes with general head boundary conditions, ie. NGB = 0)
C
C
C   INODE;   Node number corresponding to the general head boundary condition
C   BH   ;   Fixed head at the distance BD from the groundwater node INODE; [L]
C              (If less than -10000.0, then -(BH+10000.0) indicates the column
C               number in the Time Series Boundary Conditions File)
C   BA;      Area of influence surrounding groundwater node INODE; [L^2]
C   BD;      Distance from the groundwater node INODE to the source of the
C             fixed head BH; [L]
C-------------------------------------------------------------------------------
C   INODE       BH        BA         BD
C-------------------------------------------------------------------------------
*
*
C*******************************************************************************
C
C                       Layer 2 Boundary Conditions
C
C   The following lists the specified flux, constant head and general
C   head boundary conditions for Layer 2
C
C-------------------------------------------------------------------------------
C            Specified flux boundary conditions specifications (Layer 2)
C
C   NQB  ;    Number of nodes with specified flux
C   FACT ;    Conversion factor for specified flux data
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of flux listed in this file        = AC-FT/MONTH
C                     Consistent unit used in simulation      = CU.FT/DAY
C                     Enter FACT (AC-FT/MONTH -> CU.FT/MONTH) = 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   TUNIT;    Time unit of flux boundary conditions.  This should be one of the units
C             recognized by HEC-DSS that are listed in the Main Control File.
C
C  *Note* If the specified flux is zero, the nodes do not need to be specified
C-------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    0                          / NQB
    1.0                        / FACT
    1day                       / TUNIT
C-------------------------------------------------------------------------------
C
C              Specified flux boundary condition data (Layer 2)
C      (Skip if there are no nodes with a specified flux, i.e. NQB = 0)
C
C   INODE;   Groundwater node with a specified flux
C   BQ   ;   Specified flux value at groundwater node INODE; [L^3/T]
C              (If less than -10000.0, then -(BQ+10000.0) indicates the column
C               number in the Time Series Boundary Conditions File)
C-------------------------------------------------------------------------------
C     INODE     BQ
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C*******************************************************************************
C
C          Specified head boundary conditions specifications (Layer 2)
C
C   NHB ;    Number of groundwater nodes with specified head
C   FACT;    Conversion factor for specified head data
C-------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    0                          / NHB
    1.0                        / FACT
C-------------------------------------------------------------------------------
C
C              Specified head boundary condition data (Layer 2)
C   (Skip if there are no nodes with a specified head, i.e. NHB = 0)
C
C   INODE;   Groundwater node with a specified head
C   BH   ;   Specified head value for node INODE relative to a common datum; [L]
C              (If less than -10000.0, then -(BH+10000.0) indicates the column
C               number in the Time Series Boundary Conditions File)
C-------------------------------------------------------------------------------
```

```
C    INODE     BH
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C*******************************************************************************
C
C           General head boundary conditions specifications (Layer 2)
C
C   NGB   ;  Number of groundwater nodes with general head boundary conditions
C   FACTH ;  Conversion factor for head
C   FACTAR;  Conversion factor for area
C-------------------------------------------------------------------------------
C       VALUE                 DESCRIPTION
C-------------------------------------------------------------------------------
        0                     / NGB
        1.0                   / FACTH
        1.0                   / FACTAR
C-------------------------------------------------------------------------------
C
C            General head boundary conditions data (Layer 2)
C  (Skip if there are no nodes with general head boundary conditions, ie. NGB = 0)
C
C
C   INODE;   Node number corresponding to the general head boundary condition
C   BH   ;   Fixed head at the distance BD from the groundwater node INODE; [L]
C              (If less than -10000.0, then -(BH+10000.0) indicates the column
C               number in the Time Series Boundary Conditions File)
C   BA;      Area of influence surrounding groundwater node INODE; [L^2]
C   BD;      Distance from the groundwater node INODE to the source of the
C             fixed head BH; [L]
C-------------------------------------------------------------------------------
C   INODE       BH        BA         BD
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C*******************************************************************************
C
C          Boundary Conditions for Small Watershed Inflow Computation
C
C   NTWB  ; Number of small watersheds where inflows will be computed
C            and specified as boundary flux
C   FACTA ; Conversion factor for small watershed drainage area
C   FACTQ ; Conversion factor for maximum recharge rate
C            It is used to convert only the spatial component of the unit;
C            DO NOT include the conversion factor for time component of the unit.
C            * e.g. Unit of max. recharge rate listed in this file   = AC-FT/MONTH
C                   Consistent unit used in simulation              = CU.FT/DAY
C                   Enter FACT (AC-FT/MONTH -> CU.FT/MONTH)          = 2.29568E-05
C                    (conversion of MONTH -> DAY is performed automatically)
C   TUNIT ; Time unit of max. recharge rate.  This should be one of the units
C            recognized by HEC-DSS that are listed in the Main Control File.
C   ID    ; Small watershed identification number
C   IWBS  ; Watershed group number corresponding to the watershed parameter
C            groups specified in the Parameter Data File
C   AREAS ; Drainage area of the small watershed; [L^2]
C   IWBTS ; Stream node that receives the surface runoff from the small watershed
C   NWB   ; Number of groundwater nodes that receive the base flow and the
C            percolation of surface flow from the small watershed
C   IWB   ; Groundwater node number small watershed baseflow is routed through
C   QMAXWB; Maximum recharge rate for each node; [L^3/T]
C           (Enter the negative of layer number to specify which groundwater node(s)
C            at which layer receive baseflow from the small watersheds; e.g. -1 means
C            layer 1, -2 means layer 2, etc)
C
C   *Note*   Skip data input if no small watersheds are modeled (NSW=0)
C-------------------------------------------------------------------------------
C       VALUE                 DESCRIPTION
C-------------------------------------------------------------------------------
        3                     / NTWB
         1000000.0            / FACTA
         1000.0               / FACTQ
         1day                 / TUNIT
C------------------------------------------------------------------------------
C ID     IWBS    AREAS   IWBTS     NWB    IWB      QMAXWB
C---------------------------------------------------------------------
  1        1      6.0      1        2      432       -1
                                           433       -1
  2        1      5.0      3        3      436       -1
                                           414       10.0
                                           392        5.0
  3        2      5.0      21       2       15       -1
                                            35        2.0
```

Time Series Boundary Condition File

This file lists the time series data for specified head, specified flow and general head boundary conditions. The groundwater node numbers that correspond to the columns listed in this file are specified in the Boundary Conditions Data File. If both specified head and specified flow boundary conditions are listed, then each column has to have either only head values or only flow rate values. The time series input boundary conditions data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The parameters specified in this file are as follows:

NBTSD	Number of data columns
FACTHTS	Conversion factor for head values
FACTQTS	Conversion factor for the spatial component of the unit for the flow values
NSPHTS	Number of time steps to update the boundary condition head values; if time tracking simulation, enter any number
NFQHTS	Repetition frequency of the time series boundary condition data (enter zero if full time series data is supplied); iIf time tracking simulation, enter any number
DSSFL	If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Time Series Boundary Conditions Data File

Data Input from Time Series Boundary Conditions Data File

If the time series data is listed in the Time Series Boundary Conditions Data File, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

ITHTS — Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

HQTS — Time series boundary values, [L] or [L^3/T] depending if specified head or specified flow values are listed in a column

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated.

REC — Record number that coincides with the data column number for the time series data

PATH — Pathname for the time series record that will be used for data retrieval

```
C*****************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*****************************************************************************
C
C                   TIME SERIES BOUNDARY CONDITION DATA
C                           for IWFM Simulation
C
C
C             Project : IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: BoundTSD.dat
C
C*****************************************************************************
C                          File Description
C
C   This data file contains the time series data for the specified flow,
C   specified head and/or general head boundary conditions. The file provides
C   time series data for the groundwater nodes specified in Boundary Conditions
C   Data File.
C
C*****************************************************************************
C                    Time Series Boundary Condition Specifications
C
C   The following lists the time series values for the groundwater nodes
C   specified in Boundary Conditions Data File.
C
C   NBTSD  ; Number of columns (or pathnames if DSS files are used)
C   FACTHTS; Conversion factor for head values
C   FACTQTS; Conversion factor for flow values
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of flow listed in this file          = AC-FT/MONTH
C                    Consistent unit used in simulation        = CU.FT/DAY
C                    Enter FACTQTS (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   NSPHTS;  Number of time steps to update the time series boundary condition data
C             * Enter any number if time-tracking option is on
C   NFQHTS;  Repetition frequency of the time series boundary condition data
C             * Enter 0 if full time series data is supplied
C             * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C             * Leave blank if DSS file is not used for data input
C
C-----------------------------------------------------------------------------
C     VALUE                     DESCRIPTION
C-----------------------------------------------------------------------------
      1                         / NBTSD
      1.0                       / FACTHTS
      1.0                       / FACTQTS
      1                         / NSPHTS
      0                         / NFQHTS
                                / DSSFL
C-----------------------------------------------------------------------------
C                    Time Series Boundary Condition Data
C                         (READ FROM THIS FILE)
C
C   List the time series boundary condition data below, if it will not be read
C   from a DSS file (i.e. DSSFL is left blank above).
C
C   ITHTS;  Time
C   HQTS ;  Time series boundary values; [L] or [L^3/T]
C
C------------------------------------------------------------------------------------------
C   ITHTS              HQTS(1)  HQTS(2)  HQTS(3) ...
C------------------------------------------------------------------------------------------
    09/30/1991 24:00   310.0
    09/30/1992 24:00   310.0
    09/30/1993 24:00   310.0
    09/30/1994 24:00   310.0
    09/30/1995 24:00   310.0
    09/30/1996 24:00   350.0
    09/30/1997 24:00   350.0
    09/30/1998 24:00   350.0
    09/30/1999 24:00   350.0
    09/30/2000 24:00   350.0
C-----------------------------------------------------------------------------
C                    Pathnames for Time Series Boundary Condition Data
C                                (READ FROM DSS FILE)
C
C   List the pathnames for the time series boundary condition data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C------------------------------------------------------------------------------------------
C   REC       PATH
C------------------------------------------------------------------------------------------
*
*
```

Print Control File

This data file contains instructions for printing groundwater hydrographs, subsidence, and the flows at boundary nodes and element faces. The output filenames are listed in the Simulation Main Input File.

Groundwater hydrographs can be printed at specified groundwater nodes or at locations defined by x-y coordinates and aquifer layers. The data file requires the user to specify the number of groundwater hydrographs to be printed (NOUTH) and the conversion factor for nodal coordinates (FACT). If the groundwater hydrographs are required for specified groundwater nodes at specified layers, then FACT should be set to zero. If the groundwater hydrographs are required for specified x-y coordinates and specified layers, then FACT should be set to the actual conversion factor. If hydrographs at a mixture of groundwater nodes and x-y coordinate locations are required, then groundwater nodes should be treated as x-y locations and FACT should be set to 0.0. If input data is based on node numbers, the spaces reserved for x and y coordinates must be left blank. NOUTH must be set to zero if no groundwater hydrographs are required. To print the average head for all layers, IOUTHL is set to zero.

Printing of subsidence is similar to the printing of groundwater hydrographs. The user may request to print subsidence values at specified x-y coordinates or at grid nodes. In any case, the number of locations for which subsidence will be printed (NOUTS) must be specified along with the conversion factor (FACT) for the coordinates of the locations for subsidence printing. If subsidence will be printed at grid nodes, then FACT must be set to 0.0, otherwise a proper coordinate conversion factor must be specified. Then, for each location where a subsidence print-out is required, the aquifer layer number

(IOUTSL), and either the x (X) and y-coordinates (Y) of the location or the groundwater node number (IOUTS) must be specified, depending on the value specified for FACT. IOUTSL can be set to any aquifer layer number. Alternatively, it can be set to 0 to print-out the total subsidence (summation of the subsidence at all aquifer layers) at the specified location. If no subsidence printing is required NOUTS must be set to zero, FACT to any number, and no entries must be made for IOUTSL, X, Y and IOUTS variables.

For boundary node flow printing, number of hydrographs (NOUTB) and corresponding groundwater boundary node (IOUTB) and layer number (IOUTBL) should be specified.

To print out the flow rates at element faces, number of element faces (NOUTF) for print-out, the aquifer layer numbers in which the element faces are located (IOUTFL), and the node numbers that identify each of the element faces (IOUTFA and IOUTFB) should be specified.

The following variables are located in this input file for the purposes of specifying hydrograph printing options:

NOUTH	Total number of groundwater hydrographs to be printed; set NOUTH = 0 if no groundwater hydrograph data is to be printed
FACT	Factor to convert nodal coordinates into simulation unit of length. If FACT = 0.0 the input data is by nodes; if FACT > 0.0 the input data is by x-y coordinates
IOUTHL	Layer number; enter 0 to print average head for all layers

X	The x-coordinate of the hydrograph location (specify only if FACT > 0.0), [L]
Y	The y-coordinate of the hydrograph location (specify only if FACT > 0.0), [L]
IOUTH	Groundwater node number (specify only if FACT = 0.0)
NOUTS	Total number of subsidence data to be printed; NOUTS = 0 if no subsidence data is to be printed
FACT	Factor to convert nodal coordinates into simulation unit of length. If FACT = 0.0 the subsidence print-out locations are by nodes; if FACT > 0.0 the they are by x-y coordinates
IOUTSL	Layer number; enter 0 to print total subsidence for all layers
X	The x-coordinate of the location for which subsidence will be printed (specify only if FACT > 0.0), [L]
Y	The y-coordinate of the location for which subsidence will be printed (specify only if FACT > 0.0), [L]
IOUTS	Groundwater node number for subsidence print-out (specify only if FACT = 0.0)
NOUTB	Total number of flow hydrographs at boundary nodes to be printed; enter 0 if no hydrographs at boundary nodes are to be printed
IOUTBL	Layer number of the groundwater boundary node for hydrograph printing
IOUTB	Groundwater node number for boundary node hydrograph printing
NOUTF	Number of element faces for flow printing

IOUTFL	Aquifer layer number that the element face is located
IOUTFA	The first groundwater node number that defines the element face
IOUTFB	The second groundwater node number that defines the element face

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                    PRINT CONTROL DATA FILE
C                      for IWFM Simulation
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: Print.dat
C
C*******************************************************************************
C                             File Description:
C
C   This data file contains the print output control data including a list of
C   the groundwater and subsidence nodes for which hydrographs will be printed,
C   and a list of the boundary nodes and element faces for which groudwater flow
C   will be printed.
C
C*******************************************************************************
C           Groundwater Hydrograph Print Control Specifications
C
C   The following lists the node and layer numbers for which groundwater
C   hydrograph will be printed
C
C   NOUTH;   Total number of hydrographs to be printed
C             (set NOUTH = 0 if no hydrograph data is to be printed)
C   FACT ;   Conversion factor for nodal coordinates
C             If FACT = 0.0 the input data is by nodes
C             If FACT > 0.0 the input data is by X-Y coordinates
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
    42                          / NOUTH
    0.0                         / FACT
C-------------------------------------------------------------------------------
C
C   The following lists the layer number and groundwater node number for
C   each groundwater hydrograph to be printed (skip if no hydrographs are
C   to be printed, ie. NOUTH = 0)
C
C   IOUTHL;  Layer number (IOUTHL = 0 to print average head for all layers)
C   X     ;  The x-coordinate of the  well location (specify ONLY if FACT > 0.0); [L]
C   Y     ;  The y-coordinate of the  well location (specify ONLY if FACT > 0.0); [L]
C   IOUTH ;  Groundwater node number (specify ONLY if FACT = 0.0)
C
C-------------------------------------------------------------------------------
C       IOUTHL         X           Y           IOUTH
C-------------------------------------------------------------------------------
          1                                    433
          1                                    412
          1                                    391
          .                                    .
          .                                    .
          .                                    .
          2                                    55
          2                                    34
          2                                    13
C*******************************************************************************
C               Subsidence Print Control Specifications
C
C   The following lists the node and layer numbers for which subsidence
C   will be printed
C
C   NOUTS;   Total number of subsidence data to be printed
C             (set NOUTS = 0 if no subsidence data is to be printed)
C   FACT ;   Conversion factor for nodal coordinates
C             If FACT = 0.0 the input data is by nodes
C             If FACT > 0.0 the input data is by X-Y coordinates
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
     0                          / NOUTS
     1.0                        / FACT
C-------------------------------------------------------------------------------
C
C   The following lists the layer number and groundwater node number for
C   each subsidence data to be printed (skip if no subsidence data is
C   to be printed, ie. NOUTS = 0)
C
C   IOUTSL;  Layer number (IOUTSL = 0 to print total subsidence for all layers)
C   X     ;  The x-coordinate of the subsidence data location (specify ONLY if FACT > 0.0); [L]
C   Y     ;  The y-coordinate of the subsidence data location (specify ONLY if FACT > 0.0); [L]
C   IOUTS ;  Groundwater node number (specify ONLY if FACT = 0.0)
C
C-------------------------------------------------------------------------------
C       IOUTSL         X           Y            IOUTS
C-------------------------------------------------------------------------------
*
*
C*******************************************************************************
C                         Boundary Node Flow Print Control
C
C   The following lists the boundary nodes and layers for which flow values
```

```
C     will be printed
C
C   NOUTB;   Total number of flow hydrographs to be printed (set NOUTB = 0
C             if no flow hydrographs are to be printed)
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
      6                         / NOUTB
C-------------------------------------------------------------------------------
C
C   The following lists the layer number and groundwater node number for
C   each flow hydrograph to be printed (skip if no flow hydrograph is
C   to be printed, ie. NOUTB = 0)
C
C   IOUTBL;  Layer number
C   IOUTB;   Groundwater node number for flow hydrograph output
C-------------------------------------------------------------------------------
C   IOUTBL          IOUTB
C-------------------------------------------------------------------------------
      1               1
      1              22
      1              85
      1             148
      1             211
      1             274
C*******************************************************************************
C                          Element Face Flow Print Control
C
C   The following lists the element faces for which the flow output is desired
C
C-------------------------------------------------------------------------------
C
C   NOUTF  ; Number of element faces for flow output
C
C-------------------------------------------------------------------------------
C   VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
      3                         / NOUTF
C-------------------------------------------------------------------------------
C
C   The following lists the layer number and groundwater node numbers that
C   defines the element face for each face flow hydrograph to be printed (skip
C   if no element face flow hydrograph is to be printed, ie. NOUTFF = 0)
C
C   IOUTFL ; Layer number
C   IOUTFA ; The first groundwater node number that defines the element face
C   IOUTFB ; The second groundwater node number that defines the element face
C-------------------------------------------------------------------------------
C   IOUTFL     IOUTFA     IOUTFB
C-------------------------------------------------------------------------------
      1          89         90
      1          91         90
      2          91         90
```

Initial Conditions File

This data file contains the initial aquifer head values for each node and layer, initial soil moisture conditions for the unsaturated zone and small watersheds. It also includes initial interbed thickness and initial pre-consolidation head values for each layer if it is desired to overwrite the values set in the Parameter Data File.

Initial Aquifer Head Values

Initial aquifer head values must be specified for all nodes in each aquifer layer modeled. If the initial groundwater head specified is below the bottom elevation of the aquifer layer, then IWFM sets it to the elevation of the bottom of the aquifer. The list below describes the input values to define the initial aquifer head values. All values are to be specified for each layer modeled in IWFM.

FACT	Conversion factor for initial heads
HP	Initial head at each groundwater node, [L]

Initial Soil Moisture Conditions

Initial soil moisture conditions are specified in this file for the unsaturated zone and small stream watersheds modeled. If the element number for the unsaturated zone or the small watershed number is specified as zero, then the values specified are used for all elements or small watersheds, respectively, to set the initial conditions. The following variables are used to input initial soil moisture conditions:

FACT	Weighting factor for initial unsaturated zone soil moisture or conversion factor for initial groundwater storage for small watersheds
ID	Element number where the unsaturated zone initial moisture condition will be specified; if entered as zero initial conditions specified will be used for all elements
UNSATM	Initial soil moisture content for each layer of the unsaturated zone, [L/L]
IS	Small stream watershed number; specify as zero if the values for SOILS and GWSTS are to be used for all small stream watersheds
SOILS	Initial soil moisture at the small watershed, [L/L]
GWSTS	Initial groundwater storage for each watershed, [L]

Interbed Thickness for Each Layer

All values are specified for each layer modeled in IWFM. Interbed thicknesses are used to compute land subsidence. This part of the data file is used if the initial interbed depths defined in the Parameter Data File are chosen to be overwritten.

FACT	Conversion factor for initial interbed thickness; if set to 0.0 for any aquifer layer, then IWFM will not attempt to read the initial interbed thicknesses for that layer
DC	Initial interbed thickness at every groundwater node, [L]

Initial Pre-Consolidation Head Values for Land Subsidence

All pre-consolidation head values are specified for each layer modeled in IWFM in the Parameter Data File. This section of the initial conditions data file is used if pre-consolidation heads specified previously are to be overwritten.

FACT	Conversion factor for pre-consolidation head values; if set to 0.0 for any aquifer layer, then IWFM will not attempt to read the pre-consolidation head values for that layer.
HC	Pre-consolidation head at every groundwater node, [L]

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                  INITIAL CONDITIONS DATA FILE
C                      for IWFM Simulation
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: Init.dat
C
C*******************************************************************************
C                         File Description
C
C   This data file contains the initial head at each groundwater node for
C   each aquifer (layer) modeled; the initial soil moisture values for
C   unsaturated zone and small watersheds; initial interbed thickness to overwrite
C   the values set in parameter data file; and initial preconsolidation head values
C   that overwrite the values in the parameter data file.
C
C*******************************************************************************
C                      Initial Aquifer Head Values
C
C   FACT;  Conversion factor for initial heads
C   HP;    Initial head at corresponding groundwater node; [L]
C-------------------------------------------------------------------------------
C   Layer 1:
C
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    1.0                        / FACT
C-------------------------------------------------------------------------------
C    Initial Head at Layer 1
C    HP
C-------------------------------------------------------------------------------
 280.0  280.0   280.0   280.0   280.0   280.0   280.0   280.0   280.0   280.0
 280.0  280.0   280.0   280.0   280.0   280.0   280.0   280.0   280.0   280.0
 280.0  280.0   280.0   280.0   280.0   280.0   280.0   280.0   280.0   280.0
    .      .       .       .       .       .       .       .       .       .
    .      .       .       .       .       .       .       .       .       .
    .      .       .       .       .       .       .       .       .       .
 280.0  280.0   280.0   280.0   280.0   280.0   280.0   280.0   280.0   280.0
 280.0  280.0   280.0   280.0   280.0   280.0   280.0   280.0   280.0   280.0
 280.0  280.0   280.0   280.0   280.0   280.0   280.0   280.0   280.0   280.0
 280.0
C-------------------------------------------------------------------------------
C   Layer 2
C
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    1.0                        / FACT
C-------------------------------------------------------------------------------
C    Initial Head at Layer 2
C    HP
C-------------------------------------------------------------------------------
 290.0  290.0   290.0   290.0   290.0   290.0   290.0   290.0   290.0   290.0
 290.0  290.0   290.0   290.0   290.0   290.0   290.0   290.0   290.0   290.0
 290.0  290.0   290.0   290.0   290.0   290.0   290.0   290.0   290.0   290.0
    .      .       .       .       .       .       .       .       .       .
    .      .       .       .       .       .       .       .       .       .
    .      .       .       .       .       .       .       .       .       .
 290.0  290.0   290.0   290.0   290.0   290.0   290.0   290.0   290.0   290.0
 290.0  290.0   290.0   290.0   290.0   290.0   290.0   290.0   290.0   290.0
 290.0
C-------------------------------------------------------------------------------
C*******************************************************************************
C                            Initial Soil Moisture Conditions
C
C   Following are the initial soil moisture conditions for the the unsaturated
C   zone, and the small watersheds in the model. These set of data need to be
C   provided only if there is at least one rain gage that is specified in
C   Pre-processor. Skip if no rain gage is specified.
C
C-------------------------------------------------------------------------------
C                            Initial Soil Moisture Condition
C                                 For Unsaturated Zone
C
C   FACT;    Weighting factor for initial unsaturated zone soil moisture
C-------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    1.0                        / FACT
C-------------------------------------------------------------------------------
C
C   ID    ;  Element No. (0, if following values are to be used for all elements)
C   UNSATM;  Initial soil moisture content for each layer of the
C               unsaturated zone [L/L]
C-------------------------------------------------------------------------------
C                              Unsaturated Layers
C         -------------------------------------------------------------------
C  ID             1           2   ......
C-------------------------------------------------------------------------------
   0              0.0         0.0
C*******************************************************************************
```

```
C                           Initial Soil Moisture Conditions
C                                For Small Watersheds
C
C   FACT;    Conversion factor for initial groundwater storage for each of the
C             small watershed
C-------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    1.0                        / FACT
C-------------------------------------------------------------------------------
C
C   IS   ;   Watershed No (0, if following values are to be used for all watersheds)
C   SOILS;   Initial soil moisture content for for each watershed; [L/L]
C   GWSTS;   Initial groundwater storage for each watershed; [L]
C-------------------------------------------------------------------------------
C     IS              SOILS                  GWSTS
C-------------------------------------------------------------------------------
      0                0.0                   10.0
C-------------------------------------------------------------------------------
C*******************************************************************************
C                    Interbed Thickness for Each Layer
C
C   The following lists the initial Interbed Thicknesses for each node (in
C   sequential order) to overwrite what is specified in the parameter file.
C
C   FACT;   Conversion factor for initial interbed thickness
C            (enter 0.0 if the values specified in the parameter file will not
C             be overwriten).
C   DC  ;   Initial interbed thickness; [L]
C-------------------------------------------------------------------------------
C   Layer 1:
C
C   VALUE                      DESCRIPTION
C-----------------------------------------------------------------------------------
    0.0                        / FACT
C-------------------------------------------------------------------------------
C    Initial interbed thickness at Layer 1
C    DC
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C    Layer 2:
C
C    VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
     0.0                        / FACT
C-------------------------------------------------------------------------------
C    Initial interbed thickness at Layer 2
C    DC
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C*******************************************************************************
C              Initial Preconsolidation Head Values for Land Subsidence
C
C   The following lists the preconsolidation head for each groundwater node
C   (in sequential order) to overwrite the values specified in parameter file.
C
C   FACT;  Conversion factor for preconsolidation head
C           (enter 0.0 if the values specified in the parameter file will not
C            be overwriten).
C   HC  ;  Initial preconsolidation head at corresponding groundwater node; [L]
C
C-------------------------------------------------------------------------------
C   Layer 1
C
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    0.0                        / FACT
C-------------------------------------------------------------------------------
C    Initial preconsolidation head at Layer 1
C    HC
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C   Layer 2
C
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    0.0                        / FACT
C-------------------------------------------------------------------------------
C    Initial preconsolidation head at Layer 2
C    HC
C-------------------------------------------------------------------------------
*
*
```

Irrigation Fractions Data File

This data file contains the time series data for the fraction of pumping and surface water diversions to be used for agricultural purposes. The pumping and surface water diversions are associated with each of the data columns through the Pumping Specifications File and the Diversion Specifications File. In time tracking simulations the time series irrigation fractions data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NCOLIRF	Number of columns in the irrigation fractions data file
NSPIRF	Number of time steps to update the irrigation fractions; if time tracking simulation, enter any number
NFQIRF	Repetition frequency of the irrigation fractions data; a value of zero indicates that a full time series data set is supplied; if time tracking simulation, enter any number
DSSFL	If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Irrigation Specifications Data File.

Data Input from Irrigation Specifications Data File

If the time series data is listed in the Irrigation Specifications Data File, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITIRF — Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

FIRIG — Irrigation fraction used for agricultural purposes; (1−FIRIG) is used for urban water requirements

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC — Record number that coincides with the data column number for the time series data

PATH — Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C        IRRIGATION FRACTIONS FOR PUMPING AND SURFACE WATER DIVERSIONS
C                         for IWFM Simulation
C
C
C             Project : IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: IrigFrac.dat
C
C*******************************************************************************
C                           File Description
C
C   This data file contains the time series data for the fraction of pumping
C   and surface water diversions to be used for agricultural purposes.
C
C*******************************************************************************
C                         Irrigation Fractions Data Specifications
C
C   NCOLIRF;  Number of columns (or pathnames if DSS files are used) in the
C              irrigation fractions data file
C   NSPIRF ;  Number of time steps to update the irrigation fractions
C              * Enter any number if time-tracking option is on
C   NFQIRF ;  Repetition frequency of the irrigation fractions data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL  ;  The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C         VALUE                                      DESCRIPTION
C-------------------------------------------------------------------------------
          2                                          / NCOLIRF
          1                                          / NSPIRF
          0                                          / NFQIRF
                                                     / DSSFL
C-------------------------------------------------------------------------------
C                         Irrigation Fractions Data
C                           (READ FROM THIS FILE)
C
C   List the irrigation fractions data below, if it will not be read from
C   a DSS file (i.e. DSSFL is left blank above).
C
C   ITIRF;  Time
C   FIRIG;  Irrigation fraction
C
C-------------------------------------------------------------------------------
C   ITIRF            FIRIG(1)  FIRIG(2)  FIRIG(3) ...
C-------------------------------------------------------------------------------
C                    UrbIrrig    AgIrrig
  09/30/2500_24:00   0.0         1.0
*
C-------------------------------------------------------------------------------
C                        Pathnames for Irrigation Fractions Data
C                               (READ FROM DSS FILE)
C
C   List the pathnames for irrigation fractions data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C-------------------------------------------------------------------------------
C   REC       PATH
C-------------------------------------------------------------------------------
*
*
```

Supply Adjustment Specifications File

This data file contains the time series specifications for the adjustment of surface water diversions and groundwater pumping in order to minimize the discrepancy between the agricultural and urban water demand and water supply. The data contains information to specify if a diversion or pumping should be adjusted to meet agricultural demand, urban demand or both. Each diversion or pumping scheme is associated with a column in this file through the Diversion Specifications File or through the Pumping Specifications File. This file is required when the variable KOPTDV is set to a value other than 00 in the Simulation Main Input File. The time series supply adjustment specifications data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required. Also note that the file example given below specifies time series data that are constant throughout the simulation period by setting the year of the time series data to a value (year 2500) that covers the entire period.

The following variables are required to be set:

NCOLADJ	Number of time-series data columns
NSPADJ	Number of time steps to update the supply adjustment specifications data; if time tracking simulation, enter any number
NFQADJ	Repetition frequency of the supply adjustment specifications data (enter zero if full time series data is supplied); if time tracking simulation, enter any number

DSSFL — If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Supply Adjustment Specifications File

Data Input from Supply Adjustment Specifications File

If the time series data is listed in the Supply Adjustment Specifications File, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

ITADJ — Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

KADJ — Supply adjustment option specified as a two digit number; first digit from left specifies if the water supply (diversion or pumping) is to be adjusted to meet agricultural supply requirement (0 = no adjustment is required; 1 = adjust water supply to meet agricultural water requirement); second digit from left specifies if the water supply (diversion or pumping) is to be adjusted to meet urban supply requirement (0 = no adjustment is required; 1 = adjust water supply to meet urban supply requirement)

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                      SUPPLY ADJUSTMENT SPECIFICATIONS
C                            for IWFM Simulation
C
C
C             Project : IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: SupplyAdjust.dat
C
C*******************************************************************************
C                           File Description
C
C   This data file contains the time series specifications for the adjustment of
C   surface water diversions and groundwater pumping. The data contains information
C   to specify if a diversion or pumping should be adjusted to meet agricultural
C   demand, urban demand or both. This file is required when KOPTDV is set to a
C   value other than 00 in the Main Control Input file.
C
C*******************************************************************************
C                     Supply Adjustment Specifications
C
C   The following lists the time-series specifications for supply adjustment options
C   for surface water diversions and groundwater pumping.
C
C   NCOLADJ;  Number of columns (or pathnames if DSS files are used) in the supply
C              adjustment specifications data file
C   NSPADJ ;  Number of time steps to update the supply adjustment specifications data
C              * Enter any number if time-tracking option is on
C   NFQADJ ;  Repetition frequency of the supply adjustment specifications data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL  ;  The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C         VALUE                                      DESCRIPTION
C-------------------------------------------------------------------------------
          4                                          / NCOLADJ
          1                                          / NSPADJ
          0                                          / NFQADJ
                                                     / DSSFL
C*******************************************************************************
C                     Supply Adjustment Specifications Data
C                          (READ FROM THIS FILE)
C
C   List the time series supply adjustment specifications data below, if it will
C   not be read from a DSS file (i.e. DSSFL is left blank above).
C
C   ITADJ;  Time
C   KADJ;   Supply adjustment option. Enter two digits as follows:
C           1st digit(from left):
C                  0 = NO adjustment of supply to meet agricultural water demand
C                  1 = YES, adjust supply to meet agricultural water demand
C           2nd digit(from left):
C                  0 = NO adjustment of supply to meet urban water demand
C                  1 = YES, adjust supply to meet urban water demand
C
C-------------------------------------------------------------------------------
C       ITADJ            KADJ
C-------------------------------------------------------------------------------
C                       AgAdjust  UrbAdjust   NoAdjust    AgUrbAdjust
  09/30/2500_24:00    10         01           00            11
*
C-------------------------------------------------------------------------------
C                     Pathnames for Supply Adjustment Specifications Data
C                                 (READ FROM DSS FILE)
C
C   List the pathnames for supply adjustment specifications data below, if it will
C   be read from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C--------------------------------------------------------------------------------------
C   REC       PATH
C--------------------------------------------------------------------------------------
*
*
```

Precipitation File

This file contains the time series rainfall values for each of the rainfall stations used in the simulation. Each element is associated with a rainfall station in the Root Zone Component Main File as described in the *IDC v4.0 Theoretical Documentation and User's Manual*. The simulated lakes and small stream watersheds also use the data in this file by using pointers to link each lake and small watershed with a precipitation data column.. The factors that convert the precipitation at rainfall stations to the precipitation over the elements are also listed in the Root Zone Component Main File. The rainfall data for a station associated with an element is multiplied by the corresponding factor to obtain the rainfall rate over an element. Small watersheds are also linked to individual data columns in the Precipitation File through the IRNS variable defined in the Parameter Data File, while precipitation rates over individual lakes are defined through the ICPCPLK variable specified in the Lake Component Main File.

In non-time tracking simulations a time-series precipitation data set of any frequency can be used as the precipitation data in IWFM. NSPRN and NFQRN must be specified according to the frequency of the data entered. If the precipitation data is specified for the entire simulation period, NFQRN should be set to zero. In time tracking simulations the time series precipitation data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following variables are used:

NRAIN	Number of rainfall stations used in the model

FACTRN	Conversion factor for the spatial component of the unit for the rainfall rate
NSPRN	Number of time steps to update the precipitation data; if time tracking simulation, enter any number
NFQRN	Repetition frequency of the precipitation data (enter zero if full time series data is supplied); if time tracking simulation, enter any number
DSSFL	If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Precipitation File

Data Input from Precipitation File

If the time series data is listed in the Precipitation File, then the following variables need to be populated. Otherwise, these variables should be commented out using "C", "c" or "*", and the variables in the "Data Input from DSS File" section below should be populated.

ITRN	Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.
ARAIN	Rainfall rate at the corresponding rainfall station, [L/T]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC	Record number that coincides with the data column number for the time series data
PATH	Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                  PRECIPITATION DATA FILE
C                    for IWFM Simulation
C
C
C             Project : IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: Precip.dat
C
C*******************************************************************************
C                              File Description:
C
C   This data file contains the time-series rainfall at each rainfall station used
C   in the model.
C
C*******************************************************************************
C                        Rainfall Data Specifications
C
C   NRAIN ;  Number of rainfall stations (or pathnames if DSS files are used)
C             used in the model
C   FACTRN;  Conversion factor for rainfall rate
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of rainfall rate listed in this file = INCHES/MONTH
C                    Consistent unit used in simulation       = FEET/DAY
C                    Enter FACTRN (INCHES/MONTH -> FEET/MONTH) = 8.33333E-02
C                     (conversion of MONTH -> DAY is performed automatically)
C   NSPRN ;  Number of time steps to update the precipitation data
C             * Enter any number if time-tracking option is on
C   NFQRN ;  Repetition frequency of the precipitation data
C             * Enter 0 if full time series data is supplied
C             * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C             * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C         VALUE                                       DESCRIPTION
C-------------------------------------------------------------------------------
          2                                           / NRAIN
          8.33333E-2                                  / FACTRN   (in -> ft)
          1                                           / NSPRN
          0                                           / NFQRN
          TSDATA IN.DSS                               / DSSFL
C-------------------------------------------------------------------------------
C                              Rainfall Data
C                          (READ FROM THIS FILE)
C
C   List the rainfall rates for each of the rainfall station below, if it will
C   not be read from a DSS file (i.e. DSSFL is left blank above).
C
C   ITRN ;   Time
C   ARAIN;   Rainfall rate at the corresponding rainfall station; [L/T]
C
C-------------------------------------------------------------------------------
C ITRN    ARAIN(1)  ARAIN(2)  ARAIN(3) ...
C-------------------------------------------------------------------------------
*
*
C-------------------------------------------------------------------------------
C                        Pathnames for Rainfall Data
C                          (READ FROM DSS FILE)
C
C   List the pathnames for the rainfall data below, if it will be read
C   from a DSS file (i.e. DSSFL is specified above).
C
C   REC    ;  Time series record number
C   PATH   ;  Pathname for the time series record
C
C------------------------------------------------------------------------------------
C   REC        PATH
C------------------------------------------------------------------------------------
     1         /SAMPLE PROBLEM/GAGE1/PRECIP//1MON/PRECIPITATION/
     2         /SAMPLE_PROBLEM/GAGE2/PRECIP//1MON/PRECIPITATION/
```

Evapotranspiration File

The Evapotranspiration File contains time series ET data for all crop types, non-agricultural land use types, lakes and small watersheds. The conversion factor for the ET rates is a required input, as well as the number of time steps to update the data and the repetition frequency of the data. In time tracking simulations the time series evapotranspiration data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required. The ET rates listed in this file are associated with individual land-use types in each element using the related root zone component files (see *IDC v4.0 Theoretical Documentation and User's Manual* for details). ET rates over each lake are associated with the data columns in this file through the ICETLK variable in the Lake Component Main File, while they are associated with small watersheds using the variable ICETS in the Parameter Data File.

The example file given below shows how recycled time series data in a time tracking simulation can be specified using the special year 4000 flag. The following is a list of the variables that need to be specified:

NCOLET	Number of evapotranspiration data columns
FACTET	Conversion factor for the spatial component of the unit for the evapotranspiration rate
NSPET	Number of time steps to update the ET data; if time tracking simulation, enter any number
NFQET	Repetition frequency of the ET data (enter zero if full time series data is supplied); if time tracking simulation, enter any number

DSSFL If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Evapotranspiration File

Data Input from Evapotranspiration File

If the time series data is listed in the Evapotranspiration File, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITEV Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

AEVAP Evapotranspiration rate, [L/T]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC Record number that coincides with the data column number for the time series data

PATH Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                    EVAPOTRANSPIRATION DATA FILE
C                        for IWFM Simulation
C
C
C             Project : IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: ET.dat
C
C*******************************************************************************
C                         File Description:
C
C   This data file contains sets of evapotranspiration values that are used in
C   root zone, lake and small watershed components of Simulation.
C
C*******************************************************************************
C                     Evapotranspiration Data Specifications
C
C   NCOLET;  Number of ET columns (or pathnames if DSS files are used)
C   FACTET:  Conversion factor for evapotranspiration rate
C             It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of ET rate listed in this file       = INCHES/MONTH
C                    Consistent unit used in simulation        = FEET/DAY
C                    Enter FACTET (INCHES/MONTH -> FEET/MONTH) = 8.33333E-02
C                     (conversion of MONTH -> DAY is performed automatically)
C   NSPET ;  Number of time steps to update the ET data
C             * Enter any number if time-tracking option is on
C   NFQET ;  Repetition frequency of the ET data
C             * Enter 0 if full time series data is supplied
C             * Enter any number if time-tracking option is on
C   DSSFL ;  The name of the DSS file for data input (maximum 50 characters);
C             * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C         VALUE                                       DESCRIPTION
C-------------------------------------------------------------------------------
          7                                           / NCOLET
          0.083333                                    / FACTET  (in/month -> ft/month)
          1                                           / NSPET
          0                                           / NFQET
                                                      / DSSFL
C-------------------------------------------------------------------------------
C                             Evapotranspiration Data
C                              (READ FROM THIS FILE)
C
C   ITEV ;   Time
C   AEVAP;   Evapotranspiration rate; [L/T]
C
C-------------------------------------------------------------------------------
C ITEV  AEVAP[1]  AEVAP[2]  AEVAP[3] ...  AEVAP[NCOLET]
C-------------------------------------------------------------------------------
C                     Tomatoes  Alfalfa     Rice    Urban    Native   SmallWatershed      Lake
  10/31/4000 24:00     3.4       3.5       2.2      3.4      3.4        3.4             3.7
  11/30/4000 24:00     1.6       1.6       1.6      1.6      1.6        1.6             1.8
  12/31/4000 24:00     1.0       1.0       1.0      0.5      1.0        1.2             1.2
  01/31/4000 24:00     1.0       1.0       1.0      0.5      1.0        1.1             1.1
  02/29/4000 24:00     1.8       1.8       1.8      1.8      1.8        1.8             1.8
  03/31/4000 24:00     3.0       3.0       3.0      3.0      3.0        2.8             2.8
  04/30/4000 24:00     4.5       4.1       8.0      4.5      4.5        3.9             3.9
  05/31/4000 24:00     5.9       5.4       9.1      5.9      5.9        5.1             5.1
  06/30/4000 24:00     7.3       6.8      10.4      7.3      7.3        7.2             7.2
  07/31/4000 24:00     7.9       7.7       9.7      7.9      7.9        7.5             7.5
  08/31/4000 24:00     6.6       6.8       7.0      6.6      6.6        6.4             6.4
  09/30/4000 24:00     5.2       5.4       1.9      5.2      5.2        4.8             4.8
C-------------------------------------------------------------------------------
C                       Pathnames for Evapotranspiration Data
C                              (READ FROM DSS FILE)
C
C   List the pathnames for evapotranspiration  data below, if it will
C   be read from a DSS file (i.e. DSSFL is specified above).
C
C   REC  ;  Time series record number
C   PATH ;  Pathname for the time series record
C
C-----------------------------------------------------------------------------------------------
C   REC       PATH
C-----------------------------------------------------------------------------------------------
*
*
```

Tile Drain and Subsurface Irrigation Parameter File

This data file includes all the required input to model tile drains and subsurface irrigation in IWFM as well as the data to print out tile drain and subsurface irrigation hydrographs at desired locations. The first part of the data file lists the number of groundwater nodes with tile drains and parameters to simulate tile drain flows. The second part lists the number of groundwater nodes with subsurface irrigation and the relevant parameters. The last part of this data file includes information to print out tile drain and subsurface irrigation hydrographs at specified locations.

The following lists different parts of the data file and all required input to simulate tile drains and subsurface irrigation in IWFM.

Tile Drain Data Specifications

NTD	Number of groundwater nodes with tile drains; enter 0 if there are no tile drains simulated
FACTH	Conversion factor for tile drain elevations
FACTCDC	Conversion factor for the spatial component of the unit for the tile drain conductances
TUNITDR	Time unit of conductance; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
IDDR	Tile drain identification number specified in sequential order
NODEDR	Groundwater node number corresponding to the tile drain
ELEVDR	Elevation of the tile drain, [L]

CDCDR	Hydraulic conductance of the interface between the aquifer and the tile drain, [L^2/T]
TYPDST	Destination type for drain flow (0 = drain flow goes outside the model domain; 1 = drain flow goes to stream node DST as described below)
DST	Stream node number that receives the drain flow; enter any number if TYPDST is set to zero

Subsurface Irrigation Data Specifications

NSI	Number of groundwater nodes with subsurface irrigation; enter 0 if subsurface irrigation is not modeled
FACTHSI	Conversion factor for subsurface irrigation elevations
FACTCDCSI	Conversion factor for the spatial component of the unit for the subsurface irrigation conductances
TUNITSI	Time unit of conductance; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
IDSI	Subsurface irrigation identification number listed in sequential order
NODESI	Groundwater node number corresponding to the subsurface irrigation
ELEVSI	Elevation of the subsurface irrigation; [L]

CDCSI	Hydraulic conductance of the interface between the aquifer and subsurface irrigation; [L^2/T]

Tile Drain and Subsurface Irrigation Hydrograph Print Control

NOUTTD	Number of hydrographs to be printed; enter 0 if hydrograph print-out is not required
FACTVLOU	Factor to convert simulation unit of tile drain and subsurface irrigation flows into intended unit of output
UNITVLOU	Output unit of flows (maximum 10 characters long)
TDOUTFL	Filename for tile drain and subsurface irrigation hydrograph output (maximum 1000 characters)
ID	Tile drain or subsurface irrigation identification number as listed in IDDR or IDSI for hydrograph printing
IDTYP	Type of hydrograph (1 = tile drain hydrograph, 2 = subsurface irrigation hydrograph)

```
#4.0
C *** DO NOT DELETE ABOVE LINE ***
C
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C              TILE DRAIN AND SUB IRRIGATION PARAMETER DATA FILE
C                           for IWFM Simulation
C
C
C             Project : IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: TileDrain.dat
C
C*******************************************************************************
C                            File Description:
C
C   This data file contains tile drain and subsurface irrigation parameter values.
C
C*******************************************************************************
C                  Tile Drain Data Specifications
C
C   NTD    ; Number of groundwater nodes with tile drains
C   FACTH  ; Conversion factor for tile drain elevations
C   FACTCDC; Conversion factor for tile drain conductances
C            It is used to convert only the spatial component of the unit;
C             DO NOT include the conversion factor for time component of the unit.
C             * e.g. Unit of conductance listed in this file = AC/MONTH
C                    Consistent unit used in simulation      = SQ.FT/DAY
C                    Enter FACTQ (AC/MONTH -> SQ.FT/MONTH)   = 2.29568E-05
C                     (conversion of MONTH -> DAY is performed automatically)
C   TUNITDR; Time unit of conductance.  This should be one of the units
C            recognized by HEC-DSS that are listed in the Main Control File.
C-------------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-------------------------------------------------------------------------------
        21                      / NTD
        1.0                     / FACTH
        1.0                     / FACTCDC
        1day                    / TUNIT
C-------------------------------------------------------------------------------
C                     Tile Drain Parameters
C
C   The following lists the groundwater node number, elevation and conductance
C   for each tile drain. The destination type and destination ID that the tile
C   drain flows into is also listed.
C
C   IDDR   ; Tile drain ID in sequential order
C   NODEDR ; Groundwater node number corresponding to the tile drain
C   ELEVDR ; Elevation of the drain; [L]
C   CDCDR  ; Hydraulic conductance of the interface between the aquifer and
C             the drain; [L^2/T]
C   TYPDST ; Destination type for drain flow
C              0 = Drain flow goes outside the model domain
C              1 = Drain flow goes to stream node DST (see below)
C   DST   ;  Destination number for drain flow
C              * Note: Enter any number if TYPDST is 0
C
C-------------------------------------------------------------------------------
C   IDDR  NODEDR    ELEVDR     CDCDR    TYPDST    DST
C-------------------------------------------------------------------------------
     1      6       280.0     20000.0     1       20
     2      27      280.0     20000.0     1       20
     3      48      280.0     20000.0     1       20
     4      69      280.0     20000.0     1       20
     5      90      280.0     20000.0     1       20
     6      111     280.0     20000.0     1       20
     7      132     280.0     20000.0     1       20
     8      153     280.0     20000.0     1       20
     9      174     280.0     20000.0     1       20
    10      195     280.0     20000.0     1       20
    11      216     280.0     20000.0     1       20
    12      237     280.0     20000.0     1       20
    13      258     280.0     20000.0     1       20
    14      279     280.0     20000.0     1       20
    15      300     280.0     20000.0     1       20
    16      321     280.0     20000.0     1       20
    17      342     280.0     20000.0     1       20
    18      363     280.0     20000.0     1       20
    19      384     280.0     20000.0     1       20
    20      405     280.0     20000.0     1       20
    21      426     280.0     20000.0     1       20
C*******************************************************************************
C                  Subsurface Irrigation Data Specifications
C
C   NSI       ;  Number of groundwater nodes with subsurface irrigation
C   FACTHSI  ;  Conversion factor for subsurface irrigation elevations
C   FACTCDCSI;  Conversion factor for subsurface irrigation conductances
C               It is used to convert only the spatial component of the unit;
C               DO NOT include the conversion factor for time component of the unit.
C               * e.g. Unit of conductance listed in this file = AC/MONTH
C                      Consistent unit used in simulation      = SQ.FT/DAY
C                      Enter FACTQ (AC/MONTH -> SQ.FT/MONTH)   = 2.29568E-05
C                       (conversion of MONTH -> DAY is performed automatically)
```

```
C   TUNITSI  ; Time unit of conductance.  This should be one of the units
C               recognized by HEC-DSS that are listed in the Main Control File.
C
C-------------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-------------------------------------------------------------------------------
         0                       / NSI
         1.0                     / FACTHSI
         1.0                     / FACTCDCSI
         1day                    / TUNITSI
C-------------------------------------------------------------------------------
C                     Subsurface Irrigation Parameters
C
C   The following lists the groundwater node number, elevation and conductance
C   for each subsurface irrigation.
C
C   IDSI   ; Subsurface irrigation in sequential order
C   NODESI ; Groundwater node number corresponding to the subsurface irrigation
C   ELEVSI ; Elevation of the subsurface irrigation; [L]
C   CDCSI  ; Hydraulic conductance of the interface between the aquifer and
C             subsurface irrigation; [L^2/T]
C
C-------------------------------------------------------------------------------
C   IDSI  NODESI    ELEVSI    CDCSI
C-------------------------------------------------------------------------------
*
*
C*******************************************************************************
C                      Hydrograph Print Control
C
C   The following lists the tile drain and subsurface irrigation IDs for which
C   a hydrograph printing is needed, as well as output control options.
C
C   NOUTTD  ;  Number of hydrographs to be printed
C   FACTVLOU; Factor to convert simulation unit of tile drain/subsurface irrigation
C                flows into intented output unit
C   UNITVLOU; Output unit of flows (max. 10 characters long)
C   TDOUTFL ;  Filename for tile drain/subsurface irrigation hydrograph output
C                (max. 1000 characters)
C   ID      ;  Tile drain or subsurface irrigation ID for hydrograph printing
C   IDTYP   ;  Type of hydrograph
C                1 = Tile drain hydrograph
C                2 = Subsurface irrigation hydrograph
C
C-------------------------------------------------------------------------------
C       VALUE                   DESCRIPTION
C-------------------------------------------------------------------------------
         6                       / NOUTTD
         2.295684e-5             / FACTVLOU     (cu.ft. -> ac.ft.)
         ac.ft.                  / UNITVLOU
         TileDrainFlows.out      / TDOUTFL
C-------------------------------------------------------------------------------
C  ID    IDTYP
C-------------------------------------------------------------------------------
    1     1
    4     1
    7     1
   10     1
   13     1
   16     1
```

Pumping Component Files

Simulation Main Input File points to the Pumping Component Main File which is the gateway for all other data files that are needed to simulate well and element pumping in IWFM. Data input files that are used in simulating pumping are described in the following sections.

Pumping Component Main File

Pumping Component Main File is the gateway to additional data files that are used in simulating well and element pumping. Well pumping in IWFM is used when the actual coordinates of individual wells are known, whereas element pumping represents a cluster of wells located in an element and whose coordinates are not known. Element pumping can also be used even when the coordinates of individual wells are known but simulating individual wells is impractical.

The following variables are used:

WELLFL	Well pumping specifications data file (maximum 1000 characters); leave blank if no wells are simulated
ELEMPUMPFL	Element pumping specifications data file (maximum 1000 characters); leave blank if element pumping is not simulated
PUMPFL	Time series pumping data file (maximum 1000 characters)

```
#4.0
C *** DO NOT DELETE ABOVE LINE ***
C
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                            PUMPING DATA FILE
C                            Pumping Component
C                           for IWFM Simulation
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: Pump_MAIN.dat
C
C*******************************************************************************
C                              File Description:
C
C   This data file contains the file names and other relevant data that are
C   used for the simulation of pumping.
C
C*******************************************************************************
C
C  WELLFL     ; Well pumping specifications data file (max. 1000 characters)
C                  * Leave blank if no wells are simulated
C  ELEMPUMPFL ; Element pumping specifications data file (max. 1000 characters)
C                  * Leave blank if element pumping is not simulated
C  PUMPFL     ; Time series pumping data file (max. 1000 characters)
C
C-------------------------------------------------------------------------------
C     VALUE                       DESCRIPTION
C-------------------------------------------------------------------------------
                                 / WELLFL
    Pumping\ElemPump.dat         / ELEMPUMPFL
    Pumping\TSPumping.dat        / PUMPFL
```

Well Specifications Data File

Well Specifications Data File lists the parameters for the simulated wells such as well coordinates, diameter, screening depths, pumping amounts, maximum pumping rates, pumping delivery destinations, distribution of pumping at the delivery destination, pumping irrigation fractions (i.e. fraction of the well pumping that is used for agricultural purposes) and well pumping adjustment specifications so that well pumping meets either agricultural or urban, or both agricultural and urban water demands at the delivery destination.

Each simulated well is associated with a data column in the Time Series Pumping File. All or a fraction of the pumping rate specified in the data column can be applied to the specified well using user-specified fractions (FRACWL) that may be further weighted (using the IOPTWL option) with respect to the agricultural and urban area in the destination where the pumping is delivered. For instance, there may be 10 wells serving a city and the surrounding farms, each well serving a group of grid cells. Rather than specifying individual pumping rates for each well, the user might choose to specify total pumping from all 10 wells and allow IWFM to distribute the total pumping based on the proportional area of agricultural and urban lands at the destination. This setup allows IWFM to distribute total pumping among 10 wells based on the water demand for which each well is supplying water. For such a set-up, assuming that the total pumping rate is given in column 1 of the Time Series Pumping File, ICOLWL variable for all 10 wells will be set to 1, FRACWL to 1.0 and IOPTWL to 2 (see below for the explanation of the variables). This way of specifying well pumping would be particularly useful in planning studies when the future water demands are calculated dynamically and IWFM is asked to adjust well pumping to meet the water demands.

The Well Specifications Data File is divided into several sections and the following variables are used for the simulation of wells:

List of Simulated Wells

NWELL	Number of wells modeled
FACTXY	Conversion factor for well coordinates
FACTRW	Conversion factor for well diameter
FACTLT	Conversion factor for perforation depths
ID	Well identification number
XWELL	x-coordinate of well location, [L]
YWELL	y-coordinate of well location, [L]
RWELL	Well diameter, [L]
PERFT	Elevation of or depth to the top of well screen, [L]; if PERFT is greater than PERFB, then PERFT represents the elevation of the top of well screen, otherwise it represents the depth to the top of the well screen
PERFB	Elevation of or depth to the bottom of well screen, [L]; if PERFT is greater than PERFB, then PERFB represents the elevation of the bottom of well screen, otherwise it represents the depth to the bottom of the well screen

Well Pumping Characteristics

ID	Well identification number
ICOLWL	Well pumping rate; this number corresponds to the appropriate data column in the Time Series Pumping File
FRACWL	Relative proportion of the pumping in column ICOLWL of the Time Series Pumping File to be applied to the well
IOPTWL	Option for distribution of pumping in column ICOLWL at the delivery destination (0 = distribute the pumping according to the given relative fraction, FRACWL; 1 = distribute the pumping in proportion to FRACWL times the total area of the delivery destination; 2 = distribute the pumping in proportion to FRACWL times the developed area (agricultural. and urban) at the delivery destination; 3 = distribute the pumping in proportion to FRACWL times the agricultural. area at the delivery destination; 4 = distribute the pumping in proportion to FRACWL times the urban area at the delivery destination)
TYPDSTWL	Destination where the pumping is delivered to (−1 = pumping is used in the same element that pumping occurs; 0 = pumping goes outside the model domain; 2 = pumping goes to element DSTWL; 4 = pumping goes to subregion DSTWL; 6 = pumping goes to a group of elements with group identification number DSTDL where element groups are specified later in the file)

DSTWL	Pumping delivery destination identification number; enter any number if TYPDSTWL is set to −1 (i.e. pumping is delivered to the same element that the well is located) or 0 (i.e. pumping is delivered to outside the model area)
ICFIRIGWL	Fraction of the pumping that is used for irrigation purposes; this number corresponds to the appropriate data column in the Irrigation Fractions Data File
ICADJWL	Supply adjustment specification; this number corresponds to the data column in the Supply Adjustment Specifications File
ICWLMAX	Maximum pumping amount; this number corresponds to the appropriate data column in the Time Series Pumping File; enter 0 if a maximum diversion amount does not apply
FWLMAX	Fraction of data value specified in column ICWLMAX to be used as maximum pumping amount

Element Groups for Well Pumping Deliveries

NGRP	Number of element groups; enter 0 if there are no element groups where well pumping is delivered
ID	Element group identification number entered sequentially
NELEM	Number of elements in element group ID
IELEM	Element numbers that are in group ID

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                          WELL SPECIFICATION FILE
C                           for IWFM Simulation
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: Wells.dat
C
C*******************************************************************************
C                            File Description:
C
C   This data file includes the relevant data for the wells that are simulated
C   in the model.
C
C*******************************************************************************
C              List of modeled wells and their corresponding parameters
C
C   NWELL ; Number of wells modeled
C   FACTXY; Conversion factor for well coordinates
C   FACTRW; Conversion factor for well diameter
C   FACTLT; Conversion factor for perforation depths
C
C-------------------------------------------------------------------------------
C     VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
      87                        / NWELL
      3.2808                    / FACTXY  (m -> ft)
      1.0                       / FACTRW
      1.0                       / FACTLT
C-------------------------------------------------------------------------------
C*******************************************************************************
C                    Well Location and Structure Characteristics
C
C   ID      ;  Well identification number
C   XWELL   ;  X coordinate of well location, [L]
C   YWELL   ;  Y-coordinate of well location, [L]
C   RWELL   ;  Well diameter, [L]
C   PERFT   ;  Elevation of or depth to the top of well screen, [L]
C   PERFB   ;  Elevation of or depth to the bottom of well screen, [L]
C                *** Note: If PERFT > PERFB screening interval is given as elevations
C                          If PERFT < PERFB screening interval is given as depth-to
C                                      top/bottom of screening
C
C-------------------------------------------------------------------------------
C    ID       XWELL     YWELL       RWELL      PERFT      PERFB
C-------------------------------------------------------------------------------
     1        609534    4267260     8          237         510
     2        609695    4267817     7          321         330
     3        609448    4268184     7          217         344
     .        .         .           .          .           .
     .        .         .           .          .           .
     .        .         .           .          .           .
     85       623703    4270056     6          125         212
     86       623778    4269934     6          50          80
     87       623660    4269747     6          200         287
C*******************************************************************************
C                        Well Pumping Characteristics
C
C   ID       ; Well identification number
C   ICOLWL   ; Well pumping - this number corresponds to the appropriate data column
C               in the Time Series Pumping File
C   FRACWL   ; Relative proportion of the pumping in column ICOLWL to be applied
C               to well ID
C   IOPTWL   ; Option for distribution of pumping in column ICOLWL to element ID
C               0 = to distribute the pumping according to the given relative
C                     fraction, FRACWL
C               1 = to distribute the pumping in proportion to FRACWL
C                     times the total area of the destination for pumping
C               2 = to distribute the pumping in proportion to FRACWL
C                     times the developed area (ag. and urban) at the destination
C                     for pumping
C               3 = to distribute the pumping in proportion to FRACWL
C                     times the ag. area at the destination for pumping
C               4 = to distribute the pumping in proportion to FRACWL
C                     times the urban area at the destination for pumping
C   TYPDSTWL ; Destination where the pumping is delivered to
C              -1 = pumping is used in the same element that pumping occurs
C               0 = Pumping goes outside the model domain
C               2 = Pumping goes to element DSTWL (see below)
C               4 = Pumping goes to subregion DSTWL (see below)
C               6 = Pumping goes to a group of elements with ID DSTDL
C                     (element groups are listed after this section)
C   DSTWL    ; Destination number for well pumping delivery
C               * Note: Enter any number if TYPDSTWL is set to -1 or 0
C   ICFIRIGWL; Fraction of the pumping that is used for irrigation purposes -
C               this number corresponds to the appropriate data column in the
C               Irrigation Fractions Data File
C   ICADJWL  ; Supply adjustment specification - this number corresponds to
C               the data column in the Supply Adjustment Specifications
C               Data File
C   ICWLMAX  ; Maximum pumping amount - this number corresponds to the
```

```
C              appropriate data column in the Time Series Pumping File
C              * Enter 0 if a maximum diversion amount does not apply.
C   FWLMAX   ; Fraction of data value specified in column ICWLMAX to be used as
C              maximum pumping amount
C
C--------------------------------------------------------------------------------------------------
C    ID      ICOLWL   FRACWL    IOPTWL   TYPDSTWL    DSTWL   ICFIRIGWL   ICADJWL  ICWLMAX   FWLMAX
C--------------------------------------------------------------------------------------------------
     1       49       1.0        4       4           15      2           3        112       1.0
     2       50       1.0        4       4           15      2           3        113       1.0
     3       51       1.0        4       4           15      2           3        114       1.0
     .       .        .          .       .           .       .           .        .         .
     .       .        .          .       .           .       .           .        .         .
     .       .        .          .       .           .       .           .        .         .
     85      17       3.0        4       4           17      2           3        196       1.0
     86      17       3.0        4       4           17      2           3        197       1.0
     87      17       3.0        4       4           17      2           3        198       1.0
C--------------------------------------------------------------------------------------------------
C
C               Element Groups for Well Pumping Deliveries
C
C   List the elements in each group where selected well pumping above is delivered to. All
C   elements in each group must belong to the same subregion.
C
C   NGRP  ; Number of element groups
C            * Enter 0 if there are no element groups where well pumping is delivered
C   ID    ; Element group ID entered sequentially
C   NELEM ; Number of elements in element group ID
C   IELEM ; Element numbers that are in group ID
C
C-------------------------------------------------------------------------------
     0                 / NGRP
C-------------------------------------------------------------------------------
C    ID         NELEM      IELEM
C-------------------------------------------------------------------------------
*
*
```

Element Pumping Specifications Data File

Element Pumping Specifications Data File lists the parameters for the simulated element pumping such as pumping amounts, maximum pumping rates, pumping delivery destinations, distribution of pumping at the delivery destinations, pumping irrigation fractions (i.e. fraction of the element pumping that is used for agricultural purposes) and element pumping adjustment specifications so that pumping meets either agricultural or urban, or both agricultural and urban water demands at the delivery destination.

Each simulated element pumping is associated with a data column in the Time Series Pumping File. All or a fraction of the pumping rate specified in the data column can be applied to the specified element using user-specified fractions (FRACSK) that may be further weighted (using the IOPTSK option) with respect to the agricultural and urban area in the destination where the pumping is delivered. For instance, the total pumping in a subregion may be known but the locations of the wells and the actual pumping amounts at each well may be unknown. In such a case, the user can specify the total pumping for the subregion in the Time Series Pumping File, and let IWFM distribute subregional pumping among the elements in that subregion based on the agricultural and urban water demand in each element. For this set-up, assuming the subregional pumping is stored in column 1 of the Time Series Pumping File, ICOLSK for all elements in the subregion will be 1, FRACSK will be 1.0 and IOPTSK will be 2 (see the description of the variables below).

The Element Pumping Specifications Data File is divided into several sections and the following variables are used for the simulation of element pumping:

Element Pumping Characteristics:

NSINK	Number of elements where element pumping is specified
ID	Element identification number corresponding to the pumping
ICOLSK	Element pumping; this number corresponds to the appropriate data column in the Time Series Pumping File
FRACSK	Relative proportion of the pumping in column ICOLSK to be applied to element ID
IOPTSK	Option for distribution of pumping in column at the delivery destination (0 = distribute the pumping according to the given relative fraction, FRACSK; 1 = distribute the pumping in proportion to FRACSK times the total area of the delivery destination; 2 = distribute the pumping in proportion to FRACSK times the developed area (agricultural and urban) at the delivery destination; 3 = distribute the pumping in proportion to FRACSK times the agricultural area at the delivery destination; 4 = distribute the pumping in proportion to FRACSK times the urban area at the delivery destination
FRACSKL	The distribution factor of pumping for each aquifer layer
TYPDSTSK	Destination where the pumping is delivered to (–1 = pumping is used in the same element where pumping occurs; 0 = pumping goes outside the model domain; 2 = pumping goes to element DSTSK; 4 = pumping goes to subregion DSTSK; 6 = pumping goes to a group of elements with group identification number

	DSTDL where element group identifications are specified later in the file)
DSTSK	Delivery destination identification number; enter any number if TYPDSTSK is set to –1 (i.e. pumping is used in the same element where pumping occurs) or 0 (i.e. pumping is delivered to outside the model area)
ICFIRIGSK	Fraction of the pumping that is used for irrigation purposes; this number corresponds to the appropriate data column in the Irrigation Fractions Data File
ICADJSK	Supply adjustment specification; this number corresponds to the data column in the Supply Adjustment Specifications Data File
ICSKMAX	Maximum pumping amount; this number corresponds to the appropriate data column in the Time Series Pumping File (enter 0 if a maximum pumping amount does not apply)
FSKMAX	Fraction of data value specified in column ICSKMAX to be used as maximum pumping amount

Element Groups for Element Pumping Deliveries

NGRP	Number of element groups; enter 0 if there are no element groups where well pumping is delivered
ID	Element group identification number entered sequentially
NELEM	Number of elements in element group ID
IELEM	Element numbers that are in group ID

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                 EELEMENT PUMPING SPECIFICATION FILE
C                           Pumping Component
C                          for IWFM Simulation
C
C
C              Project:  IWFM Version ### Release
C                        California Department of Water Resources
C              Filename: ElemPump.dat
C
C*******************************************************************************
C                           File Description
C
C   This data file contains the specification data for element pumping.
C
C*******************************************************************************
C
C   NSINK ;  Number of elements used for element pumping
C
C-------------------------------------------------------------------------------
C   VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
     5                           / NSINK
C-------------------------------------------------------------------------------
C*******************************************************************************
C              List of elements for pumping and their corresponding parameters
C
C   ID       ; Element identification number corresponding to the pumping
C   ICOLSK   ; Element pumping - this number corresponds to the appropriate data
C               column in the Time Series Pumping File
C   FRACSK    ; Relative proportion of the pumping in column ICOLSK to be applied
C               to element ID
C   IOPTSK   ; Option for distribution of pumping at the delivery destination
C               0 = to distribute the pumping according to the given relative
C                     fraction, FRACSK
C               1 = to distribute the pumping in proportion to FRACSK
C                     times the total area of the destination for pumping
C               2 = to distribute the pumping in proportion to FRACSK
C                     times the developed area (ag. and urban) at the destination
C                     for pumping
C               3 = to distribute the pumping in proportion to FRACSK
C                     times the ag. area at the destination for pumping
C               4 = to distribute the pumping in proportion to FRACSK
C                     times the urban area at the destination for pumping
C   FRACSKL  ; The distribution factor of pumping for each aquifer layer; i.e. for
C               layers 1 to NL
C   TYPDSTSK ; Destination where the pumping is delivered to
C              -1 = pumping is used in the same element that pumping occurs
C               0 = Pumping goes outside the model domain
C               2 = Pumping goes to element DSTSK (see below)
C               4 = Pumping goes to subregion DSTSK (see below)
C               6 = Pumping goes to a group of elements with ID DSTDL
C                     (element groups are listed after this section)
C   DSTSK    ; Destination number for element pumping delivery
C               * Note: Enter any number if TYPDSTSK is set to -1 or 0
C   ICFIRIGSK; Fraction of the pumping that is used for irrigation purposes -
C               this number corresponds to the appropriate data column in the
C               Irrigation Fractions Data File
C   ICADJSK  ; Supply adjustment specification - this number corresponds to
C               the data column in the Supply Adjustment Specifications
C               Data File
C   ICSKMAX  ; Maximum pumping amount - this number corresponds to the
C               appropriate data column in the Time Series Pumping File
C               * Enter 0 if a maximum pumping amount does not apply
C   FSKMAX   ; Fraction of data value specified in column ICSKMAX to be used as
C               maximum pumping amount
C
C------------------------------------------------------------------------------------------------------------------
C ID  ICOLSK   FRACSK   IOPTSK   FRACSKL(1)   FRACSKL(2)   TYPDSTSK   DSTSK   ICFIRIGSK   ICADJSK  ICSKMAX  FSKMAX
C------------------------------------------------------------------------------------------------------------------
  73    1       1.0       0         1.0          1.0          4         1        2          4         0       1.0
  193   1       1.0       0         1.0          1.0          4         1        2          4         0       1.0
  333   1       1.0       0         1.0          1.0          4         2        1          4         0       1.0
  134   2       1.0       0         1.0          1.0          0         0        0          4         0       1.0
  274   2       1.0       0         1.0          1.0          0         0        0          4         0       1.0
C-----------------------------------------------------------------------------------------------
C
C                 Element Groups for Element Pumping Deliveries
C
C   List the elements in each group where selected element pumping above is delivered to. All
C   elements in each group must belong to the same subregion.
C
C   NGRP  ; Number of element groups
C            * Enter 0 if there are no element groups where well pumping is delivered
C   ID    ; Element group ID entered sequentially
C   NELEM ; Number of elements in element group ID
C   IELEM ; Element numbers that are in group ID
C
C-------------------------------------------------------------------------------
     0                 / NGRP
C-------------------------------------------------------------------------------
C    ID          NELEM      IELEM
C-------------------------------------------------------------------------------
*
*
```

Time Series Pumping File

The Time Series Pumping File contains the time series information for the specified wells and/or elemental pumping. This file lists the number of pumping data columns followed by conversion factor for the pumping data, number of time steps to update pumping and the repetition frequency for the pumping data. In time tracking simulations the time series pumping data can be either listed in this file or in a DSS file. If a DSS file is used for data input, then the name of the DSS file and the pathnames corresponding to each of the time series data are required.

The following is a list of the variables used in this data file:

NCOLPUMP	Number of pumping data columns
FACTPUMP	Conversion factor for the spatial component of the unit for the pumping data
NSPPUMP	Number of time steps to update pumping data; if time tracking simulation, enter any number
NFQPUMP	Repetition frequency of the pumping data (enter 0 if full time series data is supplied); if time tracking simulation, enter any number
DSSFL	If the time series data is stored in a DSS file, name of the file; leave blank if the data is listed in the Time Series Pumping File

Data Input from Time Series Pumping File

If the time series data is listed in the Time Series Pumping File, then the following variables need to be populated. Otherwise, these variables should be commented out using “C”, “c” or “*”, and the variables in the “Data Input from DSS File” section below should be populated.

ITPU — Time. For time tracking simulations use MM/DD/YYYY_hh:mm format, for non-time tracking simulations enter an integer number.

APUMP — Pumping rate (a negative value represents pumping whereas a positive value represents recharge), [L^3/T]

Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated:

REC — Record number that coincides with the data column number for the time series data

PATH — Pathname for the time series record that will be used for data retrieval

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C                      PUMPING DATA FILE
C                      Pumping Component
C                     for IWFM Simulation
C
C
C             Project : IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: TSPumping.dat
C
C*******************************************************************************
C                            File Description:
C
C   This data file contains the time series pumping/recharge data.
C
C*******************************************************************************
C                         Pumping Data Specifications
C
C   NCOLPUMP; Number of pumping sets (or pathnames if DSS files are used)
C   FACTPUMP; Conversion factor for pumping data
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of pumping listed in this file        = AC-FT/MONTH
C                     Consistent unit used in simulation         = CU.FT/DAY
C                     Enter FACTPUMP (AC-FT/MONTH -> CU.FT/MONTH)= 2.29568E-05
C                      (conversion of MONTH -> DAY is performed automatically)
C   NSPPUMP ; Number of time steps to update pumping data
C              * Enter any number if time-tracking option is on
C   NFQPUMP ; Repetition frequency of the pumping data
C              * Enter 0 if full time series data is supplied
C              * Enter any number if time-tracking option is on
C   DSSFL   ; The name of the DSS file for data input (maximum 50 characters);
C              * Leave blank if DSS file is not used for data input
C
C-------------------------------------------------------------------------------
C         VALUE                                     DESCRIPTION
C-------------------------------------------------------------------------------
          2                                         / NCOLPUMP
          43560000.0                                / FACTPUMP    (taf -> cu.ft.)
          1                                         / NSPPUMP
          0                                         / NFQPUMP
                                                    / DSSFL
C-------------------------------------------------------------------------------
C                             Pumping Data
C                         (READ FROM THIS FILE)
C
C   List the pumping data below if it will not be read from a DSS file (i.e.
C   DSSFL is left blank above).
C
C   For pumping enter negative values, for recharge enter positive values.
C
C   ITPU ;   Time
C   APUMP;   Pumping rate; [L^3/T]
C             * Negative values: Pumping
C             * Positive values: Recharge
C
C-------------------------------------------------------------------------------
C ITPU                APUMP(1)  APUMP(2)  APUMP(3) ...
C-------------------------------------------------------------------------------
01/31/4000 24:00      -3.50      0.00
02/29/4000 24:00      -3.50      0.00
03/31/4000 24:00      -3.50      0.00
04/30/4000 24:00       0.00      6.00
05/31/4000 24:00       0.00      6.00
06/30/4000 24:00       0.00      6.00
07/31/4000 24:00       0.00      6.00
08/31/4000 24:00       0.00      6.00
09/30/4000 24:00       0.00      6.00
10/31/4000 24:00      -3.50      0.00
11/30/4000 24:00      -3.50      0.00
12/31/4000 24:00      -3.50      0.00
C-------------------------------------------------------------------------------
C                        Pathnames for Pumping Data
C                          (READ FROM DSS FILE)
C
C   List the pathnames for pumping data below if it will be read from a DSS file
C   (i.e. DSSFL is specified above).
C
C   REC  ;   Time series record number
C   PATH ;   Pathname for the time series record
C
C-------------------------------------------------------------------------------
C   REC       PATH
C-------------------------------------------------------------------------------
*
*
```

Aquifer Parameter Over-write Data File

This data file can be used to over-write selected parameter values at selected groundwater nodes. IWFM initially assigns parameter values to groundwater nodes through the information specified in the Parameter Data File. Sometimes it becomes necessary to modify some of the parameter values at selected groundwater nodes. One such situation is when IWFM is used in conjunction with an automated calibration program such as PEST (Paramater ESTimation program). PEST can automatically generate parameter values at specific groundwater nodes and this file can be used to over-write the previously specified values at these nodes. This file also allows the user to bypass the need to generate excessive numbers of parametric grid groups when only a few parameter values at a few groundwater nodes need to be modified. The following variables are used in this data file:

NWRITE	Total number of groundwater nodes at which previously defined parameter values will be over-written
FKH	Conversion factor for the spatial component for the unit of horizontal hydraulic conductivity
FS	Conversion factor for specific storage coefficient
FN	Weighting factor for specific yield value
FV	Conversion factor for the spatial component for the unit of aquitard vertical hydraulic conductivity
FL	Conversion factor for the spatial component for the unit of aquifer vertical hydraulic conductivity
FSCE	Conversion factor for elastic storage coefficient

FSCI	Conversion factor for inelastic storage coefficient
TUNITKH	Time unit of horizontal hydraulic conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
TUNITV	Time unit of aquitard vertical conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
TUNITL	Time unit of aquifer vertical conductivity; this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File
ID	Groundwater node number for which one or more parameter values will be modified
LAYER	Aquifer layer in which groundwater node ID resides
PKH	Hydraulic conductivity that will over-write the previously defined value (enter −1.0 if hydraulic conductivity at this node will not be modified); [L/T]
PS	Specific storage that will over-write the previously defined value (enter −1.0 if specific storage at this node will not be modified); [1/L]
PN	Specific yield that will over-write the previously defined value (enter −1.0 if specific yield at this node will not be modified); [L/L]

PV	Aquitard vertical hydraulic conductivity that will over-write the previously defined value (enter −1.0 if aquitard vertical hydraulic conductivity at this node will not be modified); [L/T]
PL	Aquifer vertical hydraulic conductivity that will over-write the previously defined value (enter −1.0 if aquifer vertical hydraulic conductivity at this node will not be modified); [L/T]
SCE	Elastic storage coefficient that will over-write the previously defined value (enter −1.0 if elastic storage coefficient at this node will not be modified); [1/L]
SCI	Inelastic storage coefficient that will over-write the previously defined value (enter −1.0 if inelastic storage coefficient at this node will not be modified); [1/L]

```
C*******************************************************************************
C
C                  INTEGRATED WATER FLOW MODEL (IWFM)
C                         *** Version ### ***
C
C*******************************************************************************
C
C               AQUIFER PARAMETER OVER-WRITE DATA FILE
C                        for IWFM Simulation
C
C
C             Project :  IWFM Version ### Release
C                        California Department of Water Resources
C             Filename:  Overwrite.dat
C
C*******************************************************************************
C                           File Description
C
C   This data file contains node and layer numbers, and associated parameter
C   values to over-write values specified in the Parameter Data File.
C
C*******************************************************************************
C               Over-writing Parameter Value Data Specifications
C
C   NWRITE; Total number of groundwater nodes at which previously defined
C            parameter values will be over-written.
C
C-------------------------------------------------------------------------------
C   VALUE                      DESCRIPTION
C-------------------------------------------------------------------------------
    4179                       / NWRITE
C-------------------------------------------------------------------------------
C
C         Conversion factors for over-writing parameter values
C
C   FKH    ;  Conversion factor for horizontal hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                 = IN/DAY
C                     Enter FKH (FT/MONTH -> IN/MONTH)                   = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FS     ;  Conversion factor for specific storage coefficient
C   FN     ;  Weighting factor for specific yield value
C   FV     ;  Conversion factor for aquitard vertical hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                 = IN/DAY
C                     Enter FKH (FT/MONTH -> IN/MONTH)                   = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FL     ;  Conversion factor for aquifer vertical hydraulic conductivity
C              It is used to convert only the spatial component of the unit;
C              DO NOT include the conversion factor for time component of the unit.
C              * e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
C                     Consistent unit used in simulation                 = IN/DAY
C                     Enter FKH (FT/MONTH -> IN/MONTH)                   = 8.33333E-02
C                      (conversion of MONTH -> DAY is performed automatically)
C   FSCE   ;  Conversion factor for elastic storage coefficient
C   FSCI   ;  Conversion factor for inelastic storage coefficient
C   TUNITKH;  Time unit of horizontal hydraulic conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   TUNITV ;  Time unit of aquitard vertical conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C   TUNITL ;  Time unit of aquifer vertical conductivity.  This should be one of the units
C              recognized by HEC-DSS that are listed in the Main Control File.
C
C-------------------------------------------------------------------------
C  FKH         FS          FN         FV        FL       FSCE        FSCI
C-------------------------------------------------------------------------
   1.00        1.00        1.00       1.00      1.00     1.00        1.00
C-----------------------------------------------------------------------------------------------
C   VALUE                DESCRIPTION
C-----------------------------------------------------------------------------------------------
    1mon                 / TUNITKH
    1mon                 / TUNITV
    1mon                 / TUNITL
C-------------------------------------------------------------------------
C
C   The following lists the groundwater nodenumber, aquifer layer number and the
C    associated parameter values that will over-write the previously defined
C    values.
C    *** Enter -1.0 not to over-write the previously set values ***
C
C
C   ID   ;   Groundwater node number
C   LAYER;   Aquifer layer
C   PKH  ;   Hydraulic conductivity; [L/T]
C   PS   ;   Specific storage; [1/L]
C   PN   ;   Specific yield; [L/L]
C   PV   ;   Aquitard vertical hydraulic conductivity; [L/T]
C   PL   ;   Aquifer vertical hydraulic conductivity; [L/T]
C   SCE  ;   Elastic storage coefficient (Use SCE*DC if DC=0); [1/L]
C   SCI  ;   Inelastic storage coefficient (Use SCI*DC if DC=0); [1/L]
C            *Note* The above land subsidence parameters are only for interbed
C                    layers (i.e. clay layers)
C
C----------------------------------------------------------------------------------------------
```

```
C               Hydr.        Spec.          Spec.       Aquitard  Aquifer   Elastic   Inelastic
C               cond.        Stor.          Yld.         Vert. K  Vert. K  Stg. Coef. Stg. Coef.
C  ID   LAYER    PKH          PS             PN            PV       PL        SCE        SCI
C-------------------------------------------------------------------------------------------
     1     1  2404.766  9.9999997E-06  2.0151161E-02  -1.00   334.3762   -1.00       -1.00
     1     2  1052.881  5.0065097E-05  3.3468835E-02  -1.00   240.6059   -1.00       -1.00
     1     3  9706.813  1.0849720E-04  5.8463603E-02  -1.00   214.9347   -1.00       -1.00
     2     1  2407.003  1.0000001E-05  1.9952139E-02  -1.00   331.9574   -1.00       -1.00
     2     2  1044.410  5.0159750E-05  3.4741677E-02  -1.00   239.1580   -1.00       -1.00
     2     3  9612.228  1.1174077E-04  6.1085913E-02  -1.00   215.6135   -1.00       -1.00
     .     .      .           .               .          .        .         .           .
     .     .      .           .               .          .        .         .           .
     .     .      .           .               .          .        .         .           .
  1392     2  1393.980  1.9578732E-04  7.3446646E-02  -1.00   2.911047   -1.00       -1.00
  1392     3  680.7024  1.4334776E-04  5.9957355E-02  -1.00   7.285010   -1.00       -1.00
  1393     1  2391.534  9.9999997E-06  0.1486767      -1.00   4.609168   -1.00       -1.00
  1393     2  1437.810  2.3690333E-04  8.9009784E-02  -1.00   3.107419   -1.00       -1.00
  1393     3  759.8795  1.6385839E-04  9.4242930E-02  -1.00   6.028072   -1.00       -1.00
```

4.2. Output Files

IWFM generates text, DSS and binary files based on the user preference in order to view and analyze the simulation results. To generate an output file, it is only necessary to specify a name for the file in the relevant input data file. Omitting the name for an output file will suppress the generation of that file. Generation of some output files is dependent on the system being modeled. For instance, if a groundwater system with a single aquifer layer is modeled, defining a file name for layer vertical flow output file will fail to generate the required file since there are no vertical flows being calculated. Binary output files require either the Budget or the Z-Budget post-processors to convert them into meaningful tabular data.

The following sections describe each of the text and DSS output files in detail. The output files generated after post-processing Budget binary files are described in the next chapter in this document. For the description of the output file that is generated after post-processing Z-Budget binary file, please consult *Z-Budget: Sub-Domain Water Budgeting Post-Processor for IWFM – Theoretical Documentation and User's Manual*.

Simulation Standard Output File (SimulationMessages.out)

This file provides the user with information that was processed in the simulation portion of IWFM. The user is encouraged to check the contents of this file after every run. The following list indicates the information available in this output file:

- Project title (specified in the Simulation Main Input File)
- Date and time of the run

- List of input and output file specified in the Simulation Main Input File
- Various warning messages and errors
- Aquifer parameters depending on the option set by the user in the Simulation Main Input File
- Convergence information on the iterative procedures at each time step
- Total CPU time consumed by the execution of the Simulation program

```
*******************************************************************************************************************************
                                                         IWFM
                                                 Version ### Release
                                                          DWR
*******************************************************************************************************************************

 THIS RUN IS MADE ON 05/02/2012 AT 13:38:08

 THE FOLLOWING FILES ARE USED IN THIS SIMULATION:
   2       Parameter.dat
   3       RootZone\RootZone_MAIN.dat
   4       Stream\Stream_MAIN.dat
   5       Lake\Lake_MAIN.dat
   6       Bound.dat
   7       BoundTSD.dat
   8       Print.dat
   9       Init.dat
  10       IrigFrac.dat
  11       SupplyAdjust.dat
  12       Precip.dat
  13       ET.dat
  14       TileDrain.dat
  15       Pumping\Pump_MAIN.dat
  16
  17       ..\ZBudget\ZBudget.bin
  18       ..\Budget\SWShed.bin
  19       ..\Budget\GW.bin
  20
  21       FaceFlow.out
  22       BoundaryFlow.out
  23       GWHyd.out
  24       GWHeadAll.out
  25       VerticalFlow.out
  26
  27
  28       FinResults.out

NOTE: BOTH SURFACE WATER DIVERSION AND PUMPING WERE ADJUSTED.

--------------------------------------------------
*   TIME STEP 1 AT 10/01/1990_24:00
--------------------------------------------------

                         *** SUPPLY ADJUSTMENT ITERATION:     1 ***
   ITER      CONVERGENCE         MAX.DIFF    VARIABLE       PUMP.CONV.    DRY LOCATION
   -------------------------------------------------------------------------------------
      1      201.703          19.0954             486      0.00000             0()
      2      8.50811          3.11971              22      0.00000             0()
      3     0.989192         0.575612              20      0.00000             0()
      4     0.832663E-02     0.144996E-02          24      0.00000             0()
      5      0.00000          0.00000               0      0.00000             0()

                         *** SUPPLY ADJUSTMENT ITERATION:     2 ***
   ITER      CONVERGENCE         MAX.DIFF    VARIABLE       PUMP.CONV.    DRY LOCATION
   -------------------------------------------------------------------------------------
      1      201.664          19.0954             486      0.00000             0()
      2      8.41295          3.11971              22      0.00000             0()
      3     0.978747         0.575612              20      0.00000             0()
      4     0.307766E-02     0.535925E-03          24      0.00000             0()
      5      0.00000          0.00000               0      0.00000             0()

                         *** SUPPLY ADJUSTMENT ITERATION:     3 ***
   ITER      CONVERGENCE         MAX.DIFF    VARIABLE       PUMP.CONV.    DRY LOCATION
   -------------------------------------------------------------------------------------
      1      201.489          19.0954             486      0.00000             0()
      2      8.41988          3.12481              22      0.00000             0()
      3     0.979310         0.573899              20      0.00000             0()
      4     0.307765E-02     0.535924E-03          24      0.00000             0()
      5      0.00000          0.00000               0      0.00000             0()

--------------------------------------------------
*   TIME STEP 2 AT 10/02/1990_24:00
--------------------------------------------------
      .       .               .                     .      .                   .
      .       .               .                     .      .                   .
      .       .               .                     .      .                   .

**************************************************
TOTAL RUN TIME: 3 MINUTES 48.252 SECONDS
**************************************************
```

Subsidence Output File

The subsidence output file includes the simulated subsidence values at aquifer layers and nodes specified by the user in the Print Control File. The layer and node numbers for which subsidence output are desired are specified by the user. If print-out at locations other than finite element nodes are desired, then IWFM prints out the element number where the x-y coordinate lies in. If total subsidence over all the aquifer layers is desired, then a value of zero appears for the layer number at the heading of this file. A negative subsidence value indicates that interbed thickness is decreasing due to falling groundwater heads, while a positive subsidence indicates expanding interbed thickness due to rising groundwater heads.

If the subsidence values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

One of the following depending on the output data:

i. *ID*:L*XXX*:GW*YYY* (if subsidence is printed for nodes; *ID* is the subsidence print-out number listed sequentially in the Print Control File, *XXX* is the aquifer layer number and *YYY* is the groundwater node number)

ii. *ID*:L*XXX*:E*YYY* (if subsidence values are printed for x-y coordinates; *ID* is the subsidence print-out number listed sequentially in the Print Control File, *XXX* is the aquifer layer number and *YYY* is the element number that the x-y coordinate falls into)

Part C:

TOTAL_CHANGE_THICK

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

SUBSIDENCE

```
*                                       ***************************************
*                                       *   TOTAL CHANGE IN INTERBED THICKNESS *
*                                       *              (UNIT=FEET)            *
*                                       ***************************************
*                    LAYER      0           0           0           0           0
*                     NODE    168         169         170         171         178
*         TIME
10/01/1990_24:00          -0.0010      0.0001      0.0048      0.0048      0.0048
10/02/1990_24:00          -0.0010      0.0001      0.0049      0.0050      0.0050
10/03/1990_24:00          -0.0010      0.0001      0.0049      0.0050      0.0050
10/04/1990_24:00          -0.0010      0.0001      0.0049      0.0050      0.0050
10/05/1990_24:00          -0.0010      0.0001      0.0049      0.0050      0.0050
10/06/1990_24:00          -0.0010      0.0001      0.0049      0.0050      0.0050
10/07/1990_24:00          -0.0010      0.0001      0.0049      0.0050      0.0050
10/08/1990_24:00          -0.0010      0.0001      0.0049      0.0050      0.0050
10/09/1990_24:00          -0.0010      0.0001      0.0049      0.0050      0.0050
10/10/1990_24:00          -0.0010      0.0001      0.0049      0.0050      0.0049
10/11/1990_24:00          -0.0010      0.0001      0.0049      0.0050      0.0049
     .                          .           .           .           .           .
     .                          .           .           .           .           .
     .                          .           .           .           .           .
09/13/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/14/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/15/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/16/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/17/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/18/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/19/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/20/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/21/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/22/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/23/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/24/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/25/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/26/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/27/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/28/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/29/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
09/30/2000_24:00          -0.0050      0.0000     -0.0025     -0.0061      0.0044
```

Element Face Flow Output File

This output file is generated when simulated flows at specified element faces are required to be printed. The element faces and aquifer layer numbers for which flow values are printed are specified by the user in the Print Control File. The flow rates are printed in the units specified by the user in the Simulation Main Input File for every time step of the simulation period. The element numbers that interface at the specified face are listed at the top of the output file in the format *EXXX-EYYY*, where *XXX* and *YYY* are the element numbers. If the element face is located at the model boundary, then *EXXX* is reported as *E0*. If the flow rate is positive then the flow at the element face is towards the element listed first (i.e. towards *EXXX*); if the flow rate is negative then the flow at the element face is towards the element listed second (i.e. towards *EYYY*).

If the element face flow values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

L*ZZZ*:E*XXX*-E*YYY* where *ZZZ* is the aquifer layer number, *XXX* is the first element number interfacing at the face, and *YYY* is the second element number

Part C:

FLOW

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

ELEMENT_FACE_FLOW

```
*                                          ****************************************
*                                          *          ELEMENT FACE FLOW           *
*                                          *            (UNIT=AC-FT)              *
*                                          ****************************************
*               LAYER                1                2                3                1
*                FACE        E791-E795        E791-E795        E791-E795            E0-E1
*         TIME
10/31/1921_24:00               233.50           177.25             0.56             0.00
11/30/1921_24:00               121.43            90.52             0.56             0.00
12/31/1921_24:00               126.47            91.03             0.57             0.00
01/31/1922_24:00               109.06            91.68             0.57             0.00
02/28/1922_24:00               120.64            92.53             0.57             0.00
03/31/1922_24:00                65.13            94.70             0.58             0.00
04/30/1922_24:00               -56.11            93.70             0.58             0.00
05/31/1922_24:00              -176.39            94.26             0.58             0.00
06/30/1922_24:00              -109.11            96.46             0.59             0.00
07/31/1922_24:00               -28.06            97.02             0.60             0.00
08/31/1922_24:00                76.86           121.41             0.60             0.00
09/30/1922_24:00               112.13            97.79             0.60             0.00
10/31/1922_24:00               140.59            99.28             0.61             0.00
11/30/1922_24:00               156.17           101.08             0.62             0.00
12/31/1922_24:00               131.83           103.01             0.63             0.00
01/31/1923_24:00               124.50           104.92             0.65             0.00
02/28/1923_24:00               144.29           106.71             0.66             0.00
03/31/1923_24:00                55.08           111.46             0.66             0.00
04/30/1923_24:00               -53.07           109.04             0.67             0.00
05/31/1923_24:00              -154.43           110.38             0.68             0.00
06/30/1923_24:00               -59.59           113.14             0.69             0.00
      .                          .                .                .                .
      .                          .                .                .                .
      .                          .                .                .                .
      .                          .                .                .                .
09/30/1930_24:00               436.35           138.10             0.84             0.00
10/31/1930_24:00               438.48           140.41             0.86             0.00
11/30/1930_24:00               440.30           143.07             0.87             0.00
12/31/1930_24:00               441.75           145.88             0.89             0.00
01/31/1931_24:00               371.70           148.66             0.91             0.00
02/28/1931_24:00               444.66           151.26             0.93             0.00
03/31/1931_24:00                -1.51           145.56             0.89             0.00
04/30/1931_24:00               194.25           147.78             0.90             0.00
05/31/1931_24:00               227.11           150.39             0.91             0.00
06/30/1931_24:00               291.92           206.68             0.85             0.00
07/31/1931_24:00               415.62           219.91             0.80             0.00
08/31/1931_24:00               450.09           197.10             0.77             0.00
09/30/1931_24:00               484.84           147.63             0.77             0.00
```

Boundary Flux Output File

This output file is generated when simulated flows at the groundwater boundary nodes are required to be printed. The groundwater node and aquifer layer numbers for which flow values are printed are specified by the user in the Print Control File. The flow rates are printed in the units specified by the user in the Simulation Main Input File for every time step of the simulation period. A negative flow value represents outflow from the model area, and a positive value represents an inflow into the model area.

If the boundary flow values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

L*ZZZ*:GW*XXX* where *ZZZ* is the aquifer layer number, *XXX* is the groundwater node number

Part C:

FLOW

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

BOUNDARY_NODE_FLOW

```
*                                      *******************************************
*                                      *             BOUNDARY FLOW               *
*                                      *              (UNIT=AC-FT)               *
*                                      * [NOTE: INFLOW TO THE BASIN IS POSITIVE]  *
*                                      *******************************************
```

* LAYER	1	1	1	1	1	1
* NODE	435	451	460	463	473	475
* TIME						
10/31/1921_24:00	-399.57	-516.08	-420.01	-509.60	-389.90	-276.87
11/30/1921_24:00	-326.65	-355.41	-366.47	-301.16	-224.97	-64.41
12/31/1921_24:00	-289.29	-297.24	-320.69	-326.56	-274.25	-231.77
01/31/1922_24:00	-328.24	-338.35	-311.73	-389.64	-338.59	-361.52
02/28/1922_24:00	-313.12	-286.25	-394.69	-299.31	-232.86	-153.19
03/31/1922_24:00	-275.79	-247.78	-319.95	-214.82	-135.93	-33.21
04/30/1922_24:00	-264.61	-221.95	-261.04	-165.59	-76.50	28.35
05/31/1922_24:00	-371.96	-292.24	-284.77	-296.43	-214.53	-240.87
06/30/1922_24:00	-308.81	-293.54	-236.83	-304.59	-268.18	-369.21
07/31/1922_24:00	-164.90	-261.67	-198.62	-239.45	-242.11	-280.61
08/31/1922_24:00	-123.78	-246.60	-196.72	-204.27	-207.61	-181.80
09/30/1922_24:00	-169.78	-250.10	-234.31	-198.68	-165.01	-75.68
10/31/1922_24:00	-155.49	-239.69	-223.61	-187.58	-136.45	-56.91
11/30/1922_24:00	-187.10	-268.61	-235.40	-236.25	-179.53	-149.79
12/31/1922_24:00	-292.93	-334.48	-278.71	-355.62	-303.55	-376.68
01/31/1923_24:00	-372.04	-401.90	-493.96	-478.66	-451.25	-588.30
02/28/1923_24:00	-266.23	-305.53	-355.21	-284.25	-259.55	-188.00
03/31/1923_24:00	-252.96	-296.84	-319.70	-276.76	-242.56	-192.71
04/30/1923_24:00	772.03	487.36	610.48	784.93	535.35	448.91
05/31/1923_24:00	99.96	-29.09	31.57	86.76	-84.57	-93.48
06/30/1923_24:00	-232.22	-341.51	-261.01	-356.12	-456.53	-509.08
07/31/1923_24:00	-216.26	-325.23	-265.84	-326.47	-415.36	-407.59
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
09/30/1929_24:00	-74.59	-251.38	-398.55	-311.36	-508.91	-311.78
10/31/1929_24:00	-43.76	-220.08	-377.14	-271.70	-442.54	-282.59
11/30/1929_24:00	-35.84	-211.92	-368.61	-265.93	-421.42	-308.39
12/31/1929_24:00	-299.23	-473.69	-541.51	-723.76	-905.95	-1340.36
01/31/1930_24:00	-422.66	-561.38	-604.47	-865.43	-1133.35	-1354.20
02/28/1930_24:00	-261.33	-341.41	-594.03	-444.98	-674.44	-430.10
03/31/1930_24:00	-213.66	-277.91	-497.97	-342.79	-526.90	-336.88
04/30/1930_24:00	24.15	-90.65	-298.63	-86.08	-294.66	-125.49
05/31/1930_24:00	780.49	435.11	202.74	669.42	467.43	529.81
06/30/1930_24:00	-7.41	-266.40	-390.45	-390.01	-620.68	-801.72
07/31/1930_24:00	-14.11	-250.19	-378.64	-352.75	-634.15	-642.72
08/31/1930_24:00	49.66	-191.56	-340.93	-290.06	-540.86	-442.35
09/30/1930_24:00	-49.08	-220.39	-405.30	-281.13	-505.72	-292.20
10/31/1930_24:00	-35.30	-197.85	-391.37	-249.67	-446.68	-270.63
11/30/1930_24:00	-64.01	-225.37	-405.81	-296.62	-484.51	-436.86
12/31/1930_24:00	-166.72	-349.29	-478.09	-504.33	-701.18	-860.51
01/31/1931_24:00	-208.63	-369.38	-679.26	-527.71	-754.21	-775.75
02/28/1931_24:00	-136.91	-268.69	-630.96	-340.67	-556.82	-338.45
03/31/1931_24:00	-128.99	-252.23	-499.00	-324.42	-528.25	-409.83
04/30/1931_24:00	194.45	-69.60	-212.76	-113.78	-429.06	-569.94
05/31/1931_24:00	-107.51	-333.96	-463.15	-471.28	-760.04	-804.14
06/30/1931_24:00	-124.46	-353.02	-452.29	-538.87	-809.90	-859.91
07/31/1931_24:00	107.94	-340.19	-404.25	-464.39	-819.29	-758.80
08/31/1931_24:00	17.81	-333.54	-447.97	-450.26	-763.44	-645.46
09/30/1931_24:00	-35.38	-233.99	-437.98	-306.70	-567.62	-329.26

Groundwater Level Hydrograph Output

The groundwater level hydrograph output file includes the groundwater level at aquifer layers and nodes specified by the user in the Print Control File. The layer and node numbers for which hydrographs are desired are specified by the user. If hydrographs at locations other than finite element nodes are desired, then IWFM prints out the element number where the x-y coordinate lies in. If groundwater head averaged over all the aquifer layers is desired, then a value of zero appears for the layer number at the heading of this file.

If the groundwater head hydrographs are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

One of the following depending on the output data:

i. *ID*:L*XXX*:GW*YYY* (if hydrographs are printed for nodes; *ID* is the groundwater hydrograph number listed sequentially in the Print Control File, *XXX* is the aquifer layer number and *YYY* is the groundwater node number)

ii. *ID*:L*XXX*:E*YYY* (if hydrographs are printed for x-y coordinates; *ID* is the groundwater hydrograph number listed sequentially in the Print Control File, *XXX* is the aquifer layer number and *YYY* is the element number that the x-y coordinate falls into)

Part C:

HEAD

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

GROUNDWATER_HYDROGRAPHS

```
*                                          ****************************************
*                                          *       GROUNDWATER HYDROGRAPH         *
*                                          *             (UNIT=FEET)              *
*                                          ****************************************
*                 LAYER       2           3           2           3           1           2
*               ELEMENT      25          32          32          33          34          34
*       TIME
10/31/1921_24:00       497.0263    505.3219    543.3004    458.4522    433.4353    426.1700
11/30/1921_24:00       505.4606    518.8989    553.6088    461.8528    435.0066    430.3854
12/31/1921_24:00       509.2216    529.4095    557.8937    465.3780    436.2870    433.3676
01/31/1922_24:00       511.5957    537.4561    560.5013    468.7883    437.4383    435.5250
02/28/1922_24:00       513.4828    543.6903    562.5208    472.0072    438.5526    437.1873
03/31/1922_24:00       514.9638    548.5705    564.0660    474.9888    439.3772    438.4208
04/30/1922_24:00       515.8659    552.3538    564.9686    477.6812    440.0135    439.0901
05/31/1922_24:00       517.0825    555.4614    566.2022    480.1556    440.5773    439.9143
06/30/1922_24:00       517.8474    557.9856    567.0513    482.3972    441.0188    440.3641
07/31/1922_24:00       518.4698    560.0529    567.7386    484.4168    441.3708    440.6519
08/31/1922_24:00       519.1669    561.7623    568.3212    486.2388    441.6625    441.0097
09/30/1922_24:00       519.6537    563.1991    568.8564    487.8790    441.8453    441.1804
10/31/1922_24:00       520.1886    564.4162    569.3240    489.3588    441.9427    441.4149
11/30/1922_24:00       520.5497    565.4545    569.7294    490.6892    441.9696    441.5120
       .                   .           .           .           .           .           .
       .                   .           .           .           .           .           .
       .                   .           .           .           .           .           .
       .                   .           .           .           .           .           .
07/31/1930_24:00       514.7297    579.0901    580.3612    501.9473    433.1179    433.2660
08/31/1930_24:00       514.7058    579.1217    580.3654    501.9315    433.0757    433.2736
09/30/1930_24:00       514.6704    579.1412    580.3522    501.9127    433.0182    433.2902
10/31/1930_24:00       514.5757    579.1478    580.3219    501.8881    432.9141    433.2615
11/30/1930_24:00       514.4040    579.1410    580.2744    501.8546    432.7376    433.1635
12/31/1930_24:00       514.2122    579.1211    580.2141    501.8116    432.5679    433.0437
01/31/1931_24:00       514.0661    579.1037    580.2138    501.7699    432.5046    432.9541
02/28/1931_24:00       513.9512    579.0973    580.2521    501.7339    432.4586    432.8846
03/31/1931_24:00       513.7310    579.0599    580.1336    501.6841    432.3532    432.7205
04/30/1931_24:00       513.7003    579.0528    580.2108    501.6436    432.3270    432.7175
05/31/1931_24:00       513.6266    579.0446    580.2038    501.6034    432.2980    432.6976
06/30/1931_24:00       513.5331    579.0289    580.1695    501.5606    432.2466    432.6630
07/31/1931_24:00       513.2710    578.9995    580.0986    501.5057    432.1625    432.4580
08/31/1931_24:00       513.1958    578.9633    580.0439    501.4486    432.0850    432.4166
09/30/1931_24:00       513.1211    578.9190    579.9776    501.3896    432.0067    432.3979
```

Groundwater Level Output at Every Node

This output file displays the groundwater levels at each groundwater node in every layer modeled. If the aquifer dries at a ground water node, i.e. the groundwater head is equal to the elevation of the bottom of the aquifer at that node, then the elevation of the aquifer bottom is added 20000 and this value is printed out for that node. If a node is inactive, i.e. aquifer thickness becomes zero at that node, then the head at the above active node is added 40000 and this value is printed out for that node.

If the groundwater head values at all nodes are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

L*XXX*:GW*YYY* where *XXX* is the aquifer layer number and *YYY* is the groundwater node number

Part C:

HEAD

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

GW_HEAD_AT_ALL_NODES

```
*                                     ***********************************
*                                     *    GROUNDWATER HEAD AT ALL NODES    *
*                                     *             (UNIT=FEET)             *
*                                     ***********************************
*                        NODE
*       TIME                1           2           3           4 .....        1392        1393
10/31/1921_24:00     603.8759    607.5278    625.7092    581.1468 .....   1303.5031   1406.4968
                     587.3636    589.6517    609.4789    568.8487 .....    551.9865    541.2226
                     524.0269    536.3722    539.5226    520.9363 .....    512.7689    500.6641
11/30/1921_24:00     602.3052    607.6252    626.7251    583.3910 .....   1294.1678   1399.5461
                     574.1580    590.7881    611.6388    571.4923 .....    584.5448    577.6066
                     539.0812    554.0353    564.0575    538.2114 .....    512.9973    501.1272
12/31/1921_24:00     600.6682    607.3225    627.1661    584.8115 .....   1284.4702   1392.1206
                     572.5843    591.9127    614.0963    574.2521 .....    611.9763    609.1765
                     547.9035    565.6898    580.5905    550.1930 .....    513.3568    501.7591
01/31/1922_24:00     599.0127    606.9224    627.3983    585.8409 .....   1274.6344   1384.4100
                     571.7971    592.5587    615.8182    576.3203 .....    635.4563    636.7428
                     553.1150    573.3486    591.7580    558.5589 .....    513.8258    502.5345
02/28/1922_24:00     598.0007    606.5556    627.5793    586.6836 .....   1264.7956   1376.5410
                     571.4039    592.9258    617.0151    577.8796 .....    655.8388    660.9555
                     556.2206    578.3657    599.3163    564.4426 .....    514.3876    503.4325
03/31/1922_24:00     597.0432    606.0911    627.6306    587.3178 .....   1255.0360   1368.5925
                     570.9003    592.9970    617.7758    579.0182 .....    673.7538    682.3411
                     557.9847    581.5971    604.4169    568.5969 .....    515.0290    504.4355
04/30/1922_24:00     596.1069    605.4711    627.5004    587.6851 .....   1245.4098   1360.6211
                     569.9882    592.6191    617.9707    579.4381 .....    689.6646    701.3244
                     558.7786    583.5345    607.7490    571.3987 .....    515.7395    505.5288
       .                    .           .           .           . .....           .           .
       .                    .           .           .           . .....           .           .
       .                    .           .           .           . .....           .           .
       .                    .           .           .           . .....           .           .
03/31/1923_24:00     578.0787    595.6276    622.0552    586.3809 .....   1153.5250   1277.9583
                     555.8630    584.1644    613.8140    578.9021 .....    790.2306    816.2195
                     549.0497    580.4291    610.7209    576.5111 .....    526.3051    520.8205
04/30/1923_24:00     577.2108    594.6909    621.4323    586.0505 .....   1146.5714   1271.1487
                     555.7621    583.5216    613.4354    578.9625 .....    795.9619    822.1808
                     548.3036    579.6329    610.1929    576.2712 .....    527.4204    522.3596
05/31/1923_24:00     575.8130    593.7533    620.7987    585.7040 .....   1139.8494   1264.4745
                     555.4580    582.6953    612.8598    578.6788 .....    801.1448    827.5237
                     547.7248    578.8390    609.6516    576.0152 .....    528.5522    523.9093
06/30/1923_24:00     574.4749    592.8085    620.1464    585.3284 .....   1133.3543   1257.9365
                     555.1210    581.8381    612.2211    578.2846 .....    805.7389    832.2964
                     547.2408    578.0372    609.0800    575.7105 .....    529.6977    525.4665
07/31/1923_24:00     573.0619    591.8635    619.4856    584.9411 .....   1127.0784   1251.5323
                     554.5952    580.9833    611.6030    577.9300 .....    809.8029    836.5370
                     546.7502    577.2295    608.4959    575.3880 .....    530.8541    527.0284
08/31/1923_24:00     571.8148    590.9178    618.8145    584.5388 .....   1121.0136   1245.2584
                     554.0270    580.1375    610.9685    577.5478 .....    813.3713    840.2619
                     546.2428    576.4217    607.8981    575.0442 .....    532.0192    528.5923
09/30/1923_24:00     570.7008    589.9711    618.1329    584.1204 .....   1115.1568   1239.1155
                     553.3986    579.2833    610.3159    577.1388 .....    816.9789    843.8726
                     545.7051    575.6108    607.2851    574.6773 .....    533.1935    530.1578
```

Layer Vertical Flow Output File

This output file lists the vertical flows between aquifer layers at each subregion for multi-layered aquifer systems. The values listed in this file are vertical flows between an aquifer layer and the upper adjacent layer at every time step of the simulation period. A negative value represents downward flow direction, whereas a positive value represents upward flow direction.

If the subregional vertical flows are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

SR*XXX*:L*YYY*-L*ZZZ* where *XXX* is the subregion number, *YYY* is the aquifer layer number and *ZZZ* is the aquifer layer number below layer *YYY*

Part C:

FLOW

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

VERTICAL_FLOW

```
*                                         ***************************************
*                                         *          VERTICAL FLOW              *
*                                         *          (UNIT=AC.FT.)              *
*                                         *   [POSITIVE IN UPWARD DIRECTION]    *
*                                         ***************************************
```

* REGION	1		2		3	
* LAYER	L1-L2	L2-L3	L1-L2	L2-L3	L1-L2	L2-L3
* TIME						
10/31/1921_24:00	-49611.25	-26545.81	-70299.78	-27968.47	6415.07	-12948.10
11/30/1921_24:00	-35199.56	-22570.65	-42002.04	-25412.38	-2655.11	-8903.49
12/31/1921_24:00	-27561.39	-17531.45	-30188.69	-22912.35	-7136.24	-7322.48
01/31/1922_24:00	-23149.77	-14552.24	-24113.13	-20841.37	-8504.42	-6404.39
02/28/1922_24:00	-20293.05	-12440.25	-21115.48	-19180.71	-9480.44	-5807.09
03/31/1922_24:00	-18127.96	-10894.92	-18722.80	-17791.58	-9077.82	-5333.00
04/30/1922_24:00	-17066.00	-9648.41	-20588.96	-16318.18	-19695.60	-4199.87
05/31/1922_24:00	-14979.36	-9022.10	-19950.91	-15282.95	-15360.50	-4161.90
06/30/1922_24:00	-12529.45	-8176.90	-19972.24	-14280.78	-11101.21	-4087.27
07/31/1922_24:00	-11741.99	-7725.82	-20292.02	-13360.37	-9418.21	-3910.27
08/31/1922_24:00	-9112.85	-7301.80	-19461.42	-12607.80	-8664.68	-3737.56
09/30/1922_24:00	-8607.45	-6892.54	-17844.19	-11988.42	-8110.35	-3575.72
10/31/1922_24:00	-7834.85	-6582.88	-13928.76	-11580.70	-7213.94	-3420.80
11/30/1922_24:00	-7364.13	-6280.89	-11771.88	-11135.02	-6849.40	-3276.61
12/31/1922_24:00	-7011.36	-6023.94	-10704.04	-10703.95	-7132.52	-3173.19
01/31/1923_24:00	-6755.30	-5810.41	-9982.81	-10298.80	-7212.04	-3101.16
02/28/1923_24:00	-6450.23	-5613.76	-9230.00	-9909.71	-6467.46	-2995.67
03/31/1923_24:00	-6942.59	-5301.88	-10012.55	-9401.25	-6606.87	-2819.46
04/30/1923_24:00	-6163.79	-5253.35	-10932.62	-9001.99	-16771.53	-2163.60
05/31/1923_24:00	-6020.86	-5091.87	-12376.02	-8551.54	-12927.73	-2262.07
06/30/1923_24:00	-5330.12	-5006.71	-12488.83	-8193.43	-8953.24	-2396.17
.	.	.	.	.	.	.
06/30/1929_24:00	-41.18	-128.58	-6158.20	-1739.28	-6160.02	-1366.90
07/31/1929_24:00	171.88	-146.61	-7556.22	-1590.48	-6385.72	-1361.71
08/31/1929_24:00	282.00	-146.08	-7766.35	-1522.39	-6531.56	-1367.42
09/30/1929_24:00	419.24	-145.61	-6993.08	-1515.24	-6273.37	-1366.07
10/31/1929_24:00	498.04	-130.04	-5463.52	-1553.78	-5906.08	-1353.75
11/30/1929_24:00	560.29	-99.14	-3604.03	-1618.91	-5622.06	-1344.98
12/31/1929_24:00	466.72	-97.13	-2377.00	-1678.06	-5941.73	-1370.27
01/31/1930_24:00	406.55	-102.69	-2315.91	-1726.65	-5929.78	-1395.37
02/28/1930_24:00	288.21	-125.66	-2288.80	-1770.91	-5872.92	-1419.78
03/31/1930_24:00	209.65	-146.47	-1913.73	-1794.41	-5487.56	-1415.10
04/30/1930_24:00	-180.51	-90.58	-2699.81	-1686.30	-7664.89	-1191.29
05/31/1930_24:00	125.59	-148.92	-3807.46	-1618.14	-6646.55	-1315.00
06/30/1930_24:00	213.71	-153.15	-5416.16	-1474.06	-6312.25	-1334.39
07/31/1930_24:00	18.46	-106.56	-6749.40	-1341.40	-6362.15	-1331.23
08/31/1930_24:00	174.56	-114.61	-6932.39	-1284.49	-6448.21	-1336.58
09/30/1930_24:00	294.48	-113.68	-6028.20	-1293.81	-6197.88	-1340.42
10/31/1930_24:00	374.34	-97.15	-4412.63	-1346.91	-5902.11	-1317.90
11/30/1930_24:00	443.06	-65.00	-2487.50	-1424.36	-5517.79	-1307.23
12/31/1930_24:00	492.57	-37.73	-1506.47	-1447.37	-5267.86	-1285.32
01/31/1931_24:00	475.96	-24.45	-1260.46	-1459.67	-5571.25	-1287.47
02/28/1931_24:00	460.79	-18.34	-1121.43	-1463.01	-5209.33	-1269.62
03/31/1931_24:00	264.09	12.33	-1504.41	-1415.69	-5297.28	-1233.29
04/30/1931_24:00	393.57	-19.09	-4090.52	-1217.64	-5631.67	-1210.72
05/31/1931_24:00	415.78	-24.88	-4781.27	-1143.81	-6333.39	-1234.72
06/30/1931_24:00	436.10	-21.71	-5257.21	-1069.47	-6498.52	-1244.72
07/31/1931_24:00	207.00	23.21	-6679.01	-933.00	-6812.59	-1254.06
08/31/1931_24:00	353.55	10.27	-6890.77	-877.25	-6878.80	-1271.76
09/30/1931_24:00	470.97	4.74	-5970.82	-895.43	-6522.20	-1275.98

Groundwater Heads for TECPLOT

This file lists the model grid and groundwater heads at each node to be used by TECPLOT, a commercially available software. TECPLOT can be used for analysis of the simulation results including the animation of the groundwater elevations.

Subsidence Values for TECPLOT

This file lists the model grid and subsidence values at each node to be used by TECPLOT, a commercially available software. TECPLOT can be used for analysis of the simulation results including the animation of the subsidence.

Final Simulation Results File

This file lists the simulation results at the end of the simulation period. It is in a format that can readily be used as the Initial Conditions File by IWFM for the following simulation periods. For instance, consider an initial IWFM run performed for a simulation period that starts at January 1, 1973 and ends at December 31, 1992. Final simulation results output file will include all simulation results at the end of December 31, 1992. To perform a second IWFM run for a simulation period that starts at January 1, 1993 Final Simulation Results File can be used as an initial conditions data file. Similar to the groundwater head output at every node, 20000 is used as a flag at dry nodes and 40000 is used as a flag for inactive nodes in reporting the final groundwater heads. The interbed thickness and pre-consolidation head values at inactive nodes are printed as 9999.000.

```
C***********************************************************************
C ***** SIMULATION RESULTS AT TIME     30.00 1DAY
C***********************************************************************
C
C ***** GROUNDWATER HEAD VALUES
C***********************************************************************
C   LAYER   1
C***********************************************************************
   1.000000
  20605.0000000000        20605.0000000000        621.900070329929  .....    432.813026771975        496.65064510219
  387.571617077423        535.472525889578        770.051718188966  .....    715.004537846308        20720.000000000
  20520.0000000000        395.571091712471        375.646444448531  .....    366.185587858368        20465.000000000
  .                       .                       .                 .....    .                       .
  .                       .                       .                 .....    .                       .
  .                       .                       .                 .....    .                       .
  21300.0000000000        555.566649143294        450.171865581857  .....    421.932037799460        486.14618555663
  20874.0000000000        1712.64559618794        668.013419073559  .....    845.969382110627        1421.9108597647
  1027.94758321902        1330.14175314542        1434.54721746164
C***********************************************************************
C   LAYER   2
C***********************************************************************
   1.000000
  20555.0000000000        594.268212596875        621.825955555383  .....   433.552481435639        495.780718970840
  387.778092011510        491.217612864044        722.992952744224  .....   667.187888489437        670.903150916440
  458.879924305839        396.186699354260        376.254030997574  .....   366.524325678366        401.665141753486
  .                       .                       .                 .....   .                       .
  .                       .                       .                 .....   .                       .
  .                       .                       .                 .....   .                       .
  1127.85314443836        537.429105064827        455.516111277596  .....   426.995184810763        487.166626232997
  20724.0000000000        41712.6455961879        644.725948978744  .....   40845.9693821106        41421.9108597648
  41027.9475832190        41330.1417531454        41434.5472174616
C***********************************************************************
C   LAYER   3
C***********************************************************************
   1.000000
  40555.0000000000        40594.2682125969        40621.8259555554  .....   440.557604278229        487.784985841197
  40387.7780920115        40491.2176128640        40722.9929527442  .....   40667.1878884894        536.189547190331
  452.576852795560        403.915656756026        381.457930854301  .....   370.616199540561        40401.6651417535
  .                       .                       .                 .....   .                       .
  .                       .                       .                 .....   .                       .
  .                       .                       .                 .....   .                       .
  41127.8531444384        492.965764857591        446.602927522595  .....   483.122301861706        515.434989757073
  445.701134285053        41712.6455961879        532.372134681844  .....   40845.9693821106        41421.9108597648
  41027.9475832190        41330.1417531454        41434.5472174616
C ***** UNSATURATED ZONE SOIL MOISTURE AS A FRACTION OF TOTAL POROSITY
   1.000000
     1   4.438889455363878E-003   2.556338171906956E-010
     2    0.00000000000000         0.00000000000000
     3    0.00000000000000         0.00000000000000
     .    .                        .
     .    .                        .
     .    .                        .
  1390    0.00000000000000         0.00000000000000
  1391    0.00000000000000         0.00000000000000
  1392    0.00000000000000         0.00000000000000
C ***** SMALL WATERSHED SOIL MOISTURE AND GROUNDWATER STORAGE
   1.000000
     1   0.260192828355463         9.41707953957551
     2   1.412475353929657E-002    9.41707953957551
     3   5.451659260781131E-003    9.41707953957551
     .   .                         .
     .   .                         .
     .   .                         .
    14   0.128745815483066         9.41707953957551
    15   1.300964141777316E-002    9.41707953957551
C ***** INTERBED THICKNESS
C***********************************************************************
C   LAYER   1
C***********************************************************************
   1.000000
  12.9999393802902      11.9999382525607      11.9999503238972   .....    14.0001551715175      10.9998228233117
  21.9999595701265      25.9999757255399      22.9999401479066   .....     7.99997640339434      7.99997528206760
  7.99997291208803      8.00007203961515      13.0000658971613   .....     8.00002900121345     10.9999627496099
  .                     .                     .                  .....     .                    .
  .                     .                     .                  .....     .                    .
  .                     .                     .                  .....     .                    .
  6.99978170442880      0.00000000000000      6.00000464037244   .....    18.0000754952138      33.9999137364433
  16.9992171481959      32.9995389991466      100.239832534616   .....    81.0067651678598      65.0218038106907
  65.0062327569299      63.0051292138376      63.0061939804593
C***********************************************************************
C   LAYER   2
C***********************************************************************
   1.000000
  3.99999134628982      4.00000554782836      4.00002368708255   .....    4.00001084456937      2.99996153491550
  4.99989038233091      5.00005012153220      5.00002076647771   .....    5.00000692749269      4.99998409591728
  8.99987728273730      9.00003145623023      9.99997993124233   .....    9.99994079452986      10.0000074313797
  .                     .                     .                  .....    .                     .
  .                     .                     .                  .....    .                     .
  .                     .                     .                  .....    .                     .
  10.0012534674304      7.00177363467500      10.0005020371667   .....   14.9996750020413      10.0018201664987
  34.9992226881236      0.00000000000000      135.086761953138   .....    0.00000000000000      0.00000000000000
  0.00000000000000      0.00000000000000      0.00000000000000
C***********************************************************************
C   LAYER   3
C***********************************************************************
   1.000000
  0.00000000000000      0.00000000000000      0.00000000000000   .....    0.00000000000000      0.00000000000000
  0.00000000000000      0.00000000000000      0.00000000000000   .....    0.00000000000000      0.00000000000000
```

```
  0.00000000000000      0.00000000000000      0.00000000000000   .....   0.00000000000000      0.00000000000000
  .                     .                     .                  .....   .                     .
  .                     .                     .                  .....   .                     .
  .                     .                     .                  .....   .                     .
  0.00000000000000      0.00000000000000      0.00000000000000   .....   0.00000000000000      0.00000000000000
  0.00000000000000      0.00000000000000      0.00000000000000   .....   0.00000000000000      0.00000000000000
  0.00000000000000      0.00000000000000      0.00000000000000
C ***** PRECONSOLIDATION HEAD VALUES
C***************************************************************************
C   LAYER   1
C***************************************************************************
   1.000000
  506.000000000000        506.000000000000        523.000000000000   .....    330.000000000000          400.0000000000
  288.000000000000        436.000000000000        671.000000000000   .....    616.000000000000          621.0000000000
  421.000000000000        294.000000000000        275.000000000000   .....    265.000000000000          366.0000000000
  .                       .                       .                  .....    .                         .
  .                       .                       .                  .....    .                         .
  .                       .                       .                  .....    .                         .
  750.000000000000        555.566649143294        450.000000000000   .....    280.000000000000          340.0000000000
  750.000000000000        750.000000000000        668.013419073559   .....    750.000000000000          750.0000000000
  750.000000000000        750.000000000000        750.000000000000
C***************************************************************************
C   LAYER   2
C***************************************************************************
   1.000000
  455.000000000000        494.000000000000        521.000000000000   .....    333.000000000000          399.0000000000
  293.000000000000        389.000000000000        622.000000000000   .....    567.000000000000          572.0000000000
  362.000000000000        295.000000000000        277.000000000000   .....    268.000000000000          302.0000000000
  .                       .                       .                  .....    .                         .
  .                       .                       .                  .....    .                         .
  .                       .                       .                  .....    .                         .
  750.000000000000        431.000000000000        404.000000000000   .....    280.000000000000          340.0000000000
  407.000000000000        9999.00000000000        452.000000000000   .....    9999.00000000000          9999.000000000
  9999.00000000000        9999.00000000000        9999.00000000000
C***************************************************************************
C   LAYER   3
C***************************************************************************
   1.000000
  9999.00000000000        9999.00000000000        9999.00000000000   .....    339.000000000000          395.0000000000
  9999.00000000000        9999.00000000000        9999.00000000000   .....    9999.00000000000          441.0000000000
  359.000000000000        300.000000000000        282.000000000000   .....    274.000000000000          9999.000000000
  .                       .                       .                  .....    .                         .
  .                       .                       .                  .....    .                         .
  .                       .                       .                  .....    .                         .
  9999.00000000000        480.459285073626        442.320792394920   .....    280.000000000000          340.0000000000
  445.000000000000        9999.00000000000        497.860000000000   .....    9999.00000000000          9999.000000000
  9999.00000000000        9999.00000000000        9999.00000000000
```

Root Zone Component Output Files

The text, DSS and binary files that are generated by the root zone component are discussed in detail in the documentation titled *IDC v4.0 Theoretical Documentation and User's Manual*.

Stream Component Output Files

Stream Flow Hydrograph Output File

The stream hydrograph output file can either contain stream flows or stream surface elevations, depending on the option set by the user in the Stream Component Main File. The flow or elevation values are printed for the stream nodes specified by the user for each time step of the simulation period.

If the stream flow or elevation values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

R*XXX* where *XXX* is the stream node number

Part C:

One of the following, depending on the output data

i. *FLOW* (when stream flows are printed)

ii. *SURFACE_ELEV* (when stream surface elevations are printed)

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

STREAM_HYDROGRAPHS

```
*                                         ****************************************
*                                         *          STREAM HYDROGRAPH           *
*                                         *            (UNIT=ac.ft.)             *
*                                         ****************************************
*       HYDROGRAPH ID            1              2              3              4              5              6              7
*               NODES            1              2              3              4              5              6              7
*        TIME
10/01/1990_24:00           1738.80        1327.33        1013.23         773.45         590.42         911.74         695.98
10/02/1990_24:00           1738.80        1327.33        1013.23         773.45         590.42         914.19         697.85
10/03/1990_24:00           1738.80        1327.33        1013.23         773.45         590.42         916.70         699.77
10/04/1990_24:00           1738.80        1327.33        1013.23         773.45         590.42         919.28         701.74
10/05/1990_24:00           1738.80        1327.33        1013.23         773.45         590.42         921.92         703.75
10/06/1990_24:00           1738.80        1327.33        1013.23         773.45         590.42         924.62         705.82
10/07/1990_24:00           1738.80        1327.33        1013.23         773.45         590.42         927.38         707.92
10/08/1990_24:00           1738.80        1327.33        1013.23         773.45         590.42         930.20         710.07
10/09/1990_24:00           1738.80        1327.33        1013.23         773.45         590.42         956.55         730.19
10/10/1990_24:00           1738.80        1327.33        1013.23         773.45         590.42        1064.93         898.52
10/11/1990_24:00           1820.80        1392.25        1062.78         811.28         619.30        1155.14        1041.42
10/12/1990_24:00           1892.04        1637.11        1249.70         953.97         728.22        1290.60        1201.50
10/13/1990_24:00           1930.36        1779.18        1452.72        1108.94         846.52        1424.85        1350.32
10/14/1990_24:00           1950.96        1858.29        1665.33        1328.70        1014.28        1608.76        1542.56
10/15/1990_24:00           1962.05        1902.34        1785.86        1574.72        1270.38        1872.71        1815.11
10/16/1990_24:00           1968.02        1926.87        1853.93        1726.65        1527.19        2135.61        2082.78
10/17/1990_24:00           1971.24        1940.54        1892.37        1813.36        1692.18        2311.74        2267.15
10/18/1990_24:00           1972.97        1948.16        1914.09        1862.83        1787.31        2419.37        2383.77
10/19/1990_24:00           1973.91        1952.42        1926.36        1891.07        1842.15        2485.54        2457.58
10/20/1990_24:00           1974.42        1954.80        1933.31        1907.19        1873.75        2526.72        2504.61
10/21/1990_24:00           1974.70        1956.15        1937.25        1916.41        1891.98        2552.89        2534.98
      .                          .              .              .              .              .              .              .
      .                          .              .              .              .              .              .              .
      .                          .              .              .              .              .              .              .
09/19/2000_24:00           1981.48        1978.12        1975.51        1973.97        1974.44        1989.57        1999.05
09/20/2000_24:00           1981.48        1978.12        1975.51        1973.97        1974.46        1989.59        1999.08
09/21/2000_24:00           1981.48        1978.12        1975.51        1973.98        1974.47        1989.61        1999.11
09/22/2000_24:00           1981.48        1978.12        1975.52        1973.98        1974.48        1989.62        1999.14
09/23/2000_24:00           1981.48        1978.12        1975.51        1973.44        1973.43        1988.64        1998.23
09/24/2000_24:00           1981.48        1978.12        1975.52        1973.68        1973.88        1989.04        1998.59
09/25/2000_24:00           1981.48        1978.12        1975.52        1973.82        1974.15        1989.29        1998.83
09/26/2000_24:00           1981.48        1978.12        1975.52        1973.90        1974.30        1989.45        1998.99
09/27/2000_24:00           1981.47        1978.12        1975.52        1973.63        1973.78        1988.98        1998.56
09/28/2000_24:00           1981.47        1978.12        1975.53        1973.80        1974.09        1989.26        1998.83
09/29/2000_24:00           1981.47        1978.12        1975.53        1973.89        1974.28        1989.44        1999.01
09/30/2000_24:00           1981.47        1978.12        1975.53        1973.95        1974.38        1989.55        1999.13
```

Tile Drain Hydrograph Output

This output file is generated when simulated flows at the tile drains or subsurface irrigation locations are required to be printed. The corresponding groundwater node numbers for which flow values are printed are specified by the user in the Tile Drain and Subsurface Irrigation Parameter File. The flow rates are printed in the units specified by the user for every time step of the simulation period. A negative flow value represents tile drain outflow at the specified groundwater node, and a positive value represents subsurface irrigation inflow.

If the tile drain/subsurface irrigation flow values are desired to be printed out to a DSS file, a file name with the extension ".DSS" should be supplied. The following pathname parts are used for output to a DSS file:

Part A:

IWFM

Part B:

GW*XXX* where *XXX* is the groundwater node number

Part C:

FLOW

Part D:

Start date of the time series depending on the time step used in the Simulation and the value of the BDT variable (starting date and time of simulation period) set in the Simulation Main Input File

Part E:

Time step used in the Simulation

Part F:

i. *TILE_DRAIN_HYDROGRAPH* (if the print-out is a tile drain hydrograph)

ii. *SUBSURFACE_IRIG_HYDROGRAPH* (if the print-out is a subsurface irrigation hydrograph)

```
*                                           **************************************************
*                                           *  TILE DRAIN/SUBSURFACE IRRIGATION HYDROGRAPH  *
*                                           *                  (UNIT=AC-FT)                  *
*                                           *      [(+): SUBSURFACE IRRIGATION INFLOW]       *
*                                           *      [(-): TILE DRAIN OUTFLOW          ]       *
*                                           **************************************************
*                            NODES
*        TIME                  861         862         863         670         682
10/31/1921_24:00              0.00        0.00       -0.03       -0.39        0.00
11/30/1921_24:00              0.00        0.00       -0.04       -0.46        0.00
12/31/1921_24:00              0.00        0.00       -0.05       -0.52        0.00
01/31/1922_24:00              0.00        0.00       -0.05       -0.57        0.00
02/28/1922_24:00              0.00        0.00       -0.05       -0.61        0.00
03/31/1922_24:00              0.00        0.00       -0.06       -0.65        0.00
04/30/1922_24:00              0.00        0.00       -0.06       -0.69        0.00
05/31/1922_24:00              0.00        0.00       -0.06       -0.74        0.00
06/30/1922_24:00              0.00        0.00       -0.06       -0.78        0.00
07/31/1922_24:00              0.00        0.00       -0.06       -0.82        0.00
08/31/1922_24:00              0.00        0.00       -0.06       -0.84        0.00
09/30/1922_24:00              0.00        0.00       -0.07       -0.87        0.00
10/31/1922_24:00              0.00        0.00       -0.07       -0.89        0.00
11/30/1922_24:00              0.00        0.00       -0.07       -0.92        0.00
12/31/1922_24:00              0.00        0.00       -0.07       -0.94        0.00
01/31/1923_24:00              0.00        0.00       -0.08       -0.96        0.00
02/28/1923_24:00              0.00        0.00       -0.08       -0.98        0.00
03/31/1923_24:00              0.00        0.00       -0.08       -1.00        0.00
04/30/1923_24:00              0.00        0.00       -0.09       -1.03        0.00
05/31/1923_24:00              0.00        0.00       -0.09       -1.06        0.00
06/30/1923_24:00              0.00        0.00       -0.09       -1.08        0.00
     .                         .           .           .           .           .
     .                         .           .           .           .           .
     .                         .           .           .           .           .
     .                         .           .           .           .           .
11/30/1929_24:00              0.00        0.00       -0.34       -1.43        0.00
12/31/1929_24:00              0.00        0.00       -0.34       -1.43        0.00
01/31/1930_24:00              0.00        0.00       -0.34       -1.43        0.00
02/28/1930_24:00              0.00        0.00       -0.35       -1.42        0.00
03/31/1930_24:00              0.00        0.00       -0.35       -1.42        0.00
04/30/1930_24:00              0.00        0.00       -0.35       -1.42        0.00
05/31/1930_24:00              0.00        0.00       -0.36       -1.43        0.00
06/30/1930_24:00              0.00        0.00       -0.36       -1.43        0.00
07/31/1930_24:00              0.00        0.00       -0.36       -1.42        0.00
08/31/1930_24:00              0.00        0.00       -0.36       -1.41        0.00
09/30/1930_24:00              0.00        0.00       -0.36       -1.41        0.00
10/31/1930_24:00              0.00        0.00       -0.37       -1.41        0.00
11/30/1930_24:00              0.00        0.00       -0.37       -1.40        0.00
12/31/1930_24:00              0.00        0.00       -0.37       -1.40        0.00
01/31/1931_24:00              0.00        0.00       -0.37       -1.40        0.00
02/28/1931_24:00              0.00        0.00       -0.37       -1.39        0.00
03/31/1931_24:00              0.00        0.00       -0.38       -1.38        0.00
04/30/1931_24:00              0.00        0.00       -0.38       -1.38        0.00
05/31/1931_24:00              0.00        0.00       -0.38       -1.38        0.00
06/30/1931_24:00              0.00        0.00       -0.38       -1.37        0.00
07/31/1931_24:00              0.00        0.00       -0.39       -1.35        0.00
08/31/1931_24:00              0.00        0.00       -0.39       -1.33        0.00
09/30/1931_24:00              0.00        0.00       -0.39       -1.33        0.00
```

Binary Output Files

The binary files contain the simulation results and they are used in the post-processing portion (Budget and Z-Budget) of IWFM in order to generate detailed water budget tables for modeled hydrologic processes. The files are generated in the simulation program, and must be copied to the folder with the IWFM Budget and Z-Budget executable programs. The binary files that can be generated are

- Binary output for groundwater zone budget
- Binary output for small watershed flow components
- Binary output for diversion details
- Binary output for stream budget by reach
- Binary output for stream budget at user-specified stream nodes
- Binary output for lake budget
- Binary output for subregional land and water use budget
- Binary output for land and water use budget for user-specified crops
- Binary output for subregional root zone moisture budget
- Binary output for root zone moisture budget for user-specified crops
- Binary output for groundwater budget

5. Budget

The Budget program tabulates the simulation output, allowing the user to generate the following tables based on output files created in the Simulation part of IWFM: land and water use, root zone moisture accounting, groundwater, small watersheds, lakes, stream flows at reaches or individual nodes and diversion details. This chapter describes the input and output files, as well as providing input and output file samples.

5.1. Input Files

The main input file and at least one of the binary output files generated during IWFM simulation is required to run the Budget program. The binary files contain results produced by the Simulation part of IWFM. The following sections describe the input variables in the Budget Main Input File that are used to process the binary files and create tabulated data as well as the details of the processed output files.

Budget Main Input File

The Budget Main Input File contains output unit controls, beginning and ending simulation times for the budget print-out, names of the binary files to be processed, budget print-out locations and the print-out interval of the budget data.

The values stored in the binary files have units used in the Simulation. The output unit control information allows the user to print out the budget data in a different set of units. Depending on the time-tracking option used in Simulation, the user is required to enter beginning time (TBEGIN for non-time tracking simulation, BDT for time tracking simulation) and the ending time (TLAST for non-time tracking simulation, EDT for time tracking simulation) for the budget outputs. The user can process as many budget binary files as needed. A single binary file can be processed multiple times with different output interval. For each binary file to be processed, the user is required to enter the name of the binary file, the name of the output file, output interval for time-tracking simulations, number of *locations* for budget print-out and a list of the location indices. If the output interval is greater than the simulation time step, the budget flow terms will be accumulated over the output interval.

The meaning of *location* depends on the type of the budget binary file being processed. For instance, groundwater budgets are reported for each subregion. Therefore, for groundwater budget, *location* represents a subregion. For lakes, water budgets are reported for individual lakes so a *location* represents an individual lake. For stream reach budgets a *location* is an individual stream reach, while for stream node budgets a *location* is a stream node. When location is specified as −1, IWFM prints out water budget for all locations in that particular budget class. If a value of 0 is specified for the location, then IWFM suppresses the processing of the budget tables.

The following is a list of variables that need to be defined in this file:

FACTLTOU	Factor to convert simulation unit of length to output unit of length
UNITLTOU	Output unit of length (maximum of 8 characters)
FACTAROU	Factor to convert simulation unit of area to output unit of area
UNITAROU	Output unit of area (maximum of 8 characters)

FACTVLOU	Factor to convert simulation unit of volume to output unit of volume
UNITVLOU	Output unit of volume (maximum of 8 characters)
CACHE	Cache size in terms of number of output values stored in the memory before being printed to the output file; a large CACHE value (e.g. 50000 or more depending on the memory resources of the computer where Budget runs are taking place) can drastically decrease the program run-time especially when the budget tables are printed out to a DSS file.
TBEGIN	Beginning time step for the budget tables; used only for non-time-tracking simulations
TLAST	Ending time step for the budget tables; used only for non-time-tracking simulations
BDT	Beginning date and time for the budget tables; used only for time-tracking simulations
EDT	Ending date and time for the budget tables; used only for time-tracking simulations
NBUDGET	Number of budget binary files to be processed

NBUDGET, described above, informs the Budget post-processor about the number of binary files that will be processed. For each of the binary files to be processed the following variables need to be set:

BINFILE	Name of the input binary budget file (maximum 1000 characters)

OUTFILE	Name of the budget output file (maximum 1000 characters); the filename extension dictates if the output file will be text file or a DSS file (see Chapter 2 for file types and corresponding filename extensions)
INTPRNT	Interval for budget print-out (budget flow terms will be accumulated over the output interval); for time-tracking simulations, this should be one of the units recognized by HEC-DSS that are listed in the Simulation Main Input File. If left blank, the print-out interval will be the same as the Simulation time step. For non-time-tracking simulations, this variable has no effect.
NLPRNT	Number of *locations* for budget table print-out; a *location* corresponds to different spatial attributes depending on the type of the budget table being processed (e.g. a subregion for groundwater budgets, a stream reach for stream reach budget, a stream node for stream node budget, a lake for lake budget, a specific subregion-crop combination for crop root zone budget, etc.)
LPRNT	Index for locations (i.e. subregions, lakes, stream reaches, etc. depending on the budget class) for which a budget table will be generated; for budget tables at subregions, the index for the entire domain is the number of subregions plus 1 (–1 = print budget tables for all locations, 0 = suppress printing of all budget tables)

```
C*******************************************************************************
C
C                   INTEGRATED WATER FLOW MODEL (IWFM)
C                          *** Version ### ***
C
C*******************************************************************************
C
C                            BUDGET INPUT FILE
C                        for IWFM Post-Processing
C
C
C             Project:  IWFM Version ### Release
C                       California Department of Water Resources
C             Filename: Budget.in
C
C*******************************************************************************
C
C                             File Description
C
C     This file contains the the names of all binary input files,
C     conversion factors and output control options for running the post-processor.
C
C*******************************************************************************
C                    Output Unit Control
C
C     FACTLTOU; Factor to convert simulation unit of length to output unit of length
C     UNITLTOU; Output unit of length (8 characters max.)
C     FACTAROU; Factor to convert simulation unit of area to output unit of area
C     UNITAROU; Output unit of area (8 characters max.)
C     FACTVLOU; Factor to convert simulation unit of volume to output unit of volume
C     UNITVLOU; Output unit of volume (8 characters max.)
C
C-----------------------------------------------------------------------------
C    VALUE                          DESCRIPTION
C-----------------------------------------------------------------------------
     1.0                            / FACTLTOU
     ft.                            / UNITLTOU
     0.000022957                    / FACTAROU    (sq.ft. -> ac.)
     acres                          / UNITAROU
     0.000022957                    / FACTVLOU    (cu.ft. -> ac.ft.)
     ac.ft.                         / UNITVLOU
C*******************************************************************************
C                    Output Cache Size
C
C     CACHE;   Cache size in terms of number of values stored for time series
C              data output
C
C-------------------------------------------------------------------------------
C    VALUE                          DESCRIPTION
C-------------------------------------------------------------------------------
     50000                          / CACHE
C*******************************************************************************
C                        Budget Output Control Options
C                    (Simulation Date and Time NOT Tracked)
C
C     If the actual simulation date and time is NOT tracked enter the following
C     variables. Otherwise, comment out the following variables and use the
C     "Simulation Date and Time NOT Tracked" option below.
C
C     TBEGIN ; Beginning time for the budget tables
C               * Use ##.# format
C     TLAST  ; Ending time for the budget tables
C               * Use ##.# format
C
C-------------------------------------------------------------------------------
C    VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
*                                 / TBEGIN
*                                 / TLAST
C-------------------------------------------------------------------------------
C                        Budget Output Control Options
C                     (Simulation Date and Time Tracked)
C
C     If the actual simulation date and time is tracked enter the following
C     variables. Otherwise, comment out the following variables and use the
C     "Simulation Date and Time NOT Tracked" option above.
C
C     BDT    ; Begining date and time for the budget output
C               * Use MM/DD/YYYY HH:MM format
C               * Midnight is 24:00
C     EDT    ; Ending date and time for the budget output
C               * Use MM/DD/YYYY HH:MM format
C               * Midnight is 24:00
C
C-------------------------------------------------------------------------------
C    VALUE                        DESCRIPTION
C-------------------------------------------------------------------------------
     09/30/1990 24:00             / BDT
     09/30/2000 24:00             / EDT
C*******************************************************************************
C                          Budget Output Data
C
C    List below the number of budget classes (i.e. groundwater budget, stream
C    budget, small watershed budget, etc.), and for each budget class list the
C    input file, output file and the locations for which a budget table will
C    be generated.
C
C    NBUDGET ;  Number of budget classes to be printed
C    BINFILE ;  Name of the input binary budget file (max. 1000 characters)
C    OUTFILE ;  Name of the budget output file (max. 1000 characters)
C    INTPRNT ;  Interval for budget print out (e.g. 1DAY, 1MONTH, etc.). The interval
C                 must be a one of those listed in the Main Input File for the
```

```
C               executable that generated the input binary files.
C               * Leave blank to use the same interval as the data.
C               * This interval will only be used for simulation with
C                 date and time tracked
C   NLPRNT  ;  Number of location indices for budget table print-out
C   LPRNT   ;  Index for locations (i.e. subregions, lakes, stream reaches, etc.
C               depending on the budget class) for which a budget table will be
C               generated.  For budget tables at subregions, the index for the
C               entire domain is the number of subregions plus 1.
C               * Enter -1: to print budget tables for all locations
C                        0: to suppress printing of any budget tables
C
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
     4                            / NBUDGET
C*******************************************************************************
C                            Data for Budget Class 1
C
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
    GW.bin                        / BINFILE
    GW.bud                        / OUTFILE
    1YEAR                         / INTPRNT
    5                             / NLPRNT
    1                             / LPRNT[1]
    3                             / LPRNT[2]
    4                             / LPRNT[3]
    5                             / LPRNT[4]
    12                            / LPRNT[5]
C*******************************************************************************
C                            Data for Budget Class 2
C
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
    LakeBud.bin                   / BINFILE
    Lake.bud                      / OUTFILE
                                  / INTPRNT
    1                             / NLPRNT
    -1                            / LPRNT[1]
C*******************************************************************************
C                            Data for Budget Class 3
C
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
    StrmBud.bin                   / BINFILE
    Strm.bud                      / OUTFILE
    1DAY                          / INTPRNT
    1                             / NLPRNT
    -1                            / LPRNT[1]
C*******************************************************************************
C                            Data for Budget Class 4
C
C-------------------------------------------------------------------------------
C   VALUE                         DESCRIPTION
C-------------------------------------------------------------------------------
    StrmBud.bin                   / BINFILE
    StrmBud.DSS                   / OUTFILE
    1YEAR                         / INTPRNT
    1                             / NLPRNT
    -1                            / LPRNT[1]
```

Binary Input Files

The Budget program binary input files are created during IWFM Simulation. The binary files generated for post-processing are specified by the user either in the IWFM Simulation Main Input File or the relevant Simulation component (i.e. root zone component, stream component and lake component).

5.2. Output Files

The Budget program generates as many output files as required and set by the NBUDGET variable in the Budget Main Input File. The type of the output file (text versus DSS) depends on the filename extension specified by the user. The output files include information generated by IWFM Simulation. The beginning time, ending time and interval of each output file is based on the values of TBEGIN (or BDT), TLAST (or EDT) and INTPRNT specified in the Budget Main Input File.

The output terms for each budget table will be explained in the following sections.

Groundwater Budget

A groundwater budget table is produced for each subregion listed for processing in the Budget Main Input File. The title printed for each subregional groundwater budget includes IWFM version number, subregion name given by the user, the unit of data columns and the area of the subregion. The output units and the conversion factors are specified by the user in the Budget Main Input File.

The groundwater budget reports the inflows and outflows as well as the beginning and ending groundwater storages. The deep percolation of water from the root zone to the unsaturated zone to compare to the net deep percolation into the groundwater and cumulative subsidence are also reported for informational purposes.

The following list describes the columns in the groundwater budget table as printed to a text file:

GROUNDWATER BUDGET

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Time step
2	Deep Percolation	Total deep percolation from the root zone to the unsaturated zone in a subregion; this column is included to compare deep percolation to net deep percolation and is not included in the groundwater mass balance
3	Beginning Storage (+)	Groundwater storage at the beginning of the time step
4	Ending Storage (–)	Groundwater storage at the end of time step
5	Net Deep Percolation (+)	Recharge to the groundwater; this column represents the outflow from the unsaturated layer directly into the saturated groundwater system
6	Gain from Stream (+)	Amount of stream flow that contributes to groundwater; a positive value represents flow from stream into groundwater, a negative value represents flow from groundwater into stream
7	Recharge (+)	Recharge to the aquifer from injection wells and recoverable loss of diversions and bypasses
8	Gain from Lake (+)	Lake-groundwater interaction; a positive value represents flow from lake into groundwater, a negative value represents flow from groundwater into lake
9	Boundary Inflow (+)	Net inflow into groundwater due to boundary conditions

10	Subsidence (+)	Amount of flow released out of groundwater storage due to subsidence; a negative value represents expanding interbed material which takes water out of groundwater storage
11	Subsurface Irrigation (+)	Contribution of subsurface irrigation to groundwater storage
12	Tile Drain Outflow (–)	Groundwater that flows into tile drains
13	Pumping (–)	Total subregional groundwater pumping
14	Net Subsurface Inflow (+)	Net groundwater inflow into the subregion from the surrounding subregions
15	Discrepancy (=)	Error in the groundwater mass balance based on the preceding columns
16	Cumulative Subsidence	Cumulative volume of groundwater storage lost due to land subsidence

If a DSS file is used for print-out, the following pathnames parts are used:

Part A:

IWFM_GW_BUD

Part B:

TTT (SR*XXX*) where *TTT* is the name of the subregion and *XXX* is the subregion number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the groundwater budget as specified in the Budget Main

Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *DEEP_PERC* (corresponds to column 2 in text output file)

ii. *BEGIN_STORAGE* (corresponds to column 3 in text output file)

iii. *END STORAGE* (corresponds to column 4 in text output file)

iv. *NET_DEEP_PERC* (corresponds to column 5 in text output file)

v. *GAIN_FROM_STRM* (corresponds to column 6 in text output file)

vi. *RECHARGE* (corresponds to column 7 in text output file)

vii. *GAIN_FROM_LAKE* (corresponds to column 8 in text output file)

viii. *BOUNDARY_INFLOW* (corresponds to column 9 in text output file)

ix. *SUBSIDENCE* (corresponds to column 10 in text output file)

x. *SUBSURF_IRRIGATION* (corresponds to column 11 in text output file)

xi. *TILE_DRAINS* (corresponds to column 12 in text output file)

xii. *PUMPING* (corresponds to column 13 in text output file)

xiii. *NET_SUBSURF_INFLOW* (corresponds to column 14 in text output file)

xiv. *DISCREPANCY* (corresponds to column 15 in text output file)

xv. *CUM_SUBSIDENCE* (corresponds to column 16 in text output file)

Lake Budget

Lakes are modeled to determine their interaction with the groundwater and the stream system. The lake budget provides the lake water balance, lake storage and lake surface elevation at the end of each time interval. The title lines for each lake budget include IWFM version number, name and area of the lake, and the unit of output data.

The following list defines the columns in the lake budget as printed to a text file:

LAKE BUDGET

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Time step
2	Beginning Storage (+)	Lake storage at the beginning of the time step
3	Ending Storage (–)	Lake storage at the end of the time step
4	Flow from Upstream Lake (+)	Inflow from lake(s) that are located upstream of the lake
5	Flow from Streams (+)	Inflow into the lake through streams flowing directly into the lake
6	Flow from Bypasses (+)	Inflow into the lake through bypasses
7	Precipitation (+)	Amount of precipitation that falls on the lake surface
8	Gain from Groundwater (+)	Lake-groundwater interaction; a positive value indicates flow from the groundwater into the lake, whereas a negative value indicates flow from the lake to the groundwater system
9	Lake Evaporation (–)	Evaporation from the lake surface

10	Lake Outflow (−)	Spill from lake as the lake surface elevation raises above the maximum lake elevation
11	Discrepancy (=)	Mass balance error for lake
12	Lake Surface Elevation	Lake elevation that corresponds to the simulated lake storage

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_LAKE_BUD

Part B:

TTT where *TTT* is the name of the lake specified by the user

Part C:

One of the following, depending on the output:

i. *ELEV*

ii. *VOLUME*

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the lake budget as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *BEGIN_STORAGE* (corresponds to column 2 in text output file)

ii. *END_STORAGE* (corresponds to column 3 in text output file)

iii. *FLOW_FROM_UP_LAKE* (corresponds to column 4 in text output file)

iv. *FLOW_FROM_STRM* (corresponds to column 5 in text output file)

v. *FLOW_FROM_BYPASS* (corresponds to column 6 in text output file)

vi. *PRECIP* (corresponds to column 7 in text output file)

vii. *GAIN_FROM_GW* (corresponds to column 8 in text output file)

viii. *EVAPOTR* (corresponds to column 9 in text output file)

ix. *OUTFLOW* (corresponds to column 10 in text output file)

x. *DISCREPANCY* (corresponds to column 11 in text output file)

xi. *SURFACE_ELEV* (corresponds to column 12 in text output file)

Small Watershed Flow Components

Small stream watersheds surrounding the study domain are modeled as boundary conditions and contribute surface water and groundwater flows to the system. The small stream watershed flow components report provides tables for each small stream watershed listed for processing in the Budget Main Input File. The title for each small watershed includes IWFM version number, small stream watershed identification number, watershed area and the unit of output values.

The following list defines the columns in the report as printed to a text file:

SMALL WATERSHED FLOW COMPONENTS

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Time step
2	Total SW Outflow	Total amount of surface flow from the small stream watershed boundary to the modeled area
3	GW Base Outflow	Total amount of groundwater flow from the small watershed into the modeled area
4	Base Flow + Surface Percolation	The sum of the groundwater base outflow from the small watershed boundary and surface flow that percolates to the groundwater while en-route to a stream within the modeled area from the small stream watershed
5	Net Surface Outflow to Streams	Total surface water outflow less the surface percolation

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_SWSHED_BUD

Part B:

WSHED_*XXX* where *XXX* is the small watershed number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the small stream watershed flow components as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

ii. *TOTAL_SW_OUTFLOW* (corresponds to column 2 in text output file)

iii. *GW_BASE_OUTFLOW* (corresponds to column 3 in text output file)

iv. *BASEFLOW+PERCOLATION* (corresponds to column 4 in text output file)

v. *SURFACE_FLOW_TO_STRM* (corresponds to column 5 in text output file)

Budget Output Files from Stream Component

Three different budget binary files can be generated by the IWFM stream component which can be processed by the Budget post-processor. The following sections explain the components of each of these budget output files.

Stream Reach Budget

Stream reach budgets are generated for all stream reaches specified to be printed in the Budget Main Input File. The title printed for each stream reach budget includes IWFM version number, reach name given by the user and the unit of the data columns. The entire stream reach budget is in volumetric units. The output units (UNITVLOU) and conversion factor (FACTVLOU) for volume are specified by the user in the Budget Main Input File.

The stream reach budget tables provide information on the flows in and out of the reaches as well as the impacts of other processes on stream flows such as small stream watershed flows, tile drainage, surface runoff, return flows, diversions and bypass flows. The mass balance check for the reach is listed in the *Discrepancy* column. The *Diversion Shortage* column reports the difference between simulated diversions and the user specified diversion requirements. This term does not affect the mass balance in the reach but listed as an informational term.

The following table defines each column in the stream reach budget table printed out to text file:

STREAM REACH BUDGET

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Time step
2	Upstream Inflow (+)	Stream inflows to the reach which includes inflows listed in the Stream Inflow Data File and flows from upstream reaches
3	Downstream Outflow (–)	Stream flow leaving the reach and either entering another reach or exiting the modeled area
4	Tributary Inflow (+)	Surface flows from small stream watersheds to the reach
5	Tile Drain (+)	Inflows from tile drains
6	Runoff (+)	Direct runoff from rainfall into the reach
7	Return Flow (+)	Return flow of the irrigation water into streams
8	Gain from Groundwater (+)	Stream-groundwater interaction; a positive value denotes a gaining stream and a negative value indicates a losing stream

9	Gain from Lake (+)	Inflow from upstream lakes
10	Diversion (–)	Diversions from the reach
11	Bypass Flow (–)	Net bypass flow within the reach; for example, the bypass flow from one stream node to another within the reach is the amount of water loss during the bypass process whereas bypass flow from a stream node within the reach to a different reach is the total amount bypassed from the stream reach
12	Discrepancy (=)	Error in the stream flow mass balance based on the preceding columns
13	Diversion Shortage	This column indicates whether the simulated stream flows are sufficient to meet the surface water diversion requirements; a value of zero indicates that stream flows are sufficient to meet the specified diversion requirements; a positive value represents the shortage of stream flows in a reach

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_STRMRCH_BUD

Part B:

REACH *XXX* where *XXX* is the reach number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the stream reach budget as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *UPSTRM_INFLOW* (corresponds to column 2 in text output file)

ii. *DOWNSTRM_OUTFLOW* (corresponds to column 3 in text output file)

iii. *TRIB_INFLOW* (corresponds to column 4 in text output file)

iv. *TILE_DRN* (corresponds to column 5 in text output file)

v. *RUNOFF* (corresponds to column 6 in text output file)

vi. *RETURN_FLOW* (corresponds to column 7 in text output file)

vii. *GAIN_FROM_GW* (corresponds to column 8 in text output file)

viii. *GAIN_FROM_LAKE* (corresponds to column 9 in text output file)

ix. *DIVERSION* (corresponds to column 10 in text output file)

x. *BYPASS* (corresponds to column 11 in text output file)

xi. *DISCREPANCY* (corresponds to column 12 in text output file)

xii. *DIVER_SHORTAGE* (corresponds to column 13 in text output file)

Stream Node Budget

Stream node budgets are generated for stream nodes specified to be printed in the Budget Main Input File. The structure of the stream node budget is exactly the same as that of the stream budget.

For completeness, the following table defines each column in the stream node budget table printed out to text file:

STREAM NODE BUDGET

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Time step
2	Upstream Inflow (+)	Stream inflows to the node which includes inflows listed in the Stream Inflow Data File and flows from upstream nodes
3	Downstream Outflow (–)	Stream flow leaving the node and either entering another node or exiting the modeled area
4	Tributary Inflow (+)	Surface flows from small stream watersheds to the node
5	Tile Drain (+)	Inflows from tile drains
6	Runoff (+)	Direct runoff from rainfall into the node
7	Return Flow (+)	Return flow of the irrigation water into the node
8	Gain from Groundwater (+)	Stream-groundwater interaction; a positive value denotes a gaining stream node and a negative value indicates a losing stream node
9	Gain from Lake (+)	Inflow from upstream lakes
10	Diversion (–)	Diversions from the node
11	Bypass Flow (–)	Bypass flow from the node
12	Discrepancy (=)	Error in the stream flow mass balance based on the preceding columns
13	Diversion Shortage	This column indicates whether the simulated stream flows at the node are sufficient to meet the surface water diversion requirements; a value of zero indicates that stream flows are sufficient to meet the specified diversion requirements; a positive value represents the shortage of stream flows at the node

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_STRMNODE_BUD

Part B:

NODE *XXX* where *XXX* is the stream node number

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the stream node budget as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data (refer to the table above for further details):

i. *UPSTRM_INFLOW* (corresponds to column 2 in text output file)

ii. *DOWNSTRM_OUTFLOW* (corresponds to column 3 in text output file)

iii. *TRIB_INFLOW* (corresponds to column 4 in text output file)

iv. *TILE_DRN* (corresponds to column 5 in text output file)

v. *RUNOFF* (corresponds to column 6 in text output file)

vi. *RETURN_FLOW* (corresponds to column 7 in text output file)

vii. *GAIN_FROM_GW* (corresponds to column 8 in text output file)

viii. *GAIN_FROM_LAKE* (corresponds to column 9 in text output file)

ix. *DIVERSION* (corresponds to column 10 in text output file)

x. *BYPASS* (corresponds to column 11 in text output file)

xi. *DISCREPANCY* (corresponds to column 12 in text output file)

xii. *DIVER_SHORTAGE* (corresponds to column 13 in text output file)

Diversion Detail Report

This data file reports surface water deliveries and diversions, as well as the difference between the required and actual deliveries and diversions for each diversion listed for processing in the Budget Main Input File. Each report title indicates IWFM version, diversion identification number, stream node from which the diversion is taken and the unit of output data. If the diversion is imported from outside the model area, the report title shows the stream node where the diversion is taken from as zero.

Each diversion is associated with a required diversion amount, along with recoverable and non-recoverable losses, and a required delivery amount. Diversions can be delivered to outside the model area, to an individual element, a group of elements or to a subregion. The required diversion and delivery can either be specified using the Diversion Data File in the Simulation part of IWFM, or they can be computed dynamically using the supply adjustment feature of IWFM to meet the water demands in the delivery destination. The full amounts of required diversions and deliveries can only be achieved if there is enough flow at the stream nodes where the diversions are taken out. If there is not enough flow at the stream nodes to meet the entire diversion requirements, then the actual diversions and deliveries will be less. The diversion detail reports list the actual diversions and deliveries as well as the shortages.

The actual delivery and delivery shortage columns also list the delivery destinations. The destination can be a subregion, an element, a group of elements or the delivery can be made to outside the model domain. In the latter case, the delivery destination is listed as subregion 0.

The following list defines the columns in the diversion details report as printed to a text file:

DIVERSION DETAIL REPORT

COL. #	COLUMN NAME	DESCRIPTION
1	Time	Time step
2	Actual Diversion	Actual diversion amount which may be less than the required diversion amount
3	Diversion Shortage	Amount of diversion that is not met due to lack of water at the stream node where the diversion takes place; if this term is zero then the actual diversion is equal to the required diversion
4	Recoverable Loss	Portion of the actual diversion that is lost due to seepage to the groundwater from the diversions canals
5	Non Recoverable Loss	Portion of the actual diversion that is lost to evapotranspiration
6	Actual Delivery to *XXX*	Actual delivery to the delivery destination which may be less than the required delivery; *XXX* is a qualifier for the delivery destination which can be a subregion, element, element group or outside the model area

7	Delivery Shortage for *XXX*	Amount of delivery that is not met due to lack of water at the stream node where the corresponding diversion takes place; if this term is zero then actual delivery is equal to the required delivery (*XXX* is a qualifier for the delivery destination)

If a DSS file is used for print-out, the following pathnames are used:

Part A:

IWFM_DIVER_DETAIL

Part B:

DIVER*XXX*_SN*YYY* where *XXX* is the diversion identification number and *YYY* is the stream node from which the diversion originates (*YYY* is set to 0 for diversions that originate from outside the model area)

Part C:

VOLUME

Part D:

Start date of the time series depending on the values of the BDT and EDT variables (starting and ending date and time of budget print-out)

Part E:

Print-out interval for the diversion detail report as specified in the Budget Main Input File

Part F:

One of the following, depending on the output data:

i. *ACT_DIV* (corresponds to column 2 in text output file)

ii. *DIV_SHORT* (corresponds to column 3 in text output file)

iii. *RECVRBL_LOSS* (corresponds to column 4 in text output file)

iv. *NON_RCVRBL_LOSS* (corresponds to column 5 in text output file)

v. *ACT_DELI*_TTT_XXX (corresponds to column 6 in text output file; TTT is the delivery destination type and XXX is the delivery destination identification number)

vi. *DELI_SHORT*_TTT_XXX (corresponds to column 7 in text output file; TTT is the delivery destination type and XXX is the delivery destination identification number)

Budget Output Files from Root Zone Component

The root zone component can generate several different budget binary files to be processed by the Budget post-processor. The component of these budget output files are discussed in detail in the document titled *IDC v4.0 Theoretical Documentation and User's Manual*.

One of the budget binary files that the root zone component generates is the Land and Water Use Budget which lists the water demands for urban and agricultural lands, and the water supplies (in terms of stream diversions and pumping) to meet these demands. In IWFM, it is possible that the water demand may not be met fully if there are water shortages in the modeled hydrologic system, or there may be surplus water supplies with respect to the simulated water demands. In short, water demand and supply may not be equal in IWFM (this is not the case in IDC since IDC only simulates the root zone flow processes and assumes that all water demand is met since it has no "knowledge" of pumping or diversions). The Land and Water Use Budget file also lists the water supply shortages or surpluses in meeting the water demand at every simulation time step.

It should be noted that the accumulation of the water demand listed in the Land and Water Use Budget over time is not a linear process and can lead to incorrect results if performed carelessly, particularly when shortages exist. For instance, a model with daily time step will produce daily water demands. The user might be tempted to transfer these daily values to a spreadsheet application and try to calculate monthly or annual water demands by direct summation of the daily values. This approach will result in incorrect monthly or annual demands because it will involve double-counting of water demands if shortages occur in two or more consecutive simulation time steps. To avoid this problem, IWFM Budget post-processor uses special algorithms to detect and avoid double-counting of water demands when accumulating these values. Therefore, it is strongly recommended that Budget post-processor is used in accumulating land and water use budget data.

6. Running IWFM

Running IWFM is a three step procedure the first time the model is run for a specific application. The pre-processing program is executed to set geometric, hydrologic and stratigraphic characteristics of the model domain. The pre-processing information is used, in conjunction with boundary conditions, initial conditions, and hydrologic data to run the simulation model. The binary output generated from IWFM simulation is then processed into tabular form using the Budget and Z-Budget executable programs. It is not necessary to execute the pre-processor for subsequent runs of a specific study area, given the characteristics of the domain are the same. Simply use the binary file generated in the previous Pre-processor run as input to the new Simulation run.

To run IWFM, install a copy of the Pre-processor, Simulation, Budget and Z-Budget executable programs, as well as the input files necessary to run each portion of the program for a specific application. Figure 6.1 is a suggested way to organize your files within a folder structure.

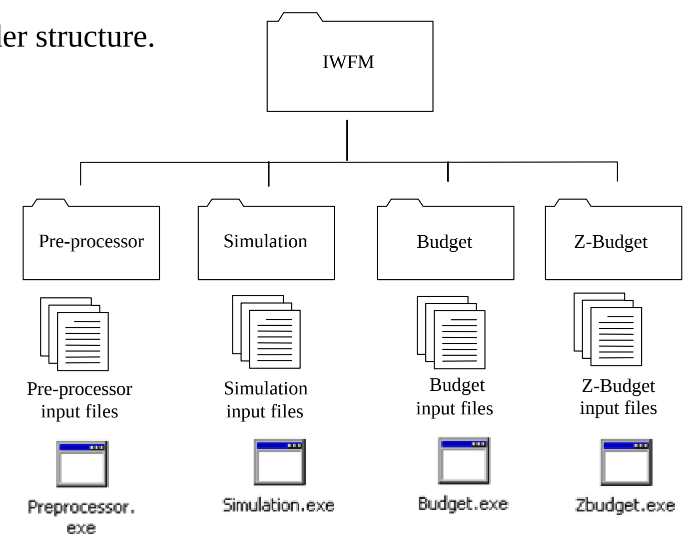
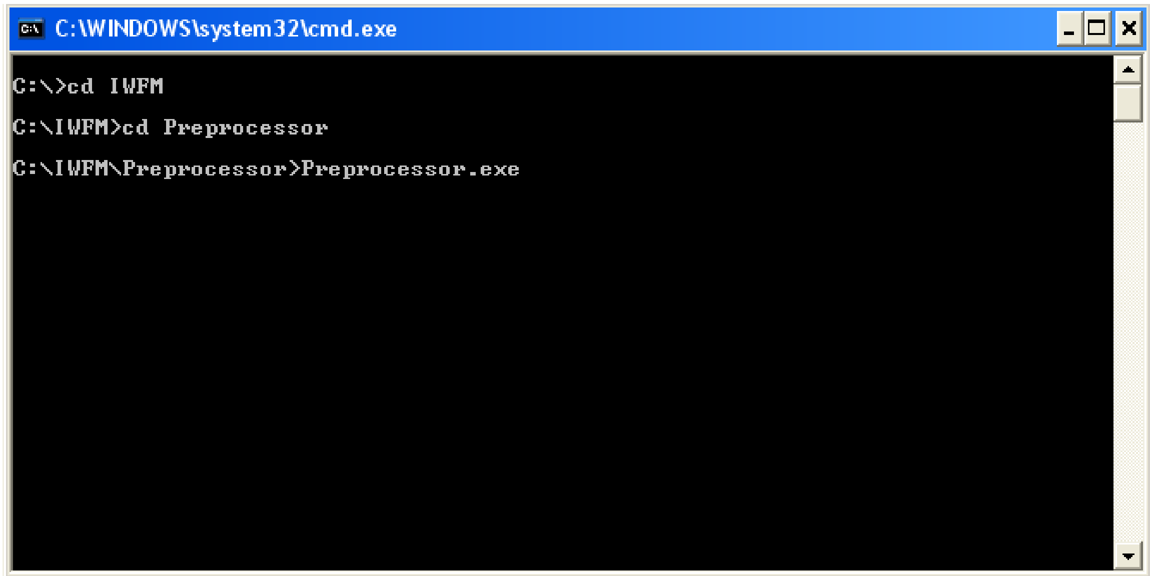
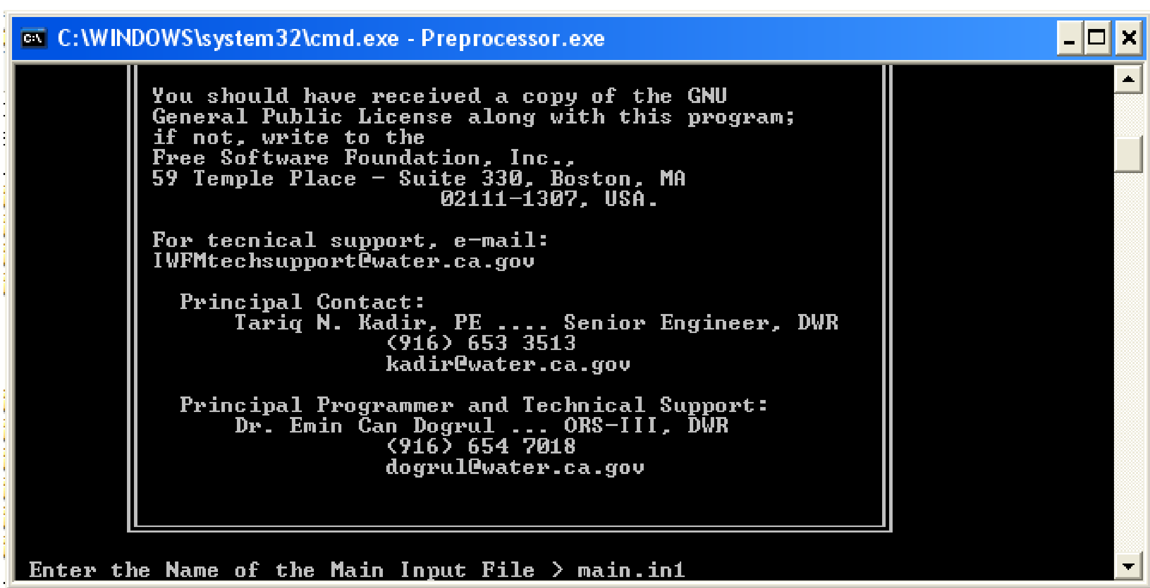


Figure 6.1 Suggested organization of IWFM folder structure

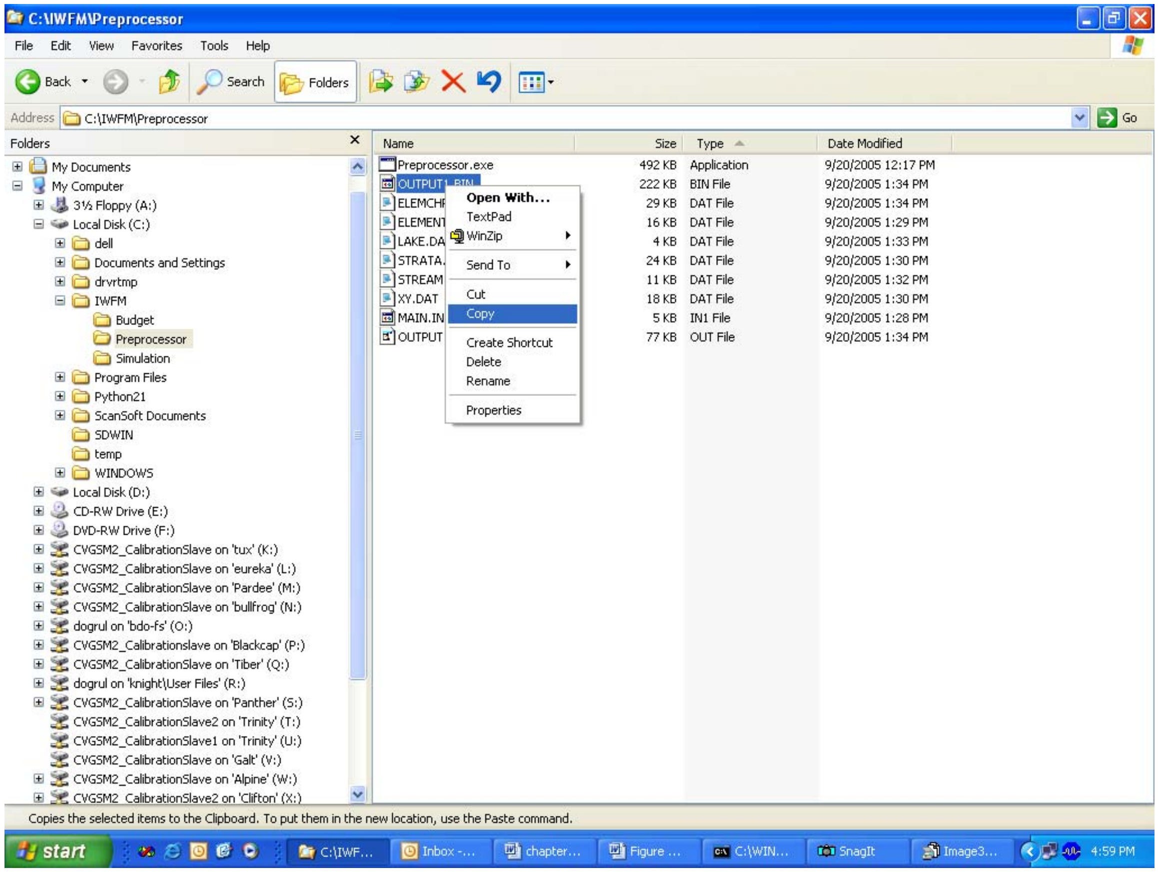
The folder structure illustrated in Figure 6.1 is used in the explanation of how to run IWFM. Once the folder structure is organized, open an MS-DOS prompt window, navigate to the directory that contains the IWFM Pre-processor executable, and enter the executable name.



The Pre-processor will then prompt the user to enter the main input control file.

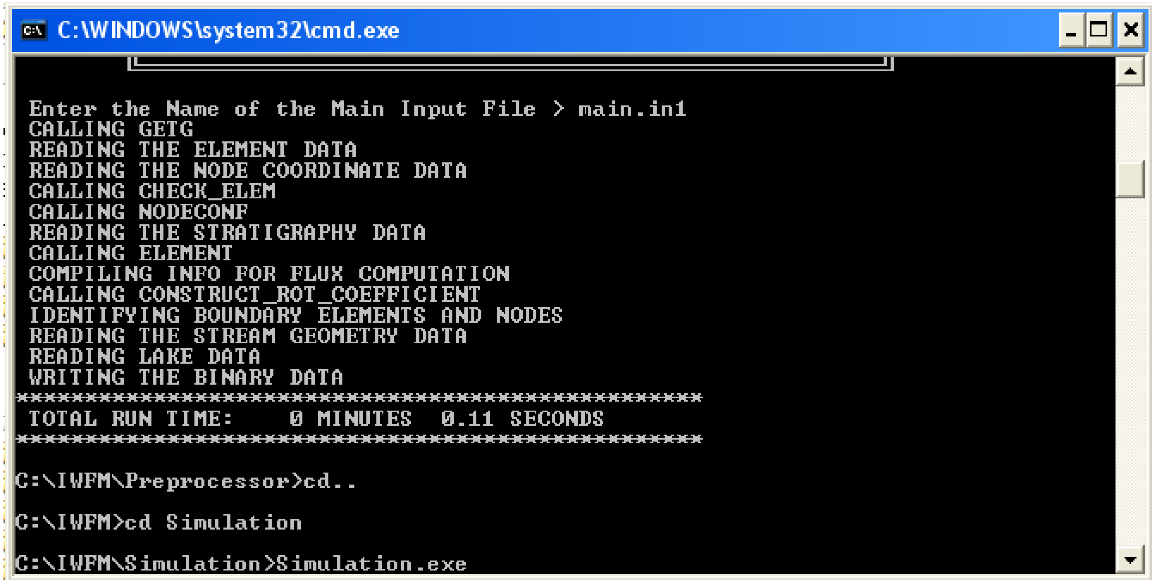


Upon completion of running the Pre-processor, the user must copy the binary output generated to the Simulation folder.

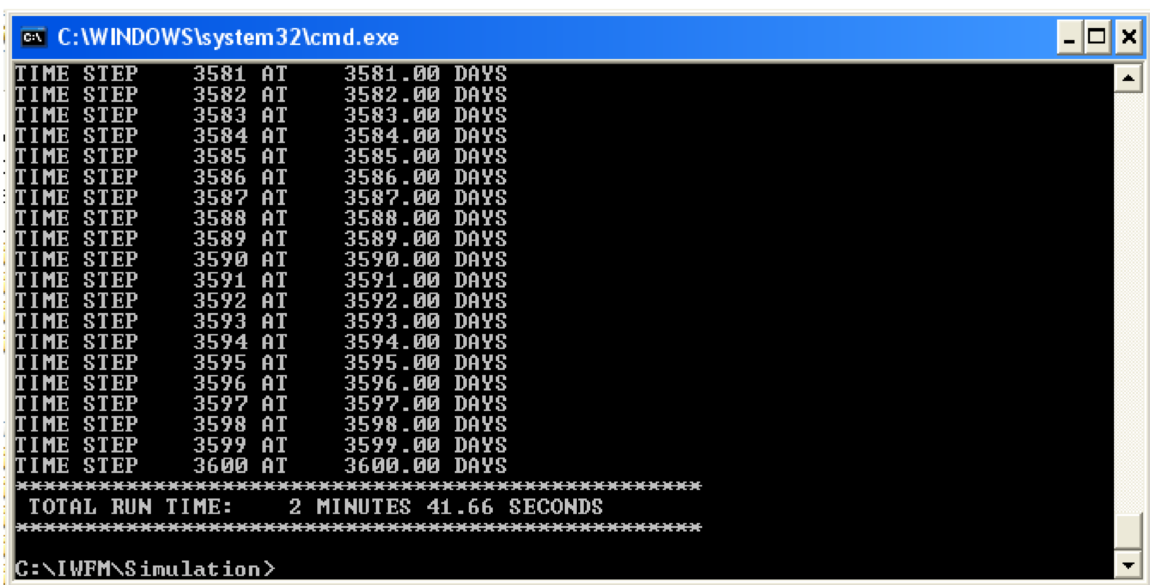


Given that the Simulation folder already includes the executable program and necessary input files, pasting a copy of the binary output file generated from the Pre-processor is the last step before running the simulation portion of IWFM.

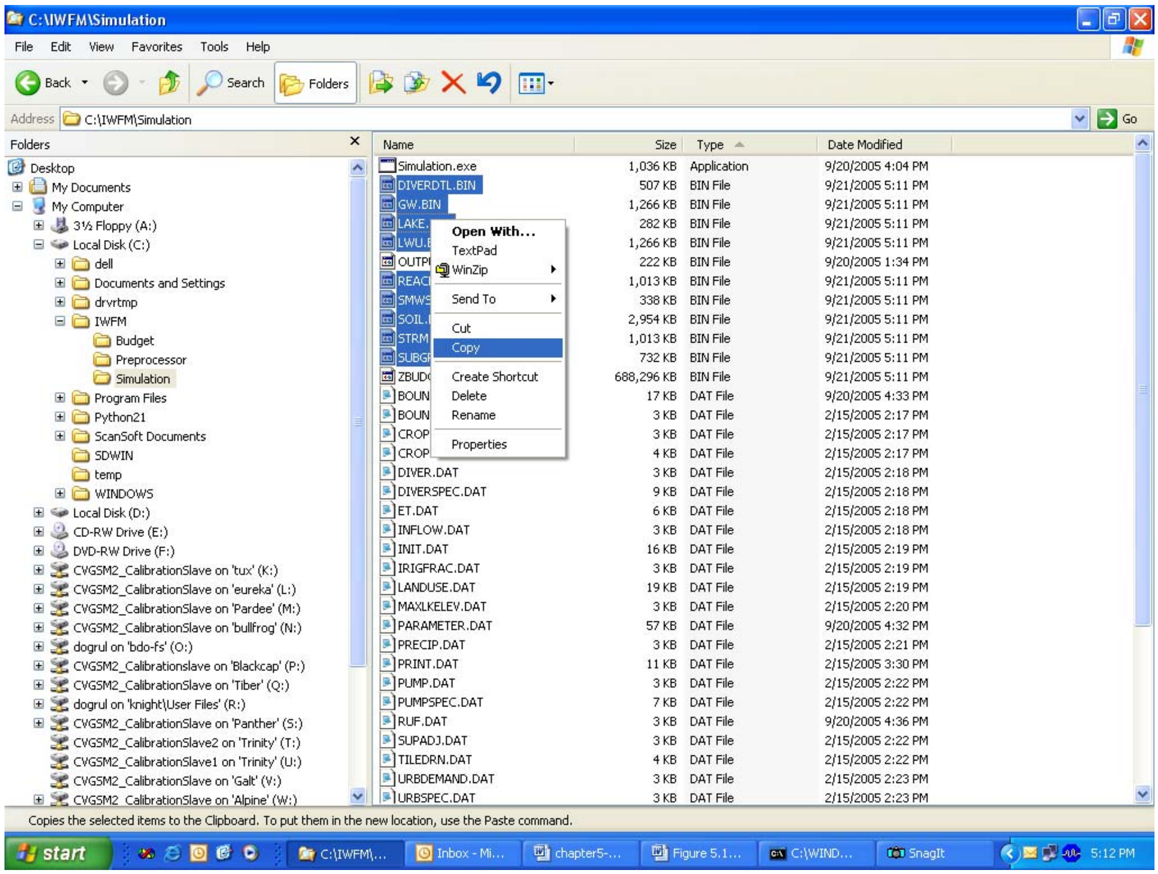
Within the MS-DOS prompt window, navigate to the Simulation folder, and enter the Simulation executable name.



The program then prompts the user to specify the main input file for Simulation. Once Simulation is completed, the program will specify the total run time required for the simulation.



The next step is to process the information generated from Simulation into tables. Copy relevant binary files generated in the Simulation and paste them into the Budget and Z-Budget folders, as shown below.



Running the Budget and Z-Budget is done in the same manner as running the first two portions of the IWFM. The user must navigate to the relevant folder (that contains the files necessary to run the executable), execute the program, and provide the main input file name. The Budget and Z-Budget executable programs organize and tabulate the Simulation output.

Compilation of IWFM requires all source code and a Fortran compiler. The California Department of Water Resources (DWR) has used Intel Visual Fortran Composer XE version 2011.9.300 for the development and testing of this version of IWFM and supplies technical support on this version. However, DWR does not provide technical support for versions of IWFM modified by other users.