

# Hydraulic Structures

## Embankments

## Reservoirs



# Hydraulic Structures in GSSHA

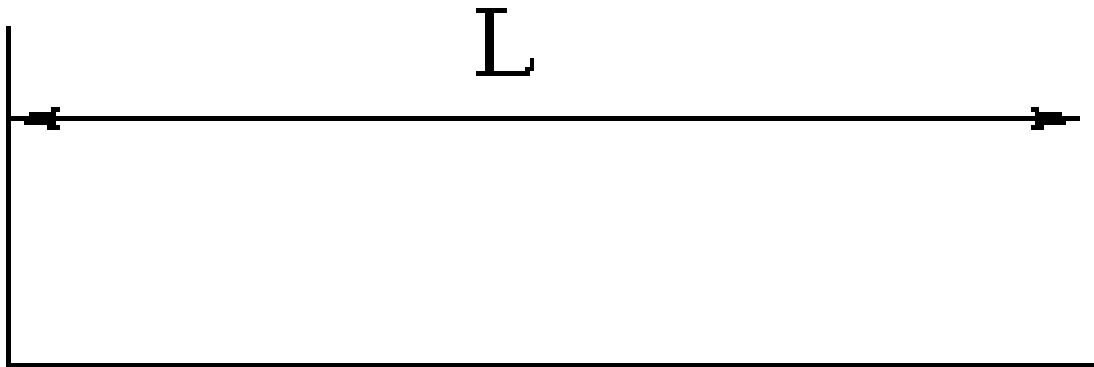
- Can be added to any model with a 1D stream network.
- Structures are special link types.
- Structures function as internal boundary conditions inside the stream network.
- Multiple structures can be combined at a single location.
- Structure types may vary in the stream network and at a single location.



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

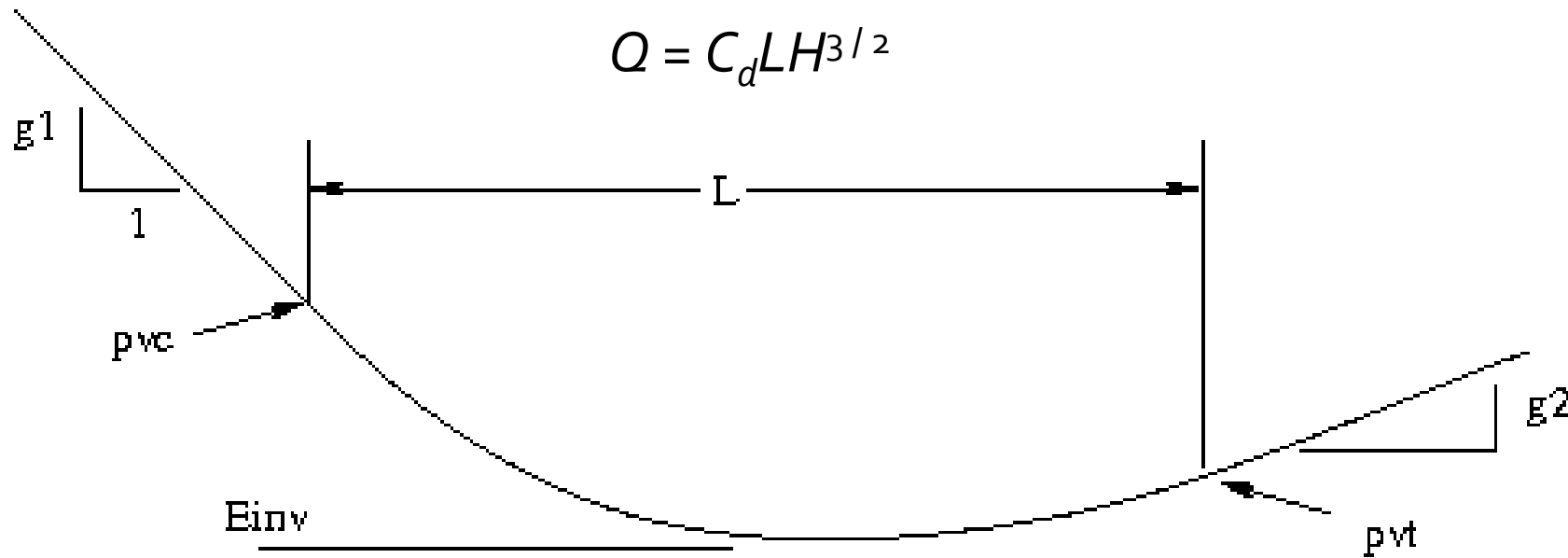


- Common outlets for detention basins.



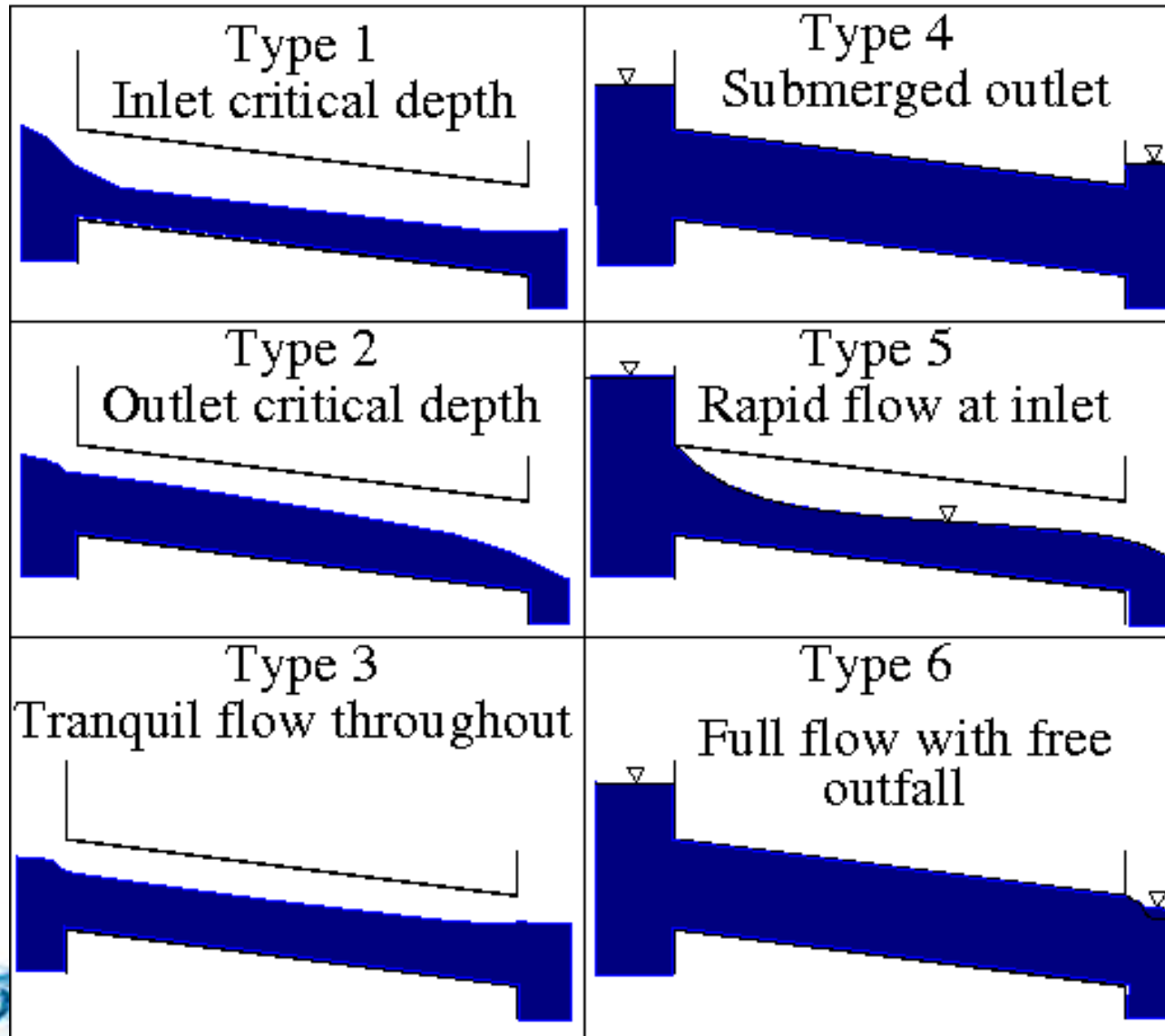
- $Q = C_d L H^{3/2}$

- STRUCTTYPE WEIR
  - CREST\_LENGTH
  - CREST\_LOW\_ELEV
  - DISCHARGE\_COEFF\_FORWARD
  - DISCHARGE\_COEFF\_REVERSE



- $g_1$  = 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)
- $g_2$  = grade of shallowest approach (positive) 0–1
- $E_{inv}$  = Elevation of the invert

# Culvert Flow Types

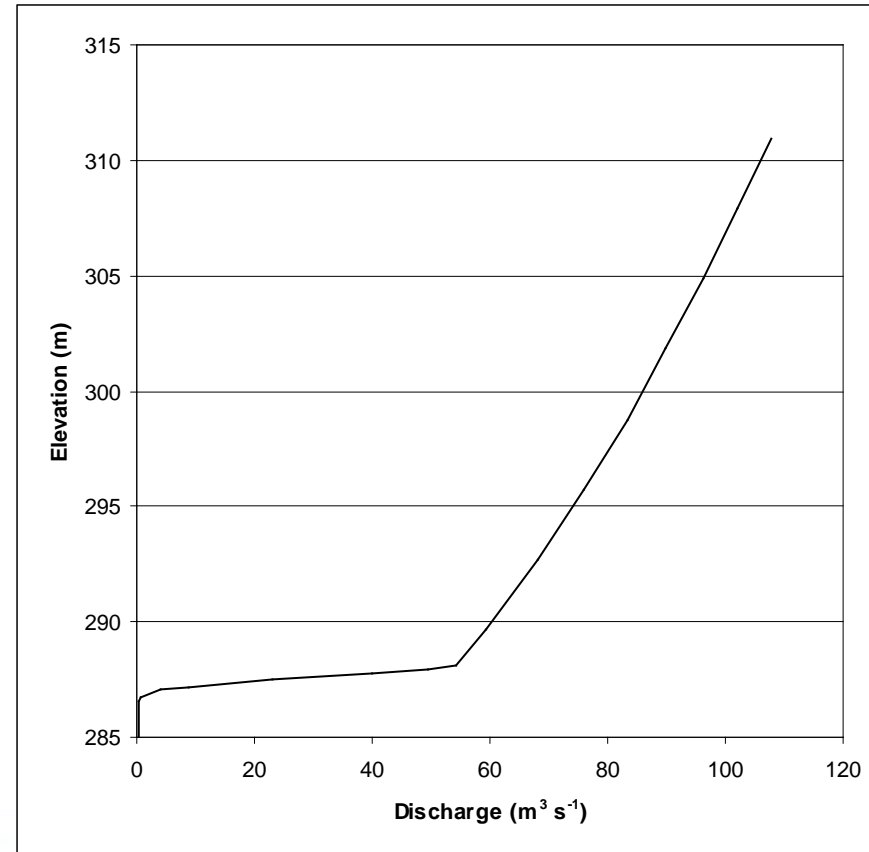


- Specified discharges as a function of time.
- History matching with known releases.



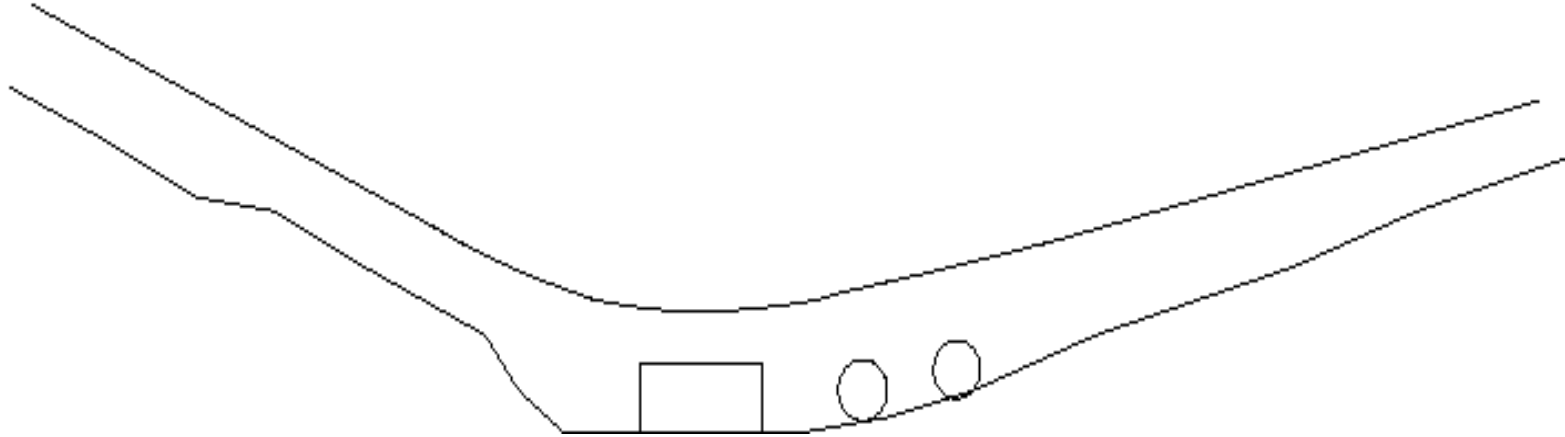
- Series of discharge vs. water surface elevation points.
- Simulate any hydraulic structure or flow control device.

•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.

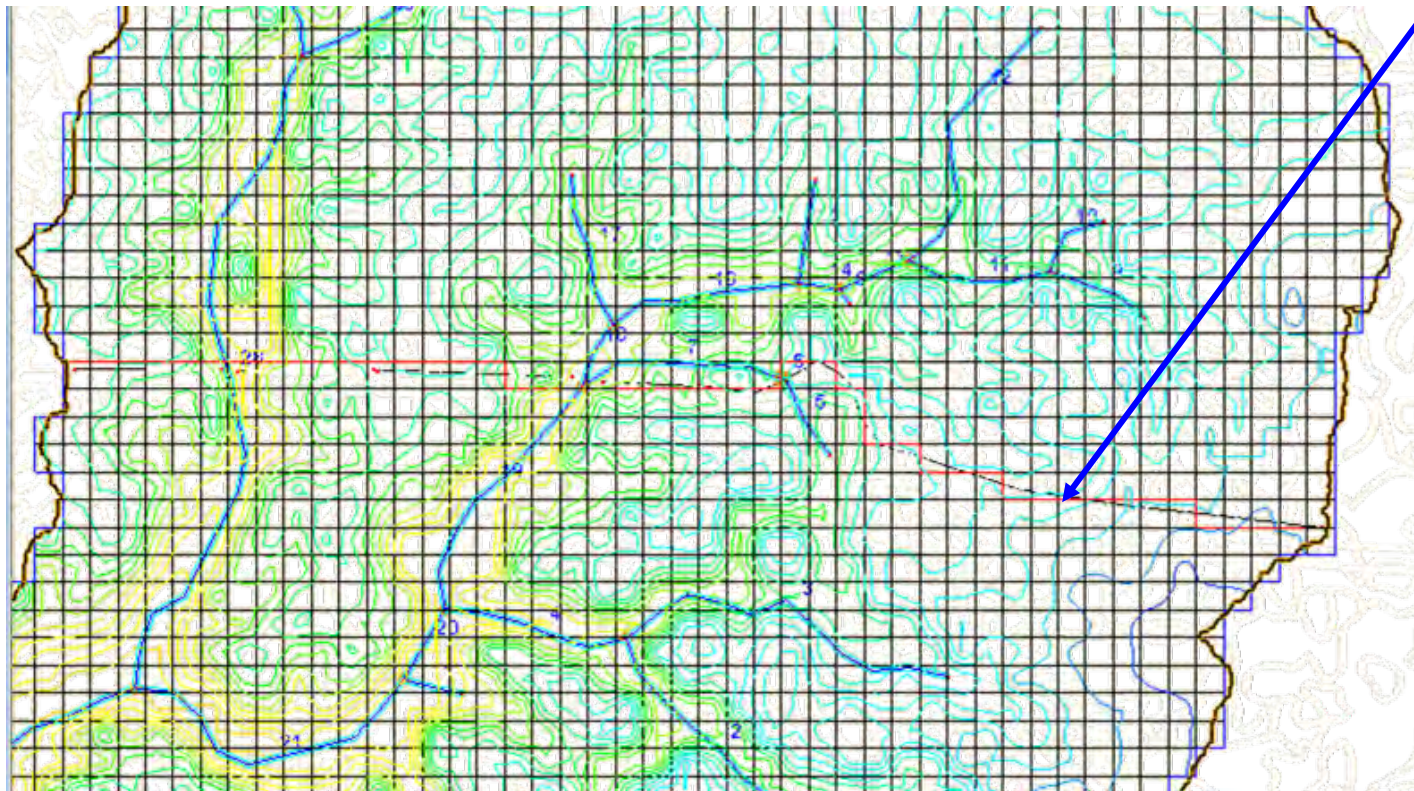


# Embankment Conceptualization

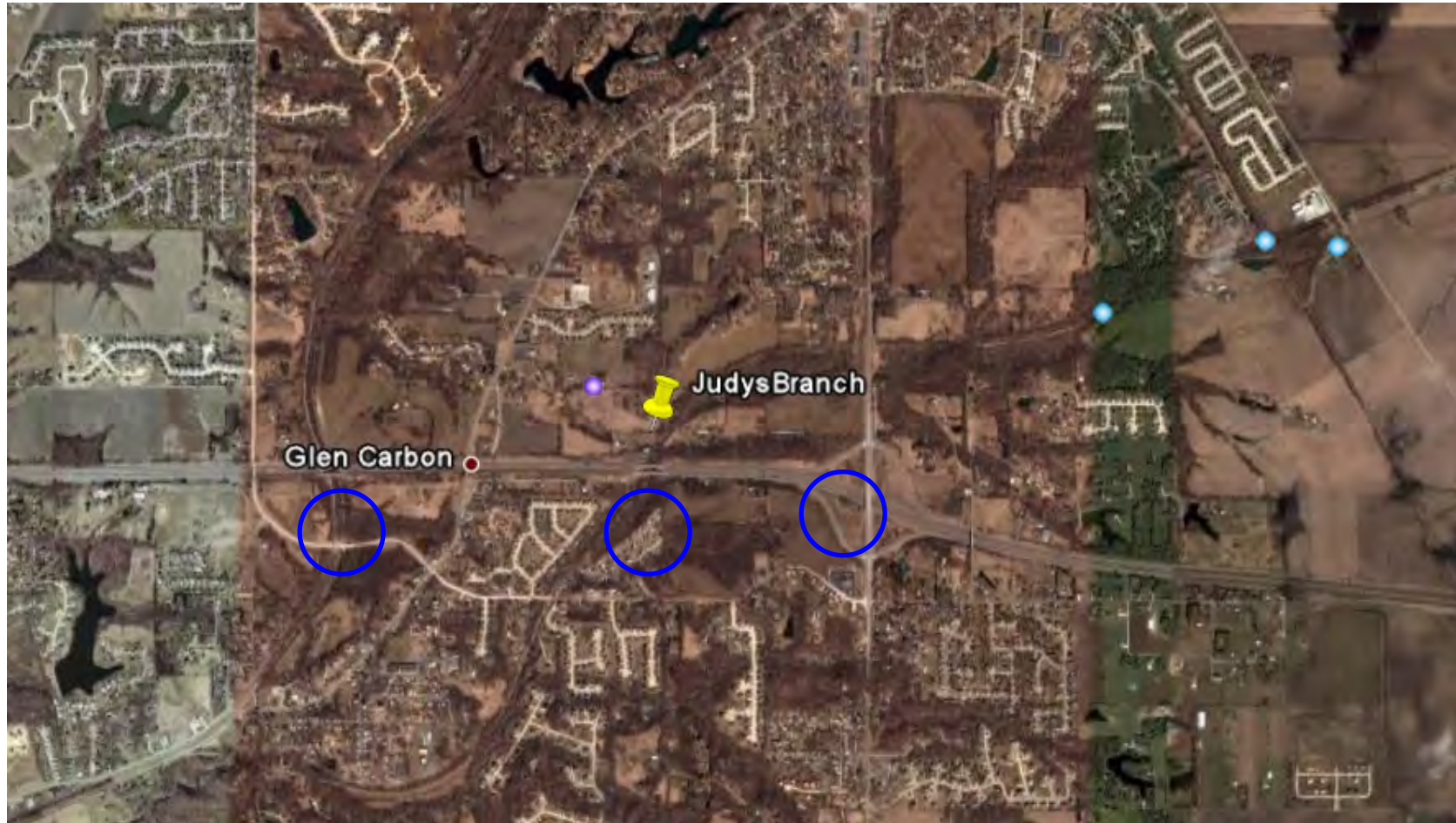


# GSSHA Embankment

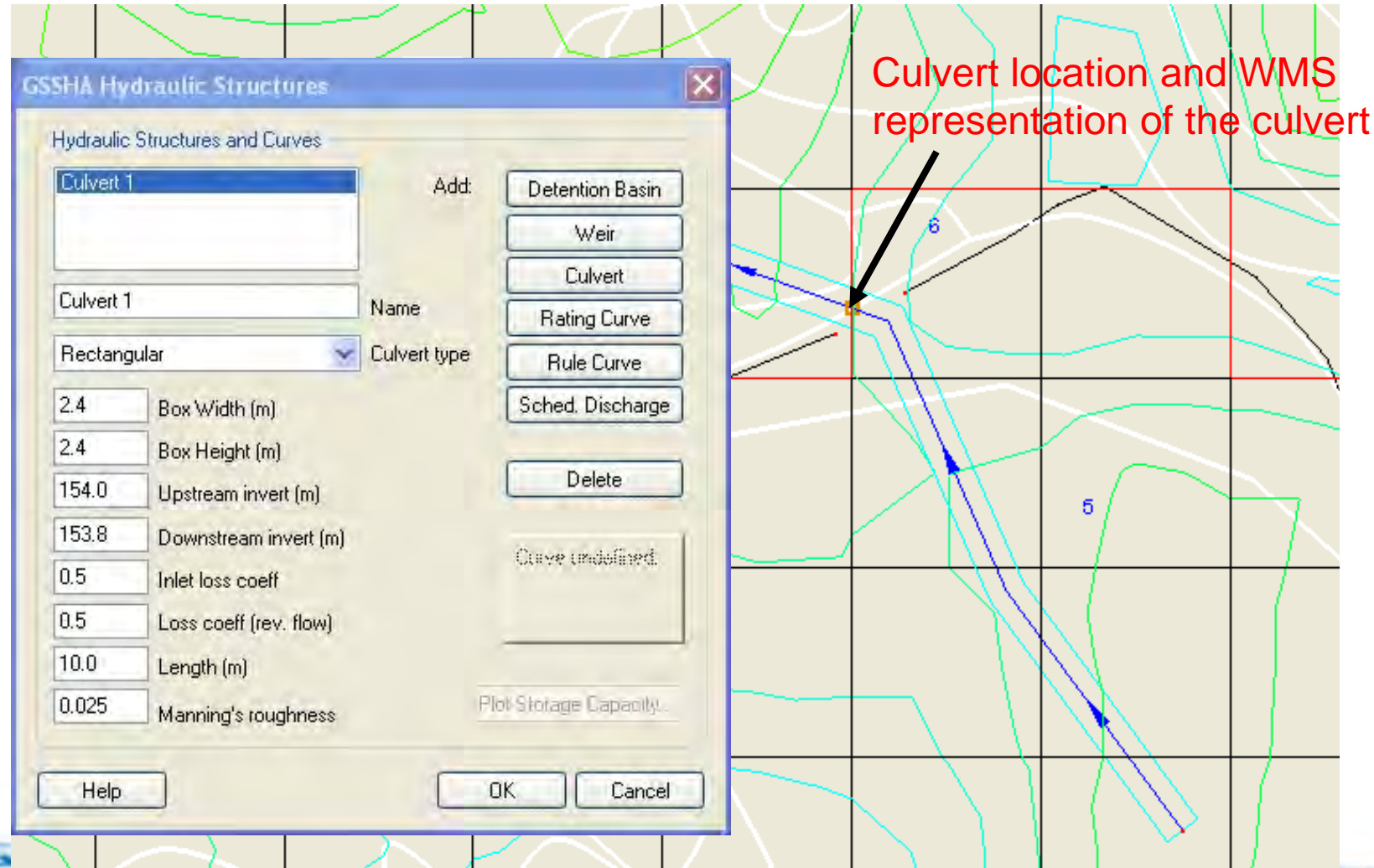
Red line representing  
embankment in WMS



# Culvert Locations



# Culvert Conceptualization

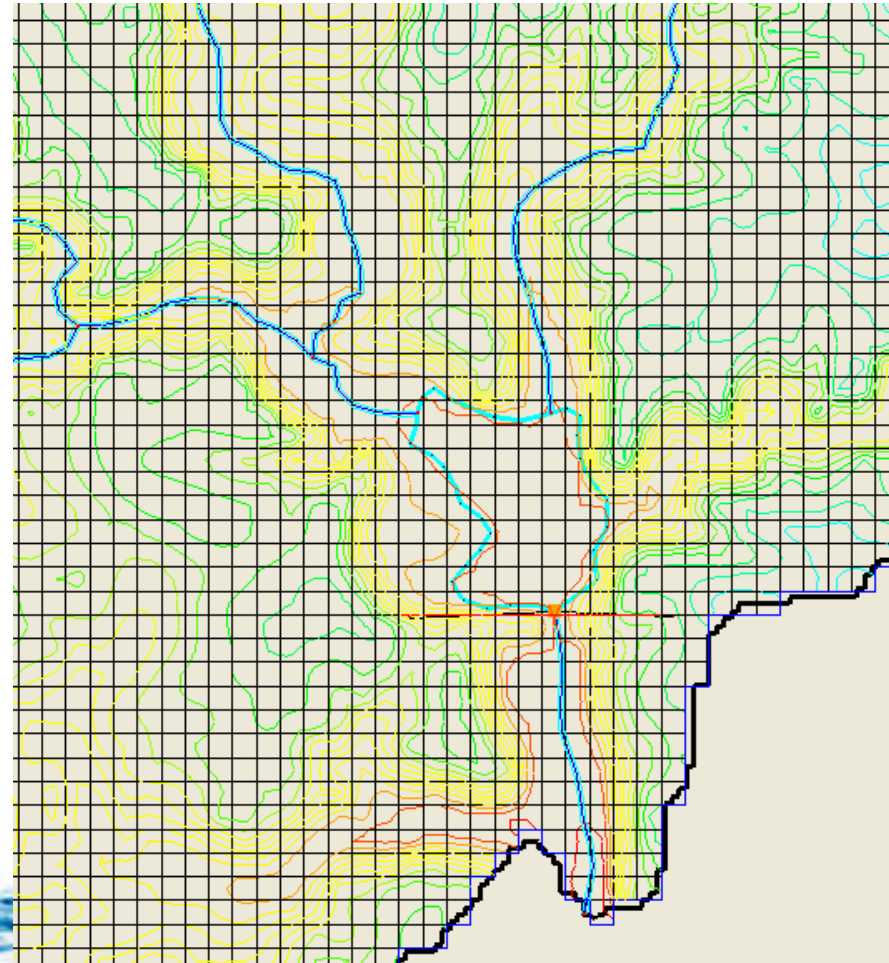


The image shows a software interface for conceptualizing a culvert. On the left is a dialog box titled "GSSHA Hydraulic Structures" with the following fields and controls:

- Hydraulic Structures and Curves:** A list containing "Culvert 1".
- Add:** Buttons for "Detention Basin", "Weir", "Culvert", "Rating Curve", "Rule Curve", "Sched. Discharge", and "Delete".
- Name:** Text field containing "Culvert 1".
- Culvert type:** Dropdown menu set to "Rectangular".
- Dimensions and Properties:**
  - Box Width (m): 2.4
  - Box Height (m): 2.4
  - Upstream invert (m): 154.0
  - Downstream invert (m): 153.8
  - Inlet loss coeff: 0.5
  - Loss coeff (rev. flow): 0.5
  - Length (m): 10.0
  - Manning's roughness: 0.025
- Plot Storage Capacity:** A button.
- Buttons:** "Help", "OK", and "Cancel".

On the right is a map showing a grid and a blue line representing a stream. A red rectangle highlights a specific area on the map. A black arrow points from the text "Culvert location and WMS representation of the culvert" to a small red dot on the stream line within the red rectangle. The number "6" is visible on the map near the highlighted area.

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



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



- 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

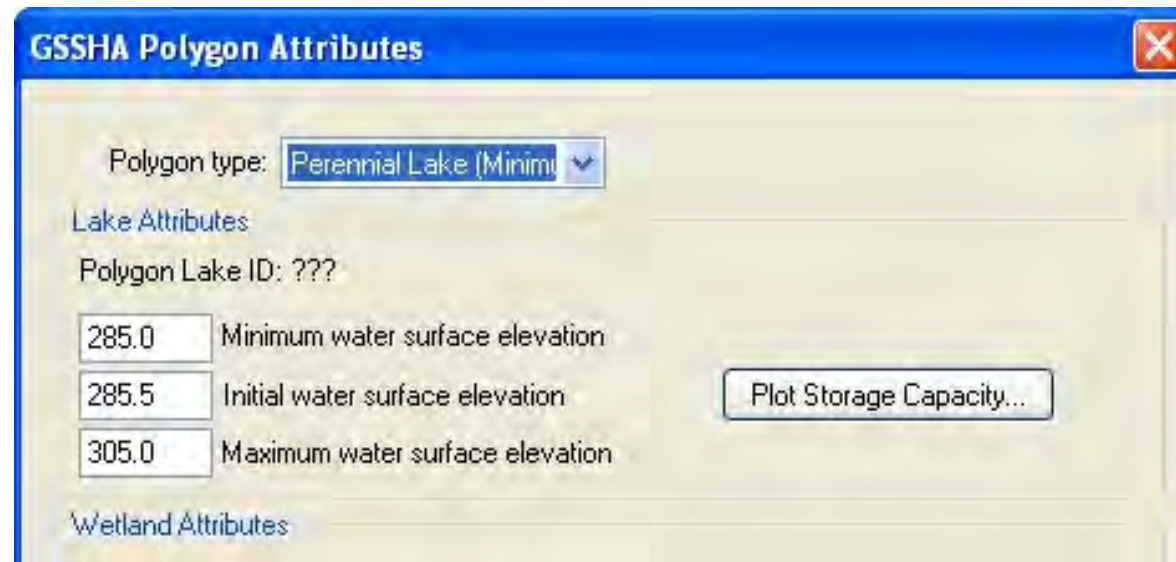


# Reservoir Stream Interaction

- 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.



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



GSSHA Polygon Attributes

Polygon type: Perennial Lake (Minimum) ▾

Lake Attributes

Polygon Lake ID: ???

285.0 Minimum water surface elevation

285.5 Initial water surface elevation

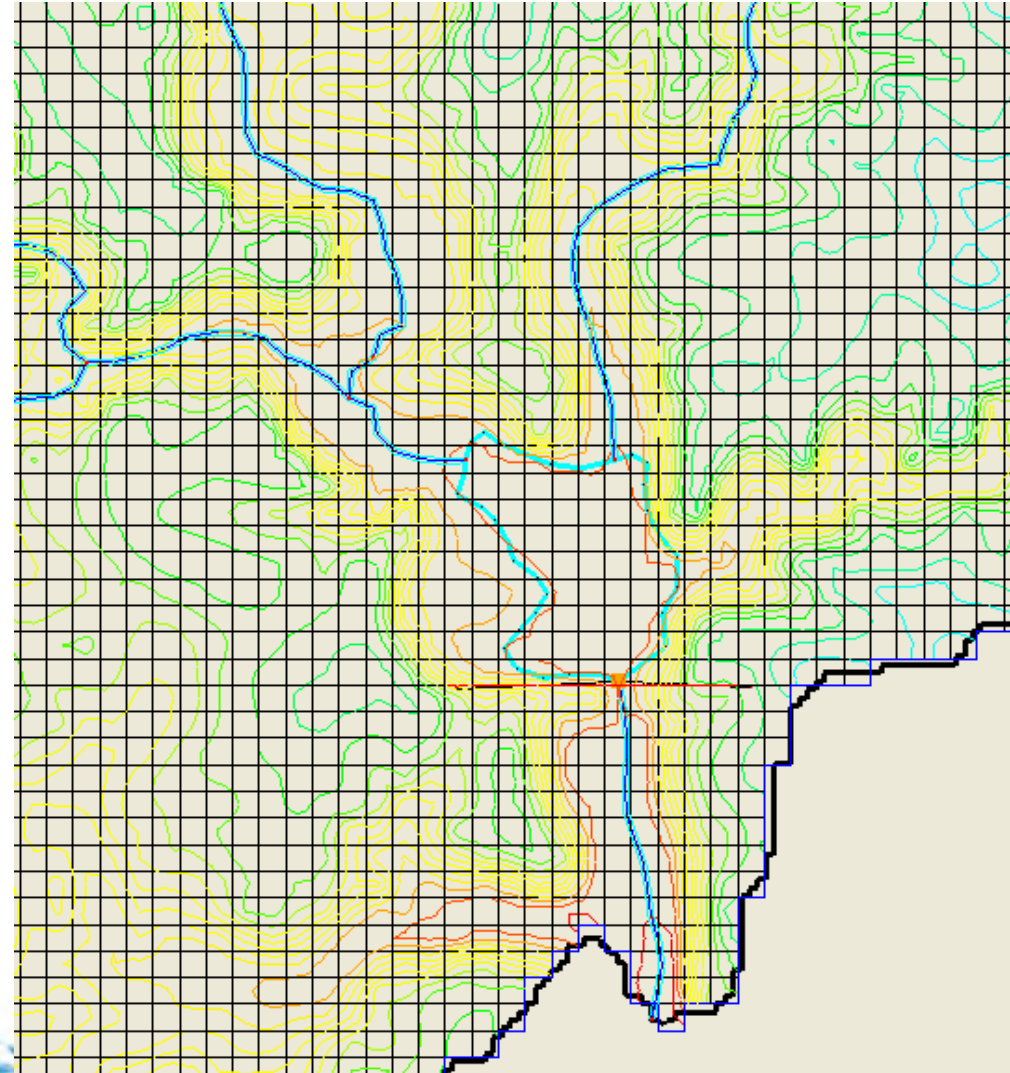
305.0 Maximum water surface elevation

Plot Storage Capacity...

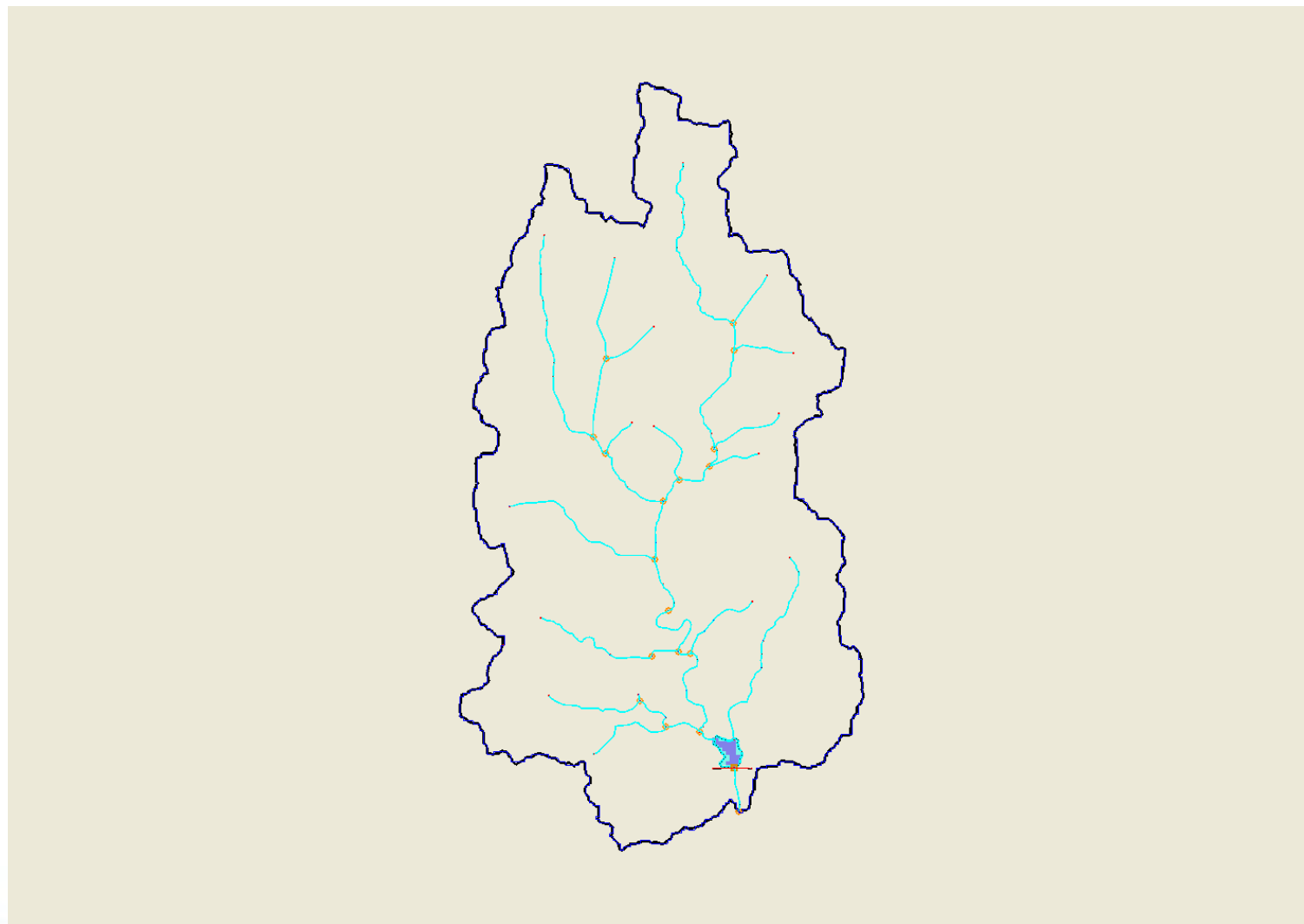
Wetland Attributes

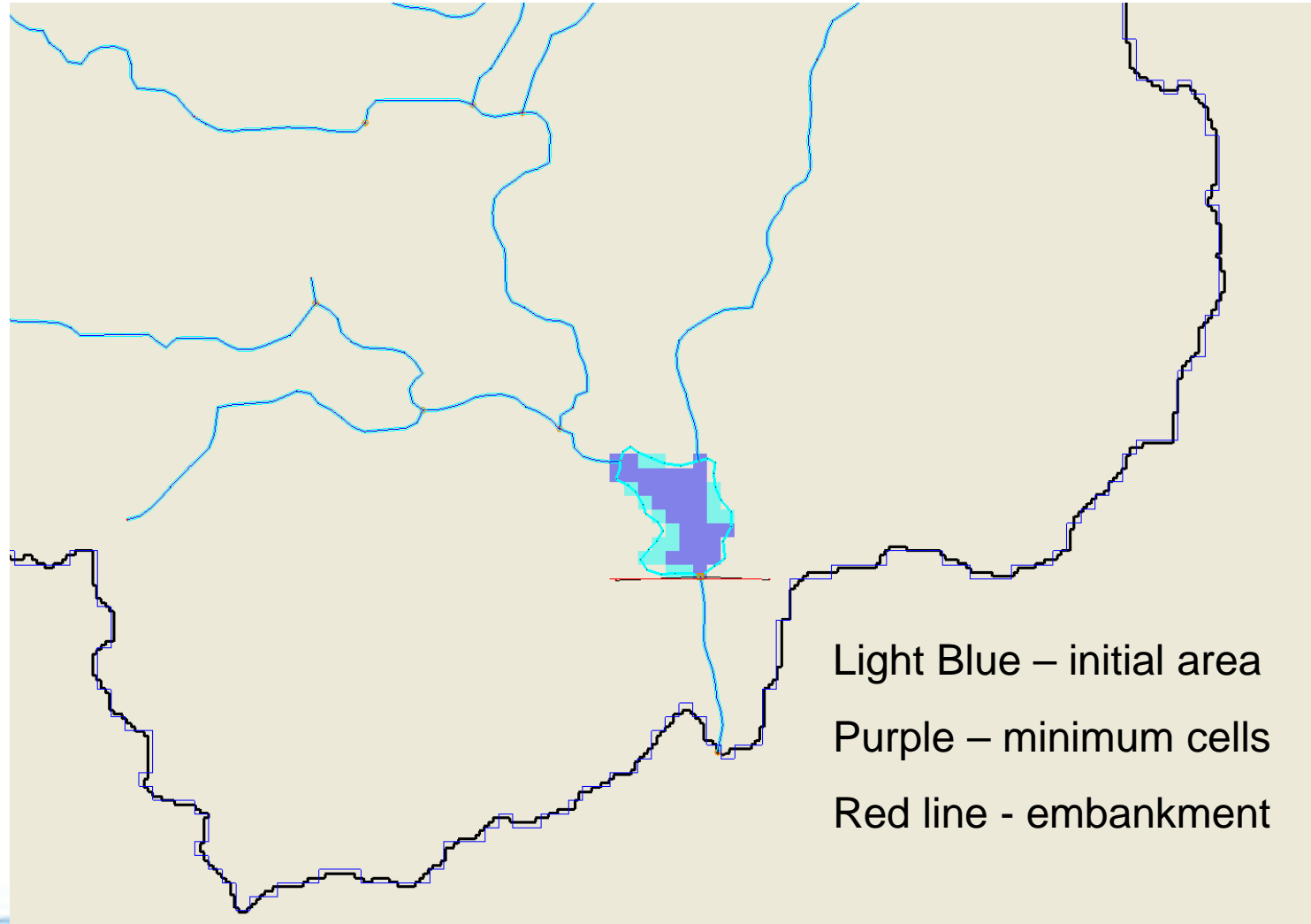
# Stage/Area/Volume Relationship

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

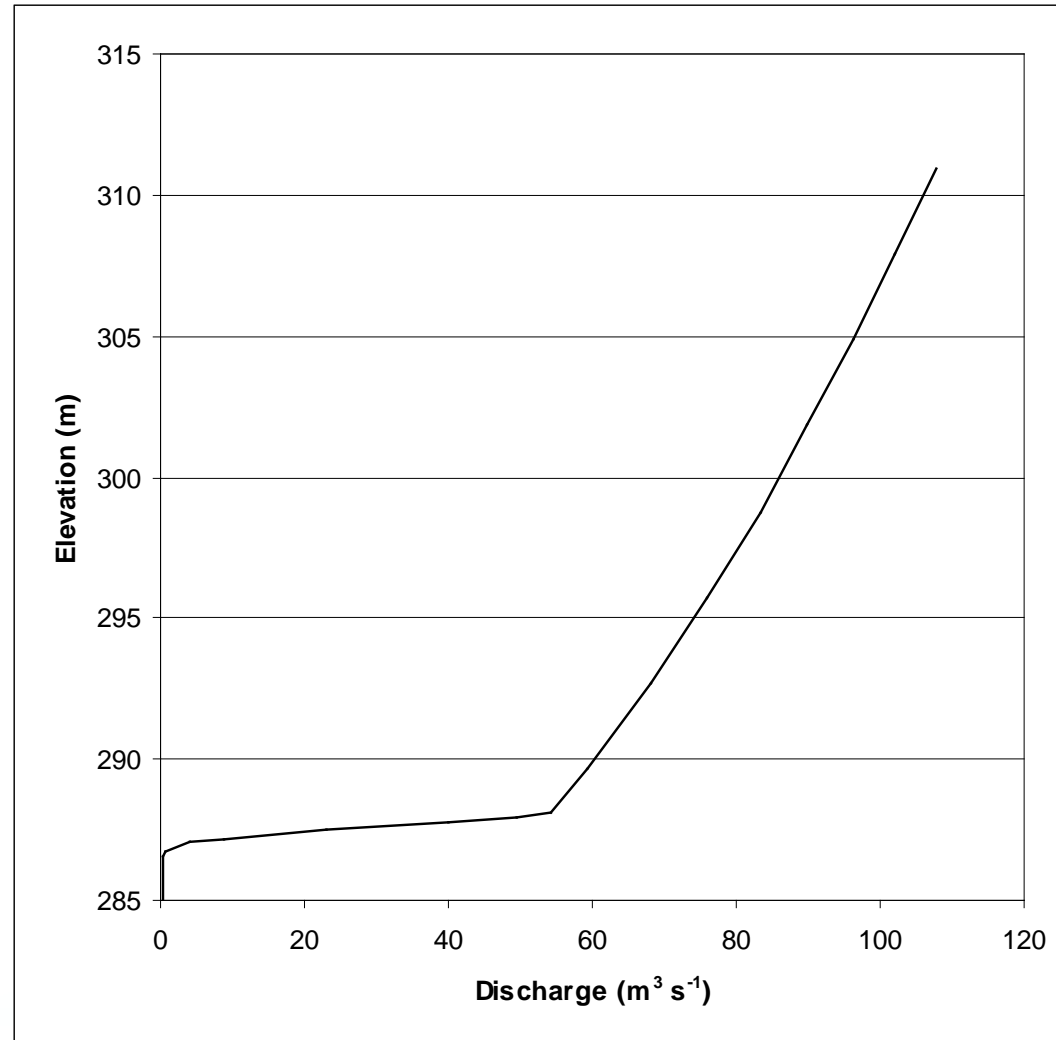


# Eau Galle Reservoir Watershed with Stream Network



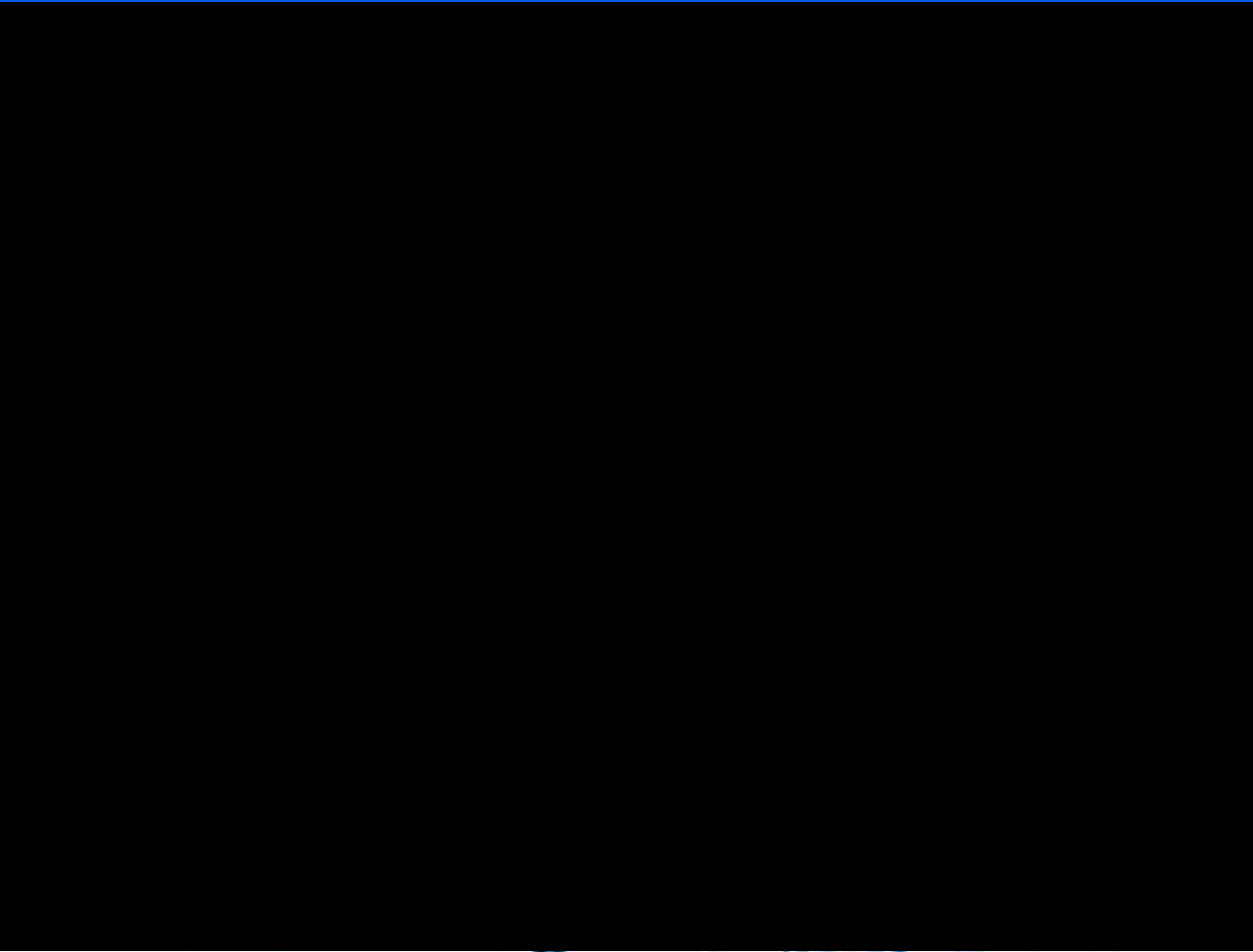


# Eau Galle Reservoir Outlet Works



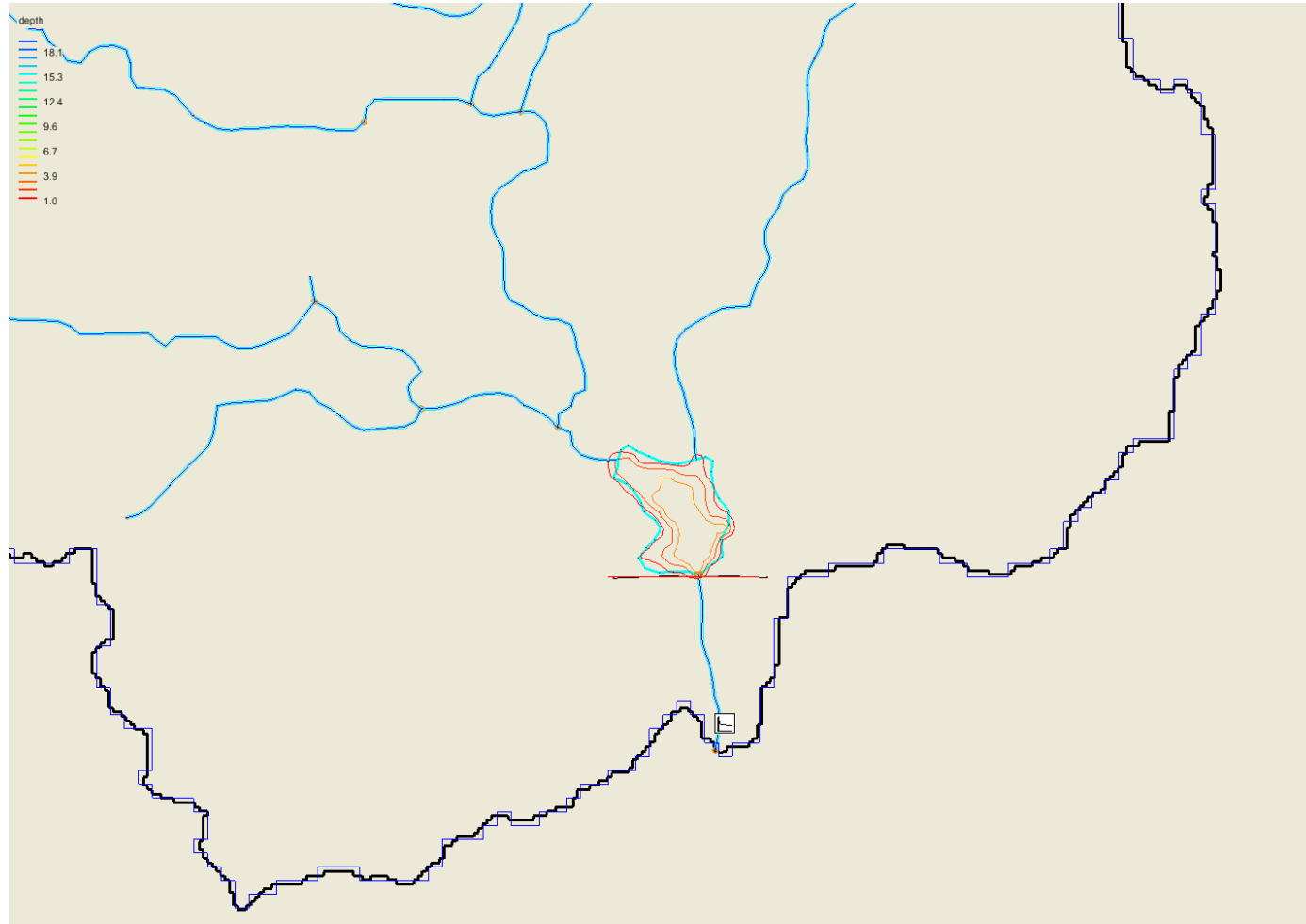


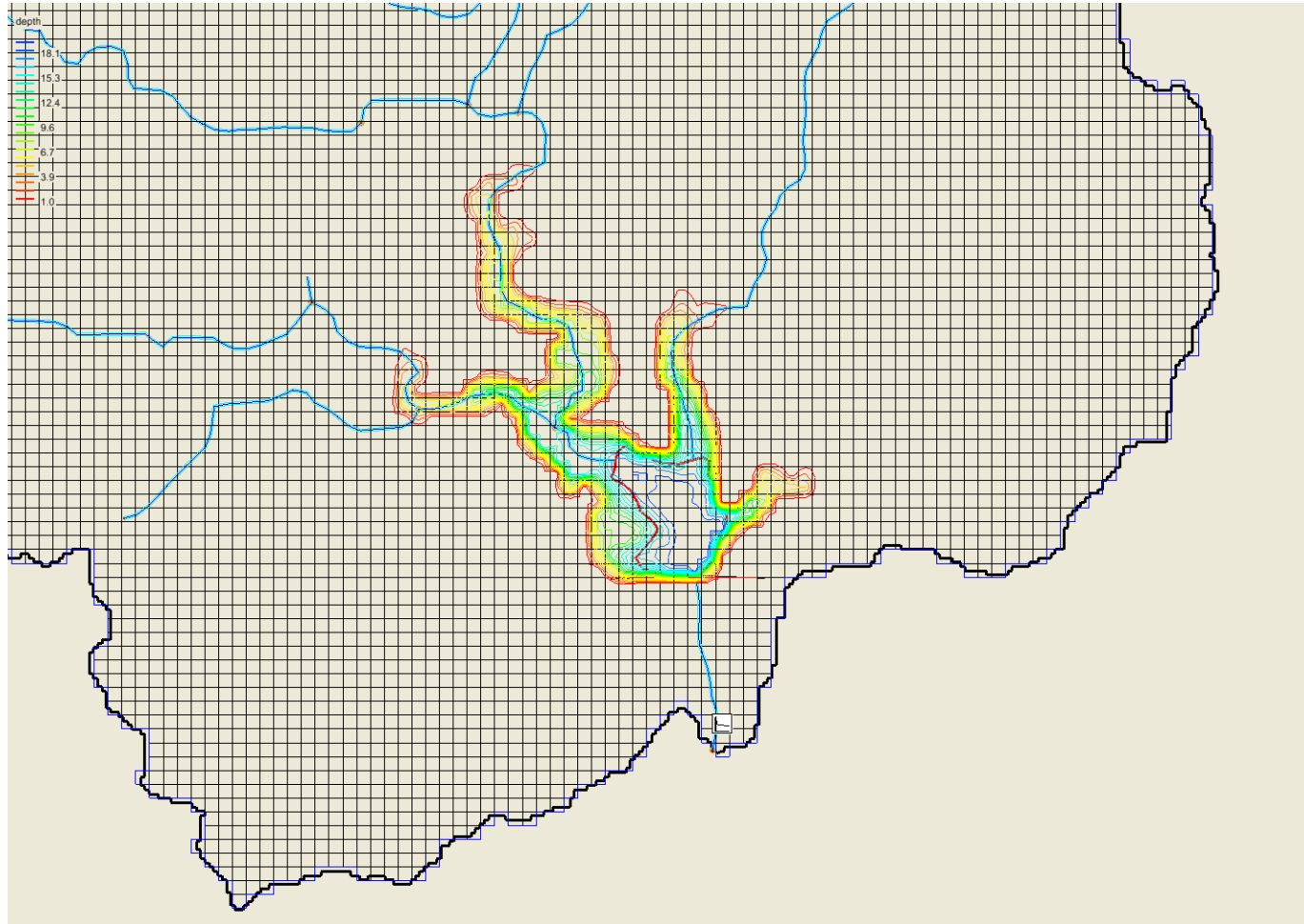
# Reservoir Animation



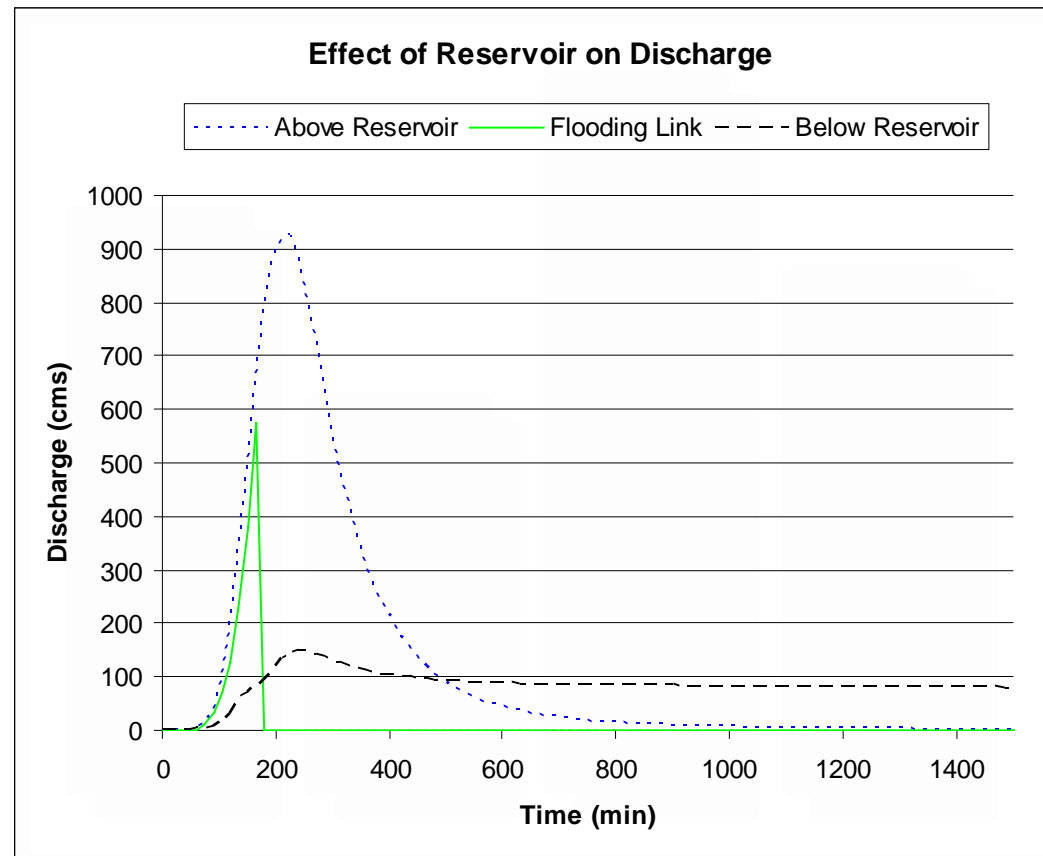


# Eau Galle Reservoir Initial Condition





# Stream Discharge Associated with Reservoir



# Reservoir Level and Volume

