User's Guide to DPM Version 3
(modified from Appendix B in Bauer and Mastin, 1997)

Basic Data Input File

A line-by-line description of the data items is given below. All data items are read free format; the variable names used in the source code are given in parentheses.

(1) Text on this line will appear as the title in the Main Output File (limit of 80 characters).

(2) Starting year (IYRSTRT), starting month (MOSTRT), ending year (IYREND), and ending month (MOEND) of the simulation period, and the ending month of the annual water-budget summaries (MOBDGT). If MOBDGT=12, the annual water-budget summaries will be for calendar years, and if MOBDGT=9, the annual water-budget summaries will be for water years.

(3) The number of subareas (NEL), also referred to as cells or blocks, that make up the basin; and the state plane projection system zone number (KZONE) when longitude and latitude are used to locate cells. KZONE is set = 0 if cell locations are given as x-y feet from some arbitrary origin. If KZONE = 0, weather-data station locations must also be given in x-y feet from this origin, and DMAXP, DMAXTF, DMAXT, and DMAXR in 10, below, must be given in feet. (If NEL>20,000, the user must modify the DPM source code by increasing parameter MXCEL accordingly in the MAIN program and in subroutine DATAIN.)

(4) Total number of precipitation weather stations (NWSP); throughfall data stations (NWSTF); temperature weather stations (NWST); and incoming solar radiation data stations (NWSR) that are used to interpolate values to cells. At least one precipitation and one temperature station are required. Incoming solar radiation will be estimated by DPM if no incoming solar radiation data are provided and throughfall can be optionally computed by DPM. (If NWSP>20, or NWSTF>20, or NWST>20, or NWSR>20, the user must modify the DPM source code by revising subroutine IOPEN and increasing parameters MXWSP, MXWST, MXWSR, and/or MXWSTF accordingly in the MAIN program and subroutines DATAIN and IOPEN.)

(5) For the first of the NWSP precipitation stations: longitude (XP(1)) and latitude (YP(1)) in decimal degrees (or feet from origin used in 3, above); and long-term average annual precipitation (ANPWS(1)) in inches. If NWSP>1 the next line will be for XP(2), YP(2), ANPWS(2), etc. Instead of providing the long-term average annual precipitation (ANPWS(1)), the user has the option of assigning ANPWS(1)<0 and specifying long-term average monthly precipitation for January through December (WSMOP(1, 1-12)) in 27 below. The NWSP precipitation stations all have to be assigned either long-term

average annual precipitation (ANPWS(1)>0 and ANPWS(2)>0, etc.) or long-term average monthly precipitation (ANPWS(1)<0 and ANPWS(2)<0, etc.).

(6) For the first of the NWSTF throughfall stations: longitude (XTF(1)) and latitude (YTF(1)) in decimal degrees (or feet from origin used in 3, above); and land-use number (1-999; see "cover type identifier" in Table 1) at this location (LTFWS(1)). Throughfall is highly dependent on land-use and generally cannot be simply distance-interpolated to other locations. Therefore a land-use number is attached to the throughfall data collection station, and data from the station will be interpolated only to cells having the same land-use number. If a cell has a land use different from any of the throughfall data collection stations, then throughfall is computed by DPM based on a maximum daily moisture capacity of the foliage, daily precipitation, and daily PET (see Bauer and Vaccaro, 1987). If NWSTF>1 the next line will be for XTF(2), YTF(2), LTFWS(2), etc.

(7) For the first of NWST temperature stations: longitude (XT(1)) and latitude (YT(1)) in decimal degrees (or feet from origin used in 3, above); altitude (ALTWS(1)) in feet above sea level, long-term average daily minimum temperature for July (TNJAVWS(1)) in degrees Fahrenheit; and long-term average daily maximum temperature for July (TXJAVWS(1)) in degrees Fahrenheit. If NWST>1 the next line will be for XT(2), YT(2), TNJAVWS(2), TXJAVWS(2), etc.

(8) For the first of the NWSR solar radiation data sites: longitude (XR(1)) and latitude (YR(1)) in decimal degrees (or feet from origin used in 3, above). If NWSR>1 the next line will be for XR(2), YR(2), etc.

(9) The maximum number of nearest weather stations to a cell from which to interpolate daily values to a cell for: precipitation (NVALP); throughfall (NVALTF); temperature (NVALT); and solar radiation (NVALR).

(10) The maximum radius from a cell that a data station must lie within to be used for data interpolation to the cell, in miles (or feet, if KZONE = 0 in 3), for precipitation (DMAXP); throughfall (DMAXTF); temperature (DMAXT); and solar radiation (DMAXR). If fewer than NVALP precipitation stations lie within DMAXP miles (or feet, if KZONE = 0 in 3) of a cell, only those will be used for interpolation.

(11) Average latitude of the basin (AVLAT), in decimal degrees.

(12) Monthly lapse rates, 12 values, for minimum daily temperature (RATEMN(1-12)) in ºF/1,000 ft. A lapse rate is coded as 0 if no altitude adjustment is to be made to the distance-weighted interpolations.

(13) Same as 12 above for maximum daily temperature (RATEMX(1-12)).

(14) A constant sublimation rate for snowpack (SBLRATE), in inches of water per day (published rates vary from 0.0028-0.0114); and a constant snowmelt coefficient (SNMCOEF) in inches of water per degrees Celsius per day (generally ranges from about 0.002-0.090).

(15) Minimum daily potential evapotranspiration, 12 values, one for each month (PETMIN(1-12)) in inches of water per day. These values are used to account for some evaporation if theoretical potential evapotranspiration = 0 when temperature is below freezing and there is no snowpack. If not deemed important, these values may be set to 0.0.

(16) Ratio of maximum observed incoming daily short-wave solar radiation (clear sky) to extraterrestrial short-wave solar radiation, 12 values, one for each month (SLRXFMX(1-12)).

(17) Initial conditions for all cells for: soil-moisture (STRTSMS) as fraction of available water capacity; soil saturation (STRTPOR) as fraction of specific yield; and snowpack (STRTSNO) as inches of water (if STRTSMS<1.0, then STRTPOR=0.0). Initial conditions for all cells can also be read from a separate file, if such a file was generated in a previous model run and the filename is provided in the Names File (described below). In this case, initial conditions from this data record will be reset.

(18) Parameter (DSUM) specifies whether the average basin-budget output has monthly averages only (DSUM=0) or daily and monthly averages (DSUM=1). Depending on the number of blocks that are simulated (NEL in item 3 above), very large output files may result if DSUM=1.

(19) The number of cells (10 maximum) for which daily soil-moisture and soil-saturation values are to be output (NSSBLKS). Soil moistures for all specified cells for all days are in one output file. The same applies for the saturation values in a separate output file.

(20) Cell index (or sequence) numbers for the NSSBLKS in 19, above (NSS(1-NSSBLKS)). Index numbers are from those assigned in the Cell Attributes Input File, discussed below.

(21) Number of different soil types (NSOLAS), maximum of 24.

(22) For the first soil type: sequence number (IS), starting with 1; depth, as number of 6-inch layers (NLAYER(1)); soil texture (SOLTEX(1)) (1=sand, 2=silt, 3=clay; mixtures are indicated with decimal values. For example, silty clay could be 2.4 and silty sand could be 1.8); available water capacity (AVLCAP(1)), as decimal fraction by volume; specific yield (SPCYLD(1)), as decimal fraction by volume; lateral hydraulic conductivity of soil (SOLPRM(1)), in feet per day; soil-limiting transpiration coefficient (SLMFAC(1) which, when multiplied by soil moisture, specifies maximum daily transpiration), in inches per day. If SLMFAC is set = 0.0, then soil-water-limited transpiration is determined from “hard wired” empirical soil texture relationships taken from Leavesley and others (1983). If NSOLAS>1 the next line will be for IS=2, NLAYER(2), SOLTEX(2), etc.

(23) Parameter (IROOT) that determines type of moisture extraction from soil by plants when SLMFAC (in 22 above) is not specified. Root mass may be assumed to be evenly distributed (IROOT = 0) or decrease exponentially with depth (IROOT = 1), and transpiration potential is divided among soil layers in proportion to root mass. (IROOT =

0 will usually result in somewhat higher transpiration rate than if IROOT = 1). If SLMFAC > 0.0 in 22, above, any value may be coded for IROOT because it is then not used in the program.

(24) Number of different land uses in a basin for which other than default values of plant characteristics defined in source code are to be used (MDLNDS).

(25) For the first of the modified land uses: land-use number (ILND) (see "cover type identifier" in Table 1); maximum root depth (RDMAX(ILND)) in inches; maximum foliar cover (FCMAX(ILND)) as a decimal fraction; maximum interception storage capacity (MAXINT(ILND)) in inches of water; starting and ending dates of two irrigation periods (IRRST1(ILND), IRREN1(ILND), IRRST2(ILND), IRREN2(ILND)) in "compressed" month-day format (for example, 0609 for June 9); and type of irrigation scheduling (IRRSCD(ILND)), with IRRSCD(ILND)=0 for constant daily rate or =1 for rate proportional to growth stage. If any of these parameters are set to 0, the default value in the appropriate land-use subroutine is used (default for irrigation is no irrigation). If there is only one irrigation period, use IRRST1 for beginning and IRREN2 for end and arbitrary intermediate values such that IRRST2=IRREN1+1). If MDLNDS>0 the next line will be these parameters for the next modified land use.

(26) Drainage area to the streamgage (BSNARA) in square miles (BSNARA does not have to equal the total area being simulated because it is used only to compute runoff per unit area); time between centroid of a storm to centroid of storm streamflow at gage (LAGDYS) in whole days.

(27) Optional. Needs to be provided if ANPWS(1)<0 and ANPWS(2)<0, etc. in 5 above. For the first of the NWSP precipitation stations: long-term average monthly precipitation for January through December (WSMOP(1, 1-12)) in inches of water. If NWSP>1, the next line will be for WSMOP(2, 1-12), etc. The NWSP precipitation stations all have to be assigned either long-term average annual precipitation (ANPWS(1)>0 and ANPWS(2)>0, etc. in 5 above) or long-term average monthly precipitation (ANPWS(1)<0 and ANPWS(2)<0, etc. in 5 above).

(28) Optional. Wind factor (WINDADJ) to compute latent and sensible heat transfer to the snowpack during a rain-on-snow event, in millimeter per millibar per 6 hours. Suggested range is 0.001 to 0.2 mm/mb/6 hrs. If this data line is not provided, a default value of 0.15 mm/mb/6 hrs is used.

Cell Attributes Input File

The first record is not read and, therefore, can be used as a comment line such as for an abbreviated heading line for the columns in the tabular file. Each subsequent record specifies the spatially dependent physical attributes for each unique subarea (or cell) within the basin. The data elements on each record are itemized below. The variable name used in the source code for each data element (or column) is given in parentheses.

Each data element (except for the cell index number and optional average monthly precipitation) is represented by a single-dimension array in the source code, which is coded for a maximum of 20,000 cells. If there are more cells, the user must modify the DPM source code by increasing parameter MXCEL accordingly in the MAIN program and in subroutine DATAIN.

(1) Cell index number (usually I, or NE), must be sequential starting with I=1.

(2) Longitude of, or distance east of arbitrary origin to, the centroid of the cell (GX(I)), in decimal degrees or feet.

(3) Latitude of, or distance north of arbitrary origin to, the centroid of the cell (GY(I)), in decimal degrees or feet.

(4) Area (AREA(I)), in square miles.

(5) Soil-type sequence number that corresponds with "IS" in 22 above (NSOIL(I)).

(6) Land use index number (LANDUS(I)). See "cover type identifier" in Table 1.

(7) Long-term average annual precipitation (ANPBLK(I)) (usually obtained from isohyet map), in inches of water. This is used to make "orographic" corrections to distance-interpolated precipitation values. If ANPBLK(I) is set to 0.0 then no orographic correction is made for this cell. Instead of providing the long-term average annual precipitation (ANPBLK(I)), the user has the option of specifying long-term average monthly precipitation for January through December for all blocks (BLKMOP(I, 1-12)) in 15 below. Monthly values are read for all blocks in 15 below if ANPBLK(1)<0.

(8) Altitude (ALTBLK(I)) in feet above sea level.

(9) Land surface slope (SLPBLK(I)) in decimal degrees from horizontal (used in computing amount of solar radiation incident on cell -- important only in steep terrain; in most cases it may be set to 0.0 and have little effect on the results).

(10) Land surface aspect (ASPECT(I)) in degrees clockwise from north (same comment as in parentheses in 9, above).

(11) Annual amount of irrigation (APPLD(I)) in inches. Irrigation is applied above the vegetation canopy if APPLD(I)>0 and below the vegetation canopy if APPLD(I)<0. If APPLD(I)<0, the annual amount of irrigation equals the absolute value of APPLD(I). DPM tracks the irrigation method with variable IRRMETHOD(I). If irrigation is applied above the vegetation canopy, IRRMETHOD(I)=0, and if irrigation is applied below the vegetation canopy, IRRMETHOD(I)=1.

(12) Saturated vertical conductivity (equivalent to infiltration rate at saturation) of the subsoil material (VKSAT(I)) in inches per year. This value is generally unknown but is of primary importance. If it is known that the soils never saturate, simply set VKSAT(I) to a large value (such as 9999). If the soils saturate, then values of VKSAT must be

"calibrated" to minimize the deficit term in the output (see discussion in Water Budget section in Bauer and Mastin, 1997). Negative deficits are computed on days when precipitation minus evapotranspiration plus saturated moisture stored in the soil is less than the observed storm runoff (streamflow minus baseflow), suggesting that lower VKSAT values be used. Positive deficits are computed on days when precipitation minus evapotranspiration minus unsaturated pore space exceeds the observed storm runoff, suggesting that a higher value of VKSAT be used. If infiltration rates are known to change with time (for example, as a function of the degree of saturation of the subsoil material), the user has the option of providing time-varying infiltration rates for VKSAT(I) in the Saturated Vertical Conductivity Input File, described below. DPM will replace the saturated vertical conductivity values provided here according to the additional information provided in the Saturated Vertical Conductivity Input File.

(13) One-half the average spacing between the smallest (probably intermittent) drainage channels in the subarea (EFFLNGTH(I)), in feet. This somewhat subjective parameter is used together with the hydraulic conductivity of the soil (specified in the Basic Data Input File), the average land surface slope (see 14, below), and VKSAT(I) (see 12, above) to compute saturated soil-water discharge to the stream channels, which, in turn, is used to allocate the total measured direct runoff from the basin to the cells.

(14) The average slope between the smallest drainage channels of 13, above, (EFFSLP(I)) as the ratio of vertical to horizontal.

(15) Optional (columns 15 through 26). Needs to be provided for all blocks if ANPBLK(1)<0 in 7 above. Long-term average monthly precipitation for January through December (BLKMOP(I, 1), BLKMOP(I,2), BLKMOP(I,3), …., BLKMOP(I,12)) in inches of water.

Saturated Vertical Conductivity Input File (Optional)

If the infiltration rate (VKSAT(I)) changes with time, VKSAT(I) values for individual cells entered on line 12 of the Cell Attributes Input File can be replaced with new values in the Saturated Vertical Conductivity File at user-specified dates.

The file has one record for each date and cell with a new VKSAT(I) value, and each record is read free format. The first three values on each record represent the date as year, month, and day (for example, 1994 10 15). The fourth and fifth values are the cell index number (usually I, or NE) and the new VKSAT(I) value (VKSATNEW(I)), respectively. Records have to be grouped by date, from the earliest to the latest date. For example, a set of 10 records is entered for 10 cells for which VKSAT(I) values changed on October 15, 1994 and a set of 20 records is entered for 20 cells for which VKSAT(I) values changed on March 15, 1995. No order by cell index number is required within a set of records with the same date.

Daily Time-Series Data Input Files

Each of the data files in the following 5 groups has one data record for each day of the budget period starting with the first day of the starting month and ending with the last day of the ending month specified on line 2 of the Basic Data Input File (except possibly for the streamflow data set, described below). All files are read free format. The first three values on each record represent the date as year, month, and day (for example, 1994 10 15). The files and subsequent values on each record in the files are as follows:

Precipitation Files

One file for each of the precipitation stations is required. The total number of stations is specified on line 4 of the Basic Data Input File. At least one station is required. On each record there is one value of daily precipitation, in inches, following the date.

Throughfall Files

Same as for precipitation files, except that the date is followed by one daily value of throughfall as a fraction of precipitation at the throughfall station. The fraction may exceed 1.0 when drip from water stored in the canopy adds to precipitation. There is no requirement on the number of files (for example, may be none).

Streamflow File

Only one streamflow file is allowed, but is not required (for example, runoff may not occur in a highly pervious area or streamflow data may not be available for the study area). On each record following the date, there is one value of mean daily discharge and one value of the estimated ground-water discharge component of the daily discharge, both in cubic feet per second. If LAGDYS > 0 (specified on line 26 of the Basic Data Input File) then LAGDYS number of additional daily streamflow records beyond the last day of the simulation must be included.

Temperature Files

Same as for precipitation files except that the date is followed by the daily minimum and then the daily maximum temperature in degrees Fahrenheit. At least one station is required.

Incoming Solar Radiation Files

Same as for precipitation files except that the date is followed by one value of daily incoming solar radiation, in langleys (calories per square centimeter). There is no requirement on the number of files (for example, may be none).

Output Files

Two output files are created for each simulation, and four additional output files are optional. However, the optional Unsaturated Soil-Moisture and Saturated Soil-Moisture files (described below) are required if NSSBLKS>0 in item 19 of the Basic Data Input File.

Main Output File

Summarizes model parameters and lists monthly or monthly and daily water-budget items. The water-budget items are averages of all the subareas or cells in the basin. Only monthly budget summaries are listed if DSUM = 0 (item 18 of the Basic Data Input File) and monthly and daily budget summaries are listed if DSUM = 1.

Cell Summary File

For each cell, water-budget summaries are printed for (1) simulation-period totals, (2) simulation-period monthly averages, and (3) if the simulation is for more than one year, the simulation-period annual averages.

Cell Monthly File (Optional)

For each month of the simulation period, the monthly totals of the water-budget items are printed for each cell.

Unsaturated Soil-Moisture File (Optional)

For selected cells (item 19 in the Basic Data Input File), calculated daily values of soil moisture in excess of the wilting point up to field capacity in inches of water, are printed. For each day of the simulation, the date and daily values for all the selected cells are printed on one record.

Saturated Soil-Moisture File (Optional)

For the same cells selected for the Unsaturated Soil-Moisture File, above, calculated daily values of soil moisture in excess of field capacity (saturated soil moisture), in inches of water, are printed. For each day of the simulation, the date and daily values for all selected cells are printed on one record.

Cell Water-Storage File (Optional)

For each cell, water-storage variables for the last day of the simulation are written in binary format. The file can be used to specify initial conditions in subsequent model simulations and, if used, resets the initial conditions specified in item 17 of the Basic Data Input file.

Names File

Model input and output file names are specified in a file called "**dpm_filenames**" (all lower case). File names can have a maximum of 120 characters. Input files are specified in lines 20 through 34 and output file in lines 35 through 42. The order of precipitation, temperature, incoming solar radiation, and throughfall stations specified in lines 28, 30, 32, and 34, respectively, has to match the order of the stations specified in items 5, 7, 8, and 6, respectively, of the Basic Data Input File described above. The Names File has the following format:

Lines 1-18: comment lines

Line 19: 11 values (IO(1), IO(2), ….., IO(11)) that specify which optional files will be used and how many weather and throughfall stations will be used. Line 19 is read in free format.

- If IO(1)=1, a streamflow input file will be used. If IO(1)=0, no streamflow input file will be used.
- If IO(2)=1, a Saturated Vertical Conductivity Input file will be used. If IO(2)=0, no Saturated Vertical Conductivity Input file will be used.
- If IO(3)=1, a Cell Water-Storage input file that was generated by a previous model simulation will be used. If IO(3)=0, no Cell Water-Storage input file will be used.
- IO(4) equals the number of precipitation stations (minimum is 1 and maximum, as currently coded, is 20)
- IO(5) equals the number of temperature stations (minimum is 1 and maximum, as currently coded, is 20)
- IO(6) equals the number of incoming solar radiation stations (minimum is 0 and maximum, as currently coded, is 20)
- IO(7) equals the number of throughfall stations (minimum is 0 and maximum, as currently coded, is 20)
- If IO(8)=1, a Cell Monthly output file will be created. If IO(8)=0, no Cell Monthly output file will be created.
- If IO(9)=1, an Unsaturated Soil-Moisture output file will be created. If IO(9)=0, no Unsaturated Soil-Moisture output file will be created.
- If IO(10)=1, a Saturated Soil-Moisture output will be created. If IO(10)=0, no Saturated Soil-Moisture output file will be created.
- If IO(11)=1, a Cell Water-Storage output file will be created. If IO(11)=0, no Cell Water-Storage output file will be created.

Line 20: comment line

Line 21: pathname to Basic Data Input file (required)

Line 22: comment line

Line 23: pathname to Cell Attributes Input file (required)

Next 2 lines if IO(1)=1:

Line 24.1: comment line

Line 24.2: pathname to streamflow input file

Next 2 lines if IO(2)=1:

Line 25.1: comment line

Line 25.2: pathname to Saturated Vertical Conductivity Input file

Next 2 lines if IO(3)=1:
    Line 26.1: comment line
    Line 26.2: pathname to Cell Water-Storage input file
Line 27: comment line
Line 28.1: pathname to precipitation file 1 (required)
Next IO(4)-1 lines:
    Line 28.2: pathname to precipitation file 2
    Line 28.3: pathname to precipitation file 3
    …
    Line 28.IO(4): pathname to precipitation file IO(4)
Line 29: comment line
Line 30.1: pathname to temperature file 1 (required)
Next IO(5)-1 lines:
    Line 30.2: pathname to temperature file 2
    Line 30.3: pathname to temperature file 3
    …
    Line 30.IO(5): pathname to temperature file IO(5)
Next IO(6)+1 lines, if IO(6)>0:
    Line 31: comment line
    Line 32.1: pathname to incoming solar radiation file 1
    Line 32.2: pathname to incoming solar radiation file 2
    …
    Line 32.IO(6): pathname to incoming solar radiation file IO(6)
Next IO(7)+1 lines, if IO(7)>0:
    Line 33: comment line
    Line 34.1: pathname to throughfall file 1
    Line 34.2: pathname to throughfall file 2
    …
    Line 34.IO(7): pathname to throughfall file IO(7)
Line 35: comment line
Line 36: pathname to Main Output file (required)
Line 37: comment line
Line 38: pathname to Cell Summary output file (required)
Next 2 lines if IO(8)=1:
    Line 39.1: comment line
    Line 39.2: pathname to Cell Monthly output file
Next 2 lines if IO(9)=1:
    Line 40.1: comment line
    Line 40.2: pathname to Unsaturated Soil-Moisture output file
Next 2 lines if IO(10)=1:
    Line 41.1: comment line
    Line 41.2: pathname to Saturated Soil-Moisture output file
Next 2 lines if IO(11)=1:
    Line 42.1: comment line
    Line 42.2: pathname to Cell Water-Storage output file

References Cited

Bauer, H.H., and Vaccaro, J.J., 1987, Documentation of a deep percolation model for estimating ground-water recharge: U.S. Geological Survey Open-File Report 86-536, 180 p.

Bauer, H.H., and Mastin, M.C., 1997, Recharge from precipitation in three small glacial-till-mantled catchments in the Puget Sound lowland, Washington: U.S. Geological Survey Water-Resources Investigations Report 96-4219, 119 p.

Leavesley, G.H., Lichty, R.W., Troutman, B.M., and Saindon, L.G., 1983, Precipitation-runoff modeling system; user's manual: U.S. Geological Survey Water-Resources Investigations Report 83-4238, 207 p.

Table1. Available land use and cover types for Deep Percolation Model version 3.

[The cover type for each block is stored in the integer array LANDUS. Each cover type is identified with a unique number that can range from 1 to 999. For example, a cover type of 1 means a block has a cover of conifer forest. More cover types can be added by creating a new cover-type subroutine, modifying subroutine CRPCOF, modifying subroutine APPSCD if the crop type may be irrigated, and modifying two if statements flagged in the MAIN program, depending on the cover type that is added. (Search for string **WARNING** to find the flagged if statements.) Alternatively, more cover types can also be added by modifying an existing cover-type subroutine. In that case, for irrigated land uses a subroutine for an irrigated cover type, for example mint, could be modified and for native vegetation the forest or grass subroutines could be modified. Note that local conditions can affect both the single crop coefficients (Kc) and the length of a particular development stage of a cover type. These types of adjustments are achieved by changing the Kc values (called CRP in a cover-type subroutine) and/or the growing-season Julian dates (called JDATE in a cover-type subroutine) in the data lines of a cover-type subroutine.]

Cover type identifier	Cover type	Growing season*
1	Conifer forest	Full year
2**	Grass—native or irrigated; evapotranspiration estimated using Priestly-Taylor method	Full year
3	Sagebrush and associated scrub	Full year
4	Winter wheat—harvested in summer and planted in autumn, each year; larger maximum water demand than cover type identifier 204	September 4 to July 4
204	Winter wheat—harvested in summer and planted in autumn, each year; smaller maximum water demand than cover type identifier 4 based on more recent information	September 4 to July 4
5	Winter wheat, grown on two-year cycle—second calendar year of cycle: harvested in summer, fallow in autumn; larger maximum water demand than cover type identifier 205	December 31 to July 4
205	Winter wheat, grown on two-year cycle—second calendar year of cycle: harvested in summer, fallow in autumn; smaller maximum water demand than cover type identifier 5 based on more recent information	December 31 to July 4
6	Winter wheat, grown on two-year cycle—first calendar year of cycle: fallow in summer, planted in autumn; larger maximum water demand than cover type identifier 206	September 14 to January 1

206	Winter wheat, grown on two-year cycle—first calendar year of cycle: fallow in summer, planted in autumn; smaller maximum water demand than cover type identifier 6 based on more recent information	September 14 to January 1
7	Orchards (low-latitudes) or deciduous trees (mid-latitudes, with thick understory, such as in riparian areas)	Full year
8	Alfalfa	Full year
208	Alfalfa	February 28 to October 31
9**	Grass—native or irrigated; evapotranspiration estimated using Jensen-Haise method	Full year
209	Row crops (mid-latitudes)—undifferentiated; annual crop water use of about 28 inches. Can be used for multiple crops in a season or crops such as asparagus.	February 28 to October 30
10	Water	—
11	Corn	May 5 to November 6
211	Corn	May 5 to September 21
12	Potato—larger maximum water demand than cover type identifier 212	June 12 to October 21
212	Potato—smaller maximum water demand than cover type identifier 12	April 19 to September 14
13	Barren soils—sand, sand dunes, and very permeable soil without vegetation	—
14	Lentil and/or Pea	April 30 to August 15
214	Lentil	April 30 to August 15
15	Spring wheat—planted in spring, harvested in autumn; larger maximum water demand than cover type identifier 215	March 30 to August 31
215	Spring wheat—planted in spring, harvested in autumn; smaller maximum water demand than cover type identifier 15 based on more recent information	March 30 to August 31
16	Impervious	—
17	Small vegetables (California) —carrots, lettuce, etc.	August 30 to January 20
18	Cotton (Texas)	March 30 to September 28
19	Mint	May 5 to August 20
20	Grape (California)	February 28 to September 23
21	Grape (Washington and Oregon)	March 30 to October 25
22	Hops (Washington, Idaho, and Oregon)	March 30 to September 6
23	Olive tree (California)	February 28 to December 3
24	Citrus	Full year
25	Soybeans (central United States)	May 5 to September 24
26	Apple and other orchards	February 28 to November 25
27	Sorghum	May 18 to October 6
28	Pasture (mid-latitudes)	February 28 to October 31
29	Bean	May 13 to August 23
30	Pea	April 13 to July 24
31	Asparagus	February 28 to October 31

*No transpiration simulated if air temperature is at or below freezing.

**Representative of shallow rooted grasses; root depth, interception capacity, and growing season would need to be adjusted for native tall grass.