VIII.3.3-CONS_USE CONSUMPTIVE USE OPERATION

Identifier: CONS_USE

Operation Number: 57

Developed By: Northwest River Forecast Center

Parameter Array: The FORTRAN identifier used for the parameter array is P. Parameter values are stored in Metric units. The contents of the P array are:

Position	Contents
1	Operation version number (integer value)
2-19	General description (maximum 72 characters)
20-21	Mean areal temperature time series identifier
22	Mean areal temperature data type code
23-24	Potential evaporation time series identifier
25	Potential evaporation data type code
26-27	Natural runoff time series identifier
28	Natural runoff data type code
29-30	Adjusted runoff time series identifier
31	Adjusted runoff data type code
32-33	Diversion flow time series identifier
34	Diversion flow data type code
35-36	Return flow in time series identifier
37	Return flow in data type code
38-39	Return flow out time series identifier
40	Return flow out data type code
41-42	Other losses time series identifier
43	Other losses data type code
44-45	Crop demand time series identifier

Position	Contents
46	Crop demand data type code
47-48	Crop evapotranspiration time series identifier
49	Crop evapotranspiration data type code
50	Option for evapotranspiration estimation method (integer value): 0 = SCS Blaney Criddle Temperature Method 1 = Potential Evaporation time series supplied
51	Latitude of irrigated area (+ North and - South in units of decimal degrees)
52	Irrigated area (units of KM2)
53	Irrigation efficiency (0.00 - 1.00)
54	Minimum Streamflow (units of CMSD)
55	Return flow accumulation rate (percentage of diversion, less than '1-efficiency')
56	Return flow decay rate (first-order decay of storage, 1/day)
57	Annual daylight hours
58-422 (365)	Daily empirical crop/meteorological coefficients

The number of positions required in the P array is 422.

Carryover Array: The FORTRAN identifier for the carryover array is C. The contents of the C array are:

Position	Contents
1	Return flow storage (units of MM)

The number of positions required in the C array is 1.

Subroutine Names and Functions:

Subroutine	Function
PIN57	Input values, make checks, make initial computations, and stores values in the P and C arrays
TAB57	Make entries into the Operation Table
PRP57	Print information stored in the P array

Subroutine	Function
PRC57	Print information stored in the C array
PUC57	Punch information stored in the P and C arrays in the format required by PIN57
EX57	Make consumptive use calculations
COX57	Provide for carryover transfer

Subroutines PIN57, PRP57, PRC57, PUC57 and COX57 have the standard argument lists as described in Section VIII.4.3.

SUBROUTINE PIN57

Function: This is the input subroutine for Operation CONS_USE. Initial computations are made in this Operation with the output being stored to the P array.

Processing Steps

1. Read parameters and report format errors

2. Check time series data code and units

3. Check value of specific input parameters:
   a. Irrigation Efficiency (0.00 - 1.00)
   b. Return Flow Accumulation Rate (Must be less than '1 - irrigation efficiency')

4. Compute daily empirical coefficients (365) from mid-month coefficients using linear interpolation

5. Compute annual daylight hours:
   a. Convert latitude from degrees to radians: RLAT = LAT * 2 * PI / 360
   b. Compute daily declination: DEC = 0.4093 * SIN(2 * PI * (284 + DAY) / 365)
   c. Compute daily sunset angle: SSANGLE = ACOS (-1 * TAN(RLAT) * TAN(DEC))
   d. Compute daily daylight hours: H = SSANGLE * 24 / PI
   e. Sum daily daylight hours to obtain annual daylight hours: HYEAR = SUM {H(1 - 365)}

6. Save variables to P and C arrays:
   a. Version number
   b. Input time series and model parameters
   c. Computed daily empirical coefficients
   d. Computed annual daylight hours

SUBROUTINE EX57 (P,C,T,PE,QNAT,QADJ,QDIV,QRFIN,QRFOUT,QOL,QCD,CE)

Function: This is the execution subroutine for Operation CONS_USE.

Argument List:

Variable	Input/ Output	Type	Dimension	Description
P	I	R	Variable	Contains parameters, options and time series information
C	I	R	Variable	Contains carryover information on input
T	I	R	Temp	Mean areal temperature time series (6-hour)
PE	I	R	L	Potential evaporation time series (24-hour)
QNAT	I	R	L3	Natural runoff time series (24-hour)
QADJ	O	R	L3	Adjusted runoff time series (24-hour)
QDIV	O	R	L3	Diversion flow time series (24-hour)
QRFIN	O	R	L3	Return flow in time series (24-hour)
QRFOUT	O	R	L3	Return flow out time series (24-hour)
QOL	O	R	L3	Other losses time series (24-hour)
QCD	O	R	L3	Crop demand time series (24-hour)
CE	O	R	L	Crop evapotranspiration time series (24-hour)

Processing Steps

1. Read in time series:
   a. Option 0 - mean areal temperature and natural flow time series
   b. Option 1 - potential evaporation and natural flow time series

2. Determine crop ET:
   a. Option 0 - SCS Blaney Criddle Temperature Method:
      1) Convert 6 hour MAT time series to 24 hour mean daily temperature (t)

        2) Convert temperature in degrees Celcius to Fahrenheit
        3) If any temperatures are below 0 degrees Fahrenheit set them equal to 0
        4) Calculate percentage daytime hours (perc)
        5) Calculate crop ET: CE(mm) = 25.4*k*t(deg F)*perc/100
    b. Option 1 - Potential evaporation time series supplied:
        1) Calculate crop ET: CE(mm) = k*PE(mm)

3. Calculate crop demand:
   QCD(cmsd) = CE(mm)*A(km2)*c(units conversion factor)

4. Calculate diversion necessary to satisfy crop demand:
   QDIV(cmsd) = QCD/efficiency(e)

5. Calculate return flow out:
   QRFOUT (cmsd) = C(0)(mm)*decay(1/day)*A*c

6. Determine if (QNAT + QRFOUT) < (QDIV + MFLOW):
    a. Yes, determine if MFLOW > (QNAT + QRFOUT)
        1) Yes, QDIV = 0
        2) No, QDIV = (QNAT + QRFOUT) - MFLOW
        QCD = QDIV*e,
        CE = QCD/(A*c),
        entire crop demand is not satisfied
    b. No, QDIV = QDIV

7. Calculate adjusted flow: QADJ(cmsd) = (QNAT + QRFOUT) - QDIV

8. Calculate return flow in: QRFIN(cmsd) = QDIV * percentage

9. Calculate other losses: QOL(cmsd) = QDIV - QCD - QRFIN

10. Calculate return flow storage:
    RFSTOR(1)(mm) = [RFSTOR(0)*A*c + QRFIN - QRFOUT]/(A*c)