APPENDIX H

DESIGN EXAMPLE – ACTIVE CHANNEL DESIGN OPTION

NOTE: The following design example uses the Active Channel Option design criteria from Appendix C-NOAA *Guidelines For Salmonid Passasge At Stream Crossings* (2001) instead of the new CDFG Low-Slope Option criteria. The design criteria may be different, but the analysis/design process is virtually the same for both Active Channel and Low-Slope design options.

In April 2009, CDFG developed Part XII: Fish Passage Design and Implementation of the *California Salmonid Stream Habitat Restoration Manual*, which contains a modified version of the Active Channel Option called Low-Slope. CDFG *Culvert Criteria For Fish Passage* (2002), in Appendix B, has not been officially updated to reflect changes within Part XII, but CDFG has verbally stated that the design criteria for Low-Slope will supersede the Active Channel Option. At the time of this Appendix update, the NMFS (NOAA) Active Channel design criteria has not changed and remains consistent with the 2002 CDFG culvert criteria document. On a project-by-project basis, the decision for using Active Channel or Low-Slope design criteria will be made by the regulatory agencies: CDFG, NMFS (NOAA), and/or US Fish & Wildlife Service.

The differences in design criteria are shown in the table below:

Active Channel vs. Low-Slope

	Active Channel	Low-Slope
Culvert Width	Minimum of 1.5 Times Active Channel Width	Minimum of 1.25 Times *Bankfull Width
Culvert Length	100 Feet or Less	75 Feet or Less
Culvert Slope	0% (Flat)	Match Natural Stream Slope
Channel Slope	3% or Less	1% or Less
Culvert Embedment	Equal or <40% (Upstream) 20%-40% (Downstream)	20%-40% Throughout
Bed Material (Backfill) Inside Culvert	Natural Recruitment	Natural Recruitment (Length<50 feet) OR Backfill With Native (Length 50-75 feet)
**Development of Long Profile	Not Required	Required

*See Figure 3-2 for presentation of bankfull width.

**See Figure 5.2 for Long Profile Example.

As seen in the table above, design criteria have changed between the Active Channel and the new CDFG Low-Slope Option, but the process for analysis/design is nearly the same. In the design example, analysis/design steps are covered. Even though the development of a Long Profile is not required for Active Channel design, it is beneficial to do so in judging the overall stability of the project stream reach. As presented in the design example, a Long Profile was generated for this reason.

Active Channel Design Tutorial

Project Description – Route 45 Expansion at New High School

A small town in Santa Cruz County has experienced severe growth within last 10 years. A new high school is being built to accommodate the increase in young students in the area. Route 45 will be used as the main entrance into the high school. Puddle Creek flows to the east of the project site and directly under Route 45 at post mile 56. With the increase in pedestrian and automobile traffic, Route 45 will need to be widened to accommodate two additional lanes and pedestrian walkways on both sides.

The existing CMP culvert barrel has rusted beyond repair. The irreversible structural damage and the need for additional length will require a full culvert replacement. The proposed culvert length is 84 ft.

Puddle Creek supports various native salmonids, non-salmonids and non-native fish species in its watershed, that have been identified by Fish and Game and NOAA, therefore, fish passage must be considered as an aspect of design.

Form 1 - Existing Data and Information Summary

The Engineer begins collecting all existing data prior to going to the field.

Summarize all existing information provided below in Form 1.

Existing Data:

- Multiple design species
- USGS topographic quadrangle
- Ground surveyed cross-sections
- Existing as-builts drawings
- Right-of-Entry is not required

Form 2 - Site Visit Summary

The Engineer and Project Team visit the project site to collect existing conditions data.

Complete Form 2 with pertinent field information listed below.

Inlet Characteristics:

- Confined Spaces: able to see and feel breeze through 4 ft diameter culvert
- Inlet Type: projecting
- Inlet Condition: corrosion and structural integrity are concerning issues
- Inlet Apron: None Applicable
- Skew Angle: 0º

- Upstream Invert Elevation: 358.5 ft (NAVD 88)

Barrel Characteristics:

- Diameter: 4 ft
- Fill height above culvert: 6.5 ft
- Length: 24 ft
- Number of Barrels: 1
- Culvert Type: Circular
- Culvert Material: CMP
- Barrel Condition: Structural Damage

Outlet Characteristics:

- Outlet Type: Projecting
- Outlet Condition: Perched, 0.83 ft drop
- Outlet Apron: none applicable
- Skew Angle: 0º
- Downstream Invert Elevation: 357.64 ft (NAVD 88)

Structure Characteristics:

- Corrugated Metal Pipe (CMP): n = 0.026 due to structural damage

Site Visit Flow Conditions:

- Estimated flow = 3 cfs
- Flow regime: subcritical
- Channel depth = 0.5 ft

Active Channel Width Measurements:

1	2	3	4	5	Average
8.9 ft	8.5 ft	7.9 ft	6.5 ft	8.2 ft	8.0 ft

Bankfull Width Measurements:

1	2	3	4	5	Average
13 ft	12.8 ft	10.2 ft	7.6 ft	6.7 ft	10.1 ft

Boundary Conditions:

- Downstream slope = 0.019, normal depth is appropriate

Form 2b - Manning's n-value Computation

Complete Form 2b with roughness coefficient data gathered in the field below.

Manning's n-values:

- Manning's "n-values" were estimated using the report titled Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Floodplains, USGS Water Supply Paper 2339. The report information was supplemented with field reconnaissance photographic documentation.

- Calculation of n-value, n = (nb + n1 + n2 + n3 +n4)m

Factor	Left Overbank	Main Channel	Right Overbank
nb	0.034	0.028	0.034
n1	0.005	0.005	0.005
n2	0.000	0.003	0.000
n3	0.004	0.003	0.004
n4	0.015	0.010	0.015
m	1.000	1.000	1.000
n-value	0.058	0.049	0.058

Form 3 - Guidance on Selection of Fish Passage Design Option

The Engineer uses Form 3 to help select the most appropriate design option for the project site.

Select the most appropriate design option for the project site based on site characteristics provided below.

Site Characteristics:

- Design for all species
- Replacement culvert
- Proposed length is less than 100 ft
- Channel slope is less than 3%

Selected Fish Passage Design Option: Active Channel Design

Form 4 - Guidance on Methodology for Hydrologic Analysis

The Engineer calculates peak discharges using USGS Regional Regression equations.

Complete Form 4 with developed peak discharges.

50-Year Event (2% Annual Probability)	100-Year Event (1% Annual Probability)
283 cfs	321 cfs

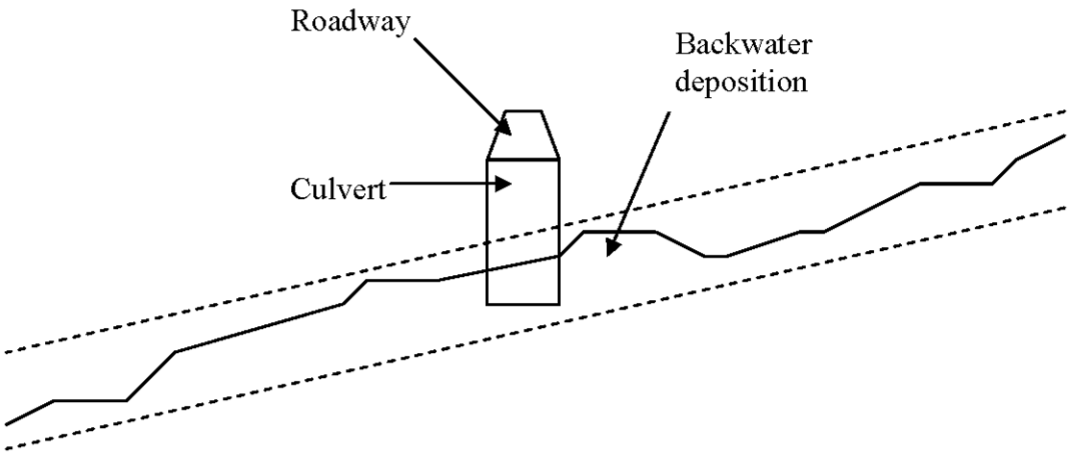
Form 6A - Active Channel Design Option

Form 6A provides guidance to appropriately design a structure that meets Active Channel design criteria while also considering hydraulic impacts and scour concerns.

The Engineer selects HEC-RAS to conduct the hydraulic modeling. Digital cross-sections are developed using the available ground surveyed data.

Step 1: Create a long profile drawing to show the upstream and downstream conditions of the culvert. Evaluate stability surrounding the culvert structure for both existing and proposed culvert conditions using the created long profile.

The existing conditions profile has been provided. Stability conditions surrounding the existing or proposed culvert have been reviewed and are found to be reasonable.



The only issue identified while developing the long profile was backwater deposition probably due to existing capacity issues.

Step 2: Create HEC-RAS model of the existing culvert geometry design to identify capacity issues and create a water surface profile for later comparison to proposed conditions.

Create Existing Conditions HEC-RAS Plan and review results.

Hinge point elevation = 371.74 ft

Check headwater elevation = 372.56 ft

Active Channel Design Option Criteria that must be met:

Active Channel Width Culvert width must be ≥ 1.5 times the Average Active Channel Width	Embedment Depth Embed 20% to 40% at Downstream End Embed ≤ 40% at Upstream End
Culvert Slope Culvert must be placed at 0% slope	

Step 3: Determine proposed culvert size by calculating Average Active Channel Width and Culvert Width.

Active Channel Width Measurements:

1	2	3	4	5	Average
8.9 ft	8.5 ft	7.9 ft	6.5 ft	8.2 ft	8.0 ft

Culvert Width = 1.5*Average Active Channel Width = 12 ft

Fill in results in Form 6A.

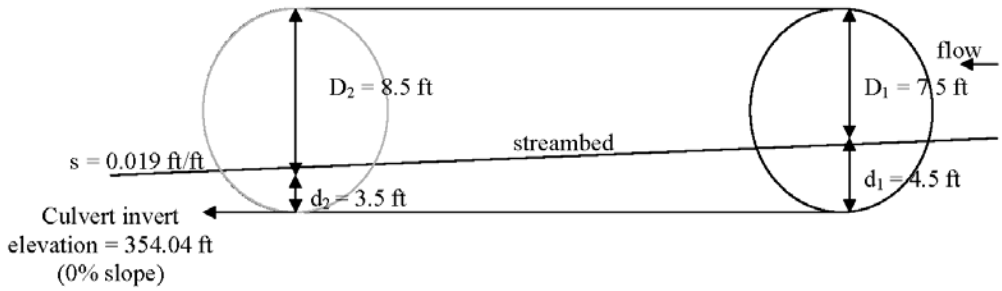
Step 4: Calculate upstream and downstream embedment depth to determine culvert invert.

Downstream Culvert Outlet:

Minimum Embedment = Culvert Width*20% = 2.4 ft
Maximum Embedment = Culvert Width*40% = 4.8 ft

Upstream Culvert Inlet:

Maximum Embedment = Culvert Width*40% = 4.8 ft



Selected Embedment at Upstream Culvert Inlet = 4.5 ft

Selected Embedment at Downstream Culvert Outlet = 3.5 ft

Fill in selected culvert embedment depths in Form 6A.

Step 5: Select remaining proposed culvert dimensions and physical characteristics to satisfy future culvert design needs.

Proposed culvert dimensions and physical characteristics have been provided.

Proposed Culvert Dimensions:

- Culvert Length: 84 ft determined by road widening geometry
- Upstream/Downstream Culvert Invert Elevation = 354.04 ft
- Culvert Centerline Stationing (HEC-RAS) = 422.26 ft

Proposed Culvert Physical Characteristics:

- Inlet Type: Headwall
- Number of barrels: 1

- Culvert type: Circular
- Culvert material: Structural steel plate pipe
- Outlet type: Headwall
- Distance to upstream cross-section: 1 ft
- Entrance loss: 0.5
- Culvert Manning's n-value: 0.024
- Blocked portion of culvert (embedded portion) Manning's n-value: 0.049

Fill in provided parameters in Form 6A.

Step 6: Create and model culvert geometry in Proposed Conditions HEC-RAS Plan. Note, HEC-RAS is limited to one constant embedment depth through the entire culvert. To account for the difference in depth between the inlet and outlet embedment depths, average embedment depth and enter into Proposed Conditions HEC-RAS Plan.

Calculated Average Embedment (Blocked) Depth = 4.0 ft

Model proposed culvert in Proposed Conditions HEC-RAS Plan. Input culvert dimensions and physical characteristics listed in Step 5.

Culvert River Station = 2427

Partially Filled or Buried Culverts

This version of HEC-RAS allows the user to fill in a portion of the culvert from the bottom. This option can be applied to any of the culvert shapes. The user is only required to specify the depth to which the culvert bottom is filled in. An example of this is shown in figure 6.11. The user can also specify a different Manning's n value for the blocked portion of the culvert (the bottom), versus the remainder of the culvert. The user must specify the depth to apply the bottom n value as being equal to the depth of the filled portion of the culvert.

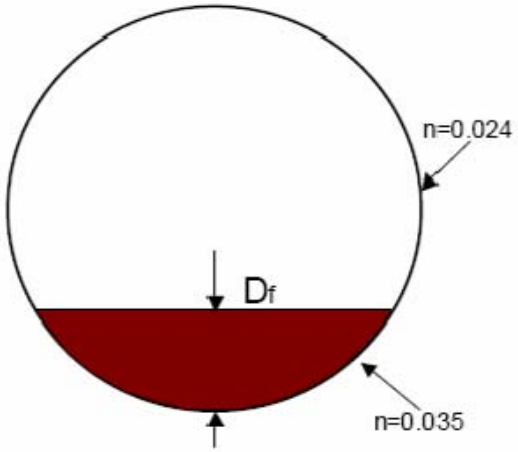
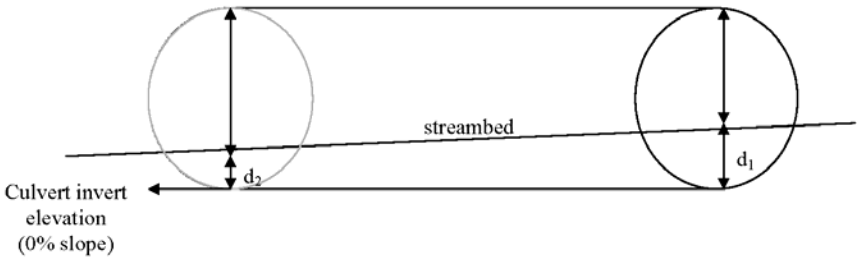


Figure 6.11 Partially Filled or Buried Culverts

HEC-RAS cannot specify two different depths like the figure shown below.



Step 7: View Proposed Condition HEC-RAS Plan results to identify possible proposed culvert design issues. Check culvert capacity based on proposed design conditions for the 100-Yr event. Summarize results in Form 6A sections *Maximum Allowable Inlet Water Surface Elevation*, *Allowable Hydraulic Impacts*, and *Velocity Summary*.

Hinge point elevation = 371.74 ft

Fill in results in Form 6A.

ACTIVE CHANNEL BASIC DESIGN STEPS

Step 1: Create a long profile drawing to show the upstream and downstream conditions of the culvert. Evaluate stability surrounding the culvert structure for both existing and proposed culvert conditions using the created long profile.

Step 2: Create HEC-RAS model of the existing culvert geometry design to identify capacity issues and create a water surface profile for later comparison to proposed conditions.

Step 3: Determine proposed culvert size by calculating Average Active Channel Width (Active Channel Design Option) or Bankfull Width (Low-Slope Design Option) to obtain Culvert Width. When using the Low-Slope Option for culverts 50 feet to 75 feet in length, calculate the largest immobile particle in natural streambed and multiply by 1.5 (minimum) to determine bed material (backfill) inside culvert.

Step 4: Calculate upstream and downstream embedment depth to determine culvert invert.

Step 5: Select remaining proposed culvert dimensions and physical characteristics to satisfy future culvert design needs.

Step 6: Model culvert geometry in Proposed Conditions HEC-RAS Plan. Note: HEC-RAS is limited to one constant embedment depth through the entire culvert. For the Active Channel Option, two embedment depths are required so the 0% slope criteria are satisfied. To account for the difference in depth between the inlet and outlet embedment depths, average embedment depth and enter into Proposed Conditions HEC-RAS Plan.

Step 7: View Proposed Condition HEC-RAS Plan results to identify possible proposed culvert design issues. Check culvert capacity based on proposed design conditions for the 100-Yr event. Summarize results in Form 6A (Appendix D) sections Maximum Allowable Inlet Water Surface Elevation, Allowable Hydraulic Impacts, and Velocity Summary.

COMPLETED FORMS

FISH PASSAGE: ACTIVE CHANNEL DESIGN OPTION — FORM 6A

Project Information		Computed: EKB	Date: 9/1/08
Route 45 Expansion at New High School		Checked: JJL	Date: 9/5/08
Stream Name: Puddle Creek	County: Santa Cruz	Route: 45	Postmile: 11

Hydrology Results - Peak Discharge Values

2% Annual Probability (50-Year Flood Event)	283 cfs	1% Annual Probability (100-Year Flood Event)	321 cfs

Establish Culvert Setting and Dimensions

Culvert Width - The minimum culvert width shall be equal to, or greater than, 1.5 times the average active channel width.

Average Active Channel Width = 8 ft	Average Active Channel Width X 1.5 = 12 ft	Culvert Width = 12 ft

Culvert Length - Must be less than 100 feet.

Culvert Length = 84 ft

Culvert Embedment - The bottom of the culvert shall be buried into the streambed 20% to 40% of culvert height at the outlet, and not more than 40% of the culvert height at the inlet.

Upstream Embedment = 4.5 ft (≤40% of culvert rise)

Downstream Embedment = 3.5 ft (≥20% to ≤40% of culvert rise)

Culvert Slope - The culvert shall be placed level (0% slope).

Upstream invert elevation = 354.04 ft	Downstream invert elevation = 354.04 ft

Summarize Proposed Culvert Physical Characteristics

Inlet Characteristics

Inlet Type	☐ Projecting	☒ Headwall	☐ Wingwall
	☐ Flared end section	☐ Segment connection	☐ Skew Angle: °

Barrel Characteristics

Diameter:	144 in	Fill height above culvert:	6 ft
Height/Rise:	- ft	Number of barrels:	1
Width/Span:	- ft		

FISH PASSAGE: ACTIVE CHANNEL DESIGN OPTION — FORM 6A

Culvert Type	☐ Arch	☐ Box	☒ Circular
	☐ Pipe-Arch	☐ Elliptical	
Culvert Material	☐ HDPE	☒ Steel Plate Pipe	☐ Concrete Pipe
	☐ Spiral Rib / Corrugated Metal Pipe		

Horizontal alignment breaks: - ft	Vertical alignment breaks: - ft

Outlet Characteristics

Outlet Type	☐ Projecting	☒ Headwall	☐ Wingwall
	☐ Flared end section	☐ Segment connection	Skew Angle: °

Develop and run Hydraulic Models to compute water surface elevations, flow depths, and channel velocities for the 50- and 100-year peak or design discharges reflecting existing and project conditions

Maximum Allowable Inlet Water Surface Elevation

Shall not be greater than 50% of the culvert height or diameter above the top of the culvert inlet for the 100-Year peak flood, and without objectionable backwater.	Allowable (maximum) WSEL: 371.74 ft

Allowable Hydraulic Impacts

Is the crossing located within a floodplain as designated by the Federal Emergency Management Agency or another responsible state or local agency? ☐ Yes ☒ No

If yes, establish allowable hydraulic impacts and hydraulic design requirements with the appropriate agency. Attach results.

Will the project result in the increase capacity of an existing crossing? ☐ Yes ☒ No

If yes, will it significantly increase downstream peak flows due to the reduced upstream attenuation? ☐ Yes ☐ No

If yes, consult District Hydraulics. Further analysis may be needed.

Velocity Summary – Proposed Conditions maximum culvert velocities at inlet, barrel, and outlet transition for the peak or design discharge:

Culvert Velocity	Design Flow Velocity (ft/s)
Culvert Inlet Velocity (evaluated at x-section immediately located upstream of culvert)	4.73
Culvert Barrel Velocity (evaluated through Culvert Output in HEC-RAS)	6.00 - 9.55
Culvert Outlet Velocity(evaluated at x-section immediately located downstream of culvert)	8.5

Do the velocities exceed the permissible scour velocities? ☐ Yes ☒ No

If yes, revise design to reduce velocities and rerun hydraulic analyses to verfiy, or design erosion protection.

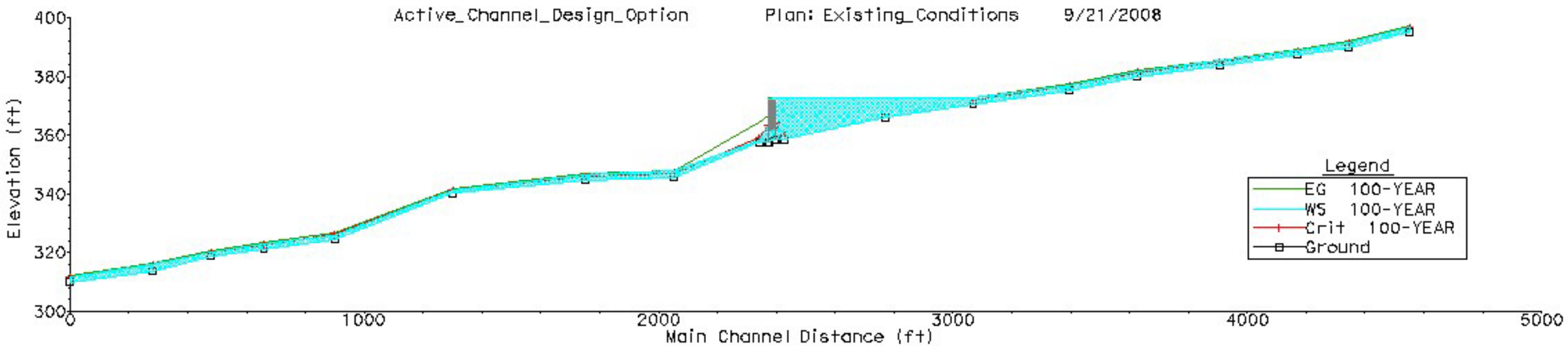
Proposed Plan and Profile Drawing Attached ☒ Yes ☐ No	Hydraulic Analysis Index Sheet Attached ☒ Yes ☐ No

HEC-RAS MODELING RESULTS

EXISTING CONDITIONS

EXISTING CONDITIONS

FLOOD FLOW RESULTS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4000
5000
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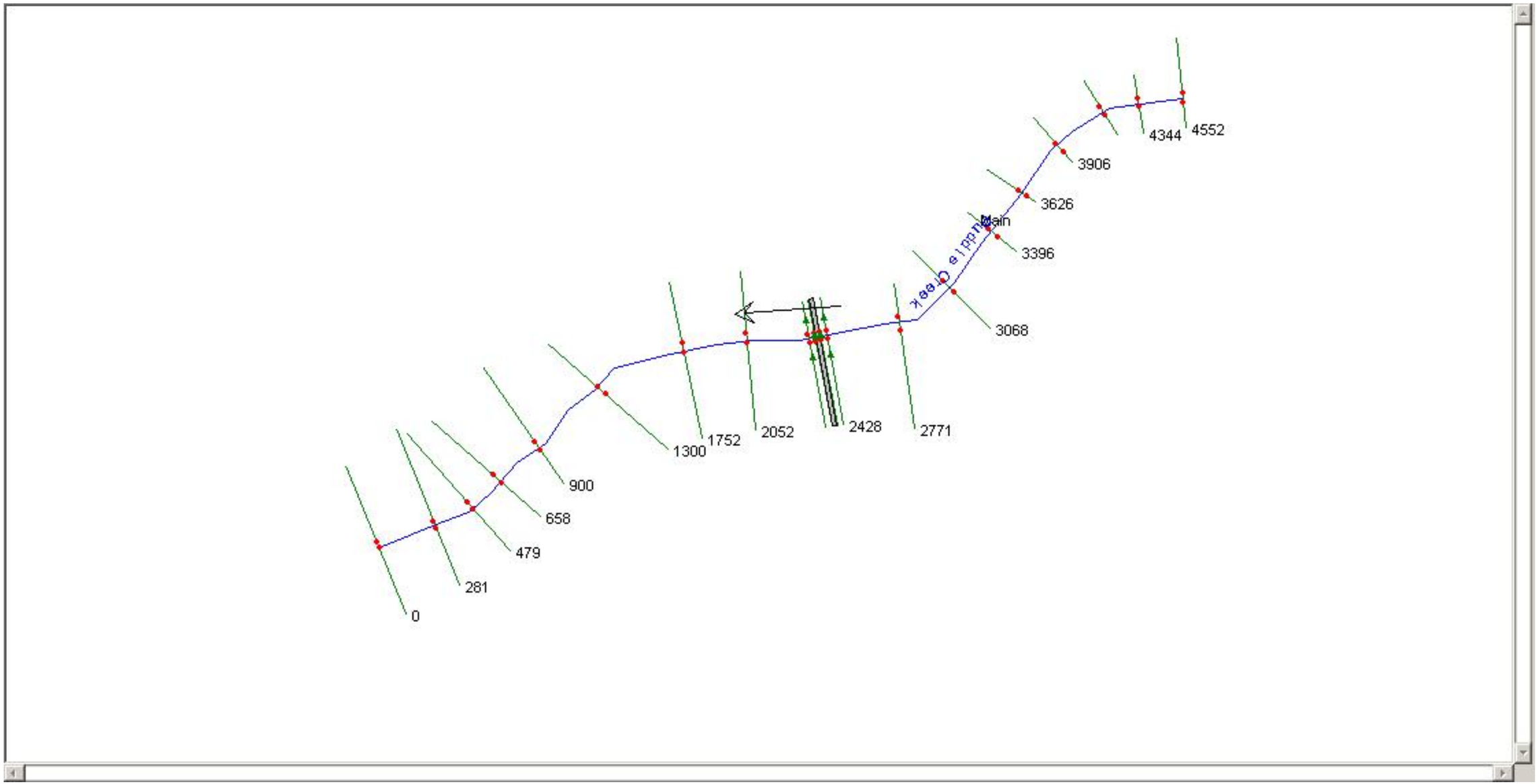
WS 100-YEAR
Crit 100-YEAR
Ground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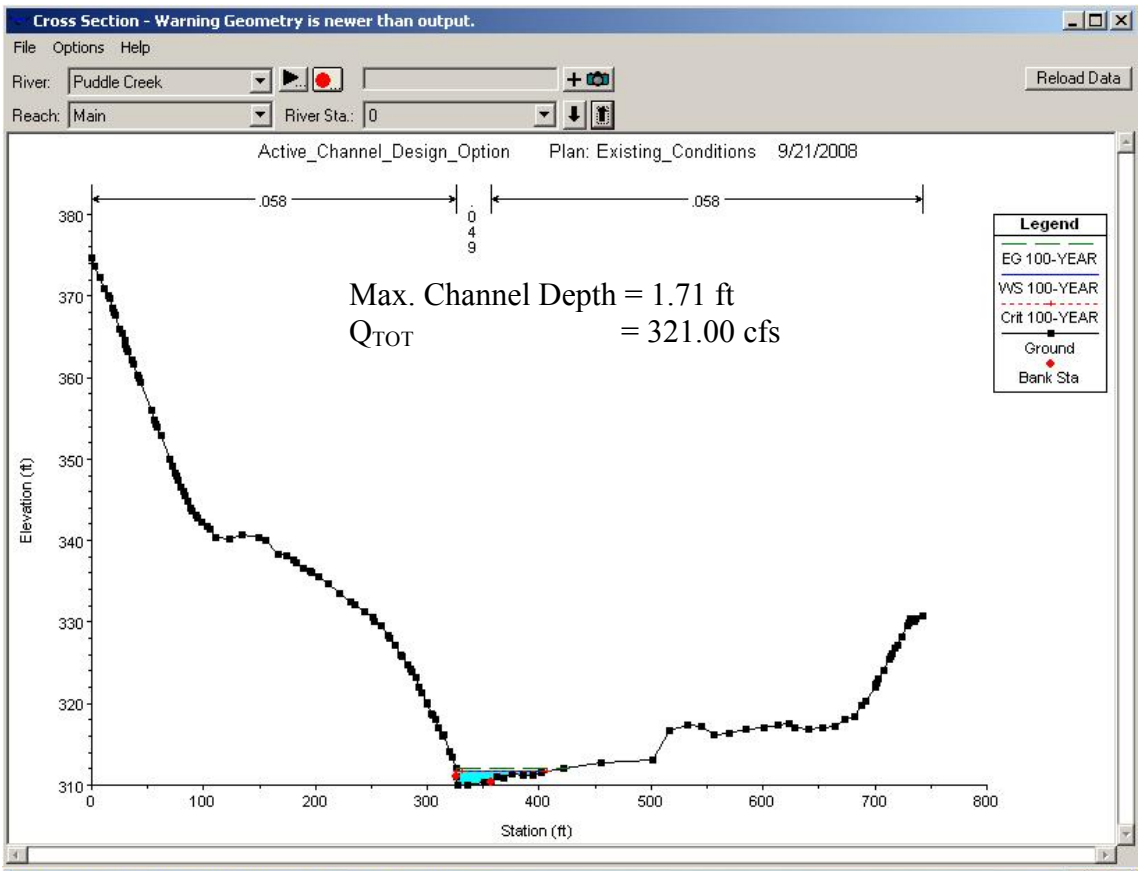
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.049
.058
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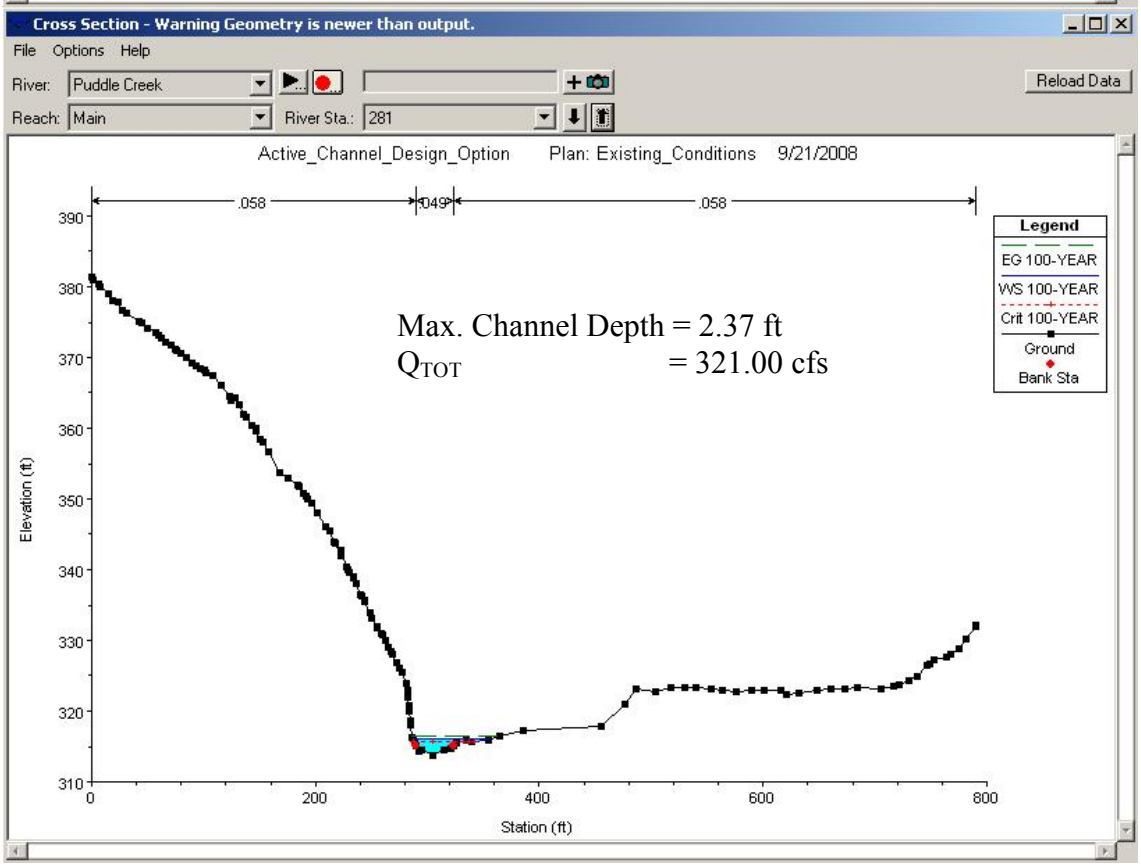
Station (ft)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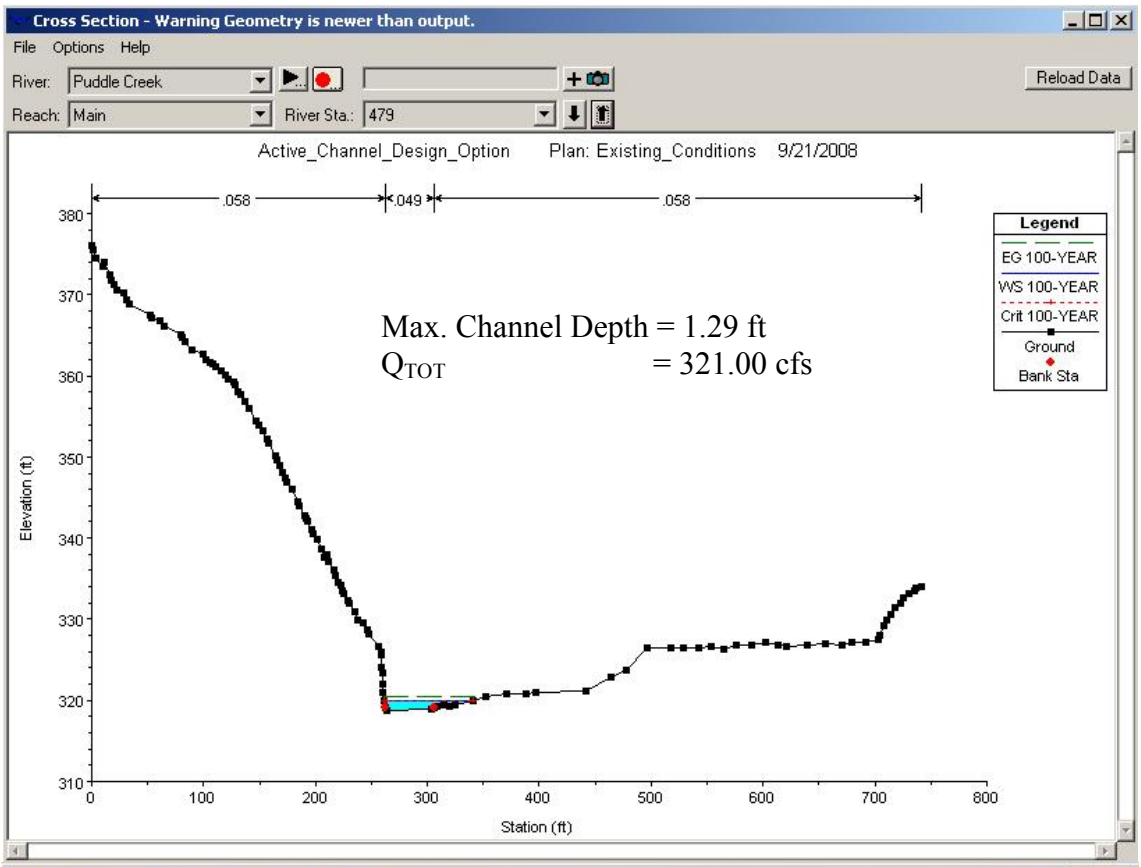
Station (ft)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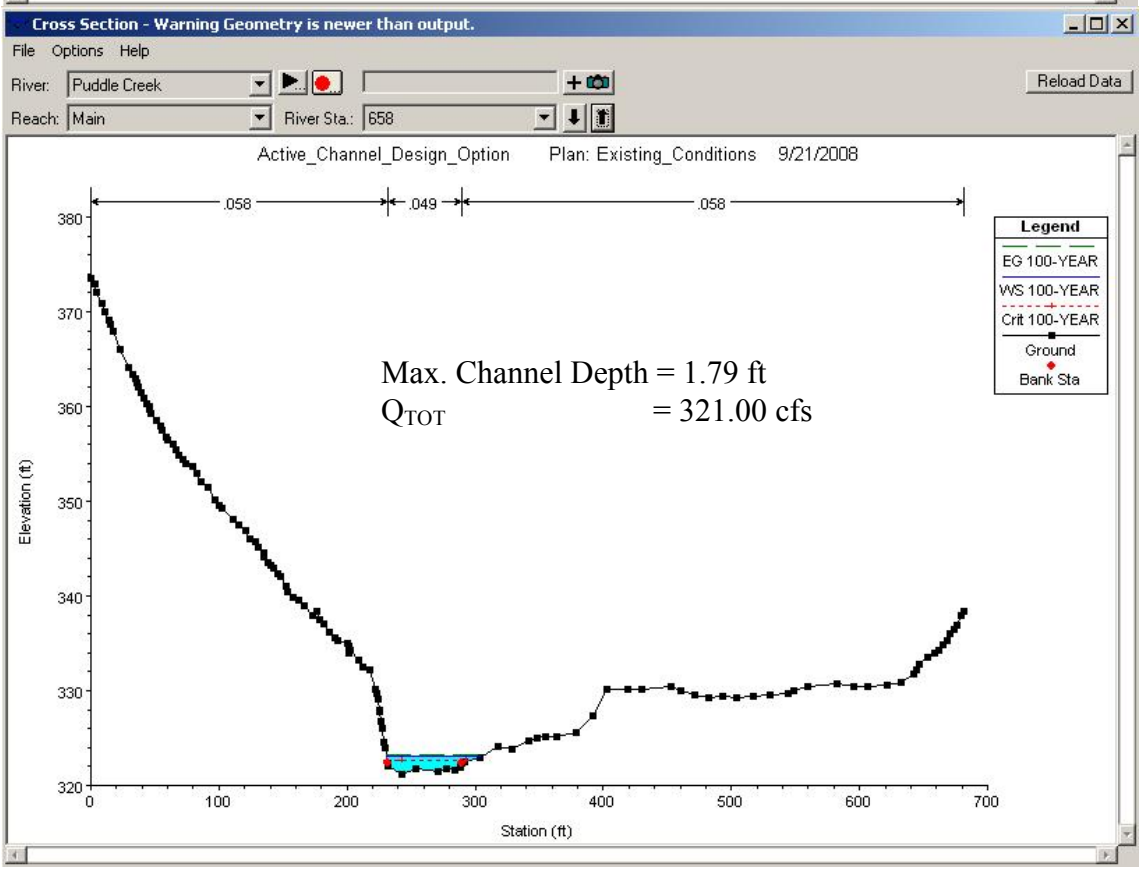
Station (ft)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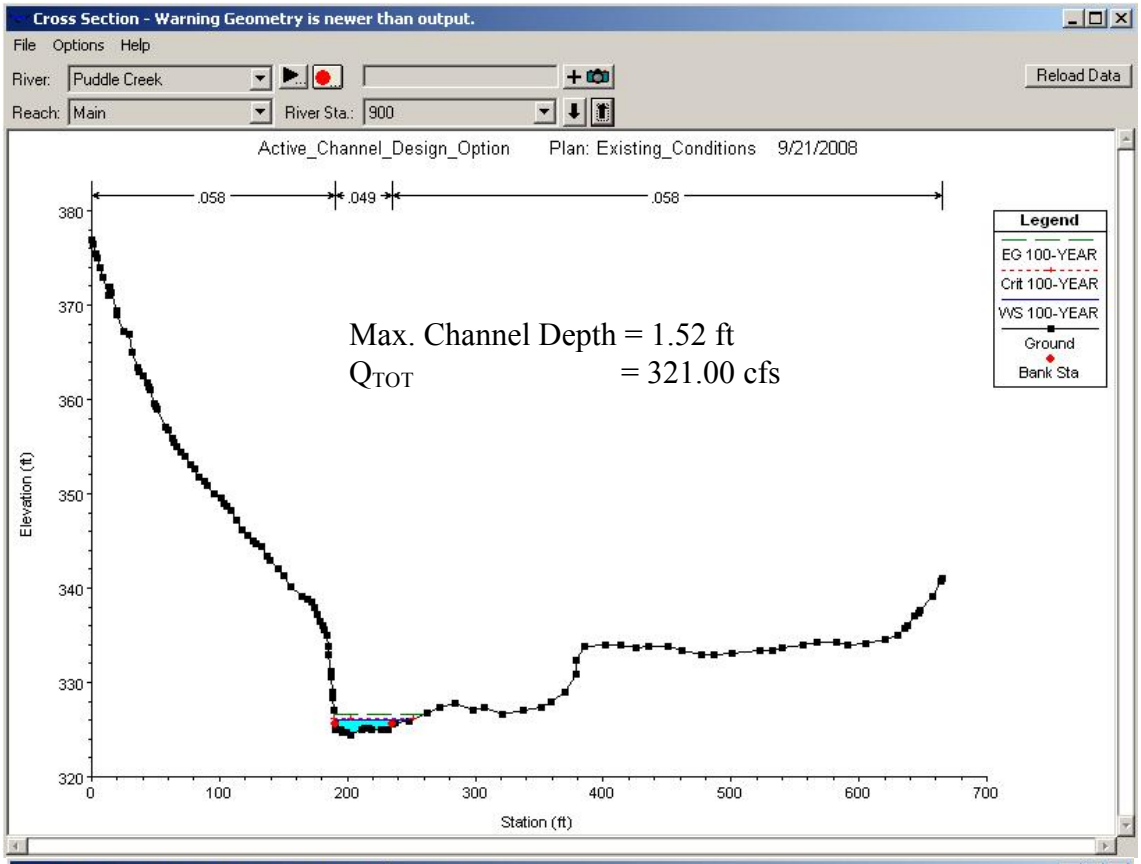
Station (ft)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.058
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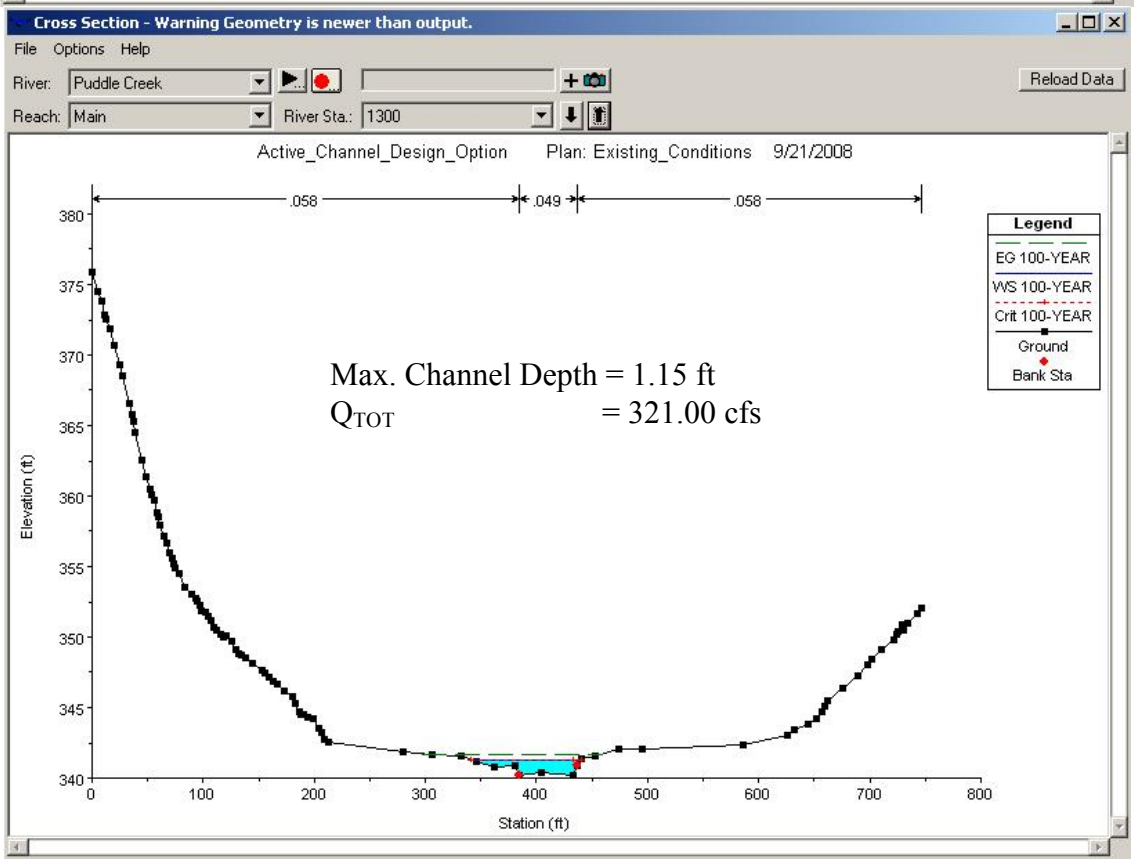
Station (ft)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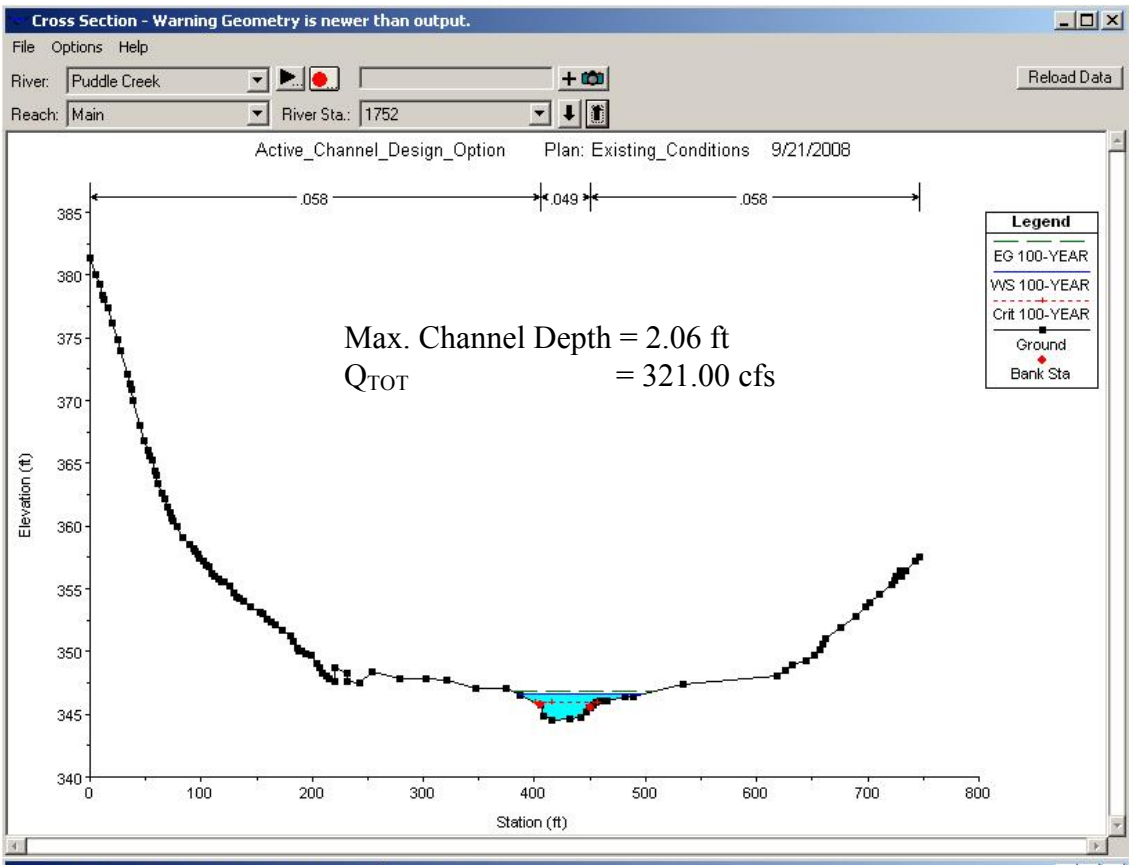
Station (ft)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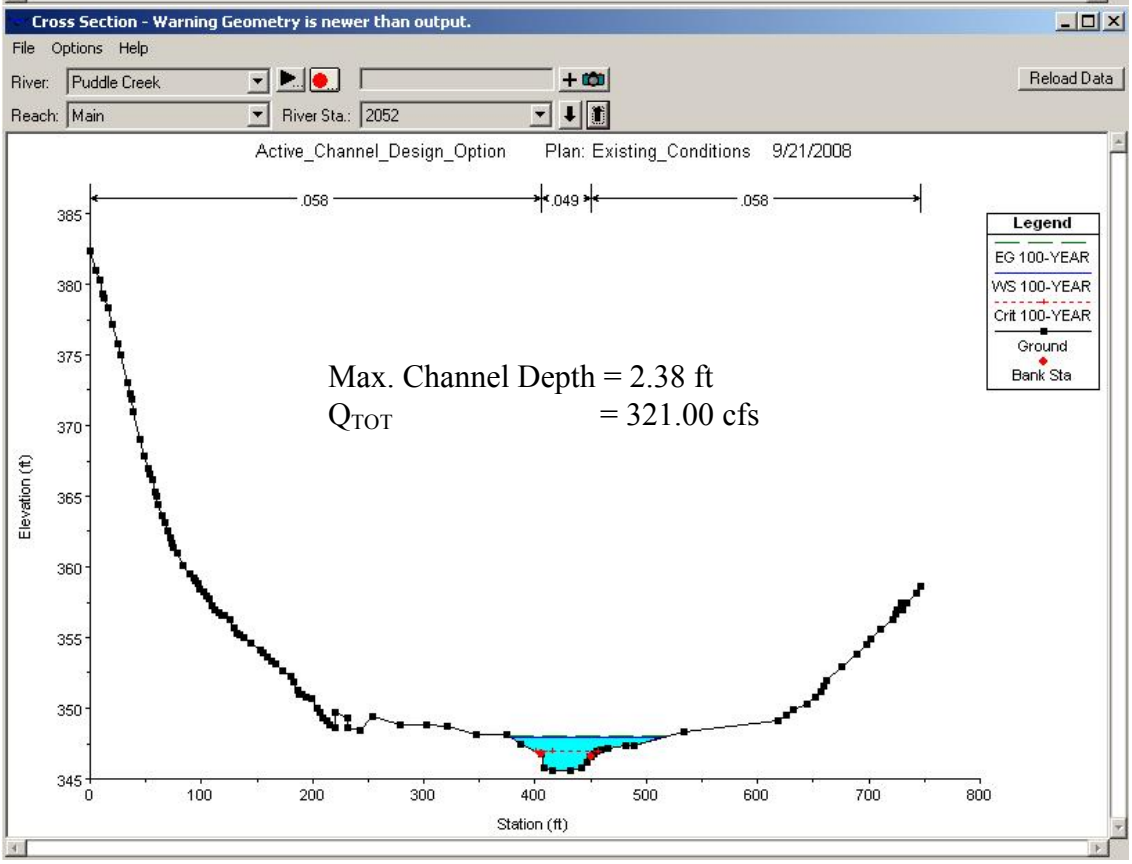
Station (ft)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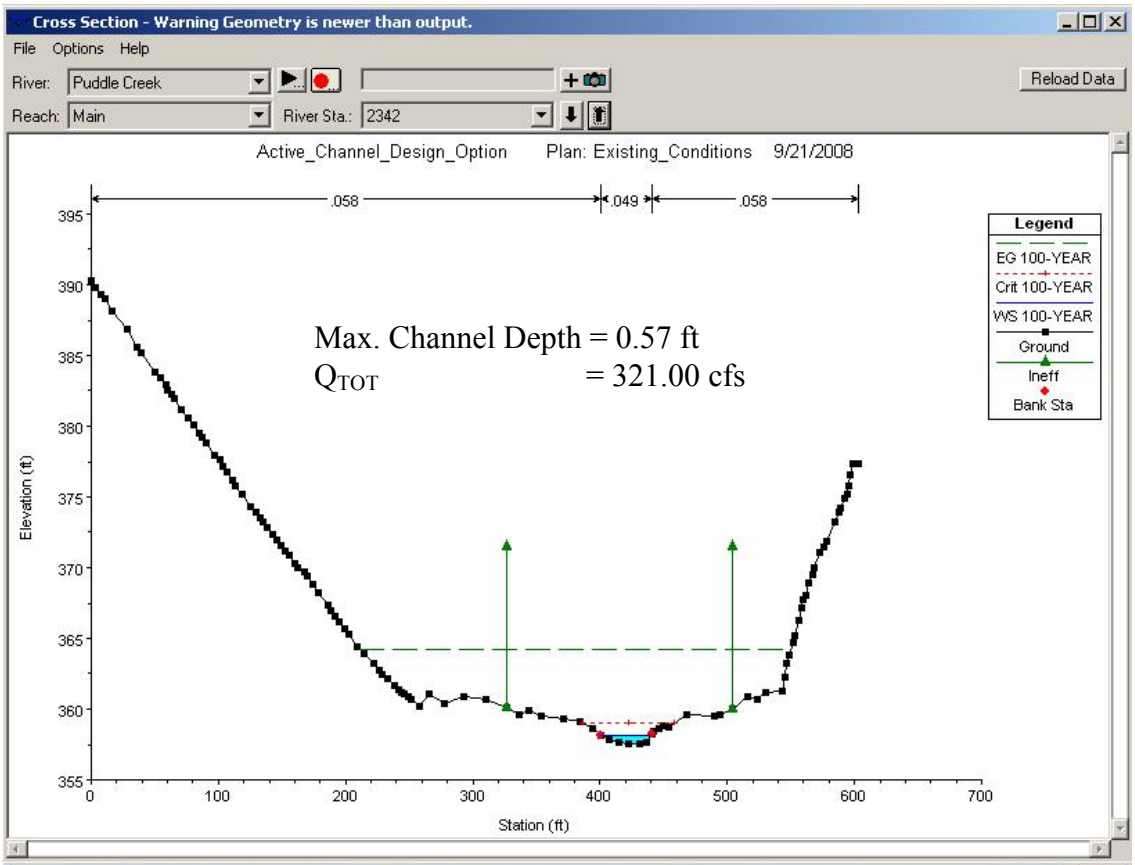
Station (ft)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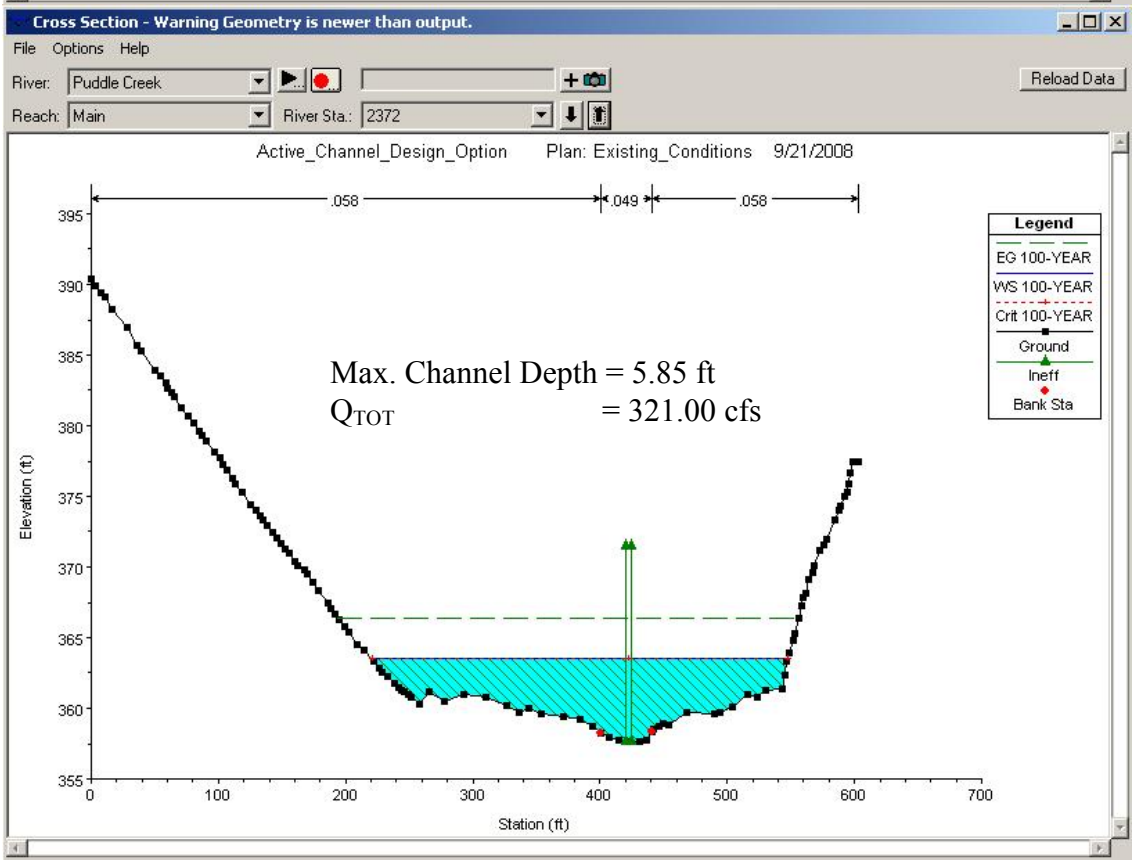
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Ground
Ineff
Bank Sta
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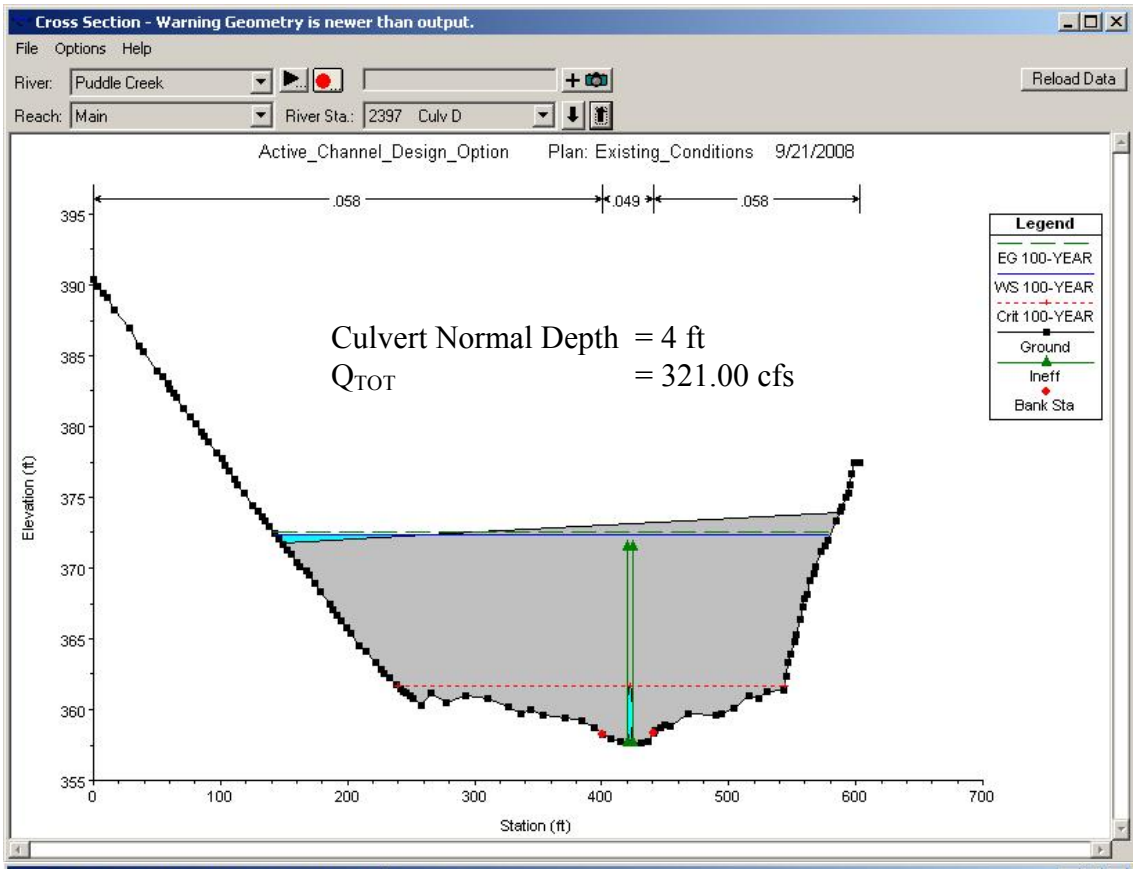
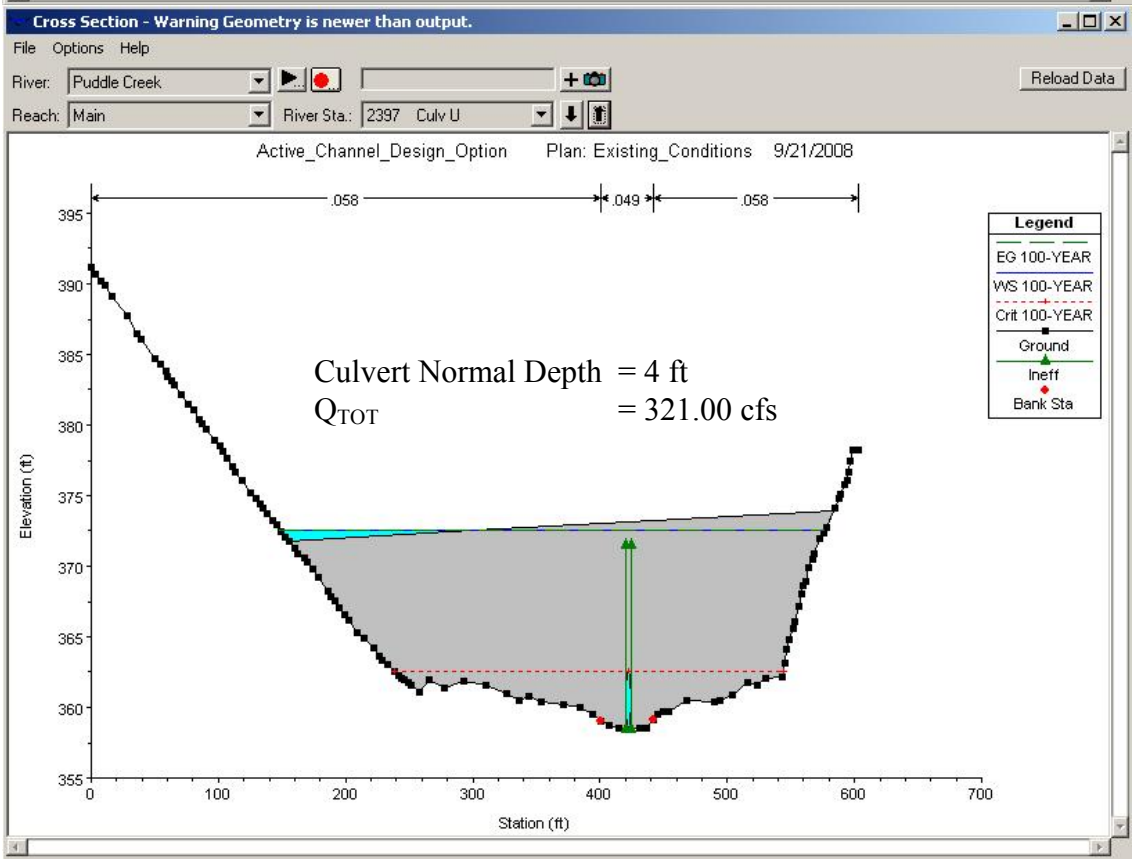
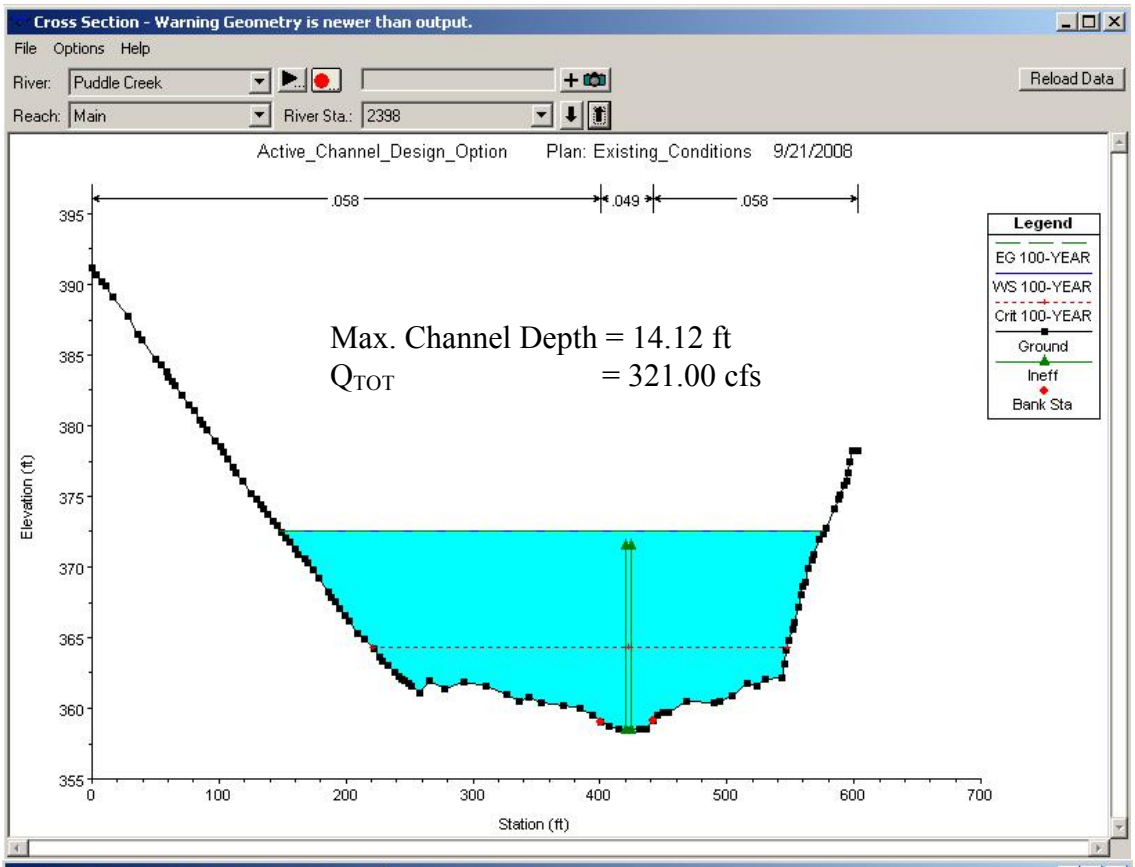
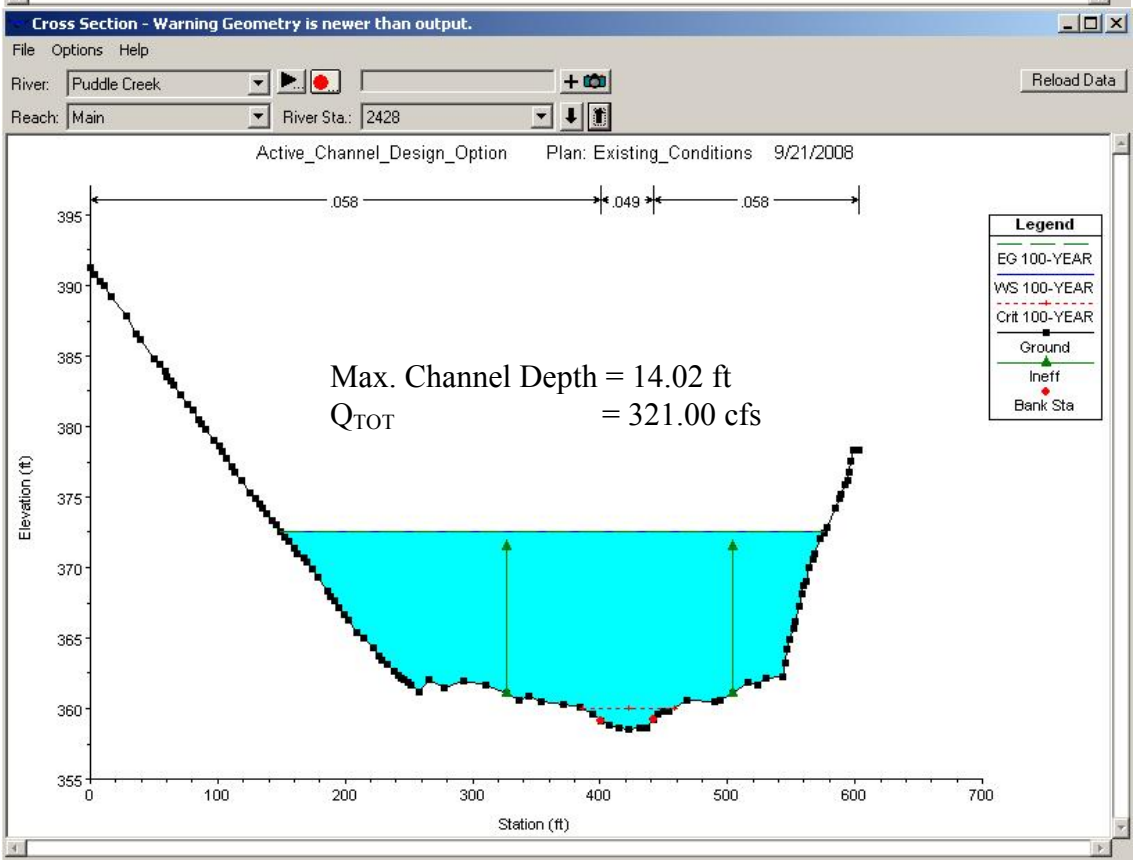
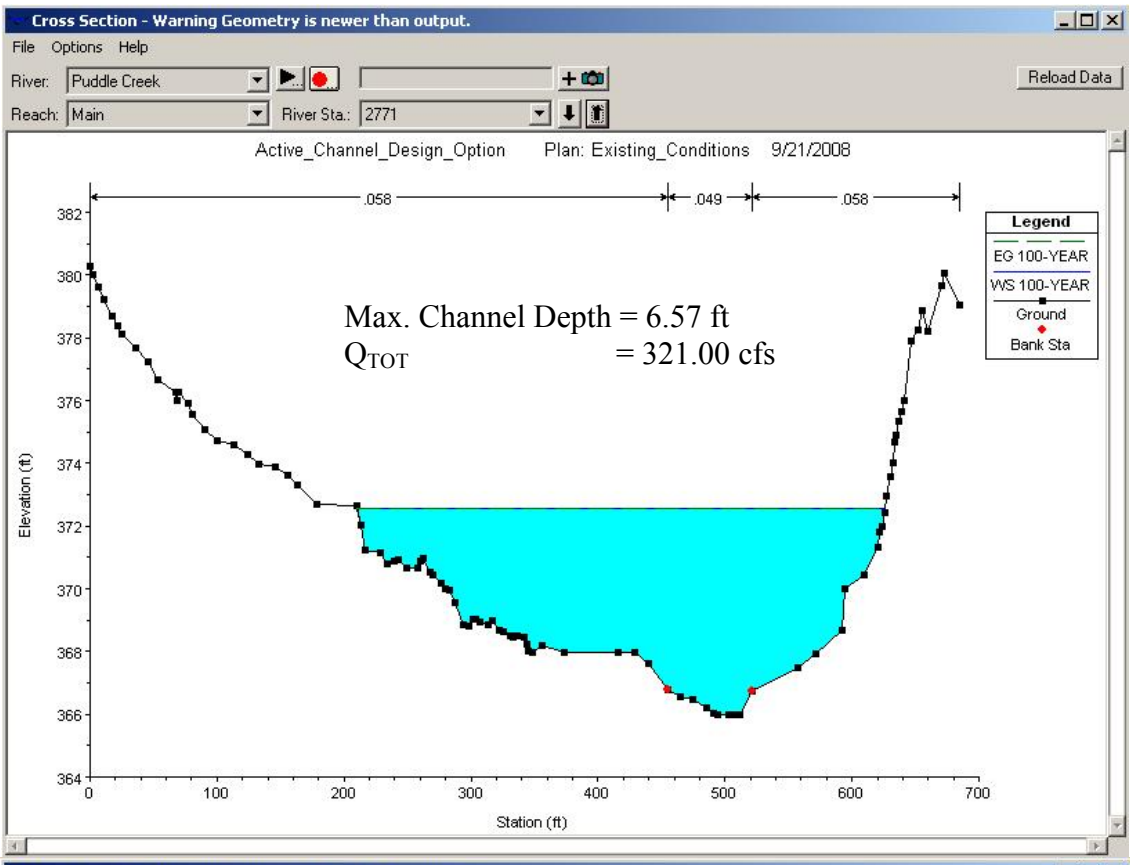
Elevation (ft)
Station (ft)

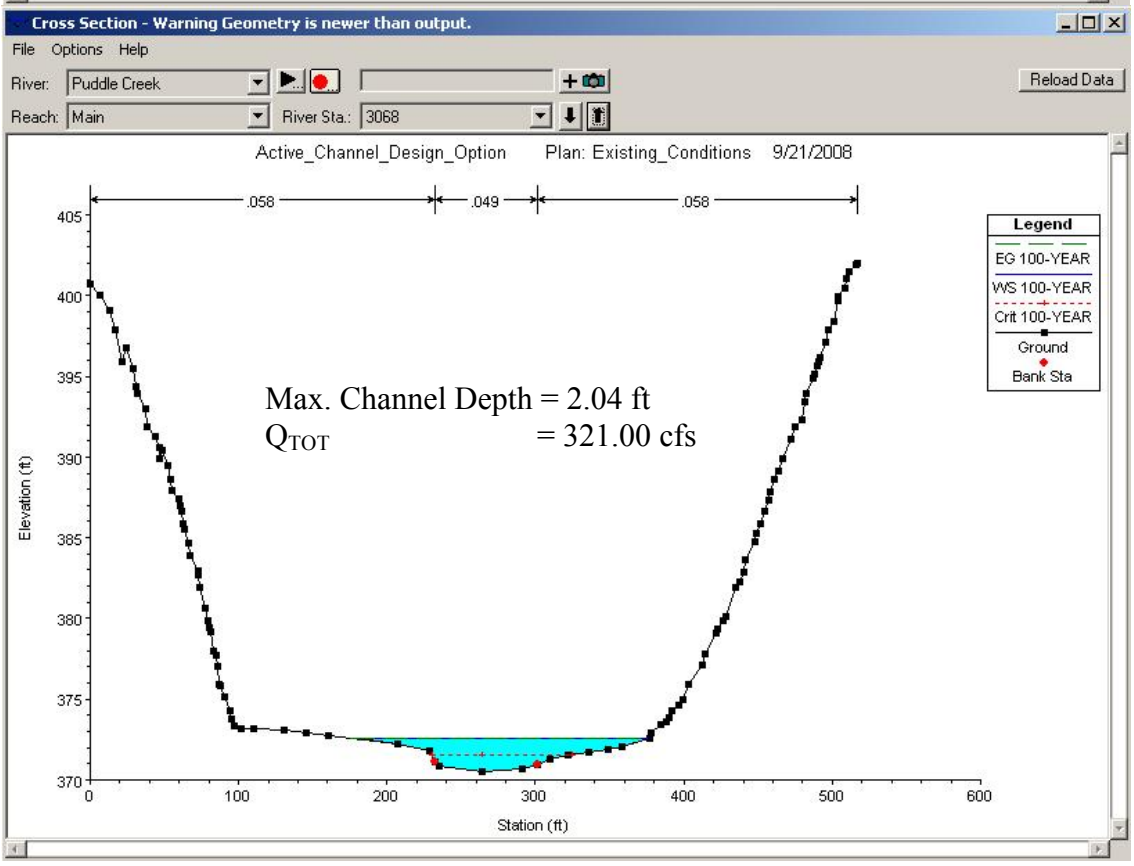

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 2397 Culv D
Reload Data
Active_Channel_Design_Option Plan: Existing_Conditions 9/21/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Ineff
Bank Sta
Culvert Normal Depth = 4 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

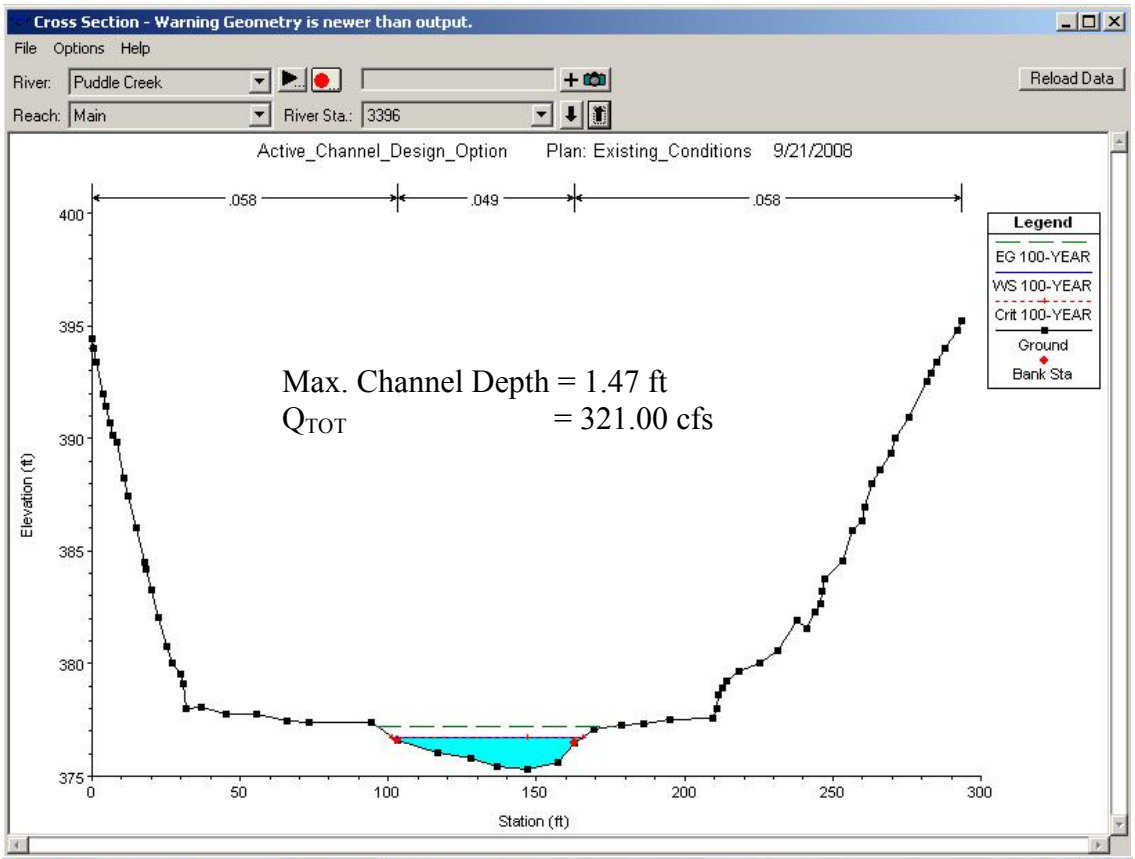

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 2397 Culv U
Reload Data
Active_Channel_Design_Option Plan: Existing_Conditions 9/21/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Ineff
Bank Sta
Culvert Normal Depth = 4 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

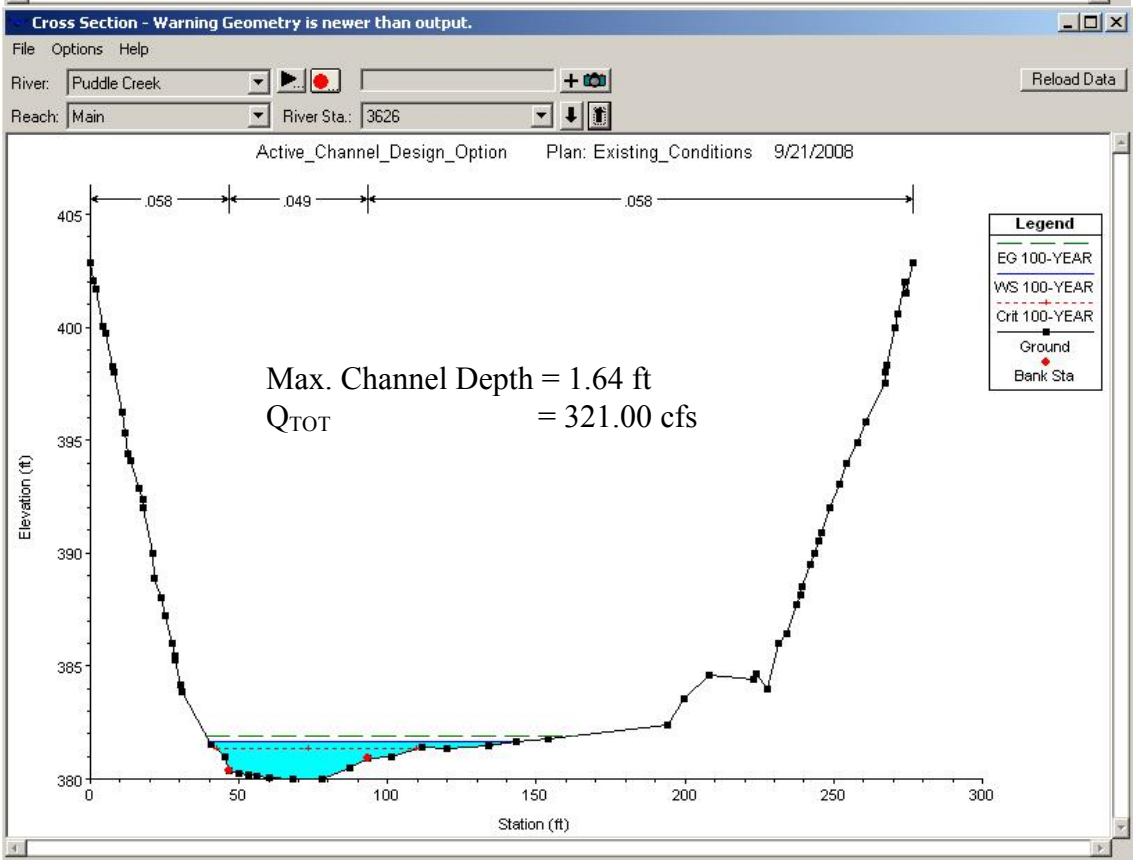

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 2398
Reload Data
Active_Channel_Design_Option Plan: Existing_Conditions 9/21/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Ineff
Bank Sta
Max. Channel Depth = 14.12 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

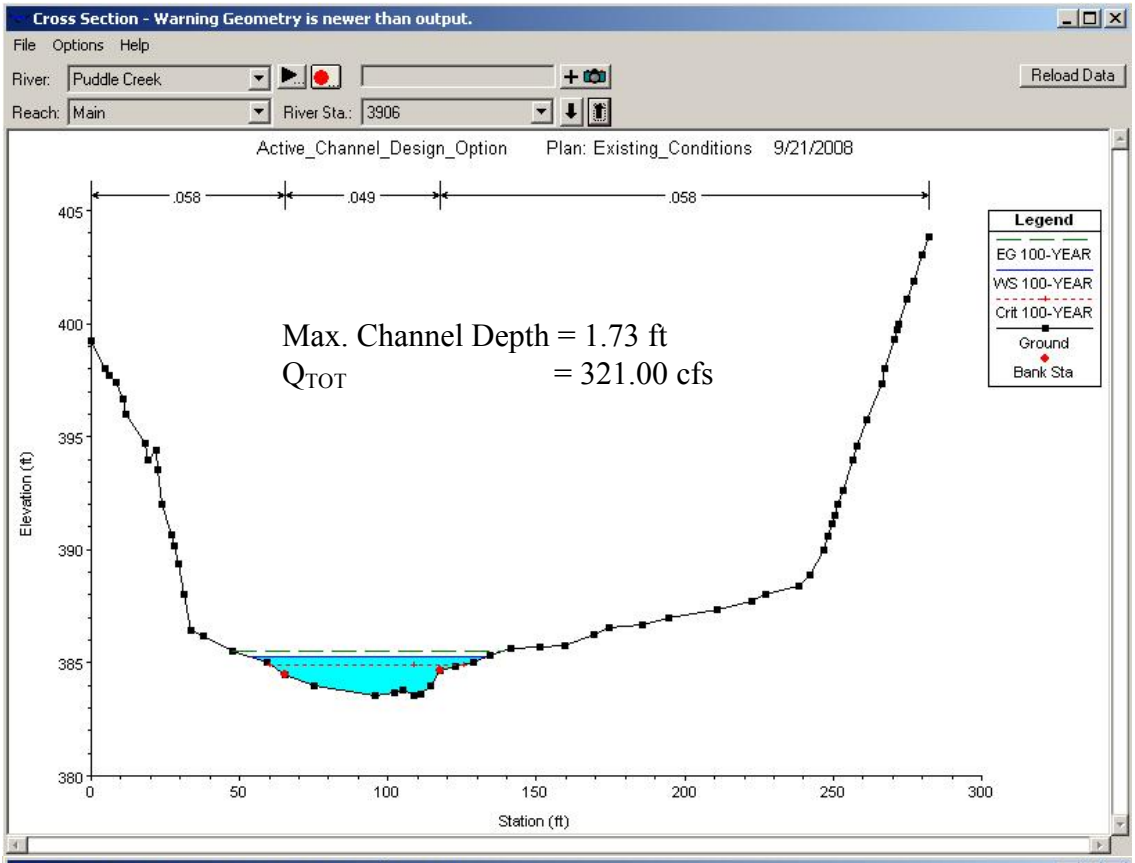

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 2428
Reload Data
Active_Channel_Design_Option Plan: Existing_Conditions 9/21/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Ineff
Bank Sta
Max. Channel Depth = 14.02 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

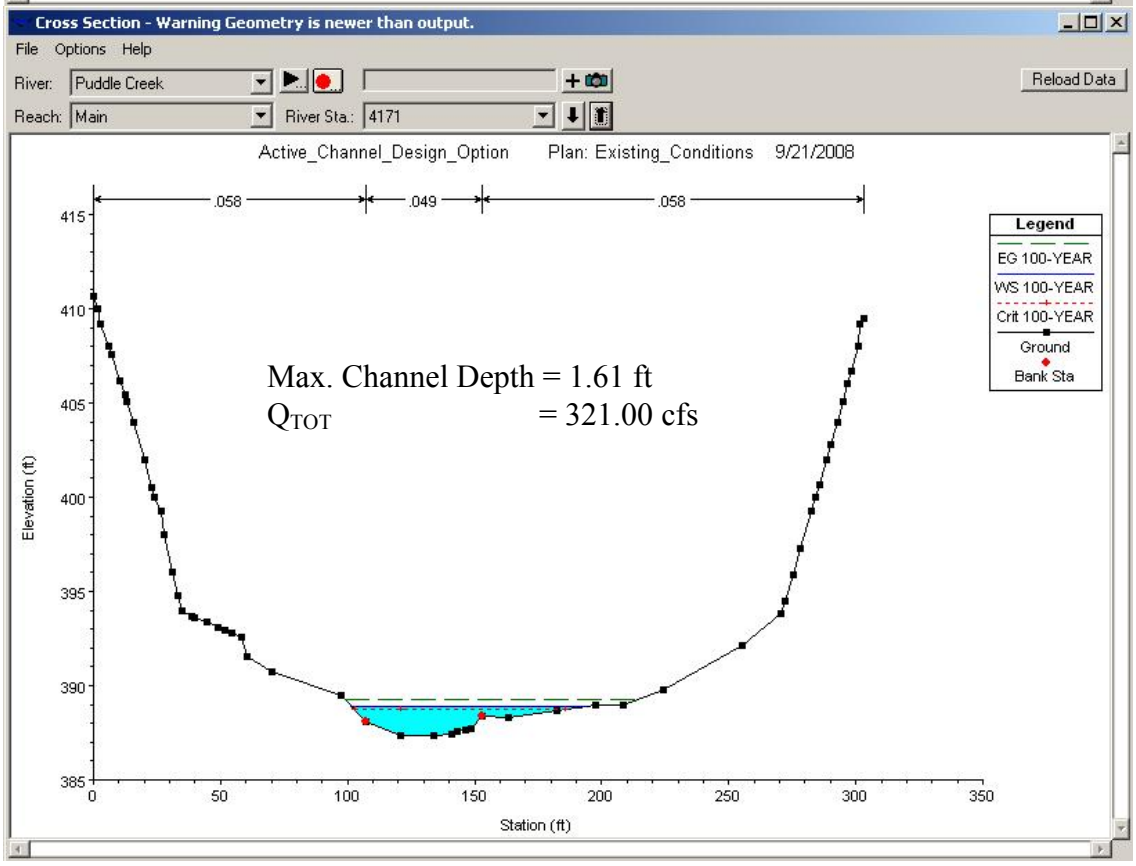

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 2771
Reload Data
Active_Channel_Design_Option Plan: Existing_Conditions 9/21/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 6.57 ft
Q_{TOT} = 321.00 cfs
Elevation (ft)
Station (ft)

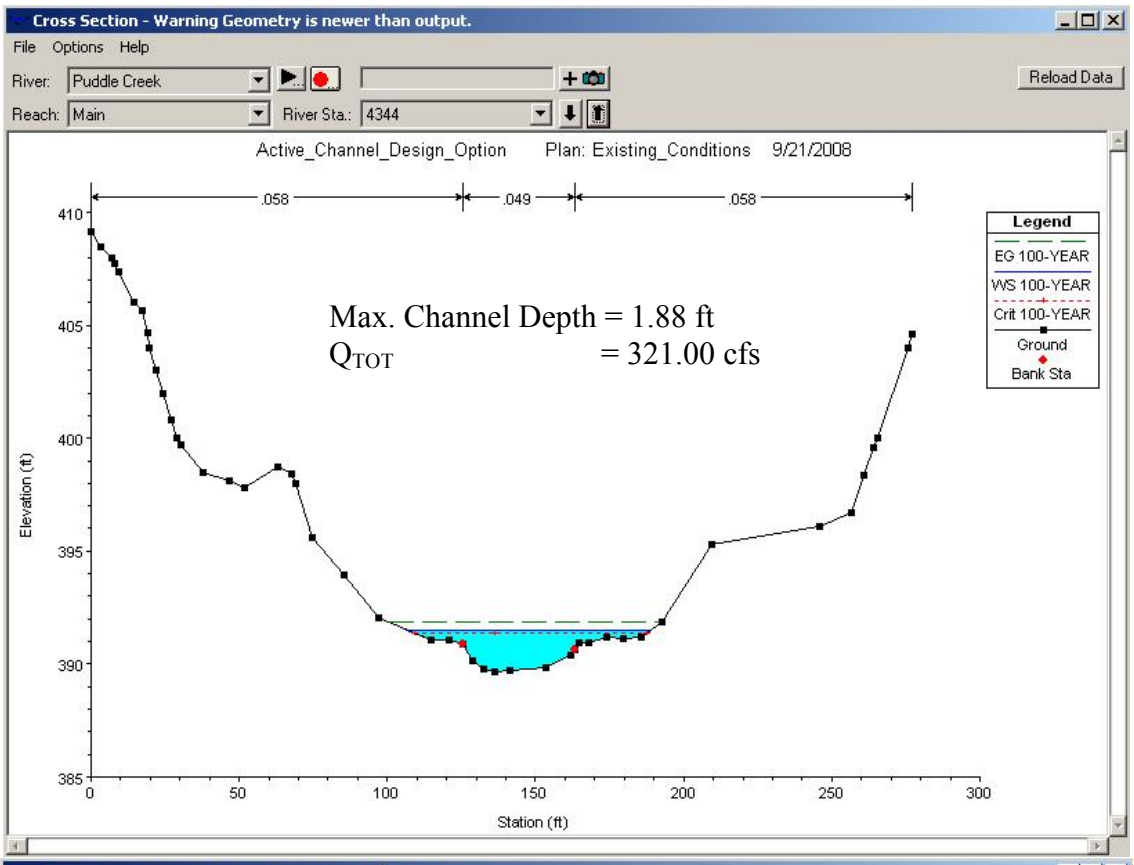

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 3068
Reload Data
Active_Channel_Design_Option Plan: Existing_Conditions 9/21/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 2.04 ft
Q_{TOT} = 321.00 cfs
Elevation (ft)
Station (ft)

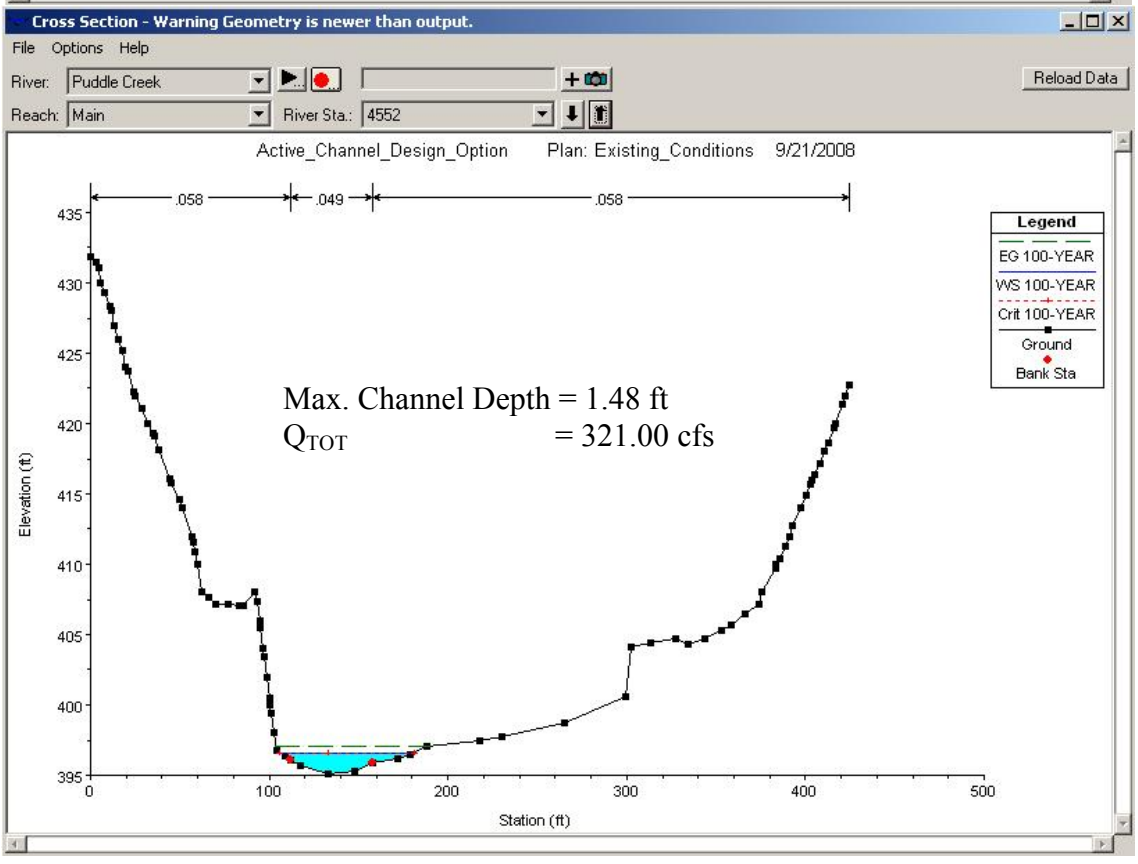

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 3396
Reload Data
Active_Channel_Design_Option Plan: Existing_Conditions 9/21/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.47 ft
Q_{TOT} = 321.00 cfs
Elevation (ft)
Station (ft)


Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 3626
Reload Data
Active_Channel_Design_Option Plan: Existing_Conditions 9/21/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.64 ft
Q_{TOT} = 321.00 cfs
Elevation (ft)
Station (ft)


Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 3906
Reload Data
Active_Channel_Design_Option Plan: Existing_Conditions 9/21/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.73 ft
Q_{TOT} = 321.00 cfs
Elevation (ft)
Station (ft)

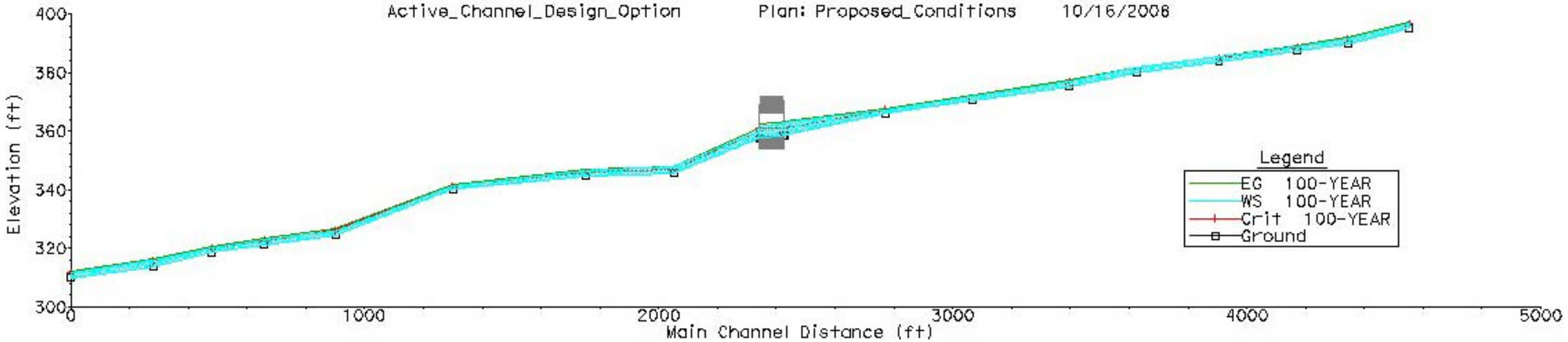

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 4171
Reload Data
Active_Channel_Design_Option Plan: Existing_Conditions 9/21/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.61 ft
Q_{TOT} = 321.00 cfs
Elevation (ft)
Station (ft)

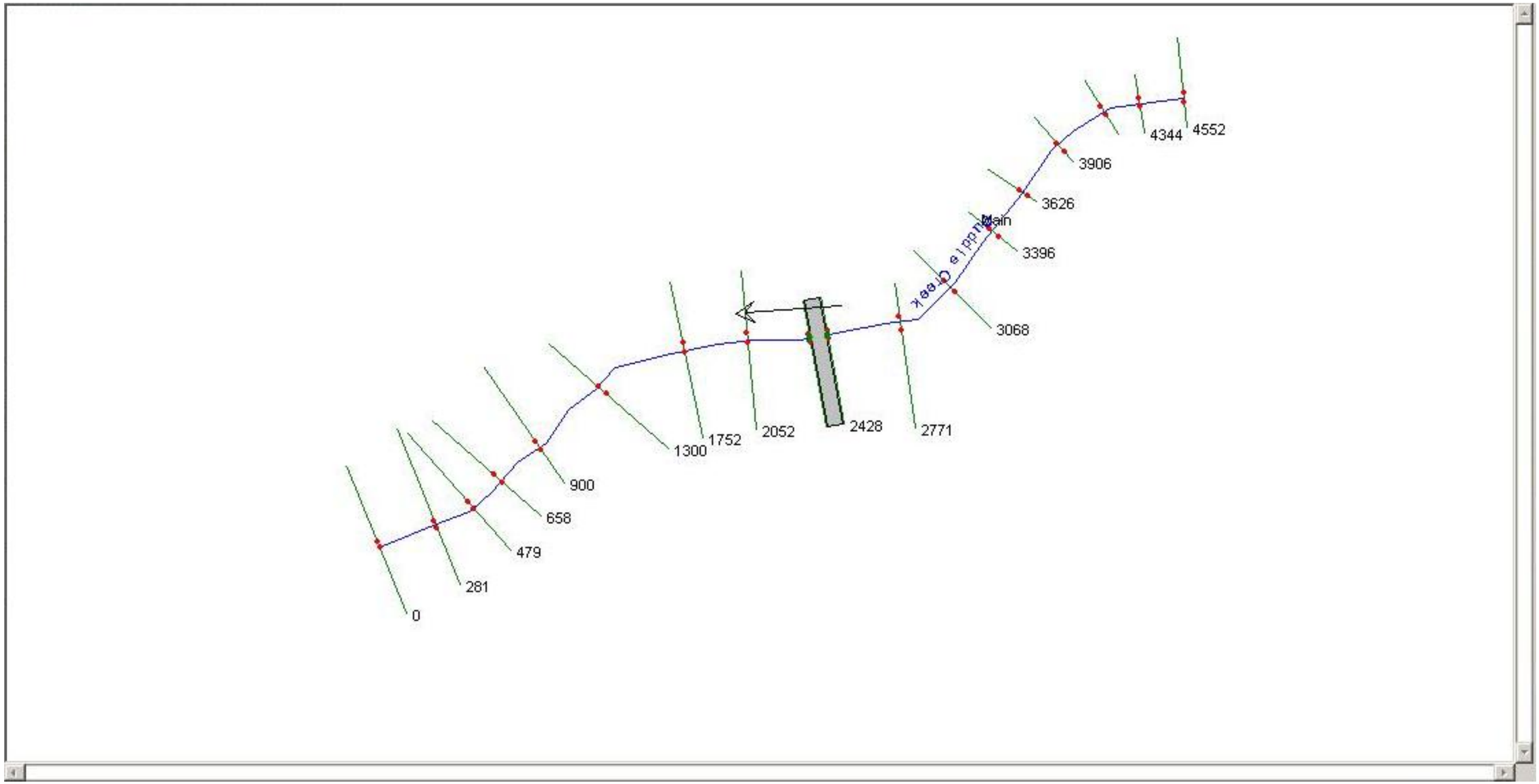

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 4344
Reload Data
Active_Channel_Design_Option Plan: Existing_Conditions 9/21/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.88 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

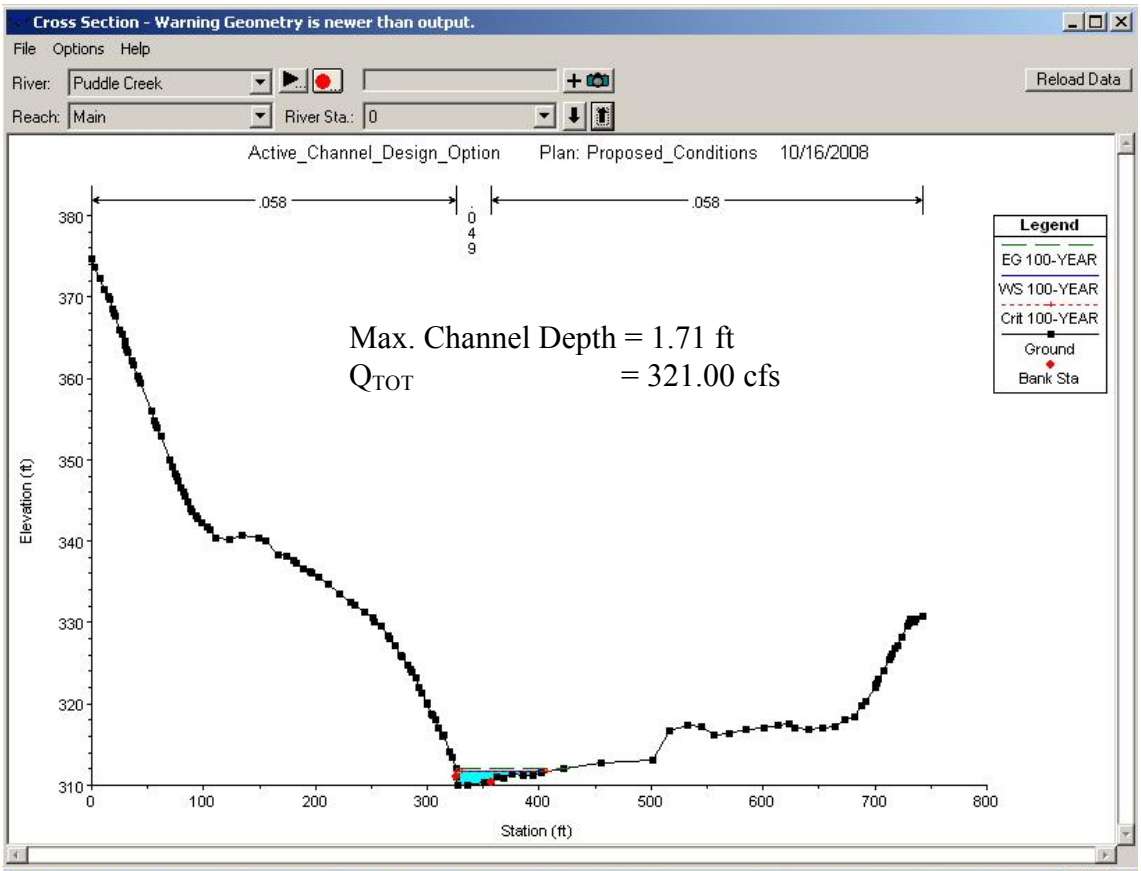

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 4552
Reload Data
Active_Channel_Design_Option Plan: Existing_Conditions 9/21/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.48 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

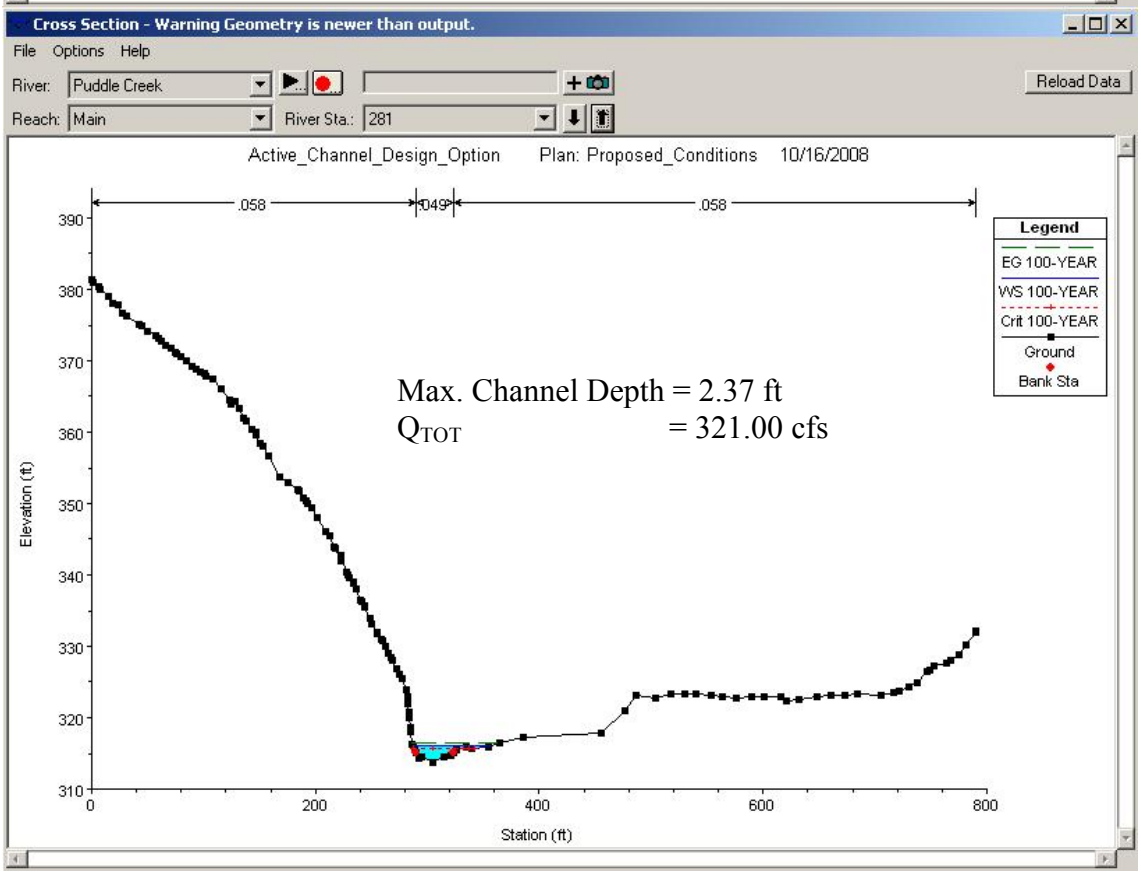
EXISTING CONDITIONS

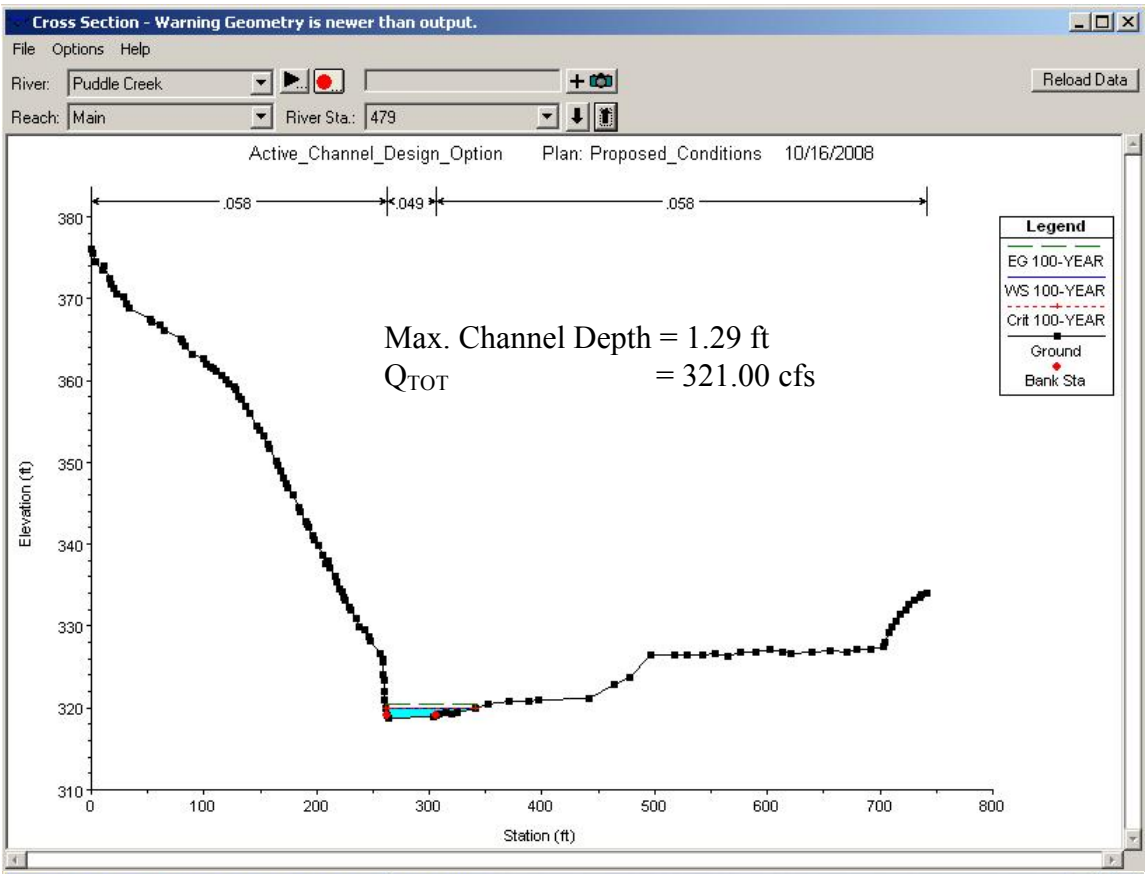
FLOOD FLOW RESULTS

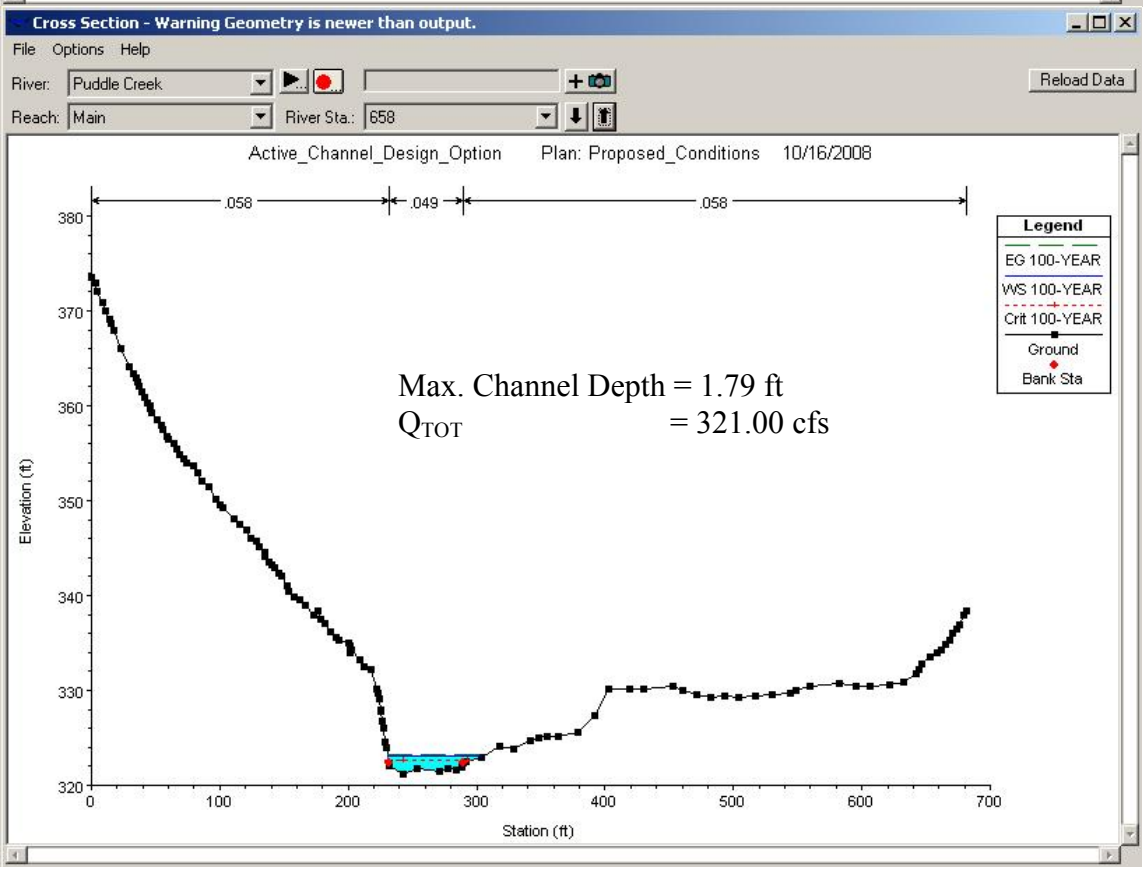

Active_Channel_Design_Option
Plan: Proposed_Conditions
10/16/2008
Elevation (ft)
400
380
360
340
320
300
0
1000
2000
3000
4000
5000
Main Channel Distance (ft)
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground

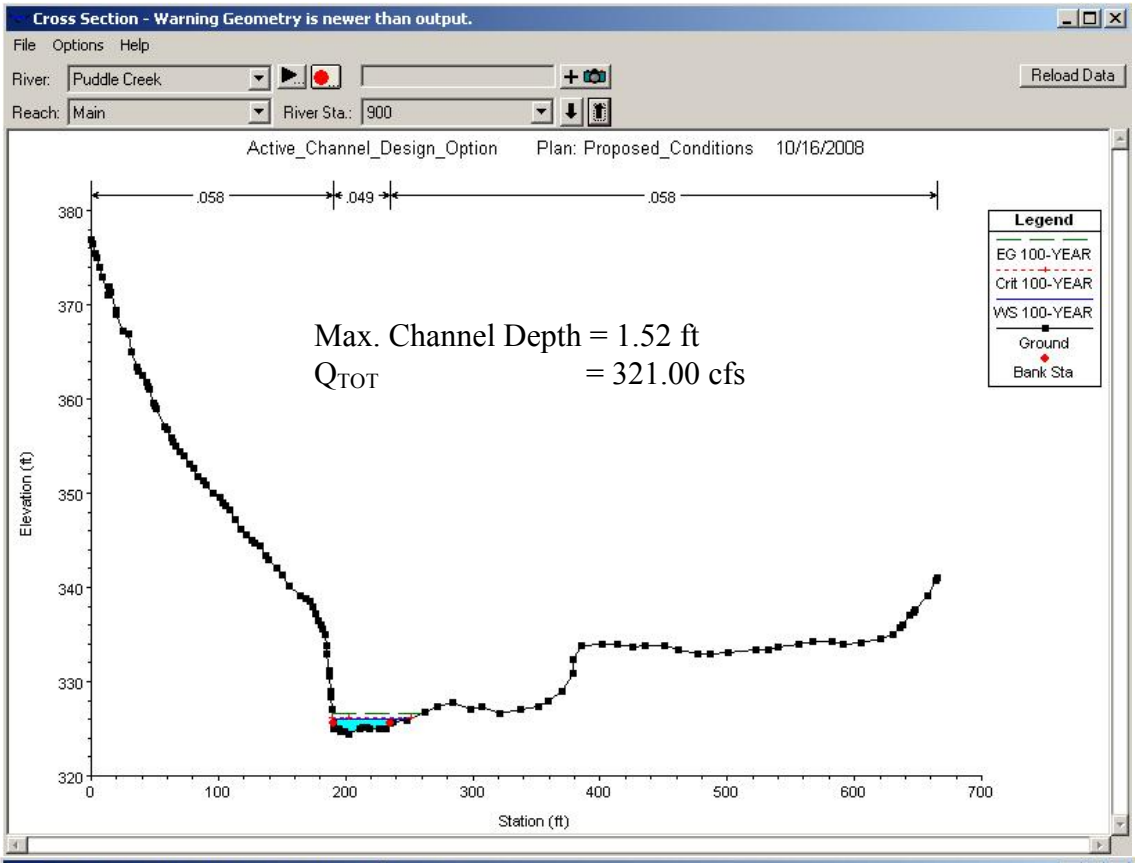

4344
4552
3906
3626
Main
3396
Saddle Creek
3068
1300
1752
2052
2428
2771
900
658
479
281
0

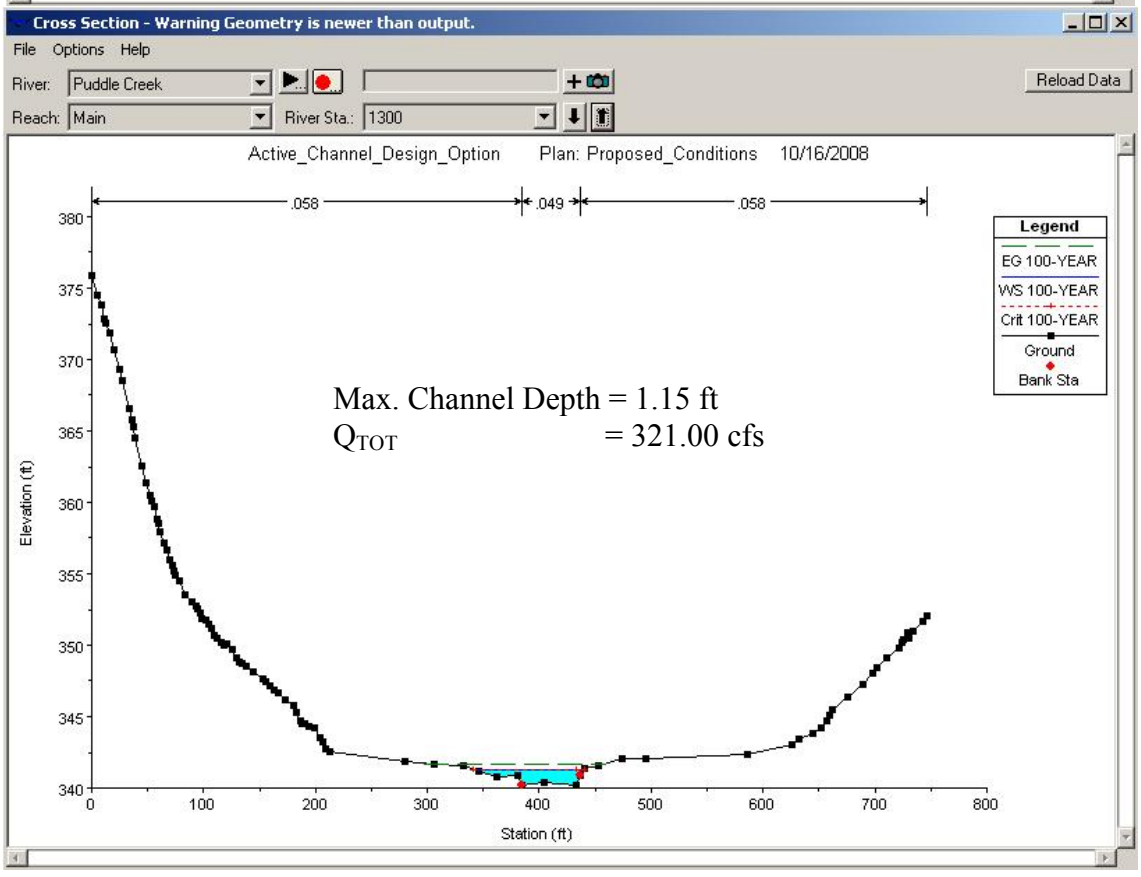

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 0
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.71 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

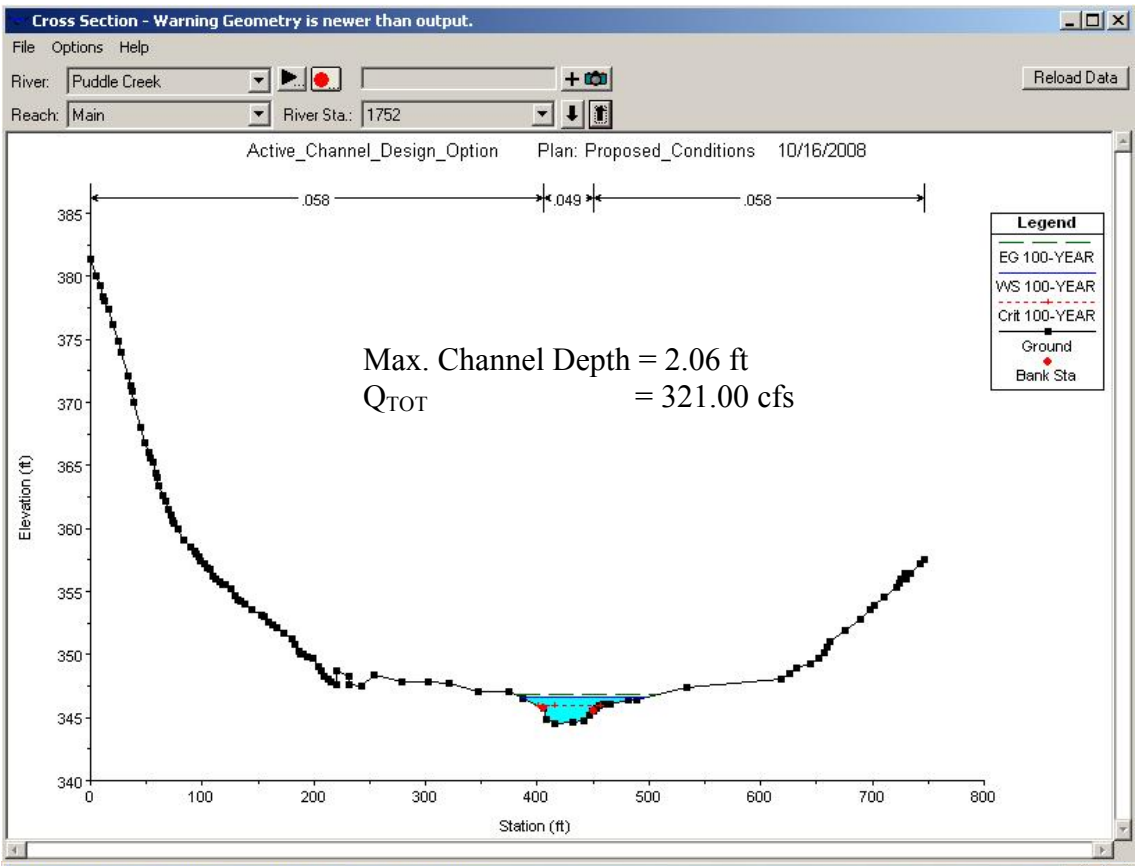

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 281
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 2.37 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

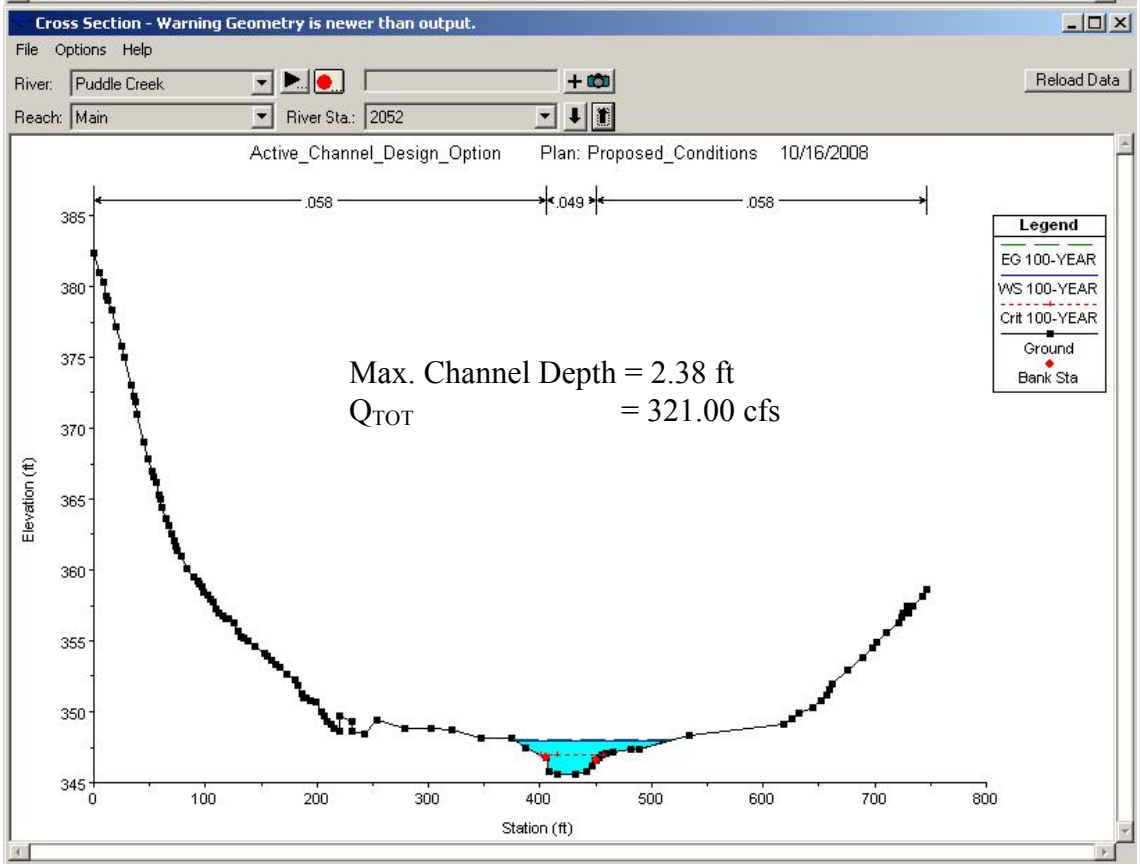

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 479
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.29 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

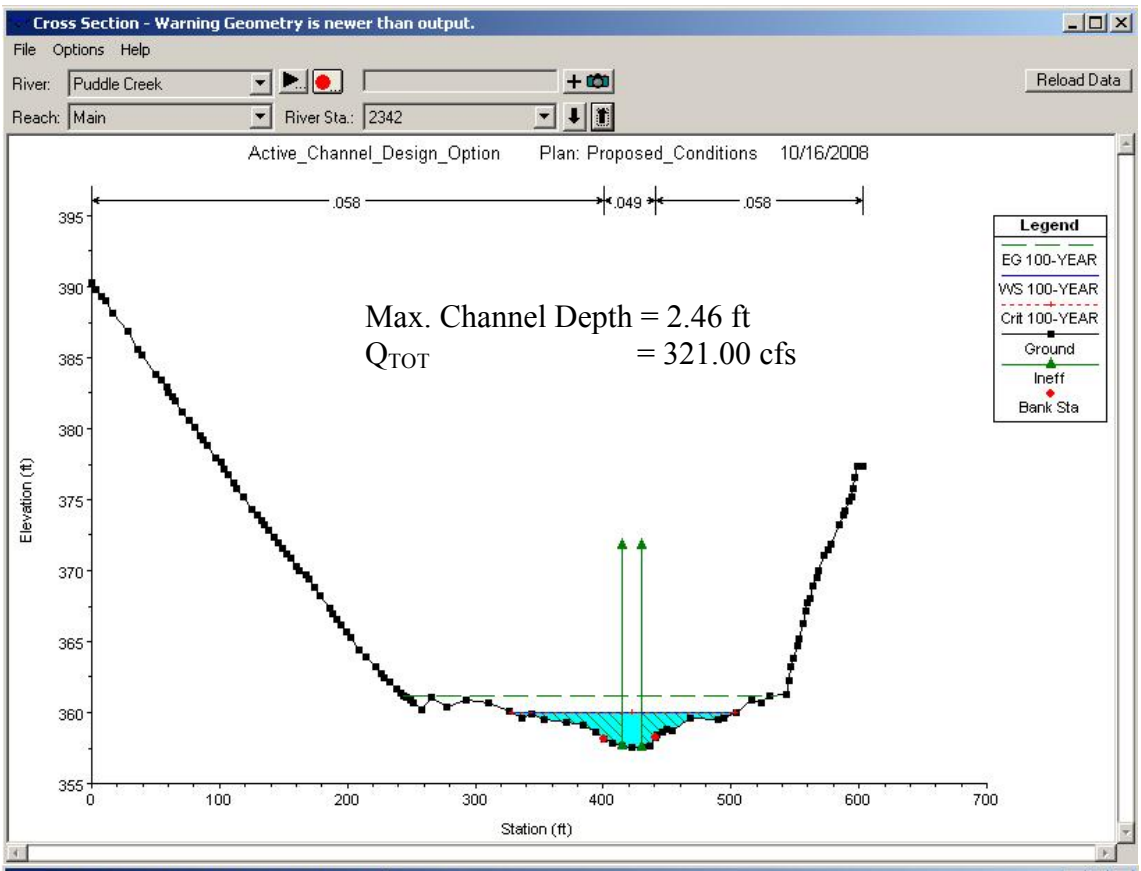

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 658
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.79 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

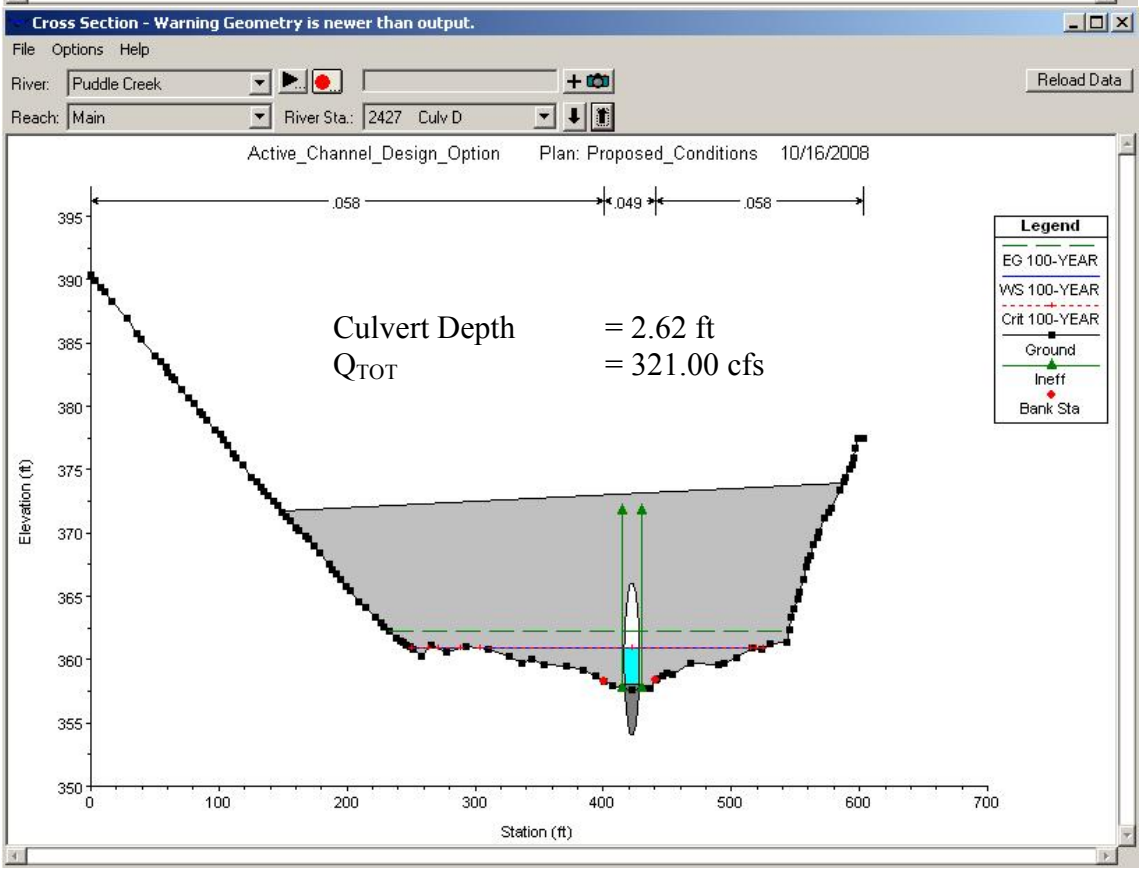

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 900
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
Crit 100-YEAR
WS 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.52 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

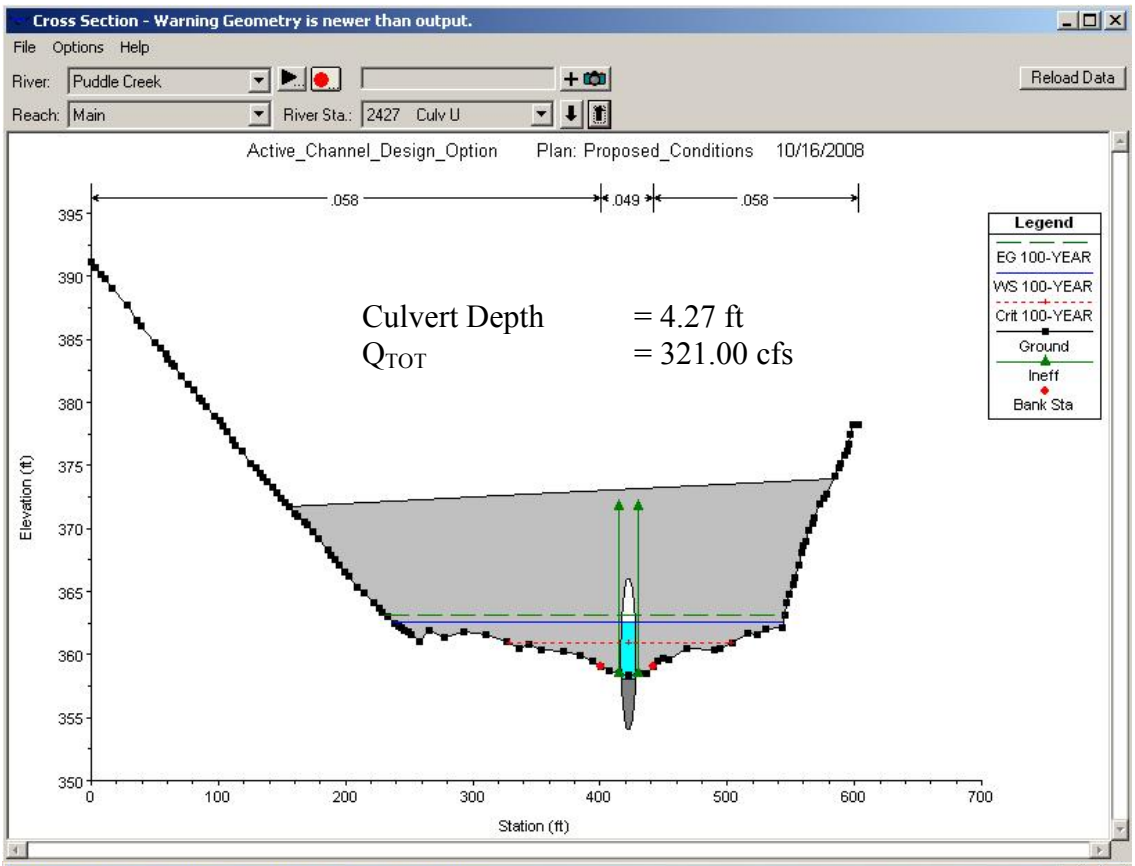

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 1300
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.15 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

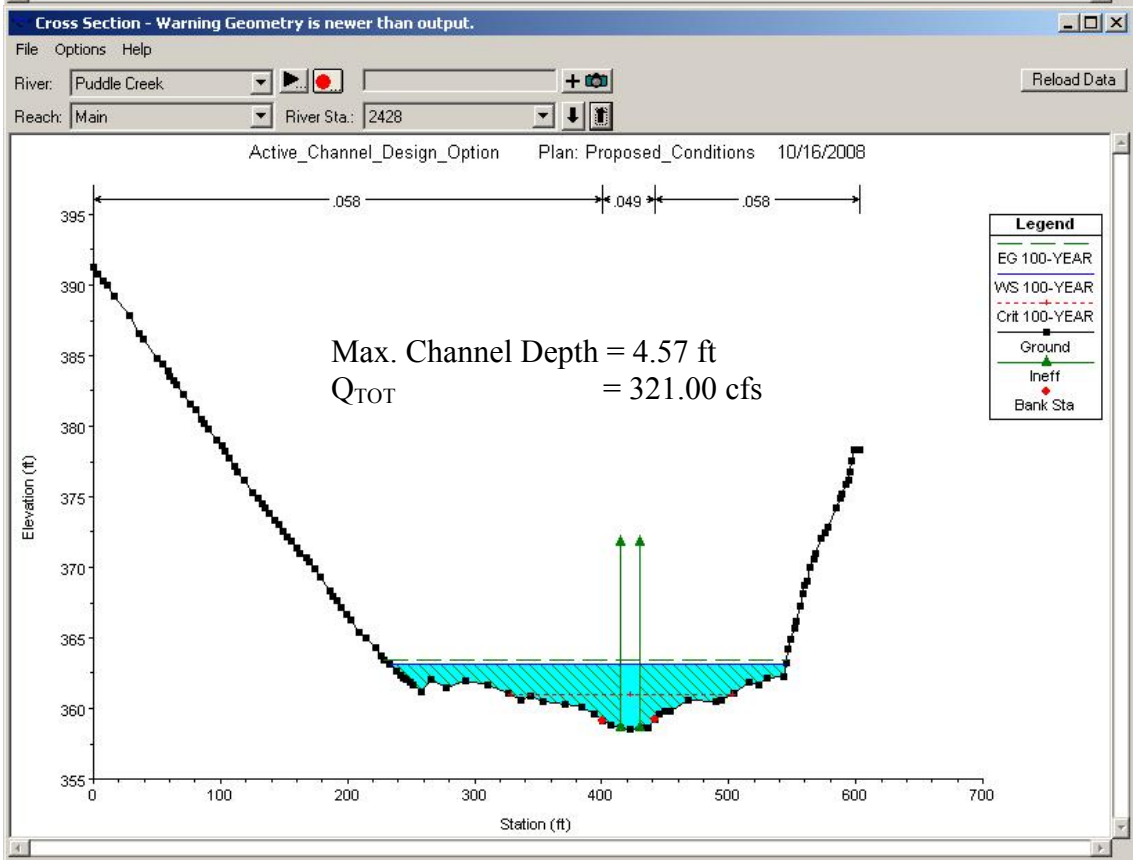

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 1752
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 2.06 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

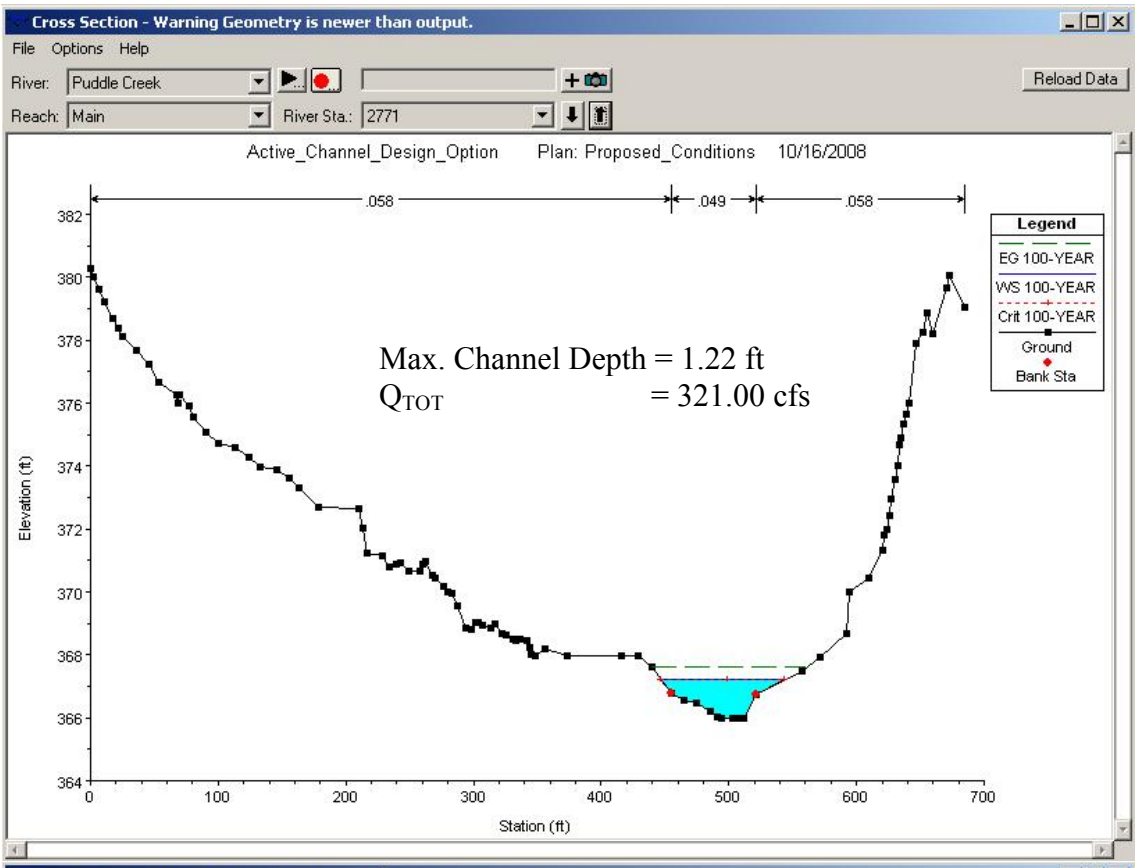

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 2052
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 2.38 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

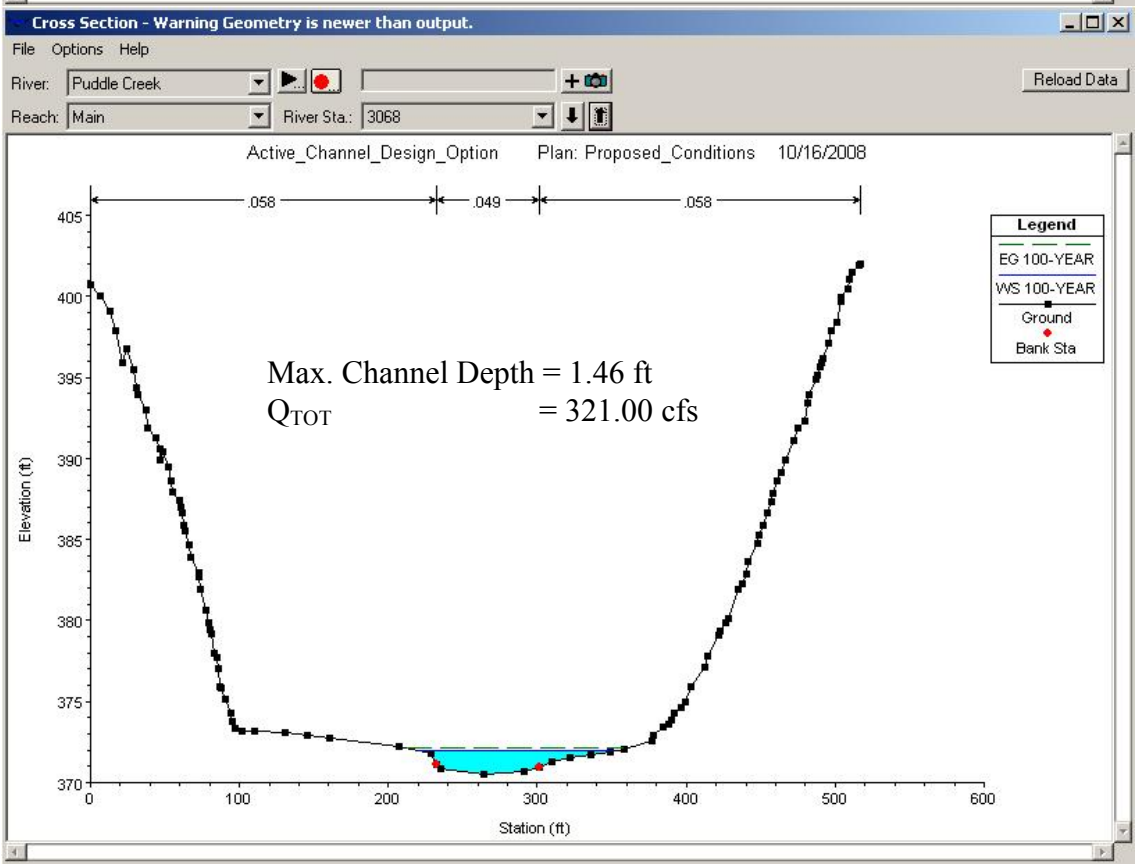

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 2342
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Ineff
Bank Sta
Max. Channel Depth = 2.46 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

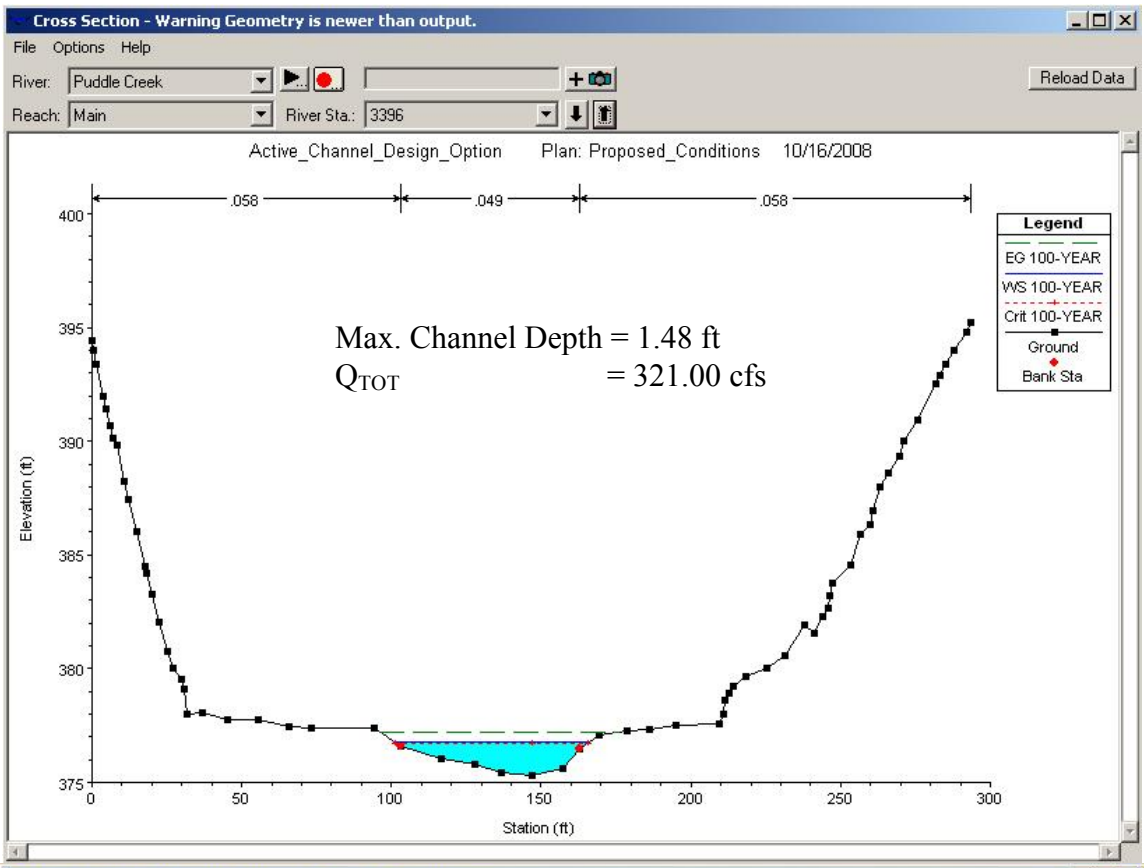

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 2427 Culv D
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Ineff
Bank Sta
Culvert Depth = 2.62 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)

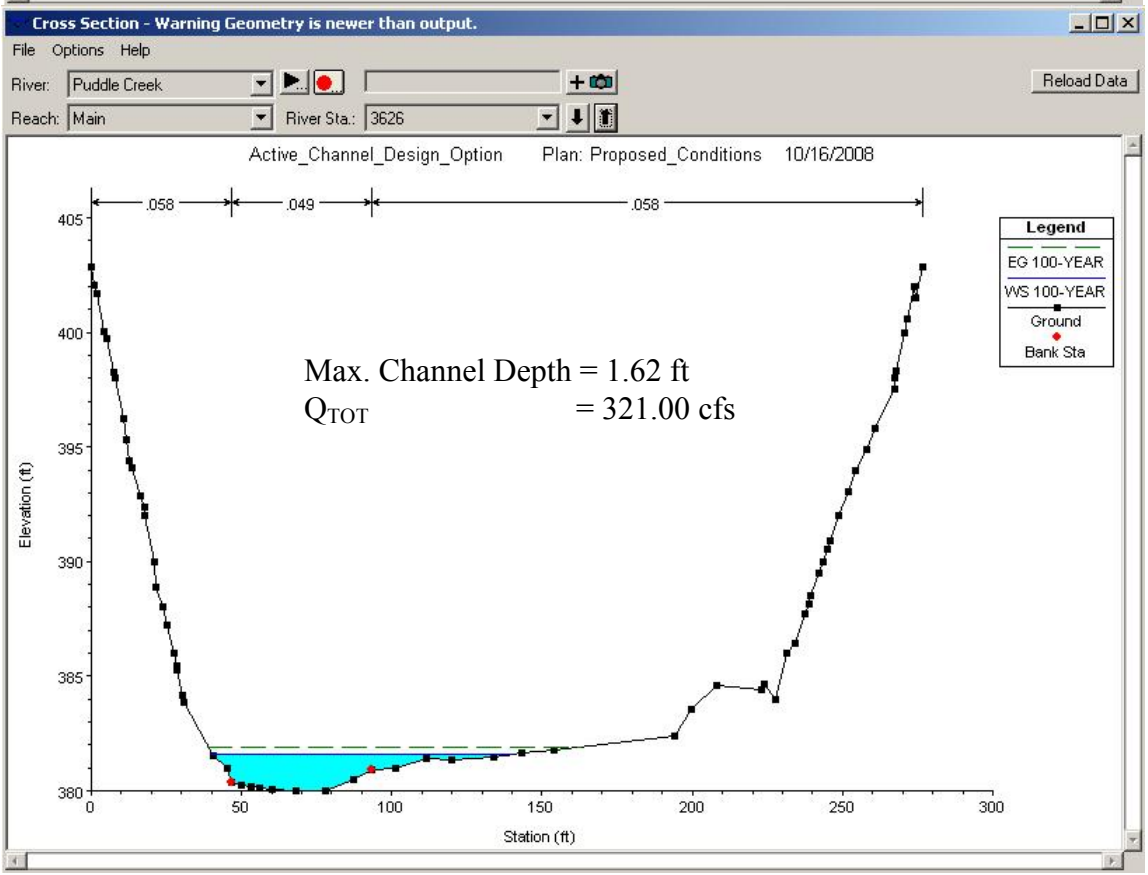

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 2427 Culv U
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Culvert Depth = 4.27 ft
Q_{TOT} = 321.00 cfs
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

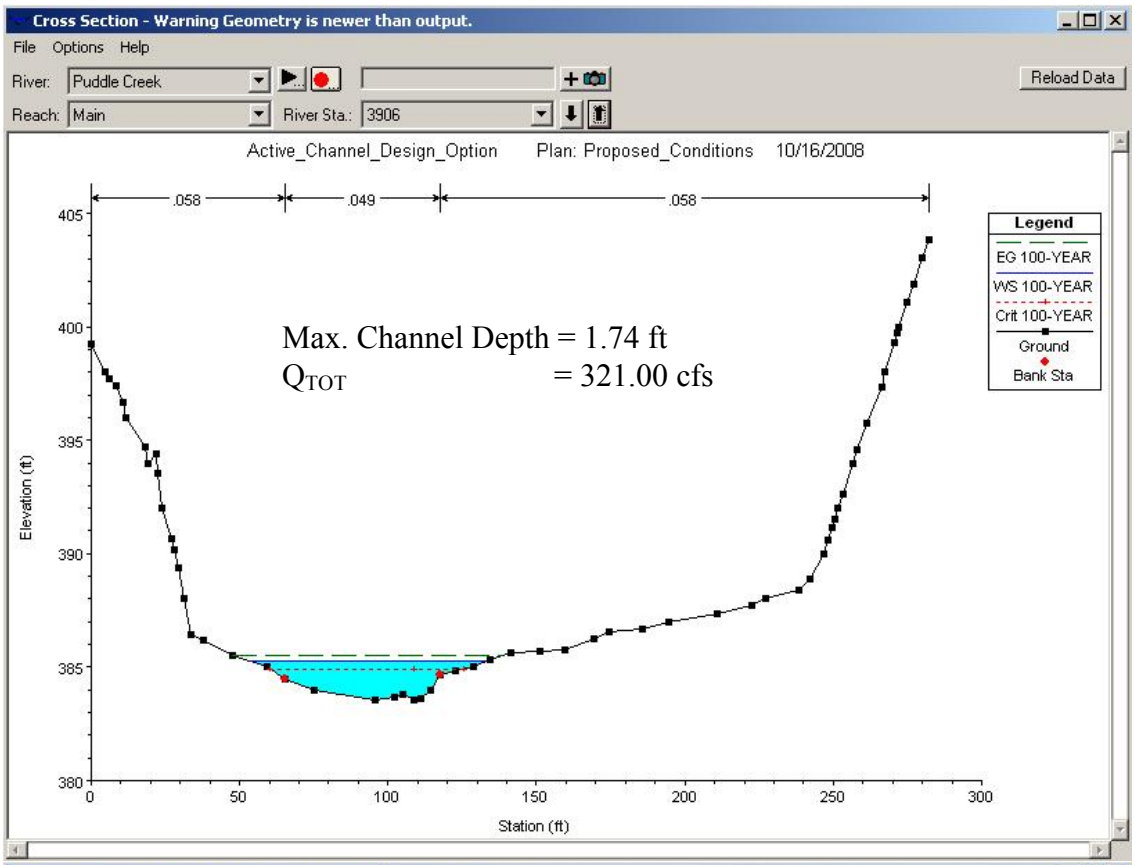

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 2428
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Max. Channel Depth = 4.57 ft
Q_{TOT} = 321.00 cfs
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

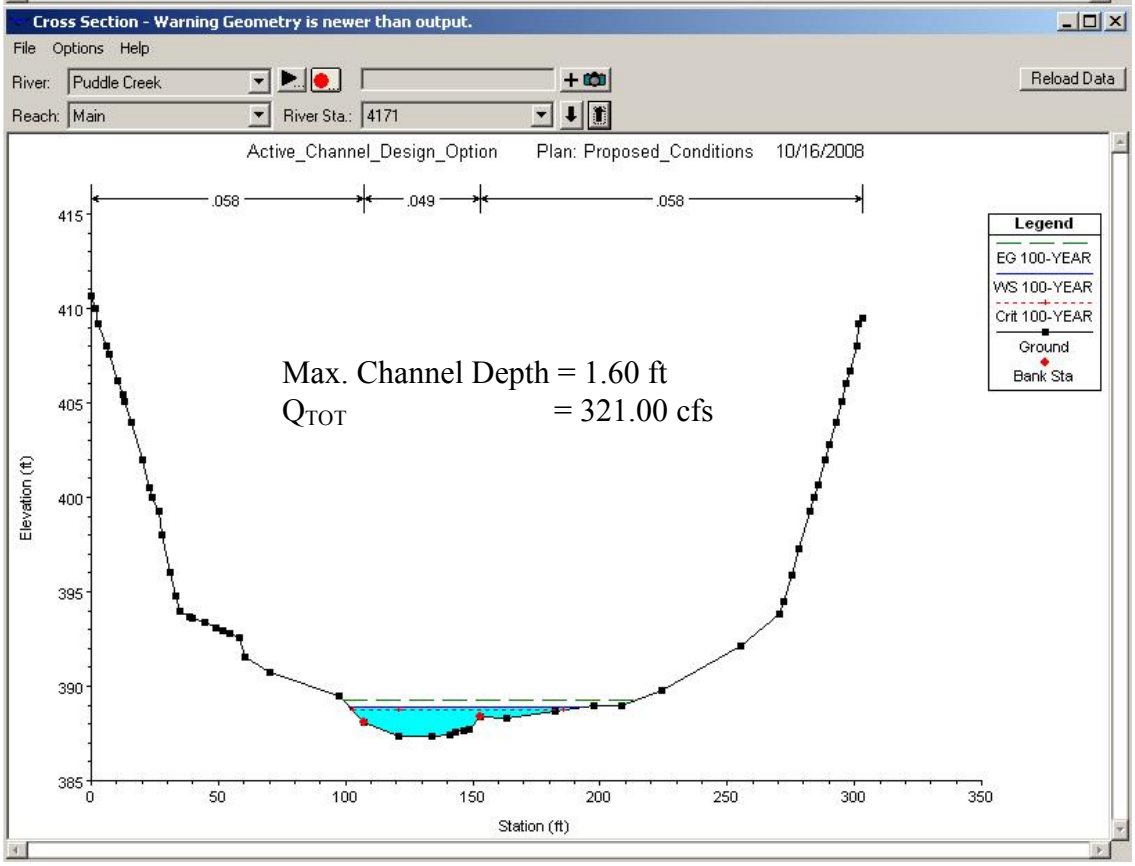

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 2771
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.22 ft
Q_{TOT} = 321.00 cfs
Elevation (ft)
Station (ft)

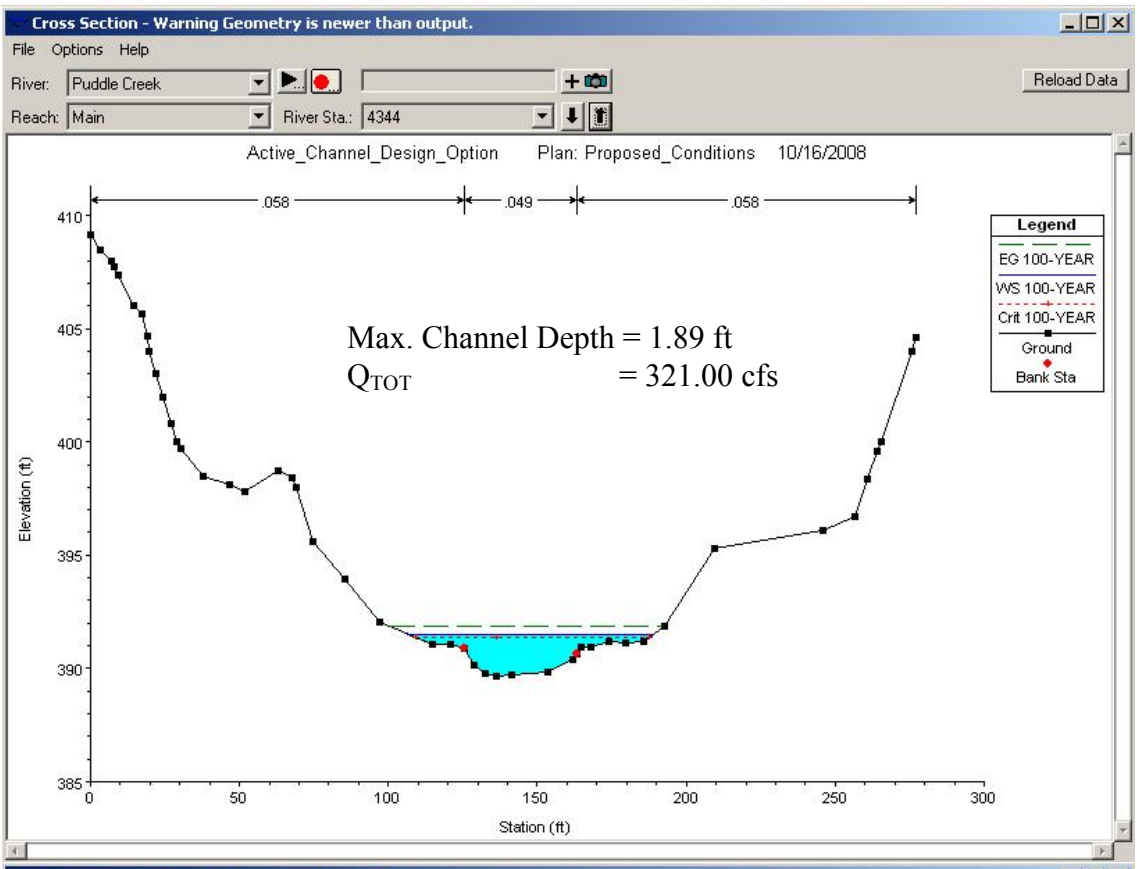

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 3068
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.46 ft
Q_{TOT} = 321.00 cfs
Elevation (ft)
Station (ft)

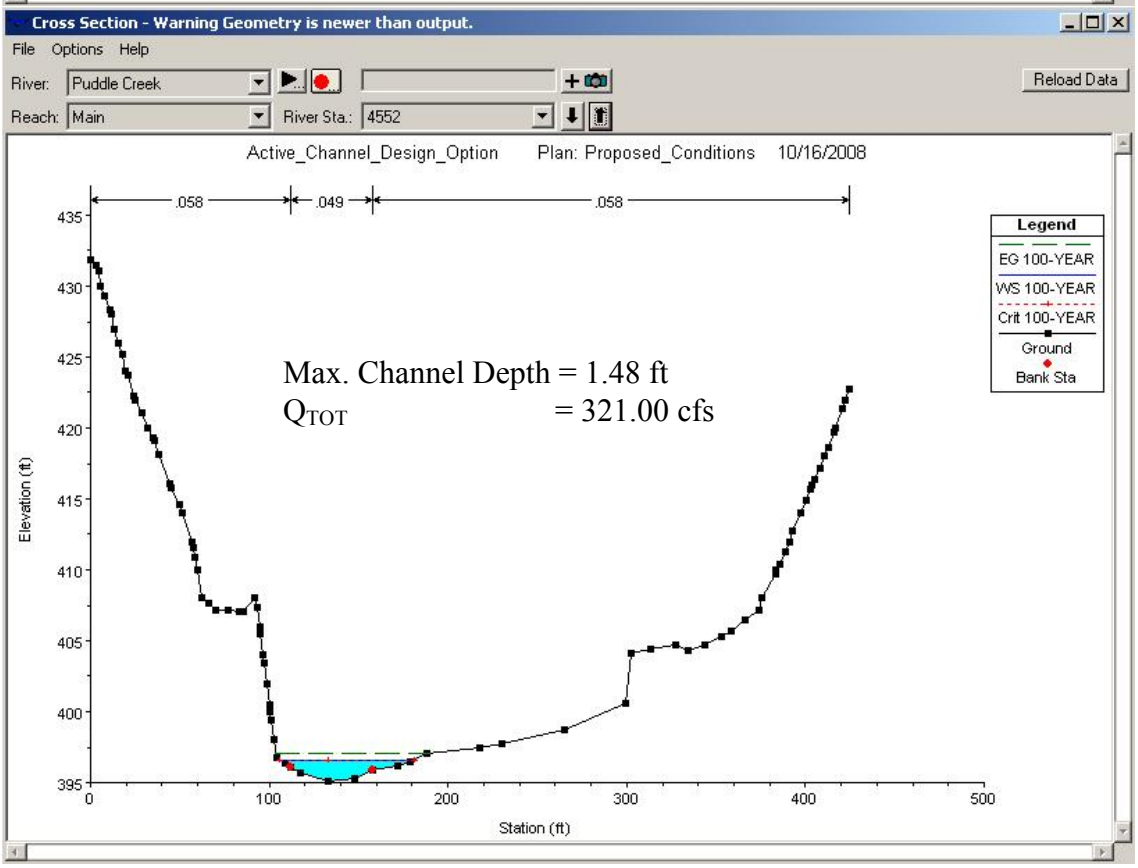

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 3396
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.48 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)


Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 3626
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.62 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)


Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 3906
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.74 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)


Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 4171
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.60 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)


Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 4344
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.89 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)


Cross Section - Warning Geometry is newer than output.
File Options Help
River: Puddle Creek
Reach: Main
River Sta.: 4552
Reload Data
Active_Channel_Design_Option Plan: Proposed_Conditions 10/16/2008
.058
.049
.058
Legend
EG 100-YEAR
WS 100-YEAR
Crit 100-YEAR
Ground
Bank Sta
Max. Channel Depth = 1.48 ft
QTOT = 321.00 cfs
Elevation (ft)
Station (ft)