Hydraulic Structures
Embankments
Reservoirs

Hydraulic Structures in GSSHA

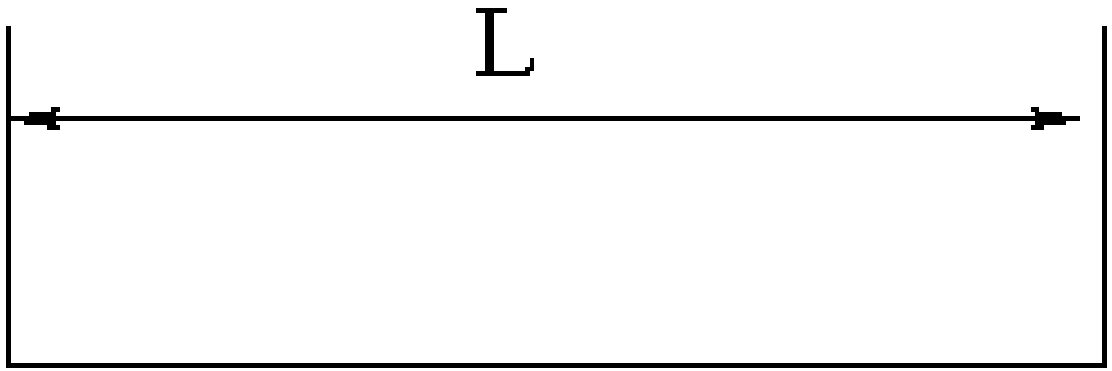
- Can be added to any model with a 1D stream network.
- Structures are special link types.
- Structures function as internal boundary conditions inside the stream network.
- Multiple structures can be combined at a single location.
- Structure types may vary in the stream network and at a single location.

Structure Types

- Broad crested weirs
  - Horizontal
  - Parabolic
- Culverts
  - Circular
  - Rectangular
- Active control structures
  - Scheduled discharge
- Generic structure rating curve

Horizontal Weirs

- Common outlets for detention basins.

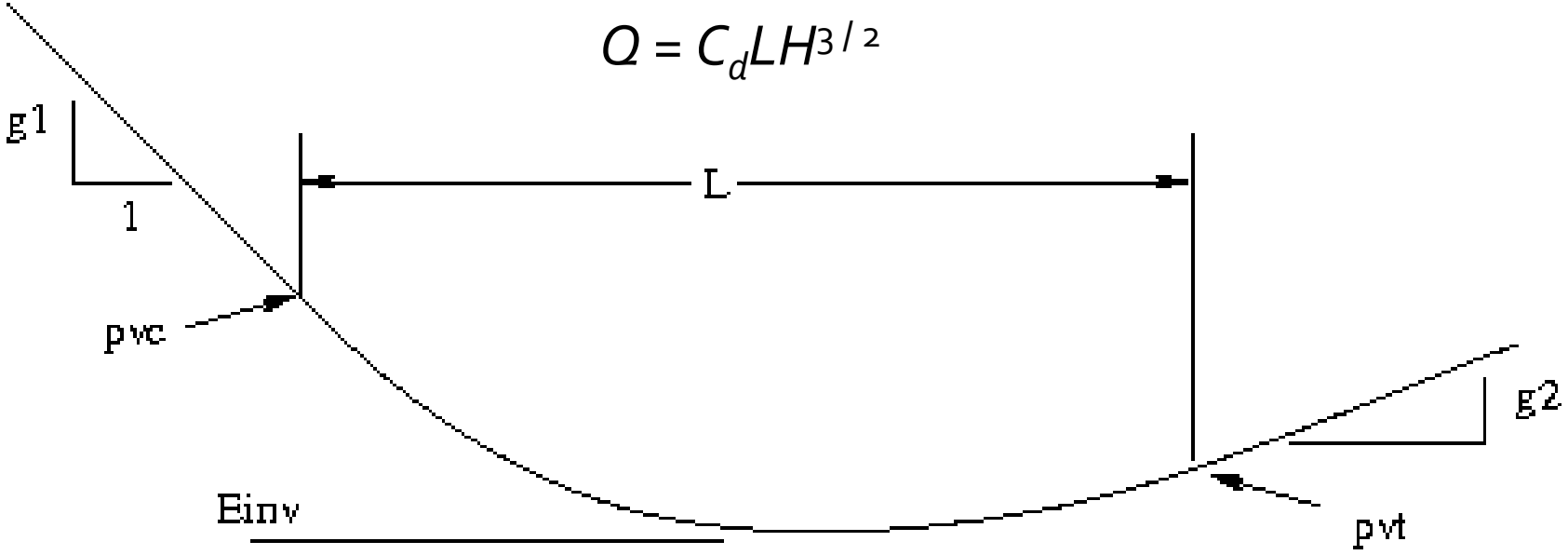


- $Q = C_d L H^{3/2}$

- STRUCTTYPE WEIR
  - CREST_LENGTH
  - CREST_LOW_ELEV
  - DISCHARGE_COEFF_FORWARD
  - DISCHARGE_COEFF_REVERSE

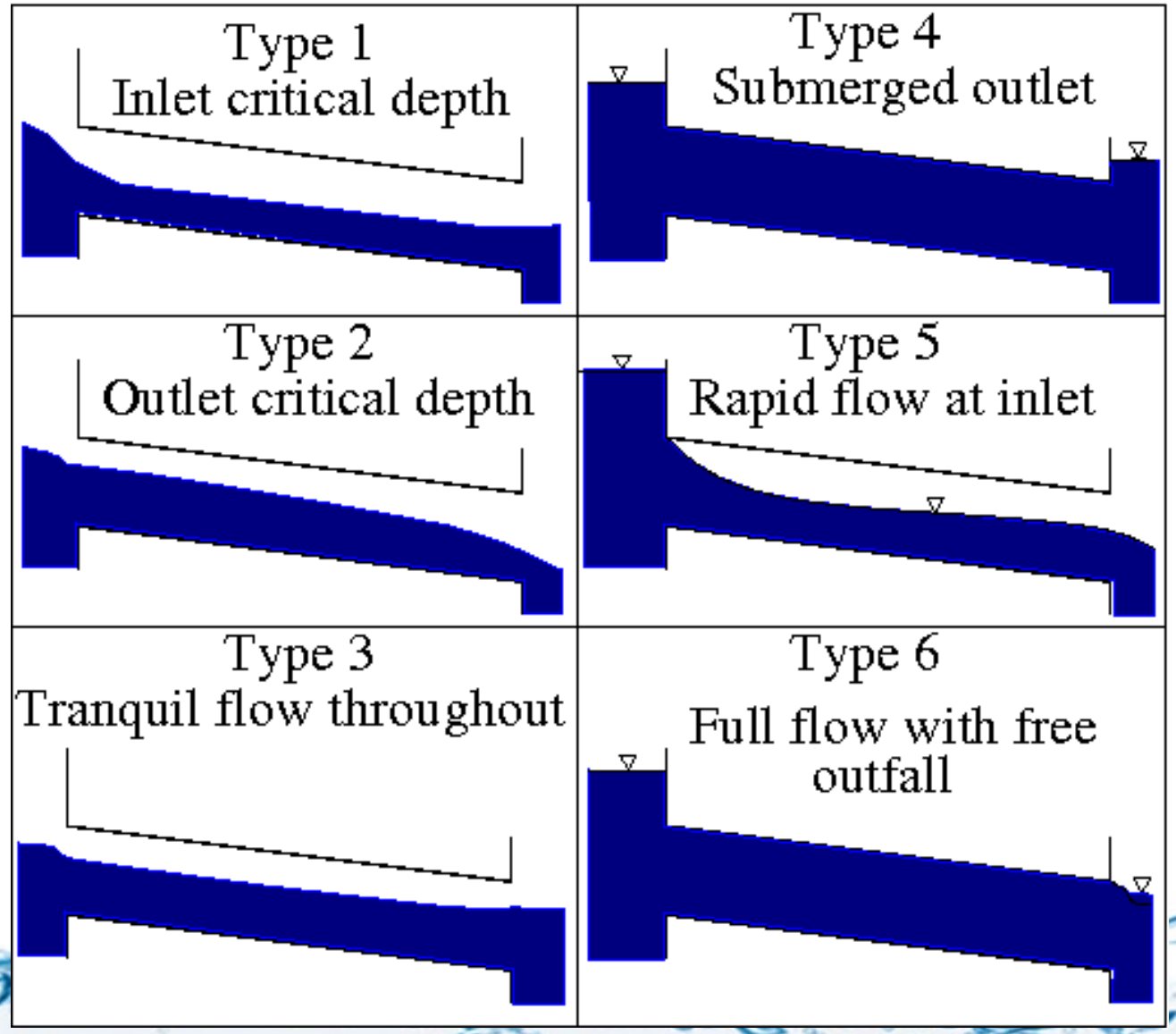
Sag Curve Weir

$$Q = C_d L H^{3/2}$$



g1= grade of steepest approach (negative) 0–1
pvc= point of vertical curve initiation
L= length of the vertical curve (horizontal dist.) meters
pvt= point of tangency (end of vertical curve)
g2= grade of shallowest approach (positive) 0–1
Einv= Elevation of the invert

Culvert Flow Types



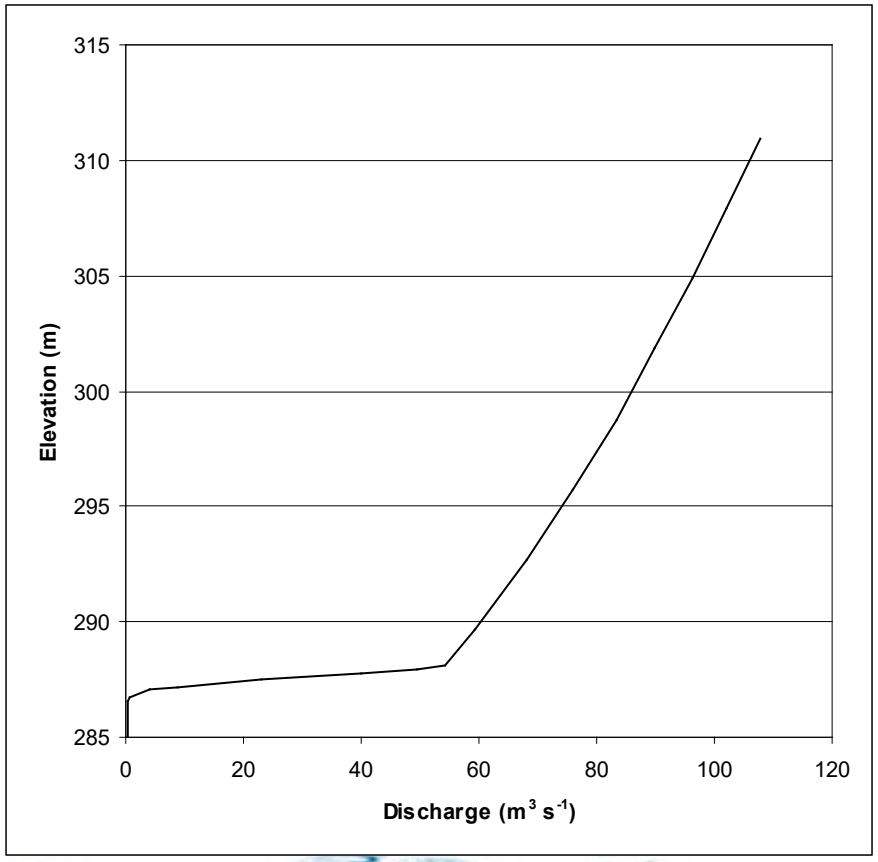
Scheduled Releases

- Specified discharges as a function of time.
- History matching with known releases.

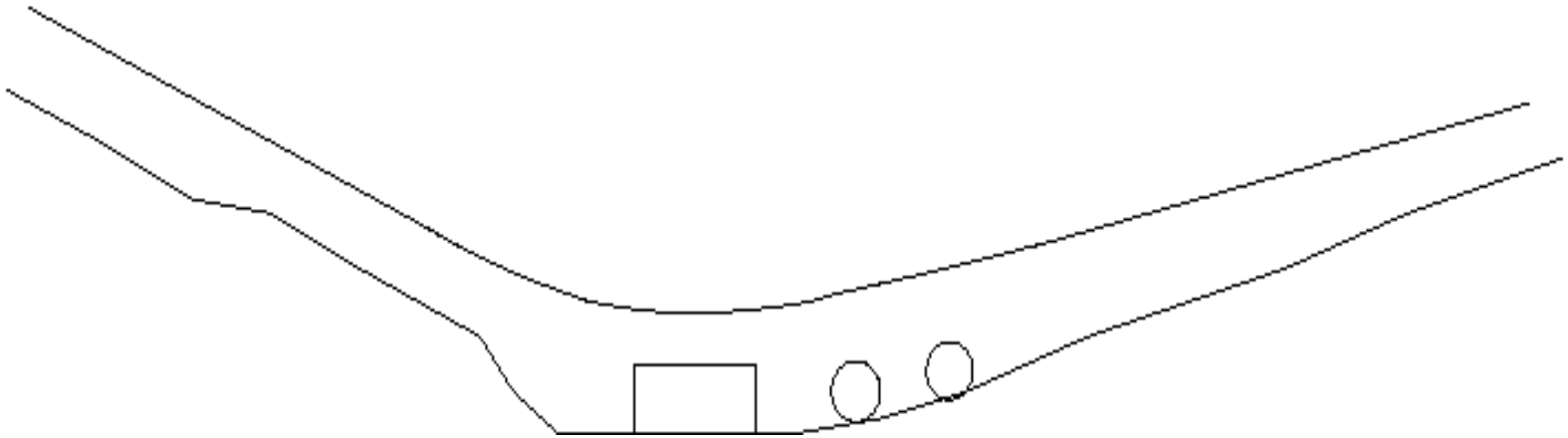
Rating Curve

- Series of discharge vs. water surface elevation points.
- Simulate any hydraulic structure or flow control device.

•286.5	0.31
•286.585	0.36
•286.737	0.714
•287.042	4.08
•287.195	8.873
•287.50	23.05
•287.80	40.06
•288.11	54.21
•292.683	68.027
•298.78	83.262
•304.878	96.372
•310.975	107.70



Compound Structure Example

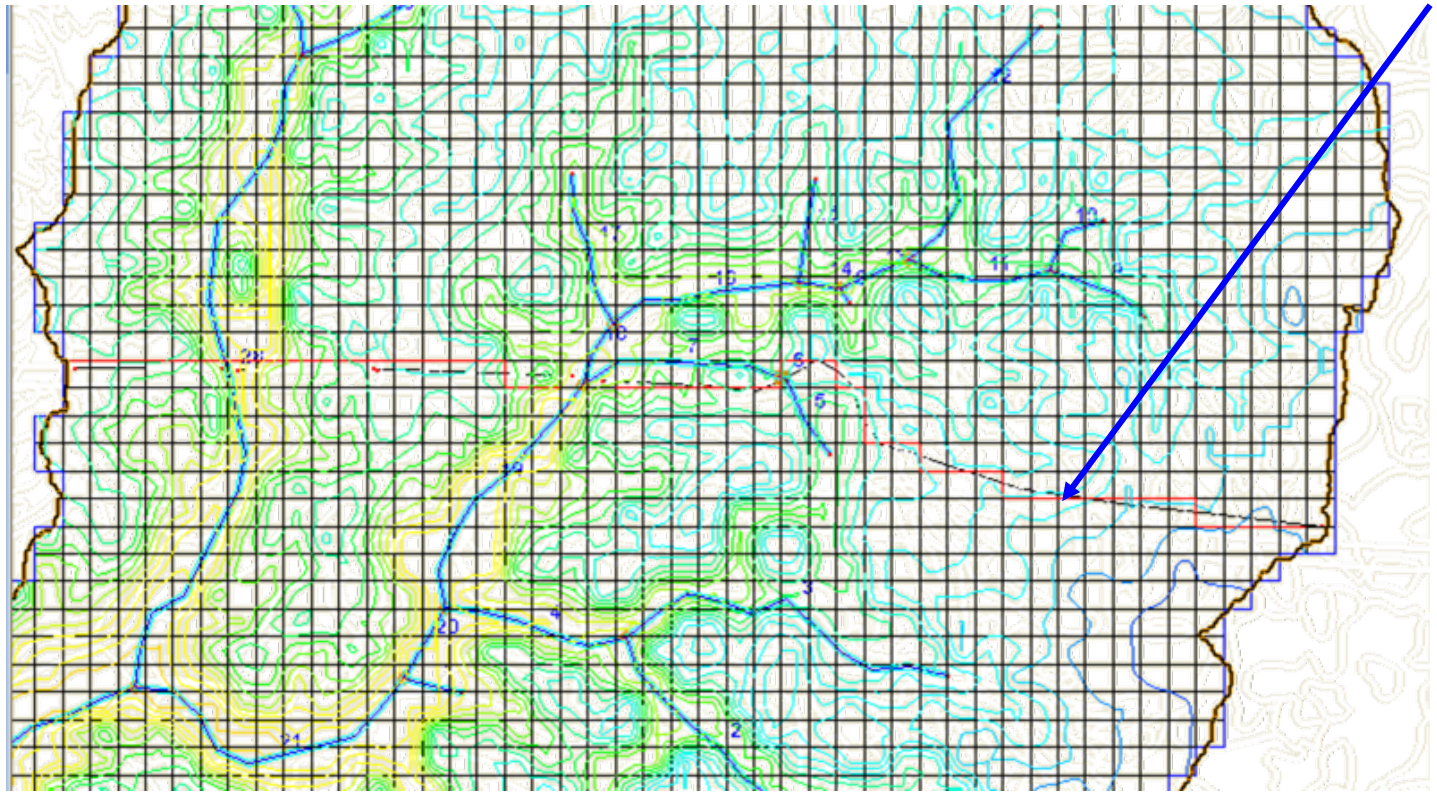


- Hydraulic structure consisting of four elements:
  - sag vertical-curve weir
  - box culvert
  - two circular culverts
- Each structure element allowed to have a different invert elevation.

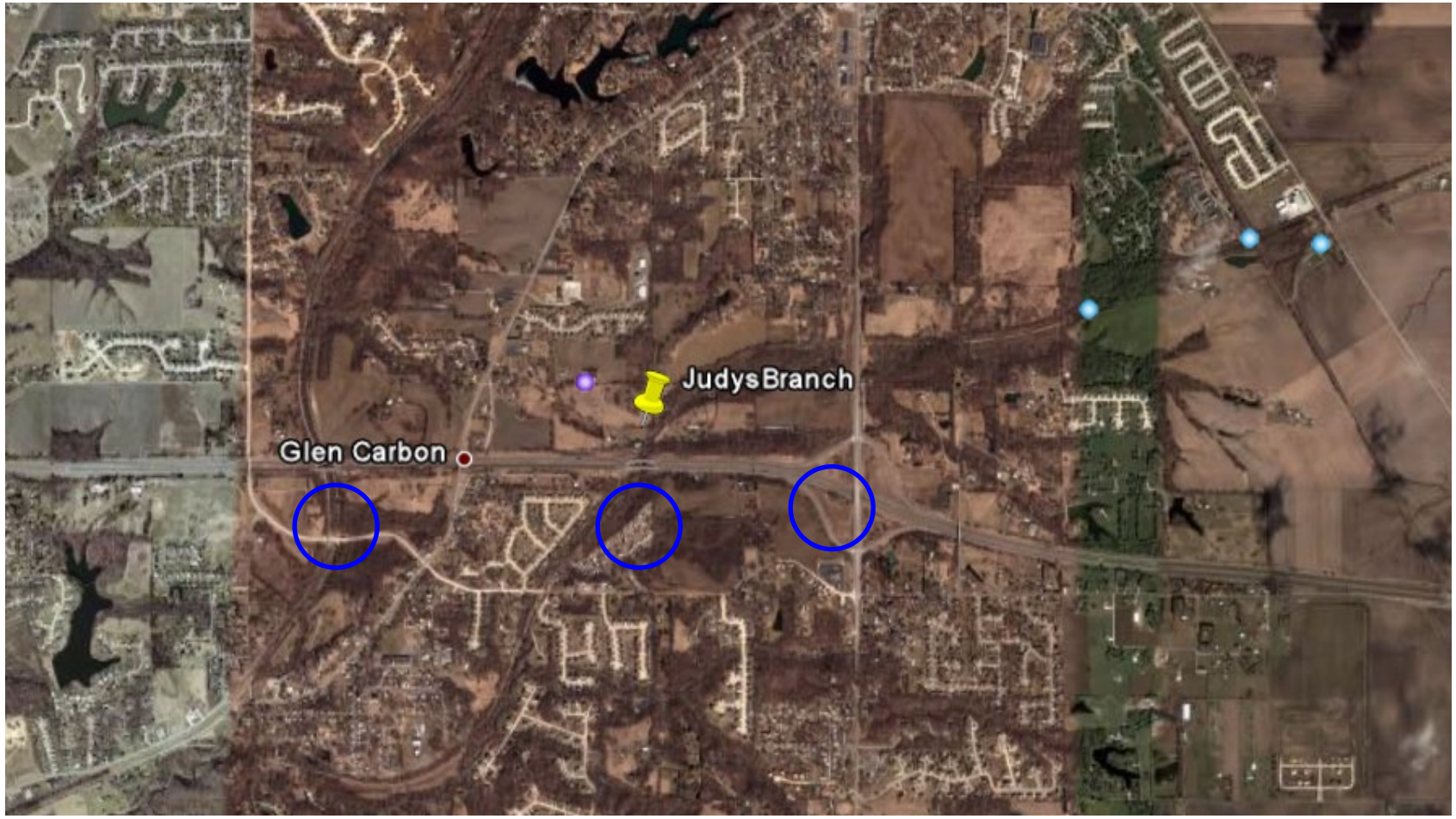
Embankment Conceptualization

GSSHA Embankment

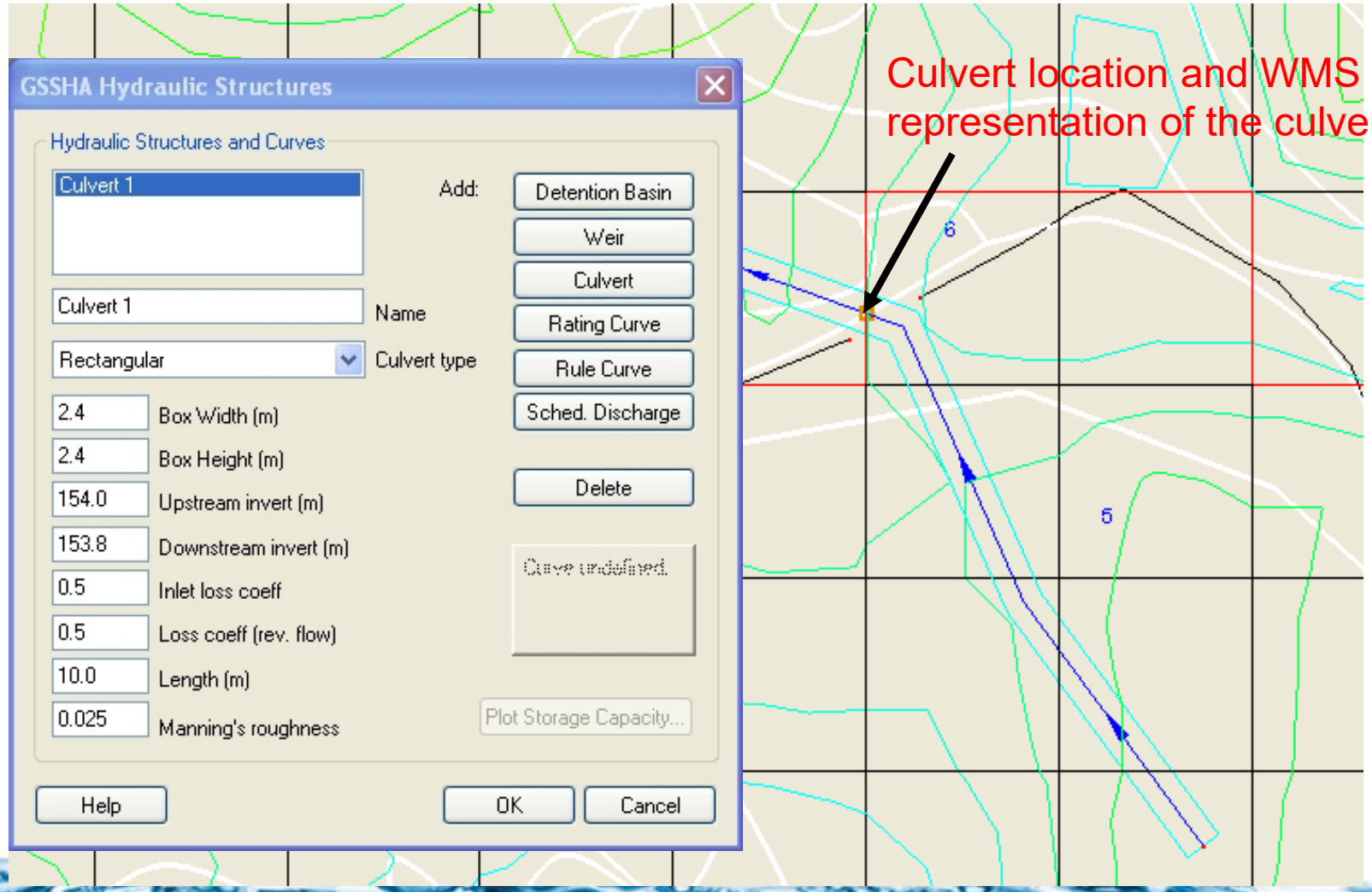
Red line representing embankment in WMS



Culvert Locations

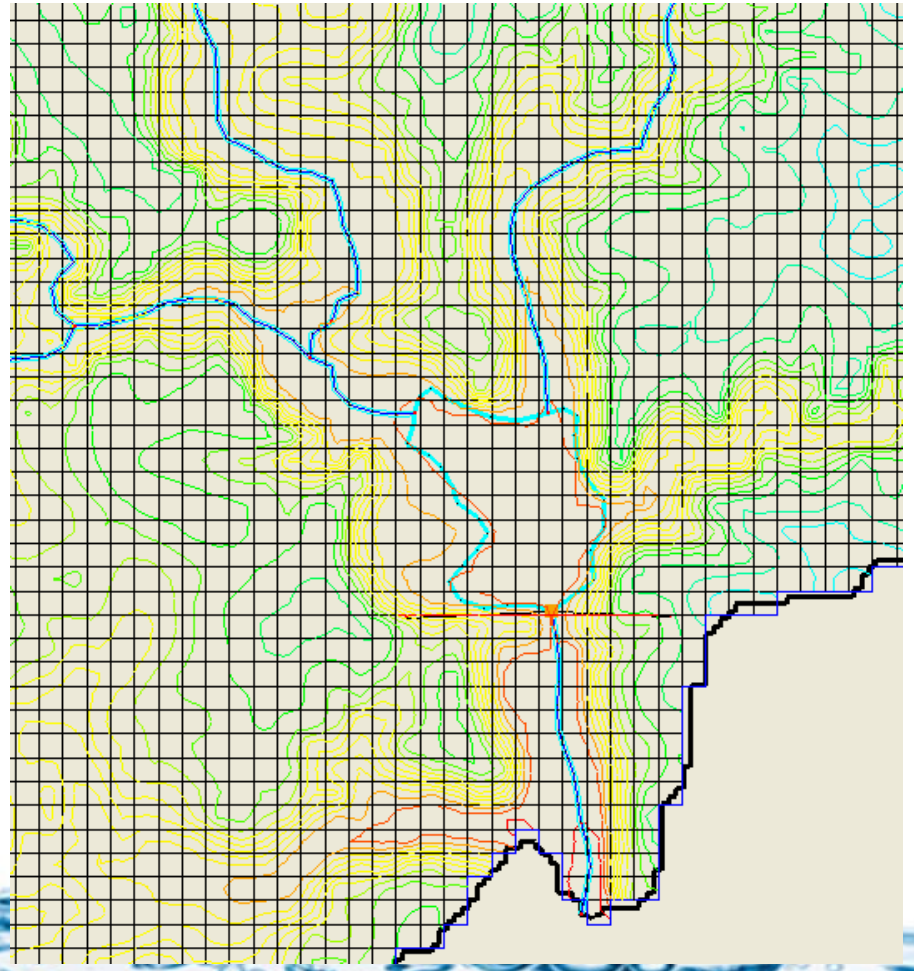


Culvert Conceptualization



Lakes/Reservoirs/ Detention Basins

- Lakes/reservoirs and detention basins are dynamic features that exist both in the stream network and on the overland flow plane.



Reservoir Fluxes

- Rainfall
- Overland flow
- Stream flow
- ET
- Outlet discharge
- Seepage/groundwater recharge

Interaction with Overland

- Reservoirs occupy overland flow cells.
- Water flows from the overland cells to the reservoirs and from the reservoirs to the overland cells.
- As reservoirs expand they overtake overland cells.
- As reservoirs recede they release overland cells.

Overland Cells Within a Reservoir

No cell processes occur while overland cells are occupied

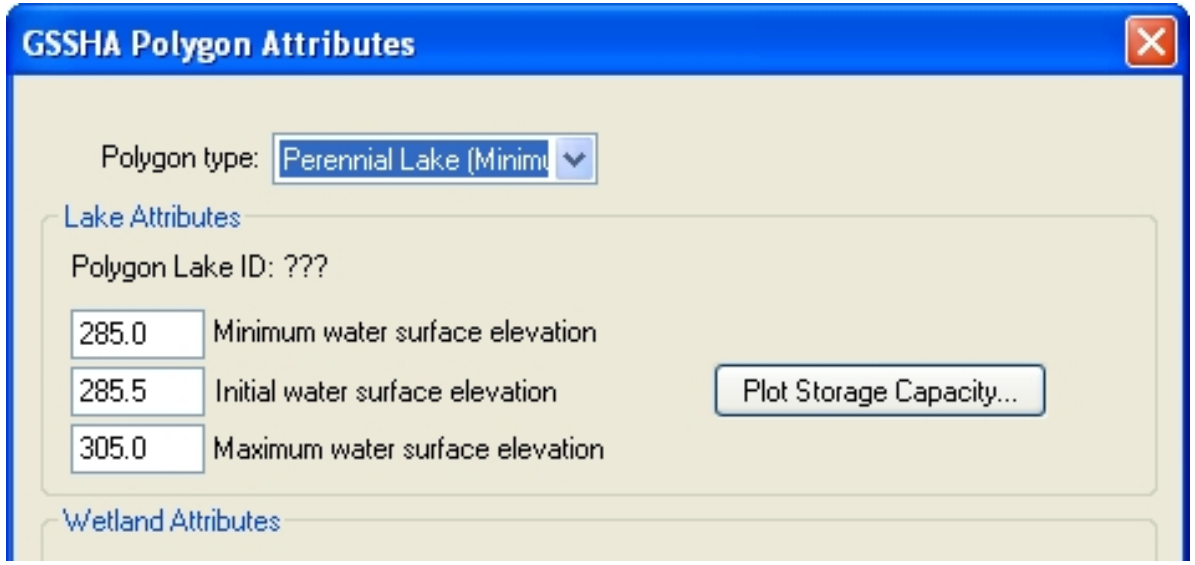
- Cell to cell flow
- Infiltration
- Soil ET

Reservoir Stream Interaction

- A reservoir is a boundary condition in stream network.
- Flow from streams to reservoirs and from reservoirs to streams
- Reservoirs overtake stream cells when the overland flow cells containing them are taken.
- Reservoir releases stream cells as overland cells are released.

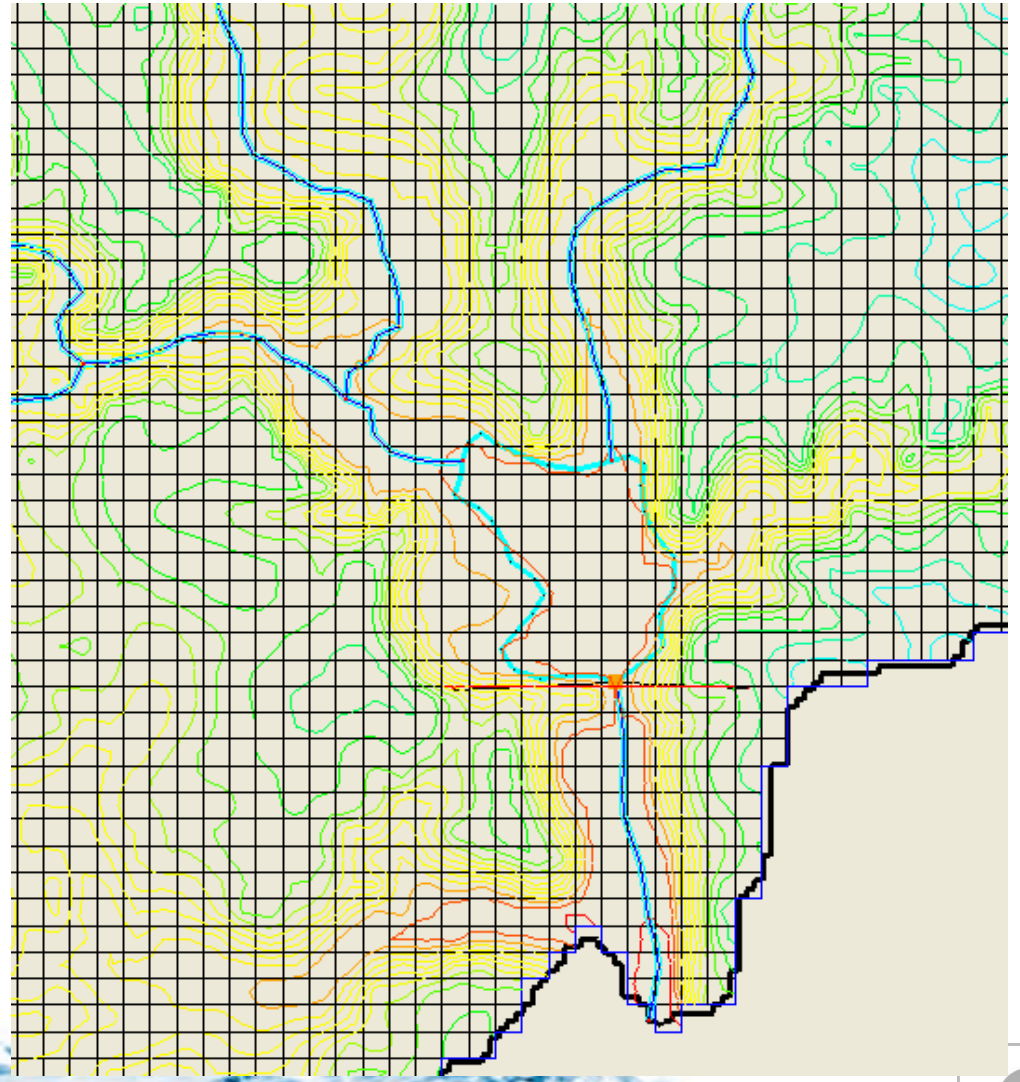
Creating Reservoirs

- Defined in stream network with polygon
- Embankment that represents the dam
- Specify outlet hydraulic structure
- Specify minimum, maximum and initial water level

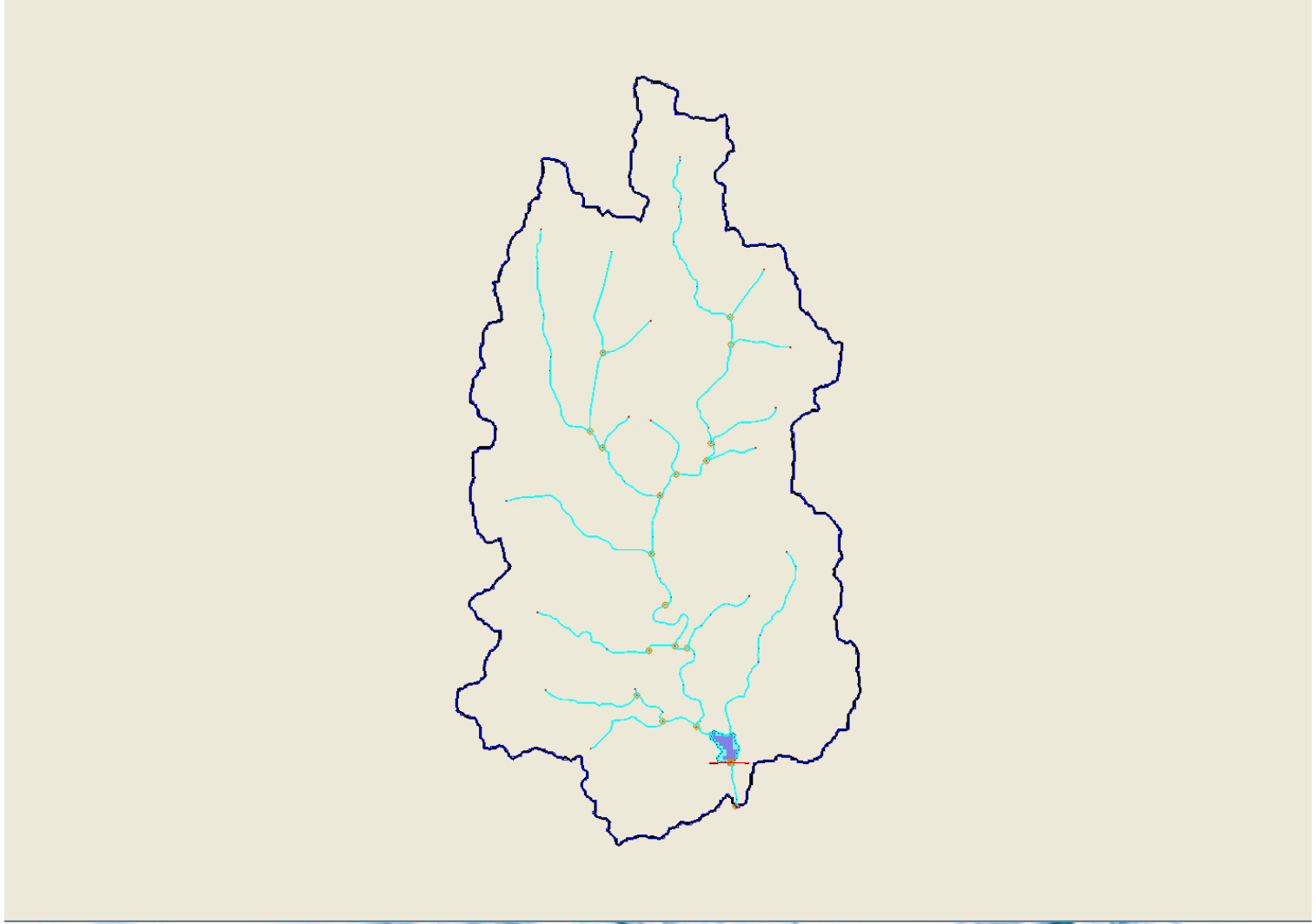


Stage/Area/Volume Relationship

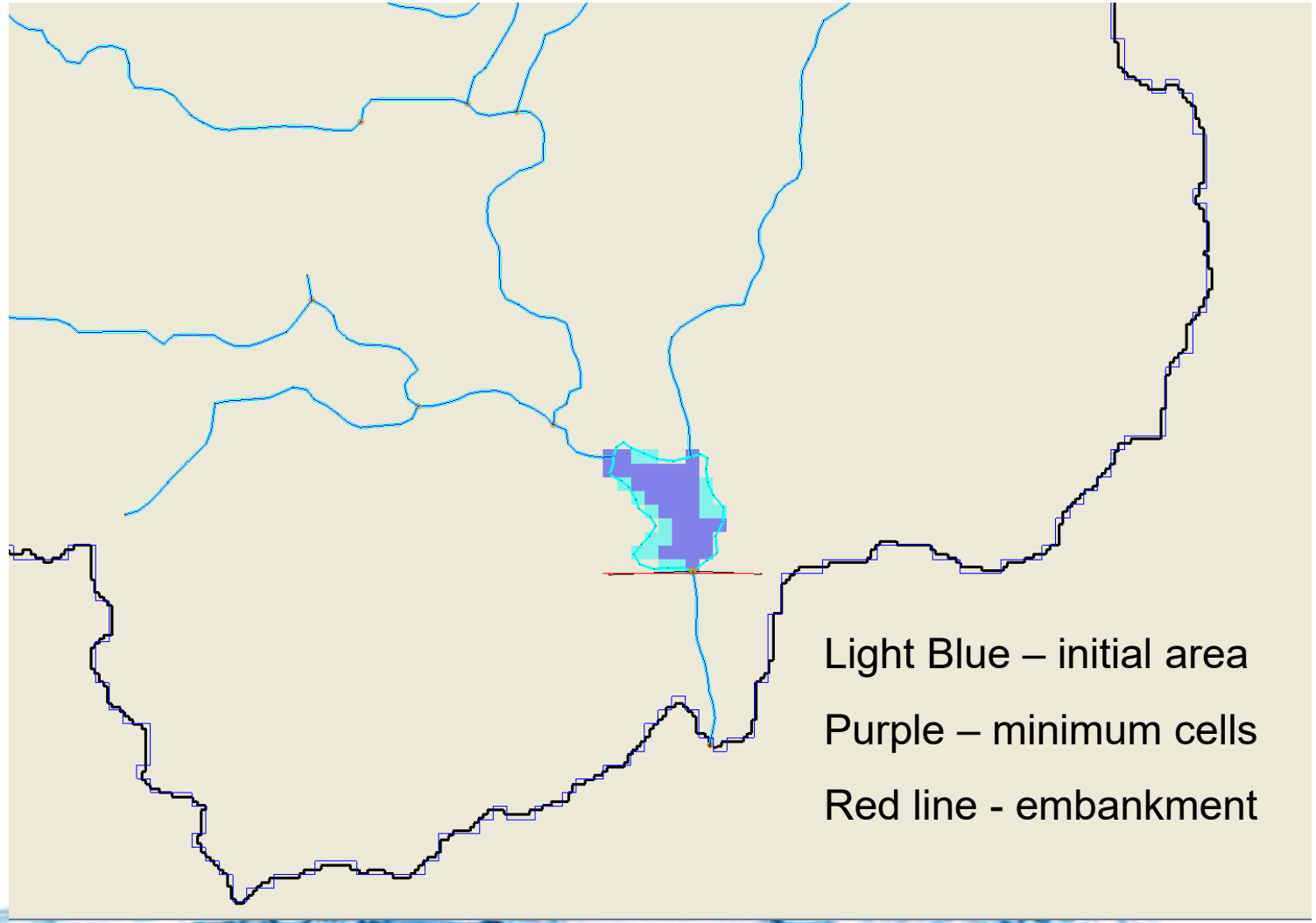
- Stage/Area/Volume relationship is calculated directly from the grid elevations.
- WMS shows plots of relationships.



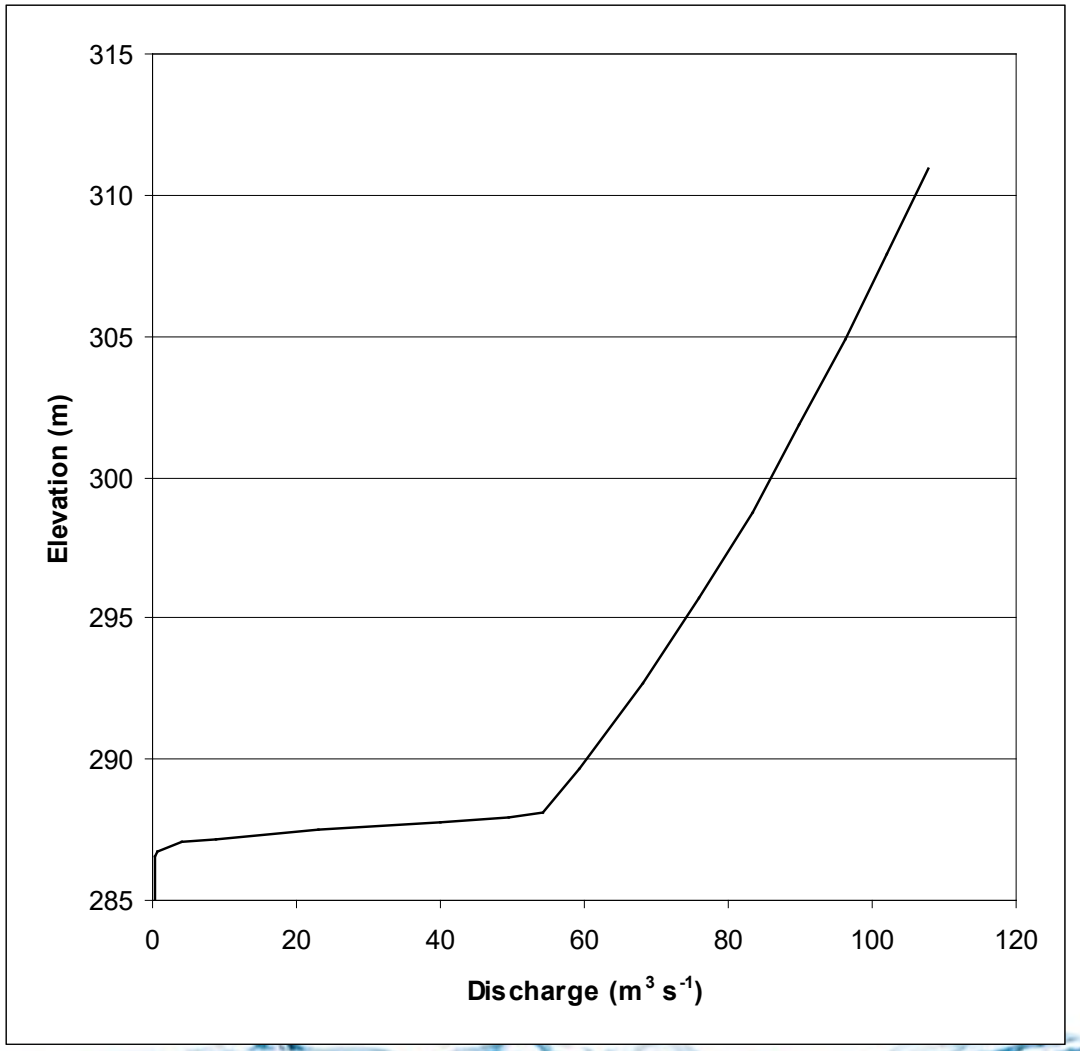
Eau Galle Reservoir Watershed with Stream Network



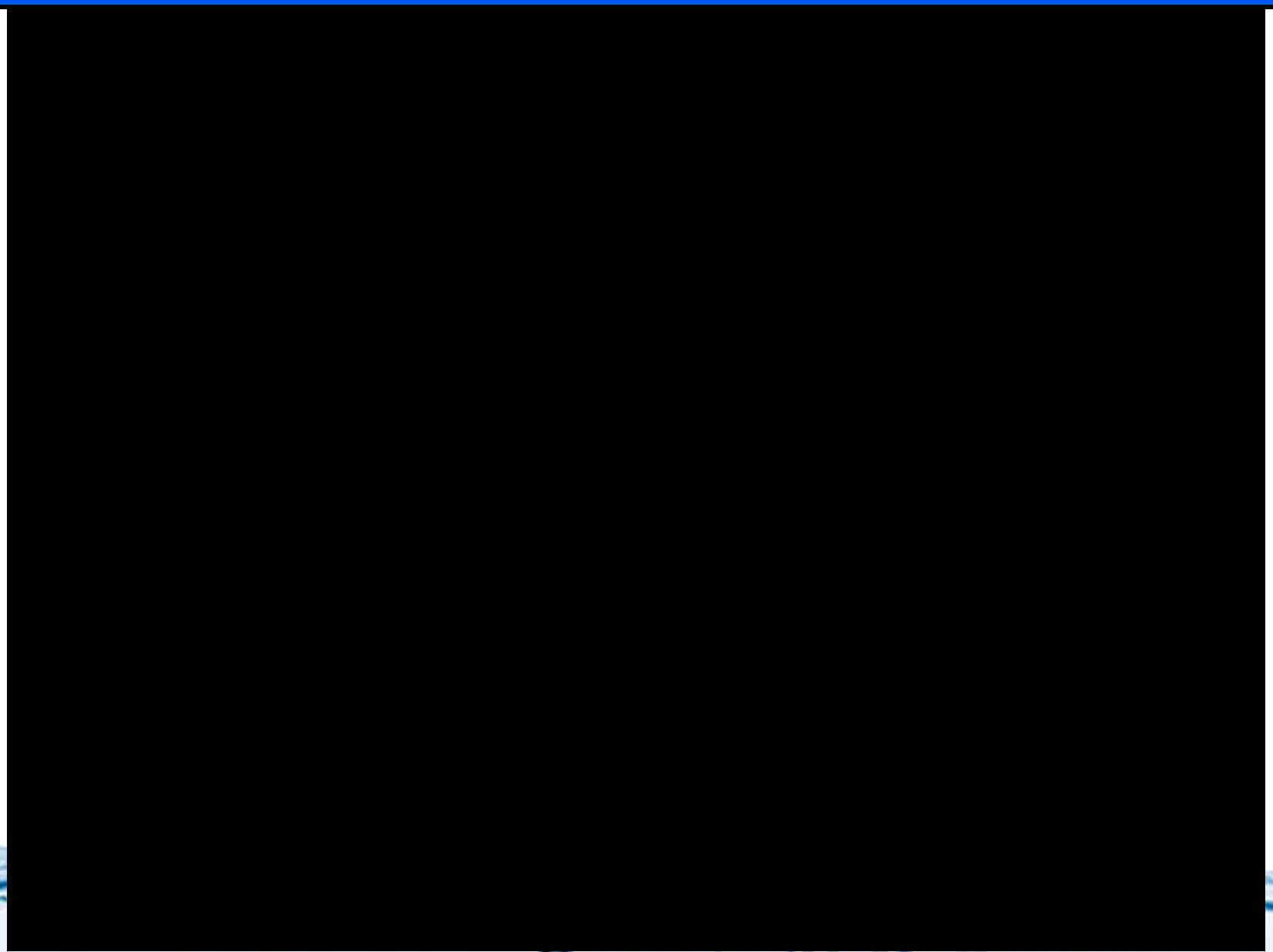
Eau Galle Reservoir



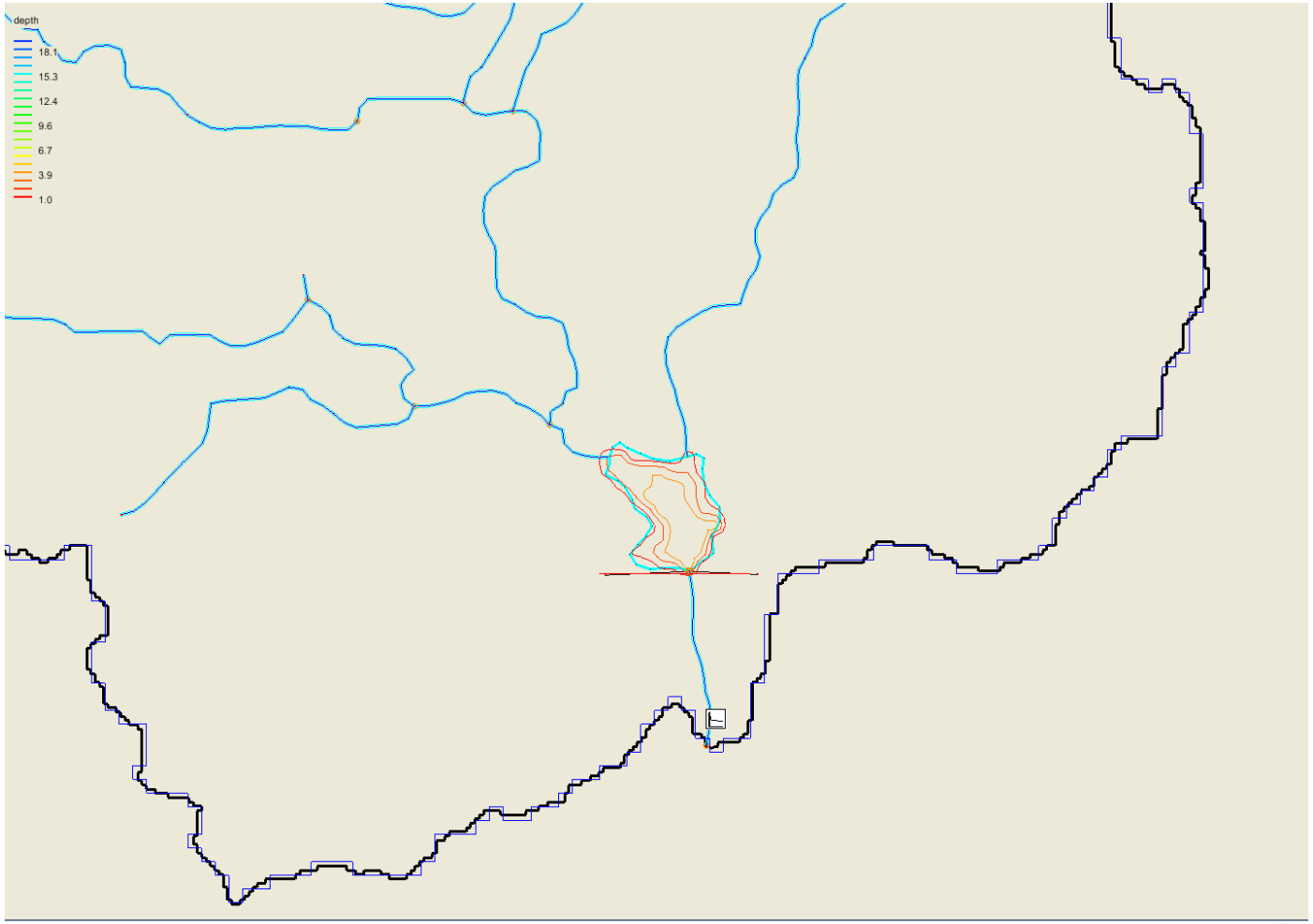
Eau Galle Reservoir Outlet Works



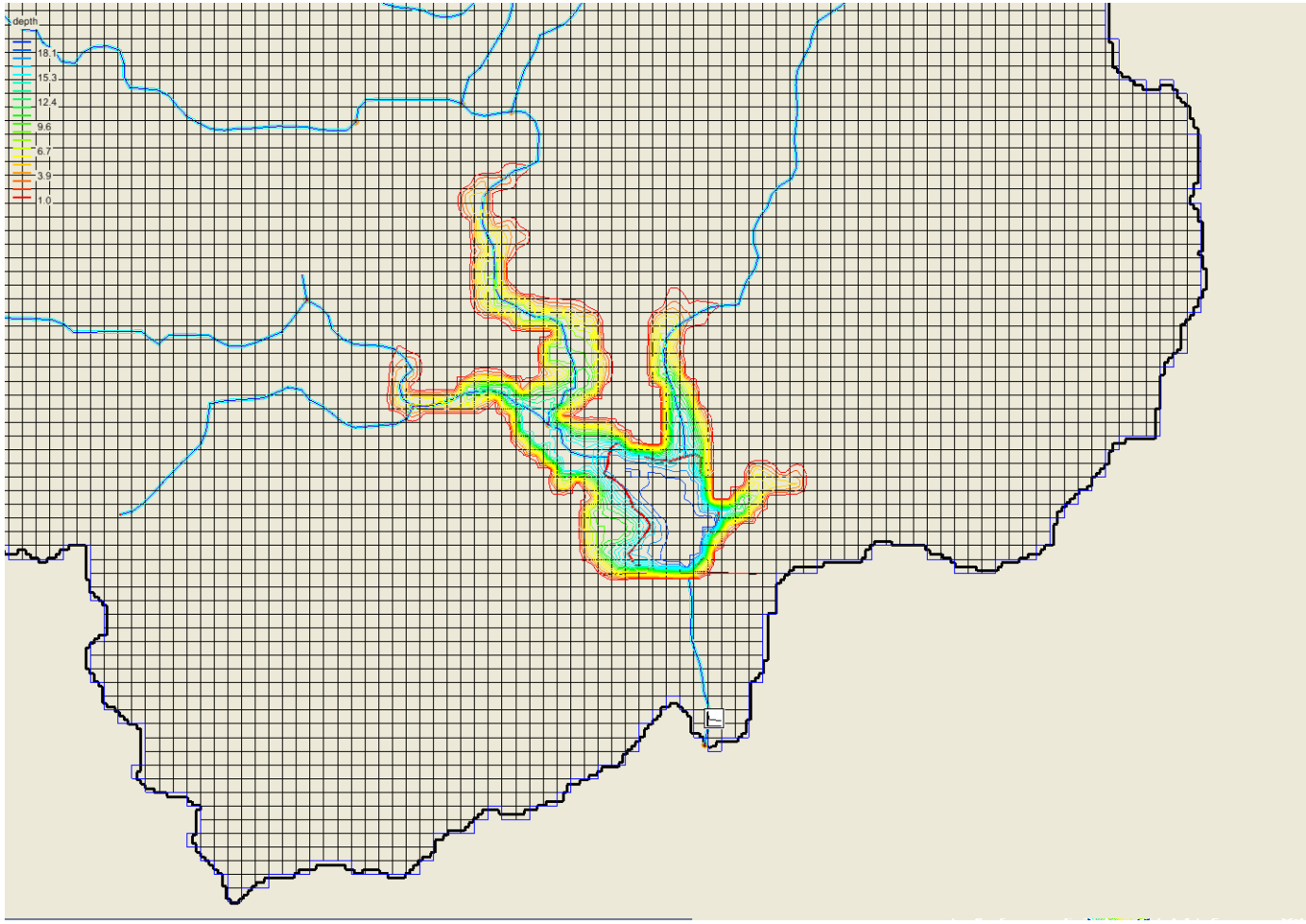
Reservoir Animation



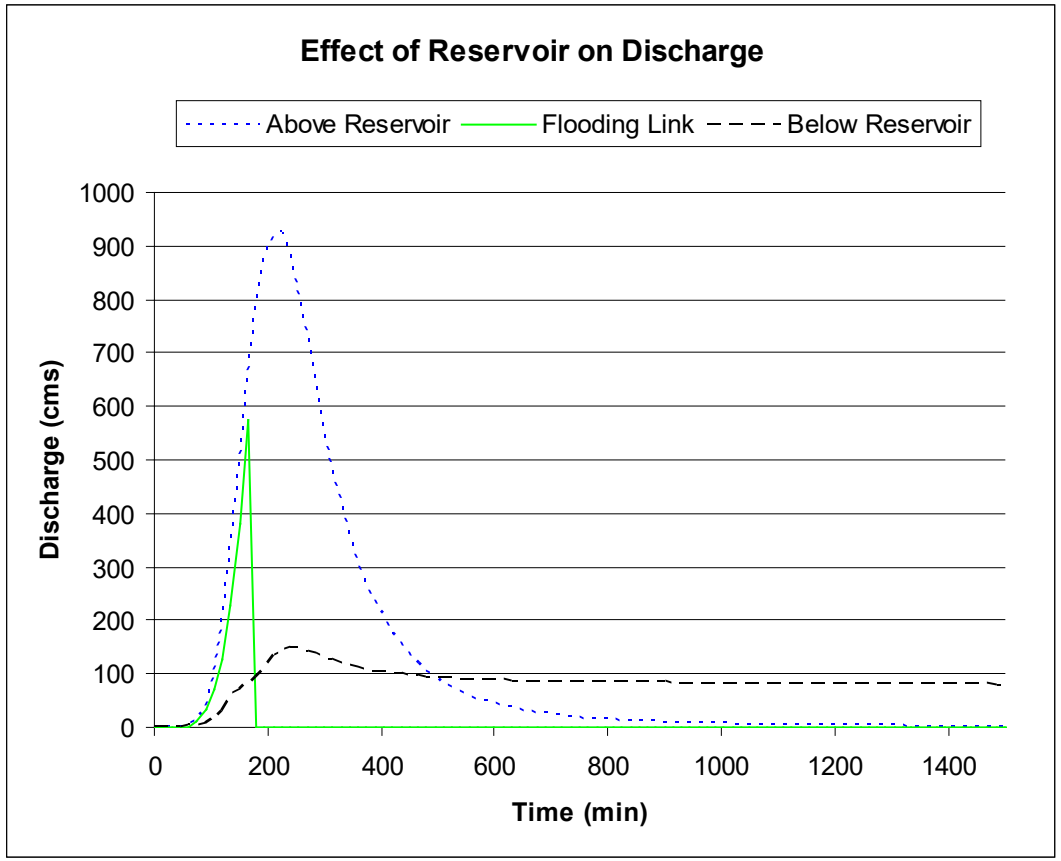
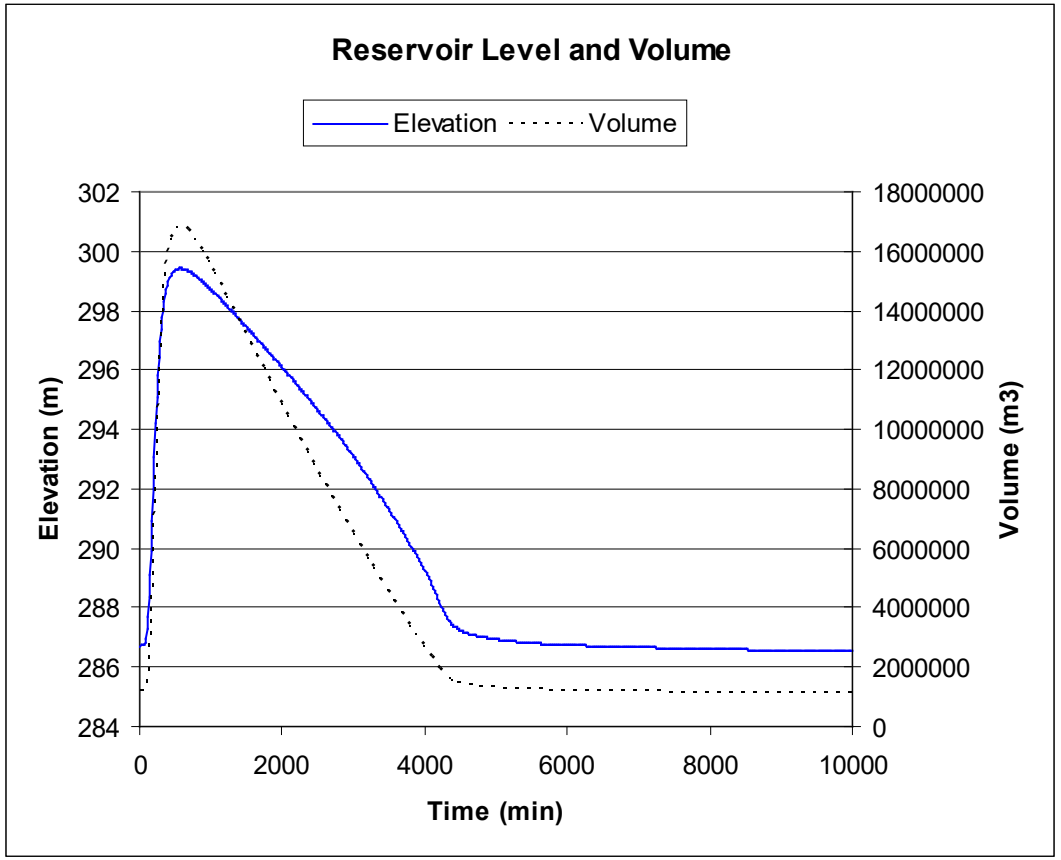
Eau Galle Reservoir Initial Condition



Eau Galle Reservoir Maximum Flood



Stream Discharge Associated with Reservoir



Reservoir Level and Volume