

SA/2D Connections

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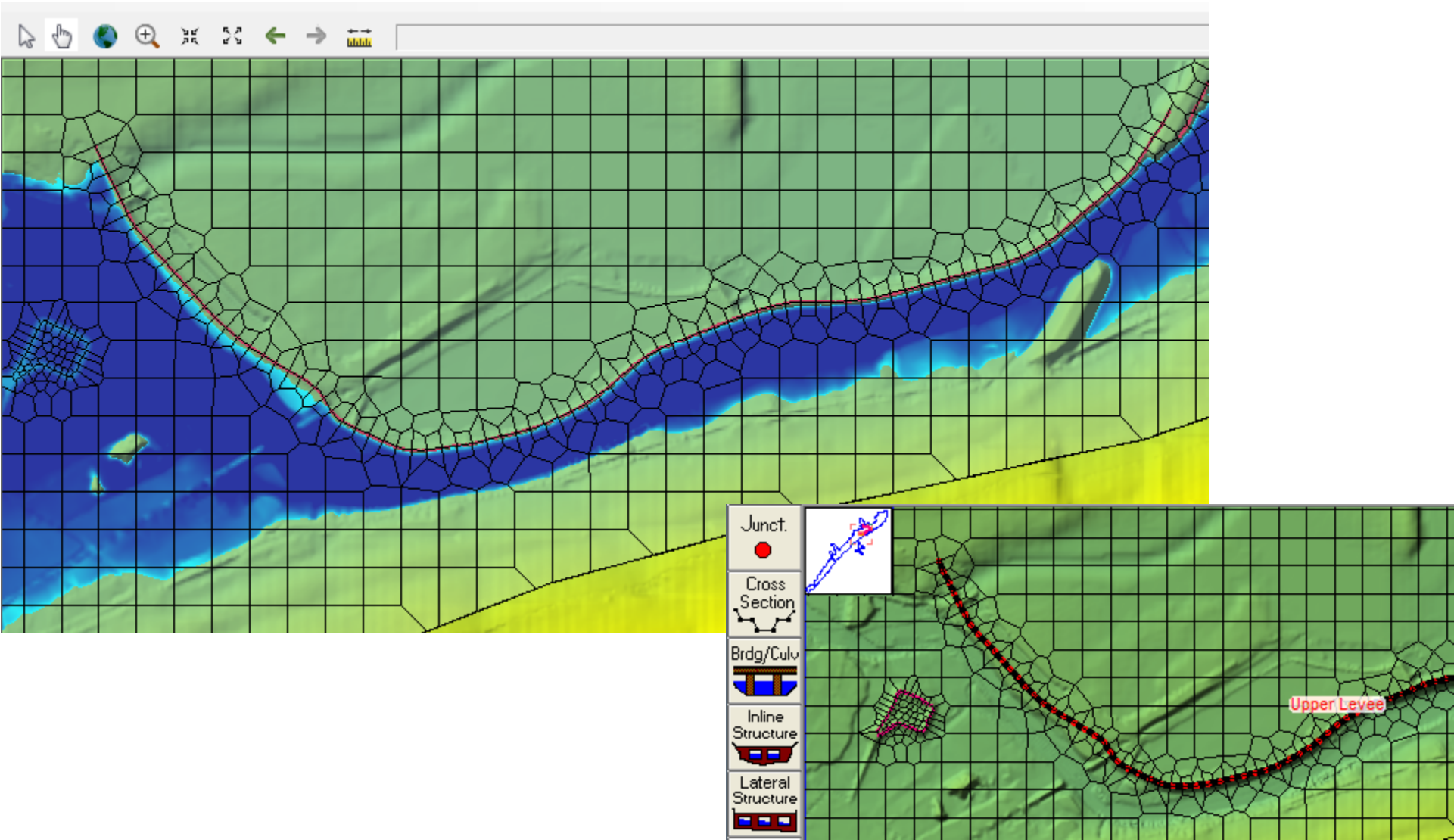


Internal SA/2D Area Conn

- Discuss using SA/2D Area Conn inside of 2D areas
 - **aka Hydraulic Structures (HS)**



Hydraulic Structure Example





Hydraulic Structures (HS)

- User entered station/elevation data overrides terrain data
- Can add breaches
- Can add culverts and gates
 - Culvert/Gates can be georeferenced
- Can model with weir equation or 2D equation
- HS centerline is also a breakline



Levees With HS

- When:
 - Bad Terrain data
 - Structure too high for 2D equations (i.e. water fall), Weir equation is a better solution
 - Need Culverts, Gates, or Breaching
- Create the HS and enter the Station/Elevation (SE) data
- The user entered SE data controls the flow over the structure



“Levees” Without HS

- Breaklines may be all that is needed!
- IF
 - The terrain data is good enough
 - The Faces line up accurately
 - Normal 2D Equation is appropriate
 - No culverts, gates, breaches, etc.
- THEN
 - No HS required!

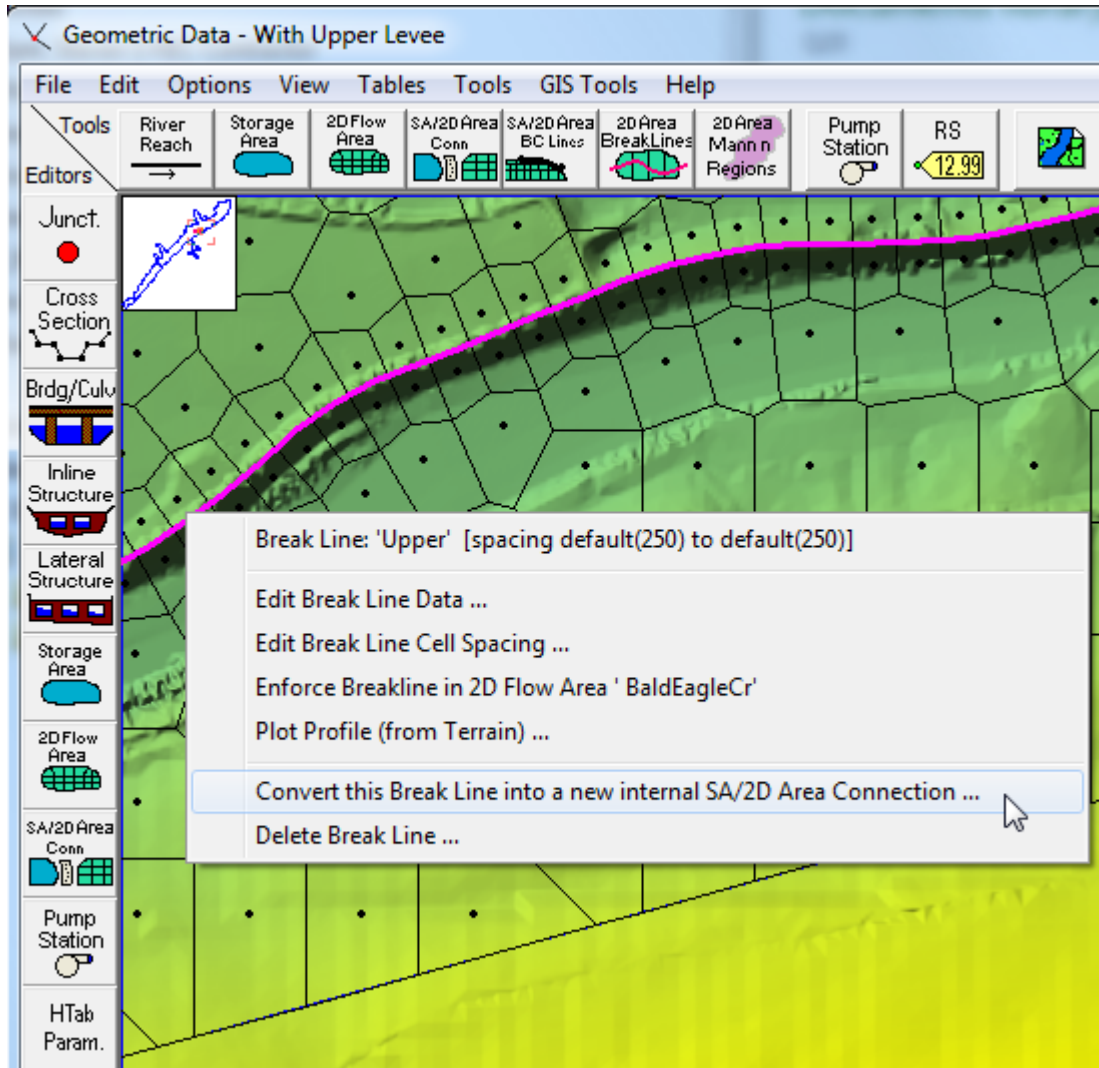


Overview Data Entry

- Create HS Centerline
 - Convert existing breakline (if breakline already exists)
 - Download centerline (if available)
 - Or draw by hand
- HS goes left to right looking downstream (for positive flow convention)
- Edit Centerline/Breakline and Cell Mesh, as needed (the centerline is also a breakline)
- Enter station/elevation of weir
- Enter culverts, gates, breach, etc.
- Select 2D Domain or Weir Eq.



Converting a Breakline

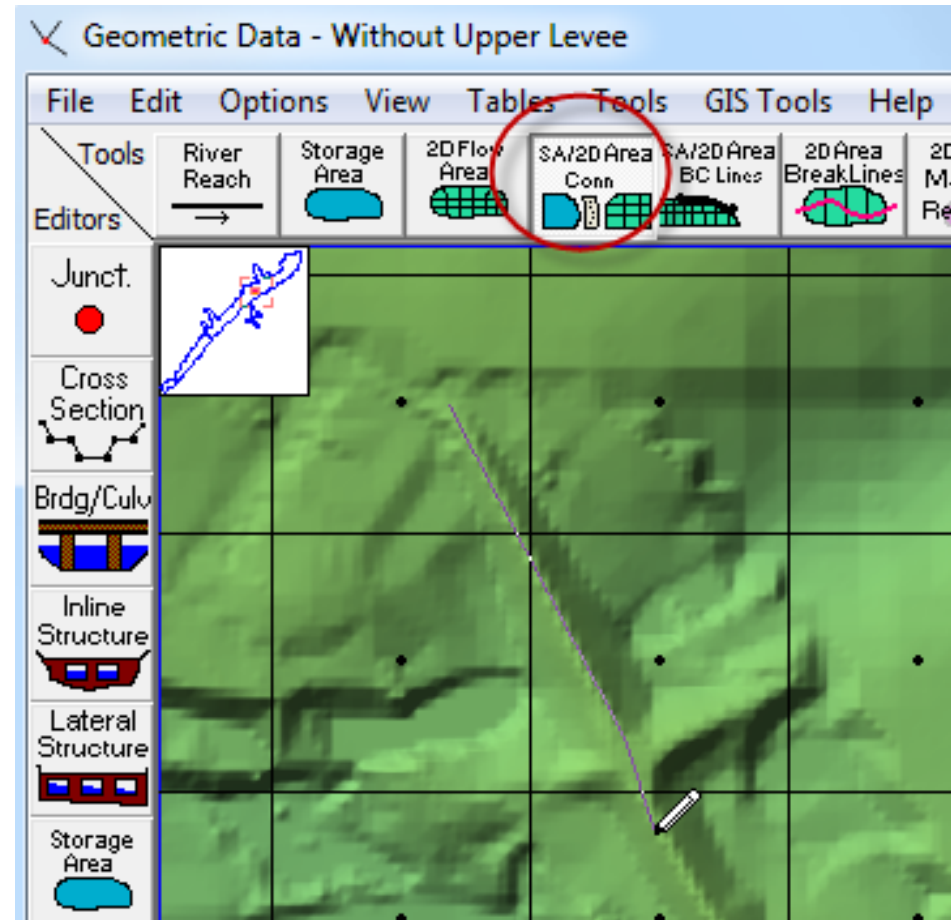


- If a Breakline has already been created, then it can be converted to a hydraulic structure.
- Left-click on the Breakline and select **Convert...**



Drawing HS Centerline

- Click **SA/2D Conn** and draw the location of the HS
- Double-click to finish drawing and name the HS
- Copy coordinates from Excel





HS Centerline Table

The screenshot shows the HEC-HMS software interface. The 'GIS Tools' menu is open, and the 'Storage Area/2D Flow Area Connection Centerline Table ...' option is selected. The 'SA Connections Centerlines GIS Coordinates' dialog box is also open, showing a list of items with 'Upper Levee' selected. The dialog box includes a table for 'Selected Area Edit Options' and buttons for 'Add', 'Multiply', 'Set Values', 'Replace', and 'Round'.

SA Connections Centerlines GIS Coordinates

Names (Select one or Many)

- Dam
- Lower Levee
- Middle Levee
- Upper Levee

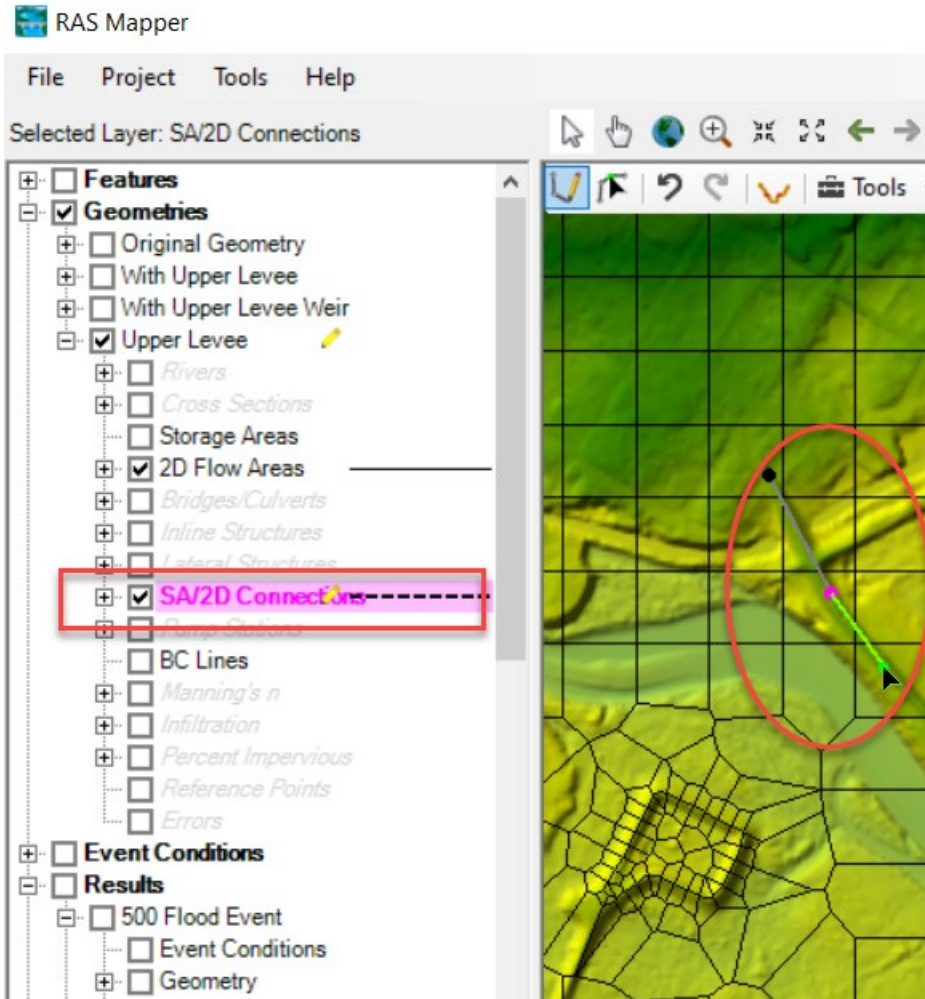
Selected Area Edit Options

	X (ft)	Y (ft)
1		

Buttons: Add, Multiply, Set Values, Replace, Round

Buttons: Import Lines, Filter Line(s), Lengths, OK, Cancel

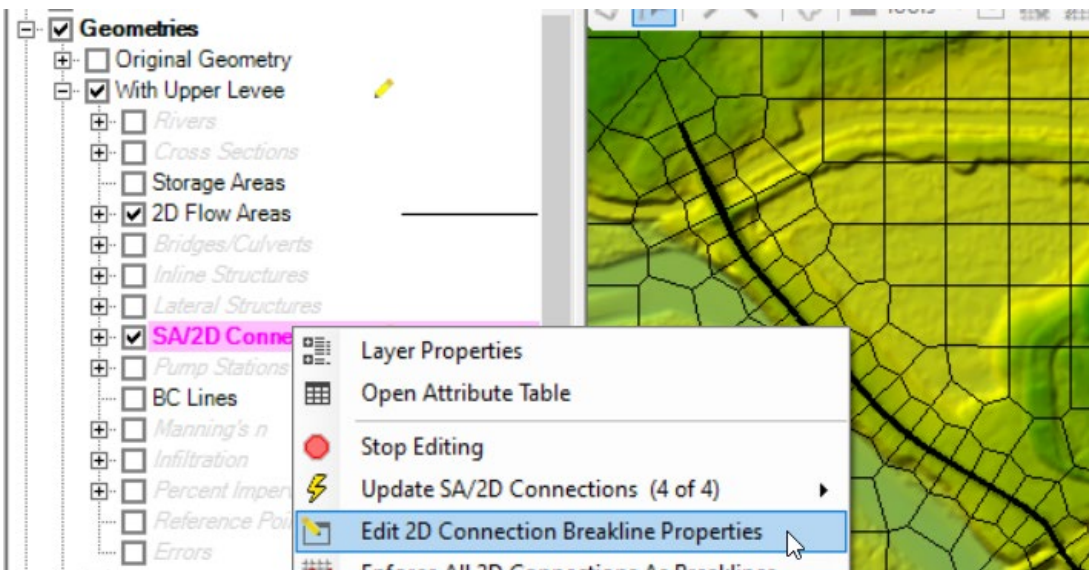
HS Centerline w/ Editing Tools



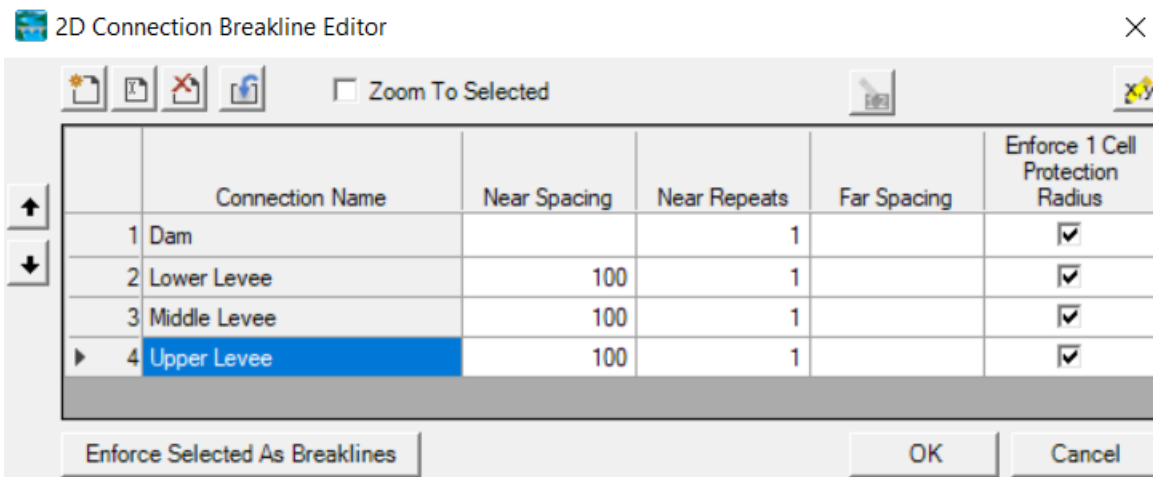
- CL can also be added from RASMapper
- Click **SA/2D Conn** and draw the location of the HS
- Double-click to finish drawing and name the HS
- Or CL can be imported as shapefile
- Weir SE data still on 2D Conn Editor/Geom Editor



HS Cell Spacing

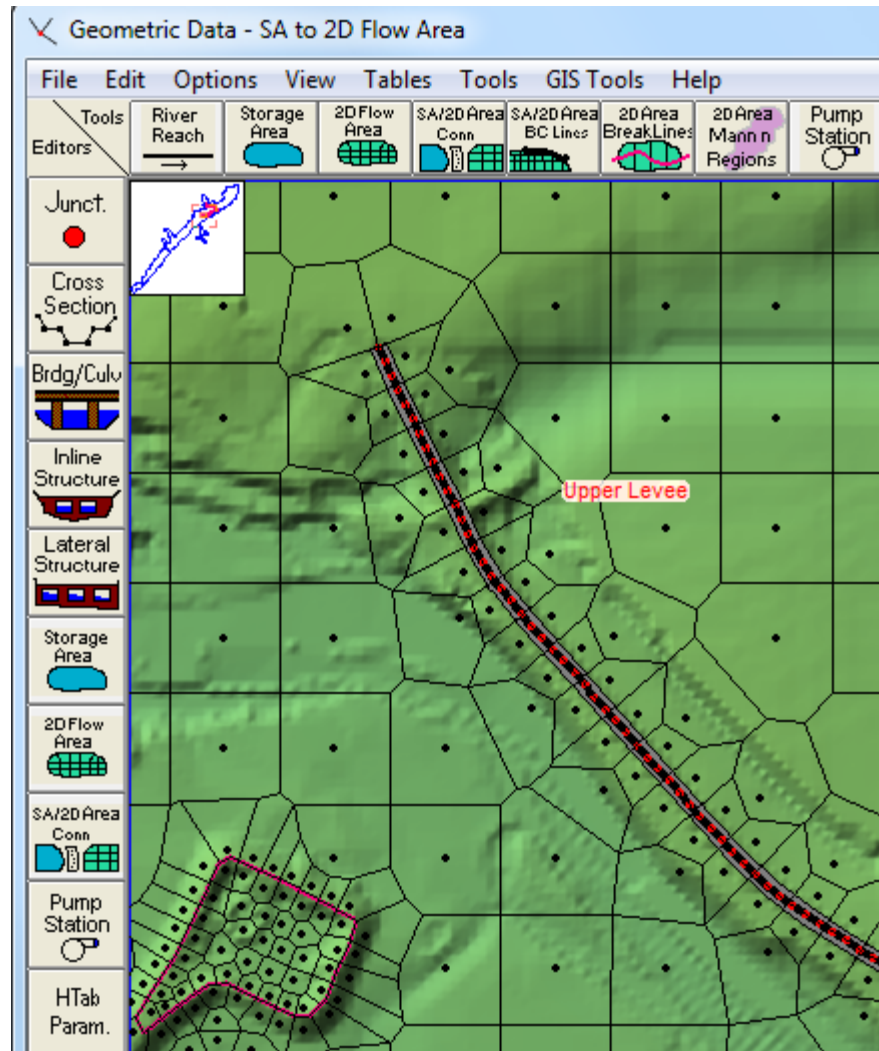


- HS/Breakline can be enforced while still in Edit mode
- Additional Cells can be added along the HS centerline
- Cell spacing should not be made too small!

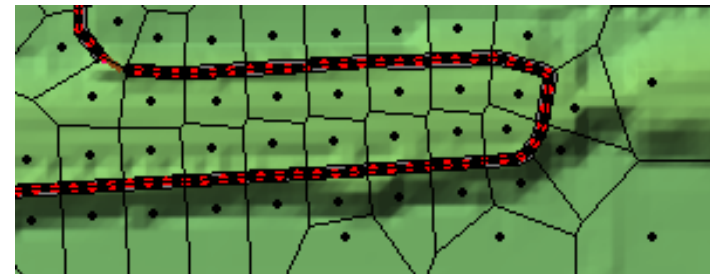




Inspect Cells Around HS

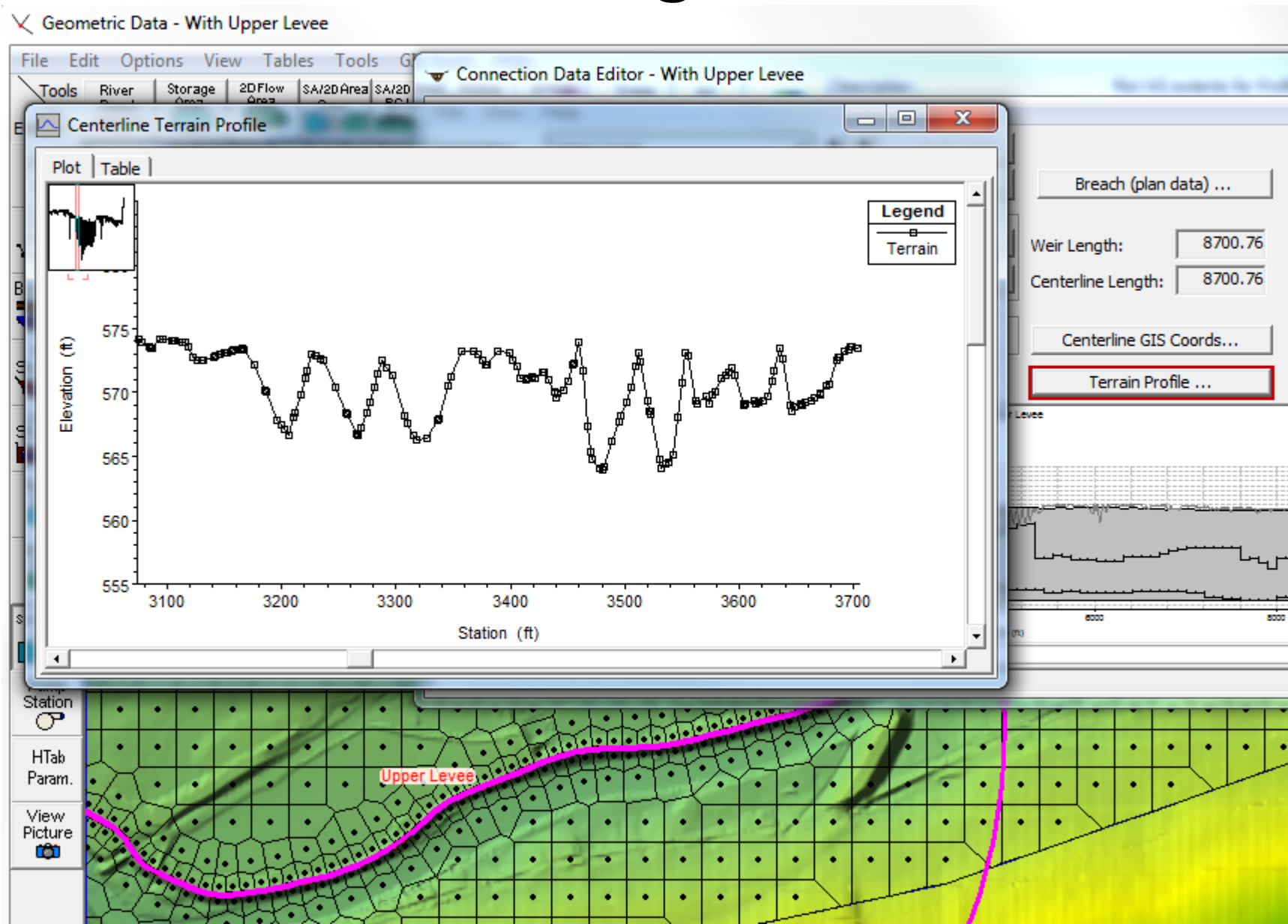


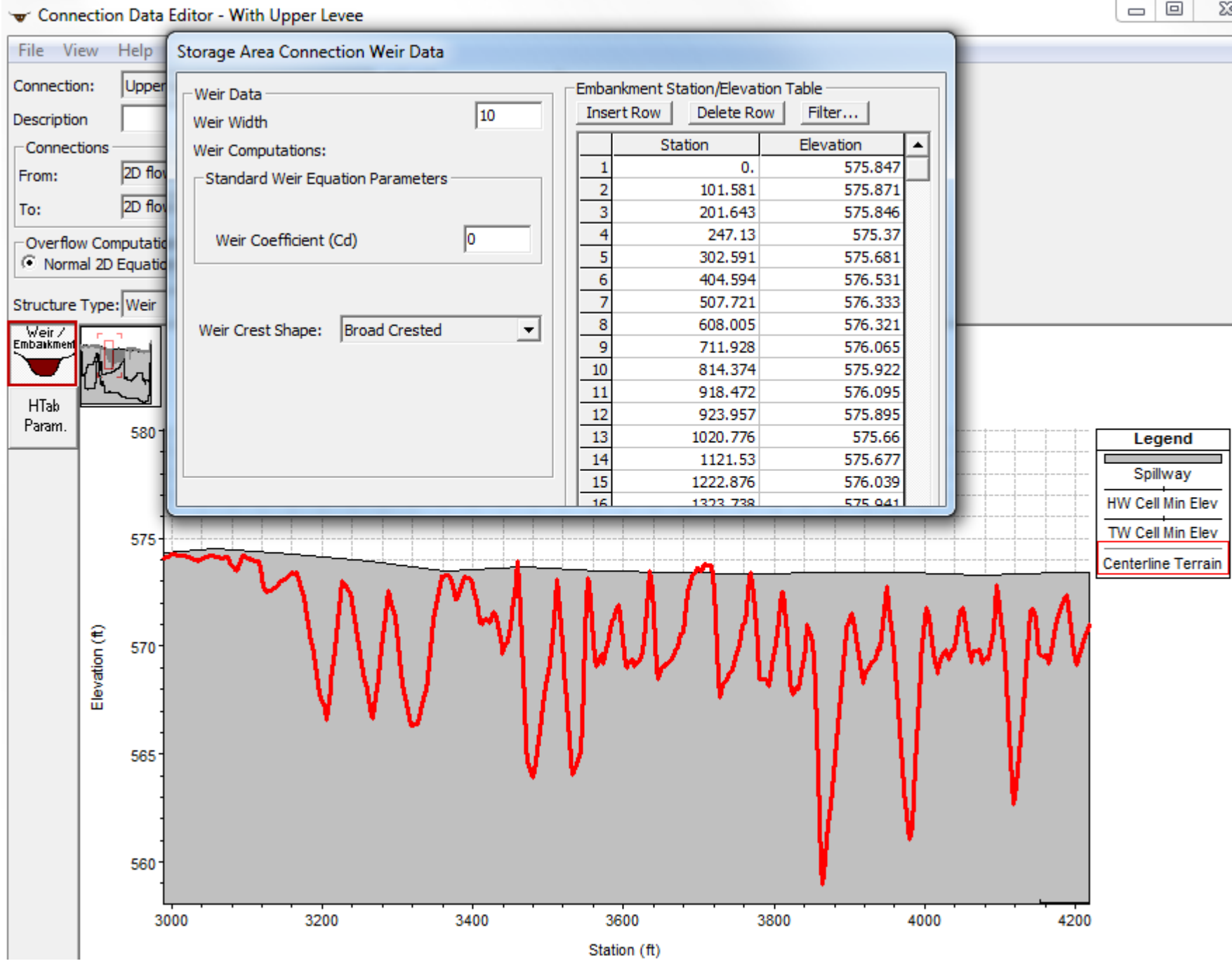
- RAS will show the HS as a black line w/ red dots
- Inspect the line for problems
 - Start/End of HS!
 - Tight Curves





Terrain CL Profile Missing Levee







Check Weir/GIS Length

✕ Edit and/or create lateral structures

File Edit Options View Tables Tools GIS Tools Help

Tools: River Reach, Storage Area, 2D Flow Area, SA/2D Area Conn, SA/2D Area BC Lines, 2D Area BreakLines, 2D Area Mann n Regions, Pump Station, RS 12.99

Description: Plot WS extents for Profile: (none)

Editors: Junct., Cross Section, Brdg/Culv., Inline Structure, Lateral Structure, Storage Area, 2D Flow Area, SA/2D Area Conn, Pump Station, HTab Param., View Picture

Connection Data Editor - With Upper Levee

File View Help

Connection: Upper Levee Apply Data

Description: Breach (plan data) ...

Connections

From: 2D flow area: BaldEagleCr Set SA/2D ...

To: 2D flow area: BaldEagleCr Set SA/2D ...

Weir Length: 8700.76

Centerline Length: 8700.76

Overflow Computation Method: Normal 2D Equation Domain Use Weir Equation

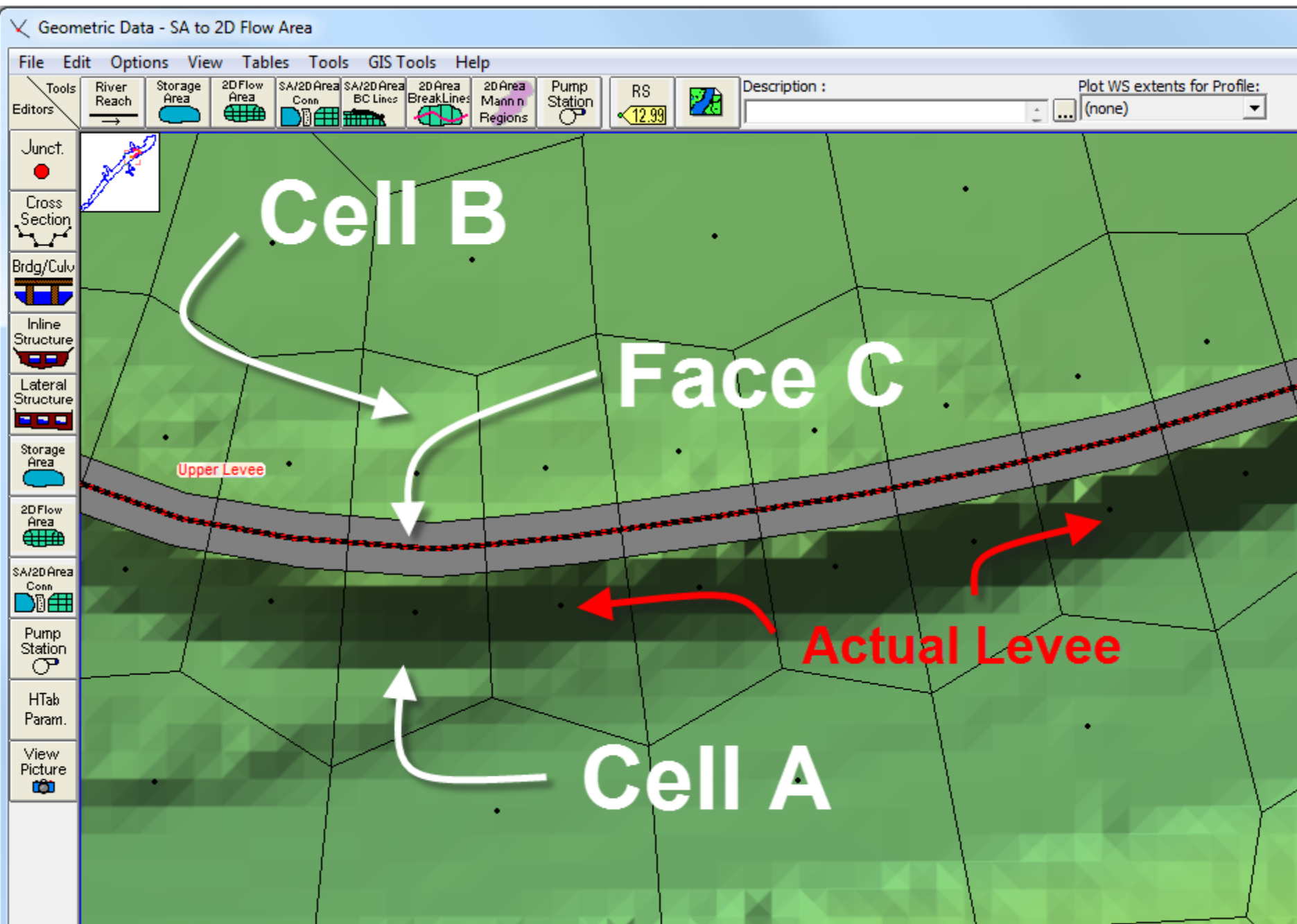
Centerline GIS Coords... Terrain Profile ...

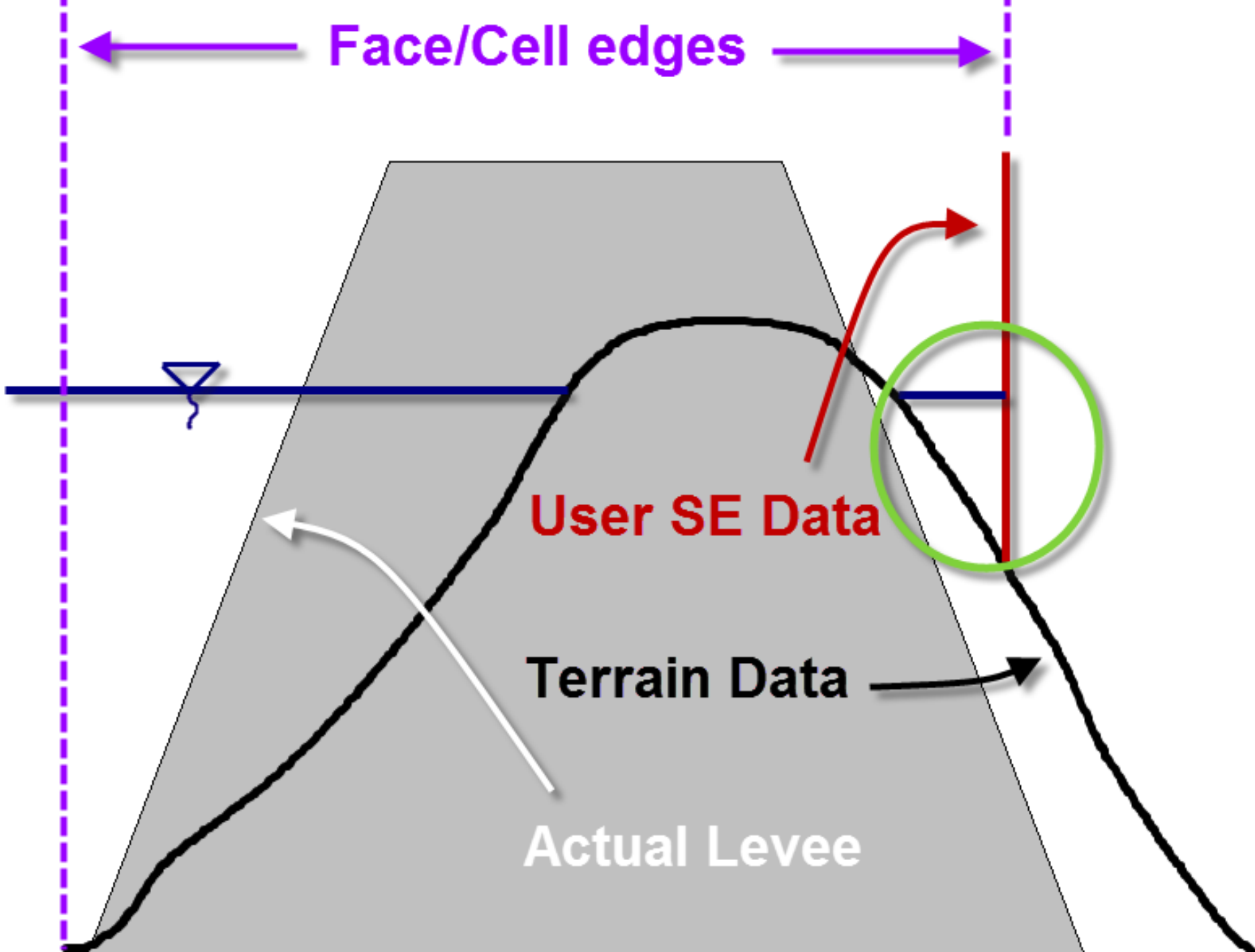
Structure Type: Weir

Weir / Embankment

HTab Param.

Select connection to Edit







Hydraulic Structures Options

Geometric Data - Single 2D Area - Dam as Internal Struct

File Edit Options View Tables Tools GIS Tools Help

Tools: River Reach, Storage Area, 2D Flow Area, SA/2D Area Conn, SA/2D Area BC Lines, 2D Area Break Lines, 2D Area Mann n Regions, Pump Station, RS

Editors: Junct., Cross Section, Brgd/Culv., Inline Structure, Lateral Structure, Storage Area, 2D Flow Area, SA/2D Area Conn, Pump Station, HTab Param., View Picture

Connection Data Editor - Single 2D Area - Internal Dam Structure

File View Help

Connection: **Sayers Dam** Apply Data

Description: Breach (plan data) ...

Connections:

From: 2D flow area: BaldEagleCr Set SA/2D ...

To: 2D flow area: BaldEagleCr Set SA/2D ...

Weir Length: 6882.06

Centerline Length: 6882.06

Centerline GIS Coords...

Terrain Profile ...

Overflow Computation Method:

Normal 2D Equation Domain Use Weir Equation

Structure Type: Weir, Gates, Culverts, Outlet RC and Outlet TS

Flap Gates: No Flap Gates

Sayers Dam

Legend:

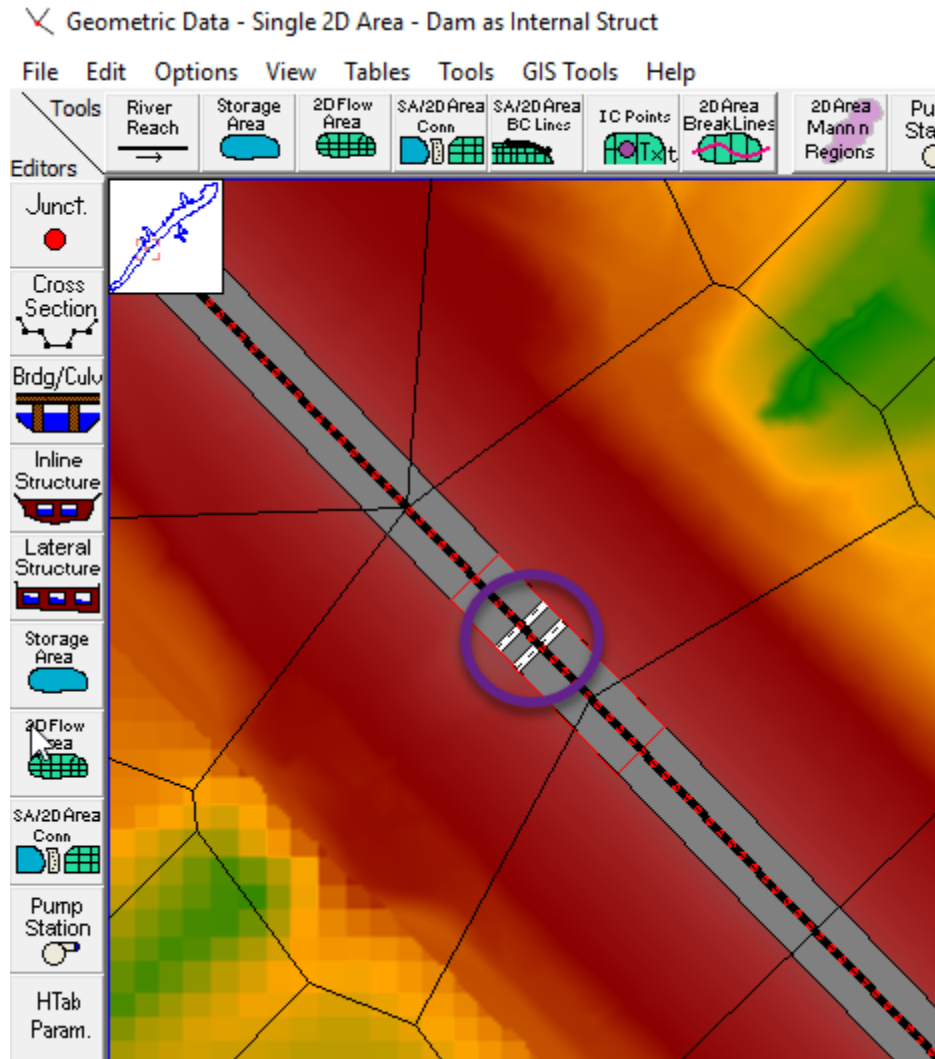
- Spillway
- HW Cell Min Elev
- TW Cell Min Elev
- Centerline Terrain

Elevation (ft) vs Station (ft) graph showing the dam profile and terrain.

Select connection to Edit



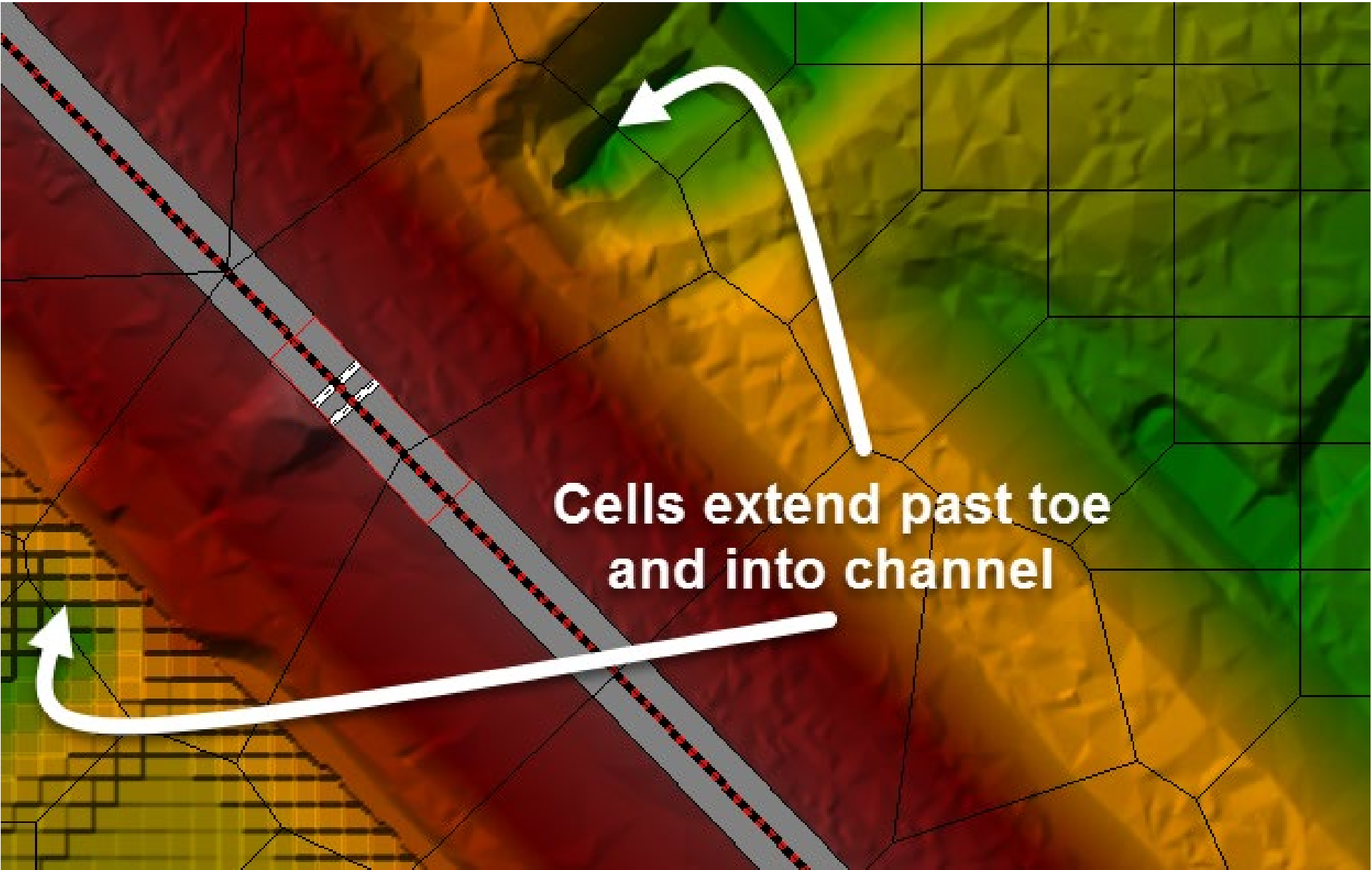
Culverts & Gates inside a HS



- By default, culverts/gates are not georeferenced and transfer flow from immediately adjacent cells
- In this case, cells need to extend past toe and into channel

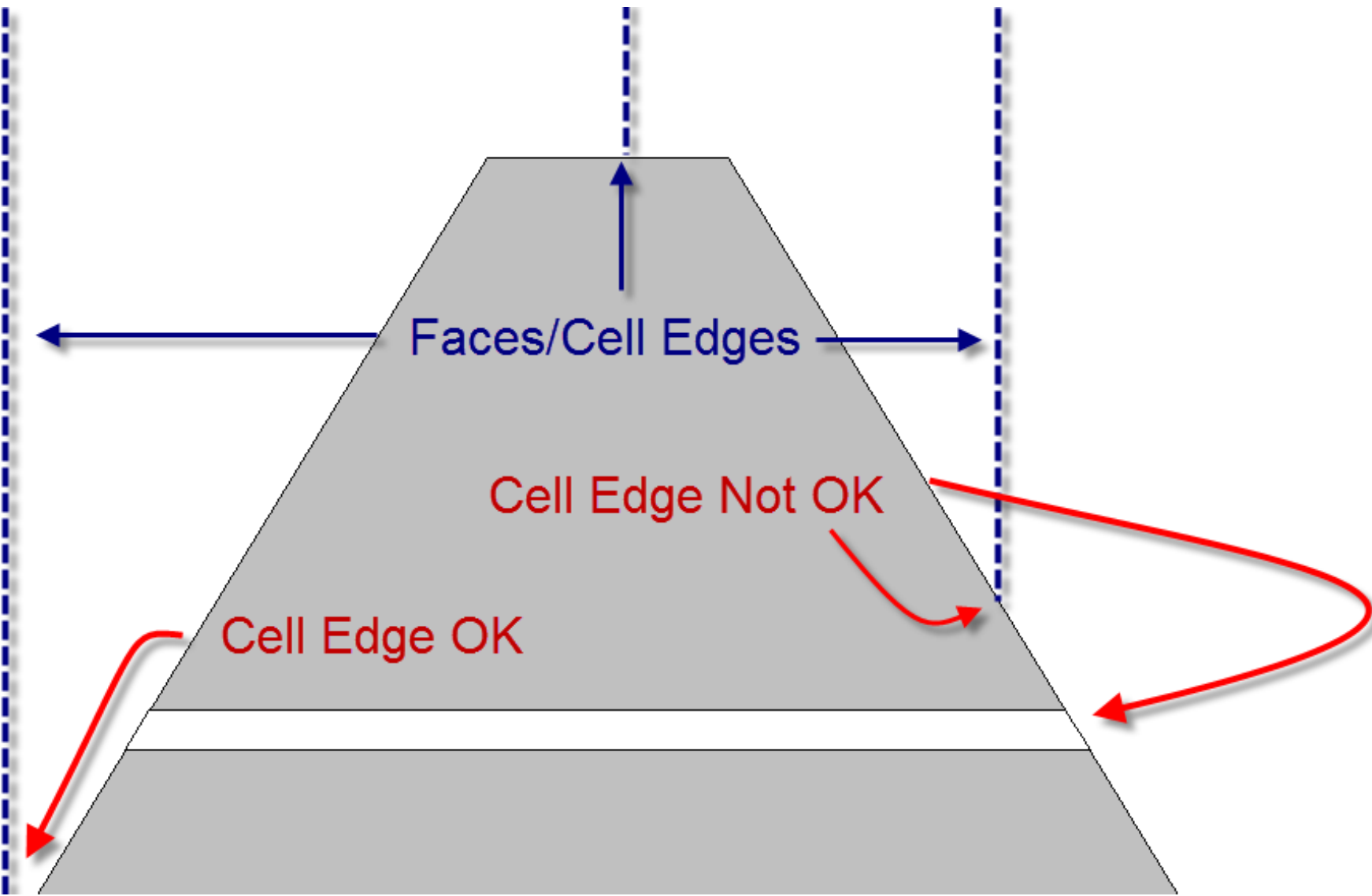


Gates/Culverts and Cell Edges



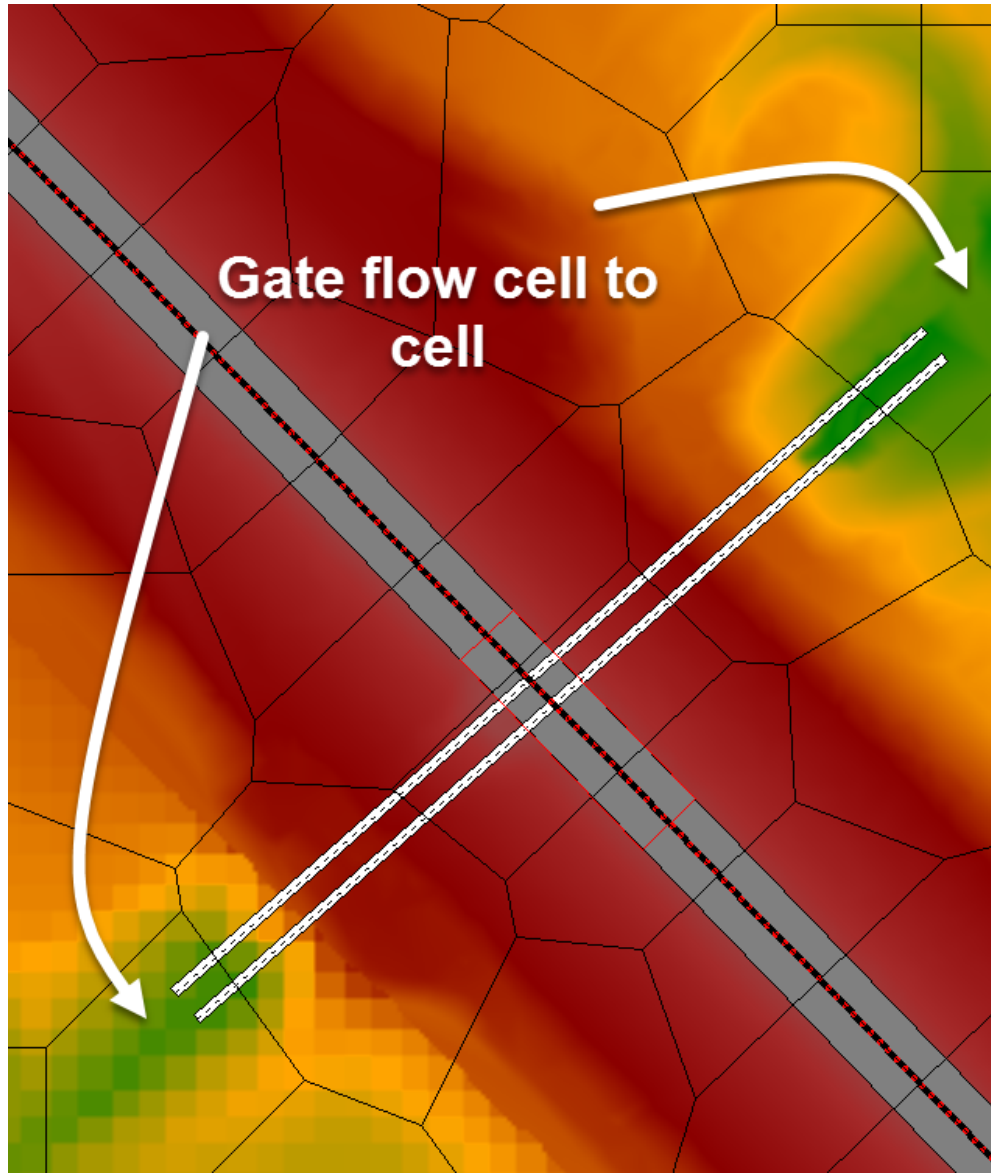


Cell Edge Location for non-georeferenced culverts/gates





Georeferenced Culverts & Gates



- Georeferenced culverts & gates transfer flow from distant cells
- In this case, cells do not need to extend past toe and into channel
- Small cells can still cause problems for 1D weir flow!



Georeference Culverts & Gates

Connection Gate Editor

Gate Group: Gate #1

Gate type (or methodology): Sluice

Gate Flow

Sluice Gate Flow

Sluice Discharge Coefficient (0.5-0.7): 0.65

Weir Flow Over Gate Sill (gate out of water)

Weir Shape: Broad Crested

Weir Coefficient: 3

Submerged Orifice Flow

Orifice Coefficient (typically 0.8): 0.8

Head Reference: Sill (Invert)

Geometric Properties

Height: 15 Width: 7 Invert: 590

Opening Centerline Stations # Openings: 2

	Opening Name	Station	GIS Sta
1	Opening #1	5745	5746.035
2	Opening #2	5765	5765.018
3			
4			
5			
6			
7			

Opening GIS Data: Opening #1
Length: 509.5

	X	Y
1	2007174.93	321353.6
2	2007546.11	321702.6
3		
4		
5		
6		
7		

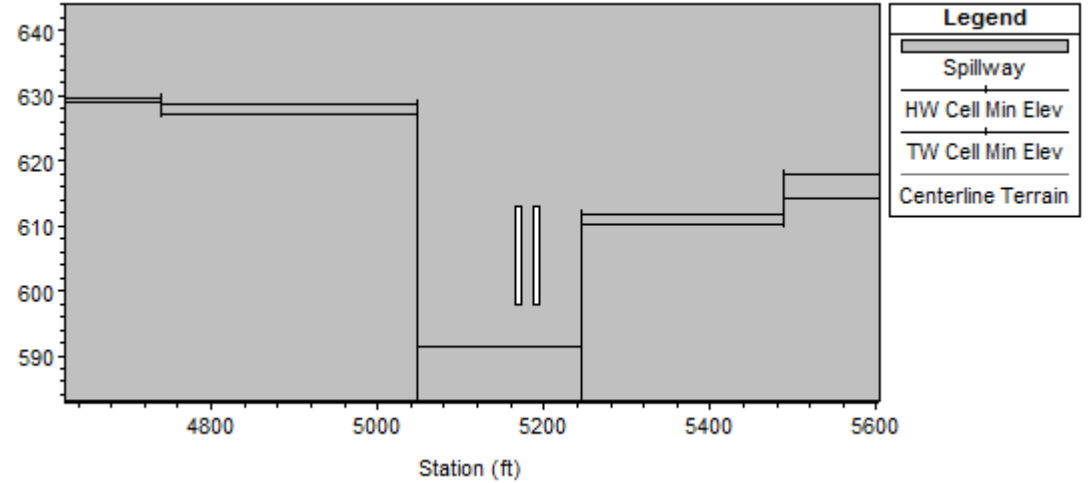
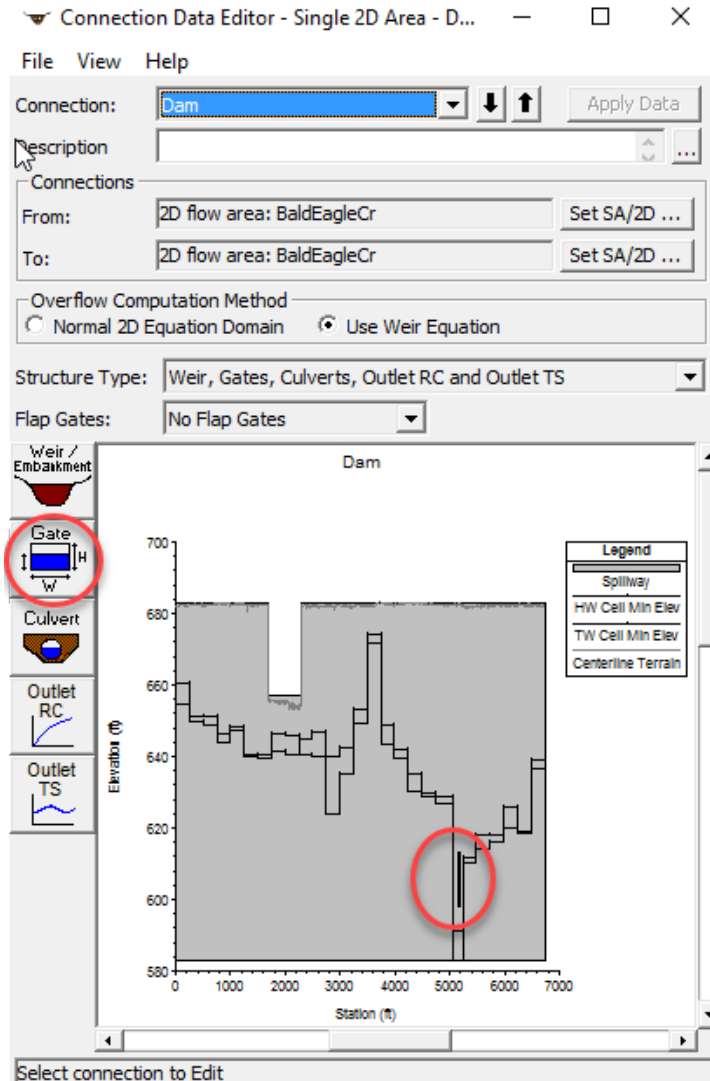
Individual Gate Centerlines ...

OK Cancel Help

- Draw the centerline with the mouse pointer and then and paste GIS coordinates for the appropriate opening
- Clicking on Individual Gate Centerlines will bring up a table that shows all of the openings



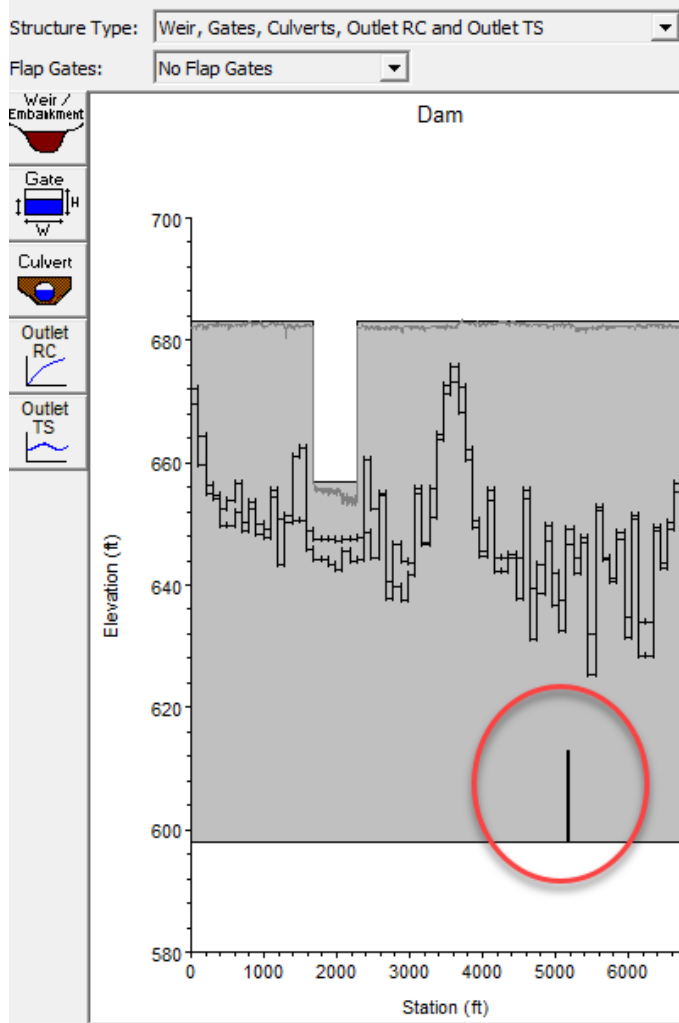
Gate in channel above Cell Invert



- Non-georeferenced gate in channel above adjacent cell minimum



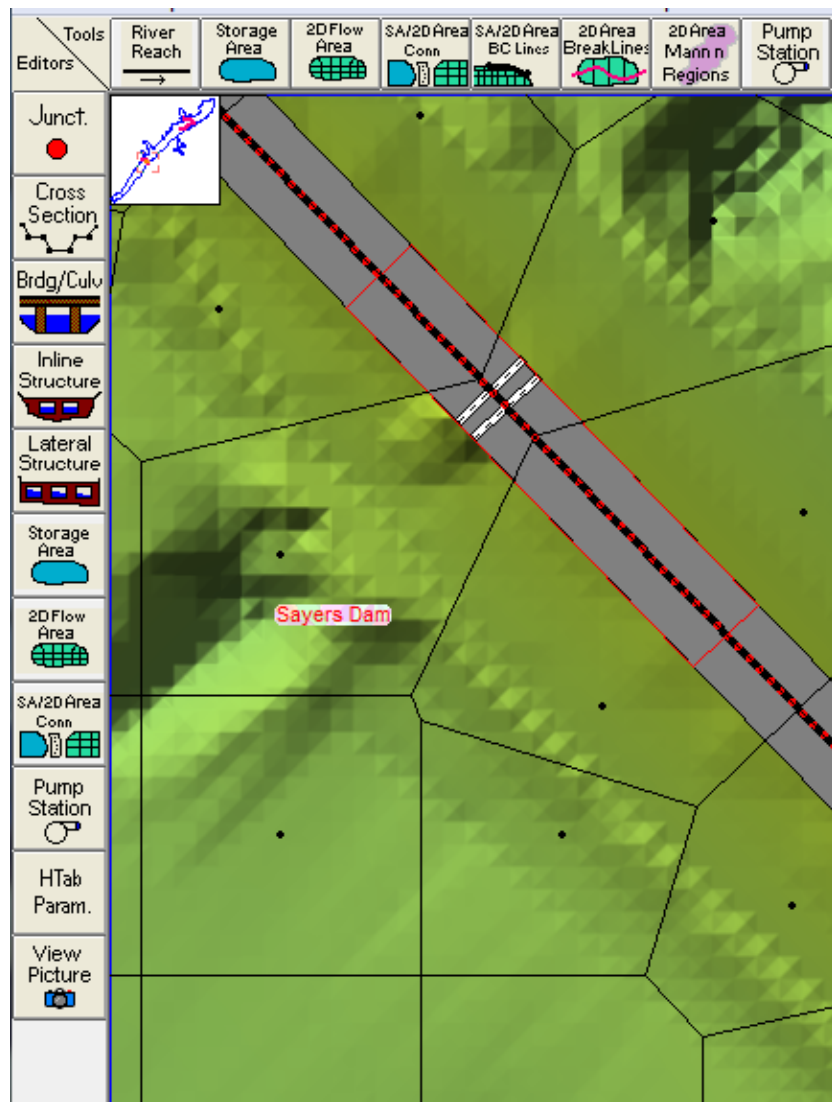
Georeferenced Gate below adjacent cell Invert



- Small HW/TW cells on abutment next to HS do not show channel location
- This plot does not show whether the georeferenced gate centerline has been properly entered or not



Breach for HS



Storage Area Connection Breach Data

SA Connection: **Sayers Dam** [Delete this Breach ...]

Breach This Structure

Breach Method: User Entered Data

Breach Plot | Breach Progression | Simplified Physical | Breach

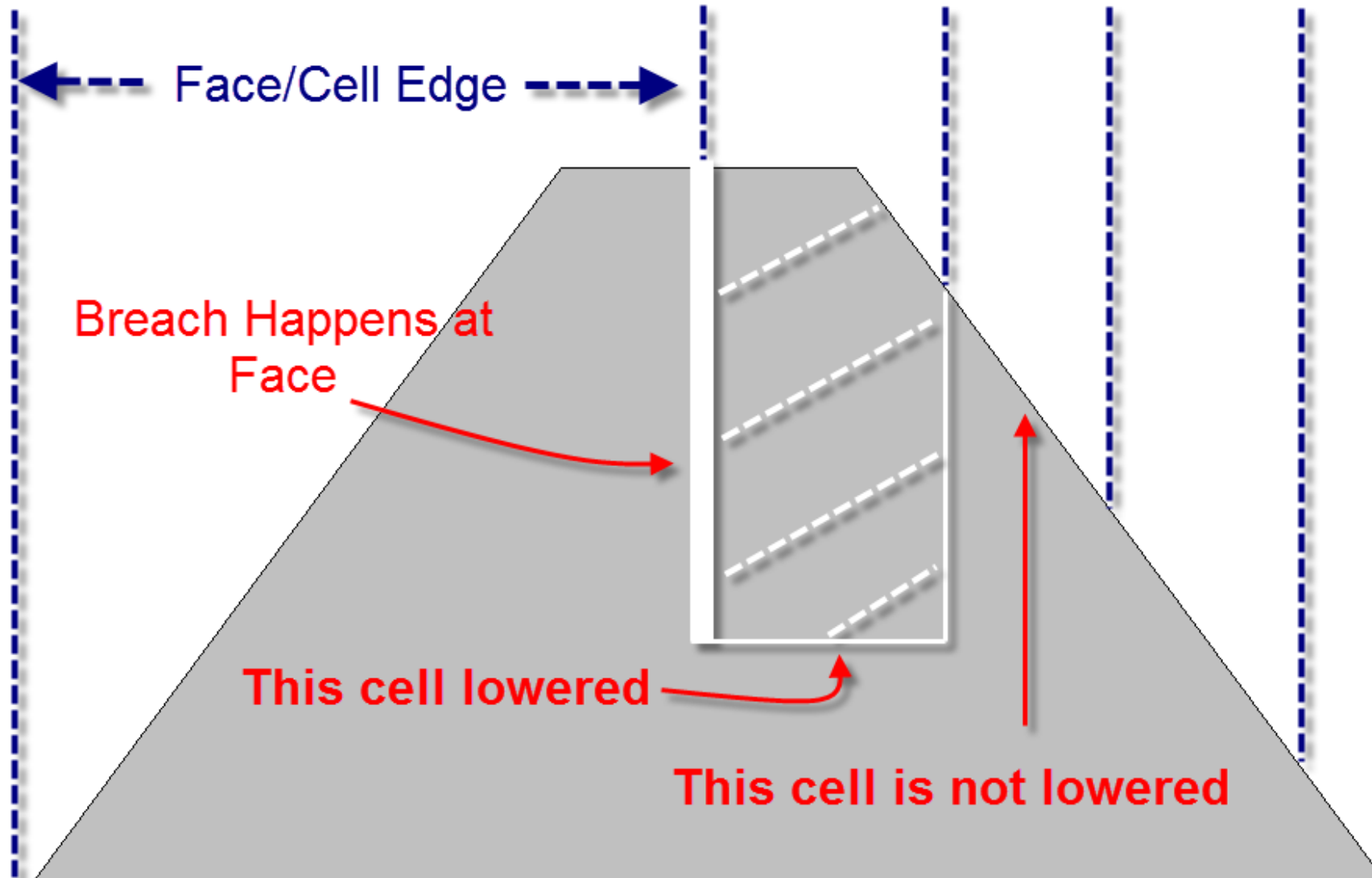
Center Station: 5250
Final Bottom Width: 446
Final Bottom Elevation: 585
Left Side Slope: 0.1
Right Side Slope: 0.1
Breach Weir Coef: 2.6
Breach Formation Time (hrs): 3.2
Failure Mode: Piping
Piping Coefficient: 0.5
Initial Piping Elev: 620
Trigger Failure at: WS Elev
Starting WS: 667

The graph shows Elevation (ft) on the y-axis (580 to 700) and Station (ft) on the x-axis (0 to 7000). A legend indicates 'Spillway' (red line) and 'Final Breach' (black line). The spillway is a vertical line at station 5250. The final breach is a vertical line at station 5250, extending from elevation 585 to 620. The dam structure is shown as a grey area between stations 2000 and 6000, with a spillway at station 5250.

OK Cancel

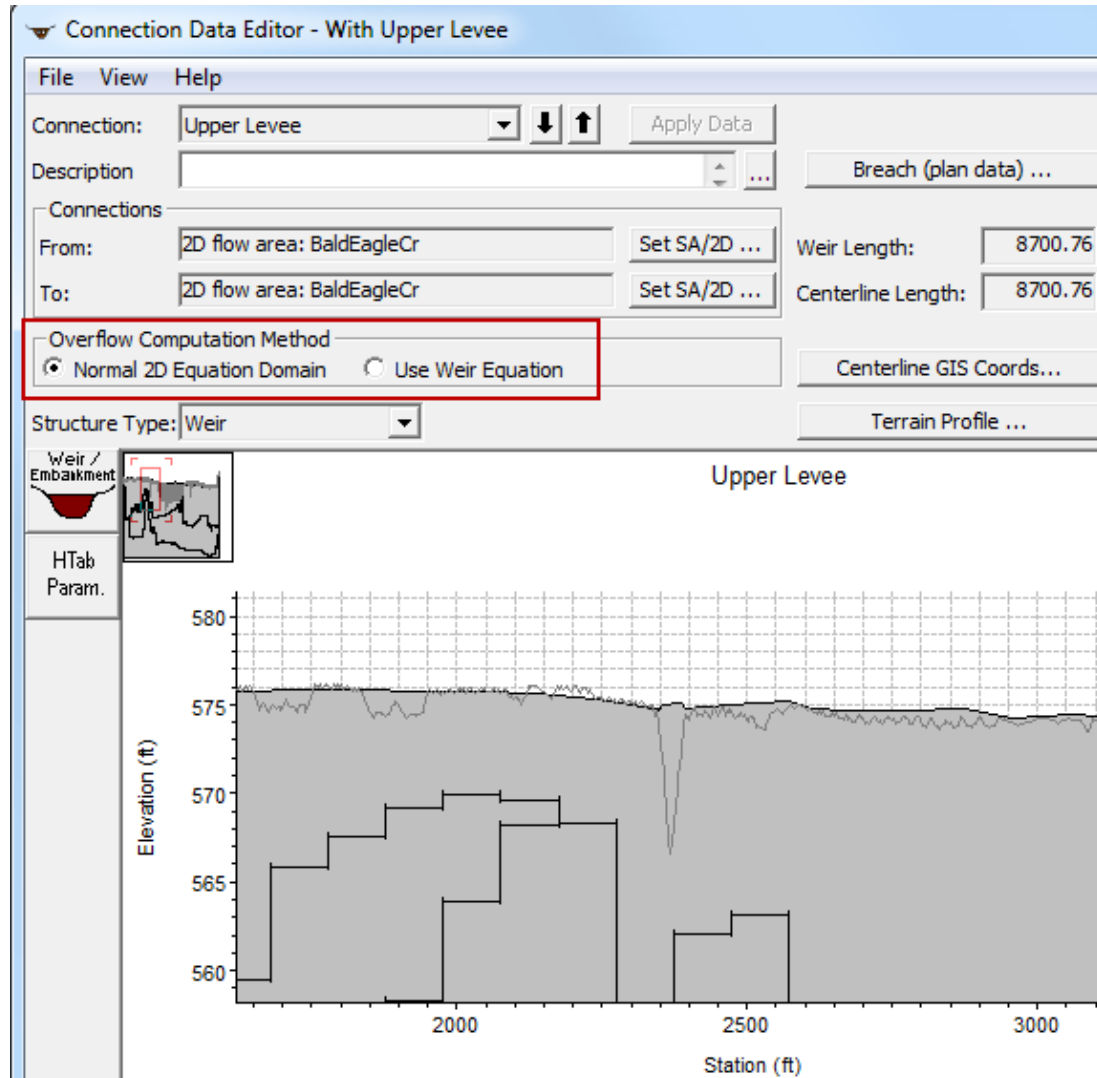


HS Breach and Cell





HS Equation Choice



- Normal 2D Equation Domain
 - flow across face computed with 2D flow equations
- Use Weir Equation
 - $Q = CLH^{1.5}$



Normal 2D Equation Domain

- Face properties are adjusted for user entered SE Data, but 2D Area is solved in the normal manner
- Generally, faster, more accurate
- But not good for true weir type
- HS with culverts/gates can still use 2D for overflow
 - culvert/gate flow is computed separately



Weir Equation

- Weir flow computed using [1D] weir equation and user SE Data
- Flow computed “just prior” to each iteration of 2D
- More appropriate for [non-submerged] weir flow

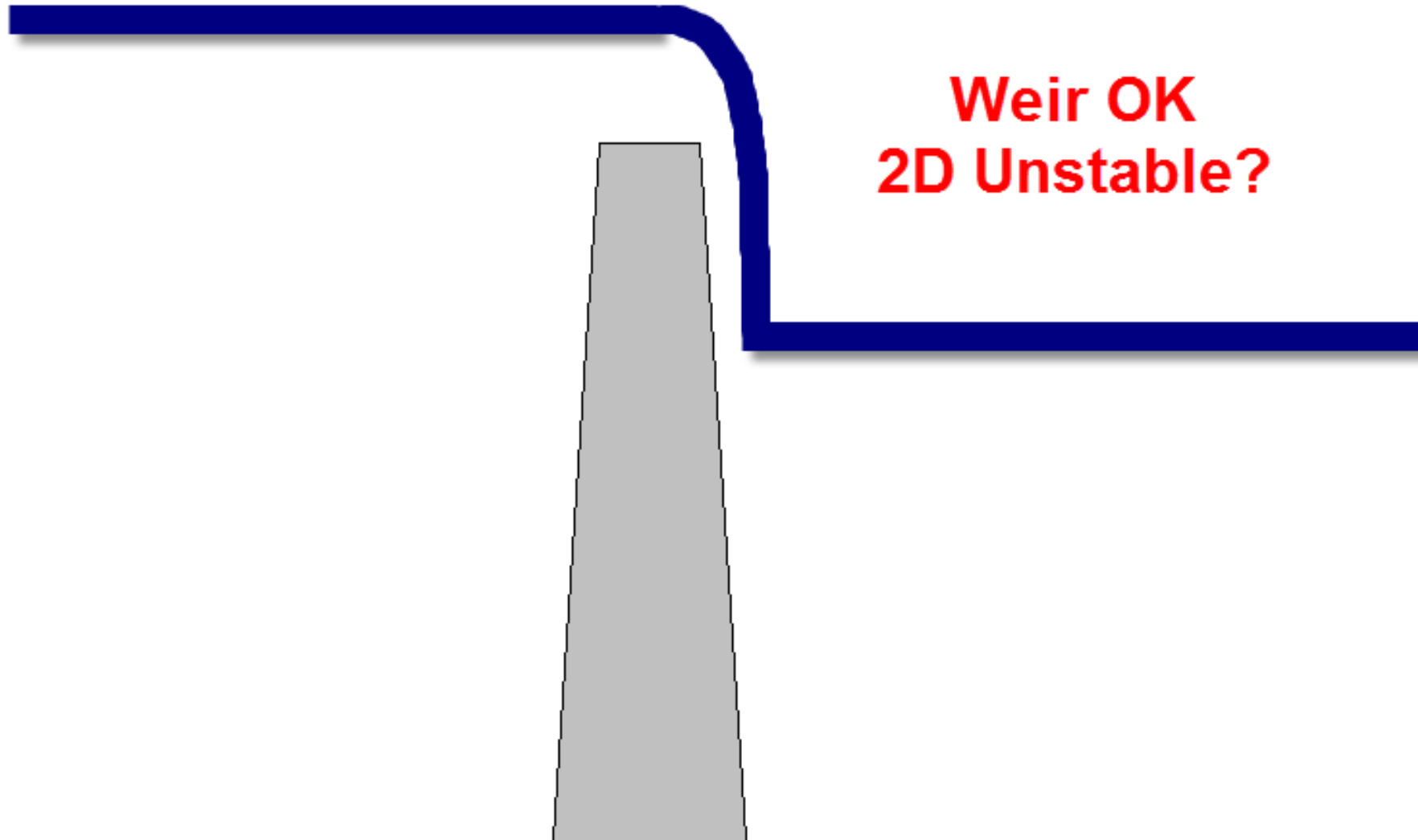


Weir Equation continued

- Less desirable for submerged conditions
 - Turn on Weir Submergence Decay Exponent!
- May require “trial and error” solution causing 2D to iterate
- Gate and culvert flow are always computed “just prior” to 2D



HS Weir Flow

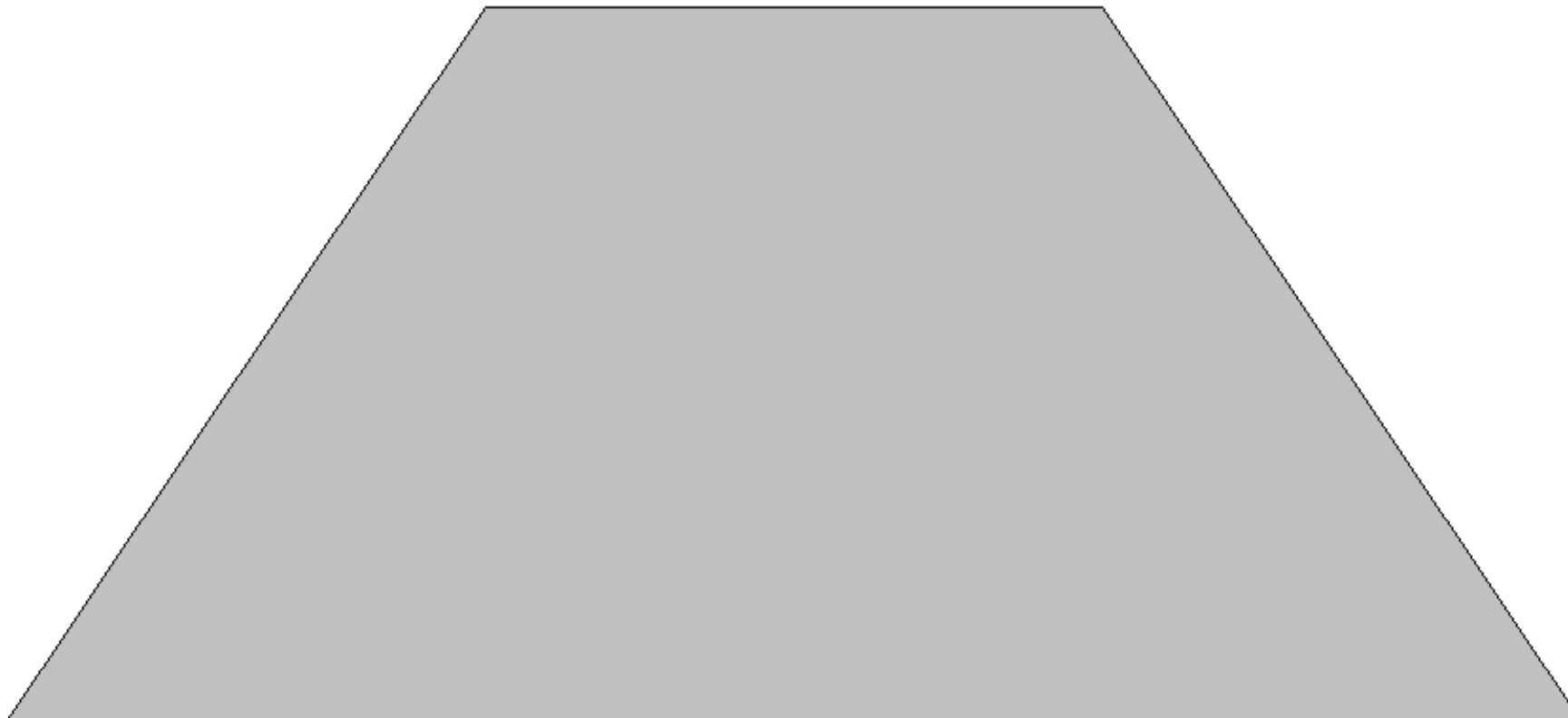




HS 2D Flow

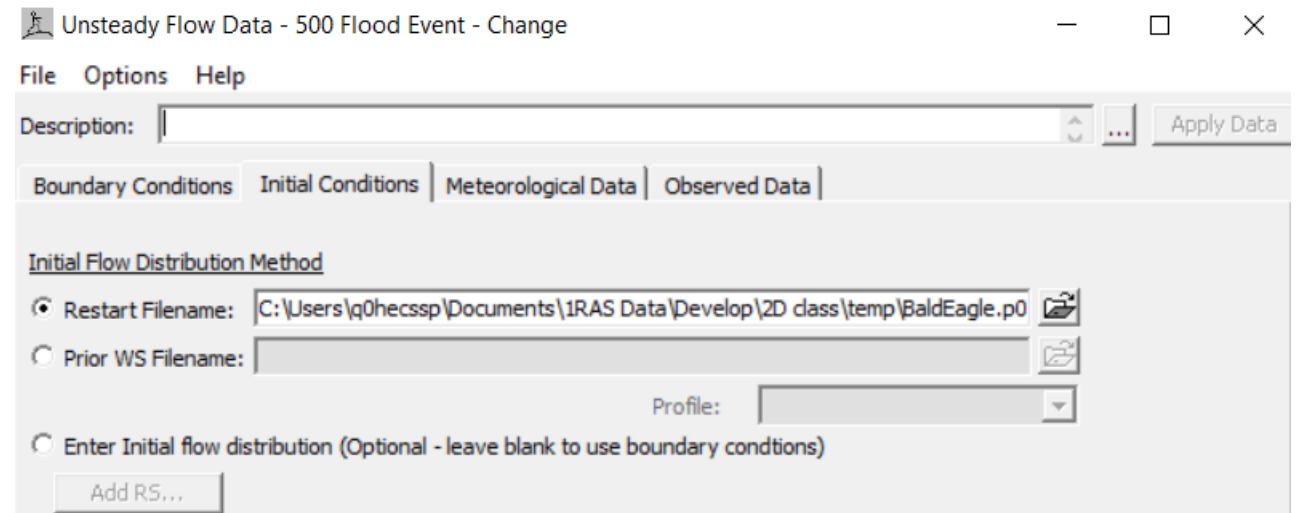
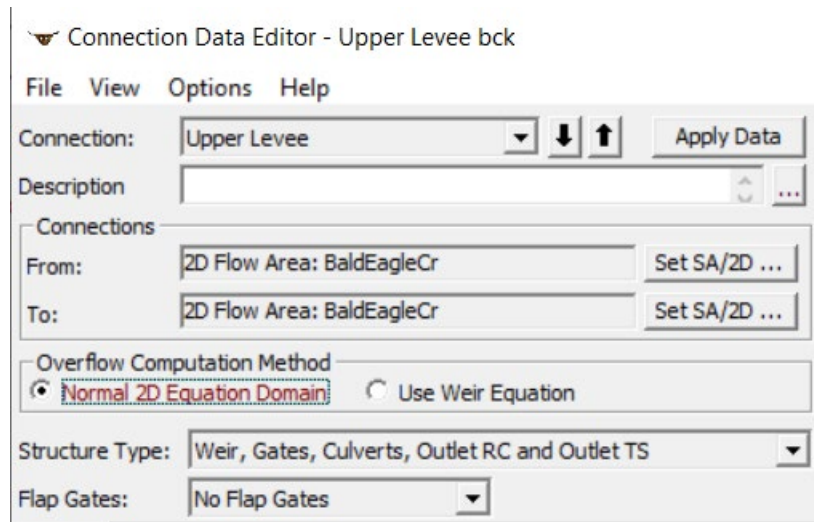


2D Solution is better





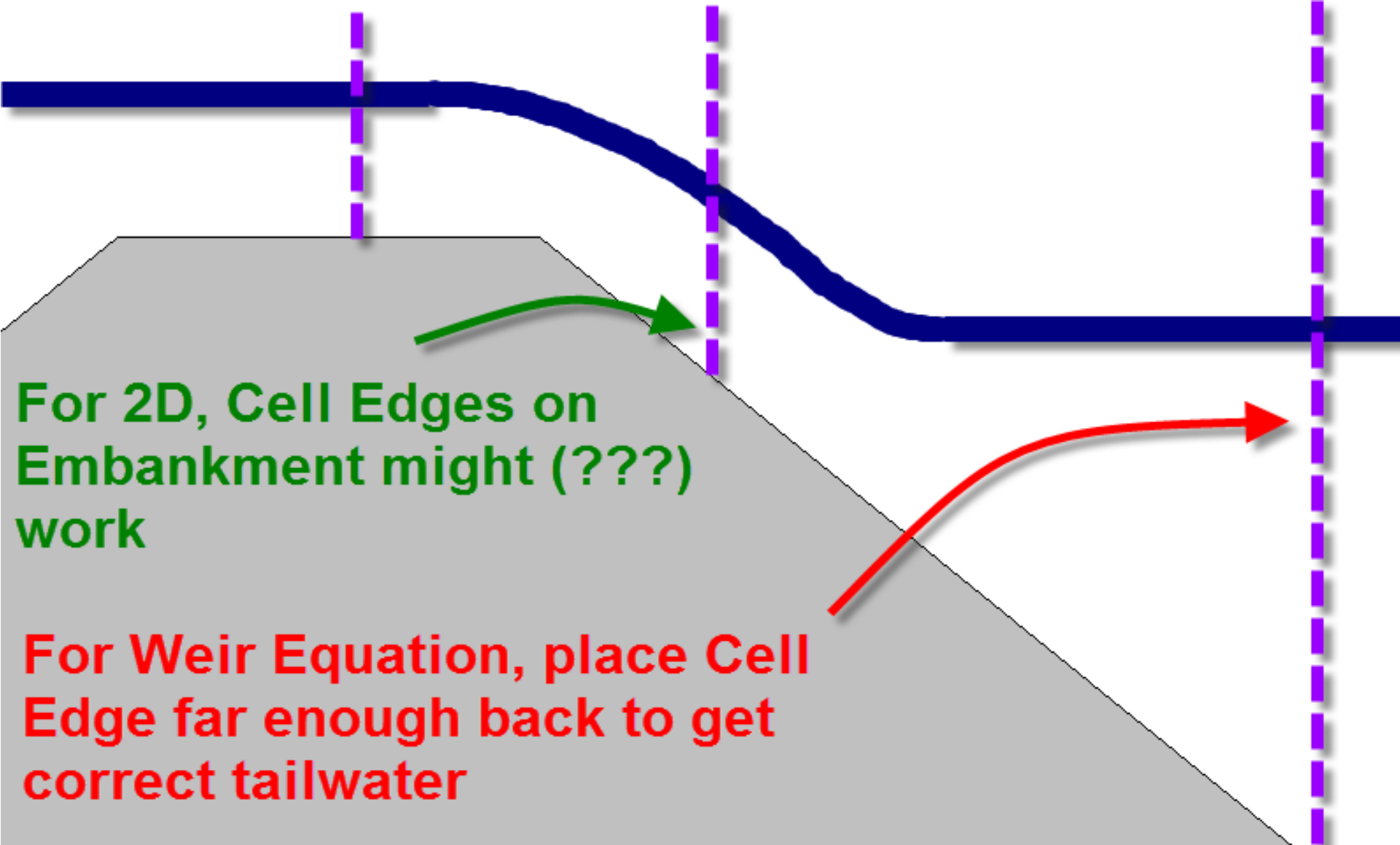
Use Restart/Prior to Switch



- Can switch methods while when using a restart/prior WS method
- Really only viable for a single location such as a levee breach



HS Tailwater Considerations



For 2D, Cell Edges on Embankment might (???) work

For Weir Equation, place Cell Edge far enough back to get correct tailwater

Questions?