

HEC-RAS Data Requirements for Unsteady Flow Models

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Overview

- Geometry Preprocessor
- Hydraulic Computations
- Manning's n Values
- Ineffective Flow Areas
- Blocked Obstructions
- Levees



Geometry Preprocessor

The screenshot displays the 'Unsteady Flow Analysis' software interface. The main window is titled 'Unsteady Flow Analysis' and contains several sections:

- Plan:** Unsteady Flow
- Short ID:** UnsteadyFlow
- Geometry File:** Imported GIS Data +Bridges
- Unsteady Flow File:** Flood Event
- Programs to Run:** A list of checkboxes where 'Geometry Preprocessor', 'Unsteady Flow Simulation', and 'Post Processor' are checked. 'Sediment' and 'Floodplain Mapping' are unchecked.
- Simulation Time Window:** Starting Date: 01jan2009, Ending Date: 04jan2009
- Computation Settings:** Computation Interval: 20 Second, Mapping Output Interval: 1 Hour, Project DSS Filename: C:\Temp\B

An inset window titled 'HEC-RAS Computations' is overlaid on the main window. It shows the following details for the 'Geometry Processor':

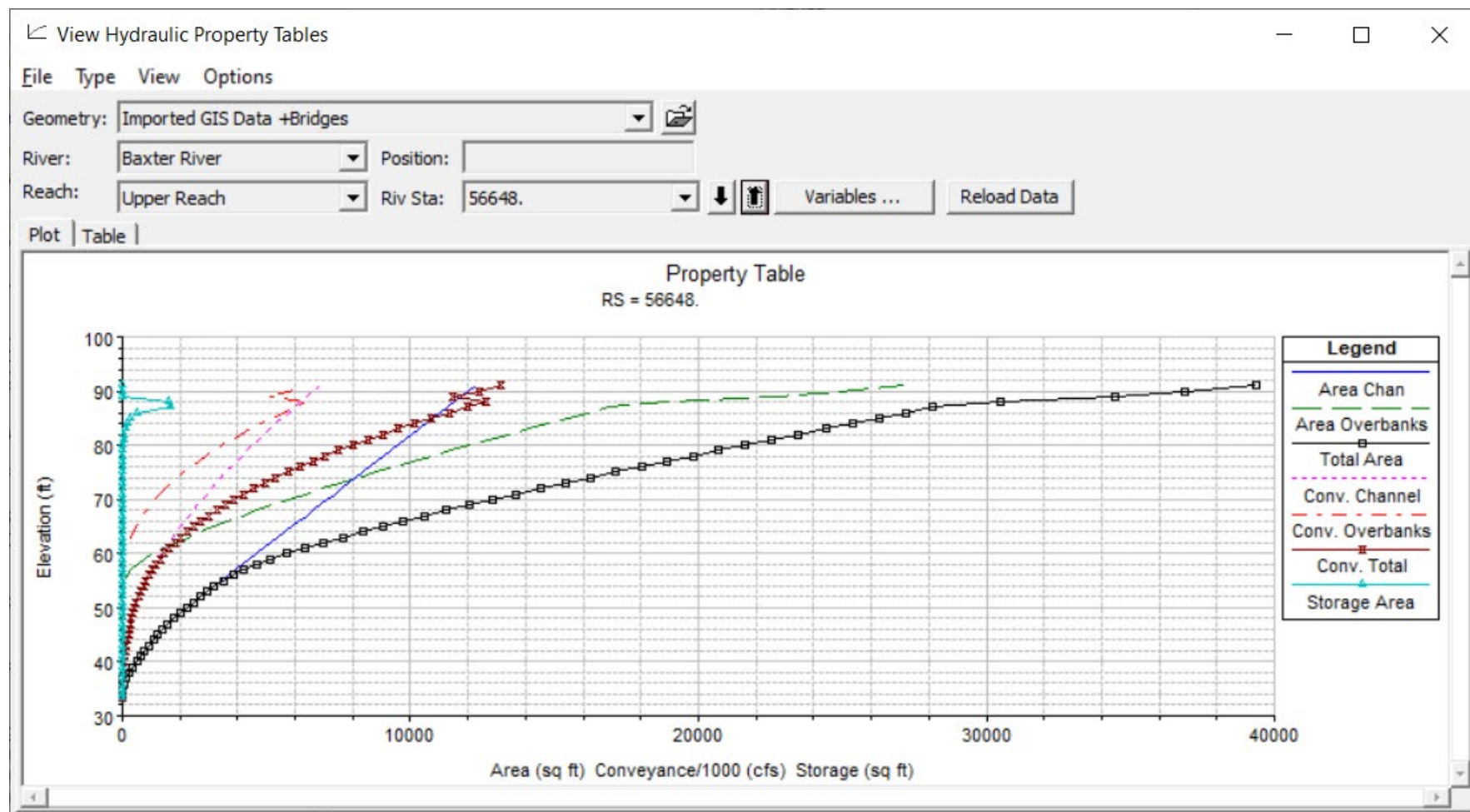
- Write Geometry Information:** Layer: COMPLETE
- Geometry Processor:** River: Baxter River, RS: 77737, Reach: Upper Reach, Node Type: Bridge, IB Curve: 41/50
- Submerged Curves:** A section with a blue progress bar.
- Unsteady Flow Simulation:** Simulation: [empty field], Time: Iteration (1D): [empty field], Iteration (2D): [empty field]
- Unsteady Post Processor:** Date/Time: [empty field]
- Computation Messages:** Plan: 'Unsteady Flow' (Baxter.p02), Simulation started at: 14Apr2022 03:13:52 PM, Writing Geometry..., Completed Writing Geometry.

At the bottom of the inset window, the text reads: **Geometric Preprocessor HEC-RAS 6.2 March 2022**



Geometry Preprocessor

- Processes geometric data into a series of hydraulic tables and rating curves.





Geometry Preprocessor

- Why do we use it for unsteady flow?
 - Instead of calculating hydraulic variables for each cross-section during each iteration, the program interpolates the hydraulic variables from the tables.

Computations Summary	
Computation Task	Time(hh:mm:ss)
Writing Geometry	2
Writing Event Conditions	<1
Preprocessing Geometry	2:46
Unsteady Flow Computations	22
Writing to DSS	<1
Post-Processing	38
Complete Process	3:48

- Hydraulic Variables: Conveyance, Area, Storage, Top Width



Conveyance Calculations

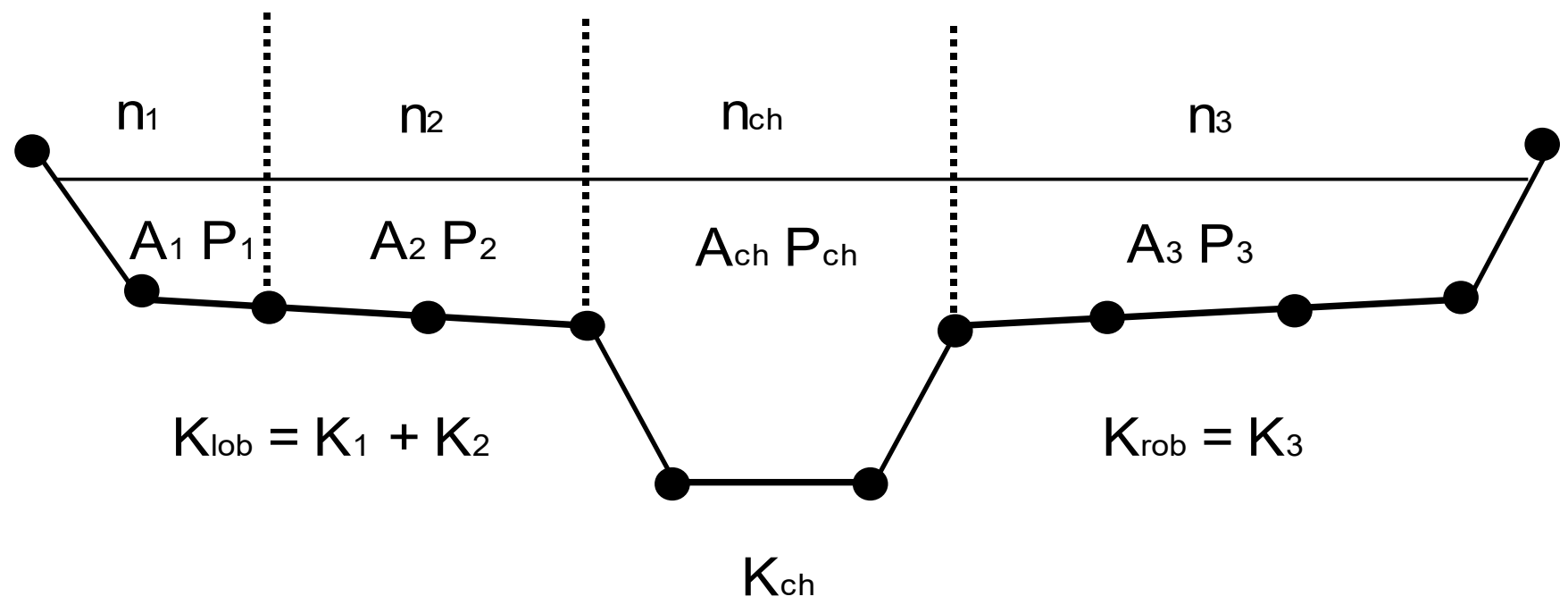
- Manning's Equation

$$Q = K S_f^{1/2}$$

$$K = \frac{1.486}{n} A R^{2/3}$$



Conveyance Calculations





Cross Section Table Parameters

The screenshot shows the HEC-RAS software interface. The title bar reads "Geometric Data - Imported GIS Data +Bridges". The menu bar includes "File", "Edit", "Options", "View", "Tables", "Tools", "GIS Tools", and "Help". The toolbar contains various tool icons, including "River Reach", "Storage Area", "2D Flow Area", "SA/2D Conn", "BC Lines", "Reference Lines", "IC Points", "Reference Points", "2D Area BreakLines", "2D Area Mann n Regions", "Pump Station", and "RS" (with a value of 12.99). The "Editors" panel on the left lists: "Junct.", "Cross Section", "Brdg/Culv", "Inline Structure", "Lateral Structure", "Storage Area", "2D Flow Area", "SA/2D Conn", "Pump Station", "HTab Param.", and "View Picture". The main workspace displays a 2D plan view of a river reach with numerous cross-sections marked by red dots and labeled with stationing numbers. A red arrow points from the "HTab Param." button in the Editors panel to the cross-sections in the workspace, with the text "Set HTab Parameters" next to it. The status bar at the bottom right shows the file path "6454012.01, 2026488.12".



Cross Section Table Parameters

- Starting Elevation, Increment, Number of Points

Cross Section Table Properties

River: Selected Area Edit Options:

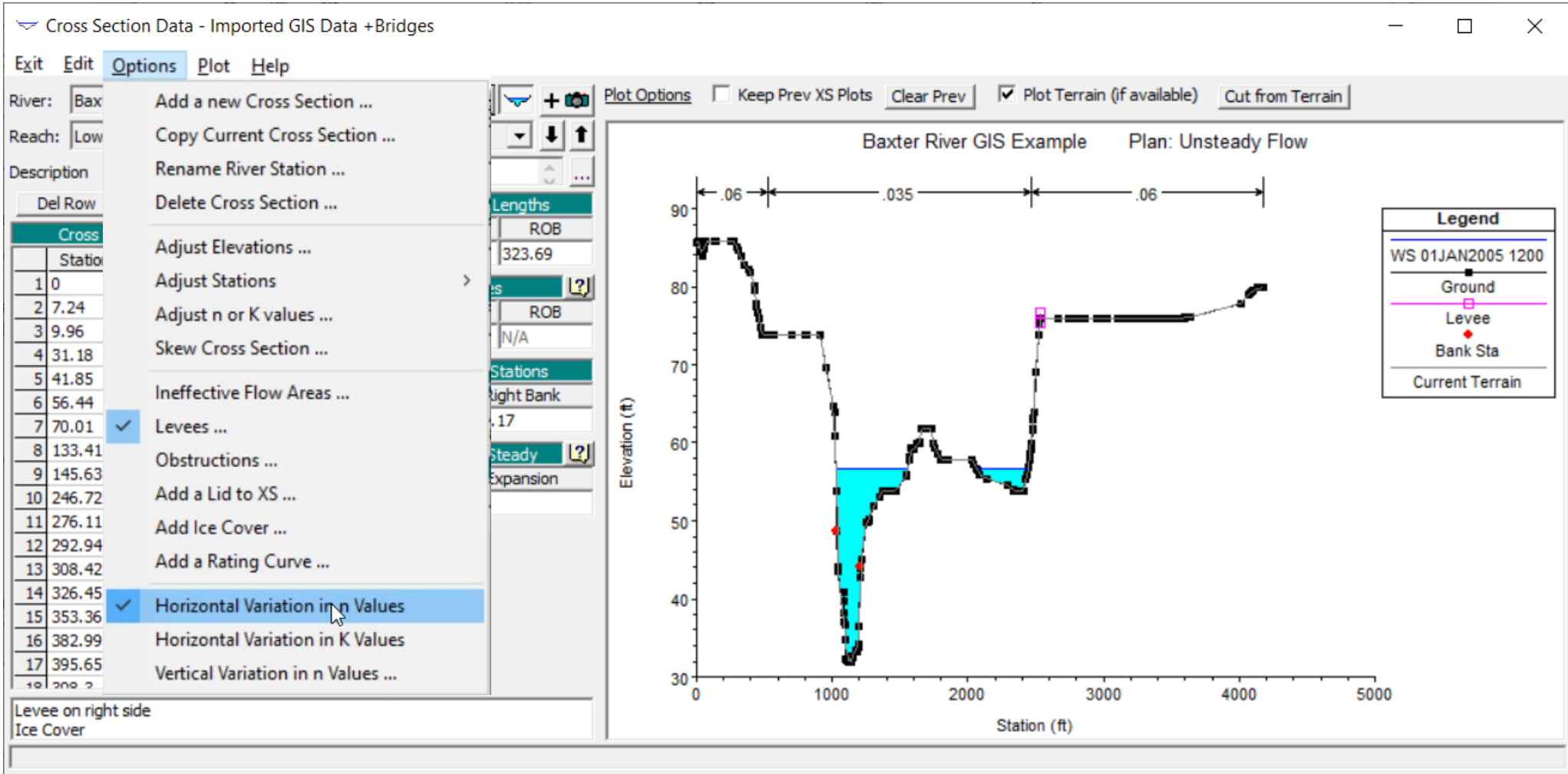
Reach:

Vertical Discretization (hydraulic properties)						Horizontal (velocity mapping)			Cross section plot is for the current row in the table	
	RS	Chan Min	Starting El	Increment	Points(20-500)	LOB	Chan	ROB		
38	62507.	30	30.5	1	73	5	5	5		Baxter River Upper Reach 55058.
39	61976.	32.02	32.52	1	71	5	5	5		
40	61506.	28.7	29.2	1	75	5	5	5		
41	60356.	28	28.5	1	73	5	5	5		
42	59797.	26.57	27.07	1	72	5	5	5		
43	58912.	23.23	23.73	1	72	5	5	5		
44	58425.	27.88	28.38	1	67	5	5	5		
45	58021.	29.88	30.38	1	65	5	5	5		
46	57459.	32.75	33.25	1	59	5	5	5		
47	56999.	33	33.5	1	59	5	5	5		
48	56648.	33.48	33.98	1	57	5	5	5		
49	56106.	34.4	34.9	1	56	5	5	5		
50	55483.	34.6	35.1	1	59	5	5	5		
51	55058.	34.6	35.1	1	59	5	5	5		
52	54372.	34.6	35.1	1	57	5	5	5		
53	53861.	34.07	34.57	1	56	5	5	5		
54	53267.	33.75	34.25	1	56	5	5	5		
55	52676.	33.3	33.8	1	52	5	5	5		
56	51858.	35.22	35.72	1	49	5	5	5		
57	51497.	35.5	36	1	48	5	5	5		
58	50871.	35.55	36.05	1	56	5	5	5		
59	50517.	36.18	36.68	1	53	5	5	5		
60	50002.	35.39	35.89	1	54	5	5	5		

OK Cancel



Manning's n Values





Ineffective Flow Areas

- Areas where water is not actively being conveyed. The velocity of water in the downstream direction is close to zero.
- This water is included in the storage calculations and other wetted cross section parameters, but it is not included as part of the active flow area.

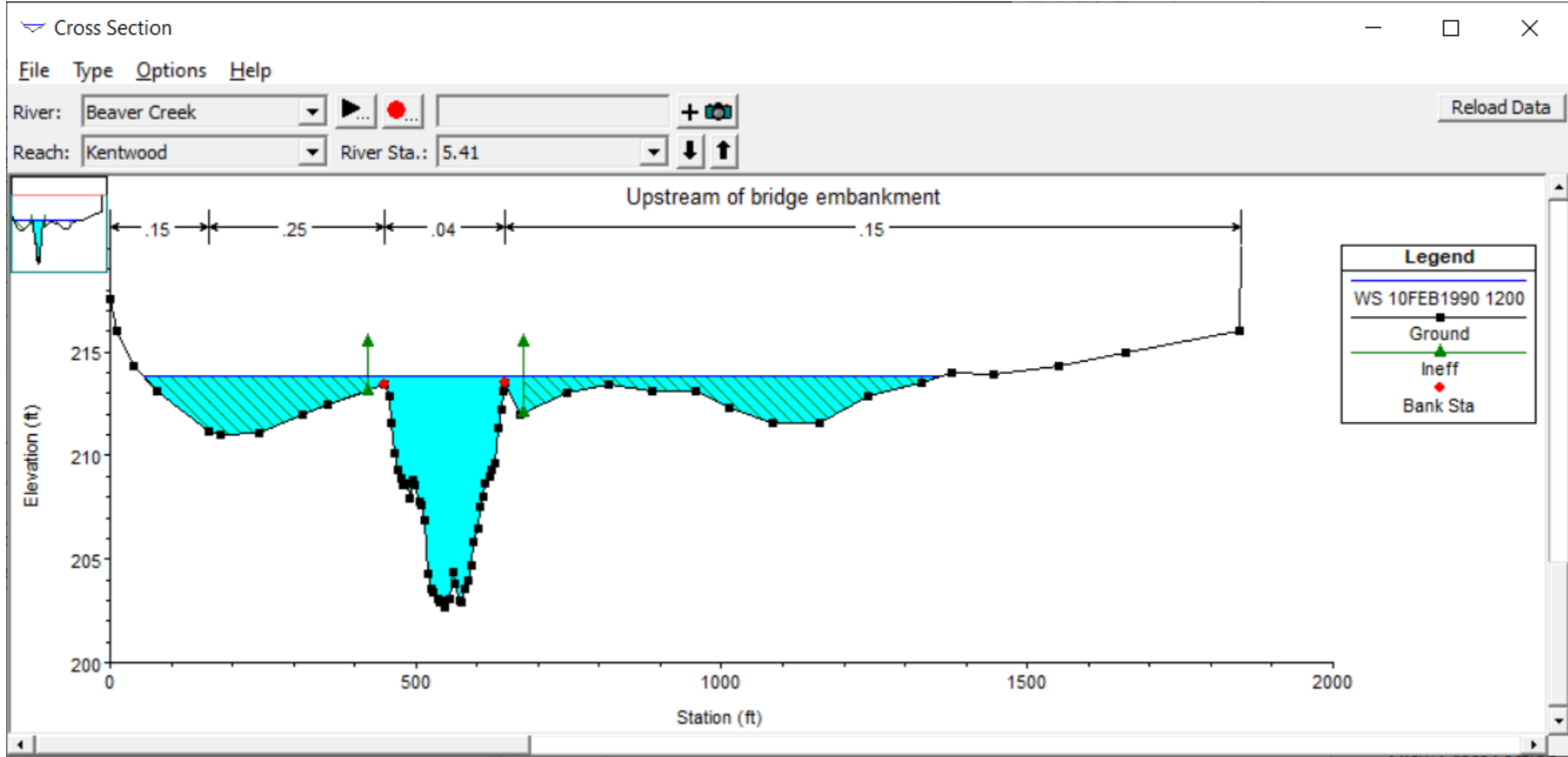


Ineffective Flow Areas Requirements

- Ineffective Flow Stations
 - Left and/or right ineffective flow stations denote the location of the ineffective flow areas along the cross section.
- Trigger Elevations
 - Water elevation at which the ineffective flow area begins to convey flow (non-permanent) or remains ineffective (permanent).

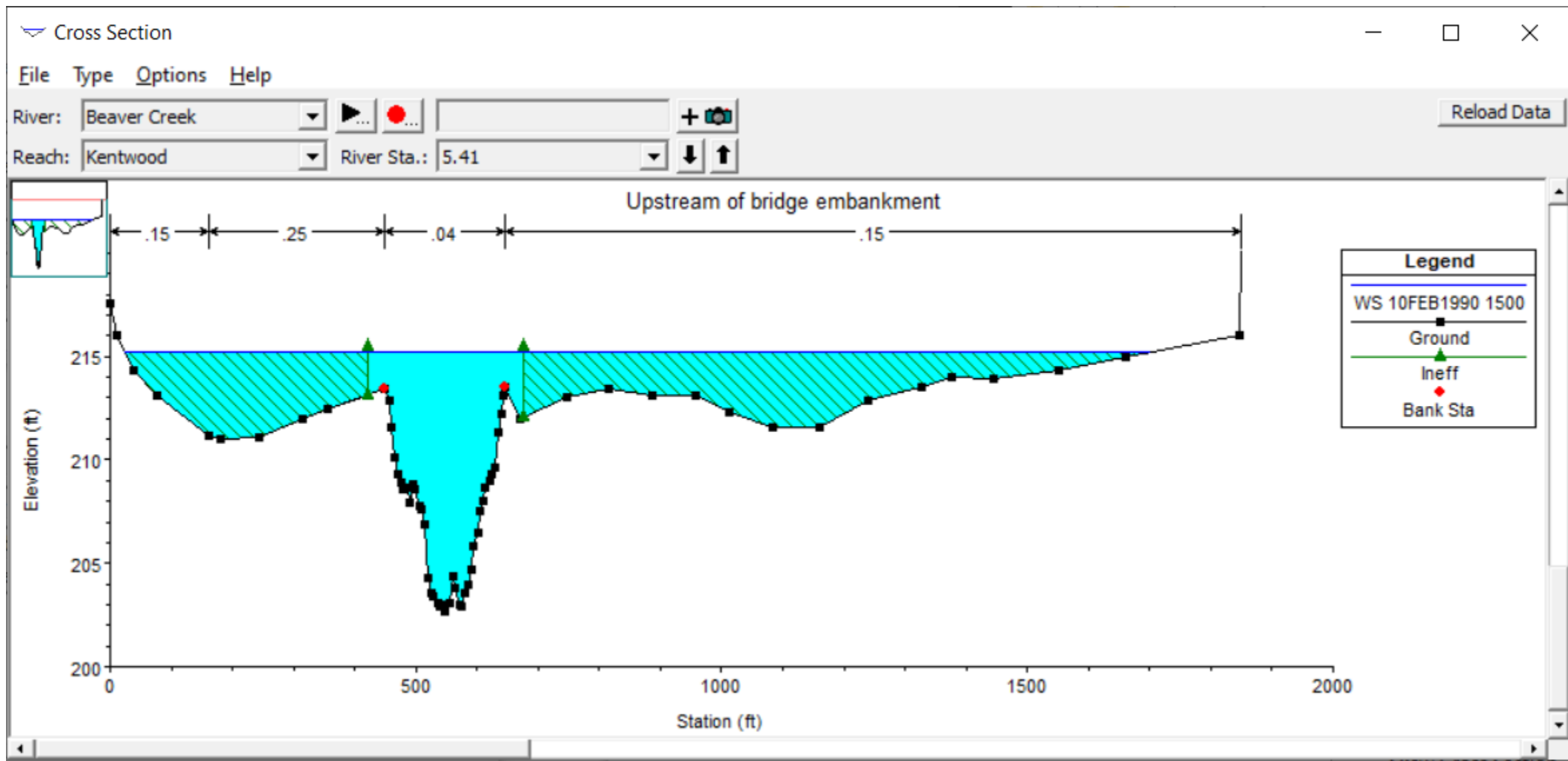


Non-Permanent Ineffective Flow Area



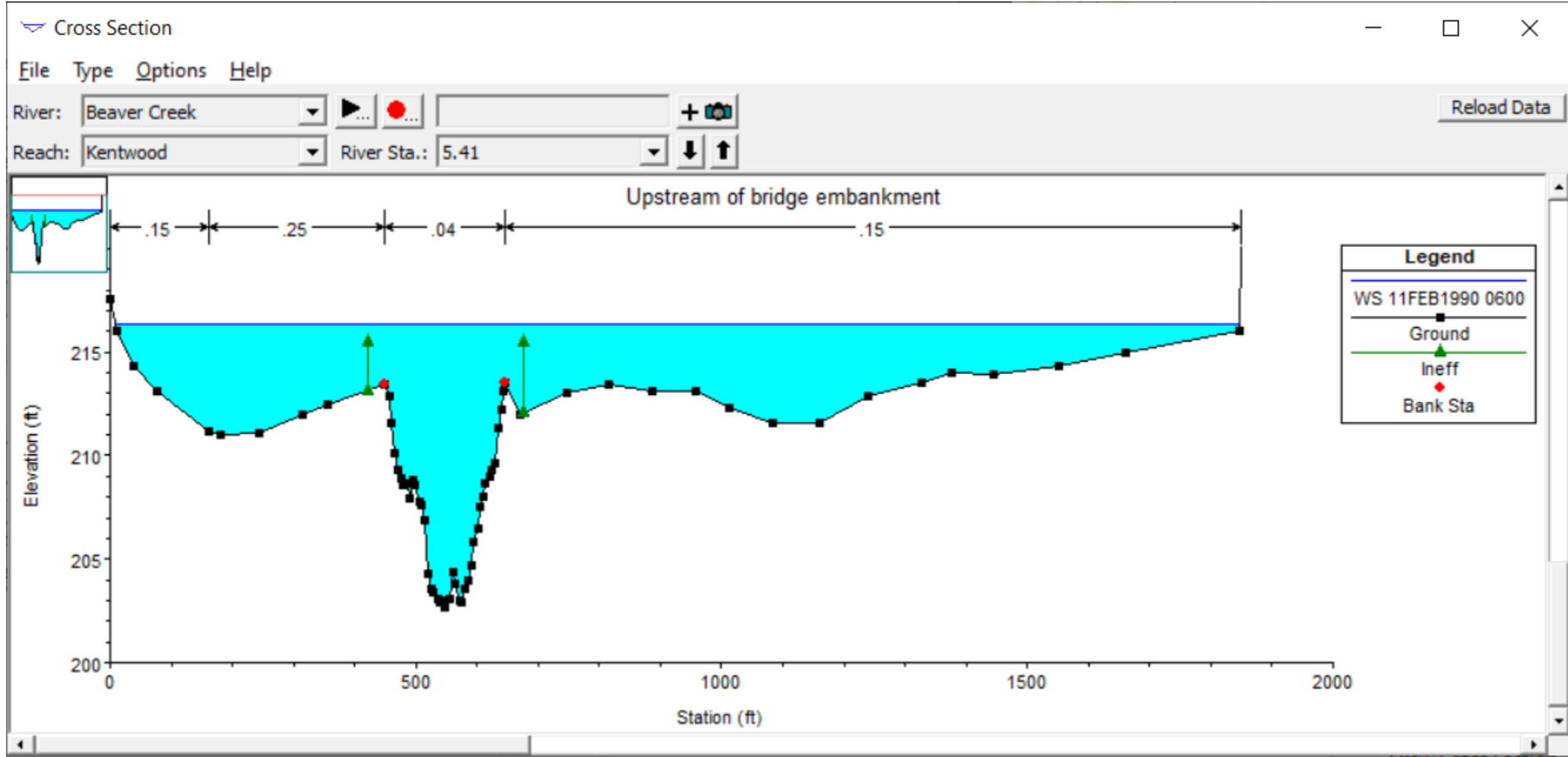


Non-Permanent Ineffective Flow Area



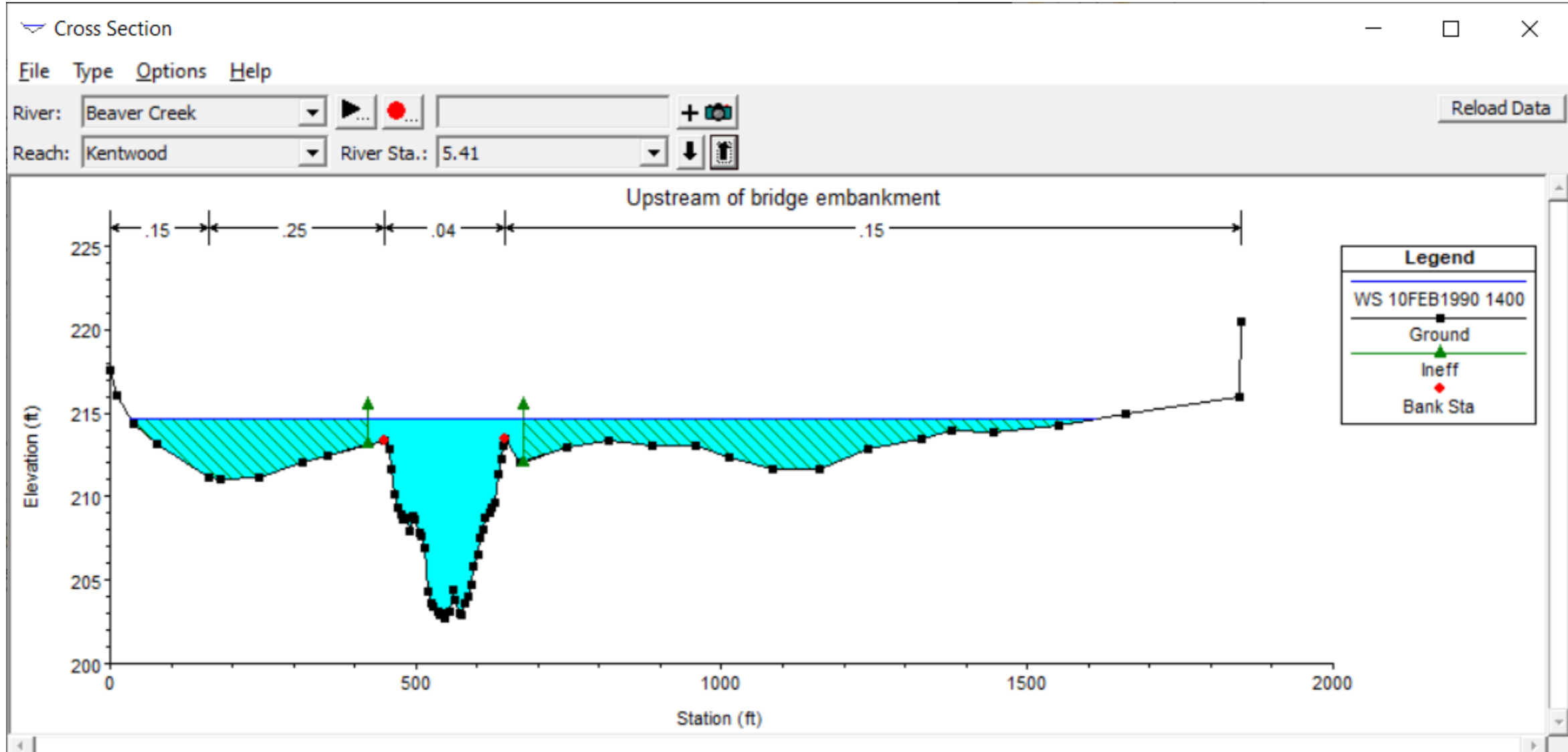


Non-Permanent Ineffective Flow Area



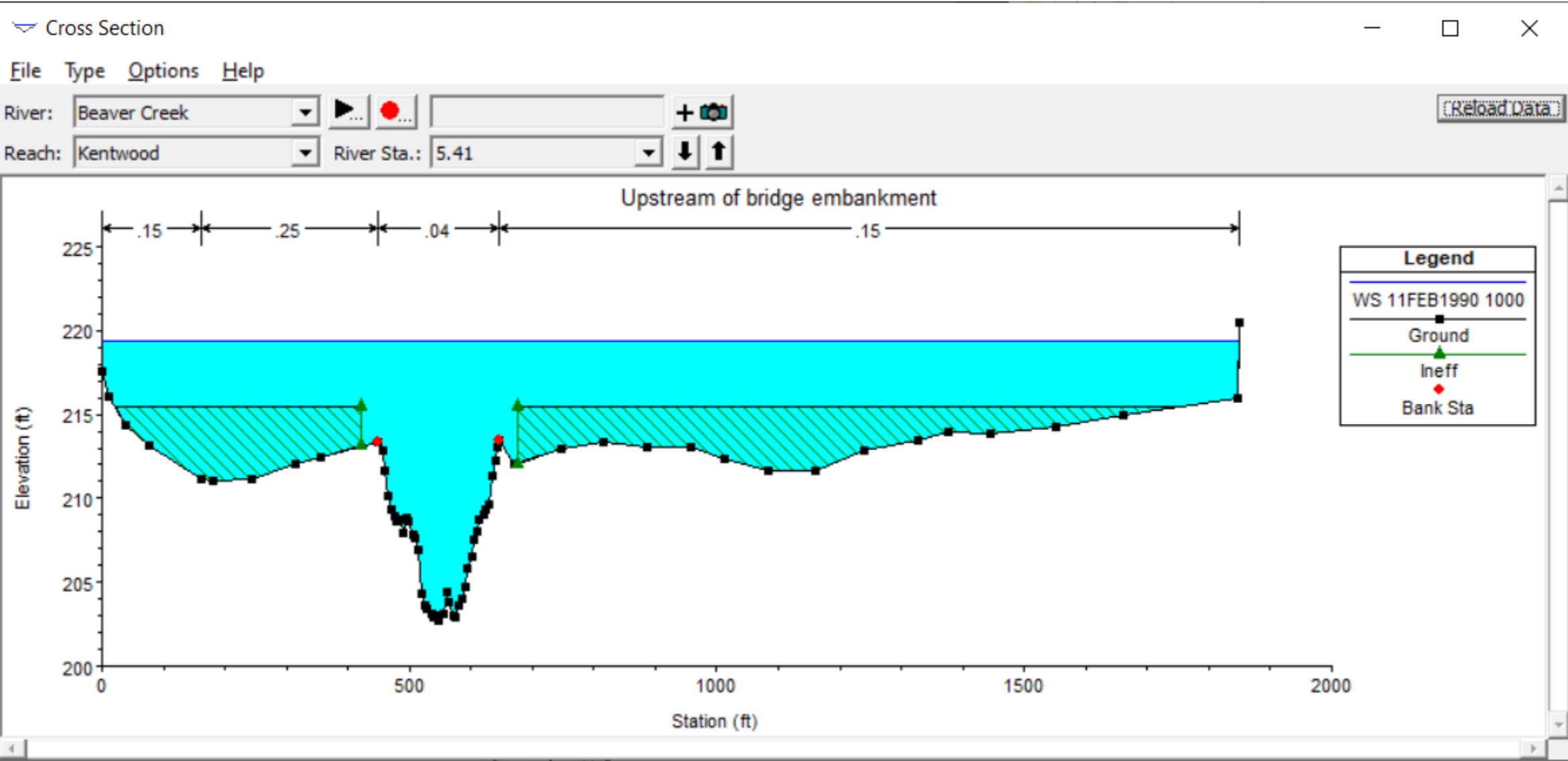


Permanent Ineffective Flow Area



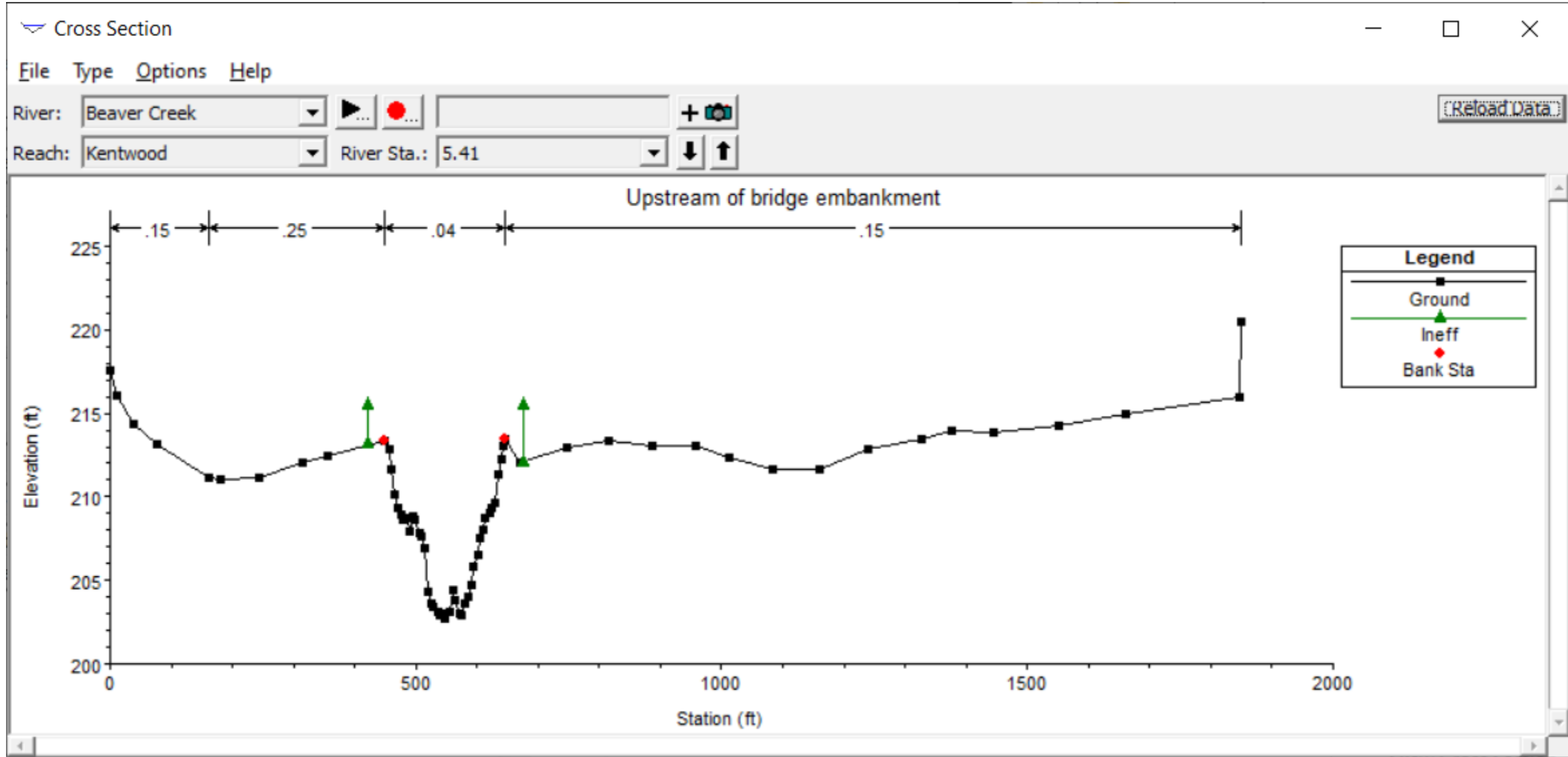


Permanent Ineffective Flow Area





Normal Ineffective Flow Areas





Normal Ineffective Flow Areas

Cross Section Data - Bridge - Normal Ineffective Areas

Exit Edit **Options** Plot Help

River: Bea
Reach: Ken
Description

Del Row

Station	...
1 0	
2 12	
3 39.5	
4 76.4	
5 161.5	
6 180.4	
7 244.8	
8 315.2	
9 355	
10 450	
11 456.6	
12 459.8	
13 466.4	
14 469.7	
15 476.2	
16 479.5	
17 486.1	
18 490.4	
19 507.0	

Plot Options Keep Prev XS Plots Plot Terrain (if available)

Upstream of bridge embankment

Legend
WS 10FEB1990 0000
Ground
Ineff

Ineffective Flow Areas

Select Ineffective Mode

Normal Multiple Blocks

	Left	Right
Station	420.	677.
Elevation	215.5	215.5
	<input type="checkbox"/> Permanent	<input type="checkbox"/> Permanent

OK Cancel Defaults Clear

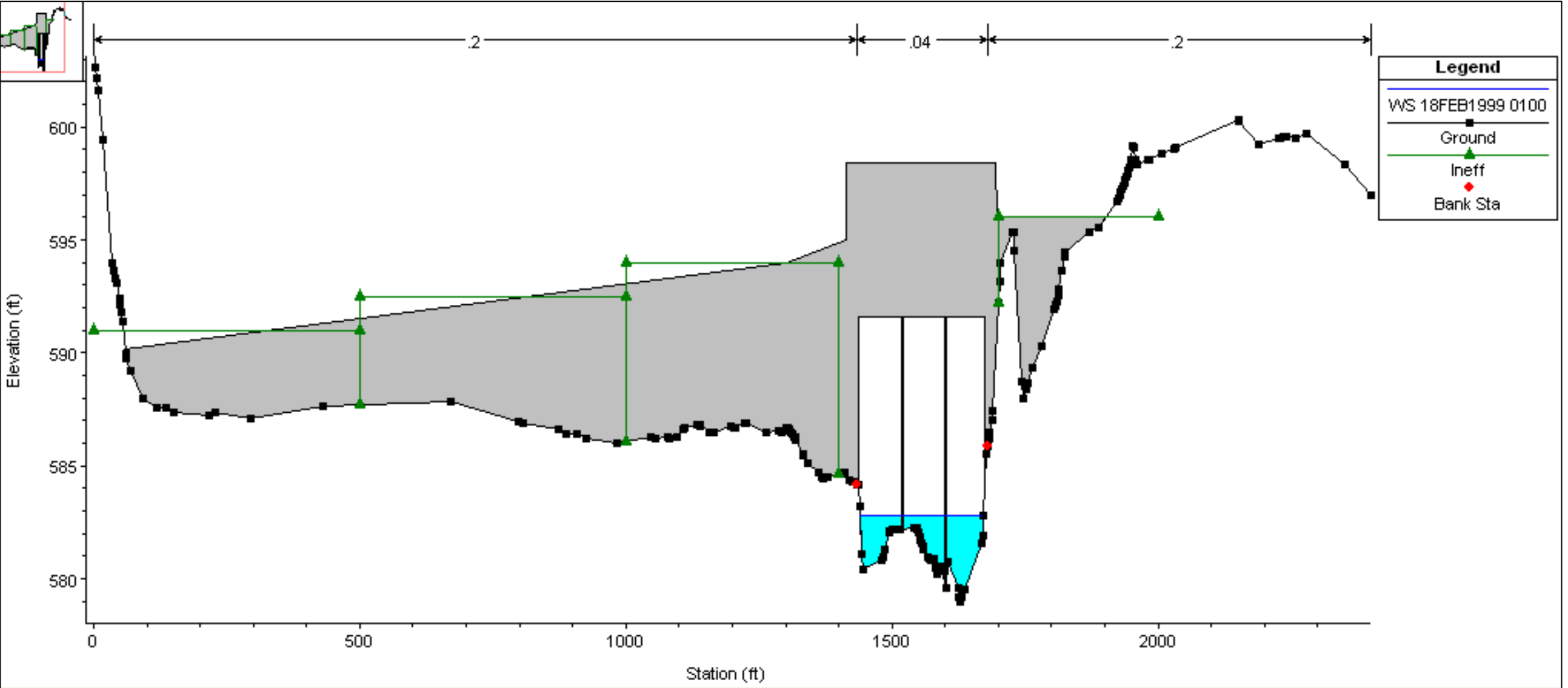
Normal Ineffective Flow Areas

Select river for cross section editing

The screenshot shows the HEC-RAS software interface. On the left, a table lists river stations from 0 to 507.0. The 'Options' menu is open, with 'Ineffective Flow Areas ...' highlighted. A red arrow points to this menu item. The main plot area shows a cross-section of a river channel with a cyan shaded area representing the ineffective flow area. The plot is titled 'Upstream of bridge embankment' and shows elevation (ft) on the y-axis (200 to 225) and station (ft) on the x-axis (0 to 2000). A legend indicates that the cyan area is 'Ineff' (Ineffective Flow Area). A dialog box titled 'Ineffective Flow Areas' is open, showing the 'Normal' mode selected. The dialog box has input fields for 'Station' (420.) and 'Elevation' (215.5) for both the left and right sides of the ineffective area. There are also checkboxes for 'Permanent' on both sides, which are currently unchecked. The dialog box has 'OK', 'Cancel', 'Defaults', and 'Clear' buttons.

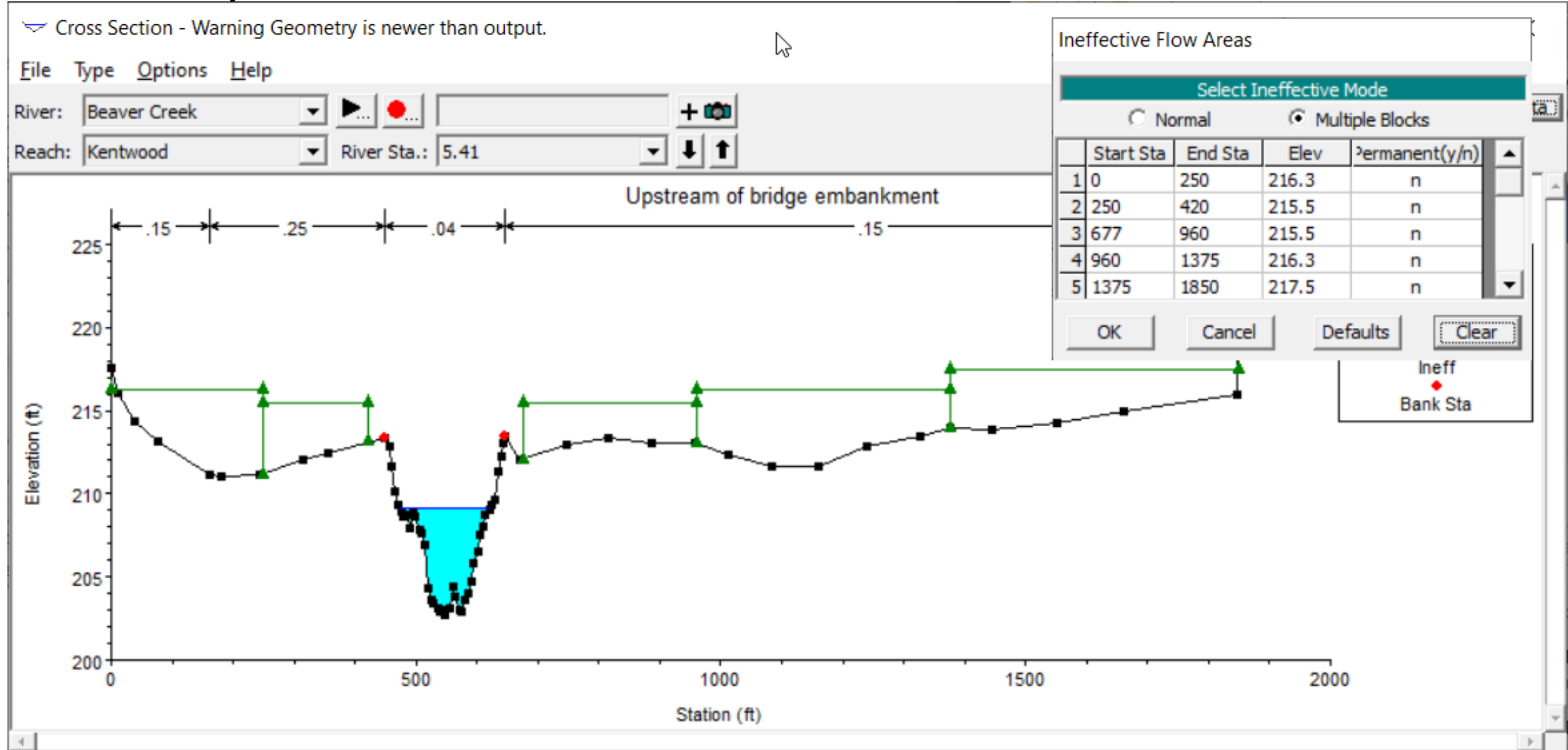


Multiple Ineffective Flow Areas





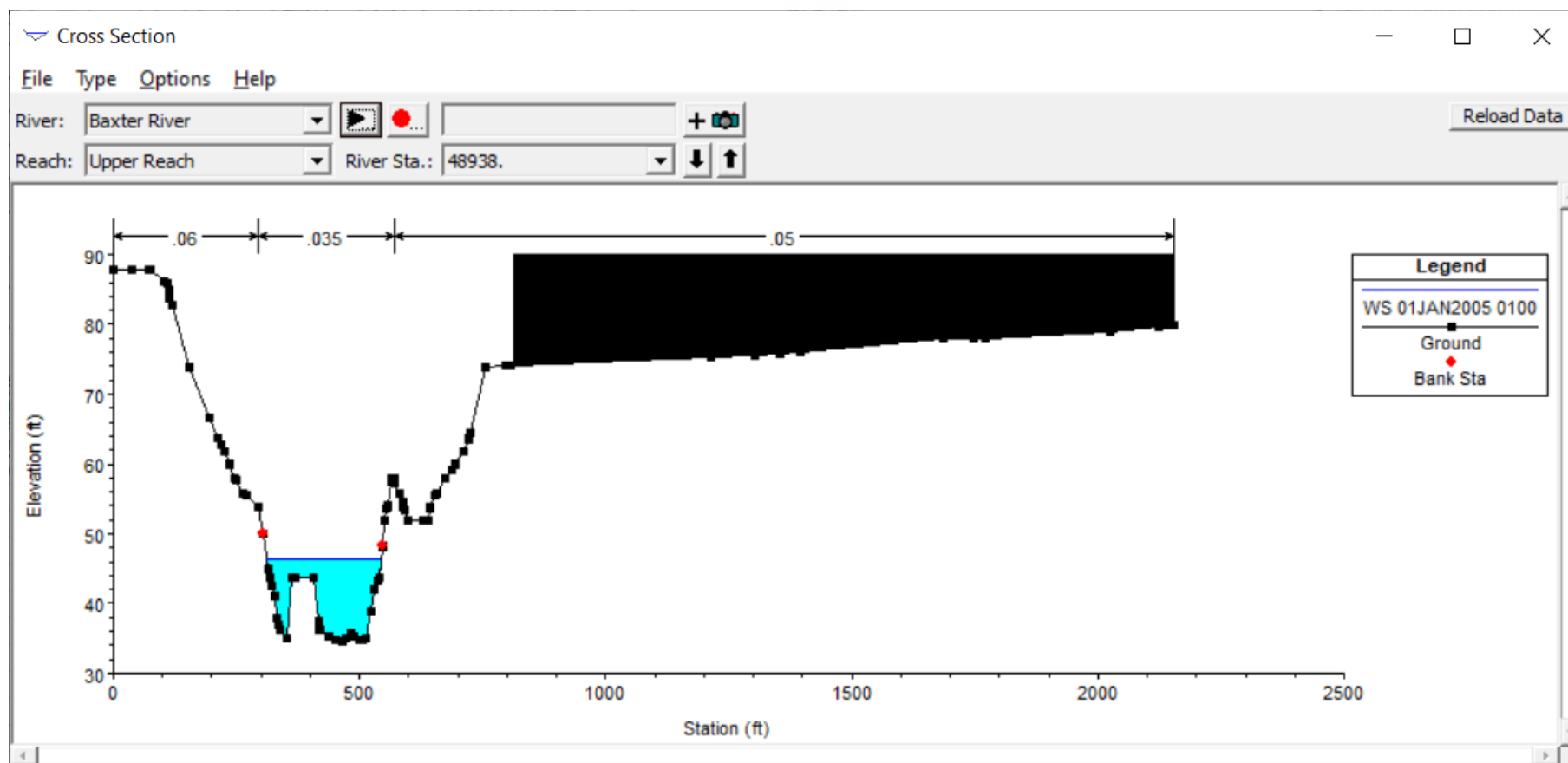
Multiple Ineffective Flow Areas





Blocked Obstructions

- Decreases Flow Area, Adds Wetted Perimeter





Blocked Obstructions

Cross Section Data - Imported GIS Data +Bridges

Exit Edit **Options** Plot Help

River: Bax
Reach: Upp
Description
Del Row

Cross	Station
1	0
2	36.15
3	70.92
4	70.97
5	71.19
6	76.05
7	103.1
8	108.99
9	111.7
10	113.77
11	118.51
12	154.99
13	194.81
14	212.86
15	220.01
16	225.86
17	234.77

Plot Options Keep Prev XS Plots Plot Terrain (if available)

Legend
WS 01JAN2005 0100
Ground
Bank Sta
Current Terrain

Obstructed Areas

Select Obstruction Mode
 Normal Multiple Blocks

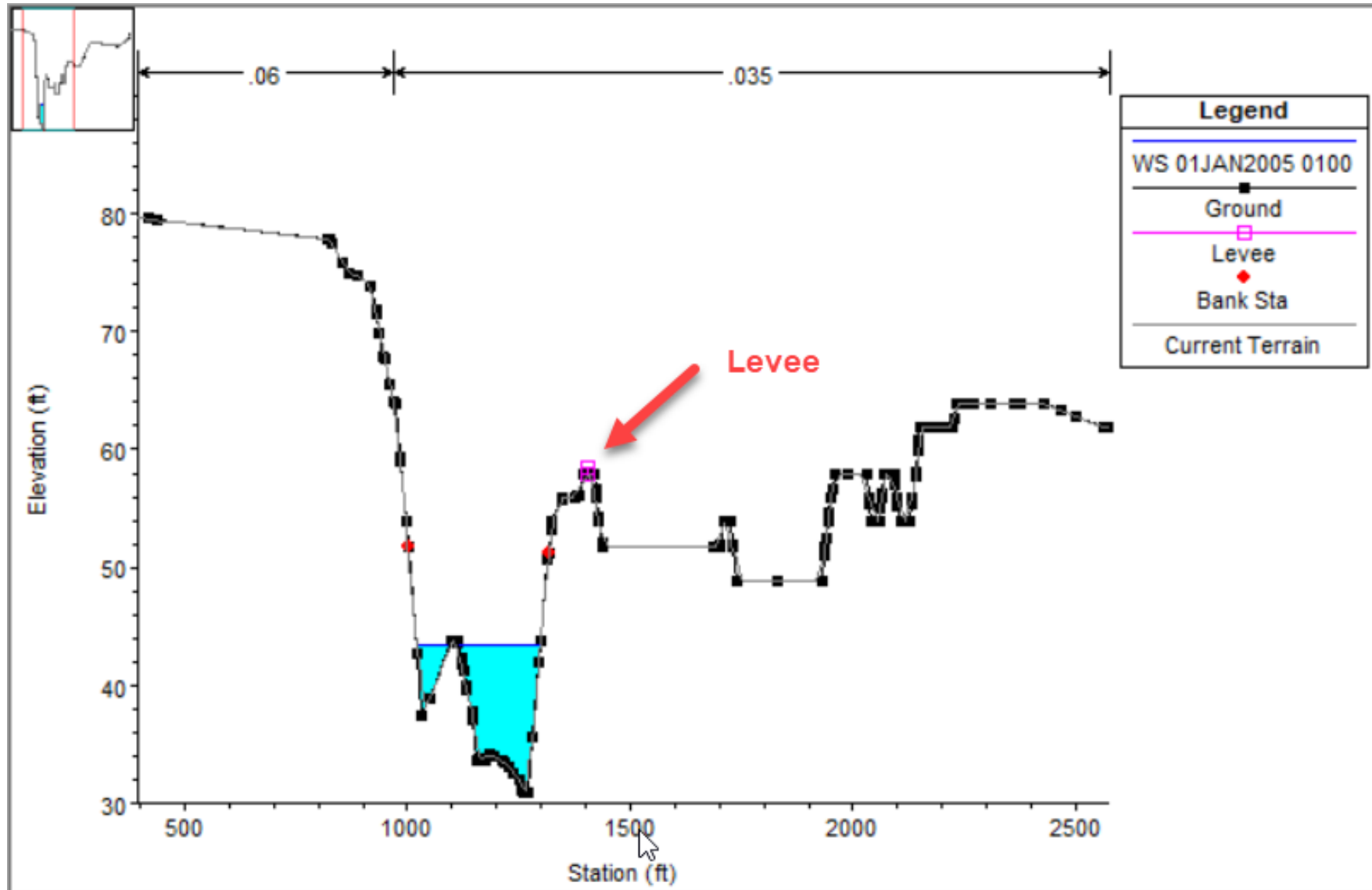
	Start Sta.	End Sta.	Elevation
1	814.71	3000	90
2			
3			
4			
5			

Multiple Block obstruction(s)

Enter to move to next downstream river station location



Levees





Levees

Cross Section Data - Imported GIS Data +Bridges

Exit Edit **Options** Plot Help

River: Bax
Reach: Low
Description
Del Row

Cross	Station
1	0
2	40.7
3	61.99
4	73.96
5	83.27
6	98.7
7	127.01
8	236.7
9	326.03
10	338.31
11	340.32
12	356.45
13	361.24
14	367.27
15	391.4
16	392.43
17	417.86

Plot Options Keep Prev XS Plots Plot Terrain (if available)

Legend

XS Levee Data

Enter station and elevation points to mark levee on cross section

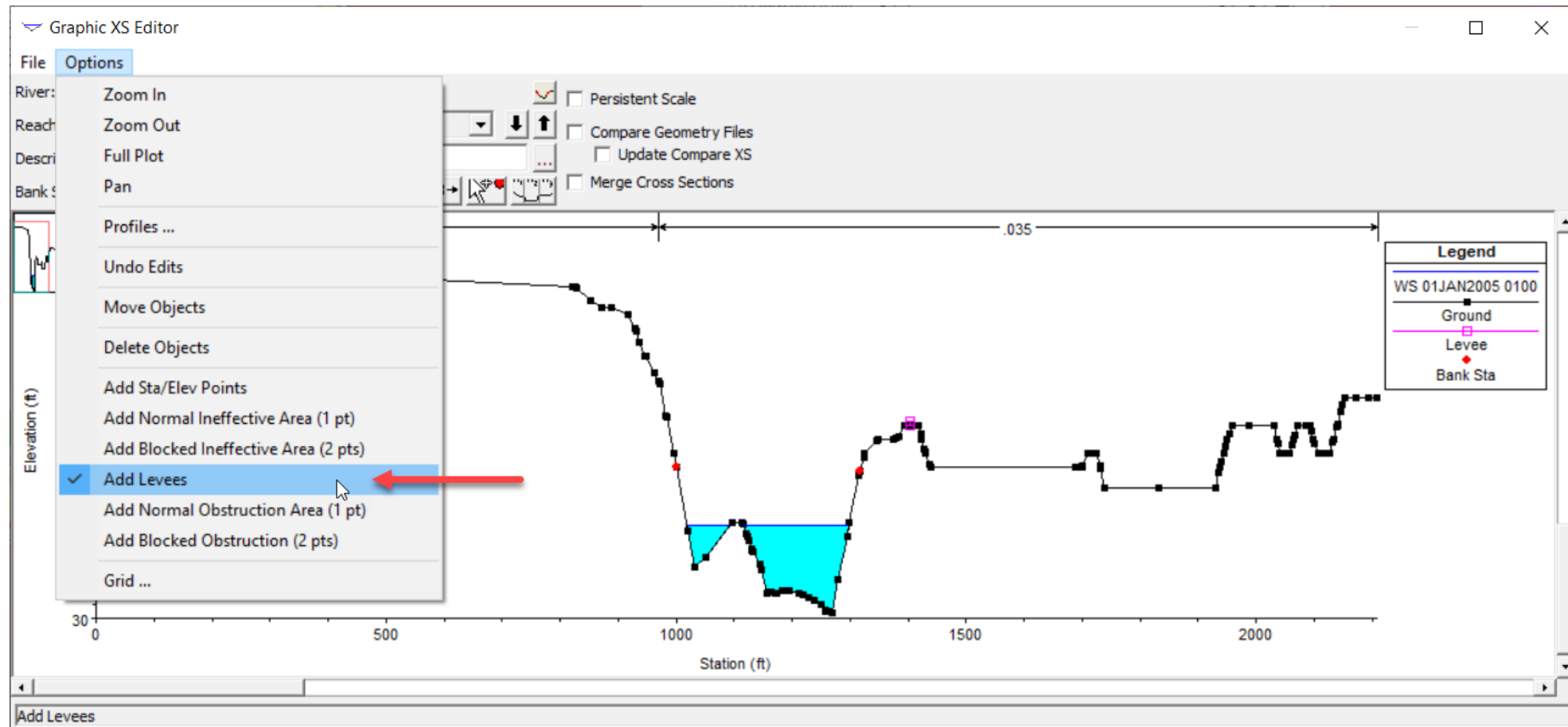
	Left	Right
Station	<input type="text"/>	1404.23
Elevation	<input type="text"/>	58.47

Levee on right side



Graphical Cross Section Editor

- Located in the Geometric Data Editor under the Tools menu.



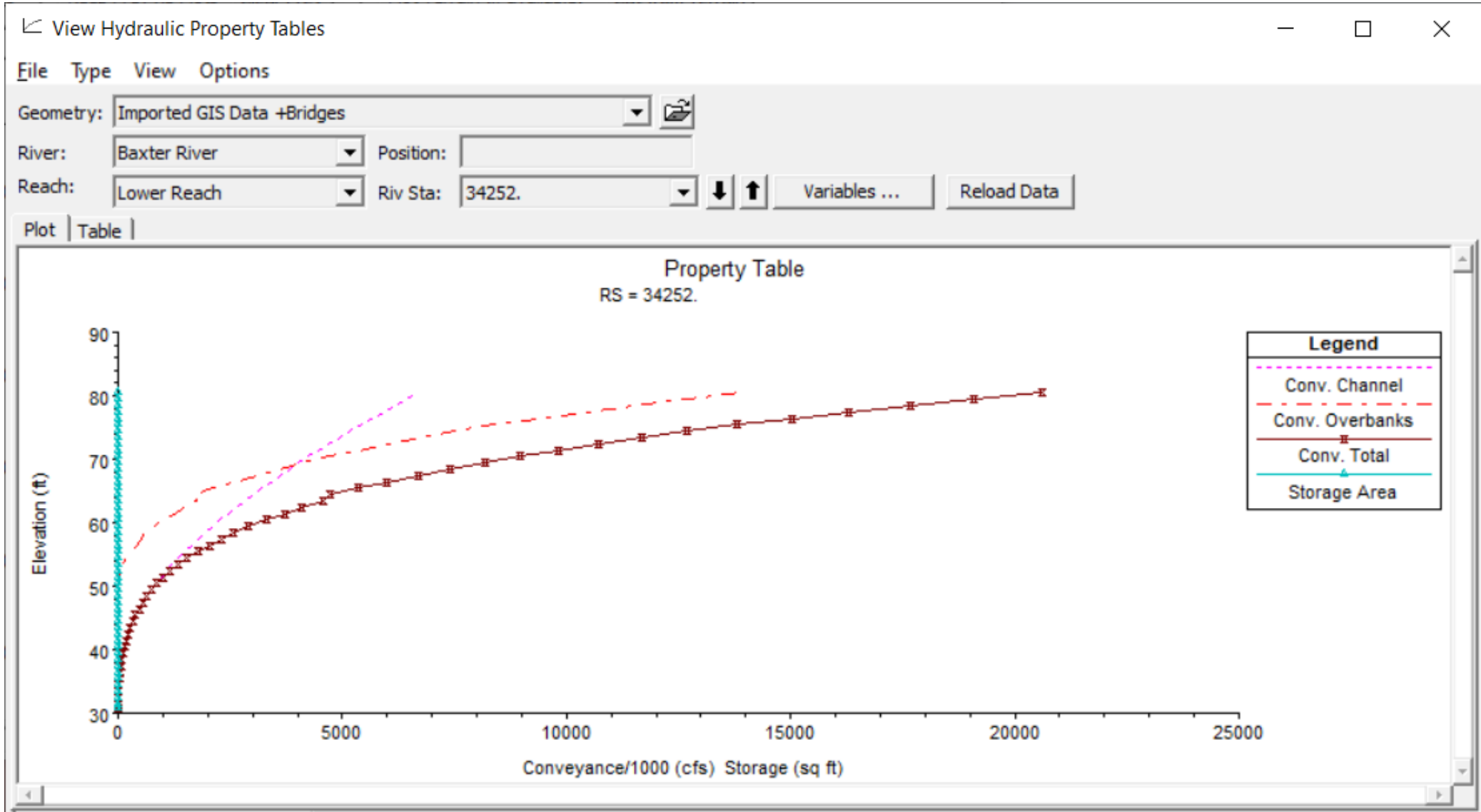


Geometry Preprocessor and HTab Curves

The image shows a screenshot of the HEC-RAS 6.2 software interface. The main window is titled "Unsteady Flow Analysis" and contains several configuration options. In the "Programs to Run" section, the "Geometry Preprocessor" checkbox is checked and circled in red. The "View" menu is open, showing options like "Cross-Sections ...", "Water Surface Profiles ...", "General Profile Plot ...", "Rating Curves ...", "3D View ...", "X-Y-Z Perspective Plots (Classic) ...", "Stage and Flow Hydrographs ...", and "Hydraulic Property Tables ...". The "Hydraulic Property Tables ..." option is highlighted in blue, with a red arrow pointing to it. The "HT" icon in the toolbar is also circled in red. The "Compute" button is visible at the bottom of the dialog box.



Hydraulic Property Plot





Hydraulic Property Table

View Hydraulic Property Tables

File Type Options

Geometry: Imported GIS Data +Bridges

River: Baxter River

Reach: Lower Reach Riv Sta: 34252. Variables ... Reload Data

Plot Table

Minimum Elevation: 30.91 Chan Length: 652.64 Avg Overbank Length: 635.515 Preiss WD: Preiss Elev:

	Elevation (ft)	Area Chan (sq ft)	Area L+R (sq ft)	Area Total (sq ft)	Storage Area (sq ft)	Conv Ch (cfs)	Conv L+R (cfs)	Conv Total (cfs)	Top Width (ft)	Alpha
1	31.40	5.77	0.00	5.77	0.00	128	0	128	15.23	1.00
2	32.40	27.41	0.00	27.41	0.00	1058	0	1058	31.24	1.00
3	33.40	70.81	0.00	70.81	0.00	3428	0	3428	57.54	1.00
4	34.40	166.20	0.00	166.20	0.00	8605	0	8605	122.42	1.00
5	35.40	291.14	0.00	291.14	0.00	21286	0	21286	127.46	1.00
6	36.40	421.20	0.00	421.20	0.00	38283	0	38283	132.73	1.00
7	37.40	556.63	0.00	556.63	0.00	59219	0	59219	138.23	1.00
8	38.40	705.04	0.00	705.04	0.00	79279	0	79279	160.95	1.00
9	39.40	878.18	0.00	878.18	0.00	104514	0	104514	183.97	1.00
10	40.40	1072.06	0.00	1072.06	0.00	136291	0	136291	203.20	1.00
11	41.40	1284.32	0.00	1284.32	0.00	173850	0	173850	221.32	1.00
12	42.40	1514.44	0.00	1514.44	0.00	217518	0	217518	238.44	1.00
13	43.40	1760.98	0.00	1760.98	0.00	267393	0	267393	254.65	1.00
14	44.40	2031.63	0.00	2031.63	0.00	317288	0	317288	281.71	1.00
15	45.40	2315.72	0.00	2315.72	0.00	389980	0	389980	286.47	1.00
16	46.40	2604.57	0.00	2604.57	0.00	468887	0	468887	291.23	1.00
17	47.40	2898.18	0.00	2898.18	0.00	553876	0	553876	295.99	1.00

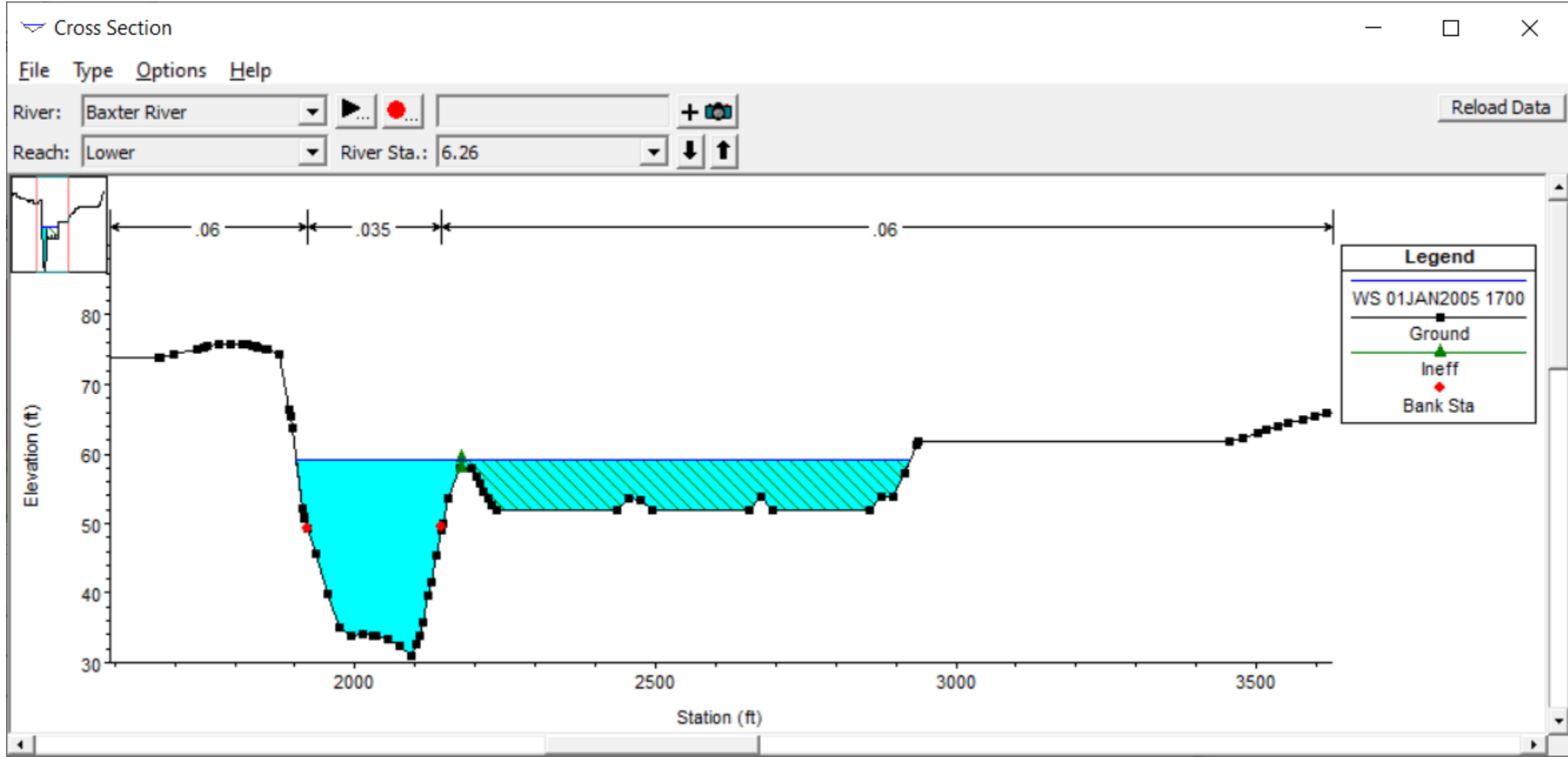


Geometry and Unsteady Flow

- What is going to happen to the water when it gets out of the channel?
- Ineffective Flow Areas
- Levees
- Conveyance Calculations Using Subdivisions

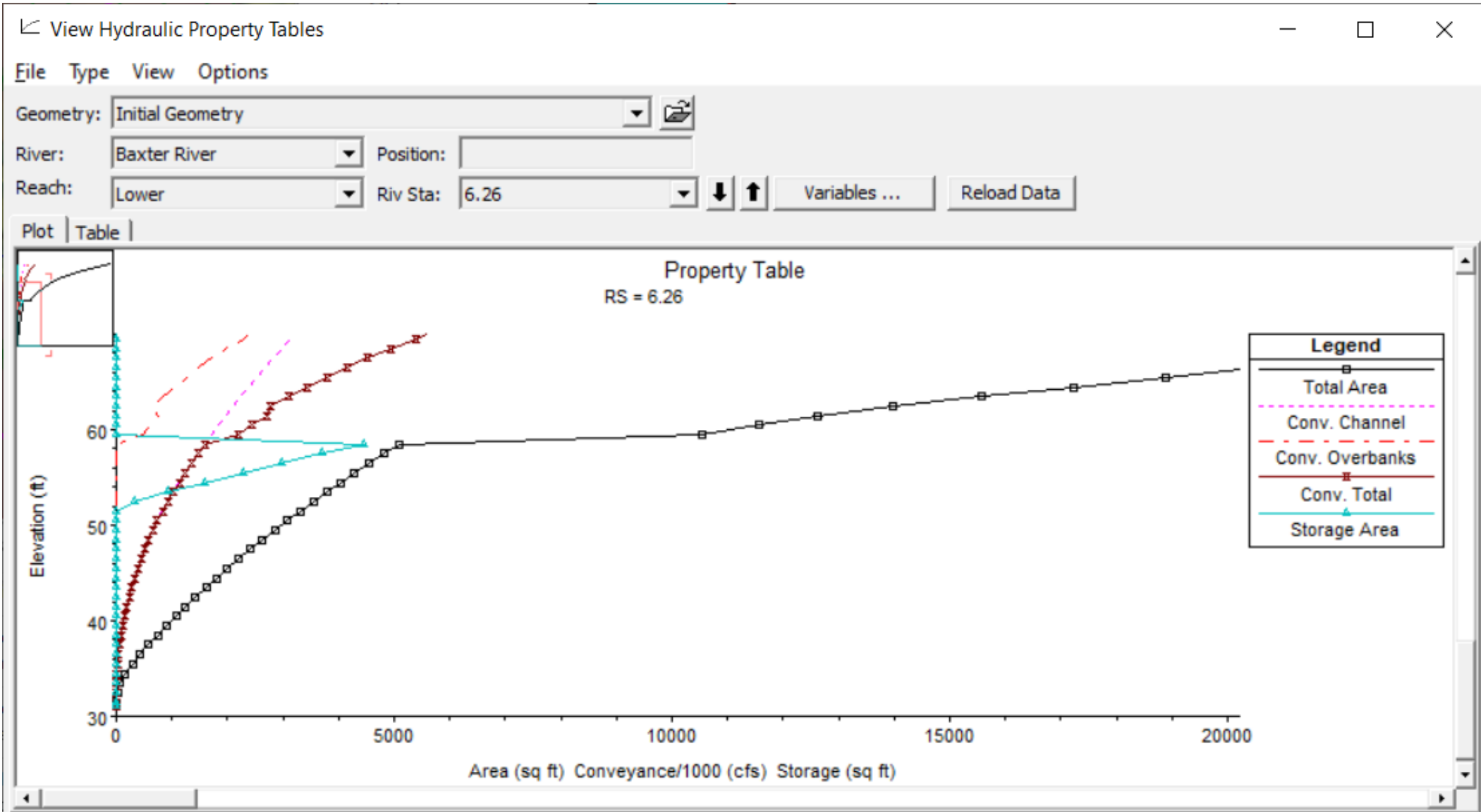


Ineffective Flow Areas



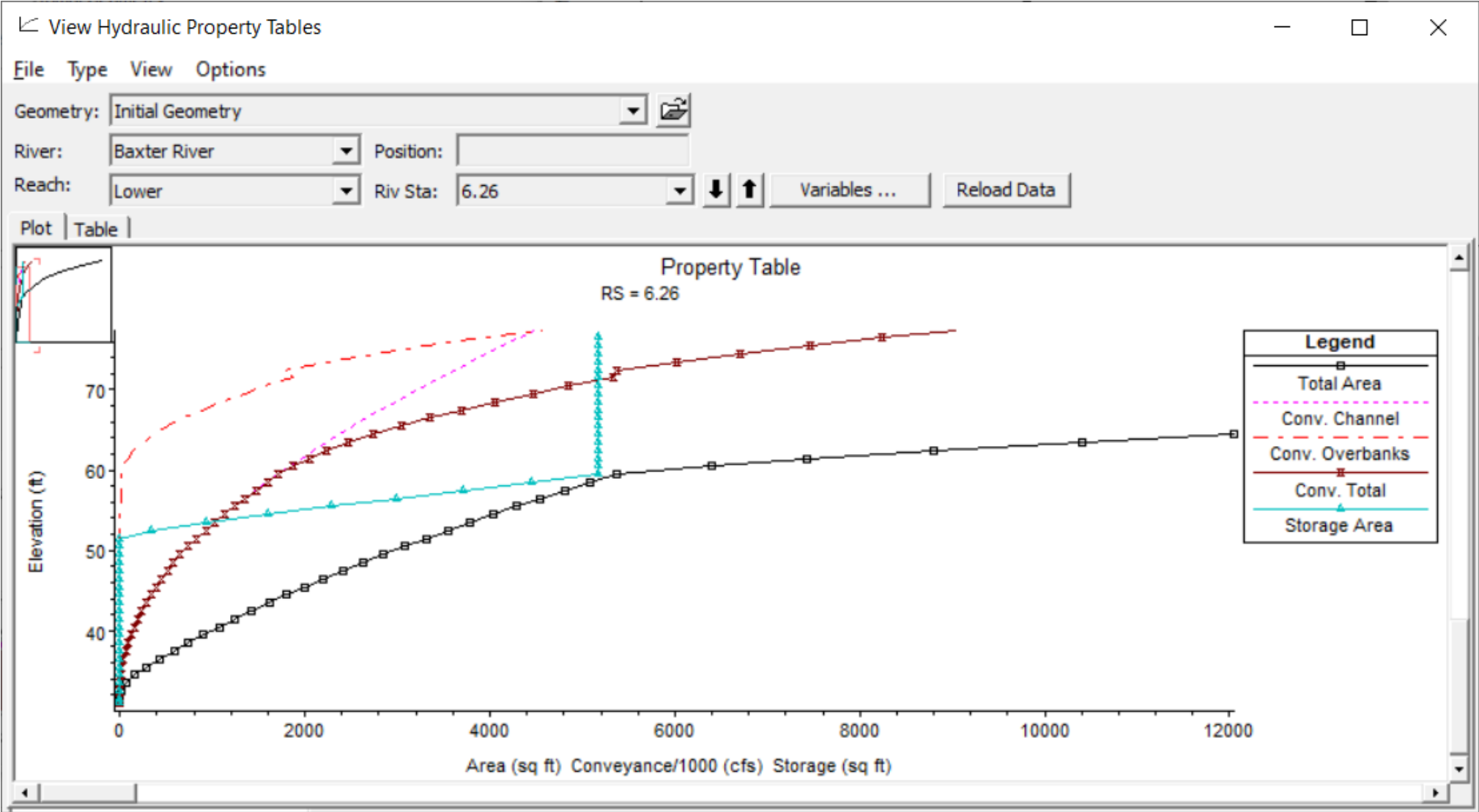


Non-Permanent Ineffective Flow



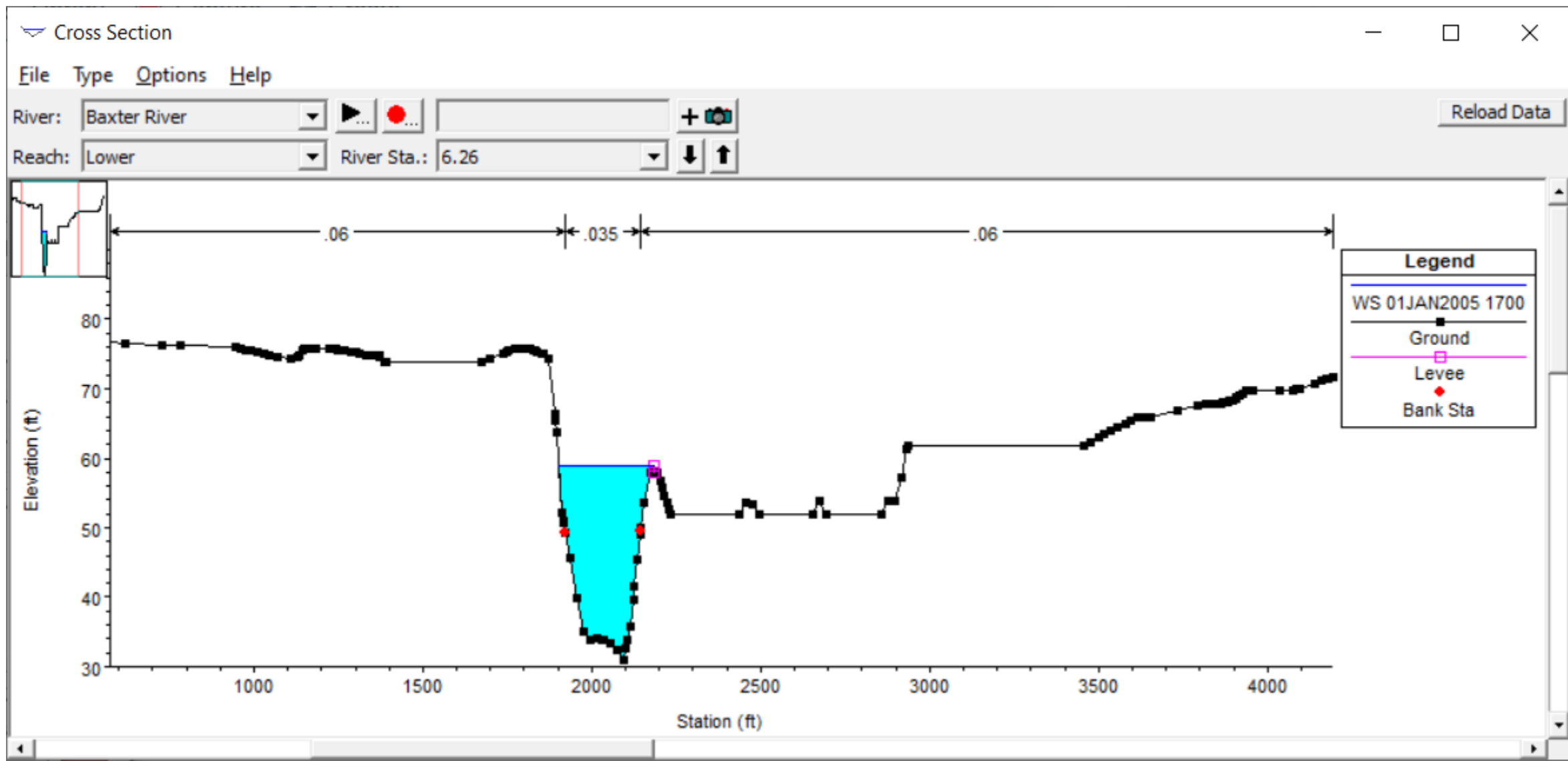


Permanent Ineffective Flow Area



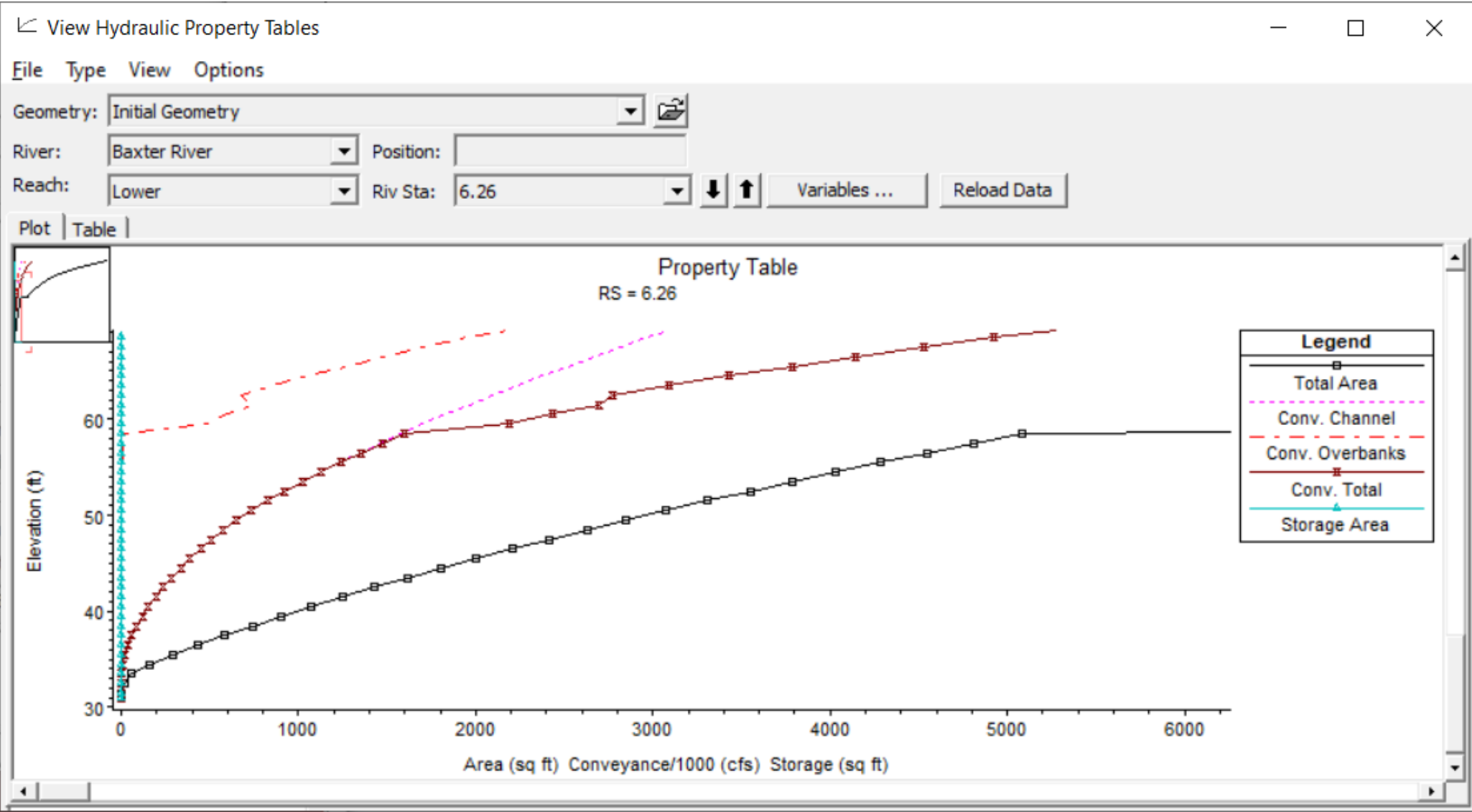


Levees





Levees



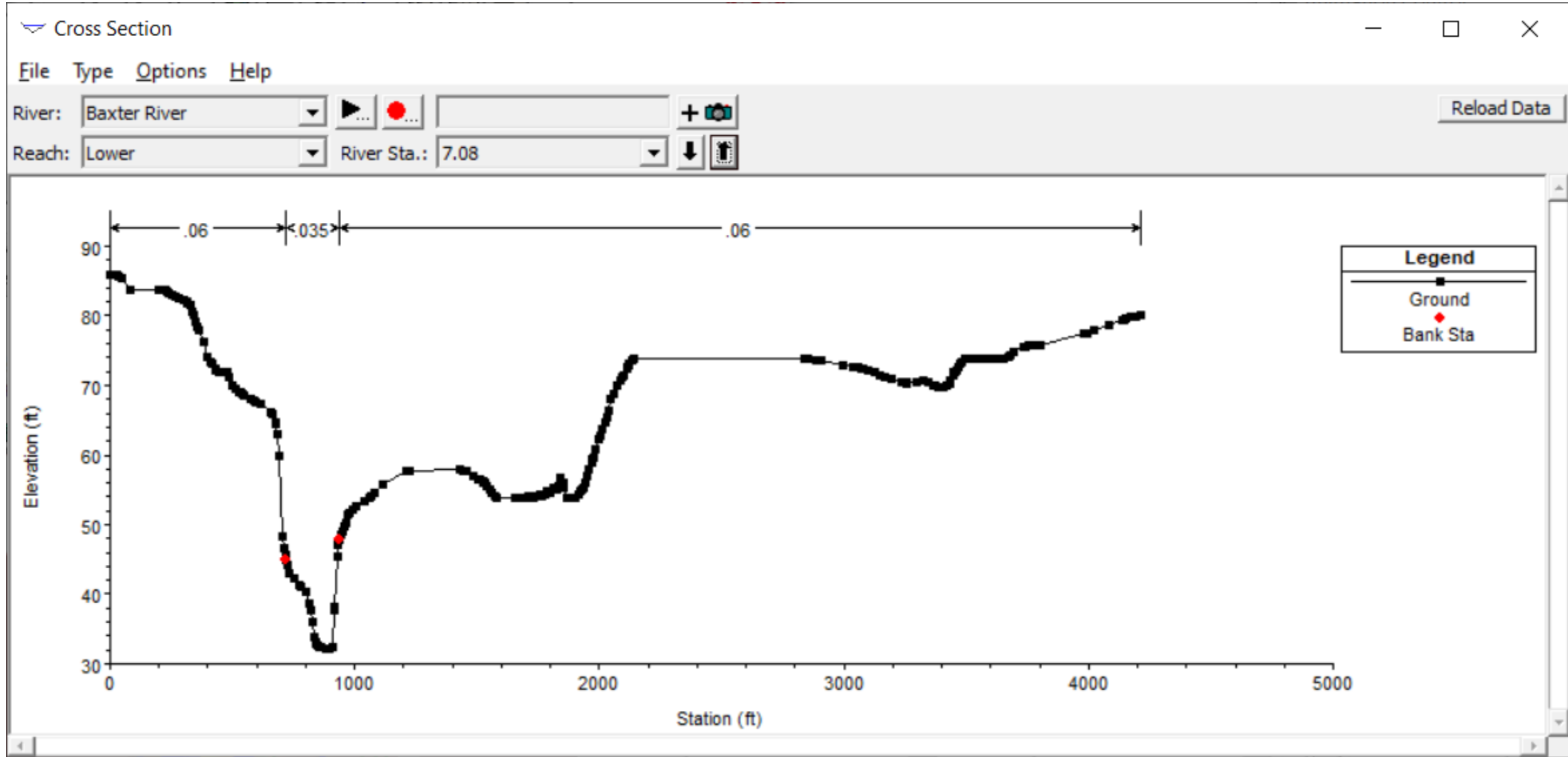


Storage Area Option

- What if adding a levee or ineffective flow area has a significant affect on the conveyance and storage relationships?
- Alter the cross section by terminating it at the beginning of the problem area and model the area that was deleted with a lateral weir and off-stream storage area or 2D flow area.

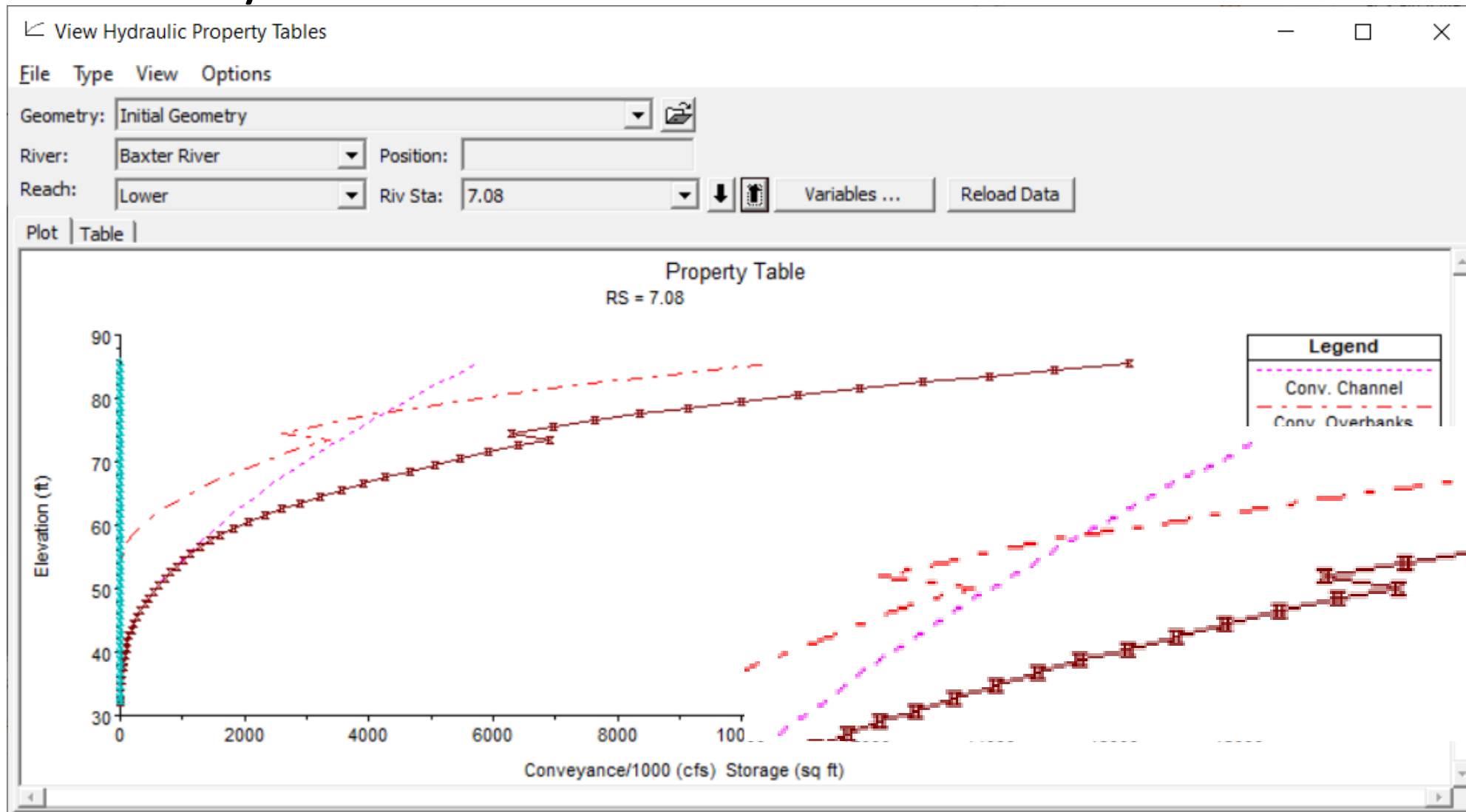


Conveyance Subdivisions



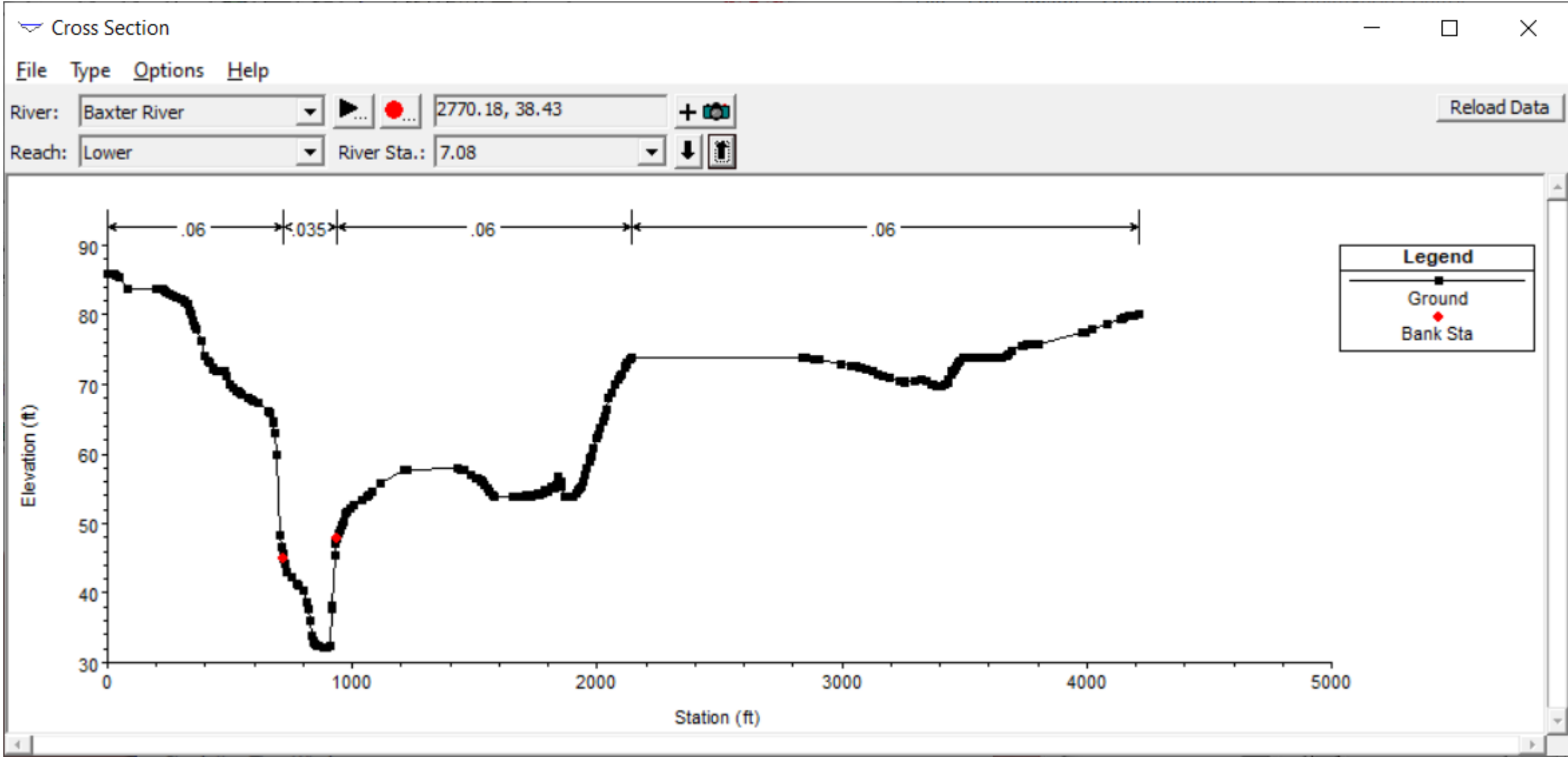


Conveyance Subdivisions



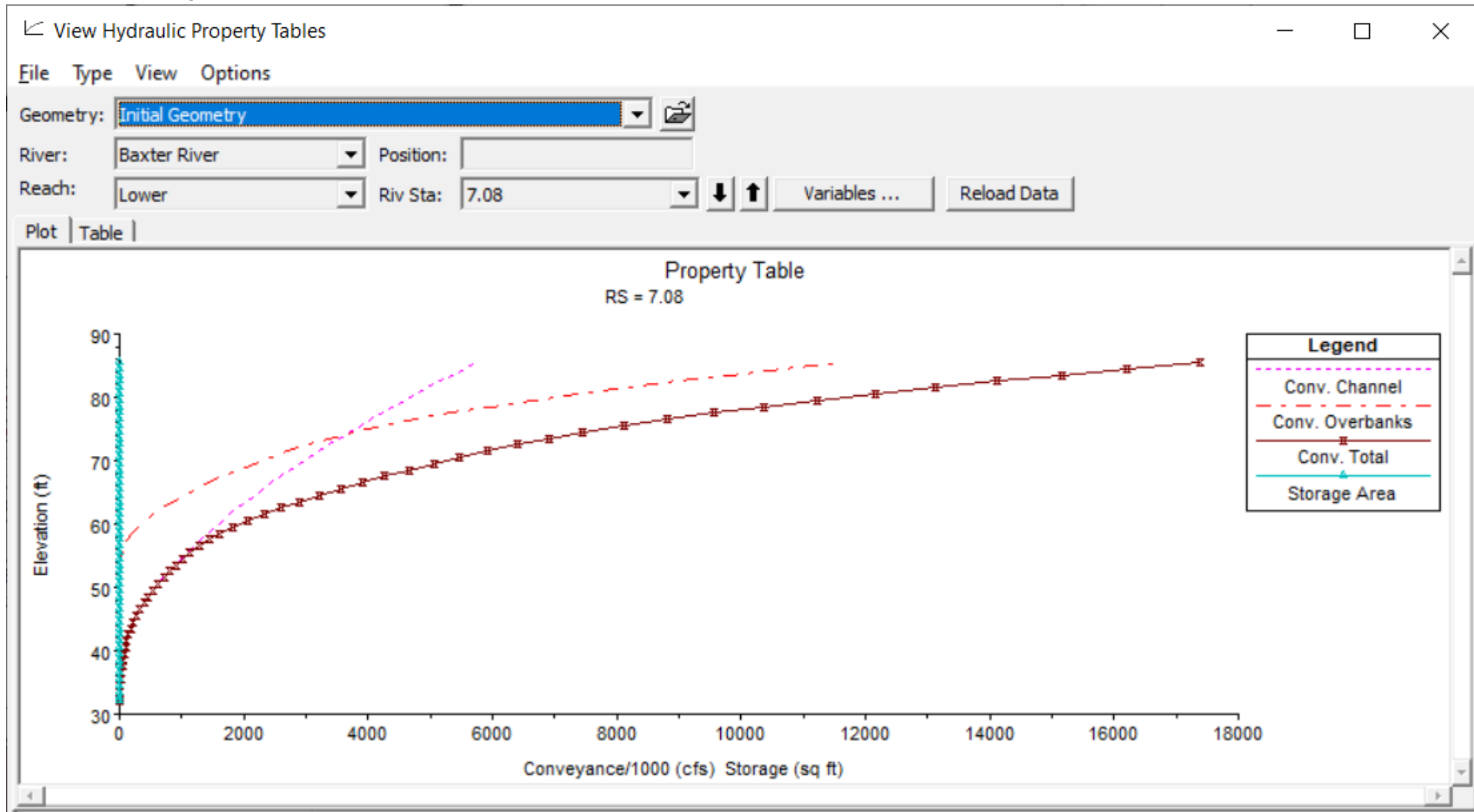


Conveyance Subdivisions





Conveyance Subdivisions



Questions?