AUTODESK UNIVERSITY 2013

Row, Row, Row Your Boat: Autodesk® AutoCAD® Civil 3D® River and Flood Extension Workflows

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CI2416-L Learn the ins and outs of the River and Flood Extension for Autodesk AutoCAD Civil 3D 2014 software. Prepare and model a floodplain, levee, and bridge system with Autodesk® Infrastructure Design Suite Ultimate. Join us in this hands-on lab to learn the River and Flood Extension for preparing design analysis of river systems.

Learning Objectives

At the end of this class, you will be able to:

- Use the River and Flood Analysis Extension for Infrastructure Design Suite Ultimate
- Identify floodplain and levee design
- Simulate storm events and visualize flooding conditions
- Model bridges for analysis

About the Speaker

Matthew is an Autodesk Consulting Business Consultant, Licensed Professional Engineer and Certified Floodplain Manager with over 19 years of consulting experience in the Infrastructure industry.

Prior to joining his current team, Matt was a QA Consultant working with Autodesk Infrastructure Modeling Division. Matthew was Vice President and Project Manager at Joseph A. Schudt & Associates in Frankfort, IL for a number of years prior to joining Autodesk.

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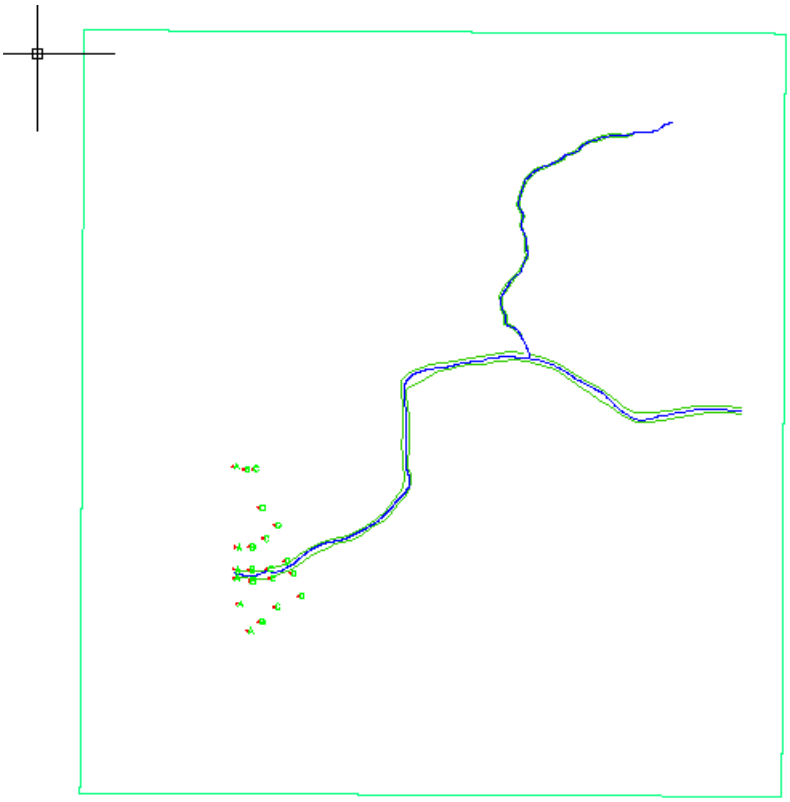
Row, Row, Row your Boat!

There is a lot of ground to cover in this fast paced Lab. In this lab, we attempt to cover as many of the possible workflows toward building and executing HEC-RAS models with the River & Floodplain Analysis Extension using the Infrastructure Design Suite Ultimate.

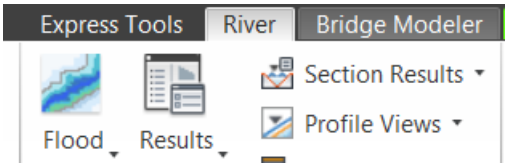
Course Outline

Exercise 1: Configure River Analysis for Cross-Sections

1. Launch AutoCAD Civil 3D.
2. Once AutoCAD Civil 3D launches, Open the **Baxter River AU 2013.dwg** from the Lab directory: *C:\DataSets\Thursday\CI2416-L Row Row Row your Boat AutoCAD Civil 3D River and Flood Extension Workflows*



3. Select the **River** ribbon tab.



4. In the **River** tab ➤ **Input** panel ➤ **Section Geometry** drop-down, select Configure Section Views

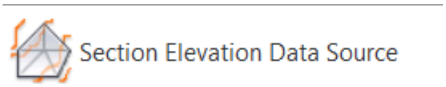
5. In the Configure Section Views dialog, modify the settings to make well-formed cross sections for this lesson as follows:

Station Scale	200
Station Tick Interval	100
Station Round off	100
Elevation Scale	20
Elevation Tick Interval	5
Elevation Round off	5

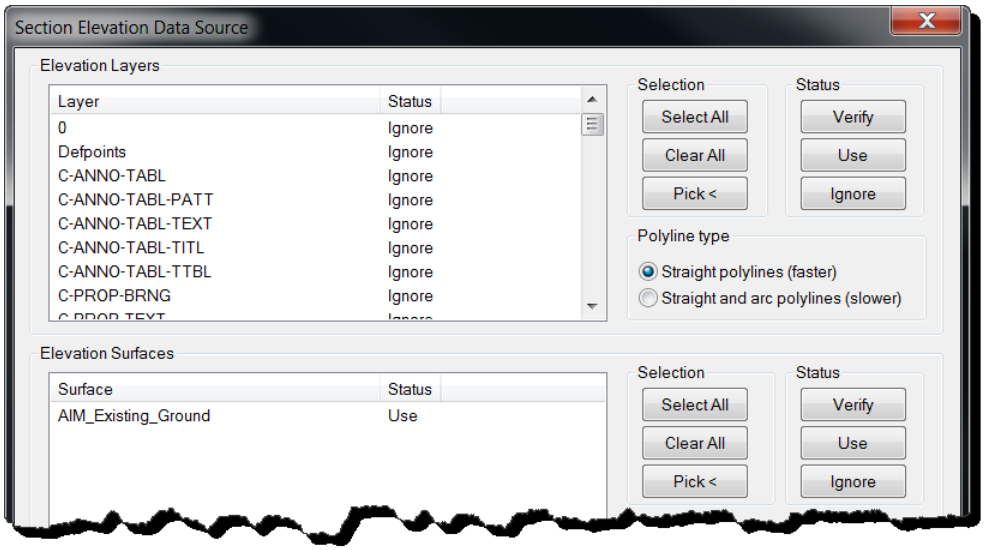
6. For proper cross-section layout pattern, enter the following settings:

Layout Point X	6406900.000
Layout Point Y	2071000.000
Grid Spacing X	50
Grid Spacing Y	50
Columns	20

7. Click the General Tab, and select modify the Map text Height to **100** units.
8. Click OK. Dismiss the No cross section grid alert.
9. In the **River** tab ➤ **Input** panel ➤ **Create Section** drop-down ➤ select



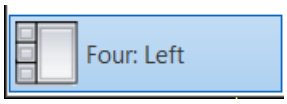
10. In the dialog box, use the Select all button adjacent to the Elevation Layers. Set the Status to Ignore.



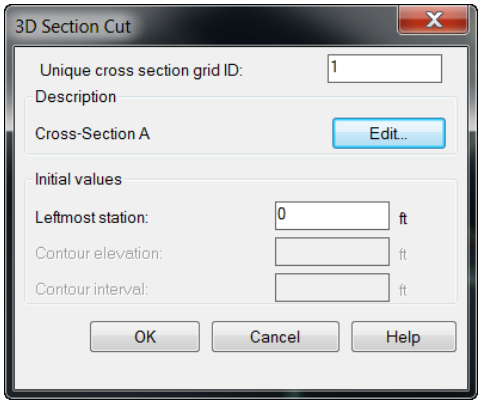
11. Select the **AIM_Existing_Ground** Surface and set the Status to Use.
12. Click OK to complete

Exercise 2 – Cutting Cross Sections

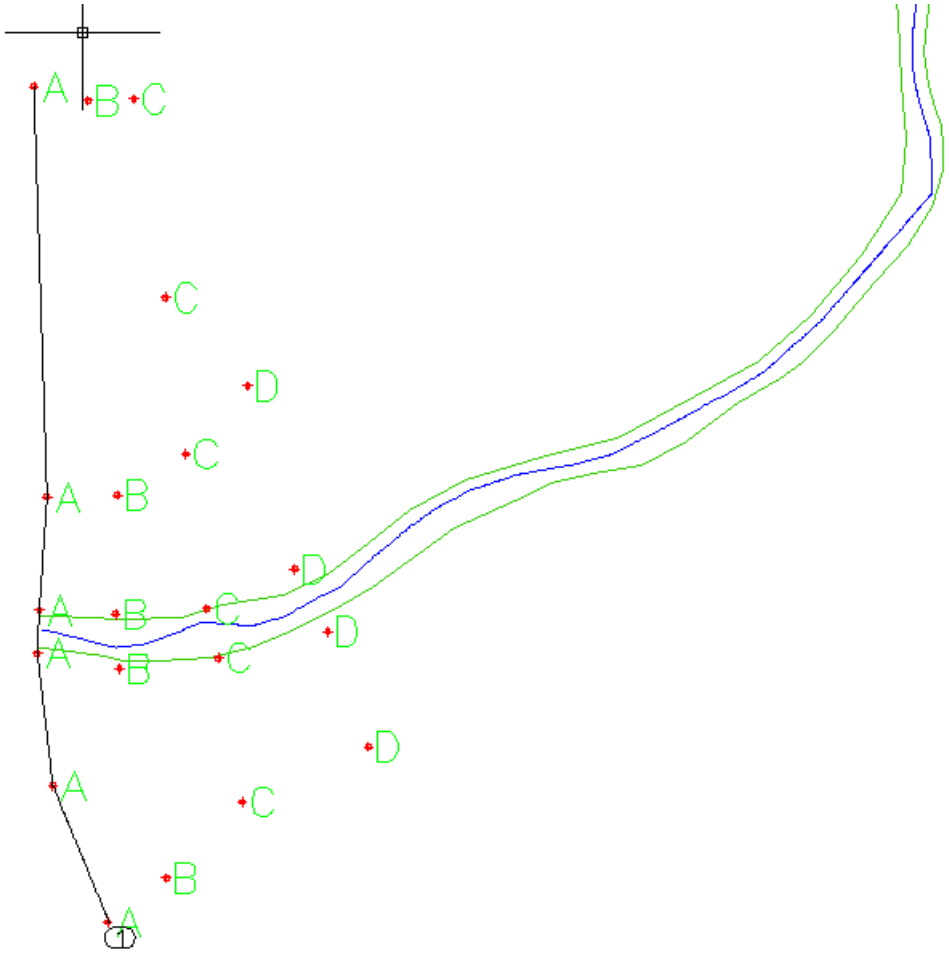
1. From the View tab, select Viewport Configuration drop-down and select **Four: Left** to place three small viewports to the left of the main view.



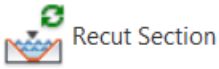
2. In the **River** tab ➤ **Input** panel ➤ **Create Section** drop-down ➤ select  **3D Section Cut**.
3. In the 3D Section Cut dialog box, Click the **Edit** button and provide the description – "**Cross Section A**". Click **Ok**.

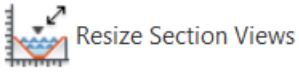


4. Edit the Leftmost Station Initial value to **100**. Click OK.
5. Draw a hydraulically correct Cross Section A between the points shown in the drawing. Cross Sections in plan should be drawn perpendicular to river flow. Four sets of suggested points existing in the drawing.

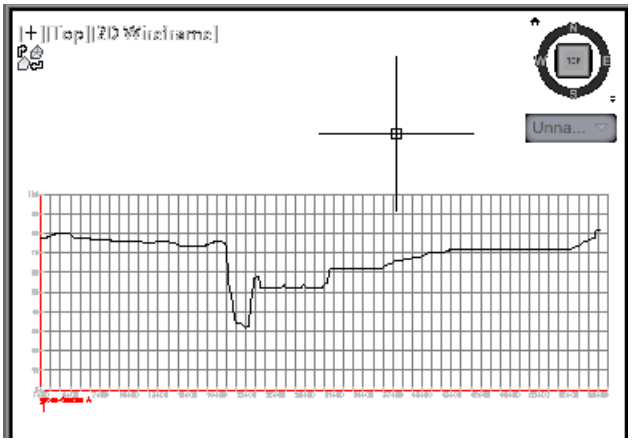


6. When finished picking points for the cross-section in plan, Press **Enter** to complete the plan view digitization. When prompted to *Select new viewport for grid, then press Enter*, pick inside the upper left viewport to place the section view and press **Enter.**

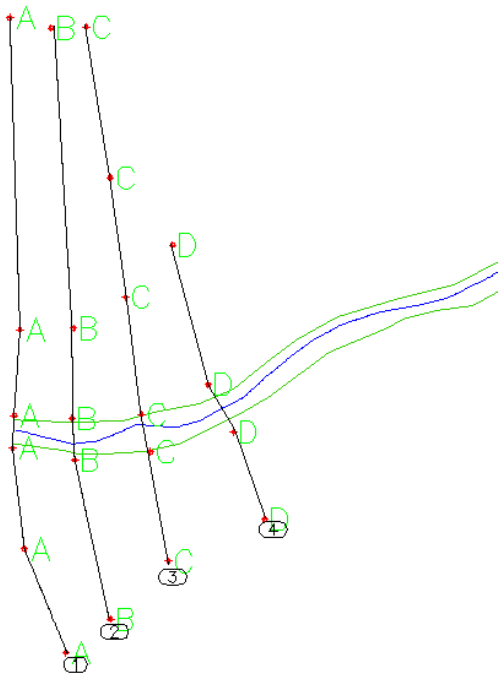
7. If your Section appears as flat line, use the Create Section ➤ 

command and the Section Geometry ➤ 

to re-draw the grid lines.



8. Repeat the 3D Cross-Section Cut command for each; Cross-Section B, C & D..
9. Place each cross-section view into the viewports.

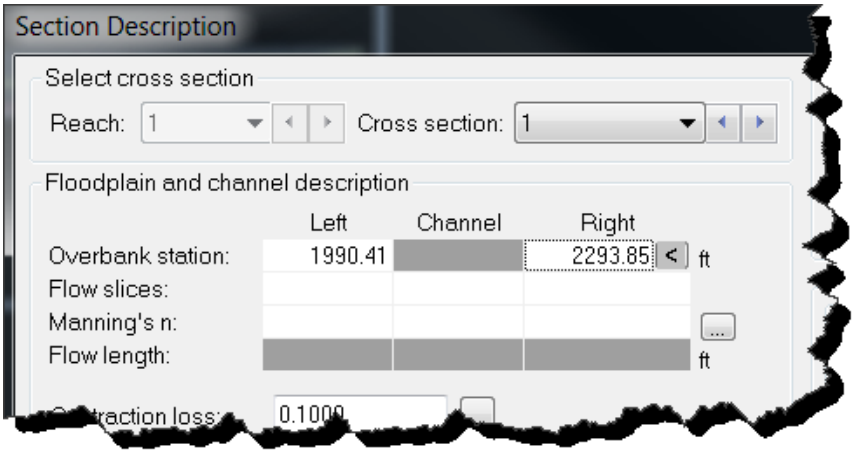


10. Be sure to use the Create Section ➤ Recut Section command to re-sample the data.

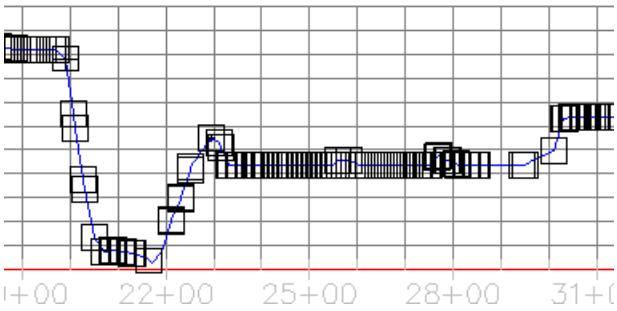
Exercise 3 – Cross Section 1 Data

Establish the starting cross-section data on the downstream most section. Manning's n values carry upstream until changed in the model.

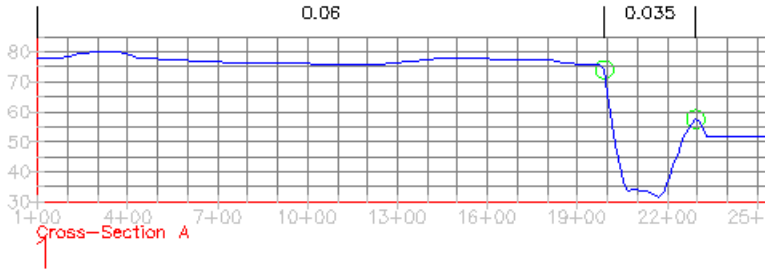
1. On the Input panel, Change the Cross-Section ID to 1 using the drop-down menu.
2. Select the Section Description command.
3. In the Section Description dialog box, click inside the Left Overbank Station and select the < arrow to graphically pick the location in the drawing.



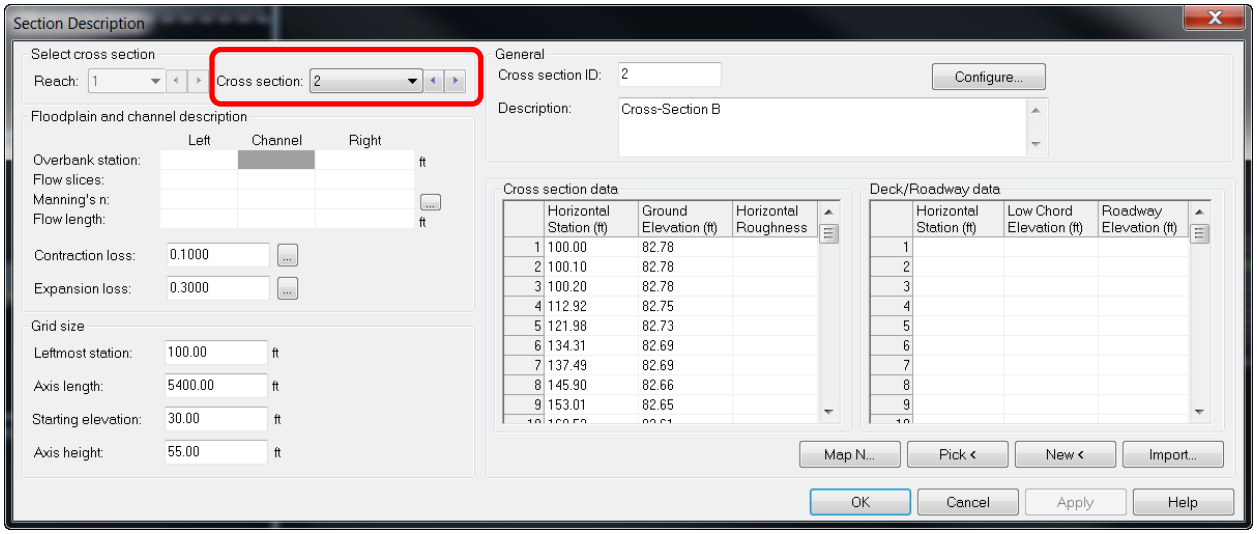
4. Pick either the plan or the section view location of the left channel overbank station.



5. Repeat the graphical selection process for the right overbank station.
6. Specify 0.06 for the left and right floodplain Manning's n roughness coefficients and 0.035 for the channel Manning's n coefficient.
7. Click Apply.
8. The Manning's n values annotation appears above the cross-section. Remain in the Section Description Dialog box.



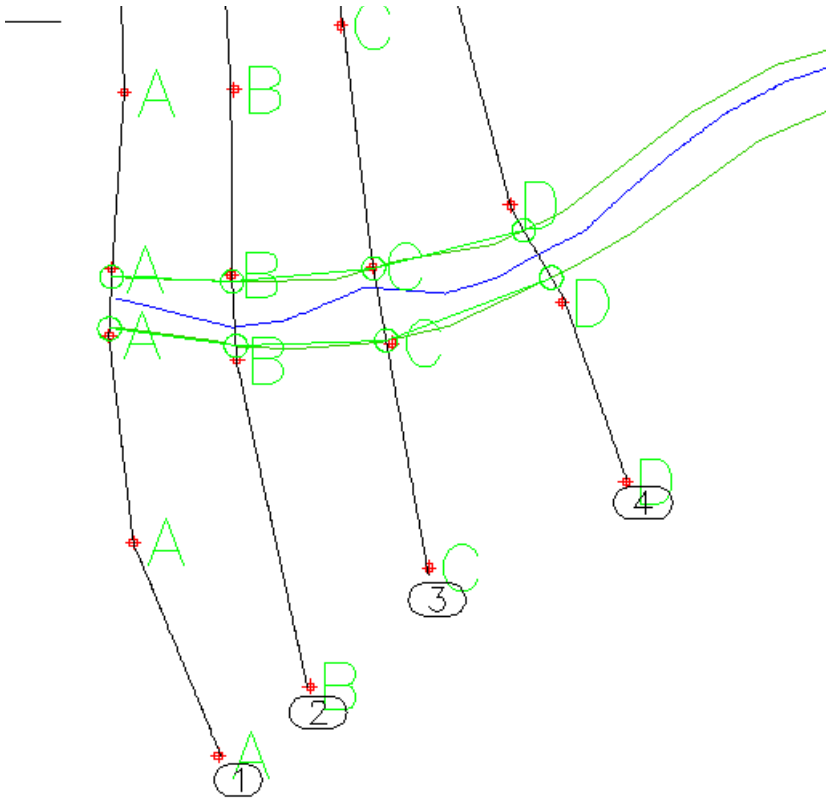
9. Remain in the Section Description dialog box, and Change the Cross-Section ID to 2.



10. Establish the Left and Right Overbank stations by selecting the < arrow and pick the locations graphically.

11. Leave the Manning's n value blank since the values for downstream Cross-Section 1 will propagate upstream when computing a subcritical hydraulic profile.

12. In the Flow Length row, click the < arrow to establish the Left, Right and Channels Flow Lengths from Cross-Section B down to Cross-Section A in plan. Digitize each flow length so that the generally accepted hydraulic principles apply.



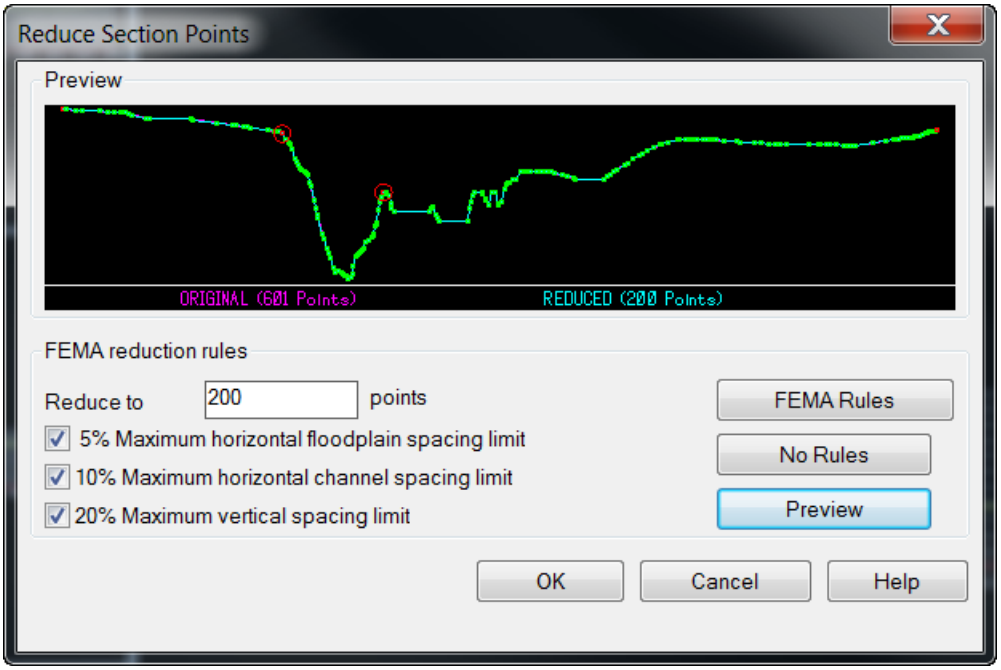
13. Click Apply to commit the changes.
14. Repeat the process for each of the the following cross-sections and specify both the Overbank and Flow Lengths for Cross-Sections B, C and D.

Cross-Section	Left	Channel	Right
B	552.61	555.81	521.18
C	652.08	645.01	617.72
D	768.20	736.34	672.93

15. The Left, Right and Channel length lines draw between cross-sections.
16. Click **Apply** and **OK** to commit the each cross-section changes.
17. In the main viewport, Use the 

command from the Navigate panel
18. **Save** the drawing.

19. Due to the detail of the terrain, the number of sampled points exceeds the allowable values for HEC-RAS. For each cross-section, reduce the number of points per cross-section, by using the **Input** Panel ➤ **Section Geometry** pull-down ➤ **Reduce Section Points**. Modify the number of points from 90 to 200 points.

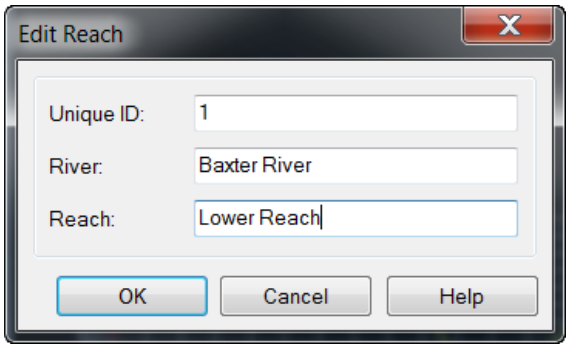


This reduces the number of elevation point to those allowed and simplifies the calculations.

HEC-RAS allows for a maximum number of cross-section points to 500 points.

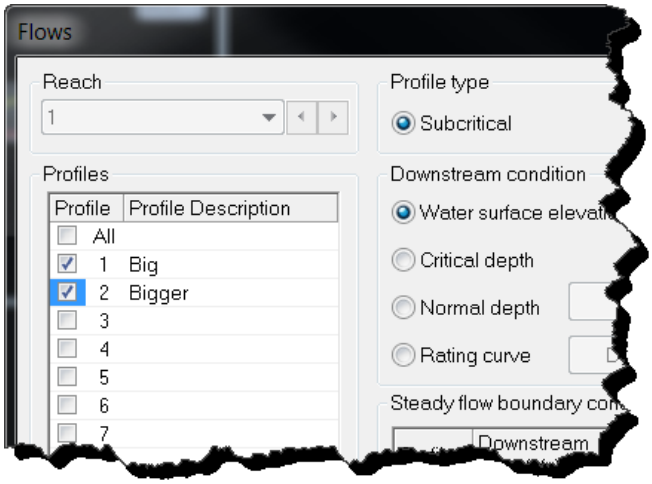
Exercise 4 –Define the Project Flows & Compute Analysis

1. On the Create Reach Data panel, select the Reaches drop-down and select Edit Reach.
2. In the Edit Reach dialog box, edit the River and Reach names.

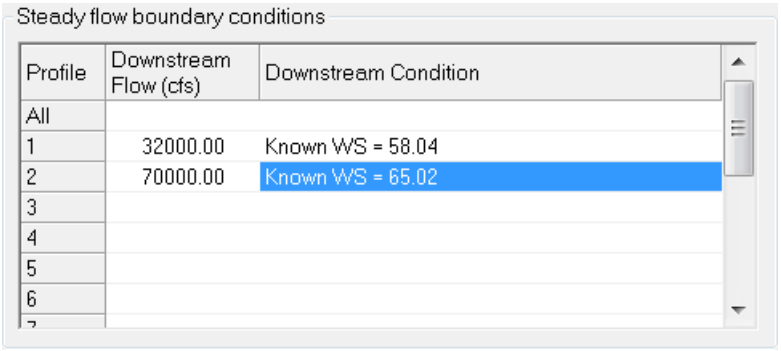


3. Click Ok.

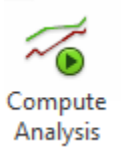
4. Click the Flows command on the Create Reach Data panel to establish the Flow and downstream boundary conditions.
5. Enter and Select the **BIG** and **BIGGER** profile descriptions.



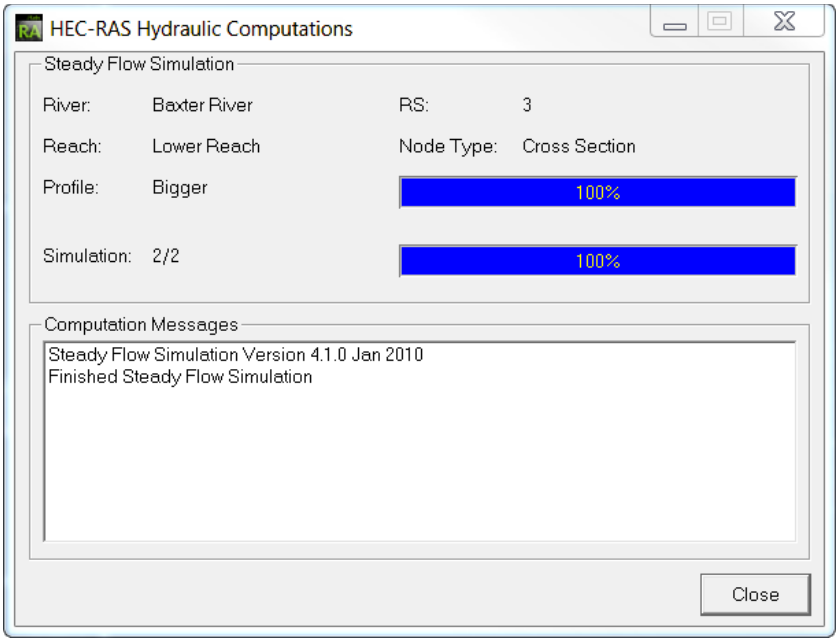
6. In the Steady flow boundary conditions of the dialog box, enter a flow of 32,000 cfs for the first profile and select the Downstream Condition to be Water Surface Elevation. Enter a Water Surface Elevation of 58.04.
7. For the 2nd profile, enter a flow value of 70,000 cfs. Select the Downstream Condition to also be Normal Depth with the same calculated slope value. Enter a Water Surface Elevation of 65.02.



8. Click Apply and OK to commit the changes.
9. Save the Drawing file.
10. On the Analysis panel, select the Compute Analysis button.



11. River and Flood Analysis will save a HEC-RAS data file , execute the HEC-RAS hydraulic calculations and display the Steady Flow Simulation dialog box.

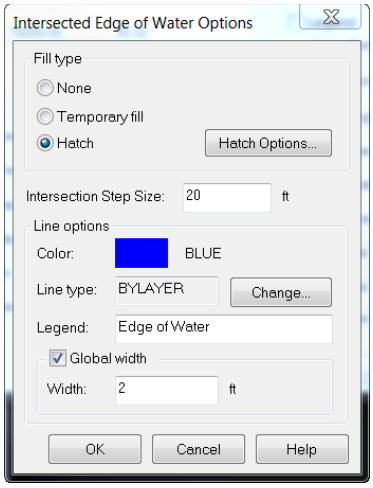


12. Click Close when the calculations complete.

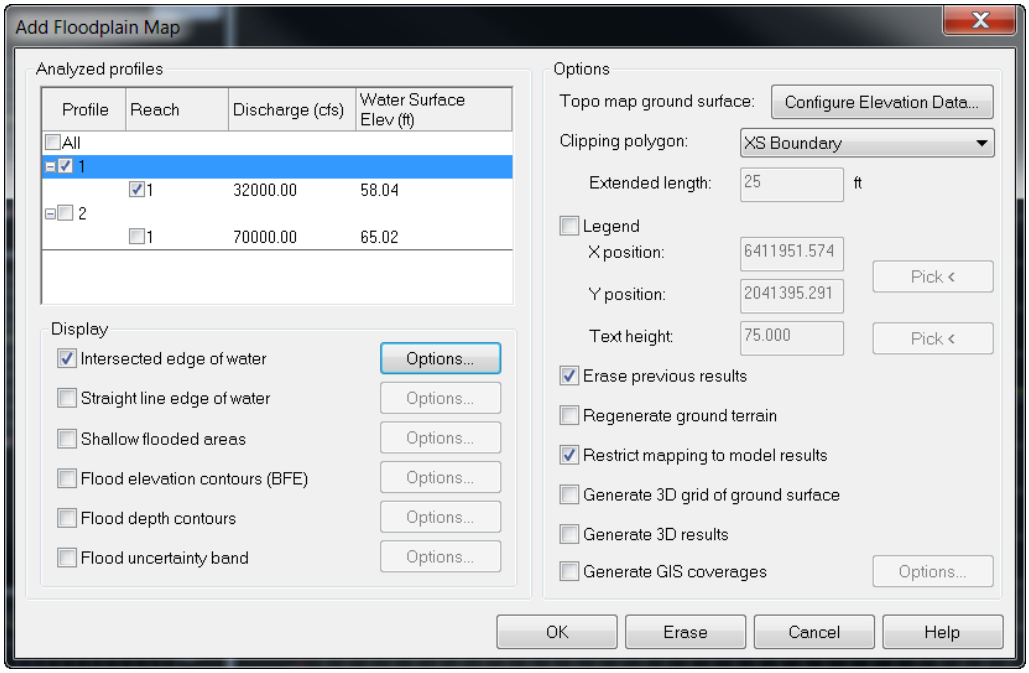
Exercise 5 –Map the Floodplain

1. With the hydraulic calculations complete, the Flood Map intersection of the water surface and the existing surface can be displayed.
2. On the Output panel, click the Flood Map drop-down, the select the  Add Floodplain Map command
3. Highlight the first Analyzed profile, edit the Display of the Intersected Edge of water as follows:

Fill Type	Hatch
Hatch Options	
ANSI31 Scale	100
ANSI31 Angle	45
Intersection Step Size	20
Color	BLUE
Global Width	Check
Width	5



4. Click **OK**.
5. For Profile 1, unselect the Flood elevation contours (BFE) and Generate GIS coverages.

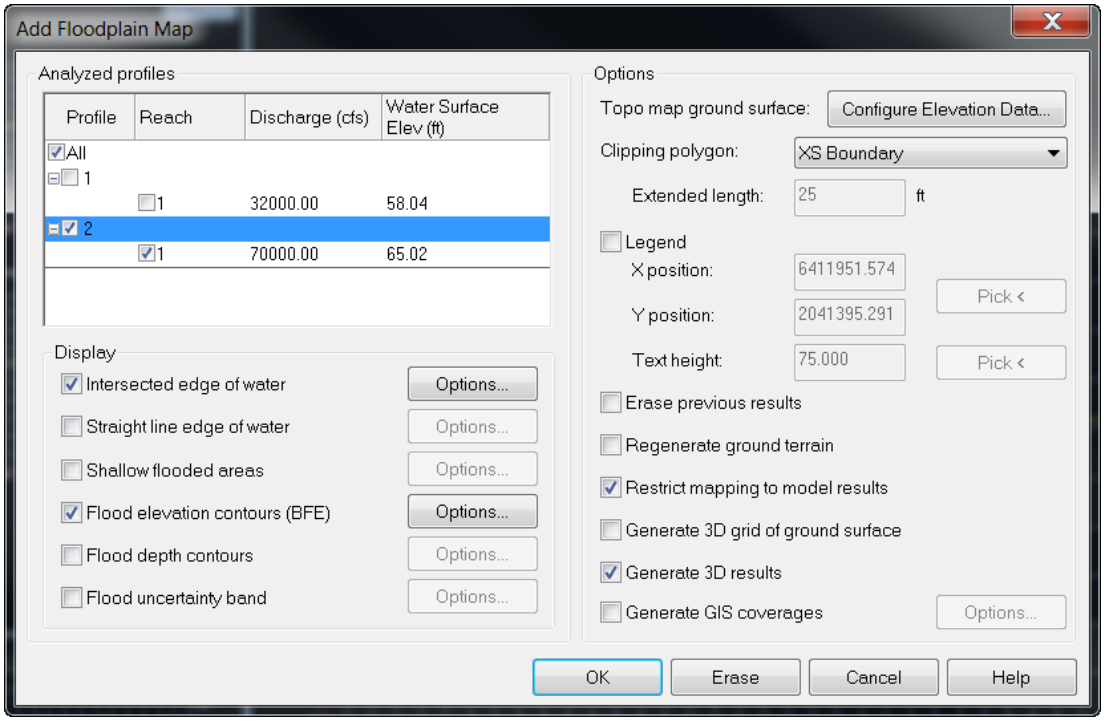


6. Click **OK** to draw the **Big** Profile Flood Profile Map.
7. Repeat the  Add Floodplain Map command.
8. Unselect the 1st Profile and Select the 2nd Profile.
9. Edit the Intersected edge of water for the second prolife as follows:

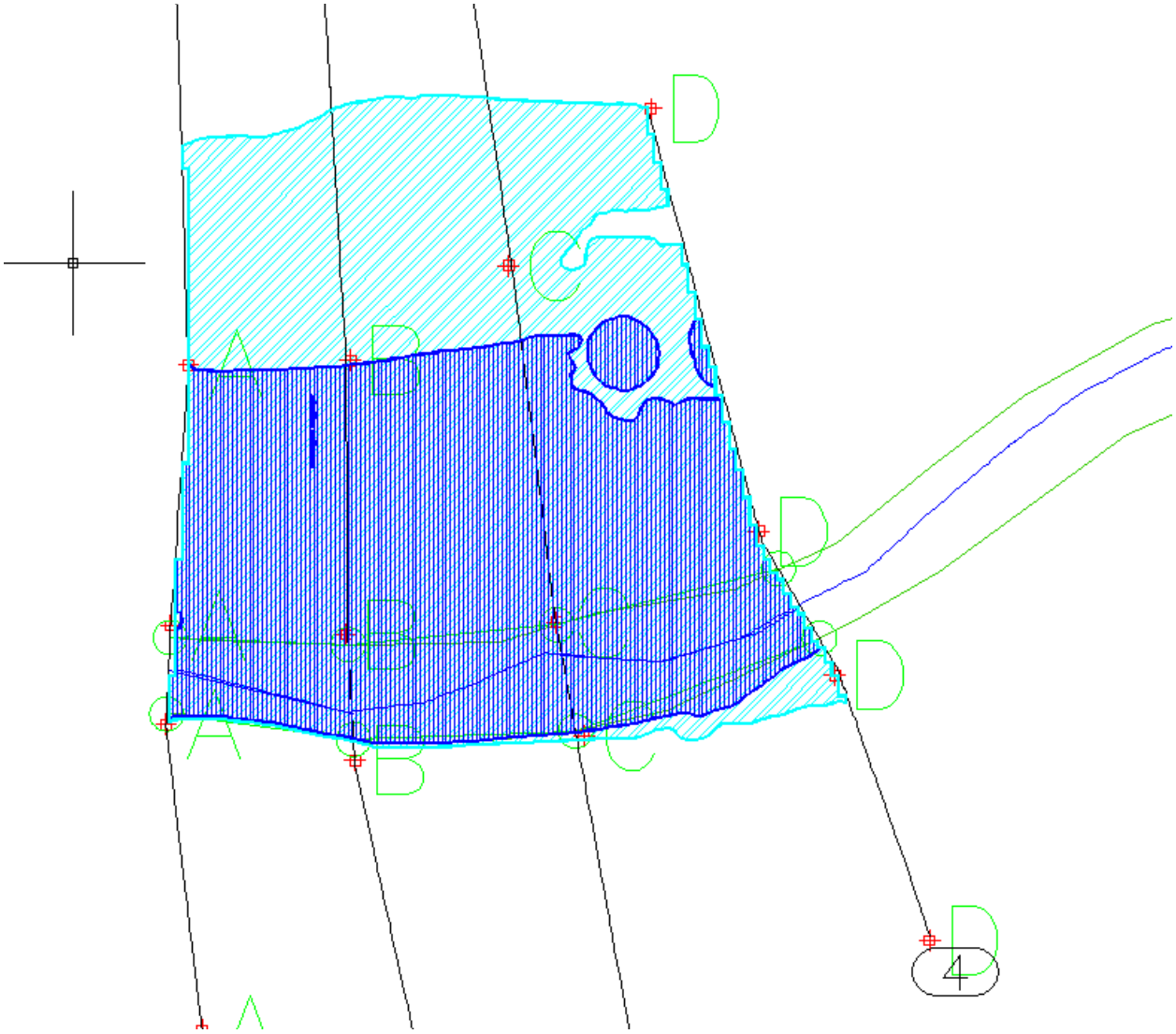
Fill Type	Hatch
Hatch Options	
Pattern	ANSI32

ANSI32 Scale	100
ANSI32 Angle	0
Intersection Step Size	5
Color	Cyan
Global Width	Check
Width	5

10. For Profile 2, Un-check the ***Erase previous results*** Options.



11. Click OK.

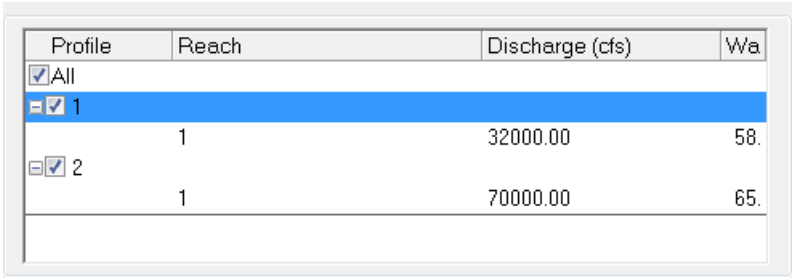


12. Selec the cyan hatch and move to the back. Save the drawing.

Exercise 6 –Results Output Report

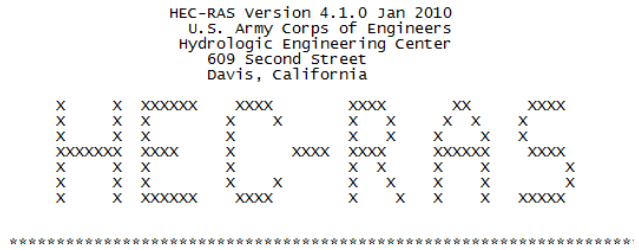
1. On the Output panel, select 

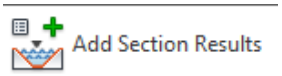
2. In the Analysis Output report dialog box, specify the report file name, and select all of the Profiles to report.



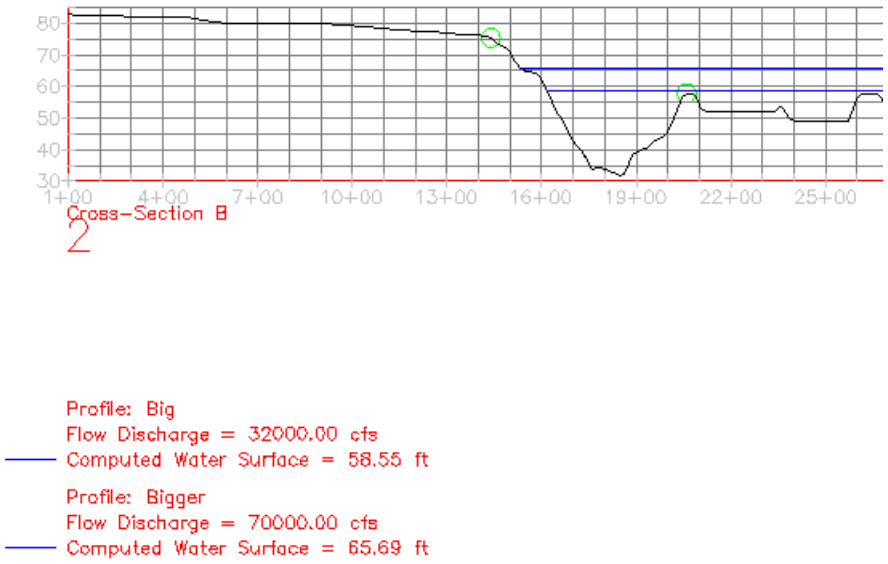
Profile	Reach	Discharge (cfs)	Wa
All			
1			
	1	32000.00	58.
2			
	1	70000.00	65.

3. Click OK
4. Notepad opens and the HEC-RAS report displays, ready for printing.



5. Close Notepad.
6. From the Output panel, select 

to draw the floodplain mapping results on the cross-sections.
7. In the Add Section Results dialog box, edit each profile's Display options accordingly so that each profile displays accordingly the necessary information.

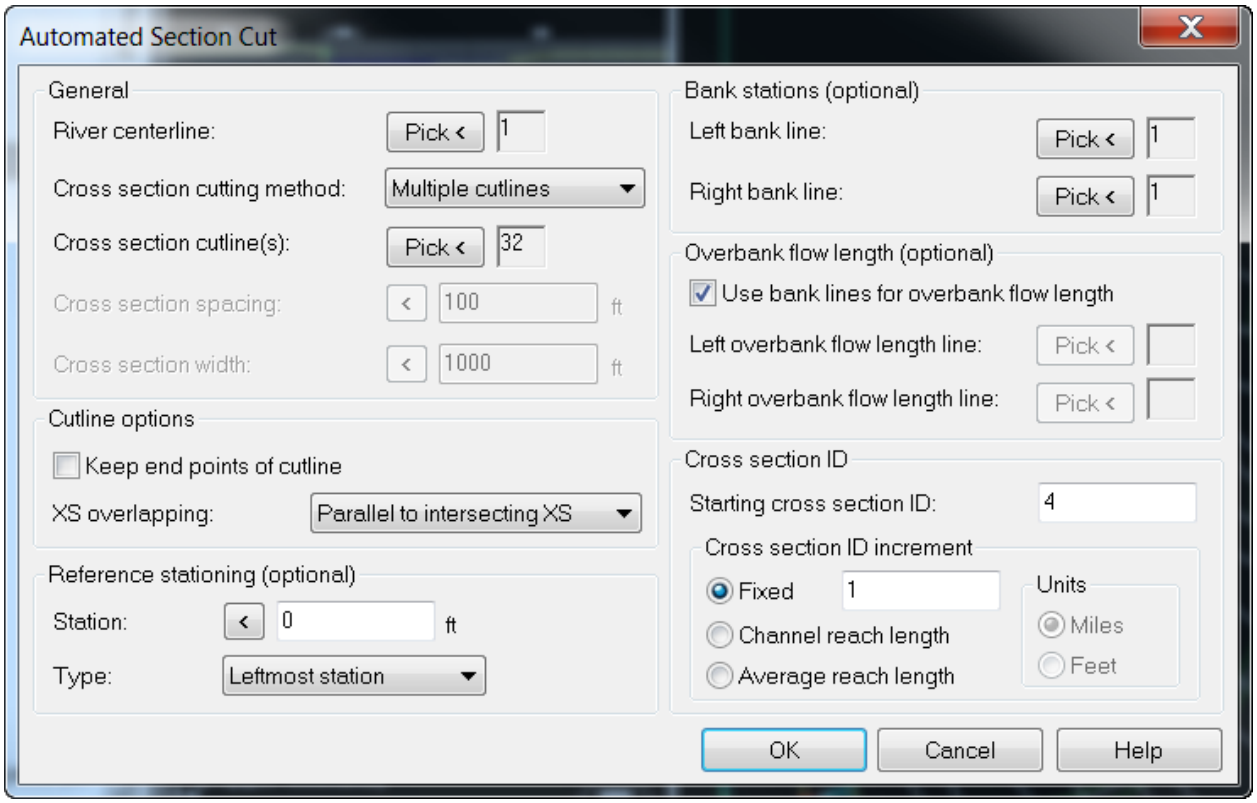


8. Press OK to draw the Computed water surface and Flow Discharge Legend into each section view.
9. Save & Close

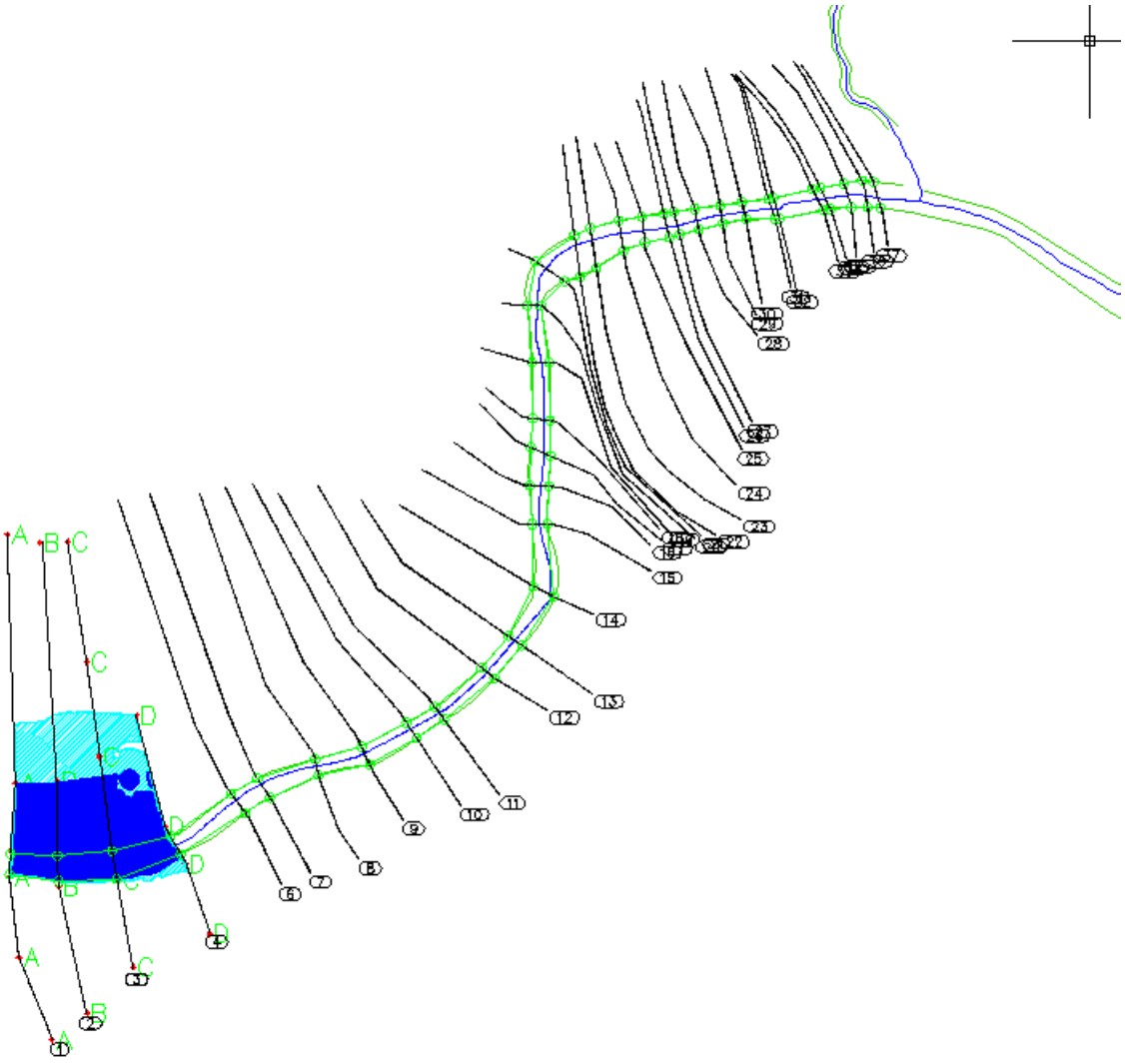
Exercise 7 - Automated Cross-Sections

River & Flood Analysis contains the ability to automate the cross-section generation. This exercise examines the steps necessary to complete this effort.

1. Turn on the _AU_XS_CUTLINES layer. This layer contains pre-drawn hydraulicly correct cross-section locations.
2. From the Input panel, select Create Section > Automated Section Cut.



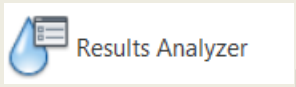
3. On the dialog box shown above, Pick the River Centerline.
4. Change the Cross-Section cutting method from **Perpendicular** to **Multple Cutlines**. Use the **Pick** button to select the 32 pre-drawn cutlines on the *_AU_XS_CUTLINES* layer**.** Pick the Left Bank (Southern most line) and Right Bank (Northern most green line) that will be used to establish the channel banks. Check the Use bank lines for overbank flow length.
5. Click **OK**.
6. Re-run the Create Section > Recut Section for all Cross-Sections.



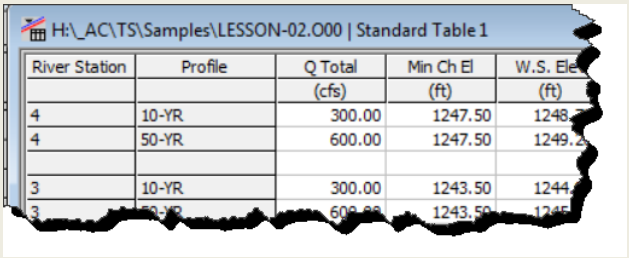
Tips:

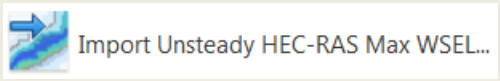
Use the 

command to make a backup HEC-RAS model as a method of data sharing these cross-sections and the modeling parameters.

The River 

provides access to familiar Cross-Section tables, Profile Tables reports and Profile Plots.



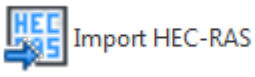
Unsteady flow modeling results import using the 

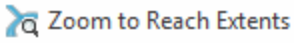
command. Be sure that the River, Reach and Cross-Sections match in River and Flood Analysis and the unsteady HEC-RAS model.

HEC-RAS Import & Bridges

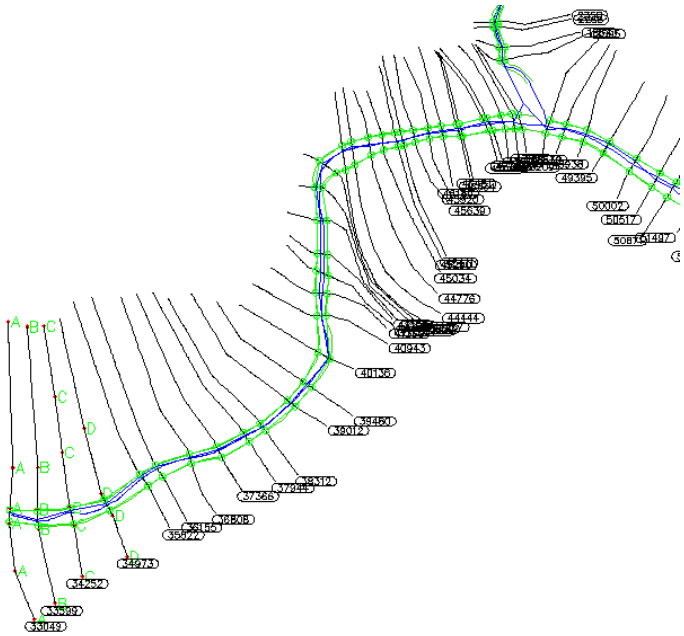
In this exercise, the lesson walks you step-by-step on how to import an existing HEC-RAS project, review a bridge, and re-compute the analysis.

Exercise 8 – Import the HEC-RAS Project

1. Open a **Baxter River – Part 2.dwg** drawing.
2. On the Create Reach Data panel ➤ Import and select the 

command.
3. In the Import HEC-RAS Project dialog box, toggle the Use real world coordinates option.
4. Press OK.
5. Browse to the Lab's HECRAS sub-directory and select the Baxter River AU 2013.prj Project file.
6. Press OK. Give it a minute of two to import all three reaches.
7. The command line will echo the cross-sections imported and resize them appropriately.
8. Use the 

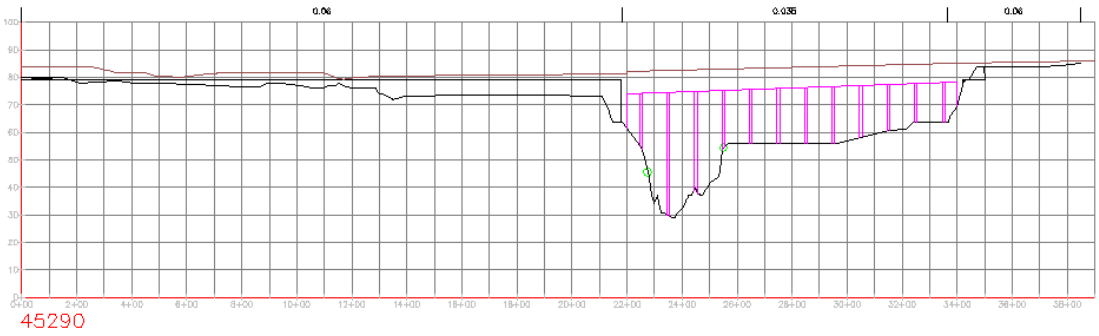
command from the Navigate panel to view the entire imported model.

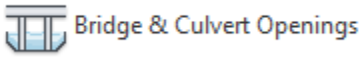


9. Save the drawing as Baxter Model.dwg

Exercise 9 – Review Sections

1. Use the Cross-Section drop-down on the Input Panel to review each cross-section.
2. Pause at Cross-section 45290 – Downstream end of Railroad Bridge.



3. Select Bridges & Culverts drop down, and the 

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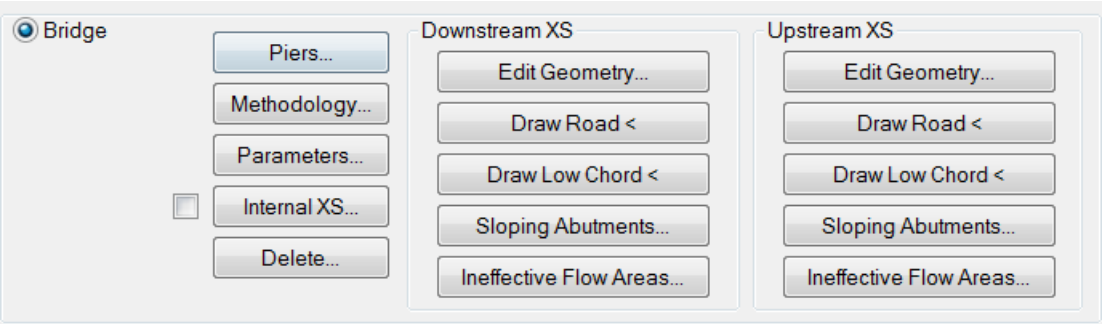
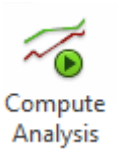
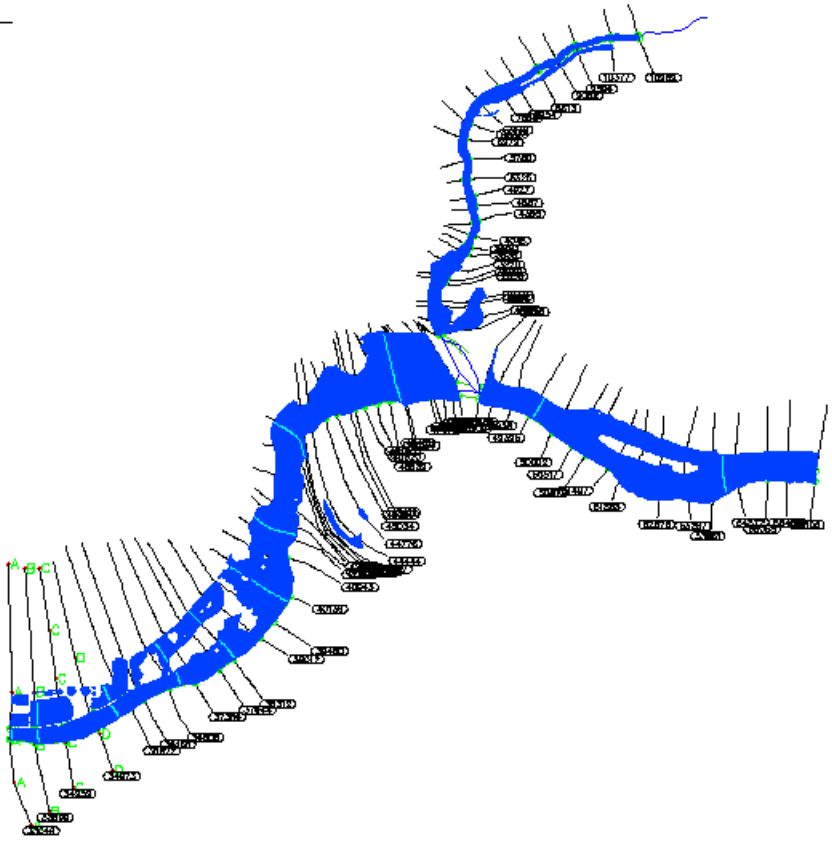
Bridge & Culverts definition or edits occur from the downstream cross-section. The bridge or culvert length together with the Distance to upstream XS must be less than the distance between the downstream cross-section and the upstream cross-section.



4. Click the Piers… button to open the Review the Peir Definition editor. Review Methodology, Paramters, and Ineffective Flow Areas to review the abailable options.
5. Click OK to dismiss.



6. Compute the Analysis.
7. Click Flood Map and map the first profile for all three reaches.



Any questions?