Unsteady Flow Modeling with HEC-RAS

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Outline

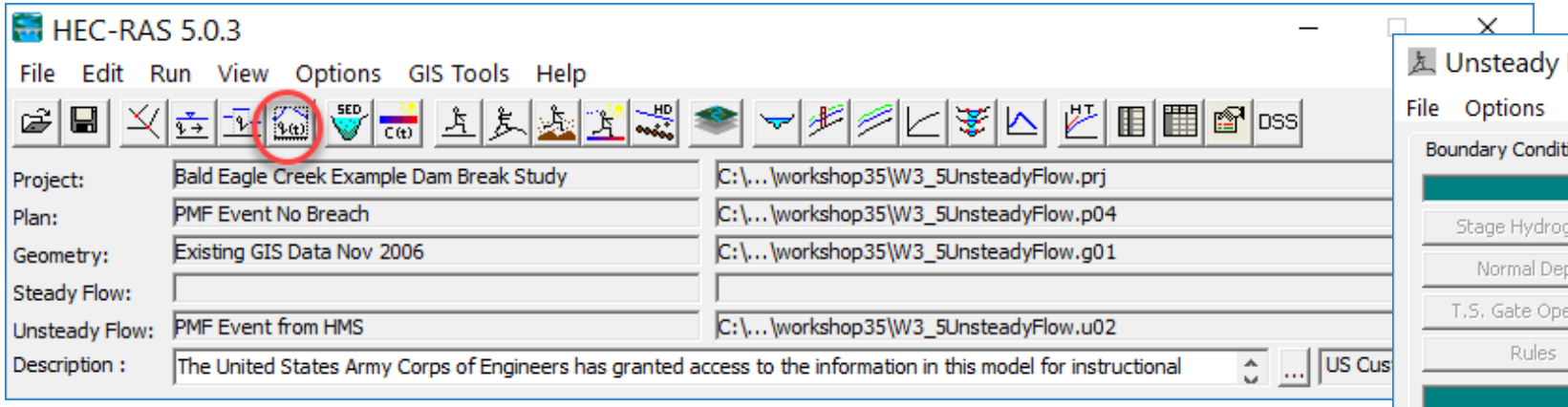
- Boundary Conditions and Computation
- Inline Structures and Gates
- Reservoir Modeling Layout Options

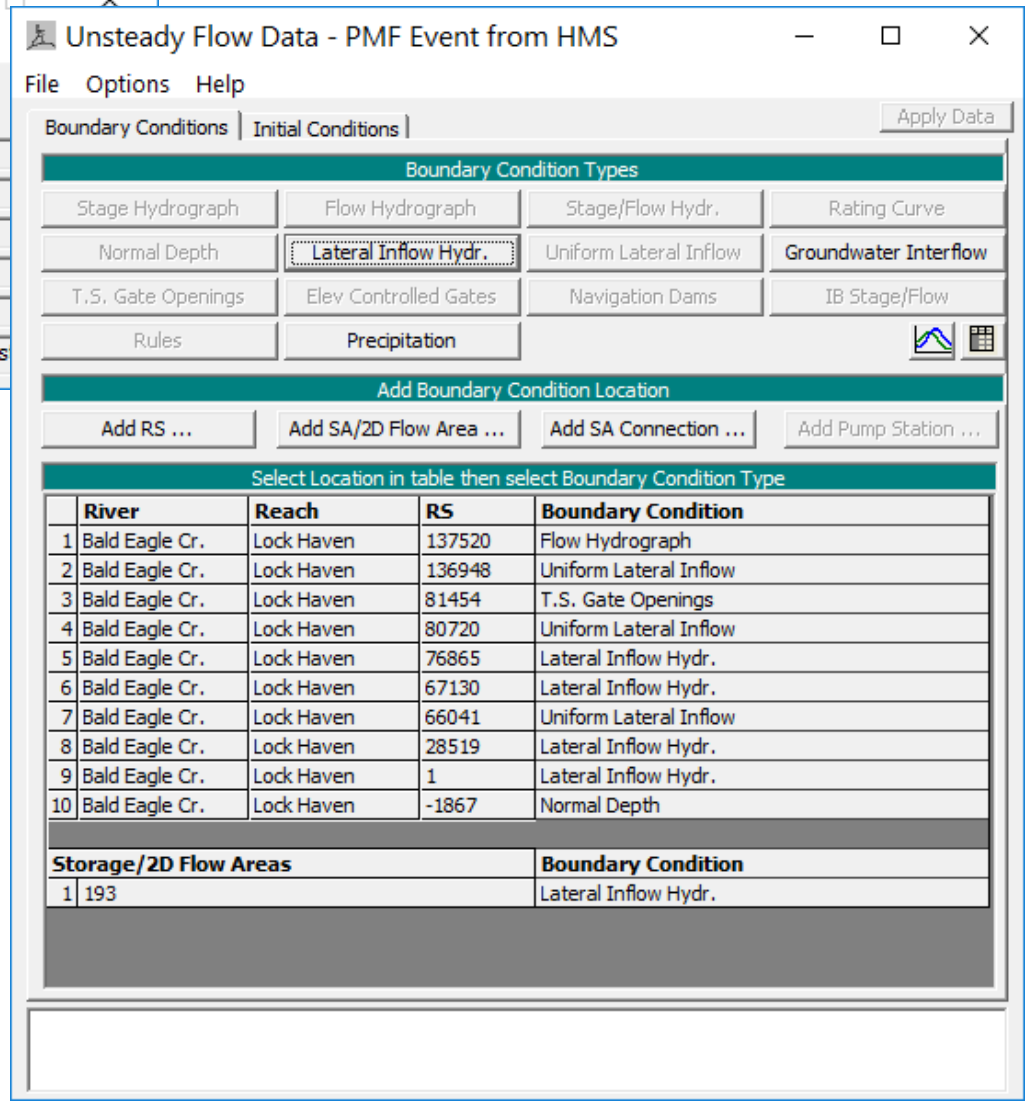
Boundary and Initial Conditions, and Computation Options and Tolerances

Unsteady Flow Data

- External Boundaries required
  - Upstream and Downstream ends of the river
  - Typically flow or stage hydrograph upstream
  - Typically rating or “normal depth” downstream
- Internal Boundaries can be added
  - Add flow within the river system
  - Define gate operation
- Initial Conditions - at the start of simulation

Unsteady Flow Data Editor



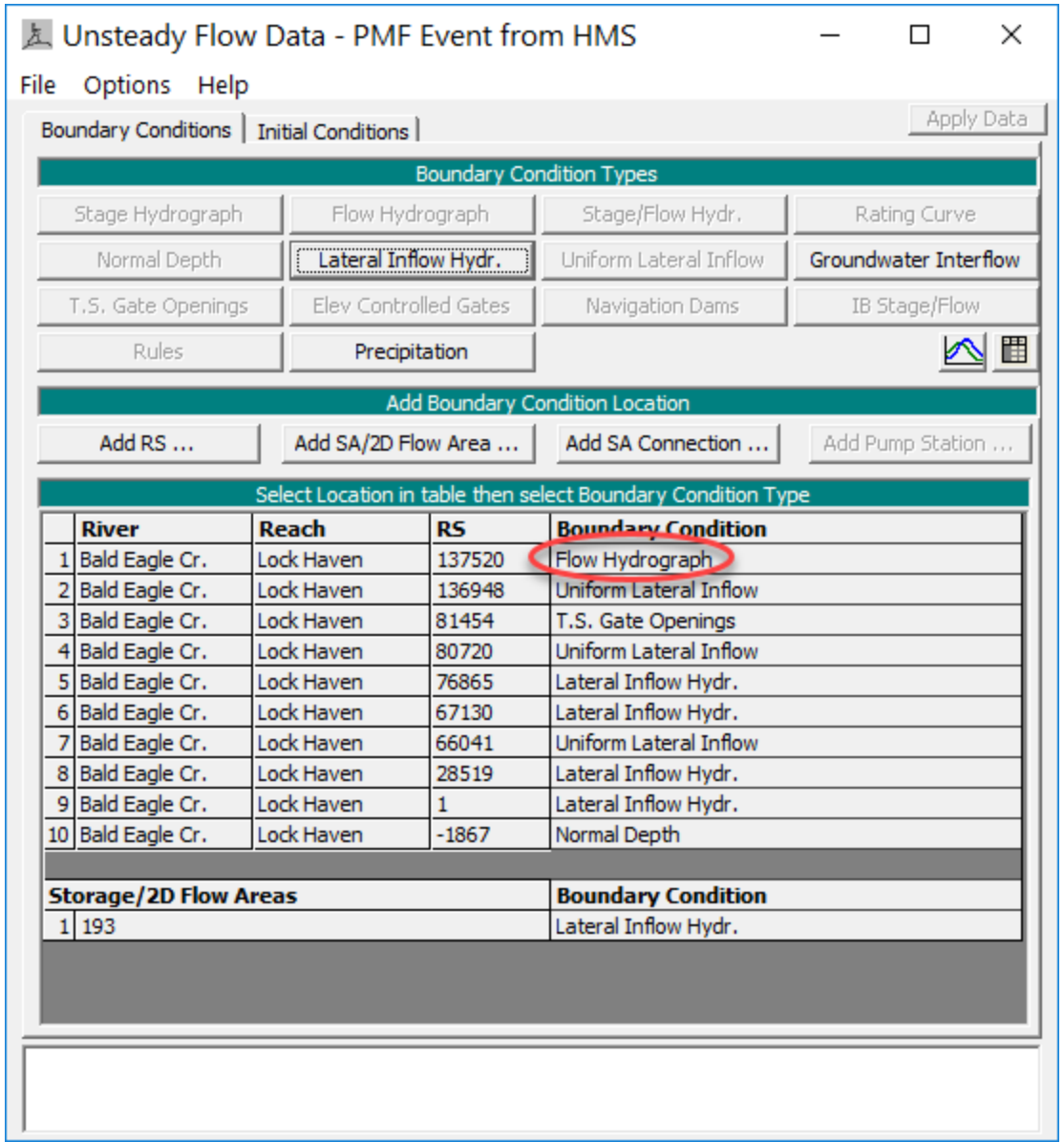


	River	Reach	RS	Boundary Condition
1	Bald Eagle Cr.	Lock Haven	137520	Flow Hydrograph
2	Bald Eagle Cr.	Lock Haven	136948	Uniform Lateral Inflow
3	Bald Eagle Cr.	Lock Haven	81454	T.S. Gate Openings
4	Bald Eagle Cr.	Lock Haven	80720	Uniform Lateral Inflow
5	Bald Eagle Cr.	Lock Haven	76865	Lateral Inflow Hydr.
6	Bald Eagle Cr.	Lock Haven	67130	Lateral Inflow Hydr.
7	Bald Eagle Cr.	Lock Haven	66041	Uniform Lateral Inflow
8	Bald Eagle Cr.	Lock Haven	28519	Lateral Inflow Hydr.
9	Bald Eagle Cr.	Lock Haven	1	Lateral Inflow Hydr.
10	Bald Eagle Cr.	Lock Haven	-1867	Normal Depth

	Storage/2D Flow Areas	Boundary Condition
1	193	Lateral Inflow Hydr.

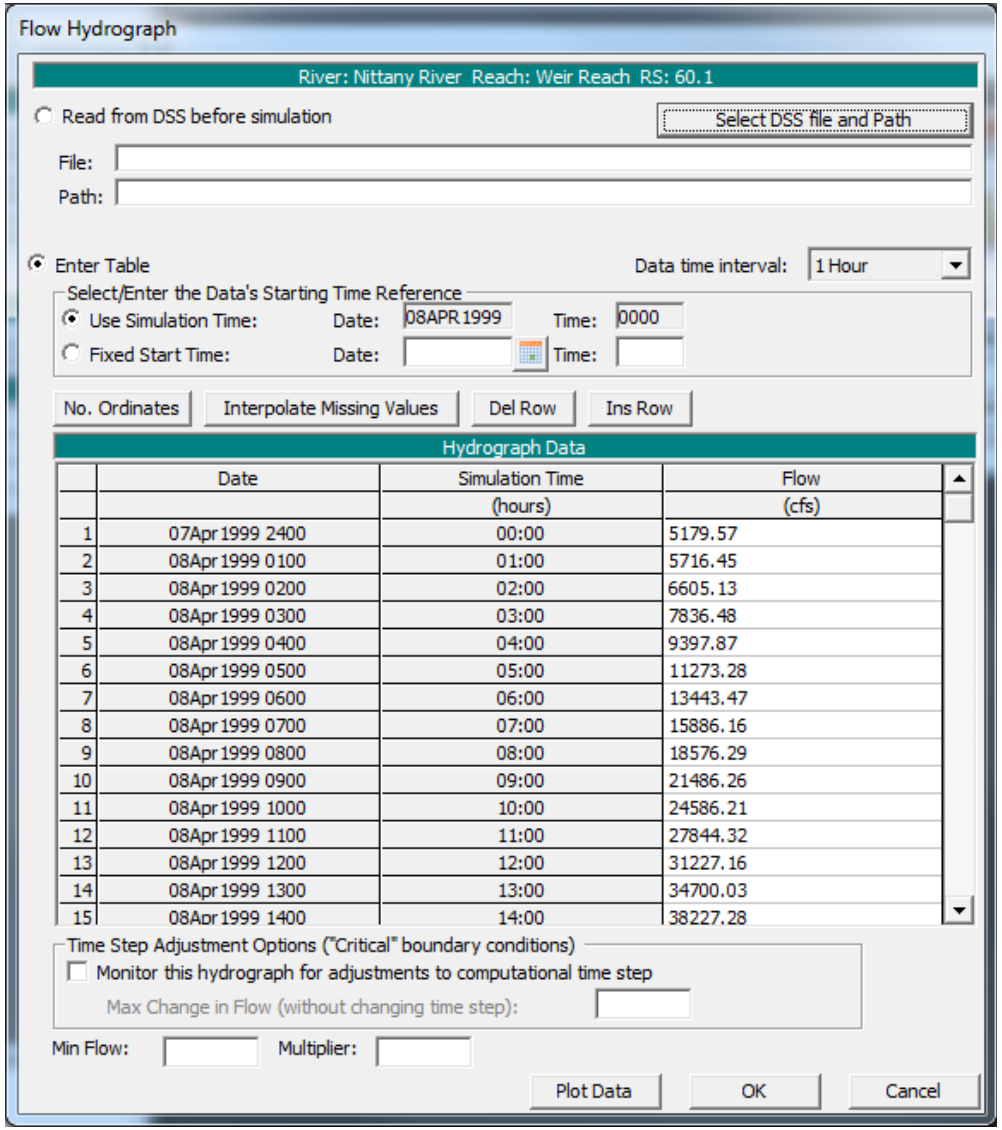
Upstream Boundary Conditions

- Flow Hydrograph
- Stage Hydrograph
- Stage/Flow Hydrograph



Flow Hydrograph

- Read from DSS
  - Select DSS file
  - Select Pathname
- Enter in Table
  - Select time interval
  - Select start date/time
  - Enter flow data - or cut & paste

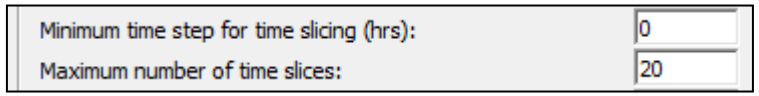


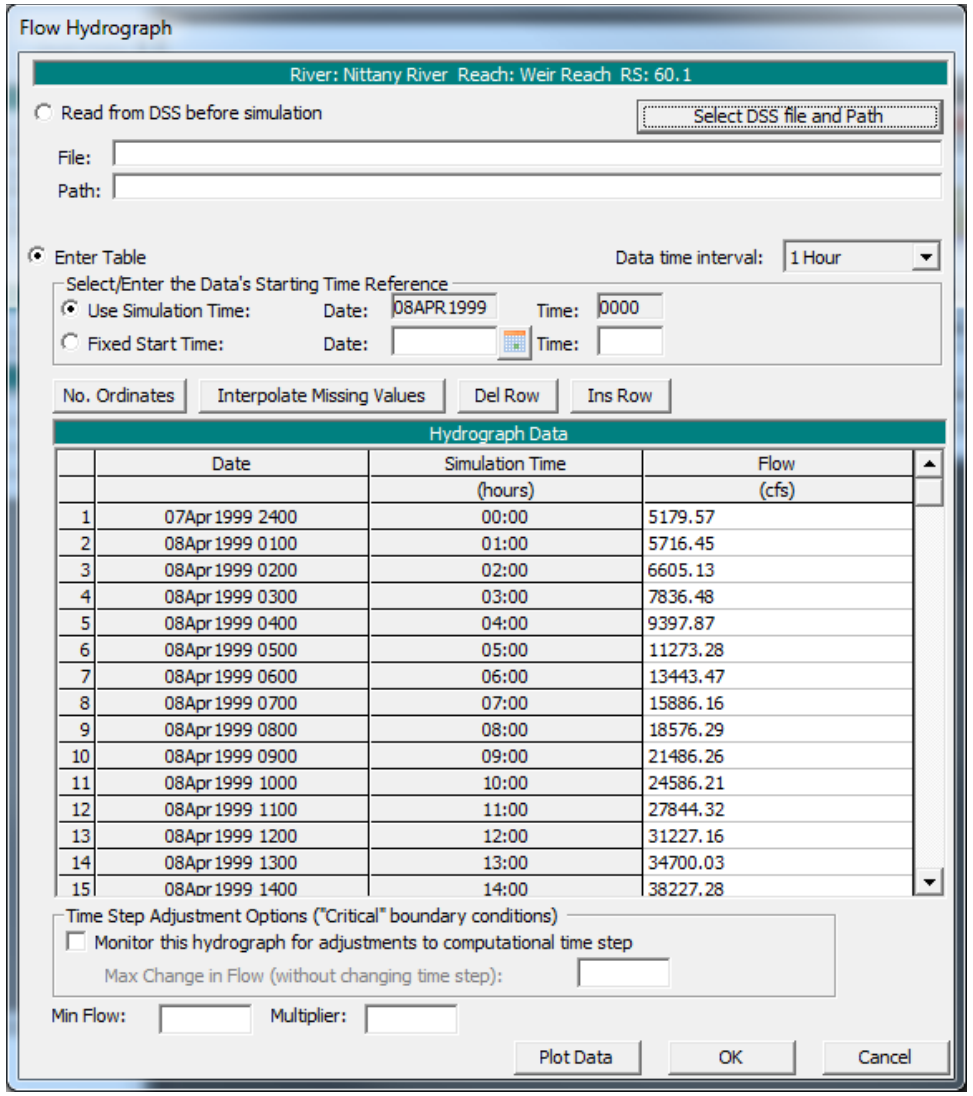
	Date	Simulation Time (hours)	Flow (cfs)
1	07Apr1999 2400	00:00	5179.57
2	08Apr1999 0100	01:00	5716.45
3	08Apr1999 0200	02:00	6605.13
4	08Apr1999 0300	03:00	7836.48
5	08Apr1999 0400	04:00	9397.87
6	08Apr1999 0500	05:00	11273.28
7	08Apr1999 0600	06:00	13443.47
8	08Apr1999 0700	07:00	15886.16
9	08Apr1999 0800	08:00	18576.29
10	08Apr1999 0900	09:00	21486.26
11	08Apr1999 1000	10:00	24586.21
12	08Apr1999 1100	11:00	27844.32
13	08Apr1999 1200	12:00	31227.16
14	08Apr1999 1300	13:00	34700.03
15	08Apr1999 1400	14:00	38227.28

Flow Hydrograph

- Min Flow
- Multiplier

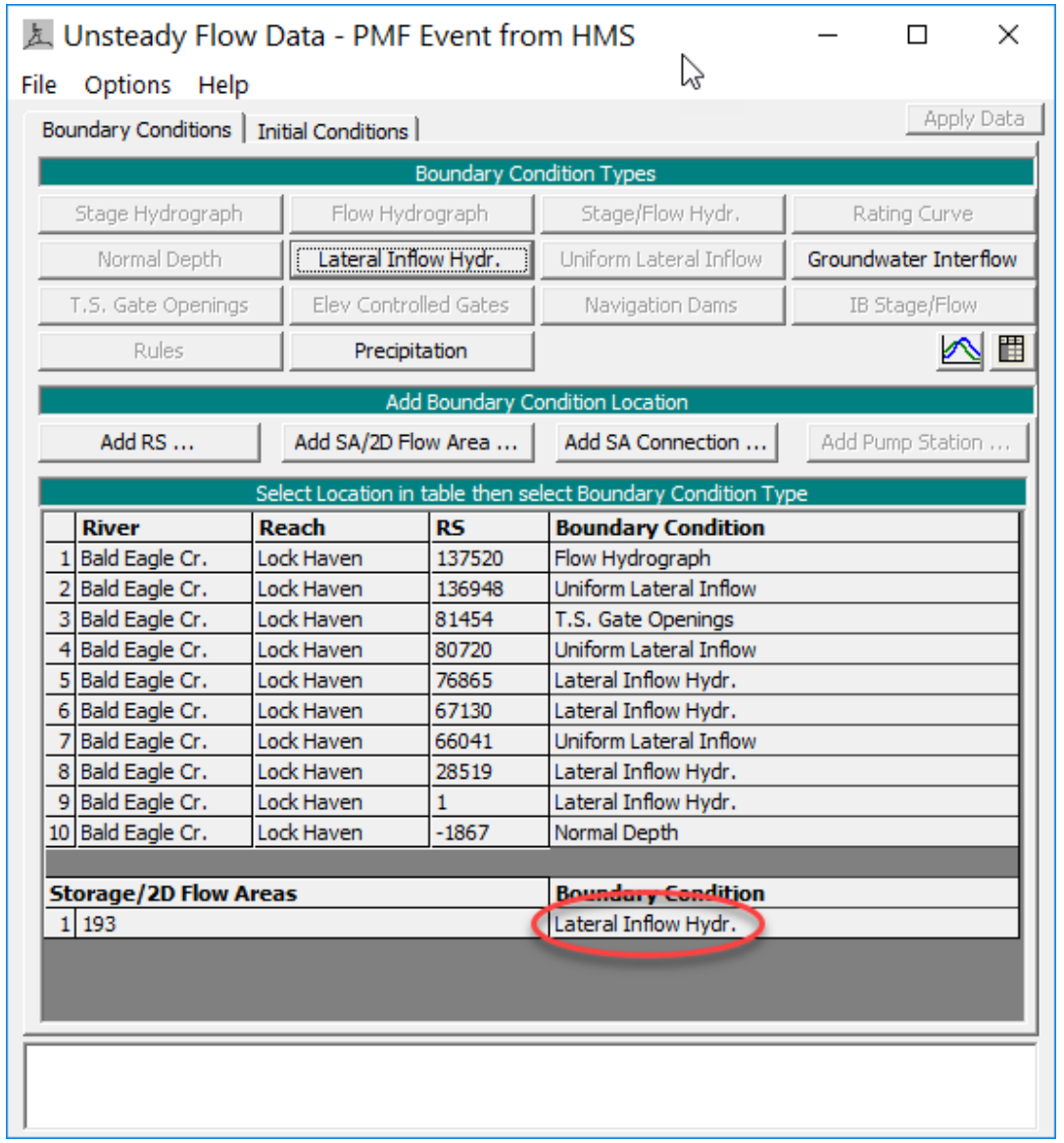
- Hydrograph Monitor for Time Slicing





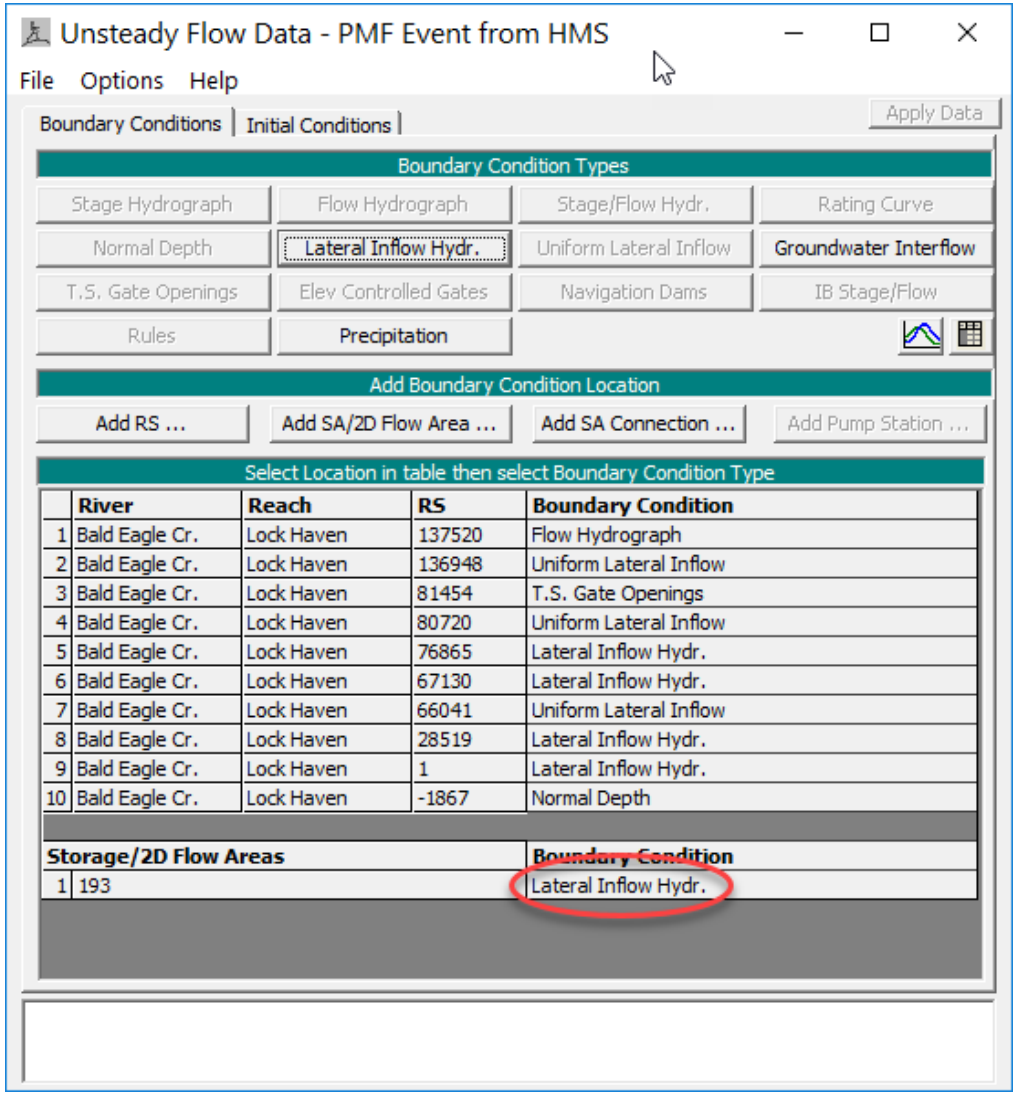
Downstream Boundary Conditions

- Downstream Options:
  - ▶ Normal Depth
  - ▶ Rating Curve
  - ▶ Stage Hydrograph
  - ▶ Flow Hydrograph
  - ▶ Stage & Flow Hydrograph



Storage Area Boundary Conditions

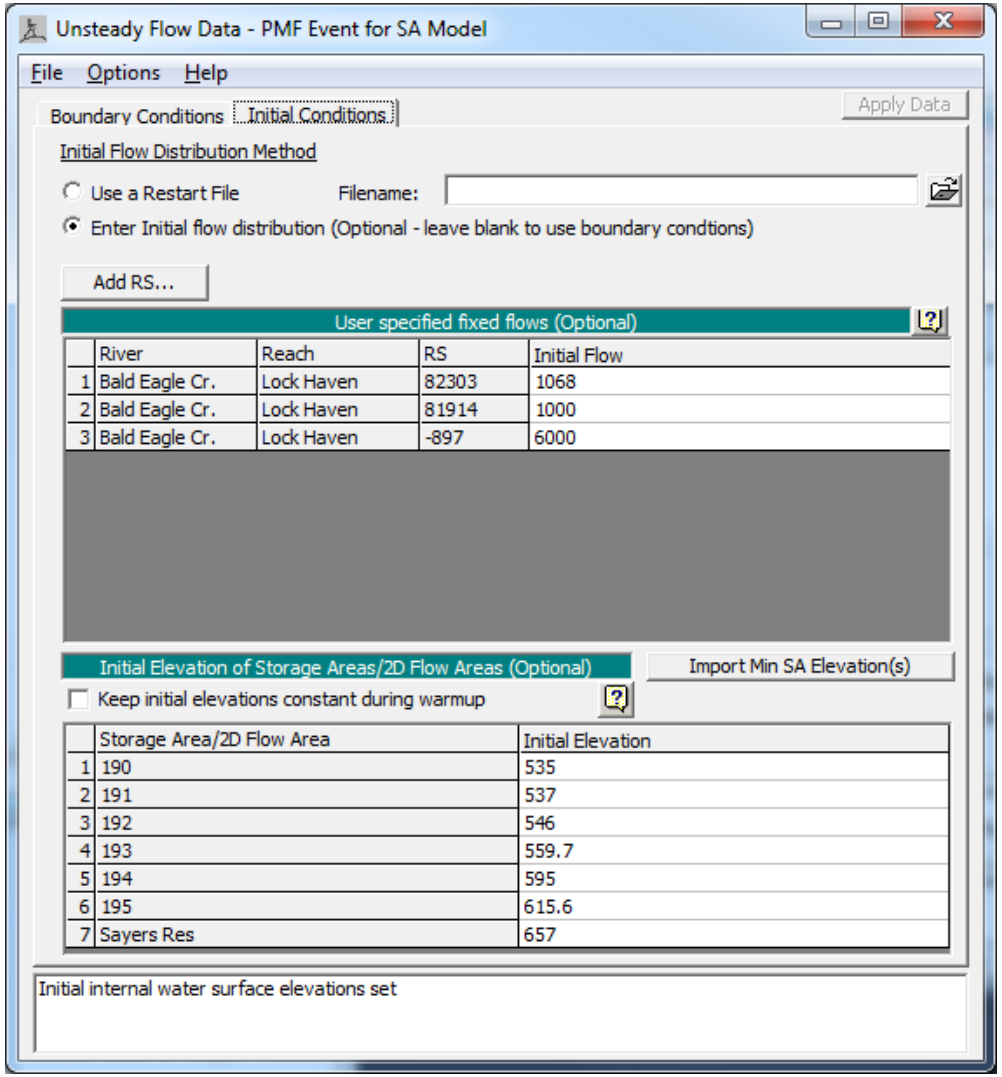
- Storage Areas are no longer limited to one lateral inflow hydrograph boundary (RAS 4.2 Alpha 2).
- Add Storage Area to table more than one time for additional hydrograph.



Initial Conditions

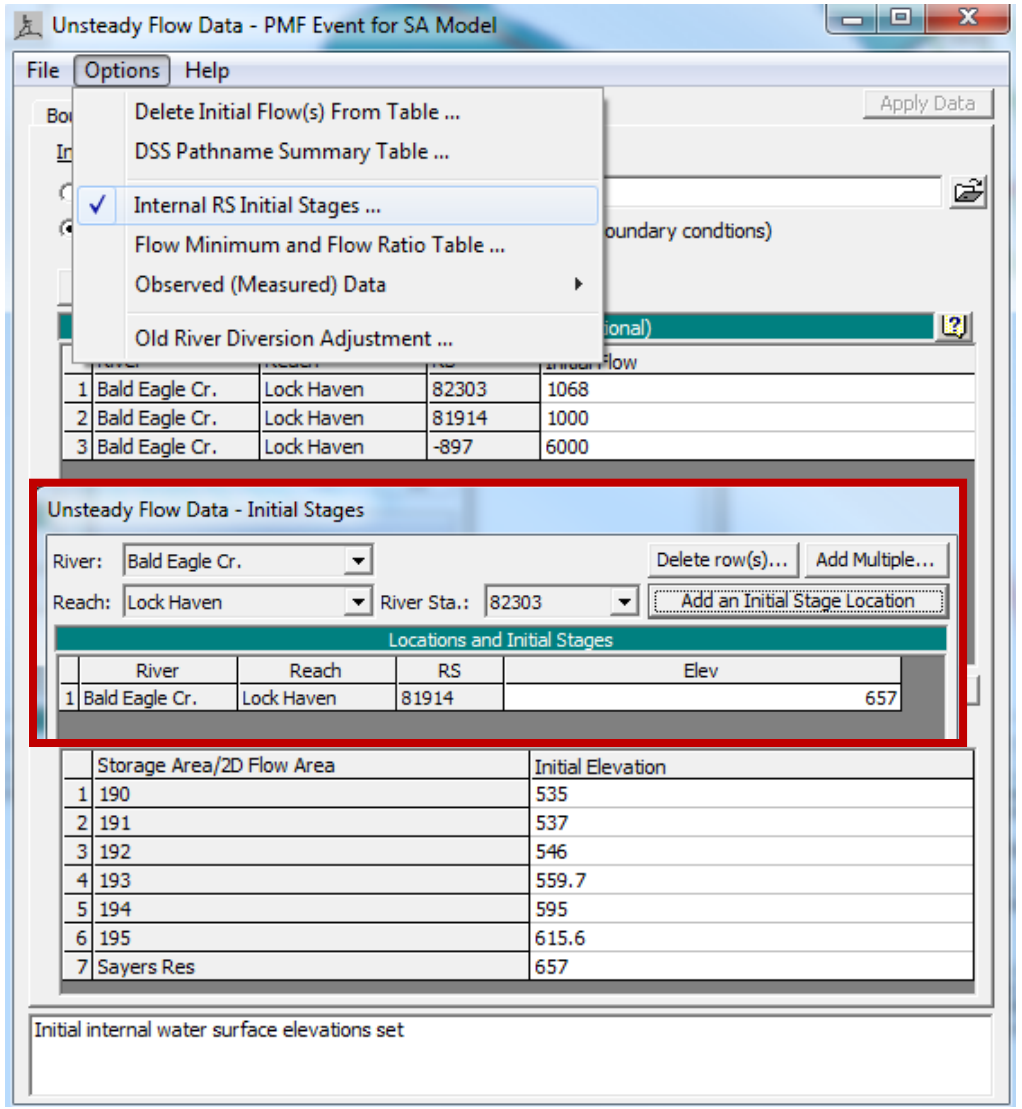
- Requires an initial flow for all reaches – can be left blank for dendritic systems
- Pool elevation for storage areas can be left blank
- Can change initial flow at any location

- Use system status from previous simulation (restart file)



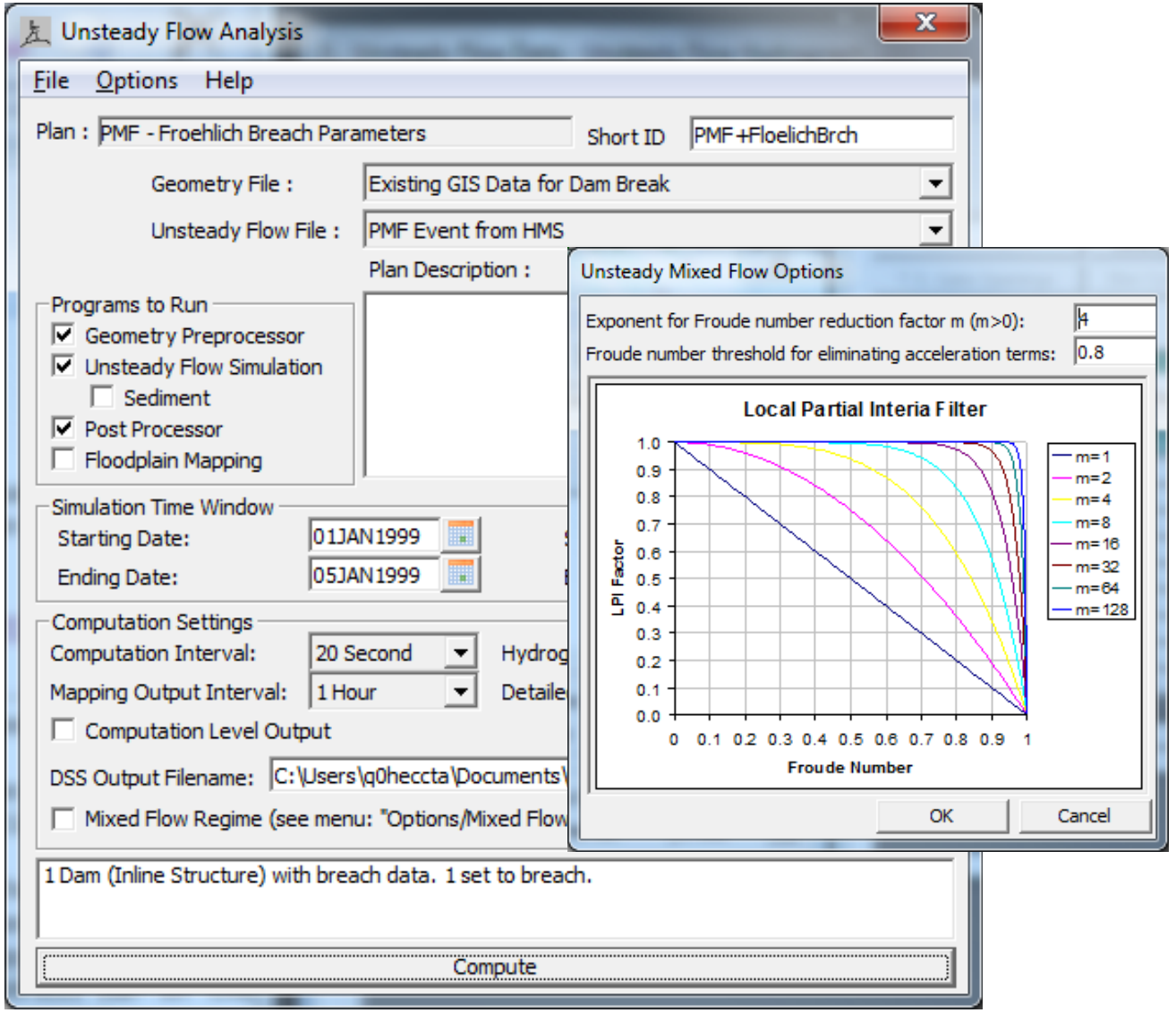
Initial Internal Stages

- Internal RS Initial Stages used to set initial water surface at a XS
- Stage U/S from inline structure is based on a balance of outlet size/gate opening and water surface



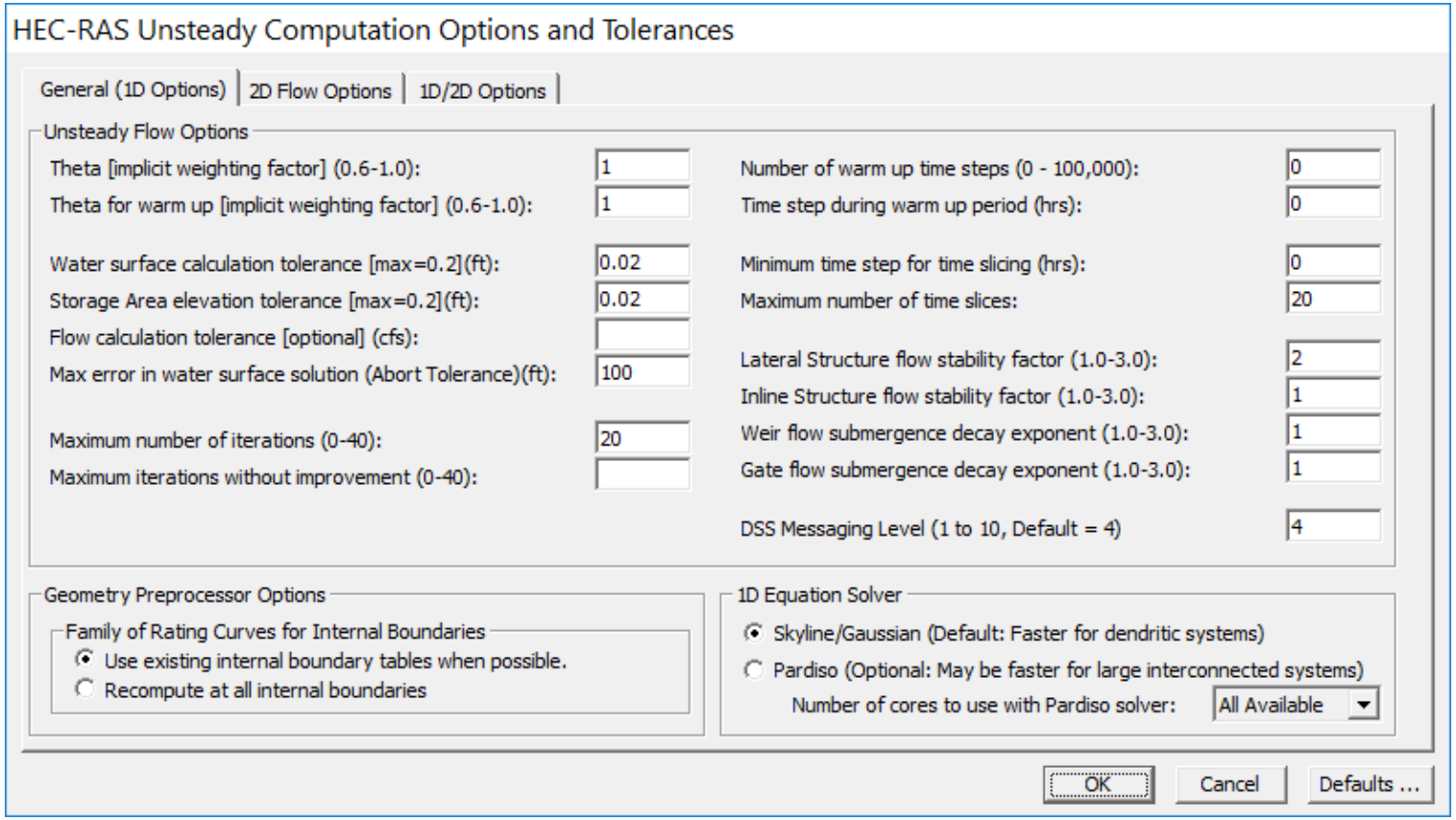
Computation

- Computation Time Step
- Hydrograph Output
- Detailed Output
- Mixed Flow Regime



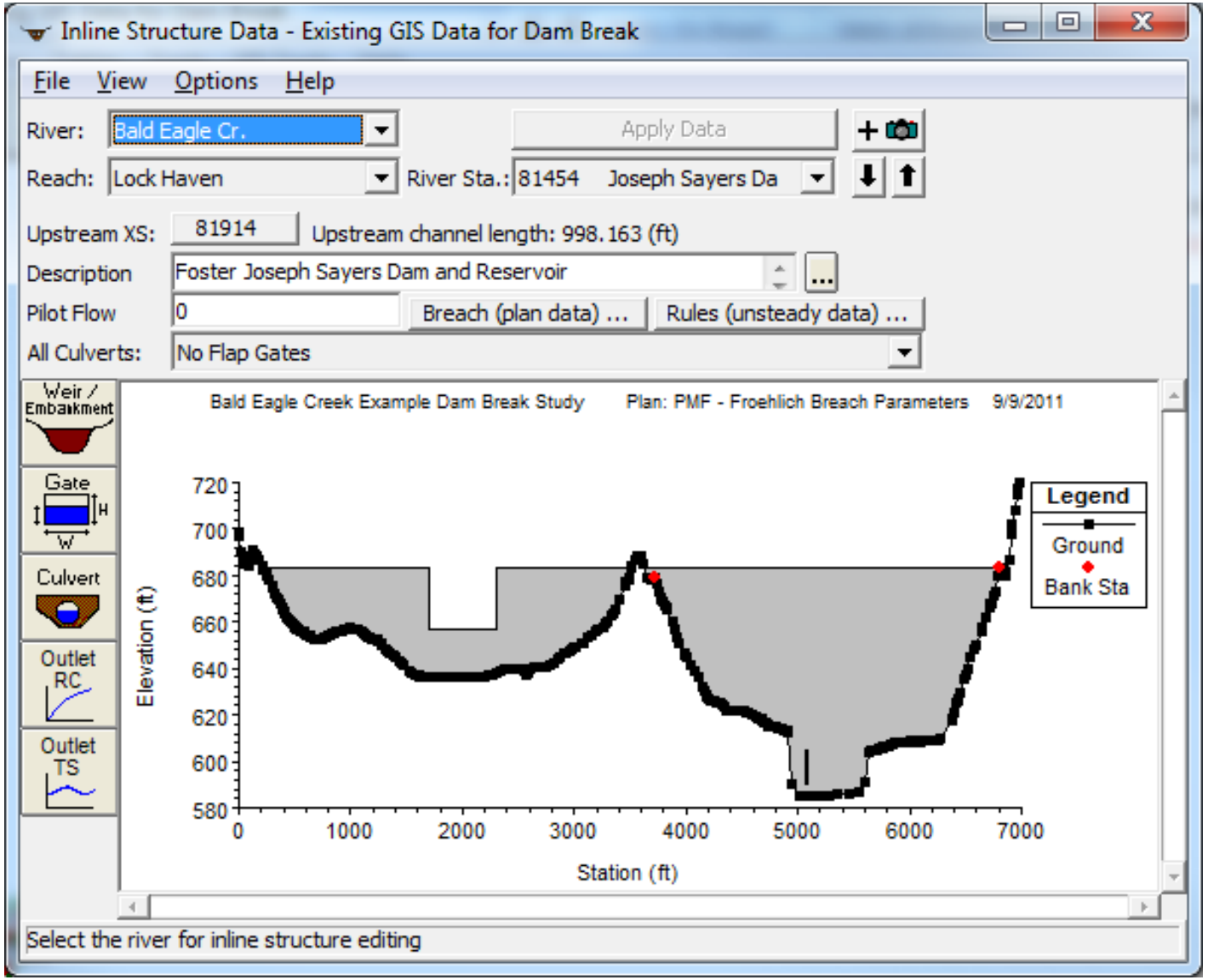
Computation Options

- Theta
  1 = Most Stable
- Water Surface Tolerance
- Stability Factors
  1 = Most Accurate
  3 = Most Stable
  - Lateral Structure
  - Inline Structure
  - Weir Flow Submergence



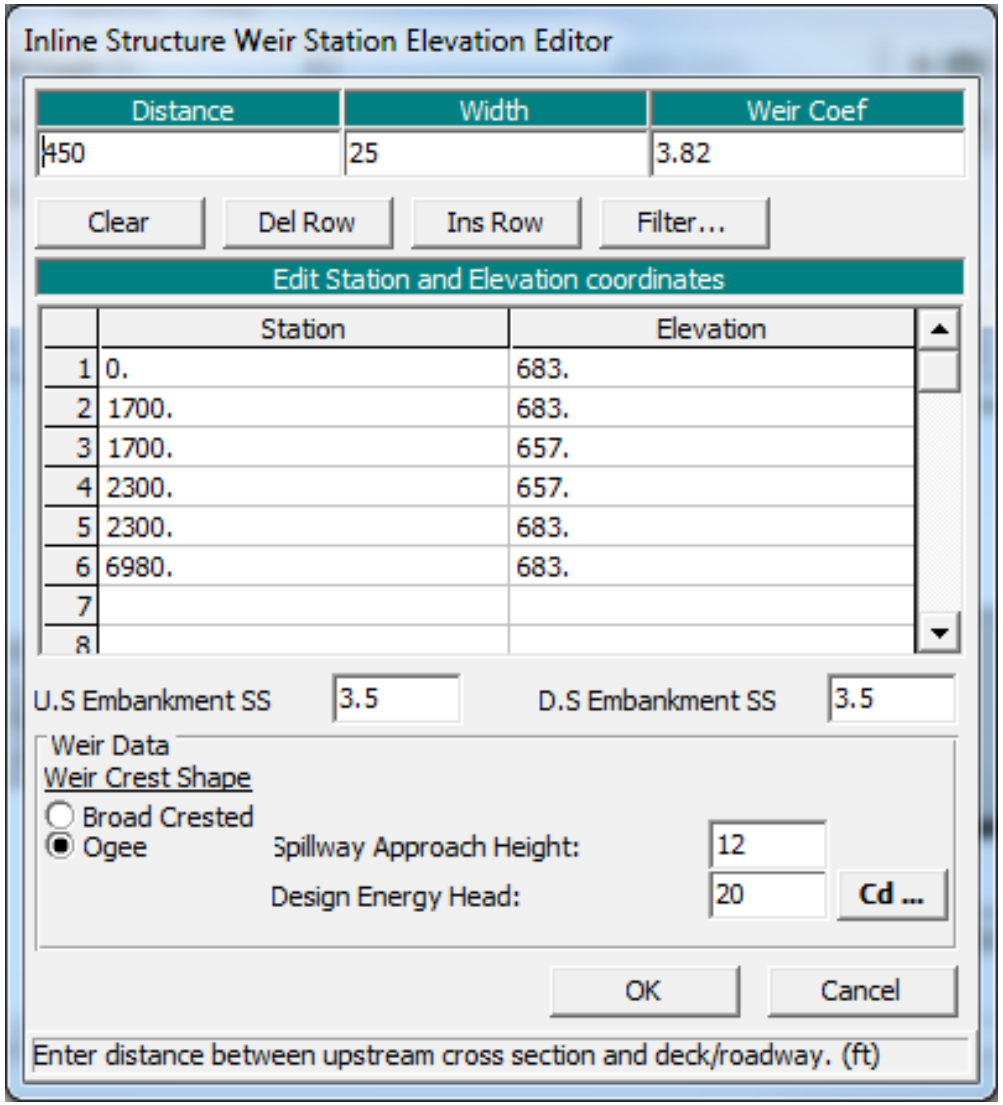
Inline Structures and Gates

Entering Inline Structure Data



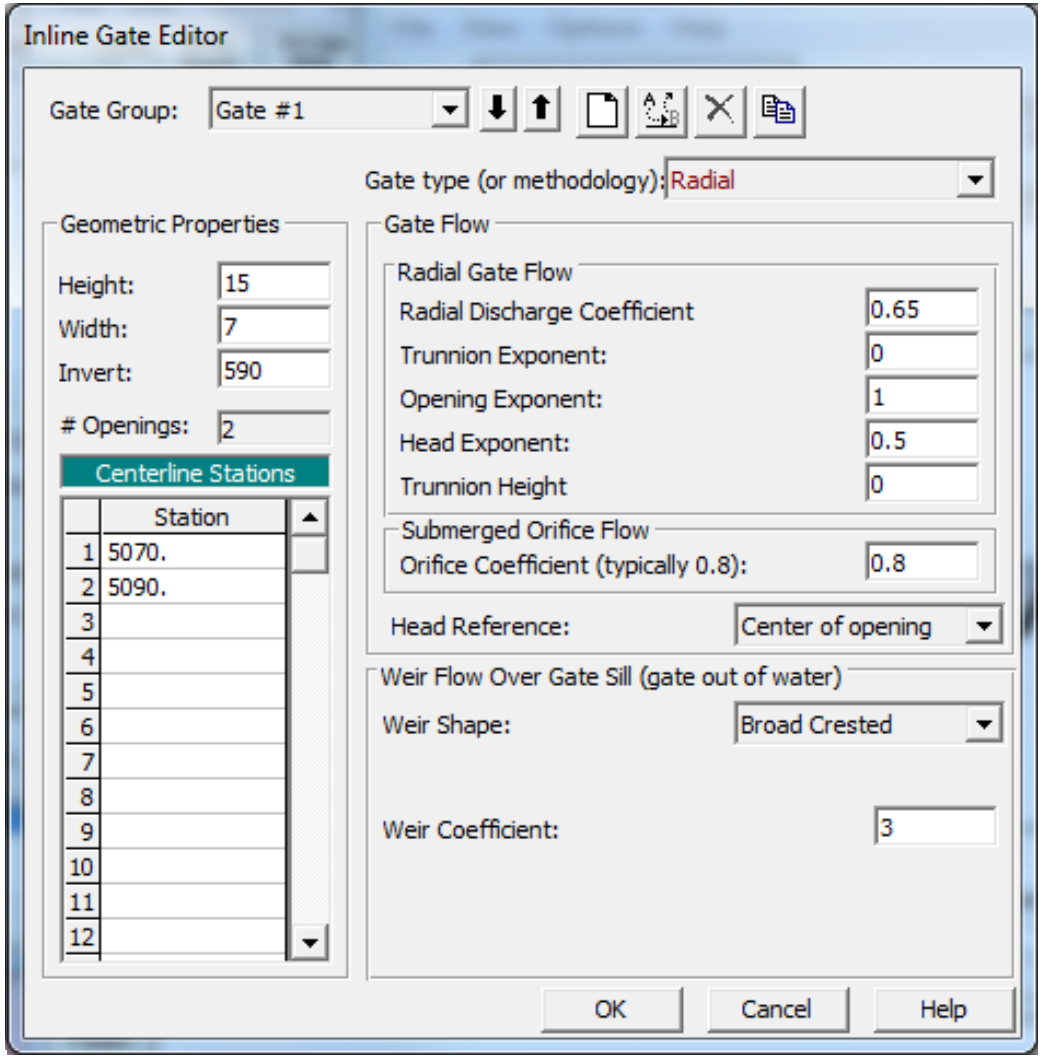
Weir and Embankment Profile

- Distance + Width < U/S XS Reach Length
- Weir include top of dam and spillway
- Weir Coef. used for both dam and spillway



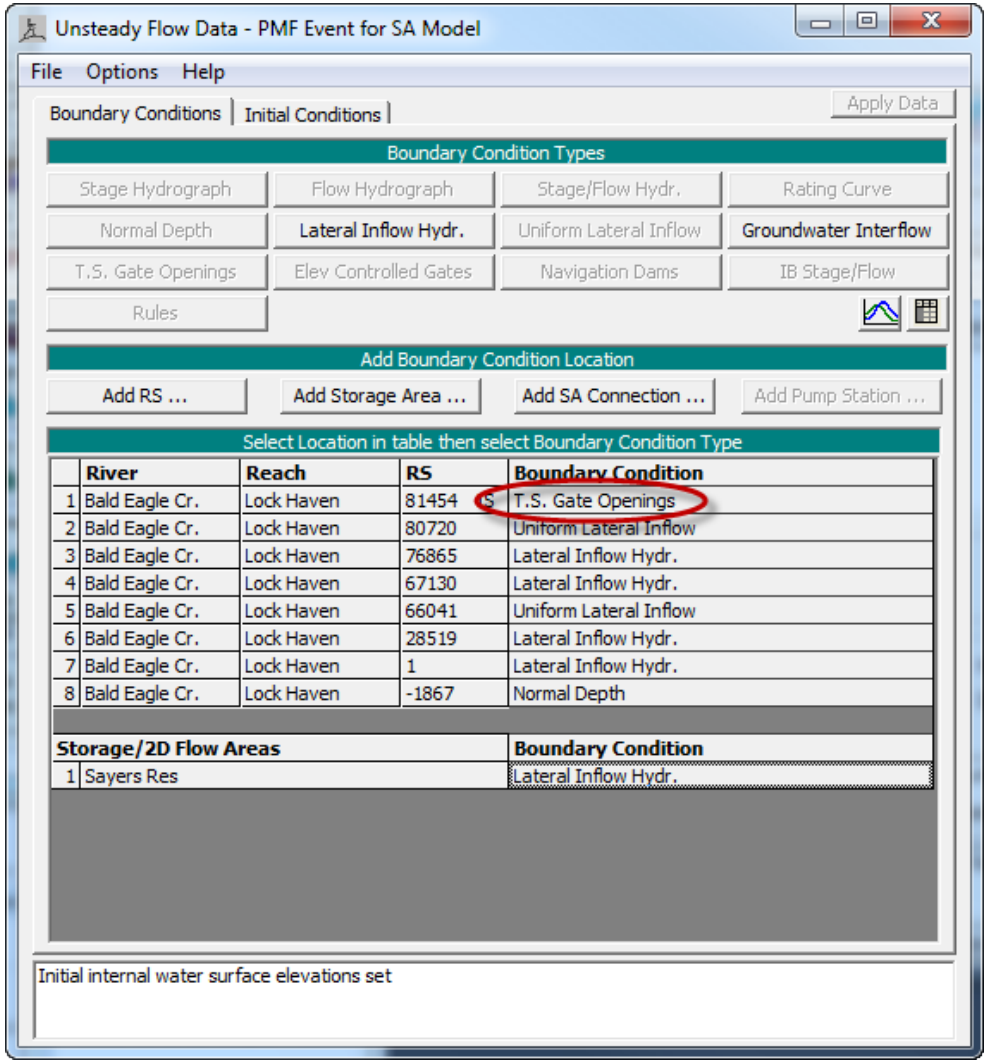
Gates

- Sluice
- Radial
- Overflow
- User Defined Curves

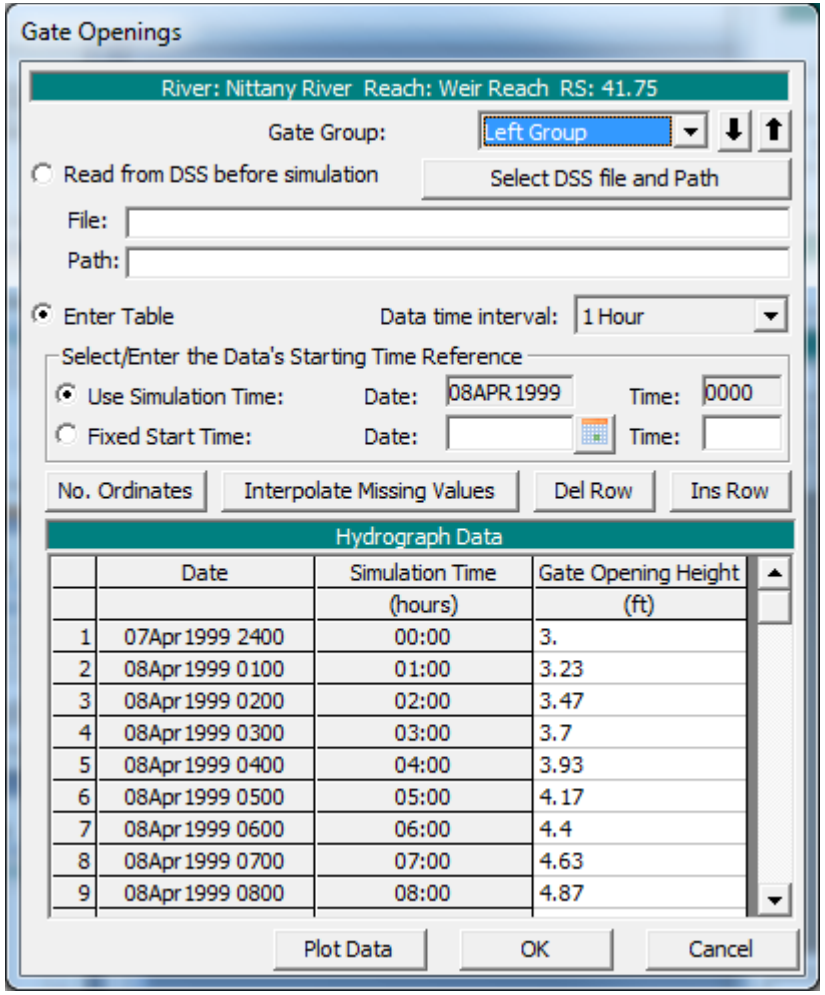


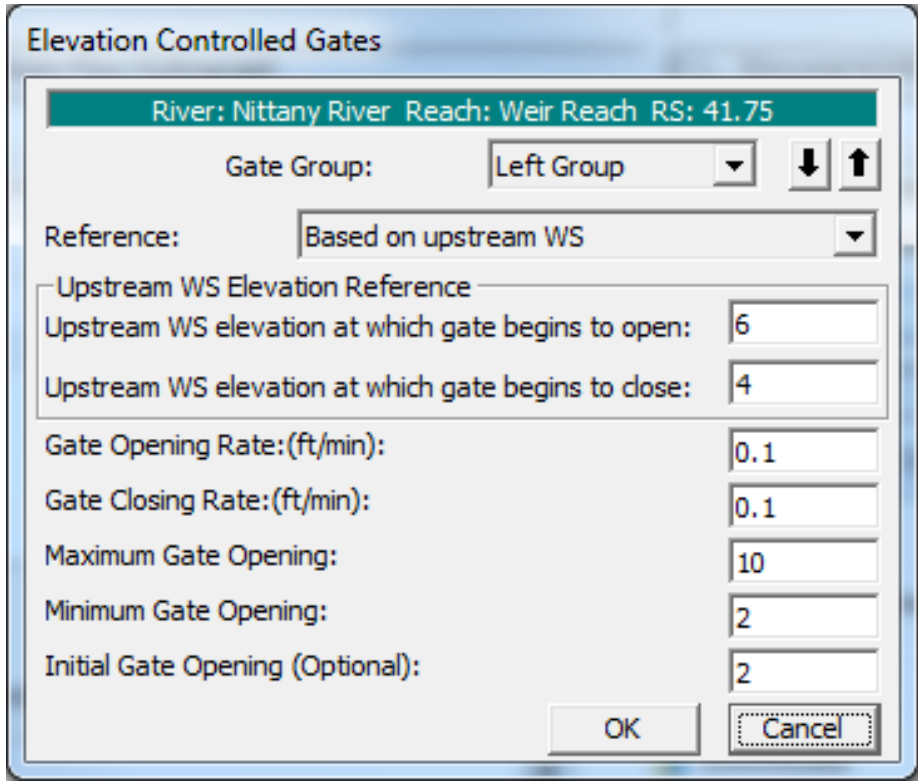
Gate Settings

- Add the Inline Structure station as a BC location to Specify Gate Settings



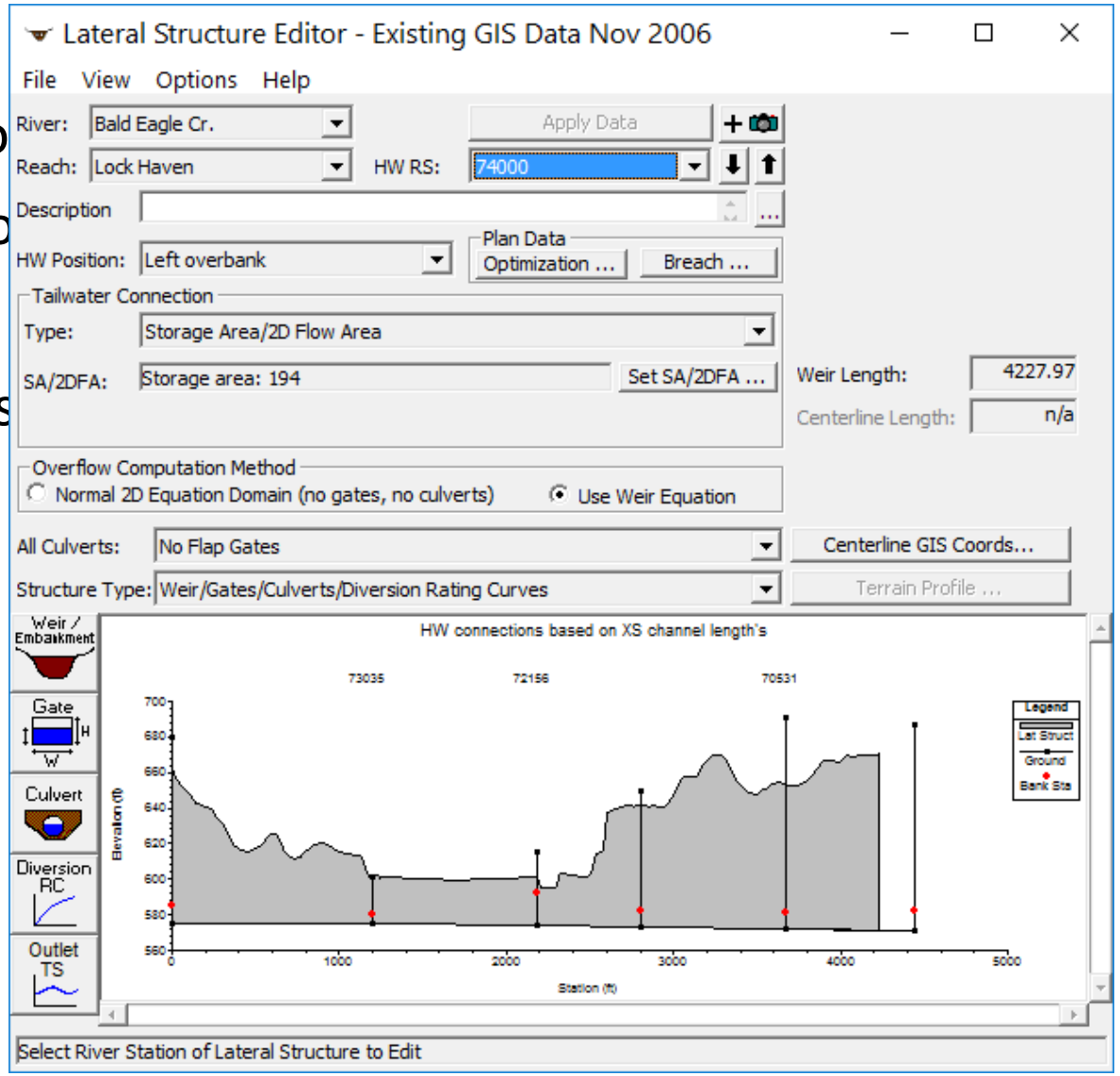
Gate Boundary Conditions



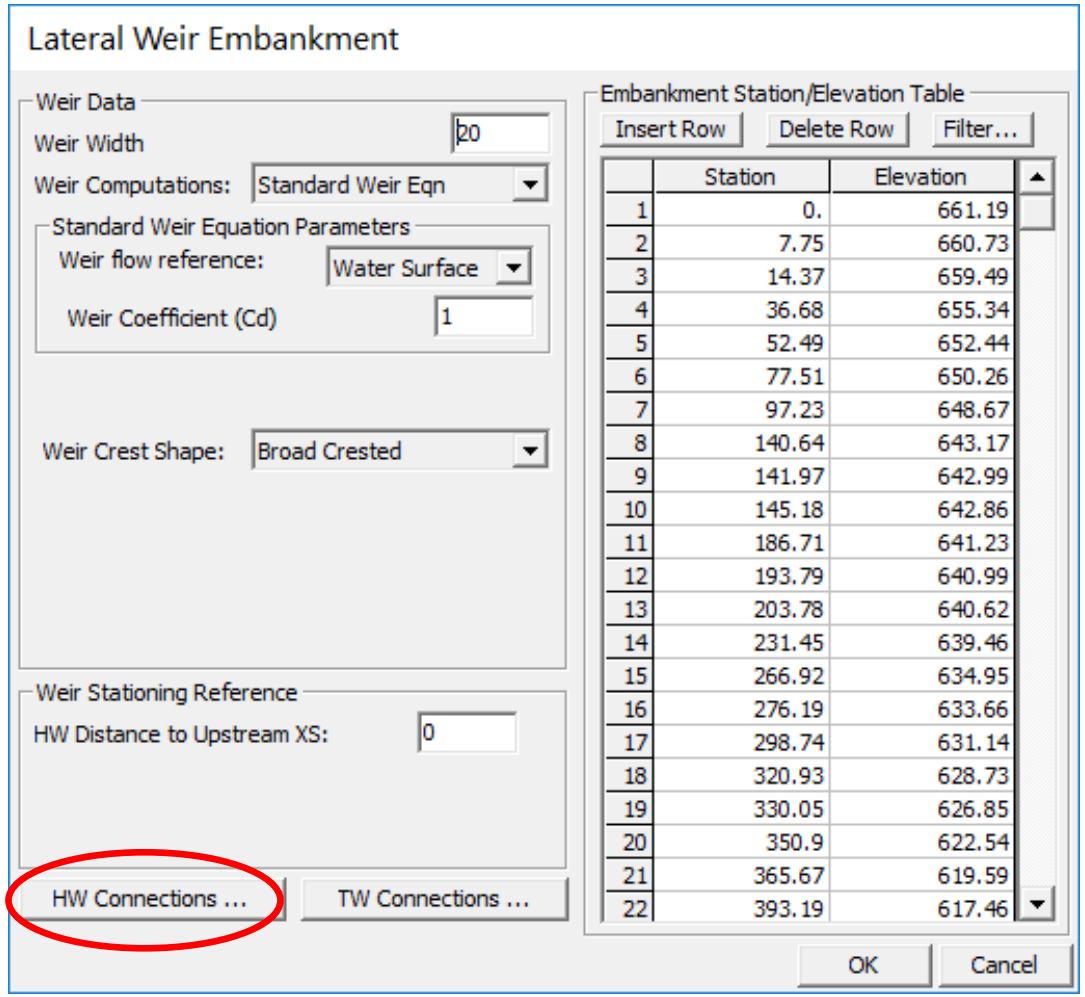


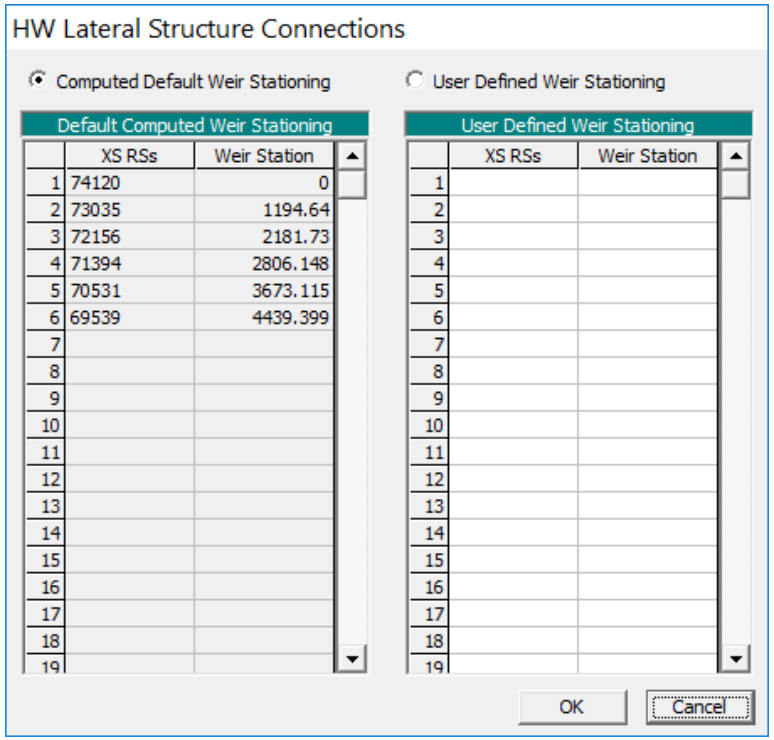
Lateral Structures

- Connect to River XSs or to a Sto
- HW Position affects computatio
- Similar options as for an inline s



Lateral Structures

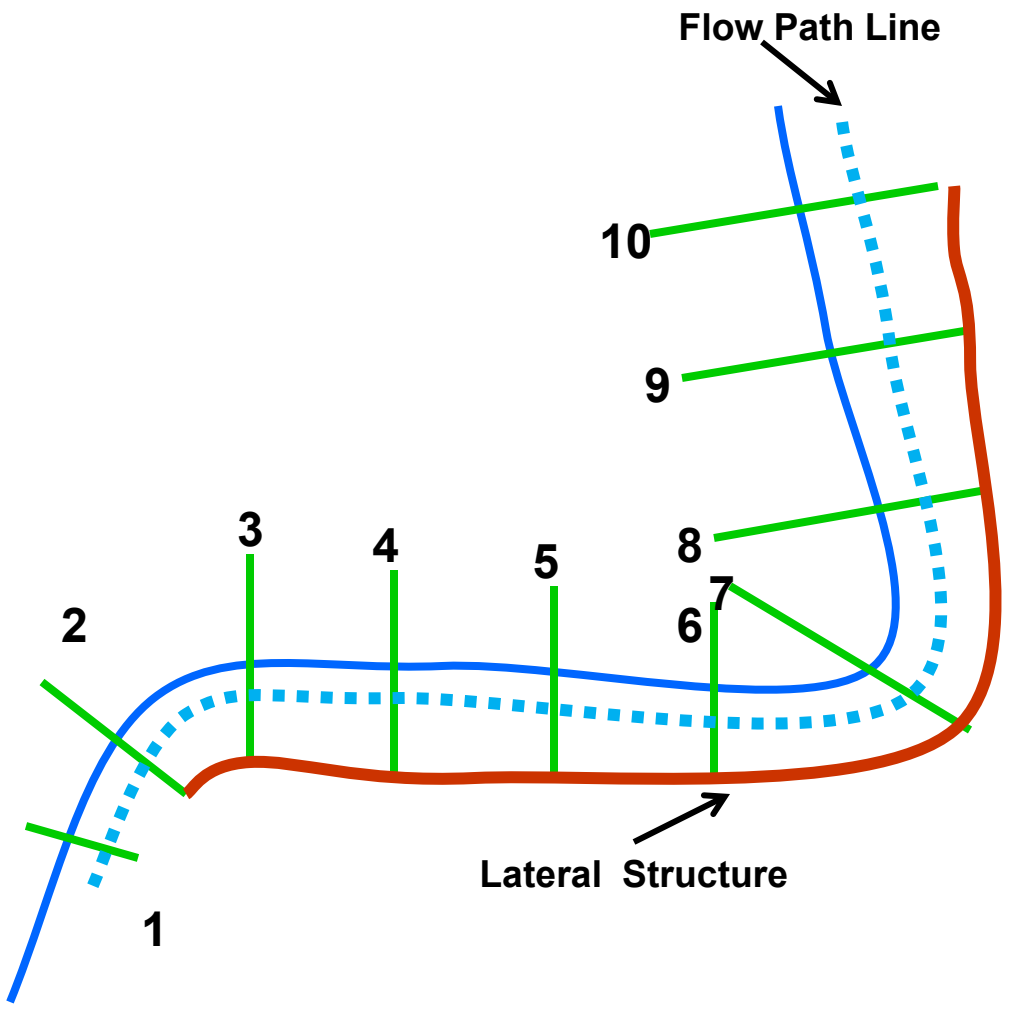




Lateral Structure

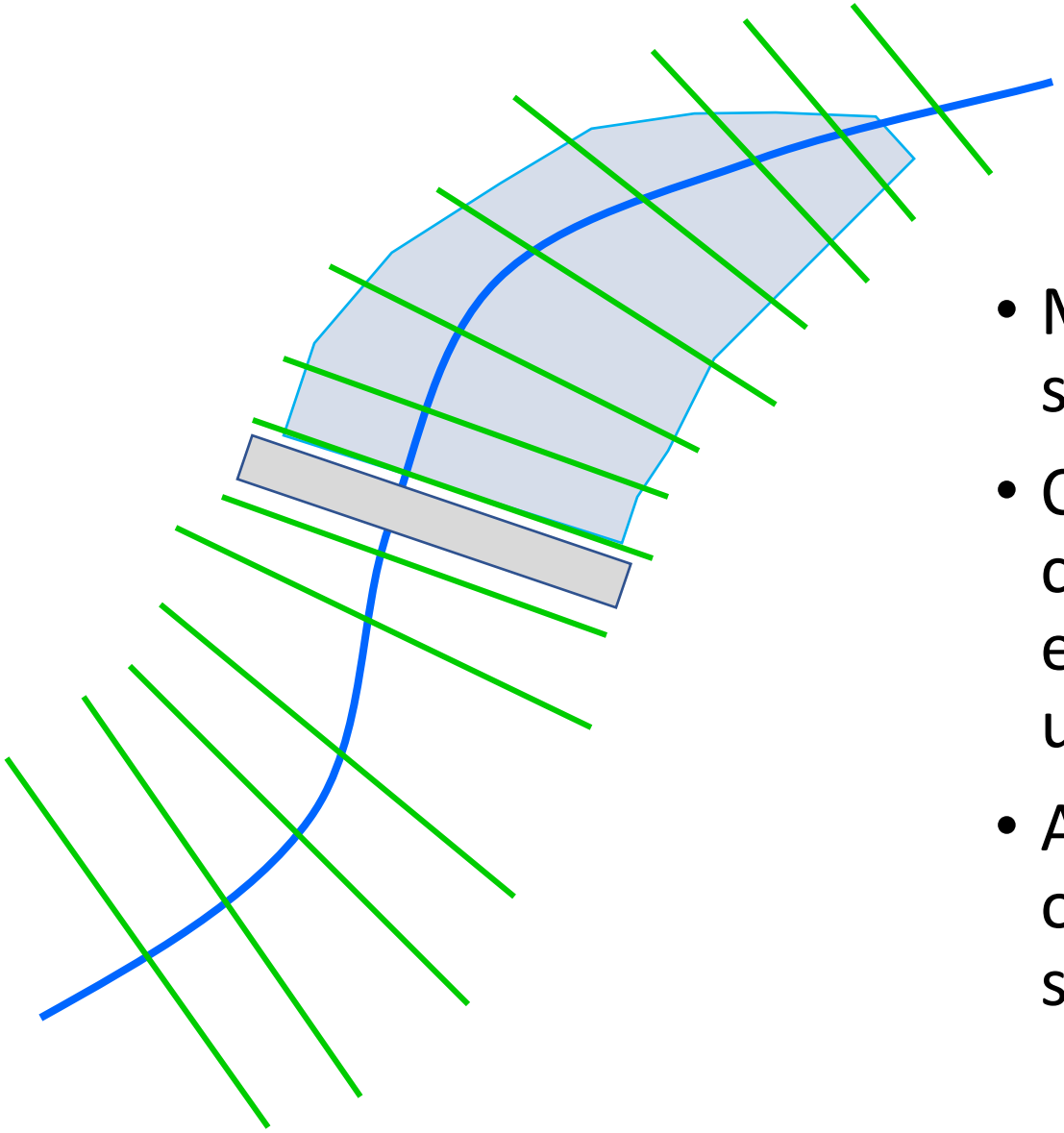
- User Specified Stationing

RAS XS	RAS Station	User Station
10	0	0
9	100	100
8	200	200
7	300	325
6	400	450
5	500	550
4	600	650
3	700	750
2	800	825
1	-	-



Reservoir Modeling Options

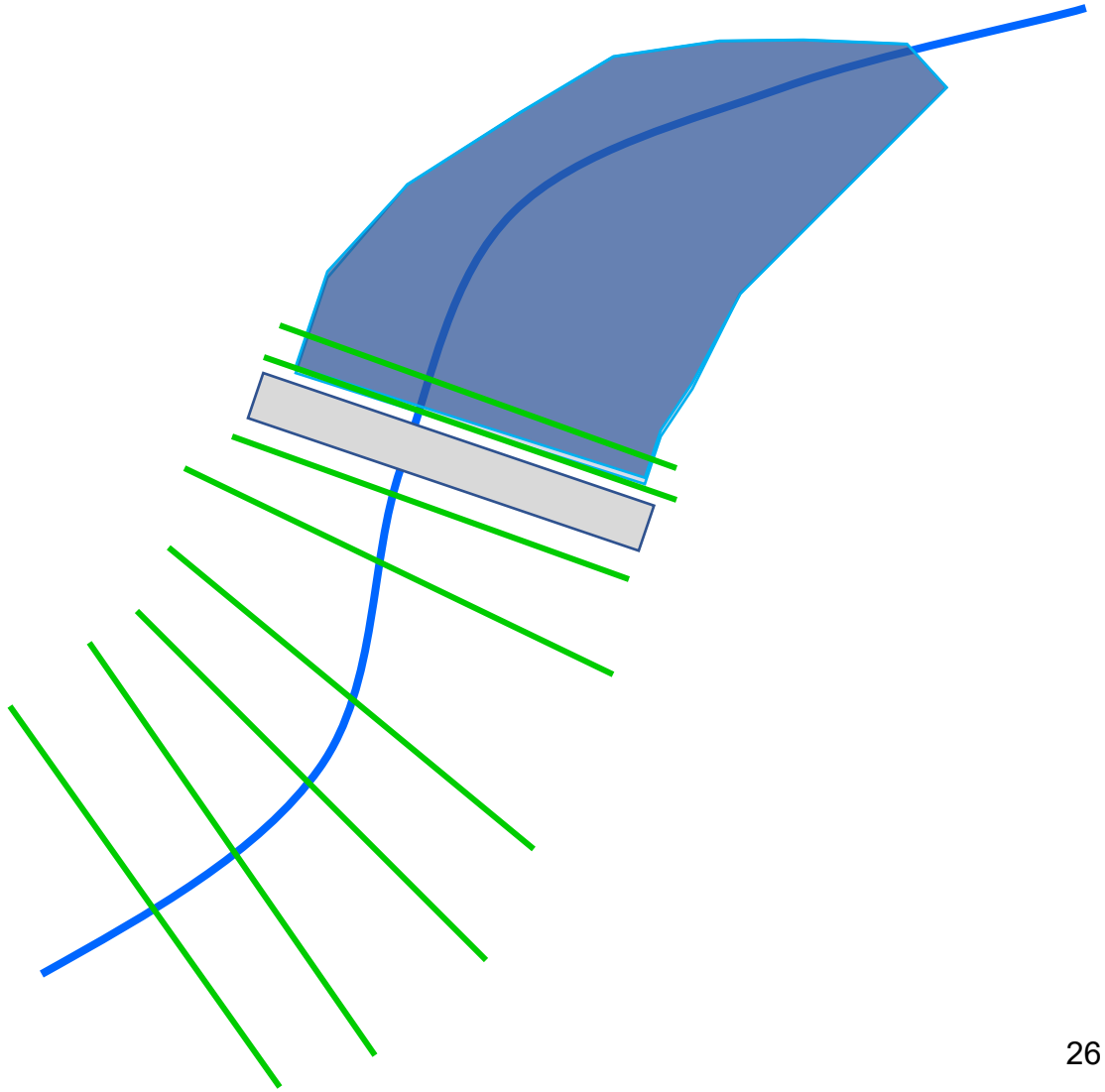
Reservoir Modeling Option



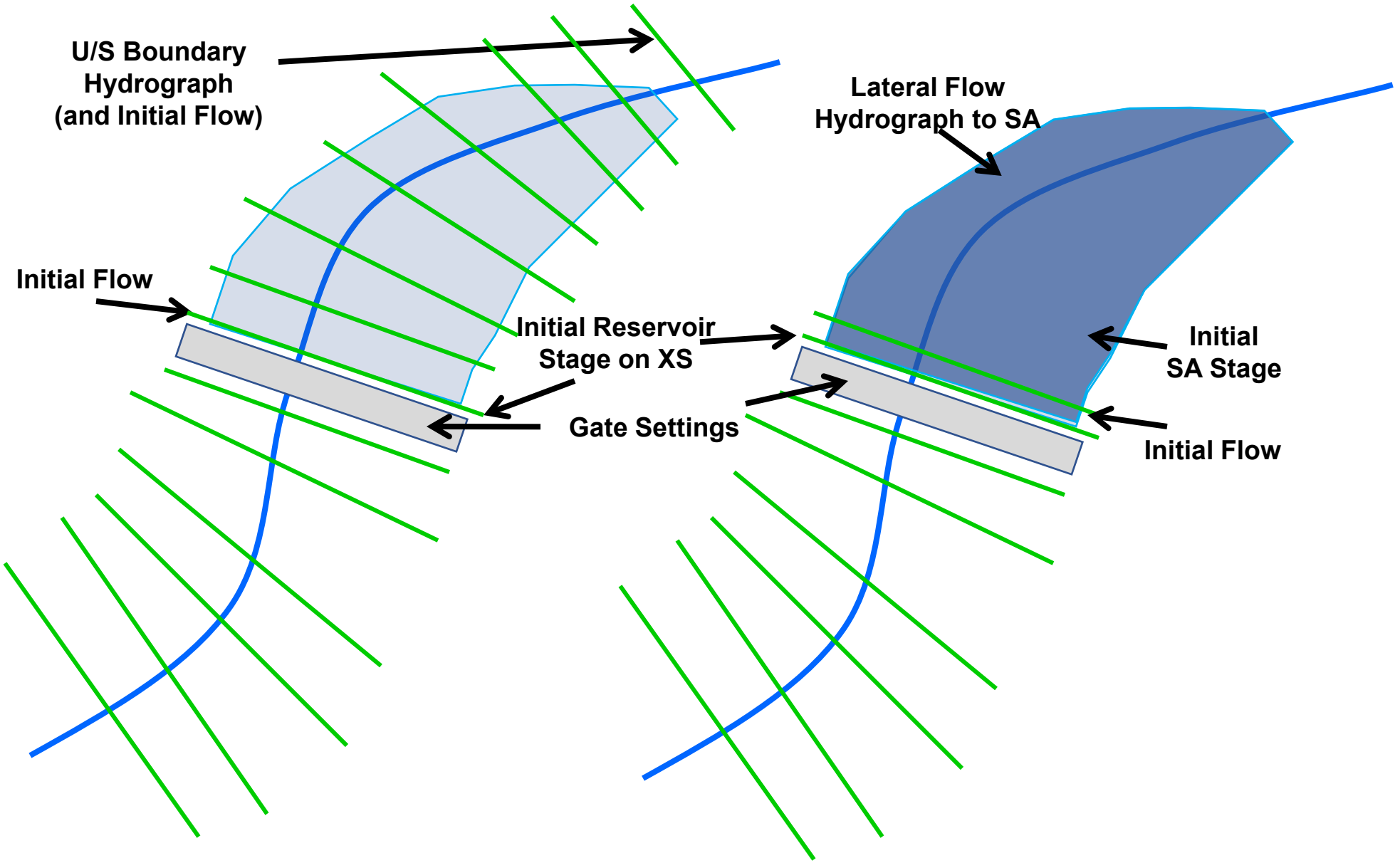
- Model Reservoir with cross sections
- Cross sections must include channel information, especially around dam both u/s and d/s
- Allows for dynamic routing of water (sloped water surface)

Reservoir Modeling Option

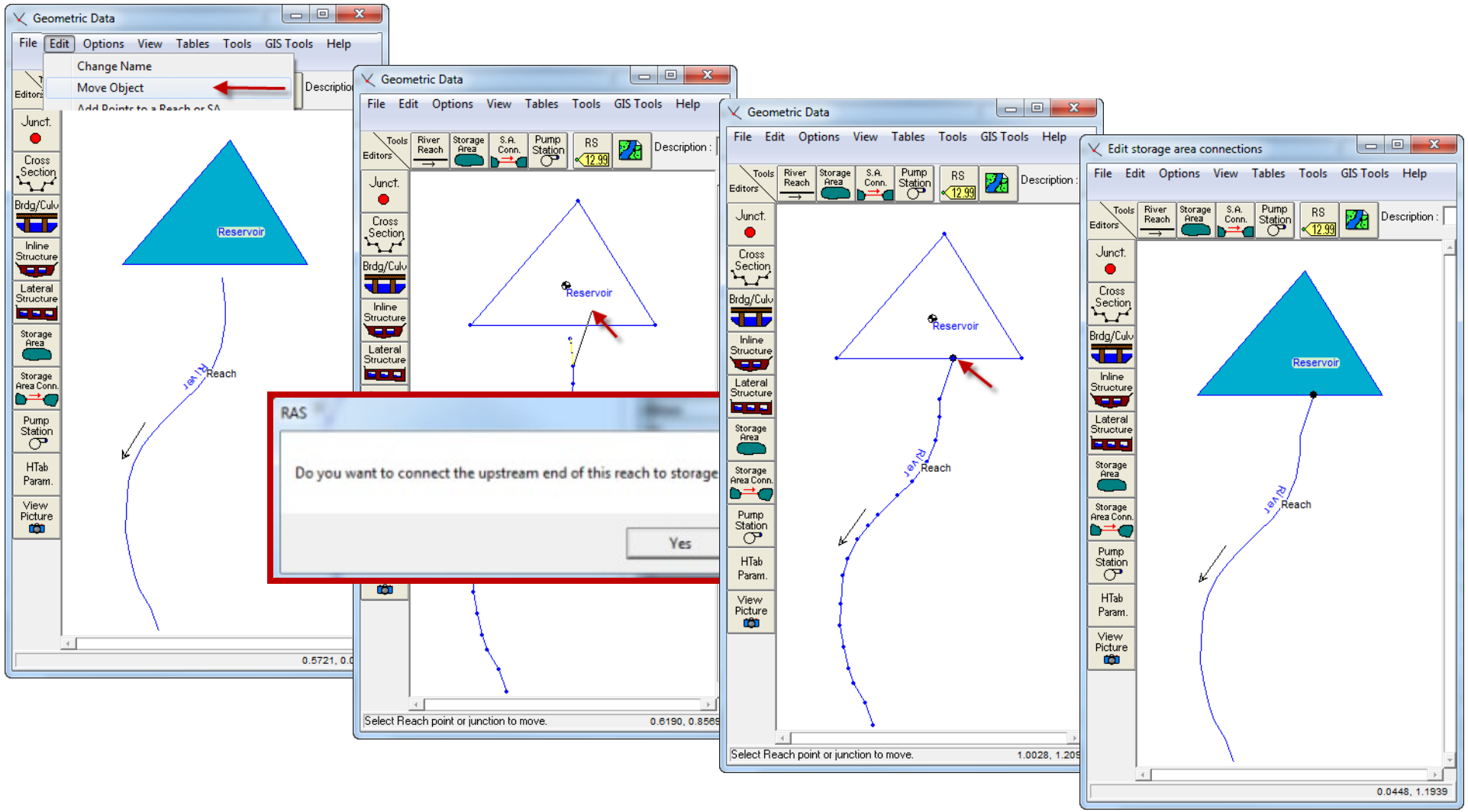
- Model Reservoir with a Storage Area
- Must have 2 cross sections U/S from inline structure
- Cross sections must include channel down to dam invert on both side of the inline structure
- Linear routing in storage area results in horizontal water surface



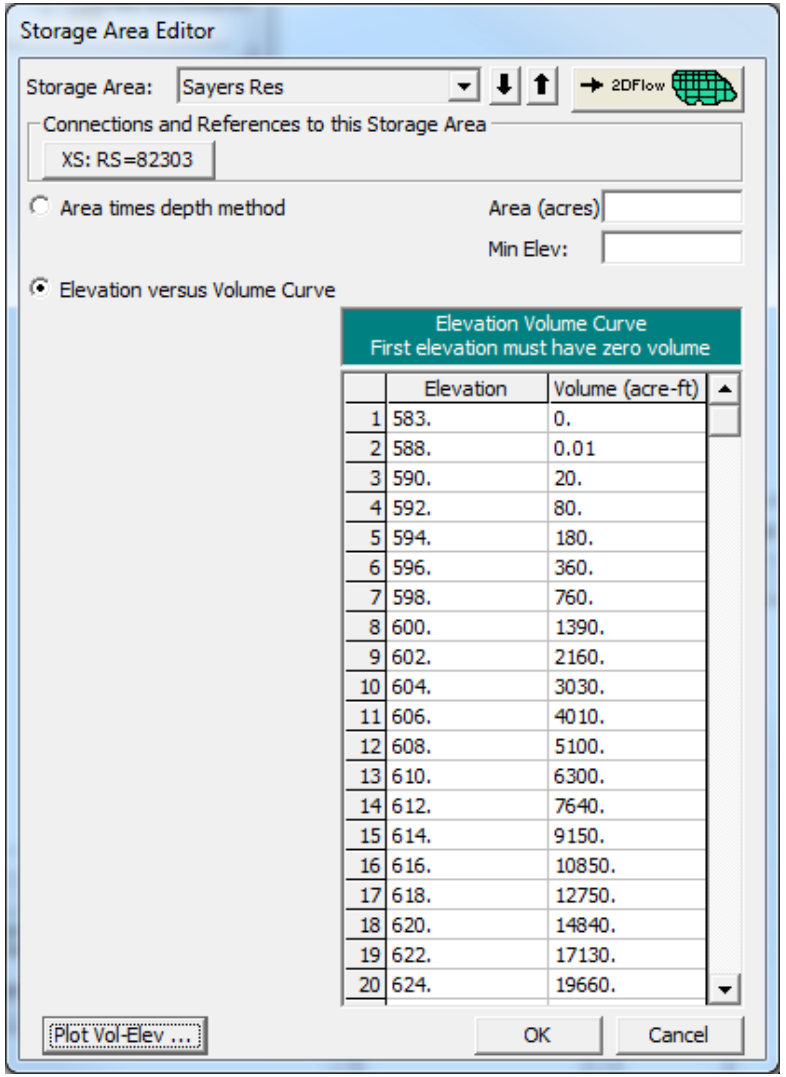
Reservoir Modeling Options



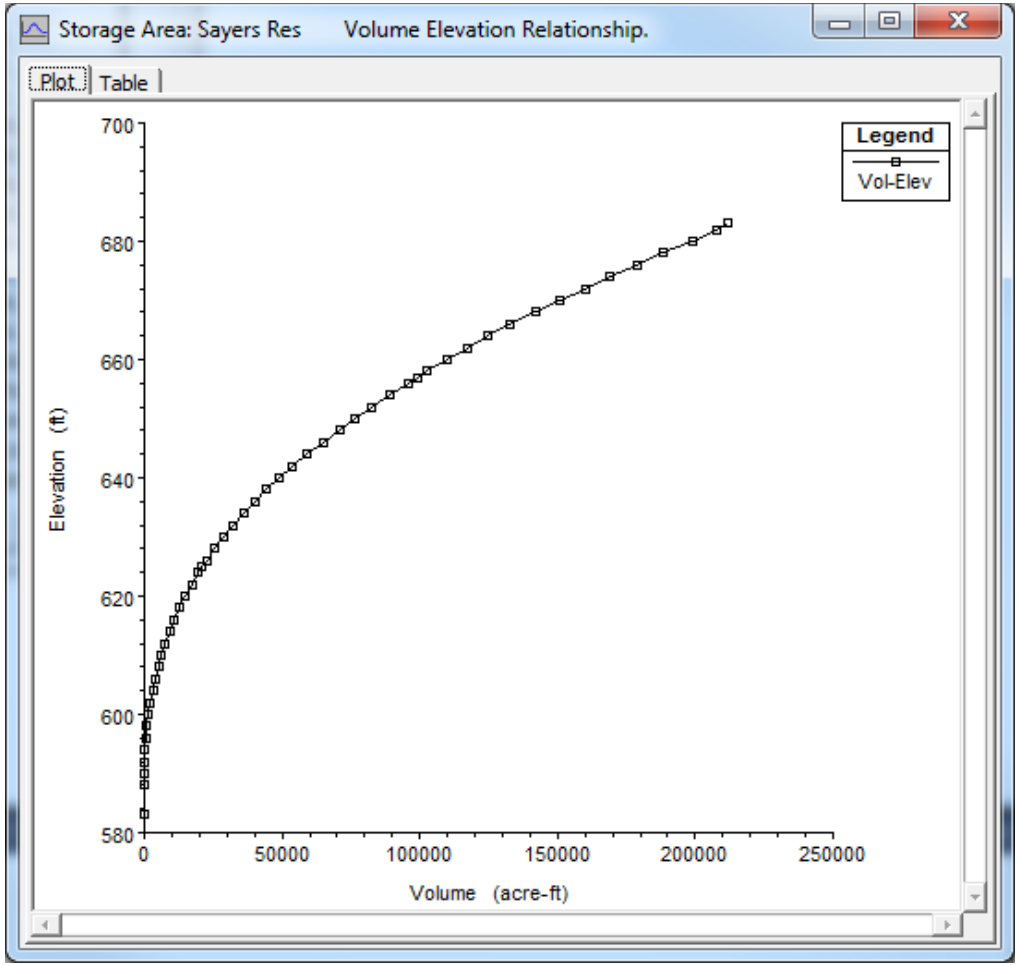
Connecting a Storage Area



Stage-Volume Curve



	Elevation	Volume (acre-ft)
1	583.	0.
2	588.	0.01
3	590.	20.
4	592.	80.
5	594.	180.
6	596.	360.
7	598.	760.
8	600.	1390.
9	602.	2160.
10	604.	3030.
11	606.	4010.
12	608.	5100.
13	610.	6300.
14	612.	7640.
15	614.	9150.
16	616.	10850.
17	618.	12750.
18	620.	14840.
19	622.	17130.
20	624.	19660.



Storage Area Inflow