Input and output instructions for the Agricultural Water Use (AG) Package for GSFLOW

The AG was developed for GSFLOW to simulate irrigation and water use by cultivated and natural plants. The AG Package works with the Streamflow-Routing (SFR2) and the Unsaturated Flow (UZF1) Packages and includes capabilities for simulating pumping wells like the WELL Package. Input required for simulating agricultural diversions, supplementary pumping, irrigation, and demand calculations are all specified within the AG Package input file. All exchanges between different packages (SFR2, UZF1, and AG) are calculated within the AG Package; however, the SFR2 and UZF1 Packages must be active to use their capabilities in conjunction with the AG Package. Diversion segments must be specified within the SFR2 Package to apply diverted water as irrigation. All data for supplementary and irrigation wells is specified within the AG Package input file; the AG Package calculates and applies its own boundary conditions to the groundwater flow equation for representing irrigation and/or supplementary wells.

The AG Package is activated by specifying a file type of "AG" within the MODFLOW-NWT Name file. The AG input file contains 4 different blocks of data, including 1) Options, 2) Time series, 3) Segment and Well Lists, and 4) Stress Period. Stress period data is used to vary agricultural practices during a simulation represented mechanically as the connectivity between segments and irrigation cells, supplemental wells and diversion segments, and wells and irrigation cells, as well as other input values that control agricultural water use.

Block 1: Simulation options

AG Package character variables can be specified in any order and must be proceeded and followed by the character variables OPTIONS and END, respectively.

```
Item 1: OPTIONS
Item 2:  [NOPRINT]
         [IRRIGATION_DIVERSION      Numirrdiversions        Maxcellsdiversion]
         [IRRIGATION_WELL           Numirrwells             Maxcellswell]
         [IRRIGATION_POND           Numirrponds             Maxcellspond]
         [SUPPLEMENTAL_WELL         Numsupwells             Maxdiversions]
         [MAXWELL                   Nummaxwell]
         [MAXPOND                   Nummaxpond]
         [TABFILESWELL              Numtabwell              Maxvalwell]
         [TABFILESPOND              Numtabpond              Maxvalpond]
         [PHIRAMP]
         [ETDEMAND                  Accel]
         [CHECKCONVERGE             Agtol          Maxagiter]
         [TRIGGER]
         [TIMESERIES_DIVERSION]
         [TIMESERIES_WELL]
         [TIMESERIES_POND]
         [TIMESERIES_DIVERSIONET]
         [TIMESERIES_WELLET]
         [TIMESERIES_PONDET]
         [DIVERSIONLIST            Unit_diversionlist]
         [WELLLIST                 Unit_welllist]
         [WELLIRRLIST              Unit_wellirrlist]
         [PONDLIST                 Unit_pondlist]
         [PONDIRRLIST              Unit_pondirrlist]
         [DIVERSIONIRRLIST         Unit_diversionirrlist]
         [WELLCBC                  Unitcbc        ISUPWEL]
Item 3: END
```

OPTIONS   Character variable specified to indicate the beginning of the key word options.

NOPRINT   Character variable that suppresses the printing of well lists.

IRRIGATION_DIVERSION   An optional character variable. When IRRIGATION_DIVERSION is specified, the option to use surface water (SW) for irrigation is activated.

Numirrdiversions   An optional integer variable. When IRRIGATION_DIVERSION is specified, the integer variable Numirrdiversions also is specified. Numirrdiversions is the maximum number of SFR2 diversion segments in any stress period that will be used for irrigation.

Maxcellsdiversion   An optional integer variable. When IRRIGATION_DIVERSION is specified, the integer variable Maxcellsdiversion also is specified. Maxcellsdiversion is the maximum number of MODFLOW cells or PRMS HRUs that will receive irrigation from a single SFR2 diversion segment in any stress period.

IRRIGATION_WELL   An optional character variable. When IRRIGATION_WELL is specified, the option to use groundwater for irrigation is active.

Numirrwells   An optional integer variable. When IRRIGATION_WELL is specified, the integer variable Numirrwells also is specified. Numirrwells is the maximum number of AG wells in any stress period that will be used for irrigation.

IRRIGATION_POND   An optional character variable. When IRRIGATION_POND is specified, the option to use PRMS detention reservoirs for irrigation is active.

Numirrponds   An optional integer variable. When IRRIGATION_POND is specified, the integer variable Numirrponds also is specified. Numirrponds is the maximum number of PRMS detention reservoirs in any stress period that will be used for irrigation.

Maxcellspond   An optional integer variable. When IRRIGATION_POND is specified, the integer variable Maxellspond also is specified. Maxcellspond is the maximum number of PRMS HRUs that will receive irrigation from a single PRMS detention reservoir in any stress period.

SUPPLEMENTAL_WELL   An optional character variable. When SUPPLEMENTAL_WELL is specified, the option to simulate supplemental groundwater for irrigation is active. The AG Package calculates supplemental GW pumping using the difference between the irrigation demand and the surface water diversion.

Numsupwells   An optional integer variable. When SUPPLEMENTAL_WELL is specified, the integer variable Numsupwells also is specified. Numsupwells is the maximum number of supplemental wells in any stress period that will pump groundwater.

Maxdiversions   An optional integer variable. When SUPPLEMENTAL_WELL is specified, the integer variable Maxdiversions also is specified. Maxdiversions is the maximum number of SFR2 diversion segments that are supplemented by a well.

MAXWELL   An optional character variable. If IRRIGATION_WELL or SUPPLEMENTAL_WELL is specified, then MAXWELL also is specified. MAXWELL is included to indicate that the maximum number of unique supplemental and irrigation wells used during a simulation (Nummaxwell) also will be read.

Nummaxwell	The maximum number of unique supplemental and irrigation wells used during a simulation.
MAXPOND	An optional character variable. If IRRIGATION_POND is specified, then MAXPOND also is specified. MAXPOND is included to indicate that the maximum number of unique PRMS detention reservoirs used during a simulation (Nummaxpond) also will be read.
Nummaxpond	The maximum number of unique supplemental and irrigation wells used during a simulation.
TABFILESWELL	An optional character variable. TABFILESWELL is included in order set pumping rates using time series input files.
Numtabwell	An integer variable equal to the number of individual TABFILES used to set pumping rates. Numtabwell can be less than MAXWELL when using a single TABFILE for multiple wells.
Maxvalwell	An integer variable equal to the maximum number of values specified for any TABFILE.
TABFILESPOND	An optional character variable. TABFILESPOND is included in order set pond maximum withdrawal rates using time series input files.
Numtabpond	An integer variable equal to the number of individual TABFILES used to set withdrawal rates. Numtabpond can be less than MAXPOND when using a single TABFILE for multiple ponds.
Maxvalpond	An integer variable equal to the maximum number of values specified for any TABFILE.
PHIRAMP	An optional character variable. PHIRAMP is included to specify the smoothing interval used to change negative pumping rates to zero when the groundwater cell dewaters. This variable only is used when the Newton Solver is active.
ETDEMAND	An optional character variable. ETDEMAND is included in order to activate automatic calculation of the net irrigation water requirement. ETDEMAND and TRIGGER cannot be used in the same simulation. Individual segments during a stress period can be assigned a specified irrigation amount rather than irrigation amounts calculated by the model using demand.
Accel	An real variable that controls the maximum change in the irrigation diversion or pumped amount between iterations. Values between 0.5 and 10 work well.
CHECKCONVERGE	An optional character variable. CHECKCONVERGE is included in order to control convergence of the nonlinear solution (outer iterations) to require the change in total applied irrigation for each irrigation source feature to be less than Agtol.
Agtol	An real variable that equal to the maximum change in applied irrigation for each irrigation source feature between nonlinear (outer) iterations for model convergence. If Agtol is not reached between outer iterations then the model will continue iterating until Maxagiter is reached, at which point the model will move on to the next time step.

Maxagiter   An integer variable that controls the maximum number of iterations taken by the model to reach convergence in the applied irrigation. If the model converges and Macagiter is reached then the model will continue onto the next time step.

TRIGGER   An optional character variable. TRIGGER is included to activate the irrigation trigger option. TRIGGER and ETDEMAND cannot be used in the same simulation.

TIMESERIES_DIVERSION   An optional character variable that activates the option for outputting diversions flow rates for specified SFR2 segments used for irrigation. Additional details are specified in the time series data input.

TIMESERIES_WELL   An optional character variable for outputting well pumping rates for specified wells used for irrigation. Additional details are specified in the time series data input.

TIMESERIES_POND   An optional character variable for outputting detention reservoir diversion rates for specified ponds used for irrigation. Additional details are specified in the time series data input.

TIMESERIES_DIVERSIONET   An optional character variable for outputting irrigation applied to all cells/HRUs supplied by 1 or more specified diversion segments. Additional details are specified in the time series data input.

TIMESERIES_WELLET   An optional character variable for outputting irrigation applied to all cells/HRUs supplied by 1 or more specified wells. Additional details are specified in the time series data input.

TIMESERIES_PONDET An optional character variable for outputting irrigation applied to all HRUs supplied by 1 or more specified ponds. Additional details are specified in the time series data input.

DIVERSIONLIST   An optional character variable for outputting a list of all diversion segments and diversion amounts used for irrigation in the AG Package when "SAVE BUDGET" or a non-zero value for ICBCFL is specified in Output Control.

Unit_diversionlist An optional integer variable that is the file unit number to which DIVERSIONLIST output is written. This unit number must correspond to a file of type Data specified in the MODFLOW Name file. A negative value indicates output will be written to the LIST file.

WELLLIST   An optional character variable for outputting a list of all active wells in the AG Package and pumped amounts when "SAVE BUDGET" or a non-zero value for ICBCFL is specified in Output Control.

Unit_welllist   An optional integer variable that is the file unit number to which WELLLIST output is written. This unit number must correspond to a file of type Data specified in the MODFLOW Name file. A negative value indicates output will be written to the LIST file.

PONDLIST   An optional character variable for outputting a list of all active PRMS detention reservoirs used for irrigation in the AG Package and diverted amounts when "SAVE BUDGET" or a non-zero value for ICBCFL is specified in Output Control.

Unit_pondlist	An optional integer variable that is the file unit number to which PONDLIST output is written. This unit number must correspond to a file of type Data specified in the MODFLOW Name file. A negative value indicates output will be written to the LIST file.
WELLIRRLIST	An optional character variable for outputting a list of MODFLOW cells or PRMS HRUs that are irrigated by AG wells and the irrigated amounts when "SAVE BUDGET" or a non-zero value for ICBCFL is specified in Output Control.
Unit_wellirrlist	An optional integer variable that is the file unit number to which WELLIRRLIST output is written. This unit number must correspond to a file of type Data specified in the MODFLOW Name file. A negative value indicates output will be written to the LIST file.
PONDIRRLIST	An optional character variable for outputting a list of PRMS HRUs that are irrigated by PRMS detention reservoirs and the irrigated amounts when "SAVE BUDGET" or a non-zero value for ICBCFL is specified in Output Control.
Unit_pondirrlist	An optional integer variable that is the file unit number to which PONDIRRLIST output is written. This unit number must correspond to a file of type Data specified in the MODFLOW Name file. A negative value indicates output will be written to the LIST file.
DIVERSIONIRRLIST	An optional character variable for outputting a list of MODFLOW cells or PRMS HRUs irrigated by irrigation segments and the irrigated amounts when "SAVE BUDGET" or a non-zero value for ICBCFL is specified in Output Control.
Unit_diversionirrlist	An optional integer variable that is the file unit number to which DIVERSIONIRRLIST output is written. This unit number must correspond to a file of type Data specified in the MODFLOW Name file. A negative value indicates output will be written to the LIST file.
WELLCBC	An optional character variable for outputting cell-by-cell flow terms when "SAVE BUDGET" or a non-zero value for ICBCFL is specified in Output Control.
Unit_cbc	An optional integer variable that is the file unit number to which cell-by-cell unformatted list output is written. This unit number must correspond to a file of type Data(binary) specified in the MODFLOW Name file.
ISUPWEL	An optional integer variable that is a flag for outputting cell by cell flows for all agricultural wells (ISUPWEL=0) or for outputting cell by cell flows only for SUP wells (ISUPWEL=1).
END	Character variable specified to indicate the end of the character options.

Block 2: Time series output

Time series data can be written to separate formatted output files for selected SFR segments and AG wells used for irrigation. These files are of type "Data" and must be included in the MODFLOW Name file. Time series data are read only if time series character variables are specified in the character options section.

Item 4: [TIME SERIES]

Item 5: [DIVERSION Segmentnum$_1$ Unit_diversion$_1$]
.
.
.
[DIVERSION Segmentnum$_{numtimeseriesdiversion}$ Unit_diversion$_{numtimeseriesdiversion}$]

Item 6: [DIVERSIONET Segmentnum$_1$ Unit_diversionet$_1$]
.
.
.
[DIVERSIONET Segmentnum$_{numtimeseriesdiversionet}$ Unit_diversionet$_{numtimeseriesdiversionet}$]

Item 7: [WELL Wellnum$_1$ Unit_well$_1$]
.
.
.
[WELL Wellnum$_{numtimeserieswell}$ Unit_well$_{numtimeserieswell}$]

Item 8: [WELLET Welletnum Unit_wellet]
.
.
.
[WELLET Wellnum$_{numtimeserieswellet}$ Unit_wellet$_{numtimeserieswellet}$]

Item 11: [WELLALL Unitwellall]

Item 12: [WELLETALL Unitwelletall]

Item 13: [POND Pondnum$_1$ Unit_pond$_1$]
.
.
.
[POND Pondnum$_{numtimeseriespond}$ Unit_pond$_{numtimeseriespond}$]

Item 14: [PONDET Pondetnum Unit_pondet]
.
.
.
[PONDET Pondnum$_{numtimeseriespondet}$ Unit_pondet$_{numtimeseriespondet}$]

Item 15: [PONDALL Unitpondall]

Item 16: [PONDETALL Unitpondetall]

Item 17: [DIVERSIONALL Unitdiversionall]

Item 18: [DIVERSIONETALL Unitdiversionetall]

Item 19: [END]

TIME SERIES   Character variable specified to indicate the beginning of the time series data block.

DIVERSION   Character variable indicating that irrigation information for a diversion will be written to a time series output file.

Segmentnum   Integer variable that is the SFR2 segment number.

Unitdiversion   Integer variable that is the formatted output file unit number.

DIVERSIONET Character variable indicating that crop ET for all cells/HRUs irrigated by a diversion will be written to a time series output file.

Segmentnum   Integer variable that is the SFR2 segment number.

Unitdiversionet   Integer variable that is the formatted output file unit number.

WELL   Character variable indicating that irrigation information for a well will be written to a time series output file.

Wellnum   Integer variable that is the AG well number.

Unitwell   Integer variable that is the formatted output file unit number. This file is of type "Data" and is included in the MODFLOW Name file.

WELLET   Character variable indicating that evapotranspiration information for a well will be written to a time series output file.

Welletnum   Integer variable that is the AG well number.

Unitwellet   Integer variable that is the formatted output file unit number. This file is of type "Data" and is included in the MODFLOW Name file.

WELLETALL   Character variable indicating that evapotranspiration information summed for all wells will be written to a time series output file.

Unitwelletall   Integer variable that is the formatted output file unit number. This file is of type "Data" and is included in the MODFLOW Name file.

WELLALL   Character variable indicating that irrigation information summed for all wells will be written to a time series output file.

Unitwellall   Integer variable that is the formatted output file unit number. This file is of type "Data" and is included in the MODFLOW Name file.

POND   Character variable indicating that irrigation information for a pond will be written to a time series output file.

Pondnum   Integer variable that is the HRU ID for the PRMS open detention reservoir for timeseries output.

Unitpond   Integer variable that is the formatted output file unit number. This file is of type "Data" and is included in the MODFLOW Name file.

PONDET   Character variable indicating that evapotranspiration information for a PRMS open detention reservoir will be written to a time series output file.

Pondetnum   Integer variable that is the HRU ID number that contains the PRMS open detention reservoir.

Unitpondet   Integer variable that is the formatted output file unit number. This file is of type "Data" and is included in the MODFLOW Name file.

PONDETALL   Character variable indicating that evapotranspiration information summed for all open detention reservoirs will be written to a time series output file.

Unitpondetall   Integer variable that is the formatted output file unit number. This file is of type "Data" and is included in the MODFLOW Name file.

PONDALL   Character variable indicating that irrigation information summed for all open detention reservoirs will be written to a time series output file.

Unitpondall   Integer variable that is the formatted output file unit number. This file is of type "Data" and is included in the MODFLOW Name file.

DIVERSIONALL   Character variable indicating that irrigation information summed for all irrigation segment diversions will be written to a time series output file.

Unitdiversionall   Integer variable that is the formatted output file unit number. This file is of type "Data" and is included in the MODFLOW Name file.

DIVERSIONETALL   Character variable indicating that evapotranspiration information summed for all irrigation diversion segments will be written to a time series output file.

Unitdiversionetall   Integer variable that is the formatted output file unit number. This file is of type "Data" and is included in the MODFLOW Name file.

END   Character variable specified to indicate the end of the time series data block.

Block 3: Segment, Well, and Pond lists

SFR segments used for irrigation during any stress period of a simulation must be listed within the SEGMENT LIST data block. Maximum segment diversion rates can be set for each time step using SFR TABFILES, and maximum diversion rates can be set for each stress period using the SFR input variable Q.

Item 12: [SEGMEMNT LIST]

Item 13: [SEGMENTNUMBER$_1$]
        .
        .
        .
      [SEGMENTNUMBER$_{MAXNUMSEGS}$]

Item 14: [END]

SEGMEMNT LIST   Character variable specified to indicate irrigation diversion segments will be included in simulation. All irrigation segments used in a simulation must be listed.

SEGMENTNUMBER$_1$ Integer value equal to the first irrigation segment used in a simulation.

SEGMENTNUMBER$_{MAXNUMSEGS}$ Integer value equal to the last irrigation segment used in a simulation.

END   Character variable specified to indicate the end segment list data block.

Wells used for irrigation, including those used to supplement surface water diversions, are defined within the WELL LIST. Well numbering is implicitly defined according to the order of wells in the WELL LIST, the first entry is well 1, numbered consecutively to the total number of wells used during a simulation. There are 2 options for specifying information in the WELL LIST. The first option uses TABFILES to vary the maximum pumping rate during a simulation, and the second option uses a single specified value for the maximum pumping rate that does not vary during the simulation.

Input instructions for AG Package TABFILES are included at the end of this document.

Item 15: [WELL LIST]

If character variable TABFILESWELL is specified in the OPTIONS block, then item 16a is read as a space delimited list in free format. Otherwise, item 16b is read.

Item 16a: [$TABWELLUNIT_1$ $TABWELLVAL_1$ $TABWELLLAY_1$ $TABWELLROW_1$
           $TABWELLCOL_1$]

     .
     .
     .

       [$TABWELLUNIT_{Numtab}$ $TABWELLVAL_{Numtab}$ $TABWELLLAY_{Numtab}$ $TABWELLROW_{Numtab}$
           $TABWELLCOL_{Numtab}$]

If character variable TABFILES is not specified in the OPTIONS block then item 16b is read as a space delimited list in free format.

Item 16b: [$WELLLAY_1$ $WELLROW_1$ $WELLCOL_1$ Q_1]

     .
     .
     .

       [$WELLLAY_{Maxwell}$ $WELLROW_{Maxwell}$ $WELLCOL_{Maxwell}$ $Q_{Maxwell}$]

Item 17: [END]

WELL LIST	Character variable specified to indicate that AG wells will be included in a simulation.
TABWELLUNIT	Integer variable equal to the unit number for the TABFILE used to specify pumping rates for a well.
TABWELLVAL	Integer variable equal to the maximum number of rows to be read from a TABFILE.
TABWELLLAY	Integer variable equal to the layer number of the cell containing a well set using TABFILES.
TABWELLROW	Integer variable equal to the row number of the cell containing a well set using TABFILES.
TABWELLCOL	Integer variable equal to the column number of the cell containing a well set using TABFILES.
WELLLAY	Integer variable equal to the layer number of the cell containing a well.

WELLROW	Integer variable equal to the row number of the cell containing a well.
WELLCOL	Integer variable equal to the column number of the cell containing a well.
Q	Real variable equal to the maximum pumping rate or applied pumping rate.
END	Character variable specified to indicate the end of the well list data block.

PRMS open depression storage ponds used for irrigation are defined within the POND LIST. Pond identification numbers are equal to the HRU_ID. There are 2 options for specifying information in the POND LIST. The first option uses TABFILES to vary the maximum pond irrigation rates during a simulation, and the second option uses a single specified value for the maximum pond irrigation rate that does not vary during the simulation.

Input instructions for AG Package TABFILES are included at the end of this document.

Item 18: [POND LIST]

If character variable TABFILESPOND is specified in the OPTIONS block, then item 19a is read as a space delimited list in free format. Otherwise, item 19b is read.

Item 19a: [TABPONDUNIT$_1$ TABPONDVAL$_1$ TABPONDHRU$_1$,   TABPONDSEG$_1$
     TABPONDFRAC$_1$]

.
.
.

     [TABPONDUNIT$_{Numtabpond}$ TABPONDVAL$_{Numtabpond}$ TABPONDHRU$_{Numtabpond}$
     TABPONDSEG$_{Numtabpond}$ TABPONDFRAC$_{Numtabpond}$]

If character variable TABFILESPOND is not specified in the OPTIONS block, then item 19b is read as a space delimited list in free format.

Item 19b: [PONDHRU$_1$ QPOND$_1$ PONDSEG$_1$ PONDFRAC$_1$]

.
.
.

     [PONDHRU$_{Maxpond}$ QPOND$_{Maxpond}$ PONDSEG$_{Maxpond}$ PONDFRAC$_{Maxpond}$]

Item 20: [END]

POND LIST	Character variable specified to indicate that AG ponds will be included in a simulation.
TABPONDUNIT	Integer variable equal to the unit number for the TABFILE used to specify maximum pond irrigation rates.
TABPONDVAL	Integer variable equal to the maximum number of rows to be read from a TABFILE.
TABPONDHRU	Integer variable equal to the HRU_ID that contains an open detention reservoir (pond) used for irrigation.
TABPONDSEG	SFR segment diversion number that supplies inflow to pond. TABPONDSEG is specified when using TABFILES to set maximum pond irrigation amounts. **This segment number should not be included in the AG Package SEGMENT LIST.** A value of zero indicates that there is no segment inflow to pond during a simulation.

TABPONDFRAC	Real variable equal to the fraction of diverted water supplied to TABPONDHRU. The sum of fractions specified for a segment used to fill ponds should equal 1.
PONDHRU	Integer variable equal to the HRU_ID that contains an open detention reservoir (pond) used for irrigation.
QPOND	Real variable equal to the maximum irrigation rate provided by a pond.
PONDSEG	SFR segment diversion number that supplies inflow to the pond. PONDSEG is specified when TABFILES are NOT used to set maximum pond irrigation amounts. **This segment number should not be included in the AG Package SEGMENT LIST.** A value of zero indicates that there is no segment inflow to pond during a simulation.
PONDFRAC	Real variable equal to the fraction of diverted water supplied to PONDHRU. The sum of fractions specified for a segment used to fill ponds should equal 1.
END	Character variable specified to indicate the end of the well list data block.

Block 4: Stress period information

Character variables "STRESS PERIOD" and "END" are required for each stress period. There are 3 options for specifying stress period information: 1) use stress period data for irrigation segments, irrigation wells, irrigation ponds, or supplemental wells from previous stress period; 2) specify data for all active irrigation segments, irrigation wells, irrigation ponds, or supplemental wells for the stress period; or 3) set all irrigation segments, irrigation wells, or supplemental wells to inactive for the stress period. Combinations of these 3 options can be used for any stress period.

Items 21a and 25a are specified for MODFLOW simulations; items 21b and 25b are specified for GSFLOW simulations. Some values are not used for a simulation due to specifications in the OPTIONS block; dummy values must be specified for unused input variables.

STRESS PERIOD

Item 18: [IRRDIVERSION]

Item 19: [NUMIRRSEGSP]

Item 20: [SEGID   NUMCELLSEG   IRRPERIODSEG/SPECIFIED
        TRIGGERFACTSEG   DUM]

Item 21a: [IRRROW_DIVERSION$_1$ IRRCOL_DIVERSION$_1$ EFF_FACT_DIVERSION$_1$
FIELD_FACT_DIVERSION$_1$]
    .
    .
    .
        [IRRROW_DIVERSION$_{numcellseg}$ IRRCOL_DIVERSION$_{numcellseg}$ EFF_FACT_DIVERSION$_{numcellseg}$
FIELD_FACT_DIVERSION$_{numcellseg}$]

Item 21b: [HRU_ID_DIVERSION$_1$ DUM_DIVERSION$_1$ EFF_FACT_DIVERSION$_1$
FIELD_FACT_DIVERSION$_1$]
    .
    .

.

[HRU_ID_DIVERSION $_{numhruseg}$ DUM_DIVERSION $_{numhruseg}$ EFF_FACT_DIVERSION $_{numhruseg}$
FIELD_FACT_DIVERSION$_{numhruseg}$]

Item 22: [IRRWELL]

Item 23: [NUMIRRWELLSP]

Item 24: [IRRWELLID   NUMCELLWELL   IRRPERIODWELL   TRIGGERFACTWELL   DUM]

Item 25a [IRRROW_WELL$_1$ IRRCOL_WELL $_1$ EFF_FACT_WELL $_1$
FIELD_FACT_WELL $_1$]
.
.
.
[IRRROW_WELL $_{numcellwell}$ IRRCOL_WELL $_{numcellwell}$ EFF_FACT_WELL $_{numcellwell}$
FIELD_FACT_WELL $_{numcellwell}$]

Item 25b [HRU_ID_WELL$_1$ DUM_WELL$_1$ EFF_FACT_WELL $_1$
FIELD_FACT_WELL $_1$]
.
.
.
[HRU_ID_WELL $_{numhruwell}$ DUM_WELL $_{numhruwell}$ EFF_FACT_WELL $_{numhruwell}$
FIELD_FACT_WELL $_{numhruwell}$]

Item 26: [SUPWELL] [SEG/POND]

Item 27: [NUMSUPWELLSP]

Item 28: [SUPWELLNUM   NUMSEGWELL/ NUMPONDWELL]

Item 29: [SEGWELLID$_1$ FRACSUP$_1$ FRACSUPMAX$_1$]
.
.
.
[SEGWELLID$_{numsegwell}$ FRACSUP$_{numsegwell}$ FRACSUPMAX$_{numsegwell}$]

Item 30: [IRRPOND]

Item 31: [NUMIRRPONDSP]

Item 32: [IRRPONDID   NUMCELLPOND   IRRPERIODPOND   TRIGGERFACTPOND
        FLOWTHROUGHPOND]

Item 33a [IRRHRUID_POND$_1$ EFF_FACT_POND $_1$ FIELD_FACT_POND $_1$]
.
.
.
[IRRHRUID_POND $_{numcellpond}$ EFF_FACT_POND $_{numcellpond}$ FIELD_FACT_POND $_{numcellpond}$]

Item 33b [HRU_ID_POND$_1$ DUM_POND$_1$ EFF_FACT_POND $_1$
FIELD_FACT_POND $_1$]
.
.

.

[HRU_ID_POND $_{numhrupond}$ DUM_POND $_{numhrupond}$ EFF_FACT_POND $_{numhrupond}$
FIELD_FACT_POND $_{numhrupond}$]

END

IRRDIVERSION   An optional character variable. IRRDIVERSION can be specified if character variable
IRRIGATION_DIVERSION is specified in the OPTIONS block.

NUMIRRSEGSP   An integer variable equal to the number of SFR2 segments active during a stress period
that will divert water to cells. If NUMIRRSEGSP < 0, irrigation segment data from the previous stress period will
be used. If NUMIRRSEGSP =0, all irrigation segments will be set to inactive.

SEGID   An integer variable equal to the SFR2 segment number for the diversion used for
irrigation.

NUMCELLSEG   An integer variable equal to the total number of MODFLOW cells or PRMS HRUs that
will be irrigated by SFR2 diversion segment SEGID.

IRRPERIODSEG/SPECIFIED   A real variable equal to the length of time water will be diverted for a single
irrigation event. This variable has two meanings, depending on whether TRIGGER or ETDEMAND is specified. If
the character variable TRIGGER is specified in the options block then IRRPERIODSEG is read to define the length
of an irrigation event. If the character variable ETDEMAND is specified, then SPECIFIED is a flag to calculate
irrigation using field demand (SPECIFIED=0). If ETDEMAND is specified and SPECIFIED=1 then irrigation is
determined from the specified diversion rate set for the segment. Units for this variable are determined from the
DIS file input variable ITMUNI. Values should be greater than or equal to the length of the largest model time step
during irrigation periods.

TRIGGERFACTSEG   A real variable between 0 and 1 that triggers an irrigation event. If TRIGGERFACTSEG
is set to 0.5 then an irrigation event will start when ETa/ETo = 0.5. Although this variable is specified for each
SEGID, it only is used if the character variable TRIGGER is specified in the options block.

IRRROW_DIVERSION   An integer variable equal to the cell row number that will be irrigated by segment
SEGID. This variable only is specified for MODFLOW-only simulations.

IRRCOL_DIVERSION   An integer variable equal to the cell column number that will be irrigated by segment
SEGID. This variable only is specified for MODFLOW-only simulations.

HRU_ID_DIVERSION   An integer variable equal to the HRU ID number that will be irrigated by segment
SEGID. This variable only is specified for PRMS-only and GSFLOW simulations.

DUM_DIVERSION   An integer variable that must be specified but is not used and can be set to zero.

EFF_FACT_DIVERSION   A real variable equal to the fraction of surface water applied to a cell that can be
used to represent crop evapotranspiration and other field losses. If evapotranspiration is being simulated explicitly
then set EFF_FACT_DIVERSION to zero.

FIELD_FACT_DIVERSION   A real variable equal to the fraction of the diverted water applied to a cell that is
used to distribute a diversion among multiple cells. The sum of all FIELD_FACT_DIVERSION values for a
diversion should sum to 1.

IRRWELL   An optional character variable. IRRWELL can be specified if character variable
IRRIGATION_WELL is specified in the OPTIONS block.

NUMIRRWELLSP   An integer variable equal to the number of AG wells active during a stress period that will pump water for irrigation on MODFLOW cells or PRMS HRUs. If NUMIRRWELLSP < 0, irrigation well data from the previous stress period will be used. If NUMIRRWELLSP =0, all irrigation wells will be set to inactive.

IRRWELLID   An integer variable equal to the well identification number used to pump groundwater for irrigation.

NUMCELLWELL   An integer variable equal to the total number of MODFLOW cells or PRMS HRUs that receive water from a well.

IRRPERIODWELL   A real variable equal to the length of time water will be pumped for a single irrigation event. Although this variable is specified for each WELL, it only is used if the character variable TRIGGER is specified in the options block and for wells that are not SUP wells. Units for this variable are determined from the DIS file input variable ITMUNI. Values should be greater than or equal to the length of the largest model time step during irrigation periods.

TRIGGERFACTORWELL   A real variable between 0 and 1.0 that triggers an irrigation event. If TRIGGERFACTORWELL is set to 0.5 then an irrigation event will start when ETa/ETo = 0.5. Although this variable is specified for each WELL, it only is used if the character variable TRIGGER is specified in the options block.

IRRROW_WELL   An integer variable equal to the cell row number to which pumped water will be applied as irrigation. This variable only is specified for MODFLOW-only simulations.

IRRCOL_WELL   An integer variable equal to the cell column number to which pumped water will be applied as irrigation. This variable only is specified for MODFLOW-only simulations.

HRU_ID_ WELL   An integer variable equal to the HRU ID to which pumped water will be applied as irrigation. An integer variable that must be specified but is not used and can be set to zero. This variable only is specified for PRMS-only and GSFLOW simulations.

DUM_ DIVERSION   An integer variable that must be specified but is not used and can be set to zero.

EFF_FACT_WELL   A real variable equal to the fraction of groundwater applied to a cell that can be used to represent crop evapotranspiration and other field losses. If evapotranspiration is being simulated explicitly then set EFF_FACT_WELL to zero.

FIELD_FACT_WELL   A real variable equal to the fraction of the groundwater applied to a cell that is used to distribute water pumped from a well among multiple cells. The sum of all FIELD_FACT_WELL values for a well should sum to 1.

SUPWELL   An optional character variable indicating that supplemental well stress period data will be specified.

NUMSUPWELLSP   An integer variable equal to the number of active supplementary wells during a stress period that will pump groundwater to meet the surface water shortfall for irrigation. If NUMSUPWELLSP < 0, supplementary well data from the previous stress period will be used. If NUMSUPWELLSP =0, all supplementary wells will be set to inactive.

SUPWELLNUM   An integer variable equal to the AG well number that supplements one or more surface water diversions.

NUMSEGWELL   An integer variable equal to the number of SFR2 segments that will be supplemented by a well.

SEGWELLID   An integer variable equal to the SFR2 segment number that will be supplemented by a well.

FRACSUP   A real variable between 0 and 1 that is equal to the fraction of the surface water shortfall for segment SEGWELLID that will be supplemented by a well.

FRACSUPMAX   A real variable between 0 and 1 that is equal to the fraction of the surface water demand that is used to calculate the net irrigation water requirement with supplemental groundwater pumping. Supplemental groundwater pumping (Q_{sup}) will be calculated as $Q_{sup} = FRACSUP * [\text{FRACSUPMAX} * Q_{demand} - Q_{div}]$, where Q_{demand} is the specified surface water diversion rate for irrigation.

IRRPOND   An optional character variable. IRRPOND can be specified if character variable IRRIGATION_POND is specified in the OPTIONS block.

NUMIRRPONDSP   An integer variable equal to the number of PRMS open detention reservoirs active during a stress period that will supply water for irrigation on PRMS HRUs. If NUMIRRPONDSP < 0, irrigation pond data from the previous stress period will be used. If NUMIRRPONDSP =0, all irrigation ponds will be set to inactive.

IRRPONDID   An integer variable equal to the HRU_ID identification number for the HRU that contains an open detention reservoir used for irrigation.

NUMCELLPOND   An integer variable equal to the total number of HRUs that receive irrigation from a pond.

IRRPERIODPOND   A real variable equal to the length of time water will be supplied from a pond for a single irrigation event. Although this variable is specified for each pond, it only is used if the character variable TRIGGER is specified in the options block. Units for this variable are determined from the DIS file input variable ITMUNI. Values should be greater than or equal to the length of the largest model time step during irrigation periods.

TRIGGERFACTORPOND   A real variable between 0 and 1.0 that triggers an irrigation event. If TRIGGERFACTORPOND is set to 0.5 then an irrigation event will start when ETa/ETo = 0.5. Although this variable is specified for each POND, it only is used if the character variable TRIGGER is specified in the options block.

FLOWTHROUGHPOND   An integer flag that is used to select an option for calculating segment inflow to a pond. A value of zero means segment inflow to the pond is specified through the SFR variable "FLOW." A value of 1 means segment inflow to the pond will be calculated using the irrigation demand. Outflow from the pond will be set equal to inflow minus shortfall and applied to fields for irrigation. A value of 1 only can be used if ETDEMAND is specified in the Options block.

IRRROW_POND   An integer variable equal to the cell row number to which pumped water will be applied as irrigation. This variable only is specified for MODFLOW-only simulations.

IRRCOL_POND   An integer variable equal to the cell column number to which pumped water will be applied as irrigation. This variable only is specified for MODFLOW-only simulations.

HRU_ID_ POND   An integer variable equal to the HRU ID to which pumped water will be applied as irrigation. An integer variable that must be specified but is not used and can be set to zero. This variable only is specified for PRMS-only and GSFLOW simulations.

DUM_ POND   An integer variable that must be specified but is not used and can be set to zero.

EFF_FACT_POND   A real variable equal to the fraction of groundwater applied to a cell that can be used to represent crop evapotranspiration and other field losses. If evapotranspiration is being simulated explicitly then set EFF_FACT_POND to zero.

FIELD_FACT_POND   A real variable equal to the fraction of the groundwater applied to a cell that is used to distribute water diverted from a pond among multiple cells. The sum of all FIELD_FACT_POND values for a pond should sum to 1.

END   Character variable specified to indicate the end of each stress period data block.

Input data for TABFILES

Item 1: [TIME$_1$ Q$_1$]
.
.
.
[TIME$_{TABVAL}$ Q$_{TABVAL}$]

TIME   A real variable equal to the simulation time that the pumping rate Q will be used to interpolate the maximum or applied pumping rate for a time step. The pumping rate for a time step is calculated using linear interpolation. The units for TIME must be consistent with the DIS Package input variable ITMUNI.
Q   A real variable equal to the maximum pumping rate for supplementary wells or for simulations that include the character variable ETDEMAND, otherwise Q is the applied pumping rate that can be used for setting the irrigation demand for wells used for irrigation (IRRWELL). Pumping rates are set equal to the pumping rate at the end of the time interval

Water budget table

Table 1: Water budget for agricultural water use package, where inflows ("IN") are sources of groundwater from wells ("AG WELLS") and surface water diversions ("DIVERSION SEGMENTS") used for irrigation, and outflows ("OUT") are consumptive use of groundwater ("GW IRRIGATION") and surface water ("SW IRRIGATION"), groundwater return flows ("SYSTEM LOSSES GW") and surface water return flows ("SYSTEM LOSSES SW").

```
VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP   15, STRESS PERIOD   8
------------------------------------------------------------------------------


     CUMULATIVE VOLUMES      L**3          RATES FOR THIS TIME STEP      L**3/T
     ------------------                    ------------------------


          IN:                                  IN:
          ---                                  ---
           AG WELLS  =    11775075.0000             AG WELLS  =             8.9560
    DIVERSION SEGMENTS =  153412592.0000    DIVERSION SEGMENTS =           50.8780
        GW IRRIGATION =          0.0000         GW IRRIGATION =            0.0000
        SW IRRIGATION =          0.0000         SW IRRIGATION =            0.0000
       SYSTEM LOSSES GW =        0.0000        SYSTEM LOSSES GW =          0.0000
       SYSTEM LOSSES SW =        0.0000        SYSTEM LOSSES SW =          0.0000


            TOTAL IN =   165187664.0000            TOTAL IN =             59.8340


          OUT:                                 OUT:
          ----                                 ----
           AG WELLS  =            0.0000            AG WELLS  =             0.0000
    DIVERSION SEGMENTS =          0.0000    DIVERSION SEGMENTS =            0.0000
        GW IRRIGATION =    11775075.0000         GW IRRIGATION =            8.9560
        SW IRRIGATION =   153415664.0000         SW IRRIGATION =           50.8790
       SYSTEM LOSSES GW =        0.0000        SYSTEM LOSSES GW =          0.0000
       SYSTEM LOSSES SW =        0.0000        SYSTEM LOSSES SW =          0.0000


           TOTAL OUT =   165190736.0000           TOTAL OUT =             59.8350


            IN - OUT =        -3072.0000            IN - OUT =         -1.0185E-03


     PERCENT DISCREPANCY =         -0.00     PERCENT DISCREPANCY =         -0.00
```