Table of Contents

List of Figures .............................................................................................................. v

List of Tables .............................................................................................................. vi

1. Introduction ........................................................................................................ 1-1
   1.1. IWFM Description ...................................................................................... 1-1
   1.2. Summary of IWFM User’s Manual ............................................................ 1-1

2. General Topics ................................................................................................... 2-1
   2.1. Simulation Time Tracking .......................................................................... 2-1
       2.1.1. Length of Simulation Time Step ........................................................... 2-3
       2.1.2. Time Stamp Format .............................................................................. 2-5
       2.1.3. Preparation of Time Series Data Input Files ......................................... 2-6
   2.2. Input and Output Data File Types ............................................................. 2-10

3. Pre-Processor ...................................................................................................... 3-1
   3.1. Subroutine Descriptions .............................................................................. 3-1
   3.2. Input Files ................................................................................................... 3-5
       Pre-Processor Main Input File (Unit 5) ...................................................... 3-5
       Element Configuration File (Unit 7)........................................................... 3-8
       Nodal X-Y Coordinate File (Unit 8)............................................................. 3-10
       Stratigraphy File (Unit 9)........................................................................... 3-12
       Stream Configuration File (Unit 10).......................................................... 3-14
       Lake Configuration File (Unit 11).............................................................. 3-19
       Well Data File (Unit 12) ........................................................................... 3-21
Element Characteristics File (Unit 13) .......................................................... 3-23

3.3. Output Files ............................................................................................. 3-27

Binary Output File (Unit 4) ........................................................................... 3-27

ASCII Output File (PreprocessorMessages.out) ........................................... 3-27

4. Simulation .................................................................................................... 4-1

4.1. Subroutine Descriptions ................................................................. 4-1

4.2. Input Files .............................................................................................. 4-12

Main Simulation Input File (Unit 5) ............................................................ 4-14

Parameter File (Unit 7) .............................................................................. 4-24

Boundary Conditions File (Unit 8) ............................................................. 4-44

Time Series Boundary Condition File (Unit 9) ............................................ 4-55

Printing Control File (Unit 10) ................................................................. 4-58

Initial Conditions File (Unit 11) ................................................................. 4-66

Supply Adjustment Specifications File (Unit 12) ....................................... 4-74

Land Use Data File (Unit 13) ..................................................................... 4-78

Crop Acreage Data File (Unit 14) ............................................................... 4-83

Precipitation File (Unit 15) ...................................................................... 4-87

Evapotranspiration File (Unit 16) ............................................................... 4-90

Tile Drain Parameter File (Unit 17) ............................................................ 4-95

Urban Water Use Specification File (Unit 18) ............................................ 4-98

Agricultural Water Supply Requirement File (Unit 19) ......................... 4-101

Urban Water Demand File (Unit 20) ......................................................... 4-104

Stream Inflow File (Unit 21) ..................................................................... 4-107
Crop Demand Parameter File (Unit 22) .................................................. 4-111
Pumping Specification File (Unit 23) ...................................................... 4-116
Pumping Data File (Unit 24) ................................................................. 4-121
Diversion Specification File (Unit 25) .................................................... 4-124
Surface Water Diversion Data File (Unit 26) ......................................... 4-131
Irrigation Fractions Data File (Unit 27) .................................................. 4-134
Maximum Lake Elevation Data File (Unit 28) ....................................... 4-137
Irrigation Water Re-use Factor Data File (Unit 29) ............................... 4-140
Aquifer Parameter Over-write Data File (Unit 30) ............................... 4-143

4.3. Output Files ..................................................................................... 4-148

Standard ASCII Output (SimulationMessages.out) ............................ 4-148
Subsidence Output File (Unit 41) ......................................................... 4-151
Virtual Crop Characteristics (Unit 42) ................................................. 4-154
Element Face Flow Output File (Unit 43) ............................................. 4-156
Boundary Flux Output File (Unit 44) .................................................... 4-158
Tile Drain Hydrograph Output (Unit 45) .............................................. 4-160
Stream Flow Hydrograph Output File (Unit 46) .................................... 4-162
Groundwater Level Hydrograph Output (Unit 47) ................................. 4-164
Groundwater Level Output at Every Node (Unit 48) ............................. 4-166
Layer Vertical Flow Output File (Unit 49) ............................................. 4-168
Groundwater Heads for TECPLOT (Unit 50) ........................................ 4-170
Subsidence Values for TECPLOT (Unit 51) ......................................... 4-170
Final Simulation Results (Unit 52) ....................................................... 4-170
5. Budget ............................................................. 5-1
   5.1. Input Files ....................................................... 5-1
       Main Input File ............................................. 5-2
       Binary Input Files ....................................... 5-7
   5.2. Output Files .................................................... 5-7
       Land and Water Use Budget (Unit 1) .............. 5-8
       Stream Flow Budget (Unit 2) ......................... 5-12
       Root Zone Moisture Budget (Unit 3) ............... 5-15
       Groundwater Budget (Unit 4) .......................... 5-22
       Element Sub-Group Report (Unit 5) ................. 5-26
       Small Watershed Flow Components (Unit 6) .... 5-28
       Lake Budget (Unit 7) ...................................... 5-30
       Stream Reach Budget (Unit 8) ......................... 5-33
       Diversion Detail Report (Unit 9) ...................... 5-36

6. Running IWFM .................................................. 6-1
## List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1.1</td>
<td>IWFM program structure</td>
<td>1-2</td>
</tr>
<tr>
<td>Figure 3.1</td>
<td>IWFM Pre-processor subroutines</td>
<td>3-2</td>
</tr>
<tr>
<td>Figure 4.1</td>
<td>IWFM Simulation subroutines</td>
<td>4-2</td>
</tr>
<tr>
<td>Figure 6.1</td>
<td>Suggested organization of IWFM folder structure</td>
<td>6-1</td>
</tr>
</tbody>
</table>
List of Tables

Table 2.1  List of allowable time step lengths in time tracking simulations........ 2-4
Table 2.2  Example for representation of recycled time series data .................... 2-8
Table 2.3  Examples for acceptable and unacceptable cases for the syncronization of time series data interval and the simulation time step ........................................................................................................... 2-9
Table 2.4  File name extensions recognized by IWFM ........................................ 2-11
Table 3.1  List of IWFM pre-processor input files ............................................... 3-5
Table 5.1  Unit numbers for binary simulation output and budget input............. 5-2
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

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 1</td>
<td>Introduction</td>
</tr>
<tr>
<td>Chapter 2</td>
<td>Discusses general topics related to time-tracking simulation option, preparation of time series input data and file formats recognized by IWFM</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>Descriptions of the pre-processor subroutines, input files and output files presented in this chapter</td>
</tr>
<tr>
<td>Chapter 4</td>
<td>Details of the subroutines included in the simulation program as well as input data files and output files</td>
</tr>
</tbody>
</table>
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
IWFM uses the value 0.25 when the numerical methods require a value for $\Delta t$ (see IWFM Theoretical Documentation), but the “month” tag does not represent anything for IWFM;

<table>
<thead>
<tr>
<th>Time Step Length</th>
<th>IWFM Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 minute</td>
<td>1MIN</td>
</tr>
<tr>
<td>2 minutes</td>
<td>2MIN</td>
</tr>
<tr>
<td>3 minutes</td>
<td>3MIN</td>
</tr>
<tr>
<td>4 minutes</td>
<td>4MIN</td>
</tr>
<tr>
<td>5 minutes</td>
<td>5MIN</td>
</tr>
<tr>
<td>10 minutes</td>
<td>10MIN</td>
</tr>
<tr>
<td>15 minutes</td>
<td>15MIN</td>
</tr>
<tr>
<td>20 minutes</td>
<td>20MIN</td>
</tr>
<tr>
<td>30 minutes</td>
<td>30MIN</td>
</tr>
<tr>
<td>1 hour</td>
<td>1HOUR</td>
</tr>
<tr>
<td>2 hours</td>
<td>2HOUR</td>
</tr>
<tr>
<td>3 hours</td>
<td>3HOUR</td>
</tr>
<tr>
<td>4 hours</td>
<td>4HOUR</td>
</tr>
<tr>
<td>6 hours</td>
<td>6HOUR</td>
</tr>
<tr>
<td>8 hours</td>
<td>8HOUR</td>
</tr>
<tr>
<td>12 hours</td>
<td>12HOUR</td>
</tr>
<tr>
<td>1 day</td>
<td>1DAY</td>
</tr>
<tr>
<td>1 week</td>
<td>1WEEK</td>
</tr>
<tr>
<td>1 month</td>
<td>1MON</td>
</tr>
<tr>
<td>1 year</td>
<td>1YEAR</td>
</tr>
</tbody>
</table>

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:

\[
\begin{align*}
\text{MM/ DD/ YYYY\_hh:mm} \\
\text{where} \\
\text{MM} &= \text{two digit month index;} \\
\text{DD} &= \text{two digit day index;} \\
\text{YYYY} &= \text{four digit year;} \\
\text{hh} &= \text{two digit hour in terms of military time (e.g. 1:00pm is represented as 13:00);} \\
\text{mm} &= \text{two digit minute.}
\end{align*}
\]

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.

<table>
<thead>
<tr>
<th>Time Stamp</th>
<th>Fraction of Urban Indoors Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/30/4000_24:00</td>
<td>0.70</td>
</tr>
<tr>
<td>08/31/4000_24:00</td>
<td>0.50</td>
</tr>
<tr>
<td>12/31/4000_24:00</td>
<td>0.35</td>
</tr>
</tbody>
</table>

*Table 2.2* Example for representation of recycled time series data
<table>
<thead>
<tr>
<th>Situation</th>
<th>Graphical Representation</th>
<th>Accepted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly time series data, monthly simulation</td>
<td>TS data: t, Simulation: t</td>
<td>Yes</td>
</tr>
<tr>
<td>Monthly time series data, daily simulation</td>
<td>TS data: t, Simulation: t</td>
<td>Yes</td>
</tr>
<tr>
<td>Monthly time series data, monthly simulation</td>
<td>TS data: t, Simulation: t</td>
<td>No</td>
</tr>
<tr>
<td>(TS data times don't match simulation times)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly time series data, weekly simulation</td>
<td>TS data: t, Simulation: t</td>
<td>No</td>
</tr>
<tr>
<td>Monthly time series data, yearly simulation</td>
<td>TS data: t, Simulation: t</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 2.3  Examples for acceptable and unacceptable cases for the synchronization 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.
<table>
<thead>
<tr>
<th>File Type</th>
<th>Extensions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.DAT</td>
</tr>
<tr>
<td></td>
<td>.TXT</td>
</tr>
<tr>
<td></td>
<td>.OUT</td>
</tr>
<tr>
<td>ASCII</td>
<td>.IN</td>
</tr>
<tr>
<td></td>
<td>.IN1</td>
</tr>
<tr>
<td></td>
<td>.IN2</td>
</tr>
<tr>
<td></td>
<td>.BUD</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Fortran binary</td>
<td>.BIN</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>HEC-DSS</td>
<td>.DSS</td>
</tr>
</tbody>
</table>

Table 2.4 File name extensions recognized by IWFM
3. Pre-Processor

The pre-processor is the first portion 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, element soil characteristics, stratigraphy, stream network, lakes and wells within the model domain are processed in this part of IWFM. This chapter gives a description of the pre-processor subroutines, input and output file descriptions and sample input and output files.

3.1. Subroutine Descriptions

The pre-processor is a procedural FORTRAN program, and consists of a main program and subroutines (Figure 3.1). This section describes each subroutine included in the pre-processor program.

**Iwfm_f1**

The main program, which reads the main pre-processor input file (Unit 5). Iwfm_f1.for generates a binary and ASCII output file. The binary file contains information necessary to run the model simulation. The ASCII output displays processed data read by the pre-processor.
Figure 3.1 IWFM pre-processor subroutines
**GetMainControlData**  This subroutine opens and reads in the title of project, file names, output options and output conversion factors from the main input file. It also opens and initializes the project input and output files.

**Getg**  This subroutine reads and processes the time-independent input data. The time independent data read in Getg is as follows: Nodal x and y coordinates, stratigraphy of groundwater layers, stream network, lake characteristics, well locations and characteristics, and element characteristics. Getg also establishes the JND and NJD arrays that are used to store the non-zero components of coefficient matrix and row-column locations.

**Check_elem**  This subroutine checks that all finite elements are convex, i.e. the internal angles at each node of an element are larger than 180 degrees.

**Nodeconf**  This subroutine compiles information based on the finite element nodes specified in the nodal coordinate data file (Unit 8) to be used for compact storage of matrices and vectors used in the solution of the quasi three-dimensional groundwater equation.
Element

This subroutine calculates elemental areas based on the nodal coordinates specified in Unit 8.

Flux_config

This subroutine numbers each of the element interfaces and identifies the interface numbers that meet at each finite element node. This information is used in Simulation in computing the flow rates through element interfaces.

Construct_rot_coeff

This subroutine computes the relevant coefficients to define the irrotationality of the flow field at a closed path around each finite element node.

Boundary_elem

This subroutine identifies the element numbers and corresponding element faces that lie on the entire modal and the subregional boundaries.

Wellfunc

This subroutine determines the fractions to vertically distribute the pumping/recharge to each aquifer layer.

Interp_2d

This is the interpolation routine that computes the relative proportion of pumping distributed to the groundwater nodes surrounding the well location.
3.2. 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.

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 7</td>
<td>Element and node specification</td>
<td>Required</td>
</tr>
<tr>
<td>Unit 8</td>
<td>Spatial location of all nodes</td>
<td>Required</td>
</tr>
<tr>
<td>Unit 9</td>
<td>Composition of groundwater layers</td>
<td>Required</td>
</tr>
<tr>
<td>Unit 10</td>
<td>Stream configuration</td>
<td>Optional</td>
</tr>
<tr>
<td>Unit 11</td>
<td>Lake configuration</td>
<td>Optional</td>
</tr>
<tr>
<td>Unit 12</td>
<td>Well locations and characteristics</td>
<td>Optional</td>
</tr>
<tr>
<td>Unit 13</td>
<td>Hydrologic characteristics of each element</td>
<td>Required</td>
</tr>
</tbody>
</table>

Table 3.1 List of IWFM pre-processor input files
the title lines. All pre-processor input file names are read from the main input file and associated with a unit number within the program. All input and output file names must be no more than 50 characters long, and each file name must be within the first 50 columns. Simply leave any file name specification columns blank if an input file is not used. Groundwater simulation requires element configuration data (Unit 7), nodal coordinate data (Unit 8), stratigraphy (Unit 9), and element characteristics (Unit 13). 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 Unit 5:

- **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 a 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
INTEGRATED WATER FLOW MODEL (IMFM)
*** Version ### ***

MAIN INPUT FILES
for IMFM Pre-Processing
(Unit 5)

Project:
Filename:

**********************************************************************************************
C Titles Printed in the Output
C *A maximum of 3 title lines can be printed.
C *Do not use '*', 'c' or 'c' in the first column.
C
**********************************************************************************************
IMFM
Version ### Release
IMFM

**********************************************************************************************
C File Description
C *Listed below are all input and output file names used when running the pre-processor for IMFM simulation.
C *Each file name has a maximum length of 200 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 description columns for unit 11 will appear as:
C
C FILE NAME                        UNIT DESCRIPTION
C--------------------------------------------------------------------------
C OUTPUT.EIN                      / 4: INITIAL OUTPUT FOR SIMULATION (OUTPUT, REQUIRED)
C ELEMENT.DAT                     / 7: ELEMENT CONFIGURATION FILE (INPUT, REQUIRED)
C XY.DAT                          / 8: NODE X-Y COORDINATE FILE (INPUT, REQUIRED)
C STRATA.DAT                      / 9: STRATIGRAPHIC DATA FILE (INPUT, REQUIRED)
C STREAM.DAT                      /10: STREAM GEOMETRIC DATA FILE (INPUT, OPTIONAL)
C LAKE.DAT                        /11: LAKE DATA FILE (INPUT, OPTIONAL)
C ELECHRG.DAT                     /13: CHARACTERISTIC DATA FILE (INPUT, REQUIRED)

**********************************************************************************************
C Pre-Processor Output Specifications
C
C KOUT: Enter 1 - Print geometric and stratigraphic information
C       Enter 8 - Otherwise
C
C KDS: Enter 2 - Print messages on the screen during program execution
C       Enter 3 - Print non-zero finite element stiffness matrix components
C       Enter 8 - Otherwise
C
C VALUE DESCRIPTION
C----------------------------------
C  1 /KOUT
C  1 /KDS

**********************************************************************************************
C Unit Specifications of Pre-Processor Output
C
C FACTLXU: Factor to convert simulation unit of length to specified output unit of length
C UNITLXU: 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 VALUE DESCRIPTION
C----------------------------------
C  1.0 /FACTLXU
C FEET /UNITLXU
C 0.080020897 /FACTAROU
C ACRES /UNITAROU

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

3-7
Element Configuration File

Unit 7

Unit 7 details the element configuration for each element represented in the finite element mesh. Each element is configured from 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. The following variables are required as input in Unit 7:

NE  Number of elements within the model domain
IE  Element number
IDE Nodes corresponding to each element number; 3 nodes are associated with each triangular element (4\textsuperscript{th} node should be set to zero) and 4 nodes are associated with each quadrilateral element
INTEGRATED WATER FLOW MODEL (IWM)
*** Version ***

ELEMENT CONFIGURATION FILE
for IWM Pre-Processing
(Unit 7)

Project: IWM Version # Release
California Department of Water Resources
Filename: ELEMENT.DAT

File Description

This file contains the element configuration for each element. The nodes that make a finite element are listed for each element in a counter-clock wise fashion starting with any node. For triangular elements, the fourth node is specified as zero.

For example,

13--------14--------17
  1 1 1 1
  2 1 3 1
  7 7 7 1
  1 1 1
15--------16

The configuration for elements 2 and 3 will be listed as,

<table>
<thead>
<tr>
<th>element</th>
<th>node 1</th>
<th>node 2</th>
<th>node 3</th>
<th>node 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>13</td>
<td>14</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>14</td>
<td>16</td>
<td>17</td>
<td>0</td>
</tr>
</tbody>
</table>

Element Configuration Data

ME: Number of elements within the model domain
VALUE DESCRIPTION

400 /ME

The data listed below represents all elements and corresponding nodes within the model domain.

ID: Element number
IDN: Nodes corresponding to each element
*Note* IDN(4) is zero for all triangular elements

<table>
<thead>
<tr>
<th>ID</th>
<th>IDN(1)</th>
<th>IDN(2)</th>
<th>IDN(3)</th>
<th>IDN(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td>24</td>
<td>23</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>4</td>
<td>25</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>5</td>
<td>26</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>6</td>
<td>27</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>187</td>
<td>416</td>
<td>417</td>
<td>438</td>
<td>637</td>
</tr>
<tr>
<td>389</td>
<td>417</td>
<td>418</td>
<td>438</td>
<td>638</td>
</tr>
<tr>
<td>189</td>
<td>418</td>
<td>419</td>
<td>440</td>
<td>439</td>
</tr>
<tr>
<td>450</td>
<td>419</td>
<td>420</td>
<td>441</td>
<td>440</td>
</tr>
</tbody>
</table>
**Nodal X-Y Coordinate File**

The nodal coordinate file contains each node number 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 Unit 7).

<table>
<thead>
<tr>
<th>ND</th>
<th>Number of groundwater nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>FACT</td>
<td>Factor to convert nodal coordinates to simulation unit of length</td>
</tr>
<tr>
<td>ID</td>
<td>Groundwater node identification number</td>
</tr>
<tr>
<td>X</td>
<td>x-coordinate of groundwater node location</td>
</tr>
<tr>
<td>Y</td>
<td>y-coordinate of groundwater node location</td>
</tr>
</tbody>
</table>
INTEGRATED WATER FLOW MODEL (IWFM)

*** Version *** ***

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

NODAL X-Y COORDINATE FILE
For IWFM Pre-Processing
(Unit B)

Project: IWFM Version Release
California Department of Water Resources
Filename: XY.GAT

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

File Description

* This file includes all groundwater nodes that represent the model domain,
  as well as the x and y coordinates that correspond with each node.
* The coordinates can be specified for any reference point and coordinate
  system

Groundwater Node Specifications

<table>
<thead>
<tr>
<th>NO.</th>
<th>Number of groundwater nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FACT: Conversion factor for nodal coordinates

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Groundwater Node Locations

The following lists the node number and x, y coordinate of each node

<table>
<thead>
<tr>
<th>ID</th>
<th>Groundwater node number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coordinates</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>-------------</td>
<td>------</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Node</th>
<th>Coordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ID</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>2000.0</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>4000.0</td>
<td>0.0</td>
</tr>
<tr>
<td>4</td>
<td>6000.0</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>8000.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>417</td>
<td>32000.0</td>
<td>40800.0</td>
</tr>
<tr>
<td>418</td>
<td>34000.0</td>
<td>40800.0</td>
</tr>
<tr>
<td>419</td>
<td>36000.0</td>
<td>40800.0</td>
</tr>
<tr>
<td>420</td>
<td>38000.0</td>
<td>40800.0</td>
</tr>
<tr>
<td>421</td>
<td>40000.0</td>
<td>40800.0</td>
</tr>
</tbody>
</table>

3-11
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. Each groundwater node, the ground surface elevation at the groundwater node, 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 groundwater 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
**INTEGRATED WATER FLOW MODEL (IWM)**

*** Version ***

**STRATIGRAPHY FILE**

for IWM Pre-Processing

(Unit 9)

Project: IWM Version Release
California Department of Water Resources
Filename: STRATA.DAT

File Description

This data file contains:
- the ground surface elevation,
- the number of aquifer layers to be modeled, and
- the thickness of each aquifer and corresponding confining layer (if any).

at each groundwater node within the model domain.

**Stratigraphy Specification Data**

**VALUE DESCRIPTION**

<table>
<thead>
<tr>
<th>( Z )</th>
<th>( /NL )</th>
<th>( /FXCT )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Stratigraphy Data**

- Each stratigraphic data represents the geology that deals with the origin, composition, distribution, and succession of groundwater layers.
- Each groundwater layer is specified as an aquifer and aquiclude or aquitard.
- If there is no aquiclude or aquitard within the layer, specify a thickness of zero.
- The stratigraphic data includes the ground surface elevation, as well as the thickness of the aquifer, aquitard, or aquiclude at each groundwater node.

**GROUNDWATER NODE**

- Ground surface elevation with respect to a common datum: \( [L] \)
- Thickness of aquiclude in Layer 1: \( [L] \)
- Thickness of aquifer in Layer 1: \( [L] \)
- Thickness of aquiclude in Layer 2: \( [L] \)
- Thickness of aquifer in Layer 2: \( [L] \)
- Thickness of aquiclude in Layer 3: \( [L] \)
- Thickness of aquifer in Layer 3: \( [L] \)

<table>
<thead>
<tr>
<th>Node</th>
<th>Elevation</th>
<th>Layer 1</th>
<th>Layer 2</th>
<th>Layer 3</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>BLV</td>
<td>( W(1) )</td>
<td>( W(2) )</td>
<td>( W(3) )</td>
<td>( W(4) )</td>
</tr>
<tr>
<td>1</td>
<td>500.0</td>
<td>0.0</td>
<td>500.0</td>
<td>10.0</td>
<td>100.0</td>
</tr>
<tr>
<td>2</td>
<td>500.0</td>
<td>0.0</td>
<td>500.0</td>
<td>10.0</td>
<td>100.0</td>
</tr>
<tr>
<td>3</td>
<td>500.0</td>
<td>0.0</td>
<td>500.0</td>
<td>10.0</td>
<td>100.0</td>
</tr>
<tr>
<td>4</td>
<td>500.0</td>
<td>0.0</td>
<td>500.0</td>
<td>10.0</td>
<td>100.0</td>
</tr>
<tr>
<td>5</td>
<td>500.0</td>
<td>0.0</td>
<td>500.0</td>
<td>10.0</td>
<td>100.0</td>
</tr>
<tr>
<td>2048</td>
<td>500.0</td>
<td>0.0</td>
<td>500.0</td>
<td>10.0</td>
<td>100.0</td>
</tr>
<tr>
<td>456</td>
<td>500.0</td>
<td>0.0</td>
<td>500.0</td>
<td>10.0</td>
<td>100.0</td>
</tr>
<tr>
<td>477</td>
<td>500.0</td>
<td>0.0</td>
<td>500.0</td>
<td>10.0</td>
<td>100.0</td>
</tr>
<tr>
<td>438</td>
<td>500.0</td>
<td>0.0</td>
<td>500.0</td>
<td>10.0</td>
<td>100.0</td>
</tr>
<tr>
<td>499</td>
<td>500.0</td>
<td>0.0</td>
<td>500.0</td>
<td>10.0</td>
<td>100.0</td>
</tr>
<tr>
<td>460</td>
<td>500.0</td>
<td>0.0</td>
<td>500.0</td>
<td>10.0</td>
<td>100.0</td>
</tr>
<tr>
<td>441</td>
<td>500.0</td>
<td>0.0</td>
<td>500.0</td>
<td>10.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Stream Configuration File

Stream flow is modeled using one-dimensional line segments. The stream configuration data file contains all of the stream nodes and spatial orientation. The data 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, and the subregion that the stream node belongs to. The subregion listed for a stream node does not have to be the one that the node physically resides. The subregion numbers are used solely for grouping and reporting the simulation output. For instance, a particular stream node may physically reside in one subregion but, for operational or management purposes, it may be reported in another subregion.
If flow from a stream reach contributes to a lake, then the lake number preceded by a negative sign should be entered for variable IDWN. The lake numbers are listed in the lake data file. Such a set-up is different than a set-up where recoverable losses from a by-pass (see Simulation part of this manual) flow into a lake. By-pass flows are computed before stream-groundwater interaction is calculated. In the former case, all flows at the reach, including the stream-groundwater interaction, will contribute to lake storage. However, in the latter case, stream-groundwater interaction will be excluded from the amount of flow that contributes to the lake.

The following parameters are specified in the stream reach specification portion of Unit 10:

- **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)
- **IRV**: Stream node number
- **IGW**: Groundwater node that the stream node IRV corresponds to
- **IRGST**: Subregion that the stream node IRV belongs 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, [L³/T]
INTEGRATED WATER FLOW MODEL (IWM)
*** Version *** ***

STREAM SPECIFICATION FILE
for IWM Pre-Processing
(Unit 1B)

Project: IWM Version *** Release
California Department of Water Resources
Filename: STREAM.DAT

File Description
*All stream/river nodes modeled in IWM are specified with respect to their corresponding groundwater nodes
*A flow versus depth rating table is specified for each stream node

Stream Reach Specifications
NHR: Number of stream reaches modeled
NR: Number of stream nodes modeled
NRTB: Number of data points in stream rating tables

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>/ NHR</td>
</tr>
<tr>
<td>22</td>
<td>/ NR</td>
</tr>
<tr>
<td>5</td>
<td>/ NRTB</td>
</tr>
</tbody>
</table>

Description of Stream Reaches
ID: Reach number
IBUR: First upstream stream node of the reach
INUR: Last downstream node of the reach
IDNN: Stream node into which the reach flows into
0: If stream flow leaves the modeled area
-nlk: If stream flow into lake number nlk

In addition, for each stream node within the reach the corresponding groundwater node and subregion number is listed.

IRV: Stream node
IGN: Corresponding groundwater node
IKST: Corresponding subregion number

REACH 1
ID, IN, IBUR, IDNN, IRV, IGN, IKST

1 1 1 10 -1 -1

REACH 2
ID, IN, IBUR, IDNN, IRV, IGN, IKST

2 11 15 17 -1 -1

REACH 3
ID, IN, IBUR, IDNN, IRV, IGN, IKST

11 222 2
### Stream Rating Tables

**FACTLT:** Conversion factor for stream bottom elevation and stream depth

**FACTQ:** Conversion factor for rating table flow rates

- It is used to convert only the spatial component of the unit.
- Do NOT include the conversion factor for time component of the unit.

* e.g. Unit of flow rate listed in this file = AC.FT./MONTH

**Consistent unit used in simulation = CU.FT./DAY**

Enter FACTQ (AC.FT./MONTH -> CU.FT./MONTH) = 2.29966E-03

(conversion of MONTH -> DAY is performed automatically)

**TUNIT:** Time unit of flow rate. This should be one of the units recognized by HEU-08S that are listed in the simulation main control file.

---

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>FACTLT</td>
</tr>
<tr>
<td>60.0</td>
<td>FACTQ [cfs -&gt; cu.ft/min since seconds cannot be represented in simulation]</td>
</tr>
</tbody>
</table>

*NOTE:* In order to define a specified stream depth, enter all NTID values as equal to the specified depth value.

**ID:** Stream node number
**BOTN:** Stream bottom elevation relative to a common datum [L]
**HRTB:** Stream depth [L]
**QRTB:** Flow rate at stream depth HRTB [L^3/T]

---

<table>
<thead>
<tr>
<th>Node</th>
<th>Bottom Elevation</th>
<th>Stream Depth</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>309.0</td>
<td>8.0</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.0</td>
<td>734.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.0</td>
<td>3299.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.0</td>
<td>49033.66</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.0</td>
<td>41568.45</td>
</tr>
<tr>
<td>2</td>
<td>298.0</td>
<td>8.0</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.0</td>
<td>734.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.0</td>
<td>3299.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.0</td>
<td>49033.66</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.0</td>
<td>41568.45</td>
</tr>
<tr>
<td>3</td>
<td>296.0</td>
<td>8.0</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.0</td>
<td>734.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.0</td>
<td>3299.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.0</td>
<td>49033.66</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.0</td>
<td>41568.45</td>
</tr>
<tr>
<td>23</td>
<td>269.0</td>
<td>8.0</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.0</td>
<td>734.94</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.0</td>
<td>3299.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.0</td>
<td>49033.66</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.0</td>
<td>41568.45</td>
</tr>
</tbody>
</table>
The lake data file specifies the number of lakes modeled and the total number of lake elements. Each lake is specified by an identification number. The identification number of the next downstream lake for 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
- **NTELAKE**: Total number of lake elements
- **ID**: Lake identification number
- **INLAKE**: Lake identification number of the next downstream lake. Enter 0 (zero) if flow from lake leaves the modeled area, -nd if flow from lake goes to stream node nd, or nd if flow from lake goes to the downstream lake nd
- **NELAKE**: Number of elements that a lake encompasses
- **IELAKE**: Element number over which the lake is located
**INTTEGRATED WATER FLOW MODEL (IWFN)**

*** Version *** ***

**LAKE CONFIGURATION DATA FILE**

for IWFN Pre-Processing

(Unit 11)

Project: IWFN Version *** Release

California Department of Water Resources

Filename: LAKE.DAT

This data file contains the number of lakes being modeled, the next downstream lake and the finite elements included in each lake.

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>/ NLAKE</td>
</tr>
<tr>
<td>10</td>
<td>/ NTXLKE</td>
</tr>
</tbody>
</table>

The following lists the area and elevation for the NLAKE number of lakes.

ID : Sequential number for the lakes
INLAKE: Next downstream lake number

<table>
<thead>
<tr>
<th>ID</th>
<th>INLAKE</th>
<th>Area</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>169</td>
<td>170</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>171</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>180</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>188</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>189</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>190</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>207</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>208</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>209</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>210</td>
</tr>
</tbody>
</table>
Well Data File

The location and characteristics of wells are specified in the well data file. Similar to the nodal coordinates data file (Unit 8), each well identification number corresponds to a location based on an x and y coordinate. The x and y coordinates can be input with any units, as long as the correct conversion factor (FACTCX) is given in the file. Other required input for each well is the diameter and the elevation of the top and bottom perforations in the well. Factors to convert the diameter and elevations from input units to simulation units are also required. The following list of variables is required input data, given that pumping and recharge are defined on the basis of well locations:

- **NWell**: Number of wells modeled
- **FACTCX**: Conversion factor for well coordinates
- **FACTRW**: Factor to convert well diameter to simulation unit of length
- **FACTLT**: Factor to convert perforation depths to simulation unit of length
- **ID**: Well identification number
- **XWELL**: x coordinate of well ID, [L]
- **YWELL**: y coordinate of well ID, [L]
- **RWELL**: Well diameter, [L]
- **PERFT**: Elevation of the top perforation, [L]
- **PERFB**: Elevation of bottom perforation, [L]
INTEGRATED WATER FLOW MODEL (IWM)
*** Version ***

-----------------------------------------------
WELL SPECIFICATION FILE
for IWM Pro-Processing
(Unit 12)

Project: IWM, Version *** Release
California Department of Water Resources
Filename: WELL_DMT

File Description:
This data file includes the identification number, location (x-y coordinates),
radius, and depth of perforations for each well.

List of modeled wells and their corresponding parameters:

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>/ JWELL</td>
</tr>
<tr>
<td>1000.0</td>
<td>/ FACTCX</td>
</tr>
<tr>
<td>1.0</td>
<td>/ FACTRM</td>
</tr>
<tr>
<td>1.0</td>
<td>/ FACTLY</td>
</tr>
</tbody>
</table>

ID: Well identification number
XWELL, YWELL: X-Y coordinates for each well; [L]
RCELL: Well diameter; [L]
PERP, PEPB: Elevations of the top and bottom perforations; [L]

<table>
<thead>
<tr>
<th>ID</th>
<th>XWELL</th>
<th>YWELL</th>
<th>RCELL</th>
<th>PERP</th>
<th>PEPB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25.0</td>
<td>7.0</td>
<td>1.0</td>
<td>480.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>26.0</td>
<td>12.0</td>
<td>1.0</td>
<td>480.0</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>25.0</td>
<td>18.0</td>
<td>1.0</td>
<td>480.0</td>
<td>0.0</td>
</tr>
<tr>
<td>4</td>
<td>26.0</td>
<td>26.0</td>
<td>1.0</td>
<td>480.0</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>25.0</td>
<td>33.0</td>
<td>1.0</td>
<td>480.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
The element characteristics file contains hydrologic characteristics of an element. The rainfall station and the fraction of the precipitation measured at the station determine the precipitation on an element. The rainfall station is associated with an element based on location. The rainfall factor is a weighted average of the long term mean annual precipitation at an element and the long term average annual precipitation associated with the corresponding rainfall station. If zero is entered for the rainfall stations for all the elements, then IWFM can be used to model only the groundwater system, streams and lakes without simulating any land processes (i.e. infiltration, evapotranspiration, direct runoff of precipitation and return flow of applied water). Otherwise, a non-zero station identification number must be entered for all elements.

The hydrologic soil properties of the elements are based on National Resources Conservation Service (previously known as Soil Conservation Service) soil reports. Refer to the National Engineering Handbook, Section 4 published by the USDA (1985) for more detail. NRCS classifies four soil groups, termed A, B, C, and D. The four soil groups represent the following runoff characteristics:

- **Soil Group A** Soils (sands and gravels) with high transmissivity, therefore having a high infiltration rate, and low runoff potential (A=1)
- **Soil Group B** Usually a mixture of fine and coarse textured soils with moderate transmissivity (and infiltration rates), therefore they have a low to moderated runoff potential (B=2)
- Soil Group C  Fine texture soils with low transmissivity rates and slow infiltration rates, which leads to moderate to high runoff potential (C=3)

- Soil Group D  Semi-pervious to impervious soils (i.e. clay) that have high runoff potential (D=4)

If a non-integer value is entered for the soil type at an element, IWFM rounds it to the nearest integer and uses it as the soil group number for the element. The drainage node related to each element routes the runoff from an element to a stream node. Several elements can drain to a single stream node. Drainage is highly dependent on the topography of the study area. If a value of zero is entered for drainage node then it is assumed that the surface flow leaves the modeled area.

Unit 13 also denotes the subregion and sub-group each element is associated with. Subregions and sub-groups contain multiple elements and are predominantly defined for reporting purposes. Much of the post-processing is tabulated by subregion.

The following list defines the input variables specified in Unit 13:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE</td>
<td>Element number</td>
</tr>
<tr>
<td>IRNE</td>
<td>Rainfall station assigned to element IE</td>
</tr>
<tr>
<td>FRNE</td>
<td>Factor to convert rainfall at rainfall station IRNE to rainfall at element IE</td>
</tr>
<tr>
<td>ISTE</td>
<td>Stream node that the surface runoff from element IE drains to (enter zero if surface flow from element IE leaves the modeled area)</td>
</tr>
<tr>
<td>IRGE</td>
<td>Subregion number corresponding to element IE</td>
</tr>
<tr>
<td>ISGE</td>
<td>Sub-element group corresponding to element IE</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>ISOILE</td>
<td>Hydrologic soil information of element IE</td>
</tr>
</tbody>
</table>
ELEMENT CHARACTERISTICS DATA FILE
for DWMF Pre-Processing
(Unit 13)

Project: DWMF Version #3 Release
California Department of Water Resources
Filename: ELEMENTC.DAT

File Description

This data file contains the hydrologic characteristics of each element including the rainfall station to be used, a rainfall factor to relate rainfall at the element to the rainfall station, stream node where runoff drains to, the sub-region corresponding to the element, and the hydrologic soil type.

Element Characteristics Data

The following lists the hydrologic characteristics of each element:

<table>
<thead>
<tr>
<th>IE</th>
<th>Element number</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRS</td>
<td>Rainfall station assigned to the element IE</td>
</tr>
<tr>
<td>FRA</td>
<td>Rainfall factor at the assigned rainfall station to rainfall at the element IE</td>
</tr>
<tr>
<td>INX</td>
<td>Stream node to which surface water from element IE drains to</td>
</tr>
<tr>
<td>ISG</td>
<td>Subregion number to which element IE belongs</td>
</tr>
<tr>
<td>ISGR</td>
<td>Element sub-group number to which element IE belongs</td>
</tr>
<tr>
<td>ISO</td>
<td>Hydrologic soil property of the element IE (A-1, B-2, C-3, D-4)</td>
</tr>
</tbody>
</table>

Reference for A-D soil types: USDA, 1985

<table>
<thead>
<tr>
<th>Element</th>
<th>Rainfall</th>
<th>Rainfall</th>
<th>Drainage</th>
<th>Subregion</th>
<th>Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE</td>
<td>IRS</td>
<td>FRA</td>
<td>INX</td>
<td>ISG</td>
<td>ISGR</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1.0</td>
<td>19</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1.0</td>
<td>18</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1.0</td>
<td>18</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1.0</td>
<td>19</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1.0</td>
<td>18</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1.0</td>
<td>19</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>18</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>19</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>21</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>22</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>23</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>24</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>26</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>27</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>28</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>29</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>30</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>31</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>32</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>33</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>34</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>35</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>36</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>37</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>38</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>39</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>40</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

3-26
3.3. Output Files

Binary Output File

The binary file contains the pre-processing information used in the simulation portion of IWFM. The file is generated in the pre-processor program, and must be copied to the folder with the IWFM simulation executable program.

ASCII Output File (PreprocessorMessages.out)

The ASCII output file provides the user with information 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 Unit 5)
- 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
- Well characteristics
- Number of active layers at each node
- Node numbers surrounding each groundwater node
- Non-zero components of conductance matrix
THE FOLLOWING FILES ARE USED IN THIS SIMULATOR:

4  OUTPUT1.BIN  01/23/2007  02:05
5  MAIN.DIR  01/23/2007  02:15
6  OUTPUT1.OUT
7  ELEMENT.DAT  01/23/2007  02:14
8  XL.DAT  01/23/2007  02:16
9  STREAM.DAT  01/23/2007  02:15
10  STREAM.DAT
11  LAKE.DAT  01/23/2007  02:16
12
13  ELEMCNRC.DAT  01/23/2007  02:14

REGION = 1     1835.00 ACRES
REGION = 2     1835.00 ACRES
TOTAL   3670.00 ACRES

NO. OF NODES (ND):  441
NO. OF TRIANGULAR ELEMENTS (NET):  0
NO. OF QUADRILATERAL ELEMENTS (NQ):  400
NO. OF TOTAL ELEMENTS (NE):  400
NO. OF LAYERS (NL):  2
SUM OF CONNECTING NODES FOR EACH NODE (MN):  9355

NODE  X    Y    AREA (ACRES)
  1  0.00  0.00  22.96
  441 400.00  400.00  22.96

ELEMENT  NODE  AREA (ACRES)
   1  1  2  23  22  91.82
   441 419 420 440 440 91.82

*** TOP AND BOTTOM ELEVATIONS OF AQUIFER LAYERS (FEET) ***

NO.  GEN.SURF. LAYER 1  LAYER 2
     TOP  BOTTOM  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 REGION  UPSTREAM  DOWNSTREAM  UPSTREAM
NO.  NO.  ELEV. ELEV. DEPTH  BOTTOM  THICKNESS  NO.  ID  ID  NODES
     ALL (UNITS ARE IN FEET)
   1  1  433 580.0 380.0 230.0 0.0 380.0 2  2  0
   2  412 580.0 298.0 282.0 0.8 298.0 2  0  1
   3  22  34 580.0 262.0 238.0 0.0 262.0 1  0  1
   3  23  13 580.0 260.0 240.0 0.0 260.0 1  0  1 22

***** THERE ARE NO WELLS *****

NO.  # OF LAYERS  TOP NODE  SURROUNDING GW NODES
   1  2  1  2  23  22
   441 2  441 440 419 420

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 MINUTES 0.12 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 structure of the simulation program and the input and output files associated with this portion of the program.

4.1. Subroutine Descriptions

The simulation program is a procedural Fortran program, and consists of a main program which calls several subroutines that simulate groundwater flow and other related hydrologic processes (Figure 4.1). This section describes each subroutine.

Iwfm_f2
This is the main subroutine that controls the simulation process and calls the subroutines listed below.

GetMainControlData
This subroutine reads the main control input data and initializes the input and output files.

Array_allocate
This subroutine reads in data from input data files and allocates array dimensions.
Figure 4.1 IWFM Simulation subroutines

Main program that controls the simulation and calls the subroutines listed below.

Reads the main control input data, initializes input and output files.

Reads information in the data files and allocates array dimensions.

Reads the parameter data file and calls subroutine Getpar.for.

Reads the boundary conditions, initial conditions and print control file.

Reads the surface water diversion specification file.

Reads the data conversion factors and data frequency information from the time series data file.

Identifies inflow/outflow components into groundwater.

Writes title headings to ASCII and binary output files.

Computes initial transmissivities and aquifer parameters as well as computing initial groundwater storage, stream elevations and lake elevations.

Initializes relevant arrays for each time step.
Figure 4.1 IWFM Simulation subroutines (continued)
Figure 4.1 IWFM Simulation subroutines (continued)
**Getgd**  This subroutine reads the information stored in the binary file generated during the execution of Pre-processor, reads in parameter data file and calls subroutine Getpar to convert parametric grid information to correspond to the finite element mesh of the project domain.

**Getpar**  Converts parametric node values to finite element node values.

**Check_elem**  This subroutine checks that all the parametric elements specified in the parameter file are convex, i.e. the internal angles at the nodes of an element are all less than 180 degrees.

**Confile**  This subroutine reads the following input data files: boundary conditions, print control file and initial conditions.

**Spefile**  This subroutine reads the surface water diversion specification file and finds the ranking of the deliveries to be used for the surface water diversions adjustment feature by calling the subroutine Delivery_rank.

**Delivery_rank**  Computes the ranking of the deliveries to be used for the surface water diversions adjustment feature.
**Tsdfile**
This subroutine reads in the data conversion factors and data frequency information from each of the time series input file.

**Flow_ids**
This subroutine identifies the different sources of inflow/outflow components to/from the aquifer system based on the hydrologic processes included in the simulation. This information is used when detailed inflow/outflow components are printed for each sub-domain by the Z-Budget post-processor.

**Outfile**
This subroutine writes title headings to ASCII and binary simulation output files.

**Initial**
This subroutine computes the initial transmissivities, storativities, vertical leakances and pre-compaction head values for groundwater nodes within the model domain. It also computes regional groundwater storage, soil moisture content in the unsaturated zone. Finally, it sets the initial stream elevations and computes lake storages.

**Initialize**
This subroutine initializes relevant arrays for each time step.

**Gettsd**
This subroutine reads the following time series data files: subregional crop and non-agricultural land use areas, elemental
land use areas, pumping specifications and time-series pumping data, surface water diversions, irrigation fractions, supply adjustment specifications, stream flows, precipitation, evapotranspiration, agricultural demand or agricultural demand parameters, urban water use specifications, urban water demand and time series boundary conditions data.

**Gener**
This subroutine computes the initial estimate of transmissivities at the beginning of each time step except the first time step. The initial estimates of transmissivities for the first time step is computed in Initial.

**Gw_depth**
This subroutine computes the distance between the ground surface and the groundwater table.

**Bound**
This subroutine computes the rating table type boundary condition and performs the small stream watershed simulation in conjunction with Soilmna.

**CUAW**
This subroutine computes the potential consumptive use of applied water based on the available soil moisture, precipitation, crop evapotranspiration and minimum soil moisture requirement.
| **Demand** | This subroutine computes the agricultural water demand based on the potential consumptive use of applied water, seasonal crop application efficiency and re-use factor. |
| **Nodal_diversion** | This subroutine computes the total surface water diversion requirement at each stream node based on the surface water diversion specifications and diversion data. |
| **Pump_dist** | Depending on the type of pumping data entered (well pumping or elemental pumping) this subroutine either distributes pumping from well locations to surrounding nodes or pumping from elements to corresponding nodes. |
| **Stream** | This subroutine computes stream flows, bypass flows, actual diversion amounts, diversion shortages and stream-groundwater interaction based on the estimate of the stream surface elevations. It also computes the relevant components of the coefficient matrix and the right-hand-side vector that are used in the solution of the system of non-linear equations. |
| **Supply** | This subroutine computes the actual surface water deliveries to urban and agricultural areas, recoverable losses and non-recoverable losses from surface water diversion and bypass |
processes as well as the amount of pumping from groundwater that is delivered to agricultural and urban lands.

**Surface**  
This subroutine includes subregional soil moisture computations for the root zone and elemental soil moisture computations for the unsaturated zone. Soil moisture computations differ slightly for native and riparian lands than agricultural and urban lands because of the computations due to the application of water to agricultural and urban lands. Therefore, subroutine Soilmag is called to perform soil moisture computations of the agricultural and urban areas whereas Soilmna is called to compute soil moisture in native and riparian areas.

**Soilmag**  
This subroutine computes ET, runoff, return flows, infiltration, deep percolation and soil moisture in agricultural, urban, native vegetation and riparian vegetation lands within the modeled area.

**Gw_source**  
This subroutine totals the groundwater sources and sinks at each finite element node.

**Lake**  
This subroutine computes lake evaporation, lake-groundwater interaction, lake overflow and lake storage based on the estimate of the lake surface elevation. It also computes the relevant
components of the coefficient matrix and the right-hand-side vector that are used in the solution of the system of non-linear equations.

Aquifer

This subroutine re-computes the element transmissivities, and the conductance matrix. It also computes the relevant components of the coefficient matrix and the right-hand-side vector that are used in the solution of the system of non-linear equations.

Solve

This subroutine solves the system of equations using the coefficient matrix and the right-hand-side vector whose components are computed in Stream, Lake and Aquifer. The solution of the system of equations results in the changes in the estimated groundwater, stream and lake elevations.

Convergence

This subroutine checks if the changes in the estimated groundwater, stream and lake elevations computed in Solve are smaller than a user-specified tolerance. It also checks if the aquifer at any node dries up due to pumping during the time step. If so, pumping rates are readjusted for the computation of the actual amount of water that is pumped from a drying well.
Adjust_supply  This subroutine adjusts, per user’s request, the stream diversions and/or groundwater pumping to minimize the discrepancy between the agricultural and urban water demand and the water supply.

Fpe_check  This subroutine checks if an arithmetic operation that causes a floating point error (division by zero, zero divided by zero, etc.) has occurred during simulation. If such an operation is detected at a time step the simulation results from previous time step are printed out to file Unit 50 and the simulation is aborted.

Boundary_flow  This subroutine computes the flow rates at the boundary nodes.

Nflow  This subroutine compiles the inflow/outflow terms for each finite element at each aquifer layer and calls the Face_flow subroutine to compute the flow rates at each element interface. This subroutine also prints out the results, i.e. detailed inflow/outflow terms for each element, to the binary file which is later used by Z-Budget post-processor to compute water budgets for sub-domains.

Face_flow  This subroutine locally solves the set of equations to compute the element face flows.
**Gwstorage**  This subroutine computes the regional groundwater storage at the end of the time step and the cumulative subsidence.

**Report_arrays**  This subroutine compiles the simulation results and computes the array values that are used in the reporting of the results.

**Output**  This subroutine writes the simulation results to the ASCII output files.

**Outbud**  This subroutine writes the simulation information to binary files that can be used to produce budget tables by running the IWFM budget post-processing program.

**Simresult**  This subroutine writes out the simulation results at the end of the simulation period to an ASCII output file in the same format as the initial conditions input data file.

### 4.2. 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. 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 the most recent version of IWFM.
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 (Unit 21) 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 monthly evapotranspiration data. In practice, potential evapotranspiration rates change from month to month but they stay the same from one year to another. Therefore, generally one value of ET rate is defined for each month of the year and these values are used for the corresponding months of all simulation years. The repetitive evapotranspiration data entry can be avoided by the use of NSP_ and NFQ_ variables. If IWFM is run on a monthly time step, then NSPET in evapotranspiration data file (Unit 16) can be set as 1, NFQET as 12 and the 12 monthly evapotranspiration rates can be listed afterwards with the first ET data corresponding to the first simulation month. This means that IWFM will read an ET value at the beginning of every time step (NSPET = 1) and when it reads in 12 values
(NFQET = 12) it will rewind the data file and start reading ET values from the beginning of the file.

As another example, consider using the same monthly ET data 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 ET data can be used by setting NSPET to 30 and NFQET to 12. This time IWFM will read an ET value and use it for 30 time steps (NSPET = 30), i.e. 30 days. At the beginning of the 31st time step, i.e. 31st day, it will read in the next ET value and use it for another 30 time steps. When a total of 12 readings from Unit 16 is made (NFQET = 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.

**Main Simulation 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 can not 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 in the ASCII output file. The program accepts a maximum of three title lines. The input and output file names and descriptions 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.

Three output and debugging options are available in IWFM. A value of 2 directs the program to print program execution to the screen. A value of 1 prints aquifer parameter data to the main text output file. Printing the aquifer parameter data is useful during model calibration. Above options can be turned off by specifying KDEB as zero.

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 (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. 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 agricultural supply requirement can be specified as input in Unit 19 or obtained based on the potential CUAW computed in IWFM and the efficiencies provided in Unit 22. KOPTDM is specified as zero when the agricultural supply requirement is specified in Unit 19, whereas a value of 1 indicates the agricultural supply requirement is computed based on the values read from input file Unit 22. The functionality of adjusting surface water diversions and/or pumping internally can be activating 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 main input file. If non-time tracking simulation, then this is the unit of time step DELTAT with a maximum of 8 characters.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDT</td>
<td>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.</td>
</tr>
<tr>
<td>KDEB</td>
<td>Switch for output and debugging options (2 = print messages on the screen to monitor execution; 1 = print aquifer parameter data to the standard output file; 0 = turn off output and debugging options)</td>
</tr>
<tr>
<td>CACHE</td>
<td>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.</td>
</tr>
<tr>
<td>FACTLTOU</td>
<td>Factor to convert simulation unit of length to output unit of length</td>
</tr>
</tbody>
</table>
UNITLTOU  Output unit of length (maximum 8 characters long)
FACTAROU  Factor to convert simulation unit of area to output unit of area
UNITAROU  Output unit of area (maximum 8 characters long)
FACTVLOU  Factor to convert simulation unit of volume to output unit of volume
UNITVLOU  Output unit of volume (maximum 8 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 8 characters long)
MSOLVE     Matrix solution method. Enter 1 to use the successive overrelaxation (SOR) method, or enter 2 to use the generalized preconditioned conjugate 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)
MXITER     Maximum number of iterations for the solution of system of equations
MXITERSM   Maximum number of iterations for the nonlinear soil moisture accounting
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]
### 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 subregion is less than the convergence criteria, then supply adjustment is skipped.

### KOPTDM

Option to specify the agricultural supply requirement: A value of 0 directs the program to read the agricultural supply requirement from Unit 19. A value of 1 specifies the agricultural supply requirement to be computed in IWFM based on the computed potential CUAW and efficiencies read in Unit 22.

### KOPTDV

Switch to turn on/off the automated water supply adjustment functionality of IWFM. It is specified as a two digit number. First digit from left turns on/off adjustment of groundwater pumping (0 = no adjustment; 1 = adjust groundwater pumping). Second digit from left turns on/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; 2 = adjust diversions so that diversions meet the total water demand). If both diversions and pumping are specified to be adjusted, then diversions are adjusted first and pumping is adjusted second. It should be noted that options 11 and 12 result in identical adjusted diversion and pumping values. If KOPTDV is
set to a value other than 00, then file Unit 12 (supply adjustment specification file) should also be supplied.

| NCROP | Number of agricultural crops modeled (a value of at least 1 should be entered) |
**VEGFLW.OUT** /04: LAYER VERTICAL FLOW OUTPUT (OUTPUT, OPTIONAL)
/05: GROUNDWATER HEADS FOR TETRAPELOT (OUTPUT, OPTIONAL)
/06: SUBSIDIENCY OUTPUT FOR TETRAPELOT (OUTPUT, OPTIONAL)
/07: FINAL SIMULATION RESULTS (OUTPUT, REQUIRED)

**ENDRESULT.OUT**

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

**Model Simulation Period**

The following lists the simulation beginning time, ending time and time step length.
Based on the entry for EDT below, the actual simulation date and time can be tracked.

**BDT** ; Beginning date and time for the simulation. Use one of the following formats:

- **DD/MM/YYYY hh:mm** = Simulation date and time will be tracked
  (Midnight is 24:00)
- **#.##** = Simulation date and time will NOT be tracked
  (any real number greater than 0 or equal to zero can be entered).

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/30/1975 24:00</td>
<td>/ EDT</td>
</tr>
</tbody>
</table>

---

**Simulation Date and Time Tracked**

If the simulation date and time will be tracked (i.e., EDT above is entered in
**MM/DD/YYYY hh:mm** format) enter values for parameters below. Otherwise, comment
out the value entry lines below and use the "Simulation Date and Time NOT Tracked"
option below.

**UNITT** ; Time step length and unit. Choose one of the following:

- **1MIN**
- **2MIN**
- **3MIN**
- **4MIN**
- **5MIN**
- **10MIN**
- **15MIN**
- **20MIN**
- **30MIN**
- **1HOUR**
- **2HOUR**
- **3HOUR**
- **4HOUR**
- **6HOUR**
- **8HOUR**
- **12HOUR**
- **1DAY**
- **1WEEK**
- **1MONTH**
- **1YEAR**

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/30/2023 24:00</td>
<td>/ EDT</td>
</tr>
</tbody>
</table>

---

**Simulation Date and Time NOT Tracked**

If the simulation date and time will not be tracked (i.e., EDT above is entered in
**#.##** format) enter values for parameters below. Otherwise, comment
out the value entry lines below and use the above "Simulation Date and Time Tracked"
option.

**DELTAT** ; Time step to be used in the simulation of hydrologic processes;
any entry that is greater than zero is acceptable.

**UNITT** ; Unit of time step DELTAT (maximum 8 characters); any entry is acceptable.

**BDT** ; Ending simulation date and time. Use **MM/DD/YYYY hh:mm** format.

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>/ DELTAT</td>
</tr>
<tr>
<td></td>
<td>/ UNITT</td>
</tr>
<tr>
<td></td>
<td>/ EDT</td>
</tr>
</tbody>
</table>

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

**Output and Debugging Options**

The following lists the options for detailed output and debugging.

**KDEB**; Enter 2 - to print messages on the screen to monitor execution
Enter 0 - to print aquifer parameter data

**CACHE**; Cache size in terms of number of values stored for time series data output

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>/ KDEB</td>
</tr>
<tr>
<td>50000</td>
<td>/ CACHE</td>
</tr>
</tbody>
</table>

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

**Output Unit Control**

**FACTUNITD**; Factor to convert simulation unit of length into intended output unit of length

**UNIUNITD**; Output unit of length (max. 8 characters long)

**FACTUNITA**; Factor to convert simulation unit of area into intended output unit of area

**UNIUNITA**; Output unit of area (max. 8 characters long)

---

4-22
FACTYLV: Factor to convert simulation unit of volume into intended output unit of volume
UNITYLV: Output unit of volume (max. 8 characters long)
FACTYLFVR: Factor to convert simulation unit of volumetric flow rate into intended output unit of volumetric flow rate
UNITYLFVR: Output unit of volumetric flow rate (max. 8 characters long)

**DESCRIPTION**

1.0 / FACTYLV
0.000022057 / FACTYVF
0.000022057 / FACTYVF
AC. 10. / UNITYLV
AC. 10. / UNITYLV
AC. 10. / UNITYLV
AC. 10. / UNITYLV

Solution Scheme Control

The following lists the solution scheme control parameters used in SIMULATION.

MBOLVE: Matrix solution method
1 = SOR method
2 = Generalized preconditioned conjugate method
RELAX: Relaxation parameter for SOR (value should be between 1.0 and 2.0)
METH: Maximum number of iterations for the solution of system of equations
MEITRES: Maximum number of iterations for the nonlinear soil moisture accounting
MEITRESF: Maximum number of iterations for supply adjustment
STORC: Convergence criteria for groundwater, stream and lake head difference; [L]
STORCM: Convergence criteria for soil moisture difference; [L]
STORCFS: Fraction of water demand to be used as convergence criteria for iterative supply adjustment

**VALUE**

1.0 / MBOLVE
1.0 / RELAX
1500 / METH
1500 / MEITRES
50 / MEITRESF
0.0001 / STORC
0.0001 / STORCM
0.001 / STORCFS

Water Budget Control Options

KOPTDM: Enter 0 or 1 as follows:
0 = Agricultural water supply requirement is read in from file Unit 19.
1 = Agricultural demand is computed based on CRW (i.e. AS. DEMAND=CRW/1.5.)
In this case file unit 32 must be provided.

KOPTDV: Enter two digits as follows:
1st digit (from left):
0 = No adjustment for groundwater pumping
1 = YES: Adjust groundwater pumping

2nd digit (from left):
0 = No adjustment for streamflow diversion
1 = YES: Surface Water Div. = Total Demand-Groundwater Pumping
2 = YES: Surface Water Div. = Total Demand

** Note: When this flag is set to a value other than 00, file Unit-12 is required.

MCROP: Number of agricultural crops

**VALUE**

1 / KOPTDM
01 / KOPTDV
1 / MCROP
The parameter data file contains multiple data types that include parameters for all
groundwater nodes and layers. Data may be by parametric grids, or node-by-node
parametric values. Parameters are also set for the unsaturated zone, soil moisture, small
stream watersheds, streambeds, lakes, and water use. 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 Unit 7:

- **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 Main Control File.
TUNITV Time unit of aquitard vertical conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
TUNITL Time unit of aquifer vertical conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control 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
<table>
<thead>
<tr>
<th>NEP</th>
<th>Number of parametric elements in the parametric grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE</td>
<td>Parametric element number</td>
</tr>
<tr>
<td>NODE</td>
<td>Corresponding parametric node</td>
</tr>
<tr>
<td>ID</td>
<td>Parametric node number</td>
</tr>
<tr>
<td>PX, PY</td>
<td>Parametric node coordinates, [L]</td>
</tr>
<tr>
<td>PKH</td>
<td>Aquifer horizontal hydraulic conductivity, [L/T]</td>
</tr>
<tr>
<td>PS</td>
<td>Specific storage, [1/L]</td>
</tr>
<tr>
<td>PN</td>
<td>Specific yield, [L/L]</td>
</tr>
<tr>
<td>PV</td>
<td>Aquitard vertical hydraulic conductivity, [L/T]</td>
</tr>
<tr>
<td>PL</td>
<td>Aquifer vertical hydraulic conductivity, [L/T]</td>
</tr>
<tr>
<td>SCE</td>
<td>Elastic storage coefficient (Use SCE*DC if DC=0), [1/L]</td>
</tr>
<tr>
<td>SCI</td>
<td>Inelastic storage coefficient (Use SCI*DC if DC=0), [1/L]</td>
</tr>
<tr>
<td>DC</td>
<td>Interbed thickness, [L]</td>
</tr>
<tr>
<td>DCMIN</td>
<td>Minimum interbed thickness, [L]</td>
</tr>
<tr>
<td>HC</td>
<td>Pre-compaction hydraulic head (set to 99999.0 to use the initial heads for the value of HC), [L]</td>
</tr>
</tbody>
</table>

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, then 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 Main Control 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
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
FN  Factor to weight unsaturated zone porosity
FL  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 units recognized by HEC-DSS that are listed in the Main Control 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:
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDP</td>
<td>Number of nodes in the parametric grid</td>
</tr>
<tr>
<td>NEP</td>
<td>Number of elements in the parametric grid</td>
</tr>
<tr>
<td>IE</td>
<td>Parametric element number</td>
</tr>
<tr>
<td>NODE</td>
<td>Corresponding parametric nodes (4 nodes should entered for each parametric element. For triangular elements 4\textsuperscript{th} node must be set to zero)</td>
</tr>
<tr>
<td>ID</td>
<td>Parametric node number</td>
</tr>
<tr>
<td>PX</td>
<td>x-coordinate of the parametric node, [L]</td>
</tr>
<tr>
<td>PY</td>
<td>y-coordinate of the parametric node, [L]</td>
</tr>
<tr>
<td>PD</td>
<td>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]</td>
</tr>
<tr>
<td>PN</td>
<td>Effective porosity of unsaturated zone, [L/L]</td>
</tr>
<tr>
<td>PL</td>
<td>Hydraulic conductivity of unsaturated zone, [L/T]</td>
</tr>
</tbody>
</table>

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.

**Parameters for Soil Moisture Routing**

This section is skipped if the root zone is not modeled, i.e. if no rain gages are specified in the Pre-processor. The following root zone parameters are specified by
subregion for the four soil types and land use types modeled:

**KUSAGE**
Enter 0 (zero) if values listed for K are the fraction of excess soil moisture that will become deep percolation; enter 1 if values listed for K are saturated hydraulic conductivity of soil

**FACT**
Conversion factor for the spatial component for the unit of root zone hydraulic conductivity

**TUNITS**
Time unit of hydraulic conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File. If KUSAGE is set to 0 (zero), this variable should still be set even though it will not be used by IWFM.

**IREGN**
Subregion number

**FC**
Field capacity (it is converted to a unit of depth in IWFM by multiplying it with the root zone depth), [L/L]

**EF**
Total porosity as a fraction of root zone depth (it is converted to a unit of depth in IWFM by multiplying it with the root zone depth), [L/L]

**K**
Hydraulic conductivity of the root zone, [L/T]

**CN**
Curve Number with respect to soil type and land use type

### Small Stream Watershed Groups

If no rain gages are specified in the Pre-processor, then this section should be skipped. 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 Main Control 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 Main Control File.
- **IS**  Small watershed group identification number
- **IRNS**  Rainfall station number associated with the small watershed
- **FRNS**  Rainfall weighting factor for the small watershed
- **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]
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CROOT</td>
<td>Root zone depth of native vegetation in the small watershed, [L]</td>
</tr>
<tr>
<td>SOILKS</td>
<td>Hydraulic conductivity of the root zone, [L/T]</td>
</tr>
<tr>
<td>CN</td>
<td>Curve number for small watershed area</td>
</tr>
<tr>
<td>GWSOS</td>
<td>Threshold value above which groundwater storage of small watershed contributes to surface runoff, [L]</td>
</tr>
<tr>
<td>SWKS</td>
<td>Recession coefficient for surface outflow, [1/T]</td>
</tr>
<tr>
<td>GWKS</td>
<td>Recession coefficient for base flow, [1/T]</td>
</tr>
</tbody>
</table>

**Stream Bed Parameters**

Values of hydraulic conductivity, thickness of streambed and the wetted perimeter are listed for each stream node in the system. Stream node numbers were input in the pre-processor stream specification input data file. Space is available at the end of each row to declare the stream name, this is optional. The list of stream bed parameters defined in this file is as follows:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FACTK</td>
<td>Conversion factor for the spatial component of the unit for the stream bed conductivity</td>
</tr>
<tr>
<td>TUNITSK</td>
<td>Time unit of conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.</td>
</tr>
<tr>
<td>FACTL</td>
<td>Conversion factor for stream bed thickness and wetted perimeter</td>
</tr>
<tr>
<td>IR</td>
<td>Stream node number</td>
</tr>
<tr>
<td>CSTRM</td>
<td>Hydraulic conductivity of stream bed, [L/T]</td>
</tr>
<tr>
<td>DSTRM</td>
<td>Thickness of stream bed, [L]</td>
</tr>
<tr>
<td>WETPR</td>
<td>Wetted perimeter, [L]</td>
</tr>
</tbody>
</table>
**Lake Parameters**

Lake parameters for each lake modeled are defined in this file. The variables must be defined for each lake modeled in IWFM and are listed as follows:

- **FACTK** Conversion factor for the spatial component of the unit for lake bed conductivity
- **TUNITLK** Time unit of hydraulic conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.
- **FACTL** Conversion factor for the thickness of lake bed
- **IL** Lake identification number
- **CLAKE** Hydraulic conductivity of the lake bed, [L/T]
- **DLAKE** Thickness of the lake bed, [L]
- **ICHLMAX** Column number in file unit 28 for maximum lake elevation

**Water Use Parameters**

If no land surface processes are modeled, i.e. no rain gages are specified in Pre-processor, the values defined below should not be specified. The water use parameters are defined by subregion and include the amount of pervious urban area, the re-use factors for the agricultural and urban return flow, and how the urban return flow is routed. Directly below the subregional water use parameter specification, the root zone depth is defined for each crop type modeled in IWFM:

- **IR** Subregion number
- **PERV** Fraction of pervious urban area to total urban area
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICRUFAG</td>
<td>Fraction of the surface runoff from agricultural applied water that is re-used (this number corresponds to the data column in irrigation water re-use factor data file, Unit 29)</td>
</tr>
<tr>
<td>ICRUFURB</td>
<td>Fraction of the surface runoff and return flow from urban areas that is re-used (this number corresponds to the data column in irrigation water re-use factor data file, Unit 29)</td>
</tr>
<tr>
<td>IURIND</td>
<td>Urban return flow specification. Return flow can leave the model boundary (-2), become groundwater recharge (-1), enter streams at the stream node that the element over which urban area lies is associated with (0); or more specifically, enter streams at a stream node, nd.</td>
</tr>
<tr>
<td>FACT</td>
<td>Conversion factor for crop root zone depths</td>
</tr>
<tr>
<td>IC</td>
<td>Crop type number</td>
</tr>
<tr>
<td>ROOT</td>
<td>Crop root zone depth, [L]</td>
</tr>
</tbody>
</table>
**INTEGRATED WATER FLOW MODEL (IWFM)**

*** Version ***

---------------------------------------------

**PARAMETER DATA FILE**
for IWFM Simulation
(Unit 7)

Project: IWFM Version #99 Release
California Department of Water Resources
Filename: PARAMETER.DAT

---------------------------------------------

**File Description:**

This data file contains the aquifer parameters for each groundwater node and each layer. The parameters may be set by using a parametric grid to interpolate values or by listing values for each node individually. In addition, this file contains the parameters for the unsaturated zone, lakes, and stream beds along with field capacity and wilting point for each soil type.

---------------------------------------------

**AQUIFER PARAMETERS**

---------------------------------------------

- **OPTION 1** - Set aquifer parameters by use of a parametric grid (HRGROUP > 0)
- **OPTION 2** - Set aquifer parameters at every groundwater node (HRGROUP = 0)
- **HRGROUP**: Number of parametric grid groups

---------------------------------------------

**VALUE** | **DESCRIPTION**
---|---

---------------------------------------------

**OPTIONS 1 & 2**: The following lists the factors to convert the aquifer parameters and grid coordinates to the appropriate units

- **FX**: Conversion factor for parametric grid coordinates
- **FRH**: Conversion factor for horizontal hydraulic conductivity
  - It is used to convert only the spatial component of the unit.
  - **e.g.**: Unit of hydraulic conductivity listed in this file = FT/MONTH
  - Consistent unit used in simulation = IN/DAY
  - Enter FRH (FT/MONTH -> IN/MONTH)
    - **e.g.**: 0.033333
    - **e.g.**: (conversion of MONTH -> DAY in performed automatically)
- **FS**: Conversion factor for specific storage coefficient
- **FN**: Weighting factor for specific yield value
- **FV**: Conversion factor for aquifer vertical hydraulic conductivity
  - It is used to convert only the spatial component of the unit.
  - **e.g.**: Unit of hydraulic conductivity listed in this file = FT/MONTH
  - Consistent unit used in simulation = IN/DAY
  - Enter FV (FT/MONTH -> IN/MONTH)
    - **e.g.**: 0.033333
    - **e.g.**: (conversion of MT -> DAY in performed automatically)
- **FL**: Conversion factor for aquifer vertical hydraulic conductivity
  - It is used to convert only the spatial component of the unit.
  - **e.g.**: Unit of hydraulic conductivity listed in this file = FT/MONTH
  - Consistent unit used in simulation = IN/DAY
  - Enter FL (FT/MONTH -> IN/MONTH)
    - **e.g.**: 0.033333
    - **e.g.**: (conversion of MONTH -> DAY in performed automatically)
- **FSCH**: Conversion factor for elastic storage coefficient
- **FSCL**: Conversion factor for inelastic storage coefficient
- **FDC**: Conversion factor for interbed thickness
- **FDCMN**: Conversion factor for minimum interbed thickness
- **FRK**: Conversion factor for pre-compaction hydraulic head
- **TUNTH**: Time unit of horizontal hydraulic conductivity. This should be one of the units recognized by HEC-DS8 that are listed in the Main Control File.
- **TUNTV**: Time unit of aquifer vertical conductivity. This should be one of the units recognized by HEC-DS8 that are listed in the Main Control File.
- **TUNTEL**: Time unit of aquifer vertical conductivity. This should be one of the units recognized by HEC-DS8 that are listed in the Main Control File.

---------------------------------------------

<table>
<thead>
<tr>
<th>FX</th>
<th>FRH</th>
<th>FS</th>
<th>FN</th>
<th>FV</th>
<th>FL</th>
<th>FSCH</th>
<th>FSCL</th>
<th>FDC</th>
<th>FDCMN</th>
<th>FRK</th>
<th>TUNTH</th>
<th>TUNTV</th>
<th>TUNTEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

---------------------------------------------

**VALUE** | **DESCRIPTION**
---|---

---------------------------------------------

**INMH** | **TUNTH**
**INMV** | **TUNTV**
**INME** | **TUNTEL**

---------------------------------------------

4-35
### GROUP 1

Enter node numbers from the FE grid for the 1st parametric group
(e.g. 1-100, 101-200, 301-359, 360)

<table>
<thead>
<tr>
<th>Node 1</th>
<th>Node 2</th>
<th>Node 3</th>
<th>Node 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
</tr>
<tr>
<td>29</td>
<td>30</td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td>33</td>
<td>34</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td>37</td>
<td>38</td>
<td>39</td>
<td>40</td>
</tr>
</tbody>
</table>

**DESCRIPTION**

- **N1**: Number of nodes in the 1st parametric grid
- **N2**: Number of elements in the 1st parametric grid

### VALUE

- **N1**: Number of nodes in the 1st parametric grid
- **N2**: Number of elements in the 1st parametric grid

### GROUP 2

Enter node numbers from the FE grid for the 2nd parametric group
(e.g. 1-100, 101-200, 301-359, 360)

<table>
<thead>
<tr>
<th>Node 1</th>
<th>Node 2</th>
<th>Node 3</th>
<th>Node 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
</tr>
<tr>
<td>29</td>
<td>30</td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td>33</td>
<td>34</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td>37</td>
<td>38</td>
<td>39</td>
<td>40</td>
</tr>
</tbody>
</table>

**DESCRIPTION**

- **N1**: Number of nodes in the 2nd parametric grid
- **N2**: Number of elements in the 2nd parametric grid

### VALUE

- **N1**: Number of nodes in the 2nd parametric grid
- **N2**: Number of elements in the 2nd parametric grid
C---------------------------------------------------------------------
  C  / NDF
  6 / NDF
C---------------------------------------------------------------------
C Element   Node 1    Node 2    Node 3    Node 4
C---------------------------------------------------------------------
  1  34  21  38  35
  2  35  38  39  36
C---------------------------------------------------------------------

C List the parametric 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  PHP : Hydraulic conductivity; [L/T]
C  PS : Specific storage; [L/L]
C  PH : Specific yield; [L/L]
C  PV : Aquifer vertical hydraulic conductivity; [L/T]
C  PL : Aquifer lateral hydraulic conductivity; [L/T]
C  SCD : Elastic storage coefficient (Use SCD*DC if DC=0); [L/L]
C  SCI : Inelastic storage coefficient (Use SCI*DC if DC=0); [L/L]
C  DC : Intertek thickness; [L]
C  DMINH : Minimum intertek thickness; [L]
C  HC : Pre-compression hydraulic head (use 99999. to use initial heads); [L]
C
C *Note* The above land subsidence parameters are only for intertek layers (i.e., clay layers)
C---------------------------------------------------------------------
C ID  PX  PY  PHP  PS  PH  PV  PL  SCD  SCI  DC  DMINH  HC
C---------------------------------------------------------------------
  34 795918 3908758 100.  1.  .12  .2 1.0  -1  -1  -1  -1  -1
  80.  5.  .07  .001  .5  -1  -1  -1  -1  -1  -1  -1
  20.  5.  .07  .6  .6  -1  -1  -1  -1  -1  -1  -1
  39  905619 3868499  80.  1.  .12  .2 1.0  -1  -1  -1  -1  -1
  50. 10.  .07  .0015 .4  -1  -1  -1  -1  -1  -1  -1
   5.  6.  .07  .6  .6  -1  -1  -1  -1  -1  -1  -1
C---------------------------------------------------------------------

C *** GROUP 6 ***
C---------------------------------------------------------------------
C Enter node numbers from the FE grid for the 6th parametric group
C (e.g. 1-180, 130, 210-259, 507)
C---------------------------------------------------------------------
792 791 798 789 788 787 786 785
784 769 768
757 756 755 754 753 752 751 750
749 729
741 740 739 738 737 736 735 734
731 701
730 700 699 698 697 696 695 694
693 683
681 680
671 560 649
657 656 655 654 653 652 651 650 649
623 622 621 620 619 618 617 616
615 595 593 576 557 558
C---------------------------------------------------------------------

C NDF: Number of nodes in the 6th parametric grid
C NEF: Number of elements in the 6th parametric grid
C
C VALUE DESCRIPTION
C---------------------------------------------------------------------
  1  / NDF
  0 / NEF
C---------------------------------------------------------------------
C Element   Node 1    Node 2    Node 3    Node 4
C---------------------------------------------------------------------
C---------------------------------------------------------------------
C List the parametric nodes, nodal coordinates and aquifer
C parameters for each layer of the 6th parametric group
C
C ID: Parametric node number
C P4, P6; Parametric node coordinates [L]
C PRH; Hydraulic conductivity [L/T]
C PS; Specific storage [L/L]
C FY; Specific yield [L/T]
C PV; Aquifer vertical hydraulic conductivity [L/T]
C PL; Aquifer horizontal hydraulic conductivity [L/T]
C SCB; Elastic storage coefficient (Use SCB2X if DC=0) [L/L]
C SCI; Inelastic storage coefficient (Use SCI2X if DC=0) [L/L]
C DC; Interbed thickness
C DOMNH; Minimum interbed thickness
C HC; Pre-compression 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)

<table>
<thead>
<tr>
<th>ID</th>
<th>PV</th>
<th>FY</th>
<th>PRH</th>
<th>PS</th>
<th>FY</th>
<th>PV</th>
<th>PL</th>
<th>SCB</th>
<th>SCI</th>
<th>DC</th>
<th>DOMNH</th>
<th>HC</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>742366.0</td>
<td>3457346.0</td>
<td>40.0</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
</tr>
</tbody>
</table>

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 PRH; Hydraulic conductivity [L/T]
C PS; Specific storage [L/L]
C FY; Specific yield [L/T]
C PV; Aquifer vertical hydraulic conductivity [L/T]
C PL; Aquifer horizontal hydraulic conductivity [L/T]
C SCB; Elastic storage coefficient (Use SCB2X if DC=0) [L/L]
C SCI; Inelastic storage coefficient (Use SCI2X if DC=0) [L/L]
C DC; Interbed thickness [L]
C DOMNH; Minimum interbed thickness [L]
C HC; Pre-compression hydraulic head (use 99999 to use initial heads) [L]
C
C******************************************************************************
C ANOMALY IN HYDRAULIC CONDUCTIVITY
C******************************************************************************
C
C List the groundwater elements and corresponding aquifer
C parameters for nodes that will overwrite the above aquifer data
C
C NEER; Number of elements where hydraulic conductivity
C values will be overwritten
C FACT; Conversion factor for the anomaly hydraulic conductivity
C
C It is used to convert only the spatial component of the unit;
C SCB; Do NOT include the conversion factor for time component of the unit.
C * e.g. Unit of anomaly hydraulic conductivity listed in this file = PV/MONTH
C consistent unit used in simulation = IN/DAY
C enter FACT (PV/MONTH -> IN/DAY) = 8.33333x-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 MODFLOW that are listed in the Main Control File.
C
C******************************************************************************
C VALUE DESCRIPTION
C******************************************************************************
C
C NEER | Number of elements where hydraulic conductivity
C FACT | Conversion factor for the anomaly hydraulic conductivity

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEER</td>
<td>Number of elements where hydraulic conductivity</td>
</tr>
<tr>
<td>FACT</td>
<td>Conversion factor for the anomaly hydraulic conductivity</td>
</tr>
</tbody>
</table>

C******************************************************************************
C Count for number of overwrite options
C IEER; Element number corresponding to counter IC
C IFK; Hydraulic conductivity at the specified node [L/T]
C******************************************************************************

<table>
<thead>
<tr>
<th>IC</th>
<th>IEER</th>
<th>LF</th>
<th>EB</th>
<th>BC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>55</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>2</td>
<td>54</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>3</td>
<td>57</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>4</td>
<td>58</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>5</td>
<td>1384</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>6</td>
<td>1384</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>7</td>
<td>1385</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
</tr>
</tbody>
</table>

4-38
UNSATURATED ZONE PARAMETERS

(NRGROUP > 0)

NRGROUP: Number of parametric grid groups

VALUE DESCRIPTION
0

NRGROUP

0

OPTIONS 1 & 2: The following lists the factors to convert the unsaturated zone parameters and grid coordinates to the appropriate units

FXi: Conversion factor for grid coordinates

FNi: Conversion factor for thickness of the unsaturated layer

FR: Conversion factor for hydraulic conductivity

UNITi: Unit of hydraulic conductivity listed in this file = FT/NMONTH

* DO NOT include the conversion factor for time component of the unit.

* e.g. Unit of hydraulic conductivity listed in this file = FT/NMONTH

* Consistent unit used in simulation

Enter FACT (FT/NMONTH -> IN/DAY) = 8.33333E-02

* (conversion of NMONTH -> DAY is performed automatically)

* TUNITi: Time unit of hydraulic conductivity. This should be one of the units recognized by HEC-ERM that are listed in the Main Control File.

FX

FD

FN

FL

1.0

1.0

1.0

1.0

1.0

VALUE DESCRIPTION

** OPTION 1 (for Unsaturated Zone Parameter Definition) **

*** GROUP 1 ***

** Enter element numbers from FE grid for the 1st parametric group

* (e.g. 1-100, 101-200, 201-350, 567)

**

NPD: Number of nodes in the 1st parametric grid

NPE: Number of elements in the 1st parametric grid

**

VALUE DESCRIPTION

* / NPD

* / NPE

The following is a list of the parametric elements and corresponding parametric nodes for the 1st parametric group

* (to be used only when parametric option is used, i.e., NPD > 0)

IE: Parametric element number

NODE: Corresponding parametric node

**

**

List the parametric nodes, coordinates, and unsaturated zone parameters for each layer of the 1st parametric group (skip if option 2 is used)

ID: Parametric node number

FX: x-coordinate of the parametric node: [L]

FY: y-coordinate of the parametric node: [L]

FD: Thickness of unsaturated layer: [L]

FN: Effective porosity: [L/L]

FL: Hydraulic conductivity: [L/T]

**

NORMAL COORDINATES Thickness Porosity Hyd. Cond.
CID     PX  PY  PD  PN  PL
*-----------------------------------------------
*  
* *** GROUP 2 ***
C Enter element numbers from FE grid for the 2nd parametric group
C (e.g. 1-100,101,301-350,567)
C
*
C NNP: Number of nodes in the 2nd parametric grid
C NEE: Number of elements in the 2nd parametric grid
C
C VALUE DESCRIPTION
C
* / NNP / NEE
C
*-----------------------------------------------
C IE1M  NID1  NID2  NID3  NID4
*-----------------------------------------------
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: Effective porosity [L/L]
C PL: Hydraulic conductivity [L/T]
C
C NID1, NID2, NID3, NID4: Node numbers
C
*-----------------------------------------------

******************************************************************************
********* OPTION 2 (For Unsatuated Zone Parameter Definition)***************
******************************************************************************
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 PL: Hydraulic conductivity [L/T]
C
C LAYER 1    LAYER 2
C
C IE    PD    PN    PL    PD    PN    PL
C 1  49.900 .120  1.860  0.000 .120  1.000
C 2  49.900 .120  1.860  0.000 .120  1.000
C
C
******************************************************************************
********* PARAMETERS FOR SOIL MOISTURE ROUTING***************

The following lists the soil moisture and hydrologic properties for each
hydrologic soil group (A,B,C,D) by subregion.
C *Note* This portion of the parameter input should be skipped if no
rain gages are specified in file unit 13 during pre-processing
C
C KURAGE: Flag that specifies how the value entered for variable K will be
interpreted. Enter
C 0: Values listed for K are the fraction of excess soil moisture
C that will become deep percolation
C 1: Values listed for K are saturated hydraulic conductivity of soil
C FACT: Conversion factor for root zone 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 = ft/DAY
C Enter FACT (FT/MONTH -> IN/MONTH) = 8.353385-02
C (conversion of MONTH -> DAY is performed automatically)
C TUNIT: Time unit of hydraulic conductivity. This should be one of the units
recognized by MEC-DSS that are listed in the Main control file.
C * Note: If KURAGE = 0, enter anything
C
The following lists the small watershed parameters that are used in the computation of runoff from the tributary watersheds outside the model boundary.

*Note* This portion of the parameter input should be skipped if no rain gages are specified in file unit IS during pre-processing.

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>USAGE</td>
</tr>
<tr>
<td>1.0</td>
<td>FACT</td>
</tr>
<tr>
<td>1.0</td>
<td>TUNIT</td>
</tr>
</tbody>
</table>

### DOIL GROUP A

<table>
<thead>
<tr>
<th>DOIL GROUP B</th>
<th>DOIL GROUP D</th>
<th>DOIL GROUP C</th>
<th>DOIL GROUP D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CN</th>
<th>EF</th>
<th>K</th>
<th>CN</th>
<th>EF</th>
<th>K</th>
<th>CN</th>
<th>EF</th>
<th>K</th>
<th>CN</th>
<th>EF</th>
<th>K</th>
<th>CN</th>
<th>EF</th>
<th>K</th>
<th>CN</th>
<th>EF</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.19</td>
<td>2.0</td>
<td>0.1</td>
<td>72</td>
<td>73</td>
<td>75</td>
<td>65</td>
<td>0.08</td>
<td>2.00</td>
<td>1.7</td>
<td>47</td>
<td>79</td>
<td>80</td>
<td>75</td>
<td>0.10</td>
<td>2.50</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>0.19</td>
<td>2.0</td>
<td>0.1</td>
<td>72</td>
<td>73</td>
<td>75</td>
<td>65</td>
<td>0.08</td>
<td>2.00</td>
<td>1.7</td>
<td>47</td>
<td>79</td>
<td>80</td>
<td>75</td>
<td>0.10</td>
<td>2.50</td>
<td>1.0</td>
</tr>
</tbody>
</table>

### SMALL STREAM WATERSHED DATA

The following lists the small watershed parameters that are used in the computation of runoff from the tributary watersheds outside the model boundary.

*Note* This portion of the parameter input should be skipped if no rain gages are specified in file unit IS during pre-processing.

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>USAGE</td>
</tr>
<tr>
<td>1.0</td>
<td>FACT</td>
</tr>
<tr>
<td>1.0</td>
<td>TUNIT</td>
</tr>
</tbody>
</table>

### DOIL GROUP A

<table>
<thead>
<tr>
<th>DOIL GROUP B</th>
<th>DOIL GROUP D</th>
<th>DOIL GROUP C</th>
<th>DOIL GROUP D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CN</th>
<th>EF</th>
<th>K</th>
<th>CN</th>
<th>EF</th>
<th>K</th>
<th>CN</th>
<th>EF</th>
<th>K</th>
<th>CN</th>
<th>EF</th>
<th>K</th>
<th>CN</th>
<th>EF</th>
<th>K</th>
<th>CN</th>
<th>EF</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.19</td>
<td>2.0</td>
<td>0.1</td>
<td>72</td>
<td>73</td>
<td>75</td>
<td>65</td>
<td>0.08</td>
<td>2.00</td>
<td>1.7</td>
<td>47</td>
<td>79</td>
<td>80</td>
<td>75</td>
<td>0.10</td>
<td>2.50</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>0.19</td>
<td>2.0</td>
<td>0.1</td>
<td>72</td>
<td>73</td>
<td>75</td>
<td>65</td>
<td>0.08</td>
<td>2.00</td>
<td>1.7</td>
<td>47</td>
<td>79</td>
<td>80</td>
<td>75</td>
<td>0.10</td>
<td>2.50</td>
<td>1.0</td>
</tr>
</tbody>
</table>

### STREAM BED PARAMETERS

The following lists the parameters that model streams.

*Note* Skip data input if no streams are modeled.
FACTK : Conversion factor for stream bed conductivity
It is used to convert only the spatial component of the unit.
DO NOT include the conversion factor for time component of the unit.
* e.g. Unit of conductivity listed in this file = FT/MONTH

Enter FACTK (FT/MONTH -> IN/MONTH) = 8.333333333

TUNTSK : Time unit of conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.

FACTL : Conversion factor for stream bed thickness and wetted perimeter

IR : Stream node number

CSYTM : Hydraulic conductivity of stream bed: [L/T]

STYTM : Thickness of stream bed: [L]

WETPR : Wetted perimeter: [L]

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>FACTK</td>
</tr>
<tr>
<td>1.0</td>
<td>FACTL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IR</th>
<th>CSYTM</th>
<th>STYTM</th>
<th>WETPR</th>
<th>River Name (Optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.0</td>
<td>1.</td>
<td>260.0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4.0</td>
<td>1.</td>
<td>260.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.0</td>
<td>1.</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>410</td>
<td>0.0</td>
<td>1.</td>
<td>260.0</td>
<td></td>
</tr>
</tbody>
</table>

LAKES PARAMETERS

The parameters required to model lakes are listed below.

*Note* Skip data input if no lakes are modeled.

FACTK : Conversion factor for lake bed hydraulic conductivity
It is used to convert only the spatial component of the unit.
DO NOT include the conversion factor for time component of the unit.
* e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH

Enter FACTK (FT/MONTH -> IN/MONTH) = 8.333333333

TUNTSK : Time unit of hydraulic conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.

FACTL : Conversion factor for thickness of lake bed

IL : Lake number

CLAKE : Hydraulic conductivity of the lake bed: [L/T]

BLAKE : Thickness of the lake bed: [L]

IOHLMX : Maximum lake elevation - this number corresponds to the data column in the maximum lake elevations data file (Unit 28)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>FACTK</td>
</tr>
<tr>
<td>1.0</td>
<td>FACTL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IL</th>
<th>CLAKE</th>
<th>CLAKE</th>
<th>IOHLMX</th>
<th>Lake Name (Optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.0</td>
<td>20.0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>20.0</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

WATER USE PARAMETERS

The following lists the water use parameters for each subregion and the crop root zone depth for each crop type including urban (lawn) and native vegetation (skip if soil moisture is not cotted, i.e. if there are no rain gauges)

<table>
<thead>
<tr>
<th>IR</th>
<th>Subregion number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERV</td>
<td>Fraction of previous area to total urban area</td>
</tr>
<tr>
<td>IRCRUNA</td>
<td>Fraction of the surface runoff from agricultural applied water that is re-used - this number corresponds to the appropriate data column in irrigation water re-use factor data file (Unit 29)</td>
</tr>
<tr>
<td>IRCRUNRIA</td>
<td>Fraction of the surface runoff and return flow from urban areas that is re-used - this number corresponds to the appropriate data column in irrigation water re-use factor data file (Unit 29)</td>
</tr>
<tr>
<td>IURINO</td>
<td>Urban return flow specification</td>
</tr>
<tr>
<td>-1</td>
<td>Urban return flow goes out of model boundary</td>
</tr>
<tr>
<td>-1</td>
<td>Urban return flow goes into groundwater recharge</td>
</tr>
<tr>
<td>0</td>
<td>Urban return flow enters streams</td>
</tr>
<tr>
<td>0</td>
<td>Urban return flow enters streams at stream node, nd</td>
</tr>
</tbody>
</table>

<p>| PERV | IRCRUNA | IRCRUNRIA | IURINO |
| 1   | .62     | 1         | 22     | -1     |</p>
<table>
<thead>
<tr>
<th>IC</th>
<th>FACT</th>
<th>IC</th>
<th>IC</th>
<th>FACT</th>
<th>IC</th>
<th>IC</th>
<th>FACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.8</td>
<td>2</td>
<td>6.0</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>16</td>
<td>2.8</td>
<td>17</td>
<td>5.0</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
</tbody>
</table>

C FACT: Conversion factor for crop root zone depths
C IC: Crop type number
C ROOT: Crop root zone depth; [L]
C
C------------------------------------------------------------------------
C VALUE DESCRIPTION
C------------------------------------------------------------------------
C 1.0
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. Rating tables
4. General head

Small stream watersheds are also listed in this file. For each aquifer layer, boundary conditions 1-4 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
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 Main Control File. If there are no specified flow boundary conditions (i.e. NQB = 0) then this variable can be left blank.
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 column number in the time series boundary conditions data file), \([L^3/T]\)

**Specified Head**

Specified head boundary conditions are input 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

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 column number corresponding to the time series boundary condition data), \([L]\)

**Rating Tables**

Rating table boundary conditions are implemented when the rate of flow at the boundary can be determined as a function of the groundwater head. The number of nodes with a rating table condition, the number of points in each rating table, and the conversion factors for the head and flow rate are specified. This information is followed by each groundwater node with a rating table boundary condition and the corresponding
head value and flow rate. The list of the description of variables for rating table boundary conditions is:

- **NMB**: Number of nodes with a rating table boundary condition
- **NMTB**: Number of points in the rating table
- **FACTH**: Conversion factor for the head value
- **FACTQ**: Conversion factor for the spatial component of the unit for the flow rate
- **TUNIT**: Time unit of flow rate in the rating table. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File. If there are no rating table type boundary conditions (i.e. NMB = 0) then this variable can be left blank.
- **INODE**: Node number corresponding to a rating table boundary condition
- **HMTB**: Head value, [L]
- **QMTB**: Flow rate at the specified head HMTB, [L^3/T]

**General Head**

General head boundary conditions are defined when head values at a specified distances from boundary nodes are 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:
<table>
<thead>
<tr>
<th>NGB</th>
<th>Number of groundwater nodes with general head boundary conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>FACTH</td>
<td>Conversion factor for the head value</td>
</tr>
<tr>
<td>FACTAR</td>
<td>Conversion factor for area</td>
</tr>
<tr>
<td>INODE</td>
<td>Node number corresponding to the general head boundary condition</td>
</tr>
<tr>
<td>BH</td>
<td>Fixed head at distance BD 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), [L]</td>
</tr>
<tr>
<td>BA</td>
<td>Area of influence surrounding groundwater node INODE, [L^2]</td>
</tr>
<tr>
<td>BD</td>
<td>Distance from the groundwater node INODE to the source of the fixed head BH, [L]</td>
</tr>
</tbody>
</table>

**Small Stream Watersheds**

To account for flow from small stream watershed 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 into the groundwater equation based on the computation of surface and subsurface flow using values defined in this file.

The surface runoff and groundwater recharge characteristics are specified for each small stream watershed modeled. Defined in this file is 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 input, followed by the stream node within the model where surface runoff flows. The number of groundwater nodes that correspond to the small watershed is followed by a list that defines each groundwater identification number and the maximum recharge rate to that groundwater node during a single stress period. A value of \(-1\) for the maximum recharge rate indicates that the subsurface flow will be directly contributed to groundwater nodes, 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.

<table>
<thead>
<tr>
<th>NTWB</th>
<th>Number of small watersheds where inflows will be computed and specified as boundary flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>FACTA</td>
<td>Conversion factor for small watershed drainage area</td>
</tr>
<tr>
<td>FACTQ</td>
<td>Conversion factor for the spatial component of the unit for the maximum recharge rate</td>
</tr>
<tr>
<td>TUNIT</td>
<td>Time unit of maximum recharge rate. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.</td>
</tr>
<tr>
<td>ID</td>
<td>Small watershed identification number</td>
</tr>
<tr>
<td>IWBS</td>
<td>Watershed group number corresponding to the numbers and parameters specified for watersheds in the parameter data file Unit 7</td>
</tr>
<tr>
<td>AREAS</td>
<td>Drainage area of the small watershed, ([L^2])</td>
</tr>
<tr>
<td>IWBTS</td>
<td>Stream node that gains small watershed surface runoff contribution</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td>---</td>
<td>-------------</td>
</tr>
<tr>
<td>NWB</td>
<td>Number of groundwater nodes that correspond with the small watershed</td>
</tr>
<tr>
<td>IWB</td>
<td>Groundwater node number small watershed baseflow is routed through</td>
</tr>
<tr>
<td>QMAXWB</td>
<td>Maximum recharge rate for each node ([L^3/T]); a value of (-1) is entered to specify the groundwater node that receives baseflow from the small watersheds, whereas a positive value indicates the amount of water that can percolate through the small stream to the groundwater</td>
</tr>
</tbody>
</table>
**BOUNDARY CONDITIONS DATA FILE**

for INEM Simulation
(Unit B)

Project: INEM Version # Release
California Department of Water Resources
Filename: BOUND.DAT

File Description:

This data file contains five types of boundary conditions for each layer.
The boundary conditions are set as constant head, prescribed flux,
rating table and general head for each layer which is to be followed by
boundary conditions for small watershed inflow computation.

Layer 1 Boundary Conditions

The following lists the specified flux, constant head, rating table
and general head boundary conditions for Layer 1

<table>
<thead>
<tr>
<th>Specified flux boundary conditions specifications (Layer 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRD</td>
</tr>
<tr>
<td>FACT</td>
</tr>
<tr>
<td>It is used to convert only the spatial component of the unit;</td>
</tr>
<tr>
<td>Do NOT include the conversion factor for time component of the unit.</td>
</tr>
<tr>
<td>* e.g. Unit of flux listed in this file = AC-FT/MONTH</td>
</tr>
<tr>
<td>Consistent unit used in simulation = CU.FT/DAY</td>
</tr>
<tr>
<td>CONVTR (AC-FT/MONTH -&gt; CU.FT/MONTH) = 2.2958686E-03</td>
</tr>
<tr>
<td>TUNIT: Time unit of flux boundary conditions. This should be one of the units</td>
</tr>
<tr>
<td>recognized by MED-UST that are listed in the Main Control file.</td>
</tr>
<tr>
<td><em>Note</em> If the specified flux is zero, the nodes do not need to be specified</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NRD</td>
</tr>
<tr>
<td>1.0</td>
<td>FACT</td>
</tr>
<tr>
<td></td>
<td>TUNIT</td>
</tr>
</tbody>
</table>

Specified flux boundary condition data (Layer 1)

(Skip if there are no nodes with a specified flux, i.e. NRD = 0)

INODE: Groundwater node with a specified flux
EQ : Specified flux value at groundwater node INODE: [L^3/T]

(If less than -1000.0, then -80=1000.0) indicates the column
number in unit 9 corresponding to the time series boundary
condition data)

<table>
<thead>
<tr>
<th>INODE</th>
<th>EQ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Specified head boundary conditions specifications (Layer 1)

| NRD | Number of groundwater nodes with specified head |

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>NRD</td>
</tr>
<tr>
<td>1.0</td>
<td>FACT</td>
</tr>
</tbody>
</table>

Specified head boundary condition data (Layer 1)

(Skip if there are no nodes with a specified head, i.e. NRD = 0)

INODE: Groundwater node with a specified head
HM : Specified head value for node INODE relative to a common datum: [L]

(If less than -1000.0, then -80=1000.0) indicates the column
number in unit 9 corresponding to the time series boundary
condition data)
C INODE IN

1 260.0
22 260.0
43 260.0
64 260.0
95 260.0
160 260.0
127 260.0
140 260.0
169 260.0
190 260.0
211 260.0
232 260.0
253 260.0
274 260.0
295 260.0
316 260.0
337 260.0
359 260.0
379 260.0
400 260.0
421 260.0

C************************************************************************************
C C Rating table boundary conditions specifications (Layer 1)
C C NNB:  Number of nodes with a rating table boundary condition
C NMTB:  Number of points in the rating table
C FACTH: Conversion factor for head value
C FACTQ: Conversion factor for flow 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 flow 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) = 2.29566E-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 NEC-88 that are listed in the Main Control File.
C VALUE DESCRIPTION
C
0 / NNB
0 / NMTB
1.0 / FACTH
1.0 / FACTQ
/TUNIT

C************************************************************************************
C C Rating table boundary condition data (Layer 1)
C (Skip if there are no nodes with rating table boundary conditions, i.e. NNB = 0)
C C INODE: Node number corresponding to a rating table boundary condition
C NMTD: Head value: [L]
C QNTD: Flow rate at the specified head NMTD: [L^3/T]
C
C INODE NMTD QMTD


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 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, i.e. NGB = 0)
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 -1000.0, than -BH+1000.0 indicates the column
C number in unit 0 corresponding to the time series boundary
C condition data
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]
Layer 2 Boundary Conditions

The following lists the specified flux, constant head, rating table and general head boundary conditions for Layer 2.

Specified flux boundary conditions specifications (Layer 2)

- **NDF**: Number of nodes with specified flux
- **FACT**: Conversion factor for specified flux data
  - It is used to convert only the spatial component of the unit.
  - DO NOT include the conversion factor for time component of the unit.
  - * e.g. Unit of flux listed in this file = AC-FT/MONTH
  - Consistent unit used in simulation = CU, PT/DAY
  - Enter FACT (AC-FT/MONTH => CU, PT/DAY) = 2.29568E-05
  - (conversion of MONTH -> DAY is performed automatically)
- **UNIT**: Time unit of flux boundary conditions. This should be one of the units recognized by MODFLOW that are listed in the Main Control File.

*Note* If the specified flux is zero, the nodes do not need to be specified.

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>#/ NDF</td>
<td>/ FACT</td>
</tr>
<tr>
<td>#/ UNIT</td>
<td></td>
</tr>
</tbody>
</table>

Specified flux boundary condition data (Layer 2)

( Skip if there are no nodes with a specified flux, i.e. NDF = 0)

- **IMODE**: Groundwater node with a specified flux
- **DQ**: Specified flux value at groundwater node IMODE [L^3/T]
  - (If less than -10000.0, then -10000.0 indicates the column number in unit 9 corresponding to the time series boundary condition data)

<table>
<thead>
<tr>
<th>IMODE</th>
<th>DQ</th>
</tr>
</thead>
</table>

Specified head boundary conditions specifications (Layer 2)

- **NHB**: Number of groundwater nodes with specified head
- **FACT**: Conversion factor for specified head data

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>#/ NHB</td>
<td>/ FACT</td>
</tr>
</tbody>
</table>

Specified head boundary condition data (Layer 2)

( Skip if there are no nodes with a specified head, i.e. NHB = 0)

- **IMODE**: Groundwater node with a specified head
- **BH**: Specified head value for node IMODE relative to a common datum [L]
  - (If less than -10000.0, then -10000.0 indicates the column number in unit 9 corresponding to the time series boundary condition data)

<table>
<thead>
<tr>
<th>IMODE</th>
<th>BH</th>
</tr>
</thead>
</table>

Rating table boundary conditions specifications (Layer 2)

- **NRC**: Number of nodes with a rating table boundary condition
- **NMTH**: Number of points in the rating table
- **FACTH**: Conversion factor for head value
- **FACTQ**: Conversion factor for flow rate
  - It is used to convert only the spatial component of the unit.
  - DO NOT include the conversion factor for time component of the unit.
  - * e.g. Unit of flow rate listed in this file = AC-FT/MONTH
  - Consistent unit used in simulation = CU, PT/DAY
  - Enter FACT (AC-FT/MONTH => CU, PT/DAY) = 2.29568E-05
  - (conversion of MONTH -> DAY is performed automatically)

4-52
c TUNIT: Time unit of flow rate. This should be one of the units
	recognized by HEC-USG that are listed in the Main Control File.
c
VALUE DESCRIPTION
* / MNS / HRT / FACTH / FACTQ / TUNIT

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
VALUE DESCRIPTION
* / NGB / FACTH / FACTAR

General head boundary conditions data (Layer 2)
c (Skip if there are no nodes with general head boundary conditions, ie. NGB = 0)
c c INODE: Node number corresponding to the general head boundary condition
 c BH: Fixed head at the distance from the groundwater node INODE: [L]
 c [If less than -10998.8, then -00010998.80 indicates the column number in unit 9 corresponding to the time series boundary condition data]
 c RA: Area of influence surrounding groundwater node INODE: [L^2]
 c RD: Distance from the groundwater node INODE to the source of the fixed head BH: [L]
c
* *

Boundary Conditions for Small Watershed Inflow Computation
c c NTWM: Number of small watersheds where inflows will be computed
 c and specified as boundary flux
 c FACTW: 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 * e.g. Unit of max. recharge rate listed in this file = AC-FT/MNTH
 c Consistent unit used in simulation
 c Entax FACT (AC-FT/MNTH -> CU,FT/DAY)
 c (conversion of MNTH -> DAY is performed automatically)
 c TUNIT: Time unit of max. recharge rate. This should be one of the units
 c recognized by HEC-USG that are listed in the Main Control File.
 c ID: Small watershed identification number
 c INWS: Watershed group number corresponding to the watershed parameter
 c groups specified in the parameter data file unit 7
 c AREAS: Drainage area of the small watershed: [L^2]
 c INMW: Stream node that receives the surface runoff from the small watershed
 c NMB: Number of groundwater nodes that receive the base flow and the percolation of surface flow from the small watershed
 c INW: Groundwater node number small watershed baseflow is routed through
 c (Specify) Maximum recharge rate for each node: [L^3/T]
 c (Enter -1 to specify which groundwater node(s) receive baseflow
 c from the small watersheds)
 c
* Note: Skip data input if no small watersheds are modeled (NTWM=0)

VALUE DESCRIPTION
* *
<table>
<thead>
<tr>
<th>ID</th>
<th>ID</th>
<th>ID</th>
<th>ID</th>
<th>ID</th>
<th>ID</th>
<th>ID</th>
<th>ID</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>5.0</td>
<td>1</td>
<td>2</td>
<td>452</td>
<td>-1</td>
<td>452</td>
<td>-1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>5.0</td>
<td>3</td>
<td>3</td>
<td>436</td>
<td>-1</td>
<td>414</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>382</td>
<td>5.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>5.0</td>
<td>21</td>
<td>2</td>
<td>15</td>
<td>-1</td>
<td>35</td>
<td>2.0</td>
</tr>
</tbody>
</table>
Time Series Boundary Condition File  Unit 9

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 (Unit 8). 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. It should be noted that the following example file is specified for a non-time tracking simulation since the time of the data is given as integer values.

The parameters specified in this file are as follows:

- **NBTSD**: Number of columns
- **FACTHTS**: Conversion factor for head values
- **FACTQTS**: Conversion factor for the spatial component of the unit for the flow values. The time component of the unit is taken to be the interval of the time series data.
- **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). 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 ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text 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 [L³/T] depending on 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
**INTEGRATED WATER FLOW MODEL (IWF)*** Version ***

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

**TIME SERIES BOUNDARY CONDITION DATA**
for IWF Simulation
(Unit 9)

Project:  IWF Version *** Release
California Department of Water Resources
Filename: BOUNDARY.DAT

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

File Description

This data file contains the time series data for the specified flow, specified head and/or general head boundary conditions. The file provides
time series data for the groundwater nodes specified in boundary condition
data file (Unit 9).

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

Time Series Boundary Condition Specifications

The following lists the time series values for the groundwater nodes
specified in Unit 9.

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>/ NETMD</td>
</tr>
<tr>
<td>1.0</td>
<td>/ FACTVTS</td>
</tr>
<tr>
<td>1.0</td>
<td>/ FACTVTS</td>
</tr>
<tr>
<td>20</td>
<td>/ NFNTS</td>
</tr>
<tr>
<td>0</td>
<td>/ NFNTS</td>
</tr>
<tr>
<td></td>
<td>/ DSSFL</td>
</tr>
</tbody>
</table>

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

Time Series Boundary Condition Data

*[READ FROM THIS FILE]*

List the time series boundary condition data below, if it will not be read
from a DSS file (i.e. DSSFL is left blank above).

<table>
<thead>
<tr>
<th>ITWTS</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWS(1) HWS(2) HWS(3) ...</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>8.2</td>
</tr>
<tr>
<td>31</td>
<td>8.1</td>
</tr>
<tr>
<td>61</td>
<td>9.9</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>11101</td>
<td>4.8</td>
</tr>
<tr>
<td>11131</td>
<td>5.5</td>
</tr>
</tbody>
</table>

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

Pathnames for Time Series Boundary Condition Data

*[READ FROM DSS FILE]*

List the pathnames for the time series boundary condition data below, if it will be read
from a DSS file (i.e. DSSFL is specified above).

<table>
<thead>
<tr>
<th>REC</th>
<th>Time series record number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PATH</td>
<td>Pathname for the time series record</td>
</tr>
</tbody>
</table>

*************************************************************
Printing Control File

This data file contains the instructions for printing groundwater, stream and tile drain/subsurface irrigation hydrograph information as well as subsidence, and the flow at boundary nodes and element faces. The tile drain/subsurface irrigation hydrographs are printed to Unit 45, stream hydrographs to Unit 46 and the groundwater hydrographs to Unit 47. Subsidence is printed to Unit 41, the element face flows are printed to Unit 43 and the boundary node flows to Unit 44.

Groundwater hydrographs can be printed at specified groundwater nodes or at locations defined by x-y coordinates and layer number. 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. If hydrographs at a layer other than the top most layer are desired, then enter the layer number and the node number at the top most layer. For instance, to print hydrographs at node 35 at layers 1 and 2 specify two entries: (i) IOUTHL = 1 and IOUTH = 35 and (ii) IOUTHL = 2 and
IOUTH = 35. The procedure is the same if hydrographs at multiple layers at an x-y location are desired.

Next, the number of stream hydrographs (NOUTR), stream hydrograph output values (IHSQR) and stream node numbers must be specified. The stream hydrographs can represent stream flows (IHSQR=0) or stream surface elevations (IHSQR=1). If no stream hydrographs are required, then NOUTR must be set to zero.

To print out tile drain/subsurface irrigation hydrographs number of required hydrographs (NOUTTD) and the corresponding groundwater node numbers (IOUTTD) should be specified. If no tile drain/subsurface irrigation hydrographs are required, NOUTTD should be 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. The nodes for which flow printing are requested should be specified boundary conditions in file Unit 8.

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 is 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:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOUTH</td>
<td>Total number of groundwater hydrographs to be printed; set NOUTH = 0 if no groundwater hydrograph data is to be printed</td>
</tr>
<tr>
<td>FACT</td>
<td>Factor to convert nodal coordinates into simulation unit of length. If FACT = 0.0 the input data is by nodes; if FACT &gt; 0.0 the input data is by x-y coordinates</td>
</tr>
<tr>
<td>IOUTHL</td>
<td>Layer number (IOUTHL = 0 to print average head for all layers)</td>
</tr>
<tr>
<td>X</td>
<td>The x-coordinate of the well location (specify only if FACT &gt; 0.0), [L]</td>
</tr>
<tr>
<td>Y</td>
<td>The y-coordinate of the well location (specify only if FACT &gt; 0.0), [L]</td>
</tr>
<tr>
<td>IOUTH</td>
<td>Groundwater node number (specify only if FACT = 0.0)</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>NOUTR</td>
<td>Total number of stream hydrographs to be printed; NOUTR = 0 if no stream</td>
</tr>
<tr>
<td></td>
<td>hydrograph data is to be printed</td>
</tr>
<tr>
<td>IHSQR</td>
<td>Switch for the output of stream surface elevations or stream flows;</td>
</tr>
<tr>
<td></td>
<td>IHSQR = 0 if output of stream flows is desired, IHSQR = 1 if output of</td>
</tr>
<tr>
<td></td>
<td>stream surface elevations is desired</td>
</tr>
<tr>
<td>IOUTR</td>
<td>Stream node number for printing hydrograph output</td>
</tr>
<tr>
<td>NOUTTD</td>
<td>Total number of tile drain/subsurface irrigation hydrographs to be printed;</td>
</tr>
<tr>
<td></td>
<td>NOUTTD = 0 if no tile drain/subsurface irrigation hydrograph is to be printed</td>
</tr>
<tr>
<td>IOUTTD</td>
<td>Groundwater node number corresponding to the tile drain/subsurface irrigation</td>
</tr>
<tr>
<td></td>
<td>location for hydrograph printing</td>
</tr>
<tr>
<td>NOUTS</td>
<td>Total number of subsidence data to be printed; NOUTS = 0 if no subsidence</td>
</tr>
<tr>
<td></td>
<td>data is to be printed</td>
</tr>
<tr>
<td>FACT</td>
<td>Factor to convert nodal coordinates into simulation unit of length.</td>
</tr>
<tr>
<td></td>
<td>If FACT = 0.0 the subsidence print-out locations are by nodes; if FACT &gt; 0.0</td>
</tr>
<tr>
<td></td>
<td>the they are by x-y coordinates</td>
</tr>
<tr>
<td>IOUTSL</td>
<td>Layer number (IOUTSL = 0 to print total subsidence for all layers)</td>
</tr>
<tr>
<td>X</td>
<td>The x-coordinate of the location for which subsidence will be printed</td>
</tr>
<tr>
<td></td>
<td>(specify only if FACT &gt; 0.0), [L]</td>
</tr>
<tr>
<td>Y</td>
<td>The y-coordinate of the location for which subsidence will be printed</td>
</tr>
<tr>
<td></td>
<td>(specify only if FACT &gt; 0.0), [L]</td>
</tr>
<tr>
<td>IOUTS</td>
<td>Groundwater node number for subsidence print-out (specify only if FACT = 0.0)</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>NOUTB</td>
<td>Total number of flow hydrographs at boundary nodes to be printed; NOUTB = 0 if no hydrographs at boundary nodes are to be printed</td>
</tr>
<tr>
<td>IOUTBL</td>
<td>Layer number of the groundwater boundary node for hydrograph printing</td>
</tr>
<tr>
<td>IOUTB</td>
<td>Groundwater node number for boundary node hydrograph printing</td>
</tr>
<tr>
<td>NOUTF</td>
<td>Number of element faces for flow printing</td>
</tr>
<tr>
<td>IOUTFL</td>
<td>Aquifer layer number that an element face is located</td>
</tr>
<tr>
<td>IOUTFA</td>
<td>The first groundwater node number that defines the element face</td>
</tr>
<tr>
<td>IOUTFB</td>
<td>The second groundwater node number that defines the element face</td>
</tr>
</tbody>
</table>
INTEGRATED WATER FLOW MODEL (IWFM)

*** Version ***

PRINT CONTROL DATA FILE
for IWFM Simulation
(Unit 10)

Project: IWFM Version *** Release
California Department of Water Resources
Filename: PRINT.DAT

File Description:
This data file contains the print output control data including a list of
the groundwater, stream and tile drain nodes for which hydrographs will be
printed, and a list of the boundary nodes for which groundwater flow will be
printed.

Groundwater Hydrograph Print Control Specifications

NOUTH: Total number of hydrographs to be printed
     (set NOUTH = 0 if no hydrograph data is to be printed)
FACT : Conversion factor for nodal coordinates
     If FACT > 0.3 the input data is in Y coordinates

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>/ NOUTH</td>
</tr>
<tr>
<td>0.3</td>
<td>/ FACT</td>
</tr>
</tbody>
</table>

The following lists the layer number and groundwater node number for
each groundwater hydrograph to be printed (skip if no hydrographs are
to be printed, i.e. NOUTH = 0)

LOUTH LOUTH
X Y LOUTH

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>433</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>412</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>391</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

Stream Hydrograph Print Control Specifications

NOUTS: Total number of hydrographs to be printed
     (NOUTS = 0 if no stream hydrograph data is to be printed)
INHQR: Switch for the output of stream surface elevations or stream flows:
     INHQR = 0 if output of stream flows is desired.
     INHQR = 1 if output of stream surface elevations is desired

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>/ NOUTS</td>
</tr>
<tr>
<td>23</td>
<td>/ INHQR</td>
</tr>
</tbody>
</table>

The following lists the stream node number for hydrograph to be printed
(skip if no hydrographs are to be printed, i.e. NOUTS = 0)

LOUTS

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>13</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>15</td>
</tr>
</tbody>
</table>
Tile Drain/Subsurface Irrigation Hydrograph Print Control Specifications

NOUTTD: Total number of tile drain/subsurface irrigation hydrographs to be printed
(set NOUTTD = 0 if no hydrographs are to be printed)

VALUE DESCRIPTION

The following lists the tile drain/subsurface irrigation node number (i.e. corresponding groundwater node) for hydrograph to be printed.
(skip if no hydrographs are to be printed, i.e., NOUTTD = 0)

IOUTTD: Tile drain/subsurface irrigation node number for printing hydrograph output

---------------------------------------------------------------

Subsidence Print Control Specifications

NOUTS: Total number of subsidence data to be printed
(set NOUTS = 0 if no subsidence data is to be printed)

FACT: Conversion factor for nodal coordinates
IF FACT = 0.0 the input data is in nodal
IF FACT > 0.0 the input data is in X-Y coordinates

---------------------------------------------------------------

VALUE DESCRIPTION

0 / NOUTS
1.0 / FACT

The following lists the layer number and groundwater node number for each subsidence data to be printed (skip if no subsidence data is to be printed, i.e., NOUTS = 0)

IOUTS: Layer number (IOUTS = 0 to print subsidence for all layers)
X : The x-coordinate of the subsidence data location (specify ONLY if FACT > 0.0); [L]
Y : The y-coordinate of the subsidence data location (specify ONLY if FACT > 0.0); [L]
IOUTS: Groundwater node number (specify ONLY if FACT = 0.0)

---------------------------------------------------------------

Boundary Node Flow Print Control

The following lists the boundary nodes and layers for which flow values will be printed

NOUTB: Total number of flow hydrographs to be printed (set NOUTB = 0 if no flow hydrographs are to be printed)

---------------------------------------------------------------

VALUE DESCRIPTION

0 / NOUTB

The following lists the layer number and groundwater node number for each flow hydrograph to be printed (skip if no flow hydrograph is to be printed, i.e., NOUTB = 0)

IOUTFL: Layer number
IOUTB: Groundwater node number for flow hydrograph output

---------------------------------------------------------------

Element Face Flow Print Control

---------------------------------------------------------------
The following lists the element faces for which the flow output is desired

<table>
<thead>
<tr>
<th>Verse 4-65</th>
</tr>
</thead>
<tbody>
<tr>
<td>\nC NOUTF : Number of element faces for flow output \nC \nC \nC VALUE DESCRIPTION \nC \n\n3 \n\n\n\n/</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>
**Initial Conditions File**

This data file contains the initial aquifer head values for each node and layer, initial soil moisture conditions for root zone, unsaturated zone and small watersheds and initial lake surface elevations. 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 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 root zone, unsaturated zone and small stream watersheds modeled. If the subregion number for initial root zone soil moisture, element number for initial unsaturated zone soil moisture or small watershed number is specified as zero, then the values specified are used for all subregions, elements or small watersheds, respectively. Initial root zone moisture can be
specified as volume or as a fraction of the average field capacity for each subregion and land use type. The following variables are used to input initial soil moisture conditions:

**FACTSM** Conversion factor for volumetric initial root zone moisture; if initial root zone moisture is to be specified as a fraction of the root zone depth, then specify a value 0.0

**ID** Subregion number for initial soil moisture in root zone or element number for initial soil moisture in unsaturated zone; specify as zero if the following initial moisture conditions are to be used for all subregions for initial root zone moisture or for all elements for initial unsaturated zone moisture

**SOILM** Initial soil moisture as a volume or as a fraction of the field capacity for each subregion, land use type and soil group, [L^3] or [L/L] depending on the value of FATSM

**FACT** Weighting factor for initial unsaturated zone soil moisture or conversion factor for initial groundwater storage for small watersheds

**UNSATM** Initial soil moisture for each layer of the unsaturated zone as fraction of the total porosity given for the unsaturated layers, [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 as a fraction of field capacity, [L/L]

**GWSTS** Initial groundwater storage for each watershed, [L]
**Initial Lake Elevations**

Initial lake elevations are also listed in this file. This section should be skipped if there are no lakes being modeled. The following variables are required to be set:

- **FACT** Conversion factor for initial lake elevations
- **ILAKE** Sequential lake number
- **HLAKE** Initial lake elevation, [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 Unit 7 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 thicknesses at corresponding groundwater nodes, [L]

**Pre-Consolidation Head values for Land Subsidence**

All pre-consolidation head values are specified for each layer modeled in IWFM in the parameter file (Unit 7). This section of the initial conditions data file is used if pre-consolidation heads specified previously are to be overwritten.
<table>
<thead>
<tr>
<th>FACT</th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HC</td>
<td>Pre-consolidation head at corresponding groundwater node, [L]</td>
</tr>
</tbody>
</table>

**INTEGRATED WATER FLOW MODEL (IWF)***  
Version ***  

**INITIAL CONDITIONS DATA FILE**  
for IWF Simulation  
(Unit Il)  

Project: IWF Version ***  
Release California Department of Water Resources  
Filename: INIT.GAT  

---

**File Description**  
This data file contains the initial head at each groundwater node for  
each aquifer (layer) modeled; the initial soil moisture values for root zone,  
unsaturated zone and small watershed; initial saturated thickness to overwrite  
the values set in parameter data file; initial preconsolidation head values  
that overwrite the values set in the parameter data file and initial lake  
elevations.  

---

**Initial Aquifer Head Values**  

FACT: Conversion factor for initial heads  

<table>
<thead>
<tr>
<th>Layer</th>
<th>Initial Head at Layer</th>
<th>HP</th>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

---

**Initial Soil Moisture Conditions**  
Following are the initial soil moisture conditions for the root zone, the  
unsaturated zone, and the small subwatersheds in the model. These set of data  
need to be provided only if there is at least one rain gage that is specified  
in pre-processor. Skip if no rain gage is specified.
Initial Soil Moisture Condition

FACTM: Conversion factor for volumetric initial root zone moisture
(enter 0.0 if initial moisture condition is given as a
dimensionless quantity)

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>FACTM</td>
</tr>
</tbody>
</table>

ID: Subregion No. (0 if following values are to be used for all subregions)
SCM: Initial root zone moisture for corresponding land use type
for each soil group: [L^3] or [L/L]

<table>
<thead>
<tr>
<th>Land use type</th>
<th>Aq.</th>
<th>Urban</th>
<th>Native Veg.</th>
<th>Riparian Veg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.9</td>
<td>0.0</td>
</tr>
<tr>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.8</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Initial Soil Moisture Conditions
For Unsaturated Zone

FACT: Weighting factor for initial unsaturated zone soil moisture

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>FACT</td>
</tr>
</tbody>
</table>

ID: Element No. (0, if following values are to be used for all elements)
USMN: Initial soil moisture content for each layer of the
unsaturated zone [L/L]

Unsaturated Layers

<table>
<thead>
<tr>
<th>ID</th>
<th>Layer</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Initial Soil Moisture Conditions
For Small Watersheds

FACT: Conversion factor for initial groundwater storage for each of the
small watershed

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>FACT</td>
</tr>
</tbody>
</table>

ID: Watershed No (0, if following values are to be used for all watersheds)
SOILS: Initial soil moisture content for each watershed [L/L]
GWMT: Initial groundwater storage for each watershed [L]

<table>
<thead>
<tr>
<th>ID</th>
<th>SOILS</th>
<th>GWMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0</td>
<td>19.0</td>
</tr>
</tbody>
</table>

Initial Lake Elevations
(Skip if there are no lakes simulated)

FACT: Conversion factor for initial lake elevations
ILAKE: Sequential lake number
HLAKE: Initial lake elevations [L]

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>FACT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ILAKE</th>
<th>HLAKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>286.6</td>
</tr>
</tbody>
</table>

Interbed Thickness for Each Layer

The following lists the initial interbed thicknesses for each node (in
sequential order) to overwrite what is specified in the parameter file.

FACT: Conversion factor for initial interbed thickness
4-72

---

C (enter 0.0 if the values specified in the parameter file will not
be overwritten).
C DC ; Initial interbed thickness: [L]
---

C Layer 1
C VALUE DESCRIPTION
---

1.0 / FACT

C Initial interbed thickness at Layer 1
C DC
---

12.00 12.00 12.00 12.00 12.00 10.00 12.00 7.00 14.00 11.00
22.00 26.00 23.00 8.00 8.60 13.00 23.00 8.00 8.00 8.00
- - - - - - - - - -
- - - - - - - - - -
17.00 33.00 101.00 104.00 105.00 42.00 44.00 65.00 81.00 65.00
65.00 65.00 65.00
---

C Layer 2
C VALUE DESCRIPTION
---

1.0 / FACT

C Initial interbed thickness at Layer 2
C DC
---

4.00 4.00 4.00 5.00 4.00 3.00 4.00 4.00 4.00 3.00
5.00 5.00 5.00 5.00 5.00 4.00 5.00 4.00 5.00 5.00
- - - - - - - - - -
- - - - - - - - - -
35.00 0.00 155.00 132.00 6.00 129.00 151.00 0.00 0.00
0.00 0.00 6.00
---

C Layer 3
C VALUE DESCRIPTION
---

0.0 / FACT

C Interbed Thickness for Layer 3
C DC
---

---

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 FACT: Conversion factor for preconsolidation head
C (enter 0.0 if the values specified in the parameter file will not
be overwritten).
C HC ; Initial preconsolidation head at corresponding groundwater node: [L]
---

C Layer 1
C VALUE DESCRIPTION
---

1.0 / FACT

C Initial preconsolidation head at Layer 1
C HC
---

255.00 494.00 521.00 475.00 394.00 436.00 438.00 361.00 393.00 399.00
293.00 389.00 622.00 571.00 322.00 331.00 281.00 517.00 567.00 572.00
- - - - - - - - - -
- - - - - - - - - -
481.00 750.00 422.00 414.00 346.00 750.00 522.00 451.00 505.00 750.00
750.00 750.00 750.00
---
<table>
<thead>
<tr>
<th>Layer 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VALUE</strong></td>
</tr>
<tr>
<td>--------------------------------</td>
</tr>
<tr>
<td>1.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reconsolidation Head at Layer 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>----</td>
</tr>
<tr>
<td>412.00</td>
</tr>
<tr>
<td>383.00</td>
</tr>
<tr>
<td>445.00</td>
</tr>
<tr>
<td>750.00</td>
</tr>
</tbody>
</table>
Supply Adjustment Specifications File  Unit 12

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 surface water diversion specification file (Unit 25) or through the pumping specification file (Unit 23). This file is required when KOPTDV is set to a value other than 00 in the main input file (Unit 5). 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 2100) that covers the entire period.

The following variables are required to be set:

NCOLADJ  Number of columns in the supply adjustment specifications data file

NSPADJ  Number of time step 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 ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text 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:
<table>
<thead>
<tr>
<th>REC</th>
<th>Record number that coincides with the data column number for the time series data.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PATH</td>
<td>Pathname for the time series record that will be used for data retrieval</td>
</tr>
</tbody>
</table>
SUPPLY ADJUSTMENT SPECIFICATIONS
for IMM Simulation
(Unit 12)

Project: IMM Version ### Release
California Department of Water Resources
Filename: SUPPLYADJ.DAT

File Description
This data file contains the time series specifications for the adjustment of
calculations that affect water diversions and groundwater pumping. The data contains information
to specify if a diversion or pumping should be adjusted to meet agricultural
demand, urban demand or both. This file is required when <DIVI> is set to a
value other than 0 in the main input file (Unit 5).

Supply Adjustment Specifications
The following lists the time-series specifications for supply adjustment options
for surface water diversions and groundwater pumping.

NCOLADJ: Number of columns (or pathnames if DSS files are used) in the supply
calculations for adjusting specifications data
NSPAJD: Number of time steps to update the supply adjustment specifications data
NFADJ: Repetition frequency of the supply adjustment specifications data
DSSFL: The name of the DSS file for data input (maximum 50 characters):
* Leave blank if DSS file is not used for data input

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NCOLADJ</td>
</tr>
<tr>
<td>1</td>
<td>NSPAJD</td>
</tr>
<tr>
<td>1</td>
<td>NFADJ</td>
</tr>
<tr>
<td></td>
<td>DSSFL</td>
</tr>
</tbody>
</table>

Supply Adjustment Specifications Data
(READ FROM THIS FILE)

List the time series supply adjustment specifications data below. If it will
not be read from a DSS file (i.e., DSSFL is left blank above).

IPADJ: Time
KADJ: Supply adjustment option. Enter two digits as follows:
1st digit (from left):
0 = No adjustment of supply to meet agricultural water demand
1 = Yes, adjust supply to meet agricultural water demand
2nd digit (from left):
0 = No adjustment of supply to meet urban water demand
1 = Yes, adjust supply to meet urban water demand

Pathnames for Supply Adjustment Specifications Data
(READ FROM DSS FILE)

List the pathnames for supply adjustment specifications data below, if it will
be read from a DSS file (i.e., DSSFL is specified above).

REC: Time series record number
PATH: Pathname for the time series record
Land Use Data File

The land use data file specifies the area (or fraction of area relative to the total elemental area) associated with each land use type within an element. The four land use types modeled in IWFM are agricultural, urban, native and riparian lands. Elemental areas must be specified for each land use type at all specified time steps. If a land use type does not exist within an element, define the area as zero. Similarly, if the user does not want to model a specified land use type, the area should be entered as zero for all elements. A pre-processor is available that interpolates and extrapolates survey year land use areas given that a complete time-series data set of subregional areas is provided.

The factor to convert land use areas to the simulation unit of area, the number of time steps to update the data, and the repetition frequency of the data file must be specified in this file. This information is followed by the value that represents the time (ITLN), as well as all elements and the land use areas within each element. In non-time tracking simulations, the time series data set can be represented by any frequency, as long as the correct time step controls are set (NSPLN and NFQLN) and they correspond to the time step controls set in crop acreage data file (Unit 14). In time tracking simulations the time series land use 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 input to Unit 13 is as follows:

FACTLN Conversion factor for land use area; a value of 0.0 should be entered when land use areas are specified as a fraction of the total elemental area
NSPLN  Number of time steps to update the land use data; the value must
equal the number of time steps to update the crop acreage data file
(NSPCR in Unit 14). If time tracking simulation, enter any
number.

NFQLN  Repetition frequency of the land use data; NFQLN must equal
NFQCR specified in Unit 14 and NFQLN is set to zero for a time
series data file that includes the entire simulation period. 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 ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text 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.

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

IE  Element identification number

ALAND  Area corresponding to each land use type (agricultural, urban,
native vegetation and riparian vegetation) over an element, [L^2]
**Data Input from DSS File**

If time series data is stored in a DSS file then the following variables should be populated. The element and the land use type identification numbers should be entered sequentially such that the land use type changes first.

<table>
<thead>
<tr>
<th><strong>IE</strong></th>
<th>Element identification number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LUTYPE</strong></td>
<td>Land use type. 1 = agricultural land, 2 = urban land, 3 = native vegetation land, 4 = riparian vegetation land.</td>
</tr>
<tr>
<td><strong>PATH</strong></td>
<td>Pathname for the time series data for the corresponding element and land use type combination</td>
</tr>
</tbody>
</table>
4-81
C NE 4 |pathname|{4*NE} |}
C
C IE : Element number
C LUTYPE : Land use type
C 1 = Agricultural
C 2 = Urban
C 3 = Native vegetation
C 4 = Riparian vegetation
C PATH : Pathname corresponding to element and land use type combination
C
C--------------------------------------------------
C IE LUTYPE PATH
C--------------------------------------------------
1 1 /INFM/G1_AG/AREA/\1YEAR/LAND_USE/
2 1 /INFM/G1_NV/AREA/\1YEAR/LAND_USE/
1 4 /INFM/G1_RV/AREA/\1YEAR/LAND_USE/
2 1 /INFM/G2_AG/AREA/\1YEAR/LAND_USE/
2 2 /INFM/G2_NV/AREA/\1YEAR/LAND_USE/
2 3 /INFM/G2_RV/AREA/\1YEAR/LAND_USE/
2 4 /INFM/G2_RV/AREA/\1YEAR/LAND_USE/
400 1 /INFM/G400_AG/AREA/\1YEAR/LAND_USE/
400 2 /INFM/G400_NV/AREA/\1YEAR/LAND_USE/
400 3 /INFM/G400_RV/AREA/\1YEAR/LAND_USE/
400 4 /INFM/G400_RV/AREA/\1YEAR/LAND_USE/
Crop Acreage Data File

Unit 14

This file contains the time series subregional acreages for all crops modeled as well as non-agricultural land use types in the modeled area. This includes urban, native, and riparian areas which are the last three listed for each time step. The sum of all crop and non-agricultural land use type areas given for a subregion should equal the subregional area specified in the model. For each time step specified, all subregional crop and non-agricultural areas are specified. In non-time tracking simulations the time series data set can be comprised of any frequency, as long as the correct time step controls are set (NSPCR and NFQCR) and they correspond to the time step controls set in Unit 13. In time tracking simulations the time series crop acreage 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 terms and descriptions encompass the data input to Unit 14:

NCOLCR  Total number of crops and non-agricultural land use types modeled
FACTCR  Factor to convert crop area to simulation unit of area
NSPCR   Number of time steps to update the subregional acreage data;
         NSPCR must equal the value specified for NSPLN in Unit 13. If time tracking simulation, enter any number.
NFQCR   Repetition frequency of the subregional acreage data; NFQCR must equal NFQLN specified in Unit 13. NFQLN is set to zero when this file includes a time-series data defined for the entire simulation period. 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 ASCII text file.

**Data Input from ASCII Text File**

If the time series data is listed in the same ASCII text 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.

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

IR  Subregion identification number

ACROP  Area of crop and land use types within each subregion, [L²]

**Data Input from DSS File**

If time series data is stored in a DSS file then the following variables should be populated. The subregion and the crop/land use type identification numbers should be entered sequentially such that the crop/land use type changes first. For a particular subregion the time series data pathnames for agricultural crops are entered first, followed by the pathnames for the urban, native vegetation and riparian vegetation lands.

IR  Subregion identification number

CRTYPE  Crop/land use type identification number

PATH  Pathname for the time series data for the corresponding subregion and crop/land use type combination
INTRODUCTION

**version III**

**Crop Acreage Data File**

*for UFWM Simulation*

(Unit 14)

Project: UFWM Version II Release
California Department of Water Resources

Filename: CROPAREA.DAT

This data file contains the time-series crop acreage data for each sub-region.

Crop Acreage Data Specifications

- **NCOLOR**: Total number of crop and non-agricultural land use types (or pathnames if DSS files are used)
- **FACTOR**: Conversion factor for crop area
- **NFCHR**: Number of time steps to update the crop acreage data
  (Note: This value should be equal to NFUM in land use data file)
  * Enter any number if time-tracking option is on
- **NFQCR**: Repetition frequency of the crop acreage data
  (Note: This value should be equal to NFQUM in land use data file)
  * Enter 0 if full time series data is supplied
  * Enter any number if time-tracking option is on
- **DS8FL**: The name of the DSS file for data input (maximum 50 characters);
  * Leave blank if DSS file is not used for data input

**Value Description**

- 5 / NOCOLOR
- 49569.0 / FACTOR
- 1 / NFCHR
- 0 / NFQCR
- / DS8FL

Crop Acreage Data

(Read from this file)

List the acreage for each crop and non-agricultural land use type for each sub-region below, if it will not be read from a DSS file (i.e., DS8FL is left blank above).

- **ITCHR**: Time of crop survey
- **IR**: Subregion number
- **ACROP**: Acreage of crop or land use type in corresponding sub-region: [L-2]

```
# **Crop/Land Use No.**   **Name**
# ------------------------
# 1 FA = PASTURE
# 2 AL = ALFALFA
# 3 UR = URBAN
# 4 NV = NATIVE VEGETATION
# 5 RV = RIPLEAF VEGETATION
```

<table>
<thead>
<tr>
<th><strong>ITCHR</strong></th>
<th><strong>IR</strong></th>
<th><strong>ACROP(1)</strong></th>
<th><strong>ACROP(2)</strong></th>
<th><strong>ACROP(3)</strong></th>
<th><strong>ACROP(4)</strong></th>
<th><strong>ACROP(5)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>09/30/1982_24:00</td>
<td>1</td>
<td>11704</td>
<td>405</td>
<td>26601</td>
<td>281334</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>41660</td>
<td>9100</td>
<td>17917</td>
<td>515377</td>
<td>0</td>
</tr>
<tr>
<td>09/30/1993_24:00</td>
<td>1</td>
<td>13514</td>
<td>405</td>
<td>32415</td>
<td>270502</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>42500</td>
<td>6000</td>
<td>10147</td>
<td>524047</td>
<td>0</td>
</tr>
<tr>
<td>09/30/1994_24:00</td>
<td>1</td>
<td>13502</td>
<td>405</td>
<td>32398</td>
<td>274359</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>43600</td>
<td>6100</td>
<td>10378</td>
<td>510616</td>
<td>0</td>
</tr>
</tbody>
</table>

Pathnames for Crop Acreage Data

(Read from DSS file)

List the pathnames for the crop acreage data below, if it will be read from a DSS file (i.e., DS8FL is specified above).

The pathnames should be listed for each sub-region, crop/non-agricultural land use type combination. They should be listed in an order such that the
Crop/land use type changes first.

Example: [simulation includes 3 agricultural crops: total of 6 crop and non-agricultural land use types]:

<table>
<thead>
<tr>
<th>IR</th>
<th>CMTYPE</th>
<th>PATH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>$(\text{pathname}[1])$ =&gt; Sub-region 1: crop 1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>$(\text{pathname}[2])$ =&gt; Sub-region 1: crop 2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>$(\text{pathname}[3])$ =&gt; Sub-region 1: crop 3</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>$(\text{pathname}[4])$ =&gt; Sub-region 1: urban land</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>$(\text{pathname}[5])$ =&gt; Sub-region 1: native veg.</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>$(\text{pathname}[6])$ =&gt; Sub-region 1: riparian veg.</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>$(\text{pathname}[7])$ =&gt; Sub-region 2: crop 1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>$(\text{pathname}[8])$ =&gt; Sub-region 2: crop 2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>$(\text{pathname}[9])$ =&gt; Sub-region 2: crop 3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>$(\text{pathname}[10])$ =&gt; Sub-region 2: urban land</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>$(\text{pathname}[11])$ =&gt; Sub-region 2: native veg.</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>$(\text{pathname}[12])$ =&gt; Sub-region 2: riparian veg.</td>
</tr>
</tbody>
</table>

IR: Subregion number
CMTYPE: Crop/non-agricultural land use type
PATH: Pathname corresponding to sub-region and crop/non-agricultural land use type combination
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. The factors that convert the precipitation at rainfall stations to the precipitation over the elements are listed in the element characteristic input file in pre-processor. The rainfall data for a station associated with an element is multiplied by the factor defined in the pre-processor to obtain the rainfall rate over an element.

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:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRAIN</td>
<td>Number of rainfall stations used in the model</td>
</tr>
<tr>
<td>FACTRN</td>
<td>Conversion factor for the spatial component of the unit for the rainfall rate</td>
</tr>
<tr>
<td>NSPRN</td>
<td>Number of time steps to update the precipitation data. If time tracking simulation, enter any number.</td>
</tr>
<tr>
<td>NFQRN</td>
<td>Repetition frequency of the precipitation data (enter zero if full time series data is supplied). If time tracking simulation, enter any number.</td>
</tr>
</tbody>
</table>
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 ASCII text file.

**Data Input from ASCII Text File**

If the time series data is listed in the same ASCII text 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
# Precipitation Data File

**For INFM Simulation**

**Project:** INFM Version *** Release

**Filename:** PRECIP.DAT

*This data file contains the time-series rainfall at each rainfall station used in the model.*

---

**Rainfall Data Specifications**

- **NRAIN:** Number of rainfall stations (or pathnames if DDS files are used)
- **FACTHN:** Conversion factor for rainfall rate
  - Used to convert only the spatial component of the unit.
- **NSFRN:** Number of time steps to update the precipitation data
  - Enter any number if time-tracking option is on
- **NPQM:** Repetition frequency of the precipitation data
  - Enter 0 if full time series data is supplied
- **DSFNL:** The name of the DDS file for data input (maximum 50 characters)
  - Leave blank if DDS file is not used for data input

---

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2</strong></td>
<td>/ NRAIN</td>
</tr>
<tr>
<td>0.0027778</td>
<td>/ FACTHN</td>
</tr>
<tr>
<td><strong>1</strong></td>
<td>/ NSFRN</td>
</tr>
<tr>
<td>1</td>
<td>/ NPQM</td>
</tr>
<tr>
<td></td>
<td>/ DSFNL</td>
</tr>
</tbody>
</table>

---

**Rainfall Data**

*(READ FROM THIS FILE)*

List the rainfall rates for each of the rainfall station below, if it will not be read from a DDS file (i.e. DSFNL is left blank above).

**ITRN:** Time

**ARAIN:** Rainfall rate at the corresponding rainfall station: [L/T]

---

<table>
<thead>
<tr>
<th>ITRN</th>
<th>ARAIN(1)</th>
<th>ARAIN(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/31/1995 24:00</td>
<td>22.90</td>
<td>21.47</td>
</tr>
<tr>
<td>02/28/1995 24:00</td>
<td>1.60</td>
<td>0.99</td>
</tr>
<tr>
<td>03/31/1995 24:00</td>
<td>14.78</td>
<td>10.03</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>11/30/2005 24:00</td>
<td>4.94</td>
<td>5.07</td>
</tr>
<tr>
<td>12/31/2005 24:00</td>
<td>11.90</td>
<td>7.67</td>
</tr>
</tbody>
</table>

---

**Pathnames for Rainfall Data**

*(READ FROM DDS FILE)*

List the pathnames for the rainfall data below, if it will be read from a DDS file (i.e. DSFNL is specified above).

**REC:** Time series record number

**PATH:** Pathname for the time series record
Evapotranspiration File

The evapotranspiration data file contains time series ETc data for all crop types, non-agricultural land use types and bare soil evaporation under standard conditions for each subregion. The ETc rates should be entered in the following order: agricultural crop types in the order listed in the parameter data file (Unit 7), urban, native vegetation, riparian vegetation and bare soil evaporation. This is followed by ETc and soil evaporation for each small stream watershed group specified in the parameter data file (Unit 7). The conversion factor for the ETc 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 example file given below shows how recycled time series data in a time tracking simulation can be specified.

The following a list of the variables that need to be specified:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEVAP</td>
<td>Number of crop and land use types</td>
</tr>
<tr>
<td>FACTET</td>
<td>Conversion factor for the spatial component of the unit for the evapotranspiration rate</td>
</tr>
<tr>
<td>NSPET</td>
<td>Number of time steps to update the ET data. If time tracking simulation, enter any number.</td>
</tr>
<tr>
<td>NFQET</td>
<td>Repetition frequency of the ET data (enter zero if full time series data is supplied). If time tracking simulation, enter any number.</td>
</tr>
</tbody>
</table>
If the time series data is stored in a DSS file, name of the file. Leave blank if the data is listed in the ASCII text file.

**Data Input from ASCII Text File**

If the time series data is listed in the same ASCII text 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.

- **IREGN**  
  Subregion number

- **AEVAP**  
  Evapotranspiration rate for all crop types, non-agricultural land use types and bare soil evaporation under standard conditions in a subregion, [L/T]. After listing ET rates for each subregion, the ETc rates for native vegetation and soil evaporation for each small watershed group should also be listed

**Data Input from DSS File**

If time series data is stored in a DSS file then the following variables should be populated. The subregion and the crop/land use type identification numbers should be entered sequentially such that the crop/land use type changes first. For a particular subregion the time series data pathnames for agricultural crops are entered first, followed
by the pathnames for the urban, native vegetation and riparian vegetation lands. Finally, the data for native vegetation and bare soil for each small watershed should be entered.

<table>
<thead>
<tr>
<th>IR</th>
<th>Subregion identification number</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRTYPE</td>
<td>Crop/land use type identification number</td>
</tr>
<tr>
<td>PATH</td>
<td>Pathname for the time series data for the corresponding subregion/small watershed and crop/land use type combination</td>
</tr>
</tbody>
</table>
Evapotranspiration Data Specifications

**NEVPF:** Number of crop and land use types (or pathnames if DSS files are used)

**FACTET:** Conversion factor for evapotranspiration rate

It is used to convert only the spatial component of the unit.

Do NOT include the conversion factor for time component of the unit.

* e.g. Unit of ET rate listed in this file = INCHES/MONTH

Consistent unit used in simulation = FEET/DAY

**MTR:** Enter FACTET (DAYS/MONTH -> FEET/MONTH) = 8.33333E-02

*conversion of MONTH -> DAY is performed automatically*

**NSHET:** Number of time steps to update the ET data

* Enter any number if time-tracking option is on

**NRXP:** Repetition frequency of the ET data

* Enter 0 if full time series data is supplied

* Enter any number if time-tracking option is on

**DSFPL:** The name of the DSS file for data input (maximun 50 characters);*

* Leave blank if DSS file is not used for data input

---

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>NEVPF</td>
</tr>
<tr>
<td>0.0027770</td>
<td>FACTET</td>
</tr>
<tr>
<td>1</td>
<td>NSHET</td>
</tr>
<tr>
<td>1</td>
<td>NRXP</td>
</tr>
</tbody>
</table>

---

Evapotranspiration Data

(READ FROM THIS FILE)

List the ET rate for each crop, non-agricultural land use, and soil for each sub-region, followed by the ET rate for native vegetation and soil for small stream watersheds. If it will not be read from a DSS file (i.e. DSFPL is left blank above).

**TTEV:** Time

**IHEGN:** Subregion number

**AEVAP:** Evapotranspiration rate for corresponding land use and sub-region: [L/T]

(Include ET rates for all crop types, non-agricultural land use types and soil. After listing ET rates for each subregion, list the values for native vegetation and soil evaporation for small stream watersheds.)

---

<table>
<thead>
<tr>
<th>CTTEV</th>
<th>IHEGN</th>
<th>AEVAP (1)</th>
<th>AEVAP (2)</th>
<th>AEVAP (3)</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/31/4000 24:00</td>
<td>1</td>
<td>1.0 1.0 0.0 1.4 0.0 1.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02/29/4000 24:00</td>
<td>1</td>
<td>1.0 1.0 1.0 1.4 1.0 1.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01/31/4000 24:00</td>
<td>1</td>
<td>1.0 1.0 0.0 1.4 0.0 1.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02/29/4000 24:00</td>
<td>1</td>
<td>1.0 1.0 1.0 1.4 1.0 1.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/30/4000 24:00</td>
<td>1</td>
<td>1.0 1.0 0.0 1.6 0.0 1.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/31/4000 24:00</td>
<td>1</td>
<td>1.0 1.0 0.0 1.0 1.0 1.6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

4-93
# Pathnames for Evapotranspiration Data

(READ FROM DS3 FILE)

List the pathnames for ETC rates for each crop, non-agricultural land use, and soil for each sub-region, followed by the ETC rate for native vegetation and soil for small stream watersheds, if it will be read from a DS3 file (i.e. DS3FL is specified above).

The pathnames should be listed for each sub-region and crop/land use type combination, as well as for each small watershed and native veg./soil combination. Use the following example for the order of pathnames.

* Example [simulation includes 3 agricultural crops and 2 small watersheds]

<table>
<thead>
<tr>
<th>IR</th>
<th>CRTYPE</th>
<th>PATH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>[pathname][1] =&gt; Sub-region 1; crop 1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>[pathname][2] =&gt; Sub-region 1; crop 2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>[pathname][3] =&gt; Sub-region 1; crop 3</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>[pathname][4] =&gt; Sub-region 1; urban land</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>[pathname][5] =&gt; Sub-region 1; native veg.</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>[pathname][6] =&gt; Sub-region 1; riparian veg.</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>[pathname][7] =&gt; Sub-region 1; bare soil</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>[pathname][8] =&gt; Sub-region 2; crop 1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>[pathname][9] =&gt; Sub-region 2; crop 2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>[pathname][10] =&gt; Sub-region 2; crop 3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>[pathname][11] =&gt; Sub-region 2; urban land</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>[pathname][12] =&gt; Sub-region 2; native veg.</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>[pathname][13] =&gt; Sub-region 2; riparian veg.</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>[pathname][14] =&gt; Sub-region 2; bare soil</td>
</tr>
</tbody>
</table>

IR : Subregion (or small watershed number)
CRTYPE : Crop, non-agricultural land use or bare soil identifier
PATH : Pathname for the time series record

*
Tile Drain Parameter File

This data file includes all the required input to model tile drains or subsurface irrigation in IWFM. The start of the data file lists the number of groundwater nodes with tile drains or subsurface irrigation, and conversion factors for tile drain (or subsurface irrigation) elevations and conductance. Next, the actual table describing the tile drains or subsurface irrigation is listed. For each node specified for tile drainage/subsurface irrigation modeling, the elevation of the drain, conductance and stream node the drain flows into are required. If the tile drain flows leave the modeled area, the stream node should be set to zero.

To distinguish tile drains from subsurface irrigation, groundwater node numbers with tile drains are listed as negative values, whereas nodes with subsurface irrigation are listed as positive values. For example:

GW node = 543
Tile drain ID = −543

For subsurface irrigation:

GW node = 543
Subsurface irrigation ID = 543

The following list includes all required input to simulate tile drain flows in IWFM:

NTD Number of groundwater nodes with tile drains/subsurface irrigation
FACTH Conversion factor for tile drain/subsurface irrigation elevations
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FACTCDC</td>
<td>Conversion factor for the spatial component of the unit for the tile drain/subsurface irrigation conductance</td>
</tr>
<tr>
<td>TUNIT</td>
<td>Time unit of conductance. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.</td>
</tr>
<tr>
<td>NODEDR</td>
<td>Node number corresponding to the tile drain (listed as a negative number) or subsurface irrigation (listed as positive number)</td>
</tr>
<tr>
<td>ELEVDR</td>
<td>Elevation of the tile drain/subsurface irrigation, [L]</td>
</tr>
<tr>
<td>CDCDR</td>
<td>Hydraulic conductance of the interface between the aquifer and the tile drain/subsurface irrigation, [L²/T]</td>
</tr>
<tr>
<td>ISTRMDR</td>
<td>Stream node into which drain flows into; 0 if the drain flows leave the modeled area</td>
</tr>
</tbody>
</table>
FILE NAME: TILE2DRN.DAT

This data file contains tile drains parameter values.

Tile Drains Data Specifications

NTD  : Number of groundwater nodes with tile drains

FACTM : Conversion factor for tile drain elevations

FACTDC : Conversion factor for tile drain conductances

It is used to convert only the spatial component of the unit.

* e.g. Unit of conductance listed in this file = AC/MONTH

Consistent unit used in simulation = $0.00/FT/DAY

Ft * FACTD (AC/MONTH -> $0.00/FT/DAY) = 2.29568E-15

TUNIT : Tile unit of conductance. This should be one of the units

recognized by NEC-089 that are listed in the Main Control File.

FILE DESCRIPTION

FILE

FILE DRN PARAMETERS

The following lists the groundwater node number, elevation and conductance
for each tile drain. The stream node that the tile drain flow contributes to
is also listed.

NODEDR : Groundwater node number corresponding to the tile drain

Case 1: For drainage out of node, list the node number as a negative value. For example,

List node 898 as -898,

Case 2: For drainage into the node, list the node number as a positive value. For example,

List node 898 as 898,

ELEVDR : Elevation of the drain [ft]

CONDUCT : Hydraulic conductance of the interface between the aquifer and

the drain. [L^2/T]

ISTMERR : Stream node into which drain flows into [input 0 |zero] if the drain flows out of the modeled area

NODEDR ELEVDR CONDUCT ISTMERR

-6  280.0  5000.0  20
-27  280.0  5000.0  20
-48  280.0  5000.0  20
-69  280.0  5000.0  20
-90  280.0  5000.0  20
-111 280.0  5000.0  20
-152 280.0  5000.0  20
-153 280.0  5000.0  20
-174 280.0  5000.0  20
-216 280.0  5000.0  20
-227 280.0  5000.0  20
-258 280.0  5000.0  20
-279 280.0  5000.0  20
-308 280.0  5000.0  20
-321 280.0  5000.0  20
-340 280.0  5000.0  20
-363 280.0  5000.0  20
-384 280.0  5000.0  20
-405 280.0  5000.0  20
-426 280.0  5000.0  20
Urban Water Use Specification File        Unit 18

The urban water use file lists the fraction of water supplied to urban areas to be used indoors for each subregion. In time tracking simulations the time series urban water use specification 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 file:

NSPURBSP Number of time steps to update the urban water use specification data. If time tracking simulation, enter any number.

NFQURBSP Repetition frequency of the urban water use specification 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 ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text 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.

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

IR Subregion number
URINDR  Fraction of total urban water that is specified for urban indoor water use

Data Input from DSS File

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

IR  Subregion identification number

PATH  Pathname for the time series record that will be used for data retrieval
INTEGRATED WATER FLOW MODEL (IWM)

*** Version *** ***

URBAN WATER USAGE SPECIFICATION DATA FILE

for IWM Simulation

(project: IWM Version Release
California Department of Water Resources
Filename: URBWAT_SPEC.DAT)

File Description

This data file contains the urban water usage specification data. The fraction of total urban water that is used indoors for each subregion is listed.

Urban Water Use Data Specifications

NSURRSP: Number of time steps to update the urban water use specification data
NFQURRSP: Repetition frequency of the urban water use specification data

DSRFL: The name of the DSS file for data input (maximum 50 characters)

VALUE DESCRIPTION

1 / NSURRSP
1 / NFQURRSP
/ DSRFL

READ FROM THIS FILE

List the urban water use data below, if it will not be read from a DSS file (i.e. DSRFL is left blank above).

ITUSR: Time
IR: Subregion number
URINOR: Fraction of total urban water that is used indoors

ITUSR  IR  URINOR
01/31/4000 24:00 1 1.0 2 1.0
02/29/4000 24:00 1 1.0
03/31/4000 24:00 1 0.6 2 0.6

Pathnames for Urban Water Use Data

READ FROM DSS FILE

List the pathnames for urban water use data below, if it will be read from a DSS file (i.e. DSRFL is specified above).

IR: Sub-region number
PATH: Pathname for the time series record

IR PATH

*/
Agricultural Water Supply Requirement File  Unit 19

This data file contains the water demand for the agricultural crops. The model requires that either this input file or Unit 22 is specified to simulate agricultural demand. Specifying this KOPTDM as zero in Unit 5 prompts the model to specify agricultural demand as seen in this file. For each time series data entry, the total agricultural demand must be specified for each subregion. A conversion factor that converts listed data to the simulation unit of volumetric flow rate is a required input, as well as the number of time steps to update the demand data and the repetition frequency of the data file. In time tracking simulations the time series agricultural water supply requirement 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 input included in Unit 19 is listed below:

FACTDAGF  Factor to convert the spatial component of the unit for the agricultural demand

NSPDAGF  Number of time steps to update the agricultural demand data. If time tracking simulation, enter any number.

NFQDAGF  Repetition frequency of the agricultural demand 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 ASCII text file.

Data Input from ASCII Text File
If the time series data is listed in the same ASCII text 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.

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

**RDMAG**
Subregional agricultural water demand, [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:

**IR**
Subregion identification number

**PATH**
Pathname for the time series record that will be used for data retrieval
AGRICULTURAL WATER SUPPLY REQUIREMENT DATA FILE
for IWFM Simulation
(Until 19)

Project:  IWFM Version ### Release
California Department of Water Resources
Filename: AGDERSAND.DAT

This data file contains the agricultural water demand for each sub-region for the model simulation period. This file is required only if EOPTDM in the main control file (Unit 5) is set to zero.

AGRICULTURAL WeGet Supply Requirement Data Specifications

FACTDAGF: Conversion factor for the agricultural supply requirement
It is used to convert only the spatial component of the unit;
DO NOT include the conversion factor for time component of the unit.
* e.g., unit of flow listed in this file = AC-FT/MONTH
Consistent unit used in simulation = CF.8/F/DAY
Enter FACTDAGF (AC-FT/MMM -> CF.8/F/DAY) = 2.09666E-05
Conversion of MMM -> DAY is performed automatically
NSFDEAF; Number of time steps to update the agricultural supply requirement data
* Enter any number if time-tracking option is on
NFDEAF; Repetition frequency of the agricultural supply requirement data
* Enter 0 if full time series data is supplied
* Enter any number if time-tracking option is on
DSFL; The name of the DSS file for data input (max 50 characters);
* Leave blank if DSS file is not used for data input

------------------------------- VALUE DESCRIPTION -------------------------------
42569301.0 / FACTDAGF
1 / NSFDEAF
0 / NFDEAF
TSDATA_IN.DSS / DSFL

------------------------------- Agricultural Water Supply Requirement Data -------------------------------
(READ FROM THIS FILE)

List the agricultural water supply requirement data below, if it will not be read from a DSS file (i.e. DSFL is left blank above).

ITOA; Time
RDMD; Sub-regional agricultural water supply requirement: [L'/3/T]

------------------------------- Pathnames for Agricultural Water Supply Requirement Data -------------------------------
(READ FROM DSS FILE)

List the pathnames for the agricultural water supply requirement data below, if it will be read from a DSS file (i.e. DSFL is specified above).

IR ; Sub-region number
IRPATH; Pathname for the time series record

------------------------------- Pathnames for Agricultural Water Supply Requirement Data -------------------------------

1 / IWFM/SRL/FLOW/1MON/AG_SUPP_Req/
2 / IWFM/SRL/FLOW/1MON/AG_SUPP_Req/
3 / IWFM/SRL/FLOW/1MON/AG_SUPP_Req/
Urban Water Demand File 

This data file contains the time series data for the urban water demand for the modeled areas, which includes both the indoor and outdoor urban water use. The input data in this file is similar to the input data in the agricultural demand file (Unit 19). The appropriate conversion factor for the urban demand, the number of time steps to update the urban demand data and the repetition frequency of the data must be specified for the urban water demand time series data. The information to follow is the subregional urban water demand. In time tracking simulations the time series urban demand 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 description of the variables used in Unit 20 is as follows:

FACTDU  Conversion factor for the spatial component of the unit for the urban water demand

NSPDU  Number of time steps to update the urban demand data. If time tracking simulation, enter any number.

NFQDU  Repetition frequency of the urban demand 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 ASCII text file.

Data Input from ASCII Text File
If the time series data is listed in the same ASCII text 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.

**ITDU**
Time. For time tracking simulations use MM/DD/YYYY hh:mm format, for non-time tracking simulations enter an integer number.

**RDMUR**
Urban water demand specified for each subregion, [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:

**IR**
Subregion identification number

**PATH**
Pathname for the time series record that will be used for data retrieval
**INTEGRATED WATER FLOW MODEL (IWF)**

*** Version ***

**Urbana Water Demand Data File**

for IWFN Simulation

(UNIT 26)

Project: IWFN Version *** Release

California Department of Water Resources

Filename: URBDEMAND.DAT

This data file contains the urban water demand on a time-series basis for each subregion for the model simulation period. The urban water demand includes indoor and outdoor water use for municipal and industrial purposes.

**Urban Water Demand Data Specifications**

FACTDU: Conversion factor for urban water demand

It is used to convert only the spatial component of the unit.

DO NOT include the conversion factor for time component of the unit.

*e.g. Unit of flow listed in this file = AC FT/ MONTH

Consistent unit used in simulation = GW FT/DAY

Enter FACTDU (AC FT/ MONTH -> GW FT/ MONTH) = 2.39668E-08

(conversion of MONTH -> DAY is performed automatically)

NDFEU: Number of time steps to update the urban water demand data

- Enter any number if time-tracking option is on

NFGETU: Repetition frequency of the urban water demand data

- Enter 0 if full time series data is supplied

- Enter any number if time-tracking option is on

DSSFL: The name of the DSS file for data input (maximum 50 characters)

- Leave blank if DSS file is not used for data input

---

**VALUE**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>4356000.0</td>
</tr>
<tr>
<td>FACTDU</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>NDFEU</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>NFGETU</td>
</tr>
<tr>
<td>DSSFL</td>
</tr>
</tbody>
</table>

**Urban Water Demand Data**

(Read from this file)

List the urban water demand data below, if it will not be read from a DSS file (i.e. DSSFL is left blank above).

**ITDU**: Time

**RDWR**: Urban water demand by subregion; [L^3/T]

---

**ITDU**

<table>
<thead>
<tr>
<th>RDWR(1)</th>
<th>RDWR(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/31/1999 24:00</td>
<td>2.3</td>
</tr>
<tr>
<td>02/28/1999 24:00</td>
<td>2.8</td>
</tr>
<tr>
<td>03/31/1999 24:00</td>
<td>2.3</td>
</tr>
</tbody>
</table>

**Pathnames for Urban Water Demand Data**

(Read from DSS file)

List the pathnames for the urban water demand data below, if it will be read from a DSS file (i.e. DSSFL is specified above).

**IK**: Sub-region number

**PATH**: Pathname for the time series record

---

**IK**

<table>
<thead>
<tr>
<th>PATH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

---
**Stream Inflow File**

The stream inflow data 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 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 ASCII text 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 ASCII Text File**

If the time series data is listed in the same ASCII text 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; negative values indicate water removed from the corresponding 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
**STREAM INFLOW DATA FILE**

For INWM Simulation (Unit 21)

Project: INWM Version $8$ Release

California Department of Water Resources

Filename: INFLOW.DAT

**FILE DESCRIPTION**

This data file contains the inflows to the stream nodes that are modeled.

**STREAM INFLOW DATA SPECIFICATIONS**

- **NCOLSTRM**: Total number of stream inflows (or pathnames if DSS files are used)
- **FACTSTRM**: Conversion factor for stream inflow
  - It is used to convert only the spatial component of the unit;
  - *e.g.* Unit of flow listed in this file = AC-FT/MONTH
  - Consistent unit used in simulation = CU.FT/CRY
  - Enter FACTSTRM (AC-FT/MONTH -> CU.FT/CRY) = 2.195506E-05
  - (conversion of MCMONTH -> DAY is performed automatically)
- **NPSTRM**: Number of time steps to update the stream inflows
  - *Enter any number if time-tracking option is on*
- **NFSTRM**: Repetition frequency of the stream inflow data
  - *Enter 0 if full time series data is supplied*
  - *Enter any number if time-tracking option is on*
- **DSIFL**: The name of the DSS file for data input (maximum 50 characters)
  - *Leave blank if DSS file is not used for data input*

**DESCRIPTION**

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>/NCOLSTRM</td>
</tr>
<tr>
<td>1.0E+00</td>
<td>/FACTSTRM</td>
</tr>
<tr>
<td>1</td>
<td>/NPSTRM</td>
</tr>
<tr>
<td>0</td>
<td>/NFSTRM</td>
</tr>
<tr>
<td></td>
<td>/DSIFL</td>
</tr>
</tbody>
</table>

**STREAM INFLOW LOCATION INFORMATION**

List the list nodes below where the inflow occurs.

- **DSIF**: Stream node where inflow occurs
  - *Enter '0' if the corresponding data set is not used*

**DSIF**

Stream Description (optional)

- **DSIF**
  - List the stream inflow data below, if it will not be read from a DSS file (i.e., DSIFL is left blank above).
  - **ETM**: Time
  - **ASTRM**: Stream inflow at the stream node specified above; [L^3/T]
    - *Negative values indicate water being removed from the corresponding stream node*

**ETM**

<table>
<thead>
<tr>
<th>ASTRM(1)</th>
<th>ASTRM(2)</th>
<th>ASTRM(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/31/1921</td>
<td>24:00</td>
<td>232.00</td>
</tr>
<tr>
<td>11/3/1921</td>
<td>24:00</td>
<td>237.00</td>
</tr>
<tr>
<td>12/3/1921</td>
<td>24:00</td>
<td>335.00</td>
</tr>
</tbody>
</table>
87/31/1998 24:00  812.00  19.02  50.24  ....  4.00  1.20  6.00
08/31/1998 24:00  862.60  9.10  33.00  ....  7.00  0.00  6.00
09/30/1998 24:00  660.87  7.14  26.72  ....  0.00  0.00  0.00

*--- Pathnames for Stream Inflow Data
*  (READ FROM DSS FILE)
*  List the pathnames for the stream inflow data below, if it will be read
*  from a DSS file (i.e. DSSFL is specified above).
*  REC  ; Time series record number
*  PATH ; Pathname for the time series record
*---
* REC  PATH
*---
Crop Demand Parameter File

The data in this file is used to compute the agricultural water demand of each subregion in the modeled area for the simulation period. The user has the option to compute agricultural demand within IWFM by setting KOPTDM to 1 in the main input file (Unit 5) and specifying agricultural demand parameters or to specify agricultural demand in Unit 19, directly.

This file contains the minimum soil moisture requirements and seasonal application efficiency of each crop in every subregion within the modeled area, for a time period and frequency that is determined by the user. The top line of input for each time step (and subregion) is minimum soil moisture requirements and the bottom line is for the seasonal application efficiencies. In time tracking simulations the time series crop demand parameter 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:

- **NSPDAG**: Number of time steps to update the crop demand data. If time tracking simulation, enter any number.
- **NFQDAG**: Repetition frequency of the crop demand 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 ASCII text file.

Data Input from ASCII Text File
If the time series data is listed in the same ASCII text 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.

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

**IR**  Subregion number

**SMMIN**  Minimum soil moisture requirement for a particular crop as a fraction of field capacity. It is given in the first data line for each region; [dimensionless]

**CREFF**  Crop efficiency for a particular crop at the specified time, given in the second data line for each region. If no irrigation is required, enter 0.

### Data Input from DSS File

If time series data is stored in a DSS file then the following variables should be populated. The subregion and the agricultural crop identification numbers should be entered sequentially such that the crop identification number changes first. For a particular subregion, the pathnames for minimum soil moisture requirement for each crop followed by irrigation efficiency for each crop should be entered.

**IR**  Subregion identification number

**CRTYPE**  Crop identification number
PATH       Pathname for the time series data for the corresponding subregion/crop combination
**INTEGRATED WATER FLOW MODEL (IWFM)**

***Version ###***

**Crop Demand Parameter Data File**

For IWFM Simulation

(Unit 22)

Project: IWFM Version ### Release

California Department of Water Resources

Filename: CROPDEMAND.DAT

---

**File Description**

This data file contains the minimum soil moisture requirements and the crop efficiency for each crop.

**Data Specifications**

**NSPAS**: Number of time steps to update the crop demand parameter data

**NFQAS**: Repetition frequency of the crop demand data

* Enter any number if time-tracking option is on

**DSSFL**: The name of the DSS file for data input (maximum 50 characters)

* Leave blank if DSS file is not used for data input

---

**Value Description**

| 20 | NHBPAS |
| 12 | NFQAS  |
|    | DSSFL  |

---

**Crop Demand Parameter Data**

(READ FROM THIS FILE)

List the crop demand parameter data below, if it will not be read from a DSS file (i.e., DSSFL is left blank above).

**TIME** : Time

**JR** : Region number

**SMIN** : Minimum soil moisture requirement for a particular crop as a fraction of field capacity. It is given in the first data line for each region. [dimensionless]

**CREFF** : Crop efficiency for a particular crop at the specified time. It is given in the second data line for each region. [dimensionless]

---

<table>
<thead>
<tr>
<th>TIME</th>
<th>JR</th>
<th>SMIN(1)</th>
<th>SMIN(2)</th>
<th>SMIN(3) ...</th>
<th>CREFF(1)</th>
<th>CREFF(2)</th>
<th>CREFF(3) ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/31/2000 24:00</td>
<td>1</td>
<td>0.44</td>
<td>0.50</td>
<td>3</td>
<td>0.65</td>
<td>0.70</td>
<td>2</td>
</tr>
<tr>
<td>11/30/2000 24:00</td>
<td>1</td>
<td>0.44</td>
<td>0.50</td>
<td>3</td>
<td>0.44</td>
<td>0.50</td>
<td>0.65</td>
</tr>
<tr>
<td>08/31/2000 24:00</td>
<td>1</td>
<td>0.44</td>
<td>0.50</td>
<td>3</td>
<td>0.65</td>
<td>0.70</td>
<td>0.65</td>
</tr>
</tbody>
</table>

---

**Pathnames for Crop Demand Parameter Data**

(READ FROM DSS FILE)

List the pathnames for crop demand parameter data below, if it will be read from a DSS file (i.e., DSSFL is specified above).

The pathnames should be listed for each subregion and crop type combination. They should be listed in the order given in the example below.

* Example (simulation includes 3 agricultural crops)
<table>
<thead>
<tr>
<th>IR</th>
<th>CRTYPE</th>
<th>PATH</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>{pathname[1]}</td>
<td>Sub-region 1; crop 1: minimum soil moisture requirement</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>{pathname[2]}</td>
<td>Sub-region 1; crop 2: minimum soil moisture requirement</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>{pathname[3]}</td>
<td>Sub-region 1; crop 3: minimum soil moisture requirement</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>{pathname[4]}</td>
<td>Sub-region 1; crop 1: crop irrigation efficiency</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>{pathname[5]}</td>
<td>Sub-region 1; crop 2: crop irrigation efficiency</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>{pathname[6]}</td>
<td>Sub-region 1; crop 3: crop irrigation efficiency</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>{pathname[7]}</td>
<td>Sub-region 2; crop 1: minimum soil moisture requirement</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>{pathname[8]}</td>
<td>Sub-region 2; crop 2: minimum soil moisture requirement</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>{pathname[9]}</td>
<td>Sub-region 2; crop 3: minimum soil moisture requirement</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>{pathname[10]}</td>
<td>Sub-region 2; crop 1: crop irrigation efficiency</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>{pathname[11]}</td>
<td>Sub-region 2; crop 2: crop irrigation efficiency</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>{pathname[12]}</td>
<td>Sub-region 2; crop 3: crop irrigation efficiency</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>Sub-region number</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>Pathname for the time series record</td>
<td></td>
</tr>
</tbody>
</table>

**CRTYPE:** Crop type number

---

```
**Pumping Specification File**  

The pumping specification data file contains the information for all wells and/or elemental sinks within the modeled area. The number of sinks as well as the distribution options for groundwater pumping should also be set. The subregion number that the pumping is delivered to and the corresponding column in the supply adjustment specification data file (Unit 12) are also listed in this file. Note that the maximum pumping amounts that are used during automated supply adjustment to limit the pumping amounts (see variables ICWLMAX, FWLMAX, ICSKMAX and FSKMAX) are not utilized in this version of IWFM. The relative proportions (or fractions) of pumping by aquifer layers are also listed for each sink.

The variable descriptions for the pumping data file are as follows:

- **NSINK**  
  Number of elements where pumping is taking place

- **IOPT**  
  Option for distributing the groundwater pumping (0 = distribute pumping according to the specified fractions, 1 = distribute pumping in proportion to the specified fraction multiplied by the total area of the element, 2 = distribute pumping in proportion to the specified fraction multiplied by the total of agricultural and urban area within the element, 3 = distribute pumping in proportion to the specified fraction multiplied by the agricultural area of the element, 4 = distribute pumping in proportion to the specified fraction multiplied by the urban area of the element)

- **ID**  
  Well/element identification number
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICOLWL</td>
<td>Well pumping (this number corresponds to the appropriate data column in the pumping data file, Unit 24)</td>
</tr>
<tr>
<td>ICFIRIGWL</td>
<td>Fraction of the well pumping that is used for agricultural purposes (this number corresponds to the data column in the irrigation fractions data file, Unit 27)</td>
</tr>
<tr>
<td>FRACWL</td>
<td>Relative proportion of the pumping as specified by ICOLWL to be applied to well, ID</td>
</tr>
<tr>
<td>IRGWL</td>
<td>Subregion number where the pumping from a well is delivered to; enter zero if pumping is exported outside the model area, enter -1 if the pumping is used in the same element that the well is located</td>
</tr>
<tr>
<td>ICADJWL</td>
<td>Supply adjustment specification (this number corresponds to the data column in the supply adjustment specifications data file, Unit 12)</td>
</tr>
<tr>
<td>ICWLMAX</td>
<td>Maximum pumping amount to be used during automated supply adjustment (this number corresponds to the data column in the pumping data file, Unit 24); not utilized in this version of IWFM</td>
</tr>
<tr>
<td>FWLMAX</td>
<td>Fraction of data value specified in column ICWLMAX to be used as maximum pumping amount; not utilized in this version of IWFM</td>
</tr>
<tr>
<td>ICOLSK</td>
<td>Data column in the pumping data file (Unit 24) which corresponds to sink ID</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ICFIRIGSK</td>
<td>Fraction of the elemental pumping that is used for agricultural purposes (this number corresponds to the data column in the irrigation fractions data file, Unit 27)</td>
</tr>
<tr>
<td>FRACSK</td>
<td>Relative proportion of the pumping in column ICOLSK to be applied to element ID</td>
</tr>
<tr>
<td>FRACSKL</td>
<td>The distribution factor of elemental pumping for each layer (i.e. for layers 1 to NL)</td>
</tr>
<tr>
<td>IRGSK</td>
<td>Subregion number where the pumping is delivered to; enter zero if pumping is exported outside the model area; enter −1 if the pumping is used in the same element</td>
</tr>
<tr>
<td>ICADJSK</td>
<td>Supply adjustment specification (this number corresponds to the data column in the supply adjustment specifications data file, Unit 12)</td>
</tr>
<tr>
<td>ICSKMAX</td>
<td>Maximum pumping amount to be used during automated supply adjustment (this number corresponds to the data column in the pumping data file, Unit 24); not utilized in this version of IWFM</td>
</tr>
<tr>
<td>FSKMAX</td>
<td>Fraction of data value specified in column ICSKMAX to be used as maximum pumping amount; not utilized in this version of IWFM</td>
</tr>
</tbody>
</table>
INTEGRATED WATER FLOW MODEL (IWFM)
*** Version *** ***

PUMP SPECIFICATION DATA FILE
for IWFM Simulation
(Unit 22)

Project: IWFM Version *** Release
California Department of Water Resources
Filename: PUMPSPEC.DAT

This data file contains the specification data for well pumping and
cell pumping (wells).

General Pumping Specifications

NSINK : Number of elements used for element pumping

IOPT : Option for distribution of element pumping (enter a value for each element pumping column)

Enter 0 - to distribute the pumping according to the given fraction
below
Enter 1 - to distribute the pumping in proportion to the fraction
times the total area of the element
Enter 2 - to distribute the pumping in proportion to the fraction
times the developed area (ag., only) within the element
Enter 3 - to distribute the pumping in proportion to the fraction
times the developed area (urban only) within the element
Enter 4 - to distribute the pumping in proportion to the fraction
times the developed area (urban only) with the element

VALUE DESCRIPTION
-----------------------------------------------
4 / NSINK
0 3 / IOPT

Well Pumping Specifications

(Skip if no wells are being modeled, i.e., SWELL = 0 as specified in preprocessor)

ID : Well identification number

IEQWEL : Well pumping - this number corresponds to the appropriate data column
in the pumping data file (Unit 24)

IEFIRISK : Fraction of the pumping that is used for irrigation purposes -
this number corresponds to the appropriate data column in the
irrigation fractions data file (Unit 27)

FRAWEL : Relative proportion of the pumping in column IEQWEL to be applied
to well ID

IRGWEL : Subregion number where the pumping is delivered to:

Enter 0, if pumping is exported to outside the model area
Enter -1, if the pumping is used in the same element

ICADWEL : Supply adjustment specification - this number corresponds to
the data column in the supply adjustment specifications
data file (Unit 12)

ICWMAX : Maximum pumping amount - this number corresponds to the
appropriate data column in the pumping data file (Unit 24)

FWMAX : Fraction of data value specified in column ICWMAX to be used as
maximum pumping amount

Elemental Pumping Specifications

(Skip if elemental pumping is not specified, i.e., NSINK = 0)

ID : Element identification number corresponding to the pumping

IEQEX : Element pumping - this number corresponds to the appropriate data
column in the pumping data file (Unit 24)

IEFIRISK : Fraction of the pumping that is used for irrigation purposes -
this number corresponds to the appropriate data column in the
irrigation fractions data file (Unit 27)

FRAEX : Relative proportion of the pumping in column IEQEX to be applied
to element ID

FRAEXL : The distribution factor of pumping for each aquifer layer, i.e., for
layers 1 to NL

IRSEX : Subregion number where the pumping is delivered to:

Enter 0, if pumping is exported to outside the model area
Enter -1, if the pumping is used in the same element

ICADSEX : Supply adjustment specification - this number corresponds to
the data column in the supply adjustment specifications
data file (Unit 12)

ICWMAX : Maximum pumping amount - this number corresponds to the
appropriate data column in the pumping data file (Unit 24)

FWMAX : Fraction of data value specified in column ICWMAX to be used as
maximum pumping amount
<table>
<thead>
<tr>
<th>C1</th>
<th>ICOLS</th>
<th>ICOL2</th>
<th>FFAC1</th>
<th>FFAC2</th>
<th>FFAC3</th>
<th>FFAC4</th>
<th>FGSK</th>
<th>ICADJS</th>
<th>ICSSMAX</th>
<th>FSXMAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>0.6</td>
<td></td>
</tr>
</tbody>
</table>
Pumping Data File

The pumping data file contains the time series information for the specified wells and/or elemental sinks from the pumping specification file (Unit 23). This file lists the number of pumping sets 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 sets
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 ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text 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
INTEGRATED WATER FLOW MODEL (IWMF)
*** Version A98 ***

PUMPING DATA FILE
for IWMF Simulation
(Unit 24)

Project : IWMF Version *** Release
California Department of Water Resources
Filename: PUMP.DAT

File Description:
This data file contains the pumping data for each set of pumping
specified in the pumping specification file.

Pumping Data Specifications

WQOFLUMP : Number of pumping sets (or pathnames if DSS files are used)
FACTPUMP : Conversion factor for pumping data

It is used to convert only the spatial component of the unit:
* e.g. Unit of pumping listed in this file = AC-FY/MONTH
Consistent unit used in simulation = GD.FY/DAY

EXTEN FACTPUMP = AC-FY/MONTH -> GD.FY/DAY

NQPMUMP : Number of time steps to update pumping data

WPQPUMP : Repetition frequency of the pumping data

DESCRIPTION

VALUES

0     / WQOFLUMP
1452000.0 / FACTPUMP
1     / WPQPUMP
1     / DSSFL

Pumping Data
(READ FROM THIS FILE)

List the pumping data below if it will not be read from a DSS file (i.e.
DSSFL is left blank above).

For pumping enter negative values, for recharge enter positive values.

ITPU ; Time
APUMP ; Pumping data; [L^3/T]

PATHNAME (READ FROM DSS FILE)

List the pathnames for pumping data below if it will be read from a DSS file
(i.e. DSSFL is specified above).

REC ; Time series record number
PATH ; Pathname for the time series record

*
**Diversion Specification File**

This data file specifies the surface water diversion locations, bypass locations and recharge zones for all diversions and bypasses modeled. Deliveries, recoverable losses and non-recoverable losses are specified for each diversion and bypass.

**Surface Water Diversions**

The first portion of the data file includes the number of surface water diversions modeled and the diversion specifications for each diversion modeled. Based on this information, the appropriate diversion data columns in Unit 26 are used to model diversions.

- **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, Unit 26); not utilized in this version of IWFM

- **FDVMAX**  
  Fraction of data value specified in column ICDVMAX to be used as maximum diversion amount; not utilized in this version of IWFM

- **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
NDLDV   Number of subregions to which diverted surface water is delivered
IRGDL   Subregion number to which the delivery is made (1...NDLV)
ICOLDL  Delivery to subregion IRGDL; this number corresponds to the appropriate data column in the diversion data file (Unit 26)
FRACDL  Relative proportion of the data value that is specified by ICOLDL to be used as delivery to subregion IRGDL
ICFSIRIG Fraction of the delivery that is used for irrigation purposes (remaining amount will be used to supply the user specified urban demand)
ICADJ   Supply adjustment specification (this number corresponds to the appropriate data column in the supply adjustment specifications data file (Unit 12)

**Recharge Zone for Each Diversion Point**

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

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Recharge zone identification number; recharge zone ID should be the same as diversion identification number</td>
</tr>
<tr>
<td>NERELS</td>
<td>Total number of elements through which recharge occurs</td>
</tr>
<tr>
<td>IERELS</td>
<td>Element number through which recharge occurs</td>
</tr>
<tr>
<td>FERELS</td>
<td>Relative proportion of the recoverable loss to be applied to element IERELS as recharge</td>
</tr>
</tbody>
</table>

**Bypass Configuration Specifications**

This portion indicates the total number of bypasses modeled, conversion factors, as well as each bypass identification number and the related bypass information. This information defines the stream nodes that the bypass originates from and ends at, and either diversion flows or a rating table detailing the available flows for each bypass number:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDIVS</td>
<td>Number of bypasses modeled</td>
</tr>
<tr>
<td>FACTX</td>
<td>Factor to convert the spatial component of the unit for DIVX to the simulation unit of volume</td>
</tr>
<tr>
<td>TUNITX</td>
<td>Time unit of stream flow. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.</td>
</tr>
<tr>
<td>FACTY</td>
<td>Factor to convert the spatial component of the unit for DIVY to the simulation unit of volume</td>
</tr>
</tbody>
</table>
TUNITY Time unit of diversion. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.

ID Bypass identification number

IA Stream node number where bypass flow is exported from

IDIVT Stream node number where bypass flow is imported to

IDIVC If positive, IDIVC is the column number in the diversion data file (Unit 26) to be used for bypass flow. If negative, IDIVC is the number of points in the rating table

DIVRL Fraction of the bypass assigned as recoverable loss

DIVNL Fraction of the bypass assigned as non-recoverable loss

DIVX Stream flow available at stream node IA, [L^3/T]

DIVY Bypass amount corresponding to DIVX, [L^3/T]

**Seepage Locations for Bypass Canals**

This section of data serves a similar purpose as the data that defines a recharge zone for each diversion point modeled. For each bypass modeled, the seepage to groundwater occurring from a bypass flow is based on the bypass recoverable loss. The following parameters define the elements where seepage from a bypass occurs, as well as the amount of the recoverable loss from a bypass flow that seeps into the groundwater.

ID Recharge zone identification number; recharge zone ID should match bypass identification number

NERELS Total number of elements encompassing the recharge zone associated with the corresponding bypass
<table>
<thead>
<tr>
<th>IERELS</th>
<th>Element number included in the recharge zone associated with the bypass. If water is bypassed to a lake, specify IERELS as the lake identification number and include a negative sign prior to the lake ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>FERELS</td>
<td>Relative proportion of the recoverable loss to be applied to element IERELS as recharge</td>
</tr>
</tbody>
</table>
INTERRGRATED WATER FLOW MODEL (IWFN)
*** Version 1.**

SURFACE WATER DIVERSION SPECIFICATION DATA FILE
for IWFN Simulation
(Unit 25)

Project : IWFN Version 1.0 Release
California Department of Water Resources
Filename: DIVERSPC.OAT

This data file contains the specification data for surface water diversions
and bypasses.

Surface Water Diversion Specifications

The following lists the number of surface water diversions and
specifications for each diversion that is included in the model.

<table>
<thead>
<tr>
<th>NVDV</th>
<th>Number of surface water diversions included in the model.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following lists the specifications for each surface water diversion
( Skip if no diversions are modeled, i.e. NVDV = 0)

<table>
<thead>
<tr>
<th>ID</th>
<th>Surface water diversion identification number</th>
</tr>
</thead>
<tbody>
<tr>
<td>NVDV</td>
<td>Number of surface water diversions included in the model.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NODE</th>
<th>Number of sub-regions to which diverted surface water is delivered</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRSEL</td>
<td>Sub-region number to which the delivery is made (1...NODEL)</td>
</tr>
<tr>
<td>ICDEL</td>
<td>Delivery to sub-region IRSEL - this number corresponds to the</td>
</tr>
<tr>
<td></td>
<td>appropriate data column in the diversion data file Unit 26</td>
</tr>
<tr>
<td>FRADEL</td>
<td>Relative proportion of the data value that is specified by ICDEL</td>
</tr>
<tr>
<td>ICDEL</td>
<td>Non-recoverable loss - this number corresponds to the appropriate</td>
</tr>
<tr>
<td></td>
<td>data column in the diversion data file Unit 26</td>
</tr>
<tr>
<td>FRACNL</td>
<td>Relative proportion of the data value that is specified by ICNL</td>
</tr>
<tr>
<td>ICNL</td>
<td>Non-recoverable loss - this number corresponds to the appropriate</td>
</tr>
<tr>
<td></td>
<td>data column in the diversion data file Unit 26</td>
</tr>
<tr>
<td>FRAKL</td>
<td>Relative proportion of the data value that is specified by ICKL</td>
</tr>
<tr>
<td></td>
<td>Skip if no diversions are modeled, i.e. NVDV = 0</td>
</tr>
<tr>
<td>ICKL</td>
<td>Supply adjustment specification - this number corresponds to the</td>
</tr>
<tr>
<td></td>
<td>appropriate data column in the supply adjustment specifications file Unit 12</td>
</tr>
</tbody>
</table>

Recharge zone for each diversion point
( Skip if no diversions are being modeled, i.e. NVDV = 0)

<table>
<thead>
<tr>
<th>ID</th>
<th>Recharge zone identification number</th>
</tr>
</thead>
<tbody>
<tr>
<td>NODE</td>
<td>Number of sub-regions to which diverted surface water is delivered</td>
</tr>
<tr>
<td>IRSEL</td>
<td>Sub-region number to which the delivery is made (1...NODEL)</td>
</tr>
<tr>
<td>ICDEL</td>
<td>Delivery to sub-region IRSEL - this number corresponds to the</td>
</tr>
<tr>
<td></td>
<td>appropriate data column in the diversion data file Unit 26</td>
</tr>
<tr>
<td>FRADEL</td>
<td>Relative proportion of the data value that is specified by ICDEL</td>
</tr>
<tr>
<td>ICDEL</td>
<td>Non-recoverable loss - this number corresponds to the appropriate</td>
</tr>
<tr>
<td></td>
<td>data column in the diversion data file Unit 26</td>
</tr>
<tr>
<td>FRAKL</td>
<td>Relative proportion of the data value that is specified by ICKL</td>
</tr>
<tr>
<td>ICKL</td>
<td>Supply adjustment specification - this number corresponds to the</td>
</tr>
<tr>
<td></td>
<td>appropriate data column in the supply adjustment specifications file Unit 12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NWELS</th>
<th>Number of elements through which recharge occurs</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRSEL</td>
<td>Sub-region number to which the delivery is made (1...NODEL)</td>
</tr>
<tr>
<td>WCHEL</td>
<td>Element number through which recharge occurs</td>
</tr>
<tr>
<td>IRSEL</td>
<td>Relative proportion of the recoverable loss to be applied to</td>
</tr>
<tr>
<td></td>
<td>element IRSEL as recharge</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 2 251 1.0
Bypass Configuration Specifications

**NDIVS**: Number of bypasses
**FACTX**: Conversion factor for DIV

* IMPORTANT: Unit of stream flow listed in this file is **AC-FT/HR**

**CONSISTENT UNIT USED IN SIMULATION**: **FT**

**FACTX** (AC-FT/HR --> FT) = 2.26806E-05

**DIV**: Time unit of stream flow. This should be one of the units recognized by HEC-2 for which the Main Control File is included.

**FACTY**: Conversion factor for DINV

* IMPORTANT: Unit of stream flow listed in this file is **AC-FT/MONTH**

**CONSISTENT UNIT USED IN SIMULATION**: **FT**

**FACTY** (AC-FT/MONTH --> FT) = 2.26806E-05

**DIVY**: Time unit of diversion. This should be one of the units recognized by HEC-2 for which the Main Control File is included.

**ID** : Bypass identification number
**IA** : Stream node number where bypass is exported
**IDIV**: Stream node number where bypass is imported
**DIVC**: If positive, DIVC is the column number in the diversion data file Unit to be used for bypass flow
**DIVR**: Fraction of the diversion assigned as recoverable loss
**DIVN**: Fraction of the diversion assigned as non-recoverable loss
**DIVY**: Stream flow available at stream node IA) [L^3/T]

---

**VALUE**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 / NDIVS</td>
</tr>
<tr>
<td>23546.0 / FACTX</td>
</tr>
<tr>
<td>1000000 / TUNITY</td>
</tr>
<tr>
<td>23546.0 / FACTY</td>
</tr>
<tr>
<td>1000000 / TUNITY</td>
</tr>
</tbody>
</table>

**ID** IA IDIV DIVC DIVR DIVN DIVY (this rating table should follow if IDIV < 0)

<table>
<thead>
<tr>
<th>ID</th>
<th>IA</th>
<th>IDIV</th>
<th>DIVC</th>
<th>DIVR</th>
<th>DIVN</th>
<th>DIVY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>6</td>
<td>0.0</td>
<td>0.8</td>
<td>1.0</td>
<td>0.5</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>21</td>
<td>-4</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0</td>
<td>0.5</td>
<td>18.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8000.0</td>
<td>4000.0</td>
<td></td>
</tr>
</tbody>
</table>

Seepage locations for bypass canals

The following information specifies the recharge zone for each bypass.

**ID** : Recharge zone identification number

*Note: Recharge zone ID’s should match bypass ID numbers*

**NEBELS**: Total number of elements through which recharge occurs
**IUEBELS**: Element number through which recharge occurs
**FEBELS**: Relative proportion of the recharge as to be applied to element IUEBELS as recharge.

<table>
<thead>
<tr>
<th>ID</th>
<th>NEBELS</th>
<th>IUEBELS</th>
<th>FEBELS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Surface Water Diversion Data File

The surface water diversion data file contains the diversions within the modeled area for the simulation time period. This data file is used in conjunction with the surface water diversion specification file (Unit 25) 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 surface water diversion points
- **FACTDV**: Conversion factor for the spatial component of the unit for the surface water 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 the ASCII text file.

Data Input from ASCII Text File
If the time series data is listed in the same ASCII text 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 rate corresponding to the stream node specified in diversion specification file, [L³/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
INTEGRATED WATER FLOW MODEL (IWM)

*** Version ***

SURFACE WATER DIVERSION DATA FILE

for IWM Simulation

(Unit SD)

Project : IWM Version Release
California Department of Water Resources
Filename : DIVER.DAT

FILE DESCRIPTION

This data file contains the surface water diversion and bypass data
for the stream nodes that have been specified in the surface water
diversion specification data file. Maximum diversion rates to be used
in supply adjustment computations are also listed in this file.

Surface Water Diversion Data Specification

The following lists the time-series surface water diversions for
each of the stream nodes where surface diversions have been specified.

NCOLID: Number of surface water diversions (or pathnames if DBS files are used)
FACTDV: Conversion factor for surface water diversions

DO NOT include the conversion factor for time component of the unit.

* e.g. Unit of diversion listed in this file = AC-FT/MONTH

Consistent unit used in simulation = CV.M2/FT/DAY

Enter FACTDV (AC-FT/MONTH -> CV.M2/FT/DAY) = 2.295663E-05

[conversion of MONTH -> DAY is performed automatically]

NSPDV: Number of time steps to update the surface water diversion data

* Enter any number if time-tracking option is on

NFQDV: Repetition frequency of the surface water diversion data

* Enter 8 if full time series data is supplied

* Enter any number if time-tracking option is on

DBSFL: The name of the DBS file for data input (maximum 80 characters)

* Leave blank if DBS file is not used for data input

C VALUE DESCRIPTION

5 / NCOLID
1452188.0 / FACTDV
1 / NSPDV
0 / NFQDV
TSM/avatar.dat / DBSFL

SURFACE WATER DIVERSION DATA

(READ FROM THIS FILE)

List the diversion data below, if it will not be read from a DBS file (i.e.
DBSFL is left blank above).

TTEV : Time
ACTIVS: Diverion rate corresponding to the stream node specified: [L^3/T]

diversion specification file (if the data column is used for maximum
diversion rate, then a value of -99.0 denotes that there is no upper
limit for the diversion rate)

C TTEVS (1) ACTIVS(2) ACTIVS(3) ...

PATHS FOR SURFACE WATER DIVERSION DATA

(READ FROM DBS FILE)

List the pathnames for diversion data below, if it will be read from a DBS file
(i.e. DBSFL is specified above).

REC : Time series record number
PATH : Pathname for the time series record

C REC PATH

1 /IWM/318/3D/flow/10ay/t1version/
2 /IWM/318/3D/flow/10ay/t2version/
3 /IWM/318/3D/flow/10ay/t1version/
4 /IWM/318/3D/flow/10ay/t1version/
5 /IWM/318/3D/flow/10ay/t1version/

4-133
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 pumping specifications (Unit 23) and surface water diversion specification (Unit 25) data files. 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 ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text 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
**INTEGRATED WATER FLOW MODEL (IWM)**

*** Version ### ***

**IRRIGATION FRACTIONS FOR PUMPING AND SURFACE WATER DIVERSIONS**

for IWM Simulation

(Version 27)

Project : IWM Version ### Release
California Department of Water Resources
Filename: IRIGFRAC.DAT

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

This data file contains the time series data for the fraction of pumping and surface water diversions to be used for agricultural purposes.

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

Irrigation Fractions Data Specifications

NOYLF: Number of columns (or pathnames if DSS files are used) in the irrigation fractions data file
NSFIRF : Number of time steps to update the irrigation fractions
* Enter any number if time-tracking option is on
NFYLF : Repetition frequency of the irrigation fractions data
* Enter 3 if full time series data is supplied
* Enter any number if time-tracking option is on
DSFPL : The name of the DSS file for data input (maximum 50 characters):
* Leave blank if DSS file is not used for data input

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>/ NOYLF</td>
</tr>
<tr>
<td>1</td>
<td>/ NSFIRF</td>
</tr>
<tr>
<td></td>
<td>/ NFYLF</td>
</tr>
<tr>
<td></td>
<td>/ DSFPL</td>
</tr>
</tbody>
</table>

Irrigation Fractions Data

(READ FROM DSS FILE)

List the irrigation fractions data below, if it will not be read from a DSS file (i.e. DSFPL is left blank above).

ITIRF: Time
FIRIS: Irrigation fraction

| Date/Time | FIRIS(1) | FIRIS(2) | FIRIS(3) | ...
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12/31/2020</td>
<td>8:00</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

Pathnames for Irrigation Fractions Data

(READ FROM DSS FILE)

List the pathnames for irrigation fractions data below, if it will be read from a DSS file (i.e. DSFPL is specified above).

RDC : Time series record number
PATH : Pathname for the time series record

* *
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 among the lake parameters in the parameter data file (Unit 7). 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 ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text 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
INTEGRATED WATER FLOW MODEL (IWFM)
*** Version *** ***

MAXIMUM LAKE ELEVATION DATA FILE
for IWFM Simulation
(Unit 26)

Project: IWFM Version *** Release
California Department of Water Resources
FILENAME: MAXLEVLEV.DAT

This data file contains the time series data for the maximum lake elevations at the modeled lakes.

Maximum Lake Elevation Data Specifications

NCOLEM: Total number of time series data columns (or pathnames if DSS files are used) for maximum lake elevations
FACTHLM: Conversion factor for maximum lake elevations
NPHLMK: Number of time steps to update the maximum lake elevations

* Enter any number if time-tracking option is on
*NPHLMK: 1

NDSSF: The name of the DSS file for data input (maximum 58 characters).
* Leave blank if DSS file is not used for data input

--------------

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NCOLEM</td>
</tr>
<tr>
<td>1.0</td>
<td>FACTHLM</td>
</tr>
<tr>
<td>1</td>
<td>NPHLMK</td>
</tr>
<tr>
<td>0</td>
<td>NDSSF</td>
</tr>
</tbody>
</table>

--------------

Maximum Lake Elevations Data
READ FROM THIS FILE

List the maximum lake elevations data below, if it will not be read from a DSS file (i.e., DSSFL is left blank above).

TIME, HMAX

HMAX(1), HMAX(2), HMAX(3), ...

Pathnames for Maximum Lake Elevations Data
READ FROM DSS FILE

List the pathnames for maximum lake elevations data below, if it will be read from a DSS file (i.e., DSSFL is specified above).

REC, PATH

--------------

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>/IWFM/UNIT1/ELEV//MON/MAX_LAKE_ELEV/</td>
</tr>
</tbody>
</table>
Irrigation Water Re-use Factor Data File  Unit 29

This data file contains the time series data for the fraction of the return flow from agricultural and urban lands that is re-used. The re-use factors are specified for agricultural urban lands for each subregion. The corresponding data column in this file is associated with each subregion and land use (in terms of agricultural and urban lands) combination through the parameter data file (Unit 7) under “Water Use Parameters” section. If this file is omitted, IWFM assumes that agricultural and urban return flows are not re-used. In time tracking simulations the time series re-use factors 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:

- **NRUF**: Number of columns for re-use factors
- **NSPRUF**: Number of time steps to update the re-use factors. If time tracking option, enter any number.
- **NFQRUF**: Repetition frequency of the re-use factor data; a value of zero indicates that a full time series data set is supplied. If time tracking option, 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 ASCII text file.

Data Input from ASCII Text File

If the time series data is listed in the same ASCII text 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.

**ITRUF**
Time. For time tracking simulations use MM/DD/YYYY_mm format, for non-time tracking simulations enter an integer number.

**RUF**
Fraction of the return flow that is re-used

**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
**INTEGRATED WATER FLOW MODEL (IWFM)**

*** Version ***

**INTEGRATED WATER RE-USE FACTOR DATA FILE**

for IWFM Simulation

(Unit 29)

Project: IWFM Version Release

California Department of Water Resources

Filename: RUF.DAT

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

File Description

This data file contains the factors for the re-use of irrigation water on a
time-series basin for each subregion for the model simulation period. It is
assumed that only the surface runoff (as opposed to tile drainage) from the
croplands can be allocated for re-use.

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

Irrigation Water Re-use Factor: Data Specifications

NRUF : Number of columns (or pathnames if DSS files are used) for
re-use factors
NSFRUT : Number of time steps to update the re-use factors
* Enter any number if time-tracking option is on
NPQRUF : Repetition frequency of the re-use factor data
* Enter 0 if full time series data is supplied
* Enter any number if time-tracking option is on
DSSFL : The name of the DSS file for data input (maximum 50 characters):
* Leave blank if DSS file is not used for data input

-------------------------------

<table>
<thead>
<tr>
<th>VALUE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NRUF</td>
</tr>
<tr>
<td>1</td>
<td>NSFRUT</td>
</tr>
<tr>
<td></td>
<td>DSSFL</td>
</tr>
</tbody>
</table>

-------------------------------

Irrigation Water Re-use Factors

(READ FROM THIS FILE)

List the irrigation water re-use factors below, if it will not be read from
a DSS file (i.e. DSSFL is left blank above).

RUF : Irrigation water re-use factor. It is defined as the ratio of the
surface runoff that is re-used to the total surface runoff: [dimensionless]

-------------------------------

<table>
<thead>
<tr>
<th>TIME</th>
<th>RUF(1)</th>
<th>RUF(2)</th>
<th>RUF(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/31/2000</td>
<td>6.00</td>
<td>6.00</td>
<td>8.73</td>
</tr>
</tbody>
</table>

-------------------------------

Pathnames for Irrigation Water Re-use Factors

(READ FROM DSS FILE)

List the pathnames for irrigation water re-use factors below, if it will be read
from a DSS file (i.e. DSSFL is specified above).

REC : Time series record number
PATH : Pathname for the time series record

-------------------------------

*
Aquifer Parameter Over-write Data File     Unit 30

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 (Unit 7). 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 (Parameter 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 by-pass 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 Main Control File.

TUNITV Time unit of aquitard vertical conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control File.

TUNITL Time unit of aquifer vertical conductivity. This should be one of the units recognized by HEC-DSS that are listed in the Main Control 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]
INTEGRATED WATER FLOW MODEL (IWFM)

*** Version *** ***

AQUIFER PARAMETER OVER-WRITE DATA FILE
for IWFM Simulation
(Unit 38)

Project :  IWFM Version ### Release
California Department of Water Resources
Filename: OVERWRITE.DAT

File Description
This data file contains node and layer numbers, and associated parameter values to over-write values specified in the parameter data file (Unit 1).

Over-writing Parameter Value Data Specifications
WRITE: Total number of groundwater nodes at which previously defined parameter values will be over-written.

VALUE DESCRIPTION

4179 / WRITE

Unit conversion factors for over-writing parameter values

FHK : Conversion factor for horizontal hydraulic conductivity
It is used to convert only the spatial component of the unit.
* e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
Consistent unit used in simulation = IN/DAY
Enter FHK (FT/MONTH -> IN/DAY) = 6.29325E-02
(conversion of MONTH -> DAY in performed automatically)

FHN : Conversion factor for specific storage coefficient
It is used to convert only the spatial component of the unit.
* e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
Consistent unit used in simulation = IN/DAY
Enter FHN (FT/MONTH -> IN/DAY) = 6.29325E-02

FL : Conversion factor for aquifer vertical hydraulic conductivity
It is used to convert only the spatial component of the unit.
* e.g. Unit of hydraulic conductivity listed in this file = FT/MONTH
Consistent unit used in simulation = IN/DAY
Enter FLH (FT/MONTH -> IN/DAY) = 6.29325E-02

FSCF : Conversion factor for elastic storage coefficient
FSCI : Conversion factor for inelastic storage coefficient

TUNITH : Time unit of horizontal hydraulic conductivity. This should be one of the units recognized by HDC-DSS that are listed in the Main Control File.
TUNITV : Time unit of aquifer vertical conductivity. This should be one of the units recognized by HDC-DSS that are listed in the Main Control File.

The following lists the groundwater node number, aquifer layer number and the associated parameter values that will over-write the previously defined values.
*** Enter -1.0 not to over-write the previously set values ***

VALUE DESCRIPTION

1.00 1.00 1.00 1.00 1.00 1.00 1.00

ID : Groundwater node number
LAY : Aquifer layer number
FH : Hydraulic conductivity: (L/LT)
FHN : Specific storage: (L/L)

4-146
4.3.

*Note* The above land subsidence parameters are only for interbed layers (i.e., clay layers)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2444.766</td>
<td>9.999997E-06</td>
<td>2.015161E-02</td>
<td>-1.00</td>
<td>324.2762</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1052.881</td>
<td>5.665079E-05</td>
<td>3.3468839E-02</td>
<td>-1.00</td>
<td>240.6599</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>976.813</td>
<td>1.0849720E-04</td>
<td>5.4965660E-02</td>
<td>-1.00</td>
<td>214.9347</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2467.385</td>
<td>1.009690E-05</td>
<td>1.9852139E-02</td>
<td>-1.00</td>
<td>331.9574</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1044.410</td>
<td>5.315975E-05</td>
<td>3.9741677E-02</td>
<td>-1.00</td>
<td>239.1580</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>962.220</td>
<td>1.1174077E-04</td>
<td>6.1805913E-02</td>
<td>-1.00</td>
<td>215.6135</td>
</tr>
<tr>
<td>1392</td>
<td>2</td>
<td>1293.980</td>
<td>1.5878732E-04</td>
<td>7.3446646E-02</td>
<td>-1.00</td>
<td>2.91047</td>
</tr>
<tr>
<td>1392</td>
<td>3</td>
<td>800.7024</td>
<td>1.4347770E-04</td>
<td>5.9927353E-02</td>
<td>-1.00</td>
<td>7.285013</td>
</tr>
<tr>
<td>1393</td>
<td>1</td>
<td>2391.523</td>
<td>9.9999997E-06</td>
<td>8.1486767</td>
<td>-1.00</td>
<td>4.699168</td>
</tr>
<tr>
<td>1393</td>
<td>2</td>
<td>1407.010</td>
<td>2.3669333E-04</td>
<td>8.9809781E-02</td>
<td>-1.00</td>
<td>3.107419</td>
</tr>
<tr>
<td>1394</td>
<td>3</td>
<td>759.6795</td>
<td>1.0398997E-04</td>
<td>9.4224530E-02</td>
<td>-1.00</td>
<td>6.029072</td>
</tr>
</tbody>
</table>
Output Files

IWFM generates ASCII, 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 control input file (Unit 5). 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 (Unit 49) will fail to generate the required file since there are no vertical flows being calculated.

The following sections describe each of the output files in detail.

Standard ASCII Output (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 Unit 5)
- Date and time of run, which is determined internally within the program
- List of input files read in the pre-processing program and the associated date that the input files were modified. Output file names specified in Unit 5 are written to this file as well
- Various warning messages and errors
• Aquifer parameters depending on the option set by the user in the main input file (Unit 5)
• Convergence information on the iterative procedures at each time step
• Total CPU time consumed by the execution of the Simulation program
**THIS RUN IS MADE ON 01/23/2007 AT 14:04:34**

**THE FOLLOWING FILES ARE USED IN THIS SIMULATION:**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>File Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/20/2006</td>
<td>08:17:55</td>
<td>OUTPUT1.BIN</td>
</tr>
<tr>
<td>12/20/2006</td>
<td>08:17:55</td>
<td>PARAMETER.DAT</td>
</tr>
<tr>
<td>12/20/2006</td>
<td>08:17:55</td>
<td>SOUND.DAT</td>
</tr>
<tr>
<td>12/20/2006</td>
<td>08:17:55</td>
<td>SOUNDSD.DAT</td>
</tr>
<tr>
<td>12/20/2006</td>
<td>08:17:55</td>
<td>PRINT.DAT</td>
</tr>
<tr>
<td>01/23/2007</td>
<td>13:16:41</td>
<td>INIT.DAT</td>
</tr>
<tr>
<td>07/31/2006</td>
<td>11:44:53</td>
<td>SUDDIN.DAT</td>
</tr>
<tr>
<td>07/31/2006</td>
<td>11:44:53</td>
<td>LANDUSE.DAT</td>
</tr>
<tr>
<td>07/31/2006</td>
<td>11:44:53</td>
<td>CROPAREA.DAT</td>
</tr>
<tr>
<td>12/20/2006</td>
<td>08:17:55</td>
<td>PRECIP.DAT</td>
</tr>
<tr>
<td>12/20/2006</td>
<td>08:17:55</td>
<td>ST.DAT</td>
</tr>
<tr>
<td>07/31/2006</td>
<td>11:44:53</td>
<td>UNUSED2.DAT</td>
</tr>
<tr>
<td>07/31/2006</td>
<td>11:44:53</td>
<td>UNUSED1.DAT</td>
</tr>
</tbody>
</table>

**NOTE:** SURFACE WATER DIVERSION WAS ADJUSTED, PUMPING WAS NOT ADJUSTED.

---

**TIME STEP 1 AT 1.00 DAYS**

<table>
<thead>
<tr>
<th>ITER</th>
<th>CONVERGENCE</th>
<th>MAX. DIFF</th>
<th>VARIABLE</th>
<th>PUMP.COMV.</th>
<th>DRY LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>195.233</td>
<td>21.0229</td>
<td>478</td>
<td>0.08000</td>
<td>0(0)</td>
</tr>
<tr>
<td>2</td>
<td>5.83995</td>
<td>3.59401</td>
<td>239</td>
<td>0.08000</td>
<td>0(0)</td>
</tr>
<tr>
<td>3</td>
<td>3.68872</td>
<td>0.660097</td>
<td>24</td>
<td>0.08000</td>
<td>0(0)</td>
</tr>
<tr>
<td>4</td>
<td>0.209938</td>
<td>0.373303E-01</td>
<td>24</td>
<td>0.08000</td>
<td>0(0)</td>
</tr>
<tr>
<td>5</td>
<td>0.404192E-04</td>
<td>0.201223E-04</td>
<td>21</td>
<td>0.08000</td>
<td>0(0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ITER</th>
<th>CONVERGENCE</th>
<th>MAX. DIFF</th>
<th>VARIABLE</th>
<th>PUMP.COMV.</th>
<th>DRY LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>195.063</td>
<td>21.0229</td>
<td>478</td>
<td>0.08000</td>
<td>0(0)</td>
</tr>
<tr>
<td>2</td>
<td>5.45175</td>
<td>1.45087</td>
<td>22</td>
<td>0.08000</td>
<td>0(0)</td>
</tr>
<tr>
<td>3</td>
<td>0.453925</td>
<td>0.279985</td>
<td>239</td>
<td>0.08000</td>
<td>0(0)</td>
</tr>
<tr>
<td>4</td>
<td>0.206186E-01</td>
<td>0.218919E-02</td>
<td>24</td>
<td>0.08000</td>
<td>0(0)</td>
</tr>
<tr>
<td>5</td>
<td>0.566253E-05</td>
<td>0.275925E-05</td>
<td>21</td>
<td>0.08000</td>
<td>0(0)</td>
</tr>
</tbody>
</table>

---

**TIME STEP 2 AT 2.00 DAYS**

<table>
<thead>
<tr>
<th>ITER</th>
<th>CONVERGENCE</th>
<th>MAX. DIFF</th>
<th>VARIABLE</th>
<th>PUMP.COMV.</th>
<th>DRY LOCATION</th>
</tr>
</thead>
</table>

| TOTAL RUN TIME: 6 MINUTES 15.56 SECONDS |

---

This document contains a list of files used in a simulation run, followed by a table of iteration results. The table shows convergence, maximum difference, variable values, pump command, and dry location for each iteration. The run was made on 01/23/2007 at 14:04:34, and the simulation used multiple files including parameter.dat, sound.dat, soundsd.dat, print.dat, init.dat, suddin.dat, landuse.dat, croparea.dat, precip.dat, st.dat, and more. The note indicates that surface water diversion was adjusted, but pumping was not. The run includes two time steps, each lasting 1.00 and 2.00 days respectively, with detailed results for each. The total run time was 6 minutes 15.56 seconds.
Subsidence Output File

The subsidence output file includes the simulated subsidence values at aquifer layers and nodes specified by the user in Unit 10. 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. \( ID:LXXX:GWYYY \) (if subsidence are printed for nodes; \( ID \) is the subsidence print-out number listed sequentially in the print control file (Unit 10), \( XXX \) is the aquifer layer number and \( YYY \) is the groundwater node number)

ii. \( ID:LXXX:EYYY \) (if subsidence values are printed for x-y coordinates; \( ID \) is the subsidence print-out number listed
sequentially in the print control file (Unit 10), $XXX$ 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 control input file

**Part E:**

Time step used in the Simulation

**Part F:**

$SUBSIDENCE$
<table>
<thead>
<tr>
<th>TIME</th>
<th>NODES</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/31/2021</td>
<td>24:00</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>11/30/2021</td>
<td>24:00</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>12/31/2021</td>
<td>24:00</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>01/31/2022</td>
<td>24:00</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>02/28/2022</td>
<td>24:00</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>03/31/2022</td>
<td>24:00</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>-0.0001</td>
</tr>
<tr>
<td>04/30/2022</td>
<td>24:00</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>-0.0001</td>
</tr>
<tr>
<td>05/31/2022</td>
<td>24:00</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>-0.0001</td>
</tr>
<tr>
<td>06/30/2022</td>
<td>24:00</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>-0.0001</td>
</tr>
<tr>
<td>07/31/2022</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>08/31/2022</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>09/30/2022</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>10/30/2022</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>11/30/2022</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>12/31/2022</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>01/31/2023</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>02/28/2023</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>03/31/2023</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>04/30/2023</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>05/31/2023</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>06/30/2023</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>07/31/2023</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>08/31/2023</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
<tr>
<td>09/30/2023</td>
<td>24:00</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0001</td>
<td>-0.0001</td>
</tr>
</tbody>
</table>
Virtual Crop Characteristics

This output file is generated when crop characteristics that are weighted averaged for each subregion are required to be printed. For each subregion average values for the root zone depth, minimum soil moisture requirement, crop evapotranspiration (ETc) and irrigation efficiency are printed out at each simulation time step. The root zone depth and ETc are printed in the units specified by the user in control input file (Unit 5).

If the virtual crop characteristics 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:**

SRXXX where XXX is the subregion number

**Part C:**

One of the following, depending on the output data:

i. *DEPTH* (for virtual crop root zone depth)

ii. *FRACTION* (for virtual crop minimum soil moisture requirement)

iii. *EVAPOTR* (for virtual crop ETc)

iv. *FRACTION* (for virtual crop irrigation efficiency)

**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 control input file

**Part E:**

Time step used in the Simulation

**Part F:**

One of the following, depending on the output data:

i. *VIRTUAL_CROP_ROOT_ZONE* (for virtual crop root zone depth)

ii. *VIRTUAL_CROP_MIN_SOIL_MOIST_REQ* (for virtual crop minimum soil moisture requirement)

iii. *VIRTUAL_CROP_ET* (for virtual crop ETc)

iv. *VIRTUAL_CROP_IRRIGATION_EFF* (for virtual crop irrigation efficiency)
Element Face Flow Output File

This output file is generated when simulated flow 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 print control file (Unit 10). The flow rates are printed in the units specified by the user in control input file (Unit 5) 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 \textit{EXXX-EYYY}, where \textit{XXX} and \textit{YYY} are the element numbers. If the element face is located at the model boundary, then \textit{EXXX} is reported as \textit{E0}. If the flow rate is positive then the flow at the element face is towards the element listed first (i.e. towards \textit{EXXX}); if the flow rate is negative then the flow at the element face is towards the element listed second (i.e. towards \textit{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:**

\textit{IWFM}

**Part B:**

\textit{LZZZ:EXXX-EYYY} where \textit{ZZZ} is the aquifer layer number, \textit{XXX} is the first element number interfacing at the face, and \textit{YYY} is the second element number

**Part C:**

\textit{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 control input file.

Part E:

Time step used in the Simulation.

Part F:

`ELEMENT_FACE_FLOW`

<table>
<thead>
<tr>
<th>LAYER</th>
<th>TIME</th>
<th>E791-E795</th>
<th>E791-E795</th>
<th>E791-E795</th>
<th>E0-E1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10/31/1992_24:00</td>
<td>233.50</td>
<td>177.25</td>
<td>0.58</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>11/31/1992_24:00</td>
<td>121.41</td>
<td>98.52</td>
<td>0.56</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>12/31/1992_24:00</td>
<td>126.47</td>
<td>91.03</td>
<td>0.57</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>01/31/1992_24:00</td>
<td>109.09</td>
<td>91.68</td>
<td>0.57</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>02/28/1992_24:00</td>
<td>120.64</td>
<td>92.53</td>
<td>0.57</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>03/31/1992_24:00</td>
<td>95.13</td>
<td>94.76</td>
<td>0.58</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>04/30/1992_24:00</td>
<td>-56.11</td>
<td>93.78</td>
<td>0.58</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>05/31/1992_24:00</td>
<td>-176.39</td>
<td>94.26</td>
<td>0.58</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>06/30/1992_24:00</td>
<td>-109.11</td>
<td>96.46</td>
<td>0.59</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>07/31/1992_24:00</td>
<td>-28.06</td>
<td>97.02</td>
<td>0.60</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>08/31/1992_24:00</td>
<td>76.06</td>
<td>121.41</td>
<td>0.60</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>09/30/1992_24:00</td>
<td>112.11</td>
<td>97.79</td>
<td>0.60</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>10/31/1992_24:00</td>
<td>140.59</td>
<td>99.28</td>
<td>0.61</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>11/31/1992_24:00</td>
<td>156.17</td>
<td>101.98</td>
<td>0.62</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>12/31/1992_24:00</td>
<td>121.93</td>
<td>103.01</td>
<td>0.63</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>01/31/1992_24:00</td>
<td>124.50</td>
<td>104.92</td>
<td>0.65</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>02/28/1992_24:00</td>
<td>144.29</td>
<td>106.71</td>
<td>0.66</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>03/31/1992_24:00</td>
<td>55.08</td>
<td>111.46</td>
<td>0.66</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>04/30/1992_24:00</td>
<td>-52.97</td>
<td>109.04</td>
<td>0.67</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>05/31/1992_24:00</td>
<td>-154.43</td>
<td>110.28</td>
<td>0.68</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>06/30/1992_24:00</td>
<td>-59.59</td>
<td>113.14</td>
<td>0.69</td>
<td>0.00</td>
</tr>
</tbody>
</table>

4-157
Boundary Flux Output File  

This output file is generated when simulated flow 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 print control file (Unit 10). The flow rates are printed in the units specified by the user in control input file (Unit 5) 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:**

LZZZ:GWXXX 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 control input file
Part E:

Time step used in the Simulation

Part F:

BOUNDARY_NODE_FLOW

<table>
<thead>
<tr>
<th>Layer</th>
<th>Node</th>
<th>Layer</th>
<th>Node</th>
<th>Layer</th>
<th>Node</th>
<th>Layer</th>
<th>Node</th>
<th>Layer</th>
<th>Node</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAYER</td>
<td>NODE</td>
<td>TIME</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/31/1923 01:00</td>
<td>-700.59</td>
<td>3</td>
<td>1/31/1923 01:00</td>
<td>420.00</td>
<td>3</td>
<td>1/31/1923 01:00</td>
<td>160.00</td>
<td>3</td>
<td>1/31/1923 01:00</td>
</tr>
<tr>
<td>1/31/1923 01:00</td>
<td>300.00</td>
<td>3</td>
<td>1/31/1923 01:00</td>
<td>-200.00</td>
<td>3</td>
<td>1/31/1923 01:00</td>
<td>-400.00</td>
<td>3</td>
<td>1/31/1923 01:00</td>
</tr>
<tr>
<td>1/31/1923 01:00</td>
<td>700.00</td>
<td>3</td>
<td>1/31/1923 01:00</td>
<td>900.00</td>
<td>3</td>
<td>1/31/1923 01:00</td>
<td>1100.00</td>
<td>3</td>
<td>1/31/1923 01:00</td>
</tr>
<tr>
<td>1/31/1923 01:00</td>
<td>1500.00</td>
<td>3</td>
<td>1/31/1923 01:00</td>
<td>1700.00</td>
<td>3</td>
<td>1/31/1923 01:00</td>
<td>1900.00</td>
<td>3</td>
<td>1/31/1923 01:00</td>
</tr>
</tbody>
</table>

**Note:** INFLOW TO THE BASIN IS POSITIVE
Tile Drain Hydrograph Output

This output file is generated when simulated flow at the tile drains and/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 print control file (Unit 10). The flow rates are printed in the units specified by the user in control input file (Unit 5) 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:

GWXXX 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 control input file
### Part E:

Time step used in the Simulation

### Part F:

**TILE\_DRAIN\_HYDROGRAPHS**

<table>
<thead>
<tr>
<th>TIME</th>
<th>NUBS1</th>
<th>062</th>
<th>063</th>
<th>070</th>
<th>062</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/31/1921 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.03</td>
<td>-0.39</td>
<td>0.00</td>
</tr>
<tr>
<td>11/30/1921 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.04</td>
<td>-0.46</td>
<td>0.00</td>
</tr>
<tr>
<td>12/31/1921 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.05</td>
<td>-0.52</td>
<td>0.00</td>
</tr>
<tr>
<td>01/31/1922 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.05</td>
<td>-0.57</td>
<td>0.00</td>
</tr>
<tr>
<td>02/28/1922 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.05</td>
<td>-0.61</td>
<td>0.00</td>
</tr>
<tr>
<td>03/31/1922 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.06</td>
<td>-0.65</td>
<td>0.00</td>
</tr>
<tr>
<td>04/30/1922 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.06</td>
<td>-0.69</td>
<td>0.00</td>
</tr>
<tr>
<td>05/31/1922 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.06</td>
<td>-0.74</td>
<td>0.00</td>
</tr>
<tr>
<td>06/30/1922 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.07</td>
<td>-0.78</td>
<td>0.00</td>
</tr>
<tr>
<td>07/31/1922 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.06</td>
<td>-0.82</td>
<td>0.00</td>
</tr>
<tr>
<td>09/30/1922 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.06</td>
<td>-0.84</td>
<td>0.00</td>
</tr>
<tr>
<td>10/31/1922 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.07</td>
<td>-0.87</td>
<td>0.00</td>
</tr>
<tr>
<td>11/30/1922 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.07</td>
<td>-0.92</td>
<td>0.00</td>
</tr>
<tr>
<td>12/31/1922 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.07</td>
<td>-0.94</td>
<td>0.00</td>
</tr>
<tr>
<td>01/31/1923 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.09</td>
<td>-0.96</td>
<td>0.00</td>
</tr>
<tr>
<td>02/28/1923 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.09</td>
<td>-0.99</td>
<td>0.00</td>
</tr>
<tr>
<td>03/31/1923 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.08</td>
<td>-1.03</td>
<td>0.00</td>
</tr>
<tr>
<td>04/30/1923 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.09</td>
<td>-1.03</td>
<td>0.00</td>
</tr>
<tr>
<td>05/31/1923 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.09</td>
<td>-1.06</td>
<td>0.00</td>
</tr>
<tr>
<td>06/30/1923 24:00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.09</td>
<td>-1.08</td>
<td>0.00</td>
</tr>
</tbody>
</table>
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 print control file (Unit 10). 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/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:
RXXX 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 control input file

Part E:
Time step used in the Simulation
## Part F:

### STREAM HYDROGRAPHS

<table>
<thead>
<tr>
<th>TIME</th>
<th>NODE1</th>
<th>STREAM HYDROGRAPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/31/1921</td>
<td>237</td>
<td></td>
</tr>
<tr>
<td>11/31/1921</td>
<td>237</td>
<td></td>
</tr>
<tr>
<td>12/31/1921</td>
<td>237</td>
<td></td>
</tr>
</tbody>
</table>

... (omitted for brevity)
Groundwater Level Hydrograph Output          Unit 47

The groundwater level hydrograph output file includes the groundwater level at aquifer layers and nodes specified by the user in Unit 10. 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:

*iii. ID:LXXX:GWYYY* (if hydrographs are printed for nodes; ID is the groundwater hydrograph number listed sequentially in the print control file (Unit 10), XXX is the aquifer layer number and YYY is the groundwater node number)

*iv. ID:LXXX:EYYY* (if hydrographs are printed for x-y coordinates; ID is the groundwater hydrograph number listed sequentially in the print control file (Unit 10), 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 control input file

Part E:

Time step used in the Simulation

Part F:

**GROUNDWATER_HYDROGRAPHS**

<table>
<thead>
<tr>
<th>TIME</th>
<th>ELEMENT</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/31/1921</td>
<td>25</td>
<td>509.3219</td>
<td>529.4095</td>
<td>517.6937</td>
<td>465.3780</td>
<td>436.2878</td>
<td>437.2465</td>
</tr>
<tr>
<td>11/30/1921</td>
<td>25</td>
<td>505.4086</td>
<td>510.8999</td>
<td>522.6088</td>
<td>461.8528</td>
<td>435.0066</td>
<td>430.2854</td>
</tr>
<tr>
<td>12/30/1921</td>
<td>25</td>
<td>509.2216</td>
<td>520.4095</td>
<td>517.6937</td>
<td>465.3780</td>
<td>436.2878</td>
<td>437.2465</td>
</tr>
<tr>
<td>01/31/1922</td>
<td>25</td>
<td>511.5957</td>
<td>531.4561</td>
<td>560.5015</td>
<td>460.7080</td>
<td>437.4083</td>
<td>435.5258</td>
</tr>
<tr>
<td>02/28/1922</td>
<td>25</td>
<td>513.6282</td>
<td>542.6902</td>
<td>562.5288</td>
<td>472.0802</td>
<td>438.5252</td>
<td>431.1873</td>
</tr>
<tr>
<td>03/31/1922</td>
<td>25</td>
<td>514.6639</td>
<td>540.3785</td>
<td>564.6660</td>
<td>474.8088</td>
<td>439.3772</td>
<td>434.4028</td>
</tr>
<tr>
<td>04/30/1922</td>
<td>25</td>
<td>515.0659</td>
<td>552.3559</td>
<td>564.9868</td>
<td>477.6015</td>
<td>440.0135</td>
<td>439.0901</td>
</tr>
<tr>
<td>05/31/1922</td>
<td>25</td>
<td>517.0825</td>
<td>555.4614</td>
<td>566.2022</td>
<td>480.1556</td>
<td>440.5772</td>
<td>439.1493</td>
</tr>
<tr>
<td>06/30/1922</td>
<td>25</td>
<td>517.6474</td>
<td>557.3858</td>
<td>567.5123</td>
<td>482.3972</td>
<td>441.8166</td>
<td>440.3642</td>
</tr>
<tr>
<td>07/31/1922</td>
<td>25</td>
<td>518.4699</td>
<td>560.0529</td>
<td>567.7386</td>
<td>484.4369</td>
<td>441.3768</td>
<td>439.6539</td>
</tr>
<tr>
<td>08/31/1922</td>
<td>25</td>
<td>519.3669</td>
<td>561.7623</td>
<td>568.3212</td>
<td>486.2388</td>
<td>441.6025</td>
<td>441.0997</td>
</tr>
<tr>
<td>09/30/1922</td>
<td>25</td>
<td>519.8537</td>
<td>565.1591</td>
<td>568.8564</td>
<td>487.8799</td>
<td>441.8483</td>
<td>441.1604</td>
</tr>
<tr>
<td>10/31/1922</td>
<td>25</td>
<td>520.1686</td>
<td>564.4162</td>
<td>569.2246</td>
<td>489.2588</td>
<td>441.9467</td>
<td>441.4169</td>
</tr>
<tr>
<td>11/30/1922</td>
<td>25</td>
<td>520.5497</td>
<td>565.4545</td>
<td>569.7124</td>
<td>490.6892</td>
<td>441.9396</td>
<td>441.5128</td>
</tr>
<tr>
<td>07/31/1930</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>08/30/1930</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>09/30/1930</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>10/31/1930</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>11/30/1930</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>12/31/1930</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>01/31/1931</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>02/28/1931</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>03/31/1931</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>04/30/1931</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>05/31/1931</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>06/30/1931</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>07/31/1931</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>08/30/1931</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
<tr>
<td>09/30/1931</td>
<td>25</td>
<td>514.7297</td>
<td>570.0991</td>
<td>580.2612</td>
<td>501.9473</td>
<td>433.1119</td>
<td>432.2669</td>
</tr>
</tbody>
</table>
**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 groundwater 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:**

\(LXXX:GWYYY\) 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 control input file
Part E:

Time step used in the Simulation

Part F:

GW HEAD AT ALL NODES

<table>
<thead>
<tr>
<th>TIME</th>
<th>NODE 1</th>
<th>NODE 2</th>
<th>NODE 3</th>
<th>NODE 4</th>
<th>NODE 5</th>
<th>NODE 6</th>
<th>NODE 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/11/1922 24:00</td>
<td>601.0169</td>
<td>601.5270</td>
<td>601.5709</td>
<td>591.1469</td>
<td>1393.5031</td>
<td>1465.4986</td>
<td>591.2636</td>
</tr>
<tr>
<td>11/11/1922 24:00</td>
<td>602.2852</td>
<td>602.6125</td>
<td>602.7251</td>
<td>593.3910</td>
<td>1294.1878</td>
<td>1359.5481</td>
<td>574.3583</td>
</tr>
<tr>
<td>01/11/1923 24:00</td>
<td>599.0527</td>
<td>606.9224</td>
<td>627.3983</td>
<td>595.8409</td>
<td>1274.6344</td>
<td>1348.4100</td>
<td>571.7971</td>
</tr>
<tr>
<td>02/28/1924 24:00</td>
<td>598.0887</td>
<td>606.5556</td>
<td>627.5793</td>
<td>586.8526</td>
<td>1264.7956</td>
<td>1376.5418</td>
<td>571.4039</td>
</tr>
<tr>
<td>03/11/1924 24:00</td>
<td>597.0432</td>
<td>606.0911</td>
<td>627.6386</td>
<td>587.3178</td>
<td>1255.8868</td>
<td>1368.5925</td>
<td>570.9583</td>
</tr>
<tr>
<td>04/10/1924 24:00</td>
<td>596.1699</td>
<td>601.4511</td>
<td>627.5084</td>
<td>597.6501</td>
<td>1245.4908</td>
<td>1356.6211</td>
<td>569.9832</td>
</tr>
<tr>
<td>05/31/1924 24:00</td>
<td>578.0287</td>
<td>595.0274</td>
<td>602.0552</td>
<td>586.3689</td>
<td>1153.5250</td>
<td>1277.9583</td>
<td>555.8620</td>
</tr>
<tr>
<td>06/30/1924 24:00</td>
<td>571.2188</td>
<td>594.6599</td>
<td>621.4232</td>
<td>596.0856</td>
<td>1148.5174</td>
<td>1271.1487</td>
<td>555.7621</td>
</tr>
<tr>
<td>05/31/1924 24:00</td>
<td>575.0130</td>
<td>591.7533</td>
<td>620.7987</td>
<td>585.7404</td>
<td>1139.8494</td>
<td>1264.4745</td>
<td>555.4580</td>
</tr>
<tr>
<td>06/30/1924 24:00</td>
<td>574.4749</td>
<td>592.8085</td>
<td>620.1464</td>
<td>585.3284</td>
<td>1137.3543</td>
<td>1257.9365</td>
<td>555.1210</td>
</tr>
<tr>
<td>07/30/1924 24:00</td>
<td>572.0619</td>
<td>591.0635</td>
<td>619.6065</td>
<td>594.9411</td>
<td>1127.0764</td>
<td>1251.5523</td>
<td>534.3552</td>
</tr>
<tr>
<td>08/31/1924 24:00</td>
<td>573.9349</td>
<td>596.9179</td>
<td>618.3145</td>
<td>584.5388</td>
<td>1121.0136</td>
<td>1245.2594</td>
<td>554.0270</td>
</tr>
<tr>
<td>09/30/1924 24:00</td>
<td>570.7688</td>
<td>599.9711</td>
<td>618.1329</td>
<td>584.1204</td>
<td>1115.1568</td>
<td>1239.1155</td>
<td>553.2986</td>
</tr>
</tbody>
</table>
Layer Vertical Flow Output File  

This output file lists the vertical flow 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:**

\[SRXXX:LYYY-LZZZ\] 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 control input file

**Part E:**

Time step used in the Simulation
### Part F:

**VERTICAL FLOW**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/31/1921 24:00</td>
<td>-4961.05</td>
<td>-2654.05</td>
<td>-7039.70</td>
<td>-7298.47</td>
<td>6415.07</td>
<td>-12948.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/30/1921 24:00</td>
<td>-3519.56</td>
<td>-2530.05</td>
<td>-4510.04</td>
<td>-5452.38</td>
<td>-5655.11</td>
<td>-8993.49</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/31/1921 24:00</td>
<td>-2755.39</td>
<td>-3735.41</td>
<td>-3018.67</td>
<td>-2593.25</td>
<td>-7136.24</td>
<td>-7322.48</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01/31/1922 24:00</td>
<td>-2349.77</td>
<td>-1455.24</td>
<td>-2411.13</td>
<td>-2094.37</td>
<td>-5594.92</td>
<td>-6484.39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02/31/1922 24:00</td>
<td>-2093.81</td>
<td>-1244.21</td>
<td>-2115.40</td>
<td>-1910.71</td>
<td>-9480.39</td>
<td>-1657.49</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03/31/1922 24:00</td>
<td>-1831.96</td>
<td>-1089.42</td>
<td>-1072.80</td>
<td>-1791.58</td>
<td>-9077.28</td>
<td>-5333.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04/30/1922 24:00</td>
<td>-1706.00</td>
<td>-9008.41</td>
<td>-2096.96</td>
<td>-1631.28</td>
<td>-1969.50</td>
<td>-4199.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05/31/1922 24:00</td>
<td>-1897.96</td>
<td>-9022.10</td>
<td>-10940.71</td>
<td>-15262.95</td>
<td>-15360.50</td>
<td>-4016.09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06/30/1922 24:00</td>
<td>-1252.45</td>
<td>-8176.99</td>
<td>-19972.24</td>
<td>-14280.28</td>
<td>-11101.21</td>
<td>-4087.27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07/31/1922 24:00</td>
<td>-1174.99</td>
<td>-7725.02</td>
<td>-20029.92</td>
<td>-13308.37</td>
<td>-9416.21</td>
<td>-3919.27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/31/1922 24:00</td>
<td>-1184.85</td>
<td>-7601.09</td>
<td>-10461.42</td>
<td>-12067.68</td>
<td>-6666.60</td>
<td>-2797.56</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09/30/1922 24:00</td>
<td>-801.45</td>
<td>-6892.54</td>
<td>-17844.19</td>
<td>-19888.42</td>
<td>-8110.35</td>
<td>-3575.72</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/31/1922 24:00</td>
<td>-7634.85</td>
<td>-6502.08</td>
<td>-13928.76</td>
<td>-11560.78</td>
<td>-7213.94</td>
<td>-3420.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/30/1922 24:00</td>
<td>-7264.13</td>
<td>-6008.19</td>
<td>-11771.60</td>
<td>-11125.62</td>
<td>-6940.49</td>
<td>-3276.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/31/1922 24:00</td>
<td>-7011.36</td>
<td>-6023.94</td>
<td>-10704.04</td>
<td>-10703.95</td>
<td>-7132.52</td>
<td>-3173.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01/31/1923 24:00</td>
<td>-6705.90</td>
<td>-5618.41</td>
<td>-9982.81</td>
<td>-9209.80</td>
<td>-7212.04</td>
<td>-3101.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02/20/1923 24:00</td>
<td>-6450.23</td>
<td>-5613.76</td>
<td>-9230.00</td>
<td>-9069.71</td>
<td>-6467.46</td>
<td>-2995.67</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03/30/1923 24:00</td>
<td>-6942.59</td>
<td>-5310.01</td>
<td>-10112.55</td>
<td>-9401.25</td>
<td>-6066.07</td>
<td>-2819.46</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04/30/1923 24:00</td>
<td>-6183.79</td>
<td>-5253.35</td>
<td>-10632.62</td>
<td>-8001.99</td>
<td>-16711.51</td>
<td>-2163.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05/31/1923 24:00</td>
<td>-6020.86</td>
<td>-5091.07</td>
<td>-10376.02</td>
<td>-8051.54</td>
<td>-12971.73</td>
<td>-3260.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06/30/1923 24:00</td>
<td>-5230.12</td>
<td>-5006.71</td>
<td>-12488.82</td>
<td>-8193.43</td>
<td>-6952.24</td>
<td>-2894.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07/31/1923 24:00</td>
<td>-3981.00</td>
<td>-4956.91</td>
<td>-10342.34</td>
<td>-8575.54</td>
<td>-6825.76</td>
<td>-2015.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/31/1923 24:00</td>
<td>-3712.11</td>
<td>-4915.00</td>
<td>-10221.22</td>
<td>-8507.92</td>
<td>-3880.49</td>
<td>-1513.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09/30/1923 24:00</td>
<td>-3519.56</td>
<td>-4873.55</td>
<td>-10131.90</td>
<td>-8458.55</td>
<td>-6212.25</td>
<td>-1234.29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/31/1923 24:00</td>
<td>-3326.95</td>
<td>-4833.04</td>
<td>-10061.27</td>
<td>-8414.26</td>
<td>-6362.15</td>
<td>-1231.23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/30/1923 24:00</td>
<td>-3140.94</td>
<td>-4793.53</td>
<td>-9991.64</td>
<td>-8375.96</td>
<td>-6492.13</td>
<td>-1230.21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/31/1923 24:00</td>
<td>-2960.94</td>
<td>-4755.53</td>
<td>-9922.03</td>
<td>-8338.66</td>
<td>-6622.11</td>
<td>-1229.20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01/31/1924 24:00</td>
<td>-2793.94</td>
<td>-4719.53</td>
<td>-9852.43</td>
<td>-8286.37</td>
<td>-8322.10</td>
<td>-1228.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02/20/1924 24:00</td>
<td>-2634.94</td>
<td>-4684.53</td>
<td>-9782.83</td>
<td>-8236.07</td>
<td>-8452.10</td>
<td>-1227.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03/31/1924 24:00</td>
<td>-2484.94</td>
<td>-4650.53</td>
<td>-9713.23</td>
<td>-8186.77</td>
<td>-8582.10</td>
<td>-1226.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04/30/1924 24:00</td>
<td>-2341.94</td>
<td>-4616.54</td>
<td>-9643.63</td>
<td>-8137.47</td>
<td>-8712.10</td>
<td>-1225.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05/31/1924 24:00</td>
<td>-2202.94</td>
<td>-4582.54</td>
<td>-9574.03</td>
<td>-8088.17</td>
<td>-8842.10</td>
<td>-1224.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06/30/1924 24:00</td>
<td>-2065.94</td>
<td>-4548.54</td>
<td>-9504.43</td>
<td>-8038.87</td>
<td>-8972.10</td>
<td>-1223.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07/31/1924 24:00</td>
<td>-1930.94</td>
<td>-4514.54</td>
<td>-9434.83</td>
<td>-7989.57</td>
<td>-9102.10</td>
<td>-1222.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08/31/1924 24:00</td>
<td>-1796.94</td>
<td>-4480.54</td>
<td>-9365.24</td>
<td>-7940.27</td>
<td>-9232.10</td>
<td>-1221.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09/30/1924 24:00</td>
<td>-1662.94</td>
<td>-4446.54</td>
<td>-9295.64</td>
<td>-7890.97</td>
<td>-9362.10</td>
<td>-1220.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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  

This file lists the simulation results at the end of the simulation period. It is in a format that can readily be used as initial conditions data file (Unit 11) for 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 file Unit 51 can be used as an initial conditions data file. Similar to the groundwater head output at every node (Unit 48), 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.
**SIMULATION RESULTS AT TIME 30.00 day**

**GROUNDWATER HEAD VALUES**

**LAYER 1**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Head (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0000</td>
<td>20065.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>20685.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>621.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>432.0812500000</td>
</tr>
<tr>
<td>0.0000</td>
<td>496.0562500000</td>
</tr>
<tr>
<td>0.0000</td>
<td>437.5161000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>323.4725000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>770.0513000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>715.0845000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>28720.00000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>28465.00000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>21300.00000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>555.5660000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>450.1178500000</td>
</tr>
<tr>
<td>0.0000</td>
<td>486.1461500000</td>
</tr>
<tr>
<td>0.0000</td>
<td>20874.00000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>1712.6455000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>608.0614000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>845.9659000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>1027.9475000000</td>
</tr>
</tbody>
</table>

**LAYER 2**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Head (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0000</td>
<td>20555.00000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>594.2601000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>621.8259000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>413.1552000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>495.7807000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>387.7969000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>401.1761000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>722.2935000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>667.1878000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>678.9933500000</td>
</tr>
<tr>
<td>0.0000</td>
<td>456.8799000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>396.1866000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>376.2500000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>436.3242000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>401.6654000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>1172.9354400000</td>
</tr>
<tr>
<td>0.0000</td>
<td>337.4321000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>455.5161000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>497.2666000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>20724.00000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>41712.64550000</td>
</tr>
<tr>
<td>0.0000</td>
<td>644.7259000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>60845.96590000</td>
</tr>
<tr>
<td>0.0000</td>
<td>40127.94750000</td>
</tr>
</tbody>
</table>

**LAYER 3**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Head (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0000</td>
<td>40255.00000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>4094.26010000</td>
</tr>
<tr>
<td>0.0000</td>
<td>46061.82590000</td>
</tr>
<tr>
<td>0.0000</td>
<td>440.2176000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>440.1761000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>40722.93250000</td>
</tr>
<tr>
<td>0.0000</td>
<td>40667.18780000</td>
</tr>
<tr>
<td>0.0000</td>
<td>556.1893500000</td>
</tr>
<tr>
<td>0.0000</td>
<td>452.5065000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>401.9350000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>381.4579000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>370.6363000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>41127.93544000</td>
</tr>
<tr>
<td>0.0000</td>
<td>492.9657000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>446.6029000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>483.1230000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>440.7012000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>41712.64550000</td>
</tr>
<tr>
<td>0.0000</td>
<td>536.3721000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>50845.96590000</td>
</tr>
<tr>
<td>0.0000</td>
<td>40127.94750000</td>
</tr>
</tbody>
</table>

**ROOT ZONE SOIL MOISTURE AS VOLUME**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0000</td>
<td>576594.00000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>5161960.00000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>1380000.00000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>1290000.00000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>1391000.00000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
</tbody>
</table>

**UNSATURATED DUNE SOIL MOISTURE AS A FRACTION OF TOTAL POROSITY**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0000</td>
<td>4.41888495530000</td>
</tr>
<tr>
<td>0.0000</td>
<td>2.55638171900000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
<tr>
<td>0.0000</td>
<td>0.0000000000</td>
</tr>
</tbody>
</table>

**SMALL WATERSHED SOIL MOISTURE AND GROUNDWATER STORAGE**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Moisture (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0000</td>
<td>1.26019282835000</td>
</tr>
<tr>
<td>0.0000</td>
<td>9.41707535975000</td>
</tr>
<tr>
<td>0.0000</td>
<td>1.5112475359357500</td>
</tr>
<tr>
<td>0.0000</td>
<td>5.4121635260711350</td>
</tr>
<tr>
<td>0.0000</td>
<td>1.5539074327427500</td>
</tr>
<tr>
<td>0.0000</td>
<td>1.5062985149388660</td>
</tr>
<tr>
<td>0.0000</td>
<td>9.41707535975000</td>
</tr>
</tbody>
</table>

**LAKE ELEVATIONS**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0000</td>
<td>201.962605362222</td>
</tr>
<tr>
<td>0.0000</td>
<td>184.611099670168</td>
</tr>
</tbody>
</table>

**INTERBED THICKNESS**

**LAYER 1**
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 (Unit 31)
- Binary output for small watershed flow components (Unit 32)
- Binary output for element sub-group details (Unit 33)
- Binary output for diversion details (Unit 34)
- Binary output for stream budget by reach (Unit 35)
- Binary output for lake budget (Unit 36)
- Binary output for land and water use budget (Unit 37)
- Binary output for stream budget (Unit 38)
- Binary output for root zone moisture budget (Unit 39)
- Binary output for groundwater budget (Unit 40)
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, stream flows, root zone moisture accounting, groundwater, element subgroup accounting, small watersheds, lakes, stream reaches 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 from the simulation of IWFM. A list of the simulation output unit numbers, corresponding budget input unit numbers and file descriptions are given in Table 5.1. The simulation output unit numbers are specified in the main simulation input file (Unit 5) and the budget input unit numbers are listed in the main budget input file. The file names are variable, depending on user specification. However, the file names for binary output from the simulation program must be the same as the binary input file names specified in the main budget input file.
<table>
<thead>
<tr>
<th>Simulation output</th>
<th>Budget input</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 37</td>
<td>Unit 1</td>
<td>Land and water use simulation output</td>
</tr>
<tr>
<td>Unit 38</td>
<td>Unit 2</td>
<td>Simulated stream flow output</td>
</tr>
<tr>
<td>Unit 39</td>
<td>Unit 3</td>
<td>Root zone moisture accounting output</td>
</tr>
<tr>
<td>Unit 40</td>
<td>Unit 4</td>
<td>Simulated groundwater output</td>
</tr>
<tr>
<td>Unit 33</td>
<td>Unit 5</td>
<td>Element sub-group accounting output</td>
</tr>
<tr>
<td>Unit 32</td>
<td>Unit 6</td>
<td>Small watershed boundary condition output</td>
</tr>
<tr>
<td>Unit 36</td>
<td>Unit 7</td>
<td>Lake simulation output</td>
</tr>
<tr>
<td>Unit 35</td>
<td>Unit 8</td>
<td>Stream reach output</td>
</tr>
<tr>
<td>Unit 34</td>
<td>Unit 9</td>
<td>Diversion detail output</td>
</tr>
</tbody>
</table>

**Table 5.1** Unit numbers for binary simulation output and budget input

**Main Input File**

The main input file contains names of the binary files generated in the simulation part of IWFM, output unit controls, beginning and ending time step as well as the frequency that the budget information is reported. The values stored in the binary files have units used in the simulation. 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), ending time (TLAST for non-time tracking simulation, EDT for time tracking simulation) and the print-out frequency (MPRNT) for the budget outputs. If the time series data for each budget table is required to be printed out to a DSS file instead of an ASCII text file, a file name with “.DSS” extension should be supplied.
The user must specify the number of subregions modeled in IWFM simulation, the name of each subregion modeled and the printing option for each subregion. To print the budget information for a subregion, the print switch value (IPRINT) is set to any value other than zero. If budget information for a subregion is not to be printed, the print switch must be set to zero. The budget information for the entire model domain is printed always. The following is a list of variables that need to be defined in this input 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)
- **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
- **MPRNT**: Frequency of budget output
NREGN  Number of subregions modeled in IWFM simulation
IR     Subregion number
IPRINT Budget print option (enter zero to depress budget printing for a subregion)
NAME   Subregion name
INTEGRATED WATER FLOW MODEL (INFM)
*** Version *** ***

BUDGET INPUT FILE
for INFM Post-Processing

Project: INFM Version *** Release
California Department of Water Resources
Filename: BUDGET.IN

File Description
This file contains the names and descriptions of all binary input files, conversion factors and output control options for running the post-processor.

File Description
* Listed below are all input and output file names used when running the INFM Budget post-processor.
* If the budget tables are desired to be created in ASCII text files, leave the DB3 output file name blank.
* If a file does not exist for a project, leave the file name blank.

For example, if stream flow budget is not desired, the file name and description columns for unit 2 will appear as:

FILE NAME UNIT DESCRIPTION
/2: binary file generated by simulation for streamflow budget

FILE NAME UNIT DESCRIPTION

LANDWATER.BIN /1: binary file generated by simulation for land and water use budget
STREAM.BIN /2: binary file generated by simulation for streamflow budget
SOIL.BIN /3: binary file generated by simulation for root zone moisture budget
GROUND.BIN /4: binary file generated by simulation for groundwater budget
ELEMENT.BIN /5: binary file generated by simulation for element sub-group details
SMOKE.BIN /6: binary file generated by simulation for small watershed flow components
LAKE.BIN /7: binary file generated by simulation for lake budget
STREAM.BIN /8: binary file generated by simulation for stream budget by reach
STREAML.BIN /9: binary file generated by simulation for diversion outputs
BUDGETS.DBS /10: DB3 output file to store the water budget data

Output Unit Control
FACT: Factor to convert simulation unit of length to output unit of length
UNITS: Output unit of length (8 characters max.)
FACT2: Factor to convert simulation unit of area to output unit of area
UNIT2: Output unit of area (8 characters max.)
FACTV: Factor to convert simulation unit of volume to output unit of volume
UNITV: Output unit of volume (8 characters max.)

Output Cache Site
CACHE: Cache size in terms of number of values stored for time series data output

Value Description
1000 / CACHE

Budget Output Control Options
(If the actual simulation date and time is NOT tracked enter the following variables. Otherwise, comment out the following variables and use the "Simulation Date and Time NOT tracked" option below.

TBEGIN: Beginning time for the budget tables
* use ##.## for MC
TLAST: Ending time for the budget tables
* use ##.## for MC
MFMT : Frequency of budget output

----------------------------------------
VALUE DESCRIPTION
----------------------------------------
** / TRDGN
** / TIAFT
** / MFMT

----------------------------------------
Budget Output Control Options
(Simulation Date and Time Tracked)

If the actual simulation date and time is tracked enter the following
variables. Otherwise, comment out the following variables and use the
"Simulation Date and Time NOT Tracked" option above.

EOT : Beginning date and time for the budget output
* Use MMD/ED/YYYY HH:MM format
* Midnight is 24:00

EDT : Ending date and time for the budget output
* Use MMD/ED/YYYY HH:MM format
* Midnight is 24:00

MFMT : Frequency of budget output

----------------------------------------
VALUE DESCRIPTION
----------------------------------------
09/30/1990_24:00 / EOT
09/30/1990_24:00 / EDT
1 / MFMT

----------------------------------------
Subregion Names and Print Options

The following lists the subregion names and the option to generate a budget
table for a subregion.

NRGN : Number of subregions modeled
IR : Subregion number
IPRINT : Budget print option |enter 0 to depress budget print-out for a subregion|
NAME : Name of subregion (maximum 20 characters long)

----------------------------------------
VALUE DESCRIPTION
----------------------------------------
** / NRGN
1 / IR
3 / IPRINT
1 / NAME

1 REGION1
2 REGION2
3 REGION3
**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 in the IWFM simulation main input file (Unit 5). As few as one and as many as nine binary files can be input for processing IWFM output in tabular form or in DSS file format. All binary files must be specified in the main budget input file. Refer to Table 5.1 for a list of unit numbers that correspond with the binary input files.

**5.2. Output Files**

The budget program generates up to nine output files. More specifically, a single ASCII output file is generated for each binary input file provided by the user, if a DSS file name is not specified. The ASCII output file names are the same with the names of binary files except that their extension names are replaced with “BUD”. For instance, if the lake budget binary file is named as LAKE.BIN, the ASCII output file name after running budget program will be LAKE.BUD. The output files include information generated by IWFM simulation. All ASCII output files organized by subregion include a table for each subregion specified for printing in the main input file, as well as the total modeled area. The other output files are organized by element sub-group, small watershed, lake or stream reach. The beginning time, ending time and frequency of each output file is based on the values of TBEGIN (or BDT), TLAST (or EDT) and MPRNT specified in the main budget input file. Therefore, each budget table ranges from time...
TBEGIN (or BDT) to TLAST (or EDT) and the values are accumulated and written for every time interval (MPRNT) within the output time range.

If a file name with extension “.DSS” is specified for budget data print-out then all time series data for all of the required budget tables are printed to that file. The pathnames to locate budget table components in the DSS file will be explained later for each budget table.

**Land and Water Use Budget**

The land and water use budget is organized by subregion. A budget table is produced for each subregion specified for printing in the main input file, as well as the total modeled area. The title printed for each subregional land and water use budget includes IWFM version number, subregion name given by the user, the unit of data columns and the area of the subregion. For example, all land and water use budget columns are in volumetric units except *Time, Agricultural Area* and *Urban Area*. The output units and conversion factors for area (UNITAROU and FACTAROU) and volume (UNITVLOU and FACTVLOU) are specified by the user in the main budget input file.

The total agricultural and urban areas, as well as the potential consumptive use of applied water are reported in the output, followed by the components that the land and water use budget is comprised of. A positive or negative sign is given for each column that is a component of the subregional mass balance. The *Shortage* column is the resulting balance, based on water use components. A value of zero in this column indicates that the available water supply (surface water diversions and groundwater...
pumping) meets the agricultural or urban supply requirements. A positive value indicates that the supply is not a large enough quantity to satisfy water requirements. Conversely, a negative value in the *Shortage* column signifies a water supply surplus. The amount of return flow that is re-used in agricultural and urban areas is also listed. In the last two columns, total water imports to and exports from the subregion are listed. The following table defines each column in the land and water use budget table printed out to ASCII file and lists the variable(s) associated with each column as represented in the IWFM code:

<table>
<thead>
<tr>
<th>LAND AND WATER USE BUDGET</th>
<th>COL. #</th>
<th>COLUMN NAME</th>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Area</td>
<td>1</td>
<td>Time</td>
<td>IFLAG</td>
<td>Time step</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Area</td>
<td>RLAND(IRL+1)</td>
<td>Agricultural area</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Potential CUAW</td>
<td>RCUAW</td>
<td>Applied water needed for optimum agricultural conditions where adequate crop production is guaranteed by maintaining ET rates at their potential levels, soil moisture losses to deep percolation are minimized, and the minimum soil moisture requirements are met at all times</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Agricultural Supply Requirement</td>
<td>RDMAG</td>
<td>Amount of water necessary to meet the agricultural demand that is either computed internally or specified by the user in the Unit 19 simulation input file</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Pumping (-)</td>
<td>RPUMP_AG</td>
<td>Portion of groundwater pumping that is used to meet the agricultural supply requirement</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Diversion (-)</td>
<td>RDELI_AG</td>
<td>Portion of the actual amount of water diverted from streams that is used to meet the agricultural supply requirement</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Shortage (=)</td>
<td>RDMSH_AG</td>
<td>Resulting water balance with respect to the agricultural supply requirements and supply specified in preceding columns</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Re-use</td>
<td>RUW_AG</td>
<td>Amount of return flow that is re-used in agricultural areas</td>
</tr>
<tr>
<td>Urban Area</td>
<td>9</td>
<td>Area</td>
<td>RLAND(IRL+2)</td>
<td>Urban area</td>
</tr>
<tr>
<td>Column</td>
<td>Description</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Urban Supply Requirement</td>
<td>RDMUR</td>
<td>User specified indoor and outdoor urban demand</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Pumping (-)</td>
<td>RPUMP_URB</td>
<td>Portion of groundwater pumping that is used to meet the urban supply requirement</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Diversion (-)</td>
<td>RDELI_URB</td>
<td>Portion of the actual amount of water diverted from streams that is used to meet the urban supply requirement</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Shortage (=)</td>
<td>RDMSH_URB</td>
<td>Resulting water balance with respect to the urban supply requirements and supply specified in preceding columns</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Re-use</td>
<td>RUW_URB</td>
<td>Amount of return flow that is re-used in urban areas</td>
<td></td>
</tr>
</tbody>
</table>

**Region Imports/Exports**

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Import</td>
</tr>
<tr>
<td>16</td>
<td>Export</td>
</tr>
</tbody>
</table>

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

**Part A:**

IWFM_L&W_USE_BUD

**Part B:**

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

**Part C:**

One of the following, depending on the output data:

i. AREA

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:

Time step used in the Simulation

Part F:

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

i. $AG\_AREA$ (corresponds to column 2 in ASCII output file)

ii. $AG\_POTNL\_CUAW$ (corresponds to column 3 in ASCII output file)

iii. $AG\_SUP\_REQ$ (corresponds to column 4 in ASCII output file)

iv. $AG\_PUMPING$ (corresponds to column 5 in ASCII output file)

v. $AG\_DIVER$ (corresponds to column 6 in ASCII output file)

vi. $AG\_SHORTAGE$ (corresponds to column 7 in ASCII output file)

vii. $AG\_RE\_USE$ (corresponds to column 8 in ASCII output file)

viii. $URB\_AREA$ (corresponds to column 9 in ASCII output file)

ix. $URB\_SUP\_REQ$ (corresponds to column 10 in ASCII output file)

x. $URB\_PUMPING$ (corresponds to column 11 in ASCII output file)

xi. $URB\_DIVER$ (corresponds to column 12 in ASCII output file)
Stream Flow Budget  

Stream flow budgets are generated for all subregions specified to be printed in the main input file and the total modeled area. The title printed for each subregional stream flow budget includes IWFM version number, subregion name given by the user, the unit of data columns and the area of the subregion. The entire stream flow budget is in volumetric units. The output units (UNITVLOU) and conversion factor (FACTVLOU) for volume are specified by the user in the main budget input file.

The stream flow budget tables provide information on the flows in and out of the subregion as well as the impacts of other processes on stream flows within a subregion such as small stream watershed flows, tile drainage, surface runoff, return flows, diversions and bypass flows. Based on stream inflows to the subregion and other processes occurring within the subregion, the stream flow amount leaving the subregion is reported (Downstream Outflow). The Diversion Shortage column reports the difference between simulated diversions and the user specified diversion requirements. The following table defines each column in the stream flow budget table printed out to ASCII file and specifies the corresponding variable in the IWFM code:

xii. **URB_SHORTAGE** (corresponds to column 13 in ASCII output file)

xiii. **URB_RE-USE** (corresponds to column 14 in ASCII output file)

xiv. **IMPORTS** (corresponds to column 15 in ASCII output file)

xv. **EXPORTS** (corresponds to column 16 in ASCII output file)
### STREAM FLOW BUDGET

<table>
<thead>
<tr>
<th>COL. #</th>
<th>COLUMN NAME</th>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time</td>
<td>IFLAG</td>
<td>Time step</td>
</tr>
<tr>
<td>2</td>
<td>Upstream Inflow (+)</td>
<td>RUFLOW</td>
<td>Stream inflows to a subregion, which includes inflows from Unit 21 and flows from upstream reaches located in other subregions</td>
</tr>
<tr>
<td>3</td>
<td>Downstream Outflow (-)</td>
<td>RDFLOW</td>
<td>Stream flows leaving the subregion and either entering another subregion, or exiting the modeled area</td>
</tr>
<tr>
<td>4</td>
<td>Tributary Inflow (+)</td>
<td>RTRIB</td>
<td>Surface flows from small stream watersheds to the streams</td>
</tr>
<tr>
<td>5</td>
<td>Tile Drain (+)</td>
<td>RSTDRAIN</td>
<td>Inflows from tile drains</td>
</tr>
<tr>
<td>6</td>
<td>Runoff (+)</td>
<td>RROST</td>
<td>Direct runoff from rainfall into the streams</td>
</tr>
<tr>
<td>7</td>
<td>Return Flow (+)</td>
<td>RRTST</td>
<td>Return flow of the irrigation water into streams</td>
</tr>
<tr>
<td>8</td>
<td>Gain from Groundwater (+)</td>
<td>-RSTINF</td>
<td>Stream-groundwater interaction; a positive value denotes a gaining stream and a negative value indicates a losing stream</td>
</tr>
<tr>
<td>9</td>
<td>Gain from Lake (+)</td>
<td>RRLKIN</td>
<td>Inflow from upstream lakes</td>
</tr>
<tr>
<td>10</td>
<td>Diversion (-)</td>
<td>RDIVS</td>
<td>Diversions from the streams</td>
</tr>
<tr>
<td>11</td>
<td>Bypass Flow (-)</td>
<td>RBYPS</td>
<td>Net bypass flow within a subregion; for example, the bypass flow from one stream node to another within the subregion is the amount of water loss during the bypass process whereas bypass flow from a stream node in the subregion to a different subregion is the total amount bypassed from the stream node</td>
</tr>
<tr>
<td>12</td>
<td>Discrepancy (=)</td>
<td>RSERR</td>
<td>Error in the stream flow mass balance based on the preceding columns</td>
</tr>
<tr>
<td>13</td>
<td>Diversion Shortage</td>
<td>RDVSH</td>
<td>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 flow in a subregion</td>
</tr>
</tbody>
</table>
If a DSS file is used for print-out, the following pathnames are used:

**Part A:**

IWFM_STREAM_BUD

**Part B:**

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

**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:**

Time step used in the Simulation

**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 ASCII output file)

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

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

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

v. RUNOFF (corresponds to column 6 in ASCII output file)
vi.  \textit{RETURN\_FLOW} (corresponds to column 7 in ASCII output file)

vii. \textit{GAIN\_FROM\_GW} (corresponds to column 8 in ASCII output file)

viii. \textit{GAIN\_FROM\_LAKE} (corresponds to column 9 in ASCII output file)

ix.  \textit{DIVERSION} (corresponds to column 10 in ASCII output file)

x.  \textit{BYPASS} (corresponds to column 11 in ASCII output file)

xi.  \textit{DISCREPANCY} (corresponds to column 12 in ASCII output file)

xii. \textit{DIVER\_SHORTAGE} (corresponds to column 13 in ASCII output file)

\textbf{Root Zone Moisture Budget Unit 3}

The root zone moisture budget is organized by subregion. A table is produced for each subregion specified for printing in the main input file, as well as the total modeled area. The title printed for each subregional root zone moisture 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 are specified by the user in the main budget input file.

The root zone moisture budget provides information on processes that are used to compute soil moisture in the root zone. Agricultural areas represent the areas where crops are located. Urban area includes indoor and outdoor urban areas and the native and riparian lands represent the undeveloped area in the subregion. For each area type (agricultural, municipal, and native and riparian vegetation), precipitation and irrigation
(except for native and riparian vegetation areas) along with direct runoff and return flows are listed. The infiltration column is computed by adding the precipitation and prime irrigation water and subtracting the runoff and return flow. The following table describes the columns in the root zone moisture budget when printed out to an ASCII file:

<table>
<thead>
<tr>
<th>COL. #</th>
<th>COLUMN NAME</th>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time</td>
<td>IFLAG</td>
<td>Time step</td>
</tr>
<tr>
<td>Agriculture Area</td>
<td></td>
<td>RLAND(IRAG)</td>
<td>Agricultural area</td>
</tr>
<tr>
<td>2</td>
<td>Area</td>
<td>RRAIN(IRAG)*RLAND(IRAG)</td>
<td>Precipitation that falls on agricultural lands</td>
</tr>
<tr>
<td>3</td>
<td>Precipitation</td>
<td>RROFF(IRAG)</td>
<td>Direct runoff of precipitation that falls on agricultural lands</td>
</tr>
<tr>
<td>4</td>
<td>Runoff</td>
<td>RDELI_AG + RPUMP_AG + RUW_AG</td>
<td>Amount of water applied for irrigation purposes excluding the re-used return flow; the time-series fraction of surface water diversions and pumping specified for irrigation purposes is located in Unit 27 of simulation</td>
</tr>
<tr>
<td>5</td>
<td>Reused Water</td>
<td>RUW_AG</td>
<td>The amount of re-used water on agricultural lands</td>
</tr>
<tr>
<td>6</td>
<td>Total Applied Water</td>
<td>RDELI_AG + RPUMP_AG + RUW_AG</td>
<td>Total irrigation water as a summation of prime applied water and the re-used water on agricultural lands</td>
</tr>
<tr>
<td>7</td>
<td>Runoff</td>
<td>RRTRN(IRAG)</td>
<td>Net return flow of irrigation on agricultural lands (after re-use)</td>
</tr>
<tr>
<td>8</td>
<td>Beginning Storage</td>
<td>RSOILM_P(IRAG)</td>
<td>Root zone moisture in agricultural lands at the beginning of time step</td>
</tr>
<tr>
<td>9</td>
<td>Net Gain from Land Expansion (+)</td>
<td>RSOILMCH(IRAG)</td>
<td>The net moisture gained from other land use areas as the area of agricultural lands increase (a negative value represents loss of moisture due to the decrease of agricultural area)</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Equation</td>
<td>Notes</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>Infiltration (+) RINFILT(IRAG)</td>
<td>Total infiltration on the agricultural lands; computed as the summation of precipitation and applied water less runoff and return flow</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Actual ET (−) RETAC(IRAG)</td>
<td>Actual evapotranspiration in agricultural lands, which is computed based on ET rates under standard conditions in Unit 16 of simulation and root zone moisture values</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Deep Percolation (−) RPERC(IRAG)</td>
<td>Deep percolation from the root zone to the unsaturated zone in agricultural areas</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Ending Storage (=) RSOILM(IRAG)</td>
<td>Root zone moisture in agricultural lands at the end of the time step; computed as the summation of the beginning storage and infiltration less actual ET and deep percolation</td>
<td></td>
</tr>
</tbody>
</table>

**Urban Area**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Equation</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Area RLAND(IRURB)</td>
<td>Urban area</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Precipitation RRAIN(IRURB) * RLAND(IRURB)</td>
<td>Precipitation that falls on urban lands</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Runoff RROFF(IRURB)</td>
<td>Direct runoff of precipitation that falls on urban lands</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Prime Applied Water RDELI_URB + RPUMP_URB</td>
<td>Amount of water used for urban indoors and outdoors usage; this is the amount of water before the re-use of return flow is considered</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Reused Water RUW_URB</td>
<td>The amount of re-used water on urban lands</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Total Applied Water RDELI_URB + RPUMP_URB + RUW_URB</td>
<td>Total applied water as a summation of prime applied water and the re-used water on urban lands</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Return Flow RRTRN(IRURB)</td>
<td>Net return flow of applied water used for urban indoors and outdoors usage (after re-use)</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Beginning Storage RSOILM_P(IRURB)</td>
<td>Root zone moisture at the beginning of time step</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Net Gain from Land Expansion (+)</strong> RSOILMCH(IRURB)</td>
<td>The net moisture gained from other land use areas as the area of urban lands increase (a negative value represents loss of moisture due to the decrease of urban area)</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td><strong>Infiltration (+)</strong> RINFILT(IRURB)</td>
<td>Total infiltration on the urban lands; computed as the summation of precipitation and applied water less runoff and return flow</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td><strong>Actual ET (−)</strong> RETAC(IRURB)</td>
<td>Actual evapotranspiration in urban lands, which is computed based on ET rates under standard conditions in Unit 16 of simulation and root zone moisture values</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td><strong>Deep Percolation (−)</strong> RPERC(IRURB)</td>
<td>Deep percolation from the root zone to the unsaturated zone in urban areas</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td><strong>Ending Storage (=)</strong> RSOILM(IRURB)</td>
<td>Root zone moisture in urban lands at the end of the time step; computed as the summation of the beginning storage and infiltration less actual ET and deep percolation</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td><strong>Native &amp; Riparian Vegetation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Area</strong> RLAND(IRNV)+RLAND(IRRV)</td>
<td>Native and riparian vegetation area</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td><strong>Precipitation</strong> RRAIN(IRNV)*RLAND(IRNV)+RRAIN(IRRV)*RLAND(IRRV)</td>
<td>Precipitation that falls on areas with native and riparian vegetation</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td><strong>Runoff</strong> RROFF(IRNV)+RROFF(IRRV)</td>
<td>Direct runoff of precipitation that falls on areas with native and riparian vegetation</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td><strong>Beginning Storage</strong> RSOILM_P(IRNV)+RSOILM_P(IRRV)</td>
<td>Root zone moisture in areas with native and riparian vegetation at the beginning of time step</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td><strong>Net Gain from Land Expansion (+)</strong> RSOILMCH(IRNV)+RSOILMCH(IRRV)</td>
<td>The net moisture gained from other land use areas as the area of native and riparian vegetation increase (a negative value represents loss of moisture due to the decrease of native and riparian vegetation area)</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td><strong>Infiltration (+)</strong> RINFILT(IRNV)+RINFILT(IRRV)</td>
<td>Total infiltration on areas with native and riparian vegetation; computed as precipitation less runoff</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Actual ET (−) RETAC(IRNV)+RETAC(IRRV)</td>
<td>Actual evapotranspiration in areas with native and riparian vegetation, which is computed based on ET rates under standard conditions in Unit 16 of simulation and root zone moisture values</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Deep Percolation (−) RPERC(IRNV)+RPERC(IRRV)</td>
<td>Deep percolation from the root zone to the unsaturated zone in areas with native and riparian vegetation</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Ending Storage (=) RSOILM(IRNV)+RSOILM(IRRV)</td>
<td>Root zone moisture in areas with native and riparian vegetation at the end of the time step; computed as the summation of the beginning storage and infiltration less actual ET and deep percolation</td>
<td></td>
</tr>
</tbody>
</table>

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

**Part A:**

$IWFM_ROOTZN_BUD$

**Part B:**

$SRXXX (TTT)$ where $XXX$ is the subregion number and $TTT$ is the name of the subregion

**Part C:**

One of the following, depending on the output data:

i. $AREA$

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:

Time step used in the Simulation

Part F:

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

i. $AG\_AREA$ (corresponds to column 2 in ASCII output file)

ii. $AG\_PRECIP$ (corresponds to column 3 in ASCII output file)

iii. $AG\_RUNOFF$ (corresponds to column 4 in ASCII output file)

iv. $AG\_PRM\_H2O$ (corresponds to column 5 in ASCII output file)

v. $AG\_RE\_USE$ (corresponds to column 6 in ASCII output file)

vi. $AG\_TOTAL\_APP$ (corresponds to column 7 in ASCII output file)

vii. $AG\_RTRN\_FLOW$ (corresponds to column 8 in ASCII output file)

viii. $AG\_BEGIN\_STOR$ (corresponds to column 9 in ASCII output file)

ix. $AG\_GAIN\_EXP$ (corresponds to column 10 in ASCII output file)

x. $AG\_INFILTR$ (corresponds to column 11 in ASCII output file)

xi. $AG\_ET$ (corresponds to column 12 in ASCII output file)

xii. $AG\_DEEP\_PERC$ (corresponds to column 13 in ASCII output file)

xiii. $AG\_END\_STOR$ (corresponds to column 14 in ASCII output file)

xiv. $URB\_AREA$ (corresponds to column 15 in ASCII output file)
xv. *URB_PRECIP* (corresponds to column 16 in ASCII output file)
xvi. *URB_RUNOFF* (corresponds to column 17 in ASCII output file)
xvii. *URB_PRM_H2O* (corresponds to column 18 in ASCII output file)
xviii. *URB_RE-USE* (corresponds to column 19 in ASCII output file)
xix. *URB_TOTAL_APP* (corresponds to column 20 in ASCII output file)
x. *URB_RTRN_FLOW* (corresponds to column 21 in ASCII output file)
xi. *URB_BEGIN_STOR* (corresponds to column 22 in ASCII output file)
xi. *URB_GAIN_EXP* (corresponds to column 23 in ASCII output file)
xxiii. *URB_INFILTR* (corresponds to column 24 in ASCII output file)
xxiv. *URB_ET* (corresponds to column 25 in ASCII output file)
xxv. *URB_DEEP_PERC* (corresponds to column 26 in ASCII output file)
xxvi. *URB_END_STOR* (corresponds to column 27 in ASCII output file)
xxvii. *NRV_AREA* (corresponds to column 28 in ASCII output file)
xxviii. *NRV_PRECIP* (corresponds to column 29 in ASCII output file)
xxix. *NRV_RUNOFF* (corresponds to column 30 in ASCII output file)
Groundwater Budget

A groundwater budget table is produced for each subregion specified for printing in the main input file, as well as the total modeled area. 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 main budget 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 the cumulative subsidence are also reported. The following list describes the columns in the groundwater budget table as printed to an ASCII file:
<table>
<thead>
<tr>
<th>COL. #</th>
<th>COLUMN NAME</th>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time</td>
<td>IFLAG</td>
<td>Time step</td>
</tr>
<tr>
<td>2</td>
<td>Deep Percolation</td>
<td>RPERCE</td>
<td>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</td>
</tr>
<tr>
<td>3</td>
<td>Beginning Storage (+)</td>
<td>RGWSTP</td>
<td>Groundwater storage at the beginning of the time step</td>
</tr>
<tr>
<td>4</td>
<td>Ending Storage (−)</td>
<td>RGWSTO</td>
<td>Groundwater storage at the end of time step</td>
</tr>
<tr>
<td>5</td>
<td>Net Deep Percolation (+)</td>
<td>RNETP</td>
<td>Recharge to the groundwater; this column represents the outflow from the unsaturated layer directly above the aquifer</td>
</tr>
<tr>
<td>6</td>
<td>Gain from Stream (+)</td>
<td>RSTINF</td>
<td>Amount of stream flow that contributes to groundwater; stream-groundwater interaction due to a losing stream is defined as a positive value whereas a gaining stream is defined as a negative value</td>
</tr>
<tr>
<td>7</td>
<td>Recharge (+)</td>
<td>RRECH</td>
<td>Recharge to the aquifer from injection wells and recoverable loss of diversions and bypasses</td>
</tr>
<tr>
<td>8</td>
<td>Gain from Lake (+)</td>
<td>RLAKE</td>
<td>Lake-groundwater interaction; a positive value represents flow from lake into groundwater, a negative value represents flow from groundwater into lake</td>
</tr>
<tr>
<td>9</td>
<td>Boundary Inflow (+)</td>
<td>RBOUND</td>
<td>Net inflow into groundwater due to boundary conditions</td>
</tr>
<tr>
<td>10</td>
<td>Subsidence (+)</td>
<td>RGWSTOC−RGWSTPC</td>
<td>Amount of flow released out of groundwater storage due to subsidence</td>
</tr>
<tr>
<td>11</td>
<td>Subsurface Irrigation (+)</td>
<td>RSUBIRIG</td>
<td>Contribution of subsurface irrigation to groundwater storage</td>
</tr>
<tr>
<td>12</td>
<td>Tile Drain Outflow (−)</td>
<td>RGWDRAIN</td>
<td>Groundwater that flows into tile drains</td>
</tr>
</tbody>
</table>
13 Pumping (−) RPUMP Total subregional groundwater pumping

14 Net Subsurface Inflow (+) RSUBFL Net groundwater inflow into the subregion from the surrounding subregions

15 Discrepancy (=) RGWERR Error in the groundwater mass balance based on the preceding columns

16 Cumulative Subsidence RGWSTOC Cumulative volume of groundwater storage lost due to land subsidence

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

**Part A:**

IWFM_GW_BUD

**Part B:**

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

**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:**

Time step used in the Simulation

**Part F:**

One of the following, depending on the output data (refer to the table above for further details):
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Corresponding Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>\texttt{DEEP_PERC} (DEEP_PERC)</td>
<td>2</td>
</tr>
<tr>
<td>ii.</td>
<td>\texttt{BEGIN_STORAGE} (BEGIN_STORAGE)</td>
<td>3</td>
</tr>
<tr>
<td>iii.</td>
<td>\texttt{END_STORAGE} (END_STORAGE)</td>
<td>4</td>
</tr>
<tr>
<td>iv.</td>
<td>\texttt{NET_DEEP_PERC} (NET_DEEP_PERC)</td>
<td>5</td>
</tr>
<tr>
<td>v.</td>
<td>\texttt{GAIN_FROM_STRM} (GAIN_FROM_STRM)</td>
<td>6</td>
</tr>
<tr>
<td>vi.</td>
<td>\texttt{RECHARGE} (RECHARGE)</td>
<td>7</td>
</tr>
<tr>
<td>vii.</td>
<td>\texttt{GAIN_FROM_LAKE} (GAIN_FROM_LAKE)</td>
<td>8</td>
</tr>
<tr>
<td>viii.</td>
<td>\texttt{BOUNDARY_INFLOW} (BOUNDARY_INFLOW)</td>
<td>9</td>
</tr>
<tr>
<td>ix.</td>
<td>\texttt{SUBSIDENCE} (SUBSIDENCE)</td>
<td>10</td>
</tr>
<tr>
<td>x.</td>
<td>\texttt{SUBSURF_IRRIGATION} (SUBSURF_IRRIGATION)</td>
<td>11</td>
</tr>
<tr>
<td>xi.</td>
<td>\texttt{TILE_DRAINS} (TILE_DRAINS)</td>
<td>12</td>
</tr>
<tr>
<td>xii.</td>
<td>\texttt{PUMPING} (PUMPING)</td>
<td>13</td>
</tr>
<tr>
<td>xiii.</td>
<td>\texttt{NET_SUBSURF_INFLOW} (NET_SUBSURF_INFLOW)</td>
<td>14</td>
</tr>
<tr>
<td>xiv.</td>
<td>\texttt{DISCREPANCY} (DISCREPANCY)</td>
<td>15</td>
</tr>
<tr>
<td>xv.</td>
<td>\texttt{CUM_SUBSIDENCE} (CUM_SUBSIDENCE)</td>
<td>16</td>
</tr>
</tbody>
</table>
An element sub-group report is given for each element sub-group specified in the element characteristics pre-processor input file (Unit 13). The report is useful for displaying output for areas that do not encompass a specified subregion. The title of each report includes the IWFM version number, the sub-group number and the unit of output values. The following list defines the columns in this output file as printed to an ASCII file:

**ELEMENT SUB-GROUP DETAILS**

<table>
<thead>
<tr>
<th>COL. #</th>
<th>COLUMN NAME</th>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time</td>
<td>IFLAG</td>
<td>Time step</td>
</tr>
<tr>
<td></td>
<td><strong>Lands within the Sub-group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Agricultural Supply Requirement</td>
<td>SDMAG</td>
<td>Sub-group agricultural demand</td>
</tr>
<tr>
<td>3</td>
<td>Urban Supply Requirement</td>
<td>SDMUR</td>
<td>Sub-group urban demand</td>
</tr>
<tr>
<td>4</td>
<td>Return Flow</td>
<td>SRTRN</td>
<td>Return flows from water applied to agricultural and urban lands</td>
</tr>
<tr>
<td>5</td>
<td>Deep Percolation</td>
<td>SPERC</td>
<td>Deep percolation of water from the root zone to the unsaturated zone within the sub-group area</td>
</tr>
<tr>
<td>6</td>
<td>Runoff</td>
<td>SROFF</td>
<td>Direct runoff of precipitation within the sub-group</td>
</tr>
<tr>
<td></td>
<td><strong>Streams within the Sub-group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Return Flow to Streams</td>
<td>SRTST</td>
<td>Return flow into the streams within the sub-group</td>
</tr>
<tr>
<td>8</td>
<td>Runoff to Streams</td>
<td>SROST</td>
<td>Direct runoff that flows into streams within the sub-group</td>
</tr>
<tr>
<td>9</td>
<td>Gain from Groundwater</td>
<td>SSTINF</td>
<td>Stream-groundwater interaction within the sub-group; a positive value indicates a gaining stream whereas a losing stream is represented as a negative value</td>
</tr>
<tr>
<td>10</td>
<td>Diversion</td>
<td>SRDV</td>
<td>Water diverted from streams within a sub-group</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Code</td>
<td>Notes</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------------</td>
<td>--------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>Diversion Shortage</td>
<td>SRDVSH</td>
<td>Amount of water unable to fulfill surface water diversion requirements due to insufficient stream flows</td>
</tr>
<tr>
<td>12</td>
<td><strong>Groundwater within Sub-group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Pumping</td>
<td>SPUMP</td>
<td>Total groundwater pumping within a sub-group</td>
</tr>
<tr>
<td>13</td>
<td>Ending Storage</td>
<td>SGWST</td>
<td>Volume of groundwater within a sub-group at the end of the time step</td>
</tr>
<tr>
<td>14</td>
<td>Cumulative Subsidence</td>
<td>SGWSTC</td>
<td>Cumulative volume of groundwater storage lost due to land subsidence</td>
</tr>
</tbody>
</table>

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

**Part A:**

IWFM_SUBGRP_BUD

**Part B:**

SGXXX where XXX is the subgroup 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:**

Time step used in the Simulation

**Part F:**

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

i.  AG_SUPP_REQ (corresponds to column 2 in ASCII output file)
ii. *URB_SUPP_REQ* (corresponds to column 3 in ASCII output file)

iii. *RTRN_FLOW* (corresponds to column 4 in ASCII output file)

iv. *DEEP_PERC* (corresponds to column 5 in ASCII output file)

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

vi. *RTRN_FLOW_STRM* (corresponds to column 7 in ASCII output file)

vii. *RUNOFF_STRM* (corresponds to column 8 in ASCII output file)

viii. *GAIN_FROM_GW* (corresponds to column 9 in ASCII output file)

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

x. *DIVER_SHORTAGE* (corresponds to column 11 in ASCII output file)

xi. *PUMPING* (corresponds to column 12 in ASCII output file)

xii. *END_STORAGE* (corresponds to column 13 in ASCII output file)

xiii. *CUM_SUBSIDENCE* (corresponds to column 14 in ASCII 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 modeled. The title for each small watershed includes IWFM version number, small stream watershed identification number and the unit of output values. The following list defines the columns in the report as printed to an ASCII file:

<table>
<thead>
<tr>
<th>COL. #</th>
<th>COLUMN NAME</th>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time</td>
<td>IFLAG</td>
<td>Time step</td>
</tr>
<tr>
<td>2</td>
<td>Total SW Outflow</td>
<td>SWSUR</td>
<td>Total amount of surface flow from the small stream watershed boundary to the modeled area</td>
</tr>
<tr>
<td>3</td>
<td>GW Base Outflow</td>
<td>SWSUB</td>
<td>Total amount of groundwater flow from the small watershed into the modeled area</td>
</tr>
<tr>
<td>4</td>
<td>Base Flow + Surface Percolation</td>
<td>SWINF</td>
<td>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</td>
</tr>
<tr>
<td>5</td>
<td>Net Surface Outflow to Streams</td>
<td>SWOFF</td>
<td>Total surface water outflow less the surface percolation</td>
</tr>
</tbody>
</table>

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

**Part A:**

IWFM_SWSHED_BUD

**Part B:**

SWXXX 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:

Time step used in the Simulation

Part F:

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

i. \textit{TOTAL\_SW\_OUTFLOW} (corresponds to column 2 in ASCII output file)

ii. \textit{GW\_BASE\_OUTFLOW} (corresponds to column 3 in ASCII output file)

iii. \textit{BASEFLOW\_PERCOLATION} (corresponds to column 4 in ASCII output file)

iv. \textit{SURFACE\_FLOW\_TO\_STRM} (corresponds to column 5 in ASCII output file)

Lake Budget Unit 7

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, lake identification number and the unit of output data.
The following list defines the columns in the lake budget as printed to an ASCII file:

<table>
<thead>
<tr>
<th>COL. #</th>
<th>COLUMN NAME</th>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time</td>
<td>IFLAG</td>
<td>Time step</td>
</tr>
<tr>
<td>2</td>
<td>Beginning Storage (+)</td>
<td>STLAKE_P</td>
<td>Lake storage at the beginning of the time step</td>
</tr>
<tr>
<td>3</td>
<td>Ending Storage (−)</td>
<td>STLAKE</td>
<td>Lake storage computed at the end of the time step</td>
</tr>
<tr>
<td>4</td>
<td>Flow from Upstream Lake (+)</td>
<td>QUPLKIN</td>
<td>Inflow from lake(s) that are located upstream of the lake</td>
</tr>
<tr>
<td>5</td>
<td>Flow from Bypasses (+)</td>
<td>QLKFL</td>
<td>Inflow into the lake from bypasses</td>
</tr>
<tr>
<td>6</td>
<td>Precipitation (+)</td>
<td>QLPRCP</td>
<td>Amount of precipitation that falls on the lake surface, which is based on precipitation and the rainfall station(s) associated with lake elements</td>
</tr>
<tr>
<td>7</td>
<td>Gain from Groundwater (+)</td>
<td>-RLKINF</td>
<td>Lake-groundwater interaction; a positive value indicates that the flow from the groundwater into the lake, whereas a negative value indicates flow from the lake to the groundwater system</td>
</tr>
<tr>
<td>8</td>
<td>Lake Evaporation (−)</td>
<td>QLKEV</td>
<td>Evaporation from the lake surface</td>
</tr>
<tr>
<td>9</td>
<td>Lake Outflow (−)</td>
<td>QLKOUT</td>
<td>Spill from lake as the lake surface elevation raises above the maximum lake elevation</td>
</tr>
<tr>
<td>10</td>
<td>Discrepancy (−)</td>
<td>RLKERR</td>
<td>Mass balance error for lake</td>
</tr>
<tr>
<td>11</td>
<td>Lake Surface Elevation</td>
<td>HLAKE</td>
<td>Lake elevation that corresponds to the simulated lake storage</td>
</tr>
</tbody>
</table>
If a DSS file is used for print-out, the following pathnames are used:

**Part A:**

IWFM_LAKE_BUD

**Part B:**

LKXXX where XXX is the lake number

**Part C:**

One of the following, depending on the output:

i. \textit{ELEV}

ii. \textit{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:**

Time step used in the Simulation

**Part F:**

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

i. \textit{BEGIN\_STORAGE} (corresponds to column 2 in ASCII output file)

ii. \textit{END\_STORAGE} (corresponds to column 3 in ASCII output file)

iii. \textit{FLOW\_FROM\_UP\_LAKE} (corresponds to column 4 in ASCII output file)
iv. *FLOW_FROM_BYPASS* (corresponds to column 5 in ASCII output file)

v. *PREcip* (corresponds to column 6 in ASCII output file)

vi. *GAIN_FROM_GW* (corresponds to column 7 in ASCII output file)

vii. *EVAPOTR* (corresponds to column 8 in ASCII output file)

viii. *OUTFLOW* (corresponds to column 9 in ASCII output file)

ix. *DISCREPANCY* (corresponds to column 10 in ASCII output file)

x. *SURFACE_ELEV* (corresponds to column 11 in ASCII output file)

---

**Stream Reach Budget**

The stream reach budget includes a table for each stream reach modeled that displays the mass balance in a stream reach. The title for each stream reach budget table includes the IWFM version number, stream reach identification number and volumetric units for the values in each column. The stream reach flow components printed to the ASCII file are listed as follows:

---

**STREAM REACH BUDGET**

<table>
<thead>
<tr>
<th>COL. #</th>
<th>COLUMN NAME</th>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Time</td>
<td>IFLAG</td>
<td>Time step</td>
</tr>
<tr>
<td>2</td>
<td>Upstream Inflow (+)</td>
<td>RHUFLow</td>
<td>Inflow at the first upstream node of the reach</td>
</tr>
</tbody>
</table>
3 Downstream Outflow (−) RHDFLOW Stream flow leaving the reach and entering another reach
4 Tributary Inflow (+) RHTRIB Surface flows from small stream watersheds into the stream reach
5 Tile Drain (+) RHDRAIN Tile drain flows into the reach
6 Runoff (+) RHIROST Direct runoff due to precipitation into the stream reach
7 Return Flow (+) RHRTST Return flow of agricultural and urban applied water to a stream reach
8 Gain from Groundwater (+) -RHSTINF Amount of water contributed to the reach from groundwater; a positive value represents a net flow from groundwater to the reach, a negative value represents a net flow from reach to the groundwater
9 Gain from Lake (+) RHRLKIN Contribution of outflow from upstream lake(s) to the reach
10 Diversion (−) RHDIVS Amount of water diverted from the stream reach
11 Bypass Flow (−) RHBYPS Net amount of water that is diverted as bypass flow from the stream reach
12 Discrepancy (=) RHSERR Error in the reach flow mass balance based on the preceding columns
13 Diversion Shortage RHDVSH This column indicates whether the simulated reach flows are sufficient to meet the surface water diversion requirements; a value of zero indicates that reach flows are sufficient to meet the specified diversion requirements; a positive value represents the shortage of flow in a reach

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

**Part A:**

IWFM_STRMRCH_BUD
Part B:

RRXXX where XXX is the stream 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:

Time step used in the Simulation

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 ASCII output file)

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

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

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

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

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

vii. GAIN_FROM_GW (corresponds to column 8 in ASCII output file)
viii.  *GAIN_FROM_LAKE* (corresponds to column 9 in ASCII output file)

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

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

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

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

---

**Diversion Detail Report**  
**Unit 9**

This data file reports surface water deliveries and diversions, as well as the difference between the specified and actual deliveries and diversions for each subregion for all time intervals within the specified beginning and ending time step. The diversion detail report for the entire model area is not produced. Each report title indicates IWFM version, the area of subregion and the volumetric units associated with the table values.

The row labeled *Diversion #* consists of the diversion identification numbers in the subregion. Diversion identification numbers are specified in the simulation file Unit 25 by the user. A delivery is specified as (+) and a diversion as (−). The row labeled *Stream Node* lists the stream nodes where the diversions originate. A value of zero indicates a stream node outside the model boundary. A delivery is exported out of the model boundary when the stream node associated with the delivery is defined as zero. A diversion is imported from outside the model boundary when a zero value is specified for the corresponding stream node. The values in the table (not in parentheses) are the actual
deliveries and diversions at each time interval. The value in parentheses represents the reduction with respect to the diversion and delivery requirements specified in simulation file Unit 26.

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

**Part A:**

$IWFM\_DIVERDTL\_BUD$

**Part B:**

$SRXX:DVYYY:RZZZ$ where $XXX$ is the subregion number, $YYY$ is the diversion ID number as listed in the diversion specifications file in the Simulation part, and $ZZZ$ is the stream node where the diversion originates ($ZZZ$ 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:**

Time step used in the Simulation

**Part F:**

One of the following, depending on the output data:

i. $DELI$ (actual delivery into subregion $XXX$, from diversion ID $YYY$ that originates from stream node $ZZZ$)
ii. **DELI_SHORT** (shortage of delivery calculated as the required delivery less actual delivery)

iii. **DIVER** (actual diversion from subregion *XXX*, through diversion ID *YYY* that originates from stream node *ZZZ*)

iv. **DIVER_SHORT** (diversion shortage calculated as the required diversion less the actual diversion)
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](image)

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. Note that the total run time will be printed correctly only when running IWFM on Windows NT, Windows 2000 and Windows XP operating systems.
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 Version XE-12.0.2 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.