VIII.3.3-SSARRESV SSARR RESERVOIR REGULATION OPERATION

Identifier: SSARRESV

Operation Number: 51

Parameter Array: The FORTRAN identifier used for the parameter array for this Operation is PO. The contents of the PO array are

Position	Contents
PO(1)	Operation version number
PO(2) to PO(6)	Operation title
PO(7)	Data time interval (units of HR)
PO(8)	Units used when parameters ware defined: 0 = English units 1 = metric units In English units, flow is in cubic-feet-per-second (CFS), flow volume is in cubic-feet-per-second-day (CFSD), elevation is in feet (FT) and storage is in acre-feet (ACFT). In metric units, flow is in cubic-meters-per-second (CMS), flow volume is in cubic-meters-per-second-day (CMSD), elevation is in meters (M), storage is in thousand-cubic-meters (TCUM).
PO(9)	Reservoir type indicator: 1 = single reservoir 2 = a two-reservoir system or a station backwater affected by a downstream reservoir
PO(10)	Parameter information pointer in the PO array for sigle reservoir; or for the downstream reservoir in a two-reservoir system or for the downstream reservoir with backwater effect to a upstream station
PO(11)	Parameter information pointer in the PO array for the upstream reservoir in a two-reservoir system or the upstream station backwater affected by a downstream reservoir: 0 = single reservoir case
PO(12)	Time series information pointer in the PO array for all reservoirs and station
PO(13)	2 = two-reservoir system 0 = otherwise If PO(13) = 2 then two SSARREG MODs are

Position	Contents
	permitted optionally for both the upstream and downstream reservoirs. If only one SSARREG MOD is used then the MOD is used for the downstream reservoir. If no MOD is entered then free flow is assumed.
PO(14)	Number of words used in PO array to store parameter and time-series
PO(15)	Number of carryover values: 5 = single reservoir case 9 = two-reservoir SYSTEM or a station-reservoir case
PO(16)	Number of words of work space
PO(17) to PO(20)	Empty space reserved for future use
PO(PO(10)) to PO(PO(11)-1)	Parameters for single reservoir or for the downstream reservoir in a two-reservoir system or for the downstream reservoir with backwater effect to an upstream station. The reservoir may be a non-backwater reservoir (SAR/ENDSAR) or a bckwater reservoir with backwater effect solely from tributary flow (LWERBKWR/ENDLWERB)
PO(PO(10))	Reservoir type indicator: 0 = non-backwater reservoir 2 = backwater reservoir with backwater effect solely from tributary flow
PO(PO(10)+1)	Number of points, N (maximum N = 50), of elevation-storage-discharge table for the reservoir
PO(PO(10)+2) to PO(PO(10)+N+1)	N values of reservoir elevation
PO(PO(10)+N+2) to PO(PO(10)+2N+1)	N values of reservoir storage
PO(PO(10)+2N+2) to PO(PO(10)+3N+1)	N values of reservoir discharge. Default to zero and pass inflow if discharge curve is not available. The last value of the discharge array, PO(PO(10)+3N+1), is used as an indicator to check for the availability of the discharge curve. A non-zero value indicates that the discharge curve is available.
PO(PO(10)+3N+2)	Number of points of backwater table, NB (maximum 200 points). NB = 0 for a non-backwater reservoir.

Position	Contents
PO(PO(10)+3N+3) to PO(PO(10)+3N+3NB+2)	3*NB backwater table values (maximum 600 values) stored in the order of reservoir outflow, reservoir elevation and tributary flow as control parameter
PO(PO(10)+3N+3NB+3)	Indicator if backwater reservior: 0 = non-backwater reservoir 1 = backwater reservoir and its outflow is controlled solely by tributary flow
PO(PO(10)+3N+3NB+4)	Maximum reservoir elevation. Default to the highest elevation of the elevation/storage table
PO(PO(10)+3N+3NB+5)	Minimum reservoir elevation. Default to the lowest elevation of the elevation/storage table.
PO(PO(10)+3N+3NB+6)	Minimum reservoir release for fishery and other water use. Default to zero release. Only used in a non-backwater reservoir.
PO(PO(11)) to PO(PO(12)-1)	Parameters for the upstream reservoir in a two-reservoir system or for the upstream station backwater controlled by a downstream reservoir
PO(PO(11))	Reservoir/station type indicator: 1 = a reservoir backwater controlled by a downstream reservoir 3 = a station with backwater effect from a downstream reservoir using three-variable table lookup without backwater routing

If PO(PO(11)) = 1 then this portion of the PO array stores the parameter information for a backwater reservoir backwater controlled by a downstream reservoir. The parameters for this portion of the PO array are stored as follows:

PO(PO(11)+1)	Number of points, N (maximum N = 50) of elevation-storage-discharge table for the backwater reservoir
PO(PO(11)+2) to PO(PO(11)+N+1)	N values of backwater reservoir elevation
PO(PO(11)+N+2) to PO(PO(11)+2N+1)	N values of backwater reservoir storage
PO(PO(11)+2N+2) to PO(PO(11)+3N+1)	N values of zero. Retained only for programming convenience, not used in actual backwater routing computation.

Position	Contents
PO(PO(11)+3N+2)	Number of points of backwater table, NB (maximum 200 points)
PO(PO(11)+3N+3) to PO(PO(11)+3N+3NB+2)	3*NB backwater table values (maximum 600 values) stored in the order of backwater reservoir outflow, backwater reservoir elevation and control parameter at downstream reservoir (elevation or flow)
PO(PO(11)+3N+3NB+3)	Indicator for type of control parameter at downstream reservoir: 1 = backwater reservoir outflow is controlled by the outflow of a downstream reservoir 2 = the backwater reservoir outflow is controlled by the elevation of a downstream reservoir
PO(PO(11)+3N+3NB+4)	Maximum backwater reservoir elevation. Default to the highest elevation of the elevation/storage table
PO(PO(11)+3N+3NB+5)	Minimum backwater reservoir elevation. Default to the lowest elevation of the elevation/storage table

If PO(PO(11)) = 3 then this portion of the PO array stores the parameter information for the backwater station with backwater effect from a downstream reservoir using three-variable table lookup without backwater reservoir routing. The parameters for this portion of the PO array are stored as follows:

PO(PO(11)+1)	2 = to designate a two-value table for a dummy elevation-storage-discharge curve. This dummy curve is required by some dummy computational procedures in the program
PO(PO(11)+2) to PO(PO(11)+N+1)	Two dummy values of 0.0 and 999999.0 are stored for station elevations. Required by some dummy computational procedures in the program
PO(PO(11)+N+2) to PO(PO(11)+2N+1)	Two dummy values of 0.0 and 999999.0 are stored for station storages. Required by some dummy computational procedures in the program.
PO(PO(11)+2N+2) to PO(PO(11)+3N+1)	Two dummy values of 0.0 and 999999.0 are stored for station discharges. Required by some dummy computational procedures in the program.
PO(PO(11)+3N+2)	Number of points of three-variable relation

Position	Contents
	table, NB (maximum 200 points)
PO(PO(11)+3N+3) to PO(PO(11)+3N+3NB+2)	3*NB values (maximum 600 values) in the order of station inflow (second independent variable), downstream reservoir control parameter (first independent variable; elevation or flow) and station elevation (dependent variable)
PO(PO(11)+3N+3NB+3)	Backwater control parameter type indicator for the backwater station: 1 = a backwater station backwater controlled by the outflow of a downstream reservoir 2 = a backwater station backwater controlled by the elevation of a downstream reservoir
PO(PO(11)+3N+3NB+4)	1 = to designate flow as the second independent variable, Z, at the backwater station
PO(PO(11)+3N+3NB+5)	2 = to designate elevation as the dependent variable, Y, at the backwater station
PO(PO(12)) to PO(PO(13)-1)	Time series information; each time series uses occupies five words. The time series are stored first with two inflow time series, followed by NTS, NTS = (PO(PO(12))-2)/PO(9), downstream reservoir time series, followed by NTS upstream reservoir time series. The first two time series are instantaneous inflow time series stored in the order of the time series at period start, then the time series at period end. The 3rd time series to the (NTS+2)th time series are reserved for single reservoir or for the downstream reservoir in a two reservoir system or for the downstream reservoir with backwater effect to an upstream station. The time series are stored in the order of instantaneous discharges at the period start and end, mean discharge, reservoir elevation, reservoir storage, observed instantaneous discharge, observed mean discharge and observed reservoir elevation. The (NTS+1)th time series is not used and is stored as blanks. The (NTS+2)th time series holds the tributary flow time series for a reservoir backwater controlled by this tributary flow. For a non-backwater reservoir, the (NTS+2)th time series is not used. The (NTS+3)th time series to the NTTS time

Position	Contents
	series are reserved for the upstream reservoir in a two-reservoir system or for the upstream station backwater affected by a downstream reservoir. Time series for an upstream reservoir are stored in the same order as the downstream reservoir except the (NTTS-1)th and (NTTS)th time series. The (NTTS-1)th and (NTTS)th time series are used to store tributary (and local) inflow at the period start and end. The time series for a backwater station are stored in the same order as the time series in the upstream reservoir. The time series used in a backwater station include instantaneous discharge time series at the period start and end, mean discharge time series, station elevation time series and two tributary (and local) inflow time series. Observed time series (not considered) and storage time series (not used) are stored as blanks.
PO(PO(12))	Number of time series, NTTS. For single reservoir NTTS = 15. For a two-reservoir system or a backwater station backwater controlled by a downstream reservoir NTTS = 28.

Beginning with NEXT = PO(12) the following values are repeated NTTS times (if an optional time series is not used five blanks are stored):

PO(NEXT+1) to PO(NEXT+2)	Time series identifier
PO(NEXT+3)	Time series data type
PO(NEXT+4)	Time series data time interval (units of HR)
PO(NEXT+5)	Input/output indicator: 0 = input time series 1 = output time series

NEXT = NEXT + 5

Carryover Array: The Fortran identifier used for the carryover array is CO.

In single reservoir the carryovers are stored first with the inflow carryover followed by four carryovers for the reservoir. The total number of carryover values needed is 5.

In a two-reservoir system or a backwater station backwater controlled by a downstream reservoir the carryovers are stored begin with the inflow carryover followed by four carryovers for the downstream reservoir followed by four carryovers for the upstream reservoir. The number of carryover values needed is 9.

Position	Contents

The contents of the CO array are:

Position	Contents
CO(1)	Instantaneous inflow at start of run. If the instantaneous inflow time series at period start is available CO(1) is not used.

The 2nd word to the 5th word of the CO array are reserved for single reservoir or the downstream reservoir. The carryovers are stored as follows:

CO(2)	Instantaneous outflow for the downstream reservoir at start of run
CO(3)	Elevation for the downstream reservoir at start of run
CO(4)	Storage for the downstream reservoir at start of run
CO(5)	Retained only for programing convenience, not used in actual computation

The following carryovers are needed only for the backwater reservoir in a two-reservoir system. The four carryovers for the backwater reservoir are stored in words 6 to 9 as follows:

CO(6)	Instantaneous outflow for the upstream reservoir at start of run
CO(7)	Elevation for the upstream reservoir at start of run
CO(8)	Storage for the upstream reservoir at start of run
CO(9)	Tributary flow into the downstream reservoir at start of run. If the instantaneous tributary inflow time series at period start is available, CO(9) is not used

For a backwater station with backwater effect from a downstream reservoir, the carryovers for the backwater station are stored as follows:

CO(6)	Instantaneous outflow for the upstream station at start of run
CO(7)	Retained only for programing convenience, not used in actual computation
CO(8)	Retained only for programing convenience, not used in actual computation
CO(9)	Tributary flow into the downstream reservoir at start of run. If the instantaneous tributary inflow time

Position	Contents
	series at period start is available CO(9) is not used.

Subroutines Names and Functions: Subroutines associated with this Operation are:

Subroutine	Function
CARD51	Read input cards and write to unit 89
COX51	Transfer carryover values
DETM51	Convert all values in a time series from metric to input unit
DMTE51	Convert all values in a time series from input unit to metric
ELST51	Check and assures values are within elevation vs storage table
EROT51	Print out error messages occurred in PIN51
ETOM51	Establish unit and conversion factor for flow, elevation and storage in English and Metric units
EX51	Execute the Operation
EXTR51	Get regulation options from the regulation information on the SSARREG MOD
FLWK51	Store one value in an array and sees if available space is exceeded
GLST51	Get list of items (integer, real or character)
INFC51	Read and stores inflow carryover values
INFL51	Read all input in INFLOW/ENDINFLW section
INFT51	Reads and stores inflow time-series information
LKRT51	Route a period through lake or reservoir; this is an original SSARR subroutine (LAKRT)
LU3F51	Interpolate for dependent variable without backwater routing given the first independent variable, the second independent variable and the three-variable relation table
LU3L51	Locate bracketing points on a line in backwater table during backwater routing

Subroutine	Function
LWB51	Reads all input in LWERBKWR/ENDLWERB section
PIN51	Input values, makes checks and stores values to the P array
PRC51	Print carryover information stored in the CO array
PRP51	Print parameter information stored in the PO array
PRPB51	Print parameter information stored in the PO array for the backwater reservoir
PUC51	Write card images that can be read by PIN51n
PUCB51	Write card images that can be read by PIN51 for a backwater reservoir
QIQL51	Compute inflow into the upstream reservoir/station and tributary inflow between the upstream reservoir/station and downstream reservoir at period start and end for use in generating results in observed periods
RFIL51	Refill a value into a reserved space in an array in PIN51
SABC51	Read and write carryover information for a backwater reservoir
SABP51	Read and write parametric information for a backwater reservoir
SAR51	Read all input in SAR/ENDSAR section
SARC51	Read and write carryover information for a non-backwater reservoir
SARP51	Read and write parametric information for a non-backwater reservoir
SART51	Read and write time series information for reservoirs and station
STER51	Store information about errors that occurred in PIN51
STRN51	Store information about errors that occurred in PIN51
TAB51	Make entry into the Operations Table
TLU251	Two-dimension table evaluation routine used for interpolating values from the elevation/storage/discharge table
TLU351	Table-lookup for three variable backwater table

Subroutine	Function
	during backwater routing; given backwater reservoir elevation and control elevation (or flow) at the downstream reservoir interpolate the backwater reservoir flow
TRAN51	Transfer all input from designated unit for card input to unit 89
TRP51	Read all input specific to a backwater station using three-variable table lookup without backwater routing (3-VAR/END3-VAR) section
TRPC51	Read and write carryover information specific to a backwater station using three-variable table lookup without backwater routing
TRPP51	Read and write parametric information specific to a backwater station using three-variable table lookup without backwater routing
TRPR51	Perform a period at a time the three-variable table lookup without backwater routing
TSID51	Get time series identifier, data type and data time interval from an input line
TSPT51	Get the starting location for all time series
UFLD51	Get next field on a line of input by calling UFIELD
UPB51	Read all input for the upstream reservoir backwater affected by a downstream reservoir (UPERBKWR/ENDUPERB section)
WKSP51	Compute amount of work space needed
WTPC51	Transfer parametric and carryover information from work array to PO and CO arrays
XLIN51	Generate missing data by linear interpolation for all the observed time series during observed periods
XNIT51	Initialize variables for execution
XOBP51	Print time series generated from observed time series during observed periods
XOBS51	Generate missing reservoir elevation, storage and discharge from observed time series during observed periods
XQT51	Loop through the entire run period one period at a time, establishing state variable values at period start, storing computed results at period end,

Subroutine	Function
	updating and saving carryover
XSMO51	Output simulated results to time series
XWKS51	Assign workspace and store parametric and state information in the SSARR database format

Subroutines PIN51, PRP51, PRC51, COX51 and PUC51 have the standard argument lists for these subroutines as given in Section VIII.4.3.

SUBROUTINE EX51 (PO,CO,D,IOPT,WK)

Function: This is the execution subroutine for Operation SSARRESV.

Variable	Input/ Output	Type	Dimension	Description
PO	Input	R*4	Variable	Contains parameter and other information
CO	Both	R*4	Variable	Contains carryover
D	Input	R*4	Variable	Array of time series data
IDPT	Input	R*4	Variable	Array of starting location of time series in the D array
WK	Both	R*4	Variable	Work array

SUBROUTINE EXTR51 (ITO,IH,IR,V,NC,ITR)

Function: This is an original SSARR subroutine (FEXTR). This subroutine extract regulation options from the regulation information generated at run-time using the SSARREG MOD.

Argument List:

Variable	Input/ Output	Type	Dimension	Description
ITO	Input	I*4	1	Period start time in tenth of hour
IH	Input	I*4	1	Period length in tenth of hour
IR	Input	*	Variable	Regulation option information; see common block MOD151 for variable definition
V	Output	R*4	1	Value from regulation option information
NC	Output	I*4	1	Reservoir regulation option (0-6) of value V
ITR	Output	I*4	1	Time in tenth of hour of returned V value

SUBROUTINE LKRT51 (IP,XH2,FLIS,EFLI,WK,NPA,IS,FA,FB,CF)

Function: This is an original SSARR subroutine (LAKRT). This subroutine route a period through lake or reservoir

Argument List:

Variable	Input/ Output	Type	Dimension	Description
IP	Input	I*4	1	Internal station number
XH2	Input	R*4	1	Half-period hours in tenth of hour
FLIS	Input	R*4	1	Inflow to reservoir at start of period
EFLI	Input	R*4	1	Inflow to reservoir at end of period
WK	Both	R*4	Variable	Work array (shares same location as NPA array)
NPA	Both	I*4	Variable	Work array (shares same location as WK array)
IS(1-24)				Not used
IS(25)	Input	I*4	1	pointer to reservoir regulation option information stored in NPA array
IS(26-27)			;	Not used
IS(28)	Input	I*4	1	72 - pointer to elevation-storage-discharge table in the current array
IS(29)			1	Not used
IS(30)	Input	I*4	1	Backwater control parameter option: 0 = non-backwater reservoir 1 = reservoir outflow control 2 = reservoir elevation control
IS(31)			1	Minimum reservoir release for fishery or other water use; only used in a non-backwater reservoir

Variable	Input/ Output	Type	Dimension	Description
IS(32)	Input	I*4	1	Pointer to backwater table in the current array
IS(33)	Input	R*4	1	Maximum reservoir elevation
IS(34)	Input	R*4	1	Minimum reservoir elevation
IS(35)	Input	I*4	1	Scan index to backwater table (used by subroutine TLU351)
IS(36-37)				Not used
IS(38)	Both	I*4	1	Reservoir storage
IS(39-49)				Not used
IS(50)	Input	I*4	1	Reservoir type identifier: 0 = non-backwater reservoir 1 = single backwater reservoir 2 = upper backwater reservoir 3 = lower backwater reservoir
IS(51)	Input	I*4	1	Internal station number: 1 = upper reservoir 2 = single reservoir or a non-backwater reservoir 4 = lower backwater reservoir
IS(52)	Input	I*4	1	Pointer to the computed flow-elevation array at period start (FA array) and end (FB array) for the reservoir currently in computation
IS(53-68)				Not used
IS(69)	Both	R*4	1	Reservoir elevation
IS(70)			1	Not used
IS(71)	Both	R*4	1	Reservoir outflow
IS(72) to IS(N*4+99)	Both	*	Variable	Header plus trailer plus N points (4 words/point) of discharge-elevation-storage table; see FCN array in subroutine TLU251 for more

Variable	Input/ Output	Type	Dimension	Description
				details
IS(32) to IS(IS(32)+NB*3)	Both	Variable	Var	NB points backwater table (maximum NB 200; 3 words/point) plus one last word for end of table indicator; see T array in subroutine LU3L51 for more details
FA(1)	Input	I*4	1	Time in tenth of hour at period start
FA(2) to FA(NP*2+1)	Input	R*4	Variable	NP: 1 = for a single reservoir 2 = two reservoir system NP*2 values are at period start and stored in the alternate sequence of outflow and elevation; if NP=2 values are stored first with the upstream reservoir followed by the downstream reservoir
FB(1)	Output	I*4	1	Time in tenth of hour at period end
FB(2) to FB(NP*2+1)	Output	R*4	Variable	NP: 1 = single reservoir 2 = two reservoir system NP*2 values are at period end and stored in the alternate sequence of outflow and elevation; if NP=2 values are stored first with the upstream reservoir followed by the downstream reservoir
CF	Input	R*4	1	Flow rate to storage volume conversion factor (CS = Q*CF)

SUBROUTINE LU3F51 (A1,A2,T,R)

Function: This is an original SSARR subroutine (TLU3F). This subroutine is called by subroutine TRPR51 to perform three-variable table lookup without backwater routing. Given the first independent variable, A1, the second independent variable, A2 and the three-variable relation table, subroutine LU3F51 interpolates for dependent variable, R.

Argument List:

Variable	Input/ Output	Type	Dimension	Description
A1	Input	R*4	1	Control parameter - elevation or flow at the downstream reservoir; First independent variable (X)
A2	Input	R*4	1	Flow at the backwater station; Second independent variable (Z)
T(1)	Input	R*4	1	Length (L) of three-variable relation table
T(2)	Input	R*4	1	First value of second independent variable (start of Z segment)
T(3)-T(4)	Input	R*4	2	First pair of words containing first independent variable (X) and dependent variable (Y) on Z = T(2) surface
T(5)-T(6)	Input	R*4	2	Second pair of words containing first independent variable (X) and dependent variable (Y) on Z = T(2) surface
T(7)-T(8)	Input	R*4	2	Third pair of words containing first independent variable (X) and dependent variable (Y) on Z = T(2) surface
T(9)-T(15)	Input	R*4	7	Second Z segments; T(9)-T(15) and each 7 word group thereafter are the same as T(2)-T(8); the 7 word group is called Z segment in program; for example if 1st

Variable	Input/ Output	Type	Dimension	Description
				independent variable is X, 2nd independent variable is Z and dependent variable is Y, three-variable table are stored in the following order: L, Z1, X11, Y11, X12, Y12, X13, Y13, Z2, X21, Y21, X22, Y22, X23, Y23 etc
R	Output	R*4	1	Interpolated elevation for the backwater station; Dependent variable (Y)

SUBROUTINE LU3L51 (ISWD,E1,E2,T,NSCI,E1N,QN,KE)

Function: This is an original SSARR subroutine (STLU3L). This subroutine is called by subroutine TLU351 to locate bracketing points on specific outflow lines during backwater routing computation.

Argument List:

Variable	Input/ Output	Type	Dimension	Description
ISWD	Both	I*4	1	Switch ISWD shows direction of outflow line search
E1	Input	R*4	1	Backwater reservoir elevation
E2	Input	R*4	1	Control elevation (or flow) at the downstream reservoir
T	Input	R*4	Variable	Backwater table containing Q vs E1/E2 for each point; the backwater table is stored via a series of three variable points; the three variables for each point are entered in the sequence of the backwater reservoir outflow (Q), the backwater reservoir elevation (E1) and the control parameter at the downstream reservoir (E2); the lowest outflow curve is stored first, followed by the second lowest outflow curve, then third, fourth, etc for all outflow curves; each outflow curve is arranged in ascending sequence of backwater reservoir elevation; the first point in the backwater table would be the lowest point in the lowest outflow curve; points following the first point would have this outflow value and continue on up that curve; they would be followed by the first point of the lowest elevation of the second outflow curve; there must be at least two points in the table for every outflow value; the backwater surface must have a positive

Variable	Input/ Output	Type	Dimension	Description
				slope in all directions; for the purpose of table lookup, the control parameter is considered to be the 'first independent variable'; the backwater reservoir elevation is the 'second independent variable'; and the backwater reservoir outflow is the 'dependent variable'
T(NB*3+1)	Input	R*4	1	= -99999.0 at last word of T array to indicate this is the end of the backwater table
NSCI	Input	I*4	1	Scan index to table where previous reference to this table found argument; input equal to zero on first reference to function; must not be changed by calling program (except to reset to zero)
E1N	Output	R*4	1	Interpolated backwater elevation (at-site)
QN	Output	R*4	1	Interpolated backwater reservoir outflow
KE	Output	I*4	1	0 = if all well N = if argument is off defined surface where N is point last searched

SUBROUTINE TAB51 (TO,LEFT,IUSET,NXT,LPO,PO,LCO,TS,MTS,LWORK,IDT)

Function: This is the Operations Table entry subroutine for Operation SSARRESV.

Argument List: The arguments for this subroutine are similar to the arguments for the Operation Table entry subroutines for other Operations. A description of the arguments is contained in Section VIII.4.2-TAB.

Operation Table Array: The contents of the TO array are:

Position	Contents
1	Operation number
2	Location in the T array of the next Operation to be executed
3	Location of the parameter array for this Operation in the P array
4	Location of the carryover array for this Operation in the C array
5	Location of work space in the D array
6 to 5+NTTS	Starting location of each time series in the D array: 0 = time series is optional and is not used

NTTS is the total number of time series used and is defined in PO(P(12)).

The order of time series is given in 'Parameter Array' positions PO(PO(12)) to PO(PO(13)-1).

SUBROUTINE TLU251 (FCN,IA,ARG,RSL)

Function: This is an original SSARR subroutine (STLU2). This subroutine is a two-dimensional evaluation routine adapted from CROHMS subroutine HFTL2 by Army Corps of Engineers. Table may be power series, coordinate points or shift-offset from Geological Survey. Only the coordinate-points option is used in Operation SSARRESV to interpolate values from the elevation/storage/discharge table.

Argument List:

Variable	Input/ Output	Type	Dimension	Description
FCN(1)	Input	R*4	1	Number of words (END) used in the current array (END = number-of-points (maximum 50) * 4 + 27)
FCN(2)	Input	R*4	1	Scan index maintained by the subroutine TLU251, points to position in array used in array by previous reference
FCN(3-6)	Input		3	Not used
FCN(7)	Input	R*4	1	4 = to indicate the FCN array is stored as table of points; each point is in 4 consecutive words; points are stored beginning at FCN(8)
FCN(8)	Input	R*4	1	Reservoir outflow; not used for a backwater reservoir
FCN(9)	Input	R*4	1	Reservoir elevation
FCN(10)	Input	R*4	1	Not used
FCN(11)	Input	I*4	1	Reservoir storage
FCN(12) to FCN(END-20)	Input	*	Variable	Repeat in the same sequence as FCN(8) to FCN(11) for all the points; END is the total number of words defined by FCN(1)
FCN(END-19) to END	Input	A	20	Not used
IA	Input	I*4	1	Word position of independent

Variable	Input/ Output	Type	Dimension	Description
				variable: 1 = for reservoir outflow 2 = for reservoir elevation 4 = for reservoir storage
ARG	Input	*	1	Value of independent variable
RSL(1)	Output	R*4	1	Reservoir outflow
RSL(2)	Output	R*4	1	Reservoir elevation
RSL(3)	Output	*	1	Not used
RSL(4)	Output	I*4	1	Reservoir storage

SUBROUTINE TLU351 (E1,E2,NSCI,T,Q,KE)

Function: This is an original SSARR subroutine (STLU3). This subroutine perform three variable table-lookup in backwater routing computation. Given elevation of a backwater reservoir and downstream control flow (or elevation) this subroutine interpolates flow for the backwater reservoir.

Argument List:

Variable	Input/ Output	Type	Dimension	Description
E1	Input	R*4	1	Elevation at the backwater reservoir
E2	Input	R*4	1	Downstream control flow (or elevation)
NSCI	Input	I*4	1	Scan index to table where previous reference to this table found argument; input equal to zero on first reference to function; must not be changed by calling program (except to reset to zero)
T	Input	R*4	Variable	Backwater table containing Q vs E1/E2 for each point; see T array in subroutine LU3L51 for more details
Q	Output	R*4	1	Interpolated backwater reservoir outflow
KE	Output	I*4	1	0 = if all well N = if argument is off defined surface where N is point last searched

SUBROUTINE TRPR51 (IP,FLIP,FLIS,EFLIE,WK,NPA,IS,FA,FB)

Function: This is an original SSARR subroutine (LAKRT). This subroutine route a period through a backwater affected station using three-variable relation table lookup without backwater routing.

Argument List:

Variable	Input/ Output	Type	Dimension	Description
IP	Input	I*4	1	Internal station number
FLIP	Input	R*4	1	Instantaneous inflow at end of previous period
FLIS	Input	R*4	1	Instantaneous inflow at start of period
FLIE	Input	R*4	1	Instantaneous inflow at end of period
WK	Both	R*4	Variable	Work array (shares same location as NPA array)
NPA	Both	I*4	Variable	Work array (shares same location as WK array)
IS(1-24)				Not used
IS(25)	Input	I*4	1	Set to zero within this subroutine to force the program to use only three-variable table lookup option in this subroutine
IS(26-27)				Not used
IS(28)	Input	I*4	1	72 = pointer to elevation-storage-discharge table in the current array; dummy curve required by the program
IS(29-48)				Not used
IS(49)+6	Input	I*4	1	Pointer to three-variable relation table in the NPA array
IS(50)	Input	I*4	1	2 = internal station number for local station -- downstream

Variable	Input/ Output	Type	Dimension	Description
				reservoir (1st independent variable, X)
IS(51)			1	1 = internal station number for adjacent station – upstream station backwater affected by a downstream reservoir (2nd independent variable, Z)
IS(52-54)				Not used
IS(55)	Input	I*4	1	2 = to designate elevation as the desired output at the backwater station (dependent variable, Y)
IS(56)	Input	I*4	1	Backwater control parameter option at downstream reservoir (1st independent variable, X): 1 = downstream reservoir outflow control 2 = downstream reservoir elevation control
IS(57)	Input	I*4	1	1 = to designate flow at the backwater station as the second independent variable (Z)
IS(58-68)				Not used
IS(69)	Both	R*4	1	Elevation at the backwater station
IS(70)			1	Not used
IS(71)	Both	R*4	1	Flow at the backwater station
IS(72) to IS(N*4+99)	Both	Variable	8	Header plus trailer plus N points (4 words/point) of discharge-elevation-storage table; see FCN array in subroutine TLU251 for further details; N is set to two in

Variable	Input/ Output	Type	Dimension	Description
				PIN51 subroutine to store two dummy points for dummy program computation
(IS(49)+6) to IS(IS(49)+6+NB*3)	Both	*	Variable	NB points (3 words/point) three-variable relation table; see T array subroutine LU3F51
FA(1)	Input	I*4	1	Time in tenth of hour at period start
FA(2) to FA(NP*2+1)	Input	R*4	4	NP = 2 for a station with backwater effect from a downstream reservoir; NP*2 values are at period start and stored in the alternate sequence of flow and elevation; values are stored first with the upstream station followed by the downstream reservoir
FB(1)	Output	I*4	1	Time in tenth of hour at period end
FB(2) to FB(NP*2+1)	Output	R*4	4	NP = 2 for a station with backwater effect from a downstream reservoir; NP*2 values are at period end and stored in the alternate sequence of flow and elevation; values are stored first with the upstream station followed by the downstream reservoir

SUBROUTINE TSPT51 (PO, CO, D, LOCWS,IDPT)

Function: This subroutine generates starting location for all the time series in the parameter array, PO, the sequential order of time series, IDPT, the time series data array, D and the work array, WK.

Argument List:

Variable	Input/ Output	Type	Dimension	Description
PO	Input	R*4	Variable	Contains parameter and other information
CO	Both	R*4	Variable	Contains carryover
D	Input	R*4	Variable	Array holding time series data
LOCWS	Input	I*4	Variable	Starting in array WK of parameters, time-series and carryover
IDPT	Input	R*4	Variable	Starting location in array D of time series

SUBROUTINE XLIN51 (IXTYPE,WK,LWKSP,D,LDOBS,IST,IND)

Function: This subroutine generates missing data for an observed time series by linear interpolation between available observed values. The observed time series may be instantaneous discharge, mean discharge or reservoir elevation.

Argument List:

Variable	Input/ Output	Type	Dimension	Description
IXTYPE	Input	I*4	1	Type of observed data: 1 = instantaneous discharge 2 = mean discharge 3 = reservoir elevation
WK	Both	R*4	Variable	Work array
LWKSP	Input	I*4	1	Starting location of the designated time-series in WK array
D	Input	R*4	Variable	Array holding time series data
LDOBS	Input	I*4	1	Starting location of the designated time-series in D array
IST	Input	I*4	1	Period to start linear interpolation
IND	Input	I*4	1	Period to end linear interpolation

SUBROUTINE XOBS51 (PO,CO,WK,D,LOCWS,IOPT,LOBS)

Function: This subroutine generates missing reservoir elevation, storage and discharge from observed time series during observed periods. Observed time series may be different combination of observed instantaneous discharge and/or observed mean discharge and/or observed reservoir elevation.

Argument List:

Variable	Input/ Output	Type	Dimension	Description
PO	Input	R*4	Variable	Contains parameter and other information
CO	Both	R*4	Variable	Contains carryover
WK	Both	R*4	Variable	Work array
D	Input	R*4	Variable	Array holding time series data
LOCWS	Input	I*4	Variable	Array holding starting location of parameters, time-series and carryover in WK array
IOPT	Input	R*4	Variable	Array holding starting locations of all time series in D array
LOBS	Output	I*4	Variable	Last period number with non-missing observed data for all the observed time series

SUBROUTINE XQT51 (PO, CO, D, WK, NPA, IOPT, LOCWS)

Function: Loop through the entire run period one period at a time, establishing state variable values at period start, storing computed results at period end, updating and saving carryover.

Argument List:

Variable	Input/ Output	Type	Dimension	Description
PO	Input	R*4	Variable	Contains parameter and other information
CO	Both	R*4	Variable	Contains carryover
D	Input	R*4	Variable	Array holding time series data
WK	Both	R*4	Variable	Work array (shares same location as NPA array)
NPA	Both	I*4	Variable	Work array (shares same location as WK array)
IOPT	Input	R*4	Variable	Array holding starting locations of time series
LOCWS	Input	I*4	Variable	Work space pointer for parameters, time-series and carryover

COMMON BLOCK LTS51

Purpose

This common block holds pointers for all the time series in PO array, IDPT array, D array and WK array.

Listing

```
COMMON /LTS51/
              LPQI1,LPQI2,LPQO1,LPQO2,LPQM,LPEL,LPST,LPOQO,LPOQM,
              LPOEL,LPQL1,LPQL2,LPBQI1,LPBQI2,LPBQIM,LIQI1,LIQI2,
              LIQO1,LIQO2,LIQM,LIEL,LIST,LIOQO,LIOQM,LIOEL,LIQL1,
              LIQL2,LIBQI1,LIBQI2,LIBQIM,LDQI1,LDQI2,LDQO1,LDQO2,
              LDQM,LDEL,LDST,LDOQO,LDOQM,LDOEL,LDQL1,LDQL2,LDBQI1,
              LDBQI2,LDBQIM,LWQO1,LWQO2,LWQM,LWEL,LWST,LWBQI1,
              LWBQI2,LWBQIM
```

Description of Variables

Variable	Type	Dimension	Word Position	Description
LPQI1	I*4	1	1	Parametric information pointer in PO array for the instantaneous inflow time series at period start
LPQI2	I*4	1	2	Parametric information pointer in PO array for the instantaneous inflow time series at period end
LPQO1	I*4	1	3	Parametric information pointer in PO array for the instantaneous outflow time series at period start
LPQO2	I*4	1	4	Parametric information pointer in PO array for the instantaneous inflow time series at period end
LPQM	I*4	1	5	Parametric information pointer in PO array for the mean outflow time series
LPEL	I*4	1	6	Parametric information pointer in PO array for the reservoir elevation time series
LPST	I*4	1	7	Parametric information pointer in PO array for the reservoir

Variable	Type	Dimension	Word Position	Description
				storage time series
LPOQO	I*4	1	8	Parametric information pointer in PO array for the observed instantaneous discharge time series
LPOQM	I*4	1	9	Parametric information pointer in PO array for the observed mean discharge time series
LPOEL	I*4	1	10	Parametric information pointer in PO array for the observed reservoir elevation time series
LPQL1	I*4	1	11	Parametric information pointer in PO array for the tributary flow time series at period start; tributary junction are assumed to locate at the downstream of the current reservoir/station
LPQL2	I*4	1	12	Parametric information pointer in PO array for the tributary flow time series at period end; tributary junction are assumed to locate at the downstream of th current reservoir/station
LIQI1 to LIQL2	I*4	12	13-24	Sequential number used to identify a specific time series in IDPT array for all the time series; the order of the time series is given in 'Parameter Array' section between PO(PO(12)) to PO(PO(13); for example LIQI1= 1, LIQI2=2, LIQO1-LIQL2=3-12 for the non-backwater reservoir, LIQO1-LIQL2=13-22 for the backwater reservoir/station, etc
LDQI1 to LDQL2	I*4	12	25-36	Starting location pointer for all the time series data in D array
LWQO1 to LWST	I*4	5	37-41	Starting location of computed

Variable	Type	Dimension	Word Position	Description
				time series data in WK array

COMMON BLOCK SARR51

Purpose

This common block holds miscellaneous variables for Operation SSARRESV.

Listing

```
COMMON /SARR51/ IBUG,IDOFST,MINODT,IRES,NRES,NRUN,NS2,NTIM24,NUM,
                ITME(1)
```

Description of Variables

Variable	Type	Dimension	Word Position	Description
IBUG	I*4	1	1	Debug output option: 1 = suppress all debug information 2 = prints all debug information
IDOFST	I*4	1	2	Number of periods offset between the start of run and the start of time series
MINODT	I*4	1	3	Data time interval (units of HR)
IRES	I*4	1	4	Counter for reservoir number currently in execution
NRES	I*4	1	5	Total number of reservoirs
NRUN	I*4	1	6	Total number of time periods with observed data
NS2	I*4	1	7	Counter for time period in a run
NTIM24	I*4	1	8	Number of time periods in 24 hour (24/MINODT)
NUM	I*4	1	9	Total number of time periods in a run
ITME(1)	I*4	1	10	Retained only for programming convenience; not used in actual computation