RES-SNGL

Schemes and Utilities

RES-SNGL Specific Model Components

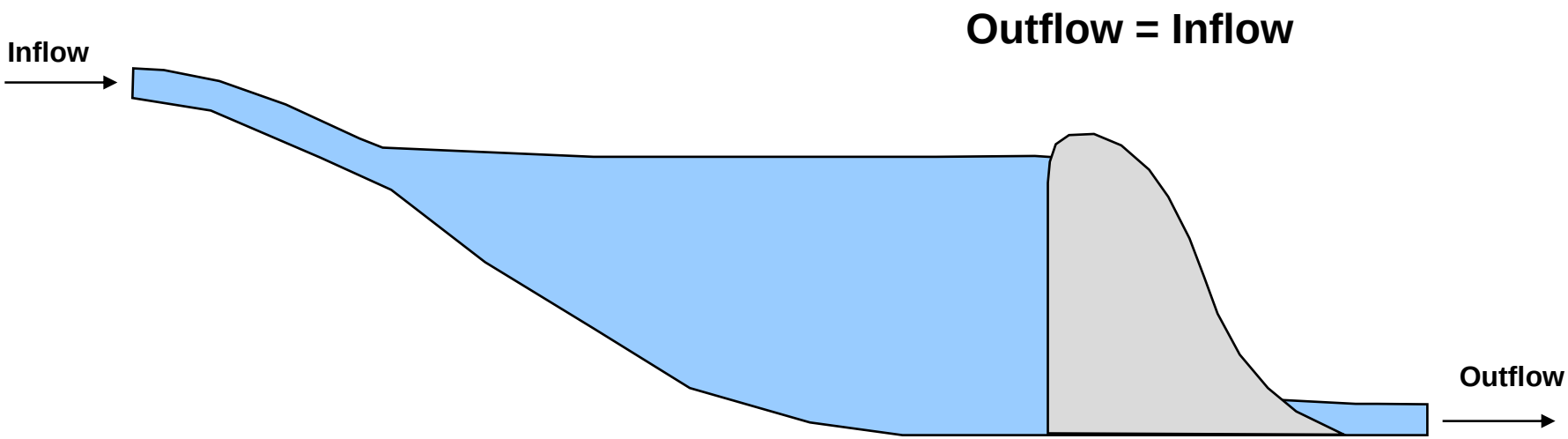
- Computational Schemes (Generates Output)
  - PASSFLOW
  - SETQ
  - SETH
  - SETDQ
  - RULECURVE
  - FILLSPILL
  - SPILLWAY
  - POOLQ
  - STPOOLQ
  - MINQ
  - MINH
  - INDSRCHGE
  - FLASSBDS
  - POWERGEN
- Utilities (Simulation Aid)
  - RULEADJ
  - SUMINF
  - RAINEVAP
  - ADJUST
  - BACKFLOW
  - MAXQ
  - ENTERISC
  - SETMIN
  - SETMAX
  - GOFLASH

Schemes and techniques shown in red have examples in this workshop.

RES-SNGL PASSFLOW SCHEME

The PASSFLOW scheme passes the reservoir inflow directly as the reservoir discharge. The pool will be maintained at the same elevation

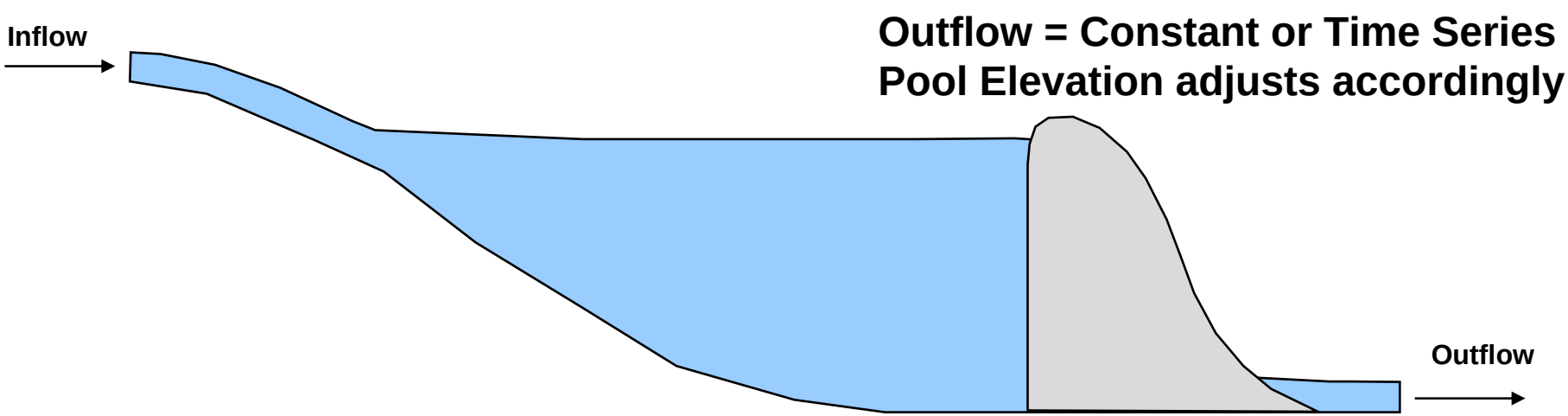
- No specific inputs are required



RES-SNGL SETQ Scheme

The SETQ scheme sets the period ending discharge as a constant value or a value in a time series.

- PARMS – Describe discharge (QVALUE) and the handling of missing values (OPTION).
- TIME-SERIES – specify outflow time series if used
- CARRYOVER – specify repeated value if used for missing data



SETQ Scheme Example

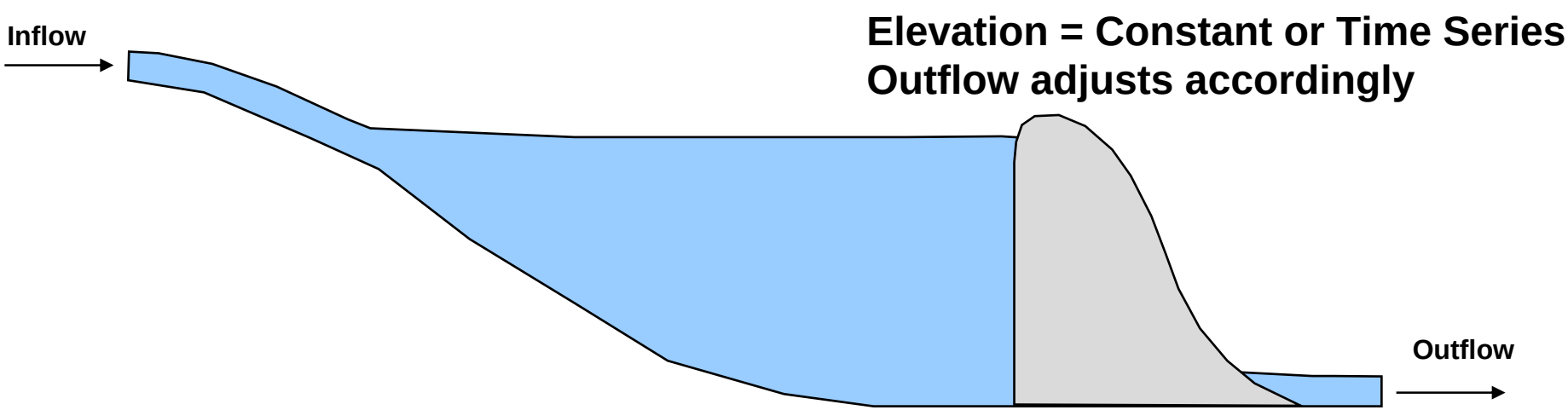
```
$SETH USED WITH TIME SERIES
SETQ(1)
PARMS
QVALUE TS
OPTION     1
ENDP
TIME-SERIES
SQTS KEYO2    RQOT  6
ENDTS
CARRYOVER
OLDQ            9648.00
ENDCO
ENDSETQ


$SETH USED WITH VALUE
SETQ(1)
PARMS
QVALUE 12000.0
ENDP
ENDSETQ
```

RES-SNGL SETH Scheme

The SETH scheme sets the period ending elevation as a constant value or a value in a time series.

- PARMS – Describe elevation (HVALUE) and the handling of missing values (OPTION).
- TIME-SERIES – specify outflow time series if used
- CARRYOVER – specify repeated value if used for missing data



SETH Scheme Example

```
$SETH USED WITH TIME SERIES
SETH(1)
PARMS
HVALUE TS
OPTION     1
ENDP
TIME-SERIES
SHTS KEYO2    PELV  6
ENDTS
CARRYOVER
OLDH         722.95
ENDCO
ENDSETH


$SETH USED WITH VALUE
SETH(1)
PARMS
HVALUE 723.0
ENDP
ENDSETH
```

RES-SNGL SETDQ Scheme

The SETDQ scheme allows the user to ramp up, ramp down or set a maximum rate of change of reservoir releases.

- PARMS
  - QVALUE: Prescribed daily rate of change of discharge. May be specified as a single value or as a table.
  - If specified as a table must give TBLTYPE and TABLE
- No Time-Series or Carryover specified for this scheme

SETDQ Scheme Example

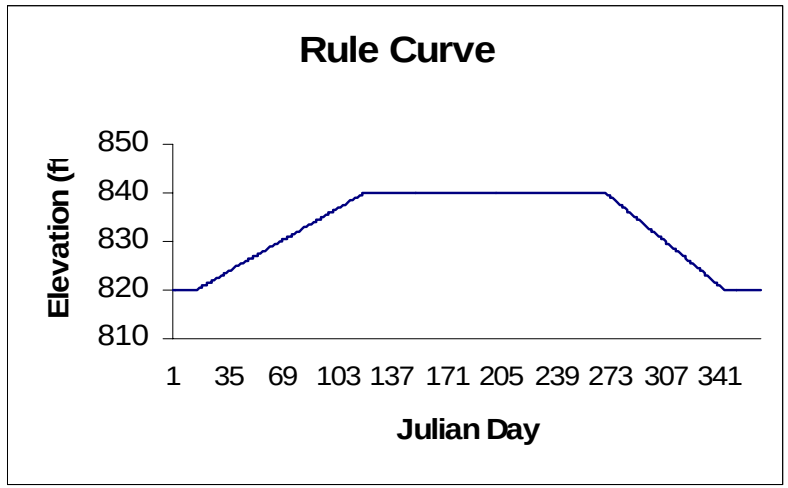
```
#SETDQ SET TO VALUE
SETDQ
PARMS
QVALUE    -500.0    INST    #Negative used for ramping down
ENDP
ENDSETDQ


#SETDQ SET TO TABLE
SETDQ
PARMS
QVALUE   TABL  MEAN
TBLTYPE  POOL                 #Ramps up change in reservoir release with pool elevation
TABLE       500.0     500.1     520.0      530.0    540.0
             50.0      50.0     200.0      300.0    400.0
ENDPARM
ENDSETDQ
```

RES-SNGL RULECURVE Scheme

The RULECURVE scheme determines reservoir discharge by setting the pool elevation as a function of time of year.

- PARMS
  - CURVE: Sets elevation as a function of Julian Day
  - RULETIME: Time of hydrologic day rule curve is set
  - BLEND: Number of periods to blend back into rule curve
  - QMAX: Maximum discharge above which rule curve is not used.
- No Time-Series or Carryover specified for this scheme

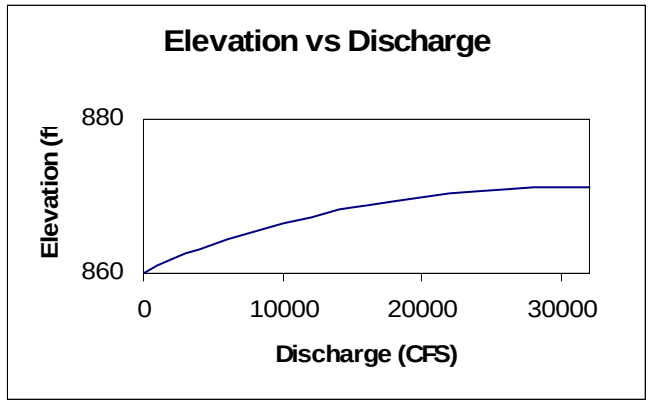


RULECURVE Scheme Example

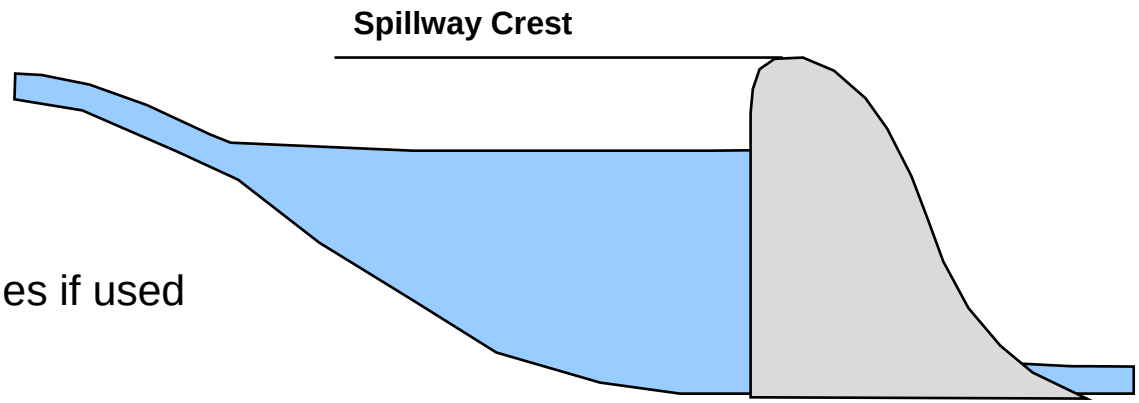
```
RULECURVE(1)
PARMS
CURVE                1        75       106       305       335         &
                   366                                                 &
                 723.00     723.00     723.00     723.00     723.00    &
                 723.00
RULETIME     6
BLEND 120
QMAX 42000.0
ENDP
ENDRULE
```

RES-SNGL SPILLWAY Scheme

The SPILLWAY scheme is used to model an uncontrolled spillway, sluices and gated spillways when the gates are fully open.



- PARMS
  - TYPE: Specify uncontrolled spillway or gated spillway
  - CREST: Specify spillway crest
  - ELVSQ: Spillway rating curve
  - QGEN or QSLUICE if used
- Time-Series
  - QGEN or QSLUICE times series if used
- Carryover
  - OLDQ: Initial non-spillway discharge (OLDQ =QGEN +QSLUICE)



SPILLWAY Scheme Example

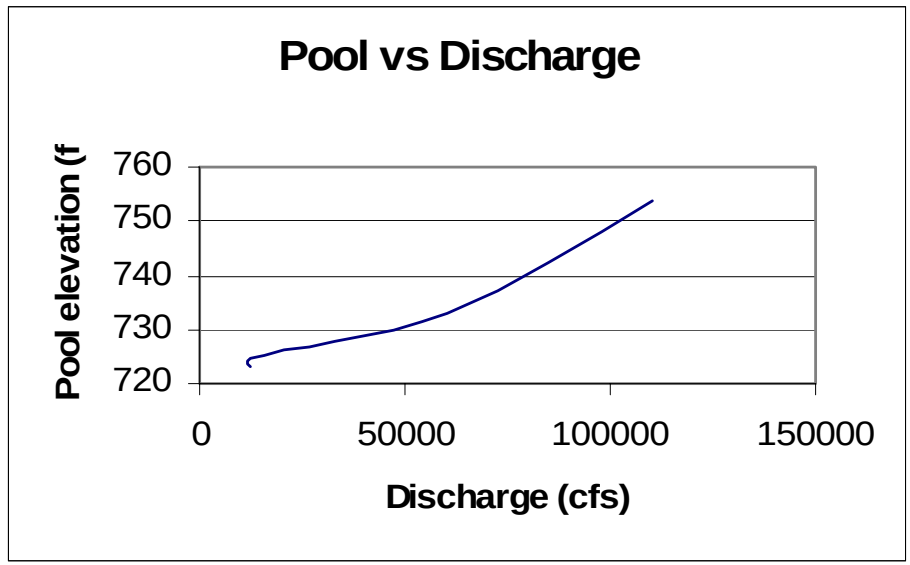
```
SPILLWAY(1)
PARMS
TYPE UNC
CREST     719.0
ELVSQ            719.0      724.0      728.0      732.0      736.0    &
                 746.0      756.9      757.0  &
                   0.00   25000.     60000.    109000.    167000.     &
              360000.    648000.    680000.
INTERP LINEAR
QGEN     12000.0
QSLUICE      30000.0
ENDP
CARRYOVER
OLDQ      12000.0
ENDCO
ENDSPWY
ENDSPEC
```

RES-SNGL POOLQ Scheme

The POOLQ scheme simulates reservoir operations as a function of the elevation of the pool.

PARMS

- POOLVSQ: pool elevation versus discharge curve.
- LINEAR: interpolate elevation/discharge curve linearly (omit to use constant discharge)
- CURVE: Elevation rule curve defined by Julian day
- RULETIME: Hour of day rule curve is set.



- No Time Series or Carryover specified for this scheme

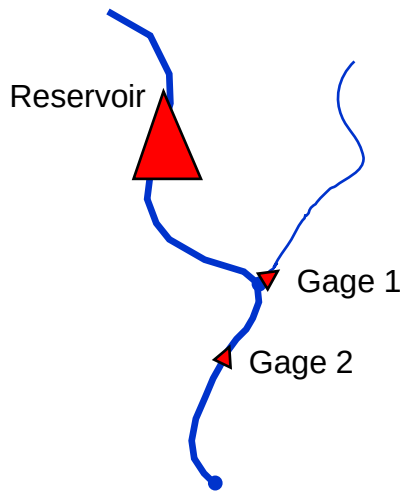
POOLQ Scheme Example

```
POOLQ(1)
PARMS
POOLVSQ      723.0      724.8      733.2      754.0  &
           12000.0    12000.0    60000.0   110000.0
ENDP
ENDPOOLQ
```

RES-SNGL STPOOLQ Scheme

The STPOOLQ scheme determines outflow from the pool elevation and stage of downstream control points.

- PARMS
  - Parameters describing controls at gage x, includes a control curve CONTROL, RISING and FALLING components and a routing component LAG/K.
- TIME-SERIES
  - Specify local inflows between reservoir outflow and gage (must be computed earlier in the segment operations table)
- User Notes
  - A maximum of two down stream control points can be on the main stem or at the tributary
  - Current outflow is determined from the previous period downstream control point conditions
  - If two control points the lesser of the two permissible outflow values is used



STPOOLQ Scheme Example

```
STPOOLQ(1)
PARMS
GAGE1
CONTROL1          0.0   1000000.0 &
             60000.0    60000.0
RISING          657.00 &
                    1
FALLING         657.00 &
                    1
CURVE               1        75       106       305       335         &
                  366                                                 &
                706.00     706.00     723.00     723.00     706.00    &
                706.00
RULETIME     6
LAG/K
RES-SNGL QINE  6                6     0     0 ENGL  .00        .0
       6.0
       0.0
       0
.
.
.
```

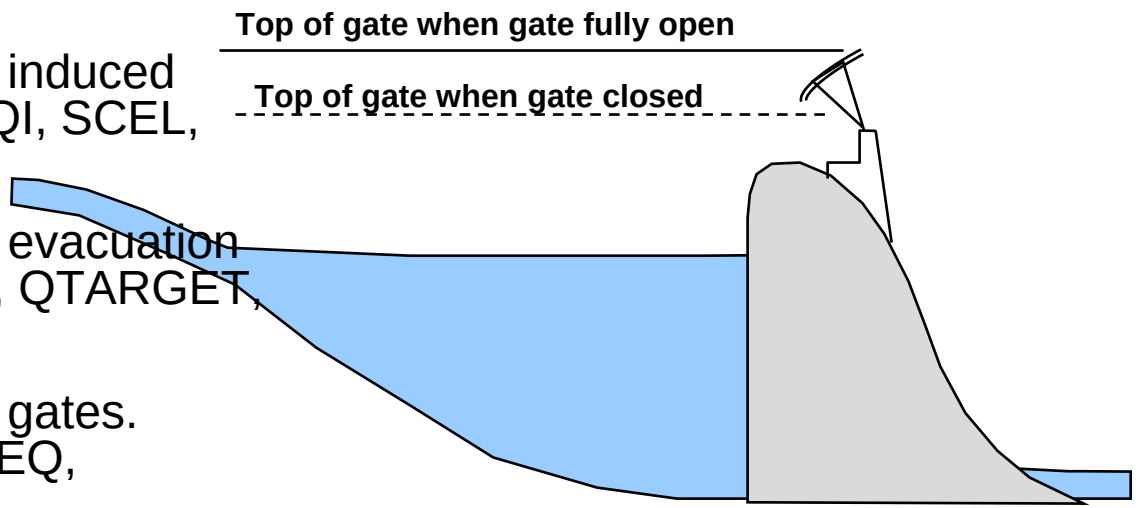
STPOOLQ Scheme Example Cont'd

```
.
.
.
GAGE2
 CONTROL1          0.0   1000000.0 &
             12000.0    12000.0
RISING           657.00 &
                     1
FALLING          657.00 &
                     1
LAG/K
RES-SNGL QINE  6                6     0     0 ENGL  .00        .0
      45.0
       3.0
       0
ENDP
TIME-SERIES
LOCAL1 PAWO2 QINE  6
LOCAL2 PAWO2 QINE  6
ENDTS
ENDSTPQ
```

RES-SNGL INDSRCHGE Scheme

The INDSRCHGE scheme provides additional storage above normal top of pool during flooding situations. Simulates a complete surcharge-evacuation cycle

- PARMS
  - Parameters needed to describe the conservation pool. HUPPER, HLOWER, HCHECK…
  - Parameters to describe the induced surcharge relationship. SCQI, SCEL, SCQO
  - Parameters to describe the evacuation cycle. DTABL, HTARGET1, QTARGET, DIFFQI
  - Parameters to describe the gates. GATEOPEN, GATEL, GATEQ, GATESET



- No Time Series specified for this scheme

INDSRCHGE Scheme Example

```
INDSRCHGE(1)
PARMS
HUPPER  723.00
HCHECK  723.00
HLOWER  RULE
COMPINQ     2
SCQI           10000.00  400000.00  800000.00
SCEL             723.00     748.00     752.00     756.00     757.00
SCQO           12000.0    12000.0   112000.00  152000.00   312000.0 &
               21000.00  122000.00  164000.00  322000.00   452000.0 &
               56000.00  332000.00  432000.00  672000.00   692000.0
CONV 0.020
DTYPE   1
DTABLE      754.00     3  &
            757.00     1
HTARGET1      757.00
REDUCE     0000.00
QTARGET1   110000.00
QTARGET2   110000.00
QTARGET3   110000.00
DIFFQI1     0000.00
DIFFQI3     0000.00
.
.
.
```

INDSRCHGE Scheme Example Cont'd

```
.
.
.
GATEOPEN          0.0       10.00      20.00      30.00      35.00
GATEL           723.00     740.00     750.00     759.80
GATEQ         12000.     12000.     12000.     12000.  &
              31800.    156000.    195600.    226200.  &
              31800.    247800.    375600.    451200.  &
              31800.    247800.    469200.    669000.  &
              31800.    247800.    469200.    754000.
GATESET     1
IOPTND     1
CURVE               1        75       106       305       335         &
                  366                                                 &
                723.00     723.00     723.00     723.00     723.00    &
                723.00
RULETIME     6
ENDP
ENDINDS
```

RES-SNGL POWERGEN Scheme

The POWERGEN scheme computes generation outflow from a hydroelectric dam.

- PARMS
  - Parameters describing the power generation rule curve: TOD, DAILY, DOW, WEEKLY
  - Parameters describing discharge constraints: MINQDAY, MINQWEEK, MINQINST, QGENMAX, DSMAXQ
  - Parameters describing elevation constraints: HUPPER, HLOWER
  - Parameters describing power generation discharge rules: ELEVSMAXQ, HEADVSQ, TWCURVE
  - Parameters describing elevation rule curve as a function of Julian Day: CURVE, RULETIME
- No Time Series specified for this scheme
- CARRYOVER
  - OLDQ: Time interval mean discharge values.

POWERGEN Scheme Example

```
$ DAILY POWER GENERATION
POWERGEN(1)
PARMS
TOD 6
DAILY 0.0 0.1 0.8 0.1
HUPPER RULE
HLOWER RULE-0.2
QGENMAX 12000.0
CURVE INDSRCHGE(1)
ENDP
ENDPOWER

$ WEEKLY POWER GENERATION
POWERGEN(2)
PARMS
TOD 6
DAILY 0.0 0.3 0.4 0.3
DOW 2
WEEKLY 0.0 0.2 0.2 0.2 0.2 0.2 0.0
HUPPER RULE
HLOWER RULE-0.2
QGENMAX 12000.0
CURVE INDSRCHGE(1)
ENDP
ENDPOWER
```

RES-SNGL RULEADJ Utility

The RULEADJ utility computes a constant adjustment value by averaging the deviations between the observed pool elevations and the rule curve elevations . This value is then used in the reservoir operation scheme to establish an adjusted rule curve.

- PARMS
  - CURVE: Elevation vs Julian day rule curve may be specified here/
  - PERIODS: Number of time intervals used to compute adjustment value.
  - MAXQI: Inflow value above which deviations are ignored
  - ELEVDIFF: Maximum difference between observed levels and rule curve to ignore deviation.
- Time Series
  - Specify observed pool elevation time series.
- Carryover
  - MSNG and DEV

RULEADJ Utility Example

```
RULEADJ(1)
PARMS
CURVE    INDSRCHGE(1)
PERIODS    24
ELEVDIFF        2.00
MAXQI    40000.00
ENDP
TIME-SERIES
ELEV KEYO2    PELV  6
ENDTS
CARRYOVER
MSNG    0
DEV                0.00       0.00       0.00       0.00       0.00    &
                   0.00       0.00       0.00       0.00       0.00    &
                   0.00       0.00       0.00       0.00       0.00    &
                   0.00       0.00       0.00       0.00       0.00    &
                   0.00       0.00       0.00       0.00
ENDCO
ENDRADJ
```

RES-SNGL SUMINF Utility

The SUMINF utility creates a running cumulative summation of time interval mean inflow for the entire run. Needed by POWERGEN and MINQ schemes. Also switches on FLOOD variable when threshold elevation is exceeded.

- PARMS
  - NORMQ: Constant period mean discharge
  - ELTEST: Pool level within ELEVSTOR curve above which reservoir operates under flooding conditions
- No time series or carryover specified for this utility
- User Notes:
  - Continuity equation is used to compute the resultant storage/elevation from the period inflow and NORMQ. If elevation >= ELTEST FLOOD variable is set to TRUE

SUMINF Utility Example

```
SUMINF
PARMS
NORMQ 12000.0
ELTEST 754.0
ENDP
ENDSUM
```

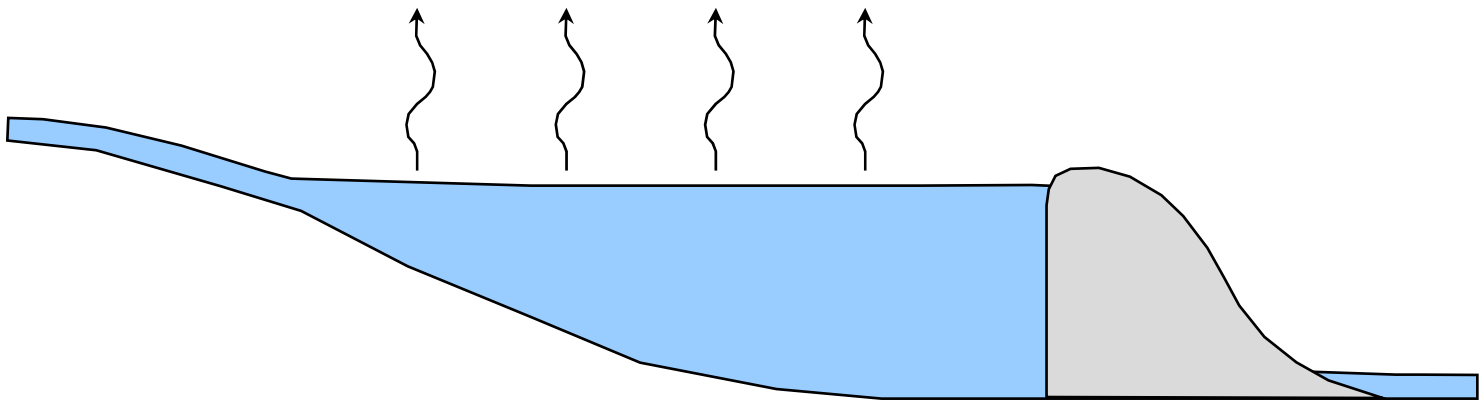
RES-SNGL RAINEVAP Utility

The RAINEVAP utility accounts for direct rainfall and evaporation effects on the reservoir.

- PARMS
  - EVAP: mid-month evaporation curve (omit if t.s. available)
  - DIST: period distribution curve (defaults to uniform)
  - HREA: constant reservoir surface area option
- TIME-SERIES
  - Specify precip and evap time series
- No carryover specified for this utility

RAINEVAP Utility Example

```
RAINEVAP(1)
PARMS
DIST                0.25       0.50       0.20       0.05
HREA 754.
ENDP
TIME-SERIES
PCPN KEYO2   MAPX   6
EVAP OKC     MAPE  24
ENDTS
ENDRAIN
```



RES-SNGL Adjust Utility

The ADJUST utility uses observed (and predicted) instantaneous discharges, mean discharges, and/or pool elevation values to adjust the simulated values to be consistent with the observations.

- PARMS
  - BLEND - # of blend steps from an observed value
  - CFACTOR – Correction factor method (DIFF or RATIO)
- TIME-SERIES - Specify observed and adjusted time series.
- Carryover
  - QDIFF: Initial difference between observed and simulated
  - STEPS: initial number of missing observed time periods
- User Notes
  - Problems when adjusting to OBSH (small change in elevation)
  - Simulated pool is adjusted at each time step

Adjust Utility Example

```
ADJUST(1)
PARMS
BLEND     4
CFACTOR DIFF
ENDP
TIME-SERIES
OBSQO    KEYO2    RQOT  6
OBSH     KEYO2    PELV  6
ADJH     KEYO2    PELE  6
ENDTS
CARRYOVER
QDIFF    -0.01
STEPS     20
ENDCO
ENDADJ
```

RES-SNGL Backflow Utility

The BACKFLOW utility is used to adjust the simulated inflow using observed pool elevation and observed mean daily discharge values.

- PARMS – No parameters are needed for this utility
- TIME-SERIES
  - OBSQ – Observed mean discharge
  - OBSH – Observed pool elevation
  - NEWQ – Adjusted inflow time series
- Carryover – specify pool elevation one time period before start of run

Backflow Utility Example

```
BACKFLOW(1)
TIME-SERIES
OBSQ KEYO2    QME  24
OBSH KEYO2    PELV  6
NEWQ KEYO2I   QINE  6
ENDTS
CARRYOVER
ELEV      722.98
ENDCO
ENDBACK
```

RES-SNGL ENTERISC Utility

The ENTERISC is used to determine if the proper conditions exist for the INDSRCHGE scheme to be used. Sets SURCHARGE flag.

- No PARMS, time series or carryover specified for this utility
- IF ENTERISC Utility is specified an INDSRCHGE scheme must be defined.

RES-SNGL SETMIN Utility

The SETMIN utility is used to select the minimum of any of the various types of model output previously generated by two or more schemes.

- PARMS
  - TYPE: Specify type of data to perform utility on. Valid types are INSTQ, MEANQ or POOL
- No time series or carryover specified for this utility

SETMIN Utility Example

```
SETMIN(1)
PARMS
TYPE MEANQ
ENDP
ENDSMIN
```