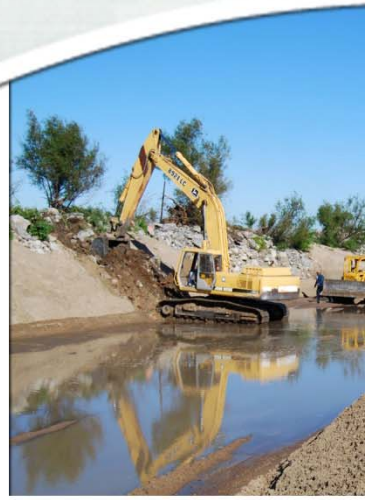
Unsteady State Model
White River Comp Study

Presenter: (Louie) L. Yu Lin

Title: Hydraulics Engineer

Memphis District

Date: August 23, 2010



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Objectives

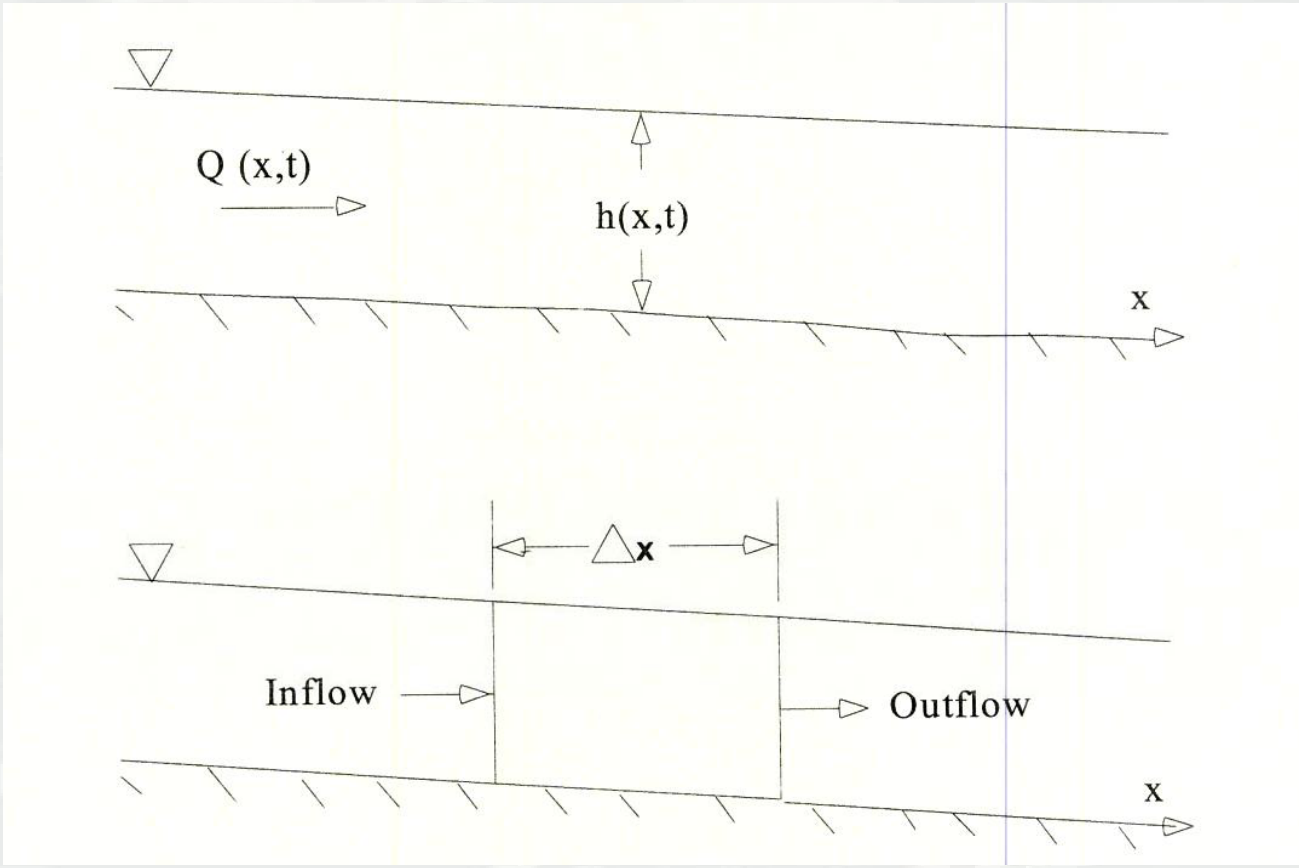
- Develop Unsteady State Model Using Hec-RAS Model
- Support the White River Comprehensive Study

Procedures

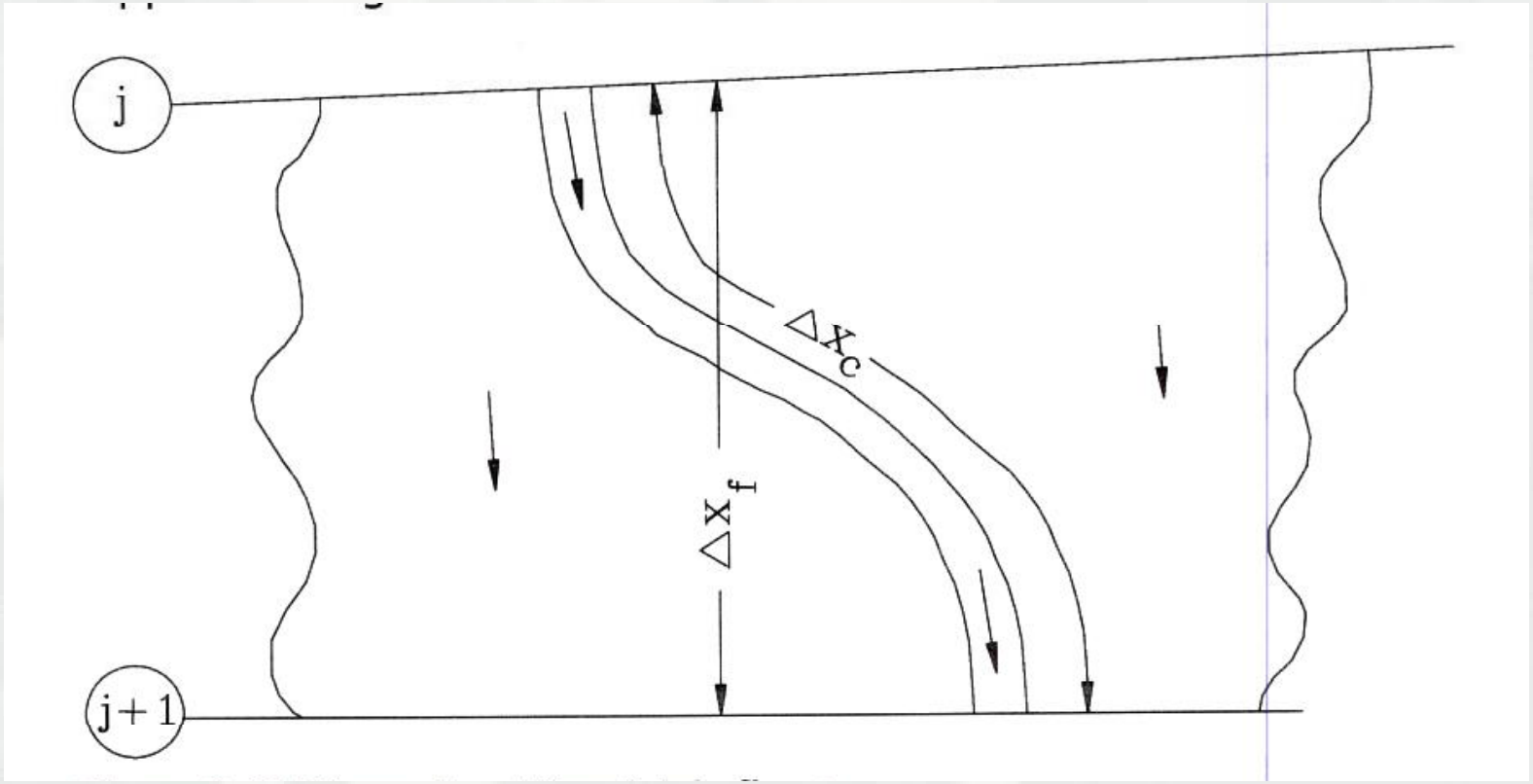
- Develop GIS Based Information
- Conduct Field Study
- Perform Hyro-Survey
- Collect Gage Stage/Flow Data
- Develop Cross Sections
- Build Hec-RAS Model
- Calibrate Model

Unsteady State Model
Hec-RAS

- Conservation of Mass
- Conservation of Momentum
- Conservation of Energy



$$\rho \frac{\partial A_T}{\partial t} \Delta x = \rho \left[\left(Q - \frac{\partial Q}{\partial x} \frac{\Delta x}{2} \right) - \left(Q + \frac{\partial Q}{\partial x} \frac{\Delta x}{2} \right) + Q_l \right]$$

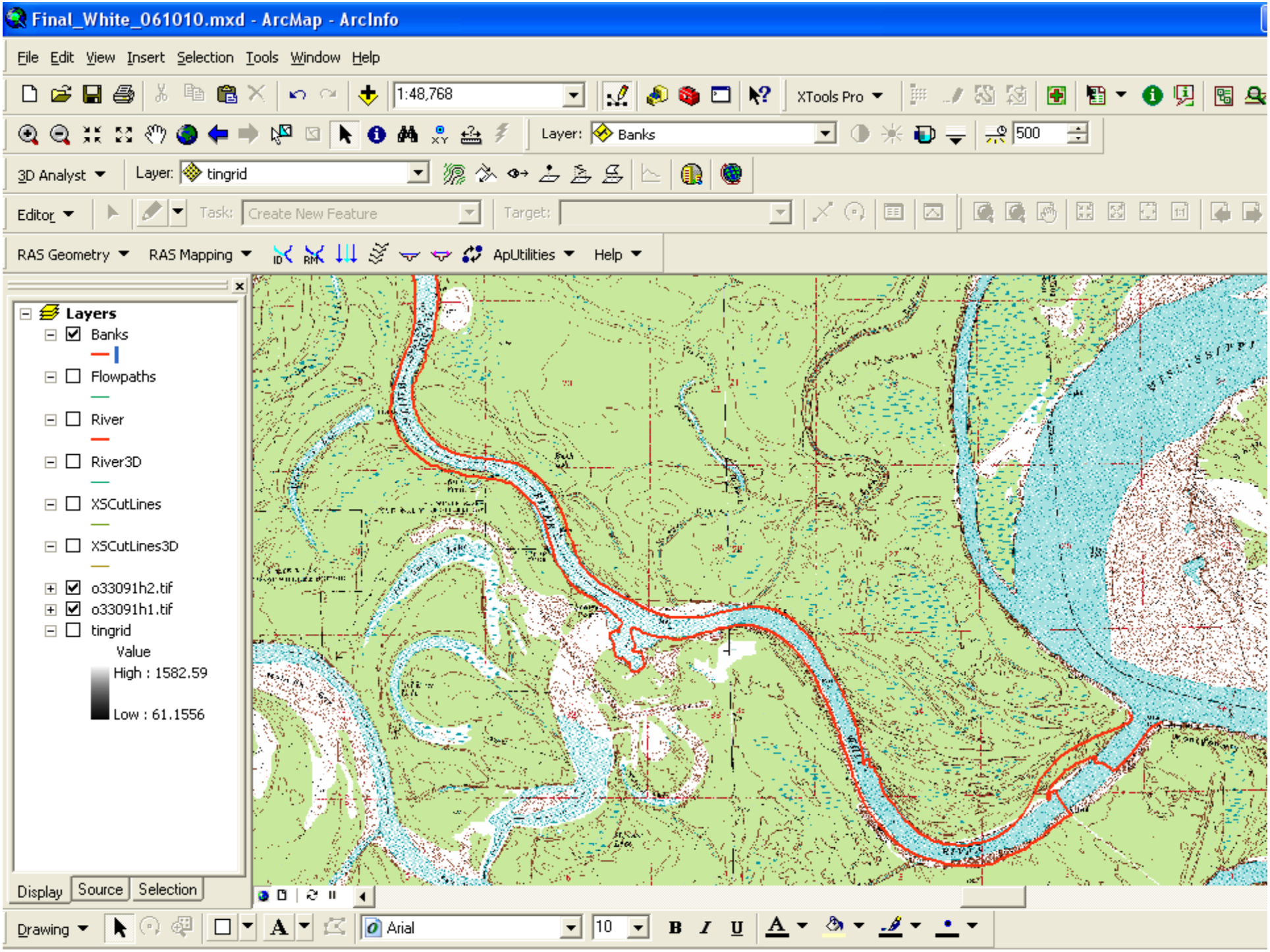


$$\frac{\partial A}{\partial t}+\frac{\partial(\Phi Q)}{\partial x_c}+\frac{\partial[(1-\Phi)Q]}{\partial x_f}=0$$

$$\frac{\partial Q}{\partial t}+\frac{\partial\left(\Phi^2 Q^2/A_c\right)}{\partial x_c}+\frac{\partial\left((1-\Phi)^2 Q^2/A_f\right)}{\partial x_f}+gA_c\left[\frac{\partial Z}{\partial x_c}+S_{fc}\right]+gA_f\left[\frac{\partial z}{\partial x_f}+S_{ff}\right]=0$$

GIS Information

- 2006 Aerial Photos
- U.S.G.S Quad Maps
- White River Center Line
- White River Overbank
- White River Flowlines (1 – 2 year flowlines)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File Edit View Insert Selection Tools Window Help
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XTools Pro
Layer: Banks
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3D Analyst
Layer: tingrid
Editor
Task: Create New Feature
Target:
RAS Geometry
RAS Mapping
ApUtilities
Help
Layers
Banks
Flowpaths
River
River3D
XSCutLines
XSCutLines3D
o33091h2.tif
o33091h1.tif
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Value
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Low : 61.1556
Display
Source
Selection
Drawing
Arial
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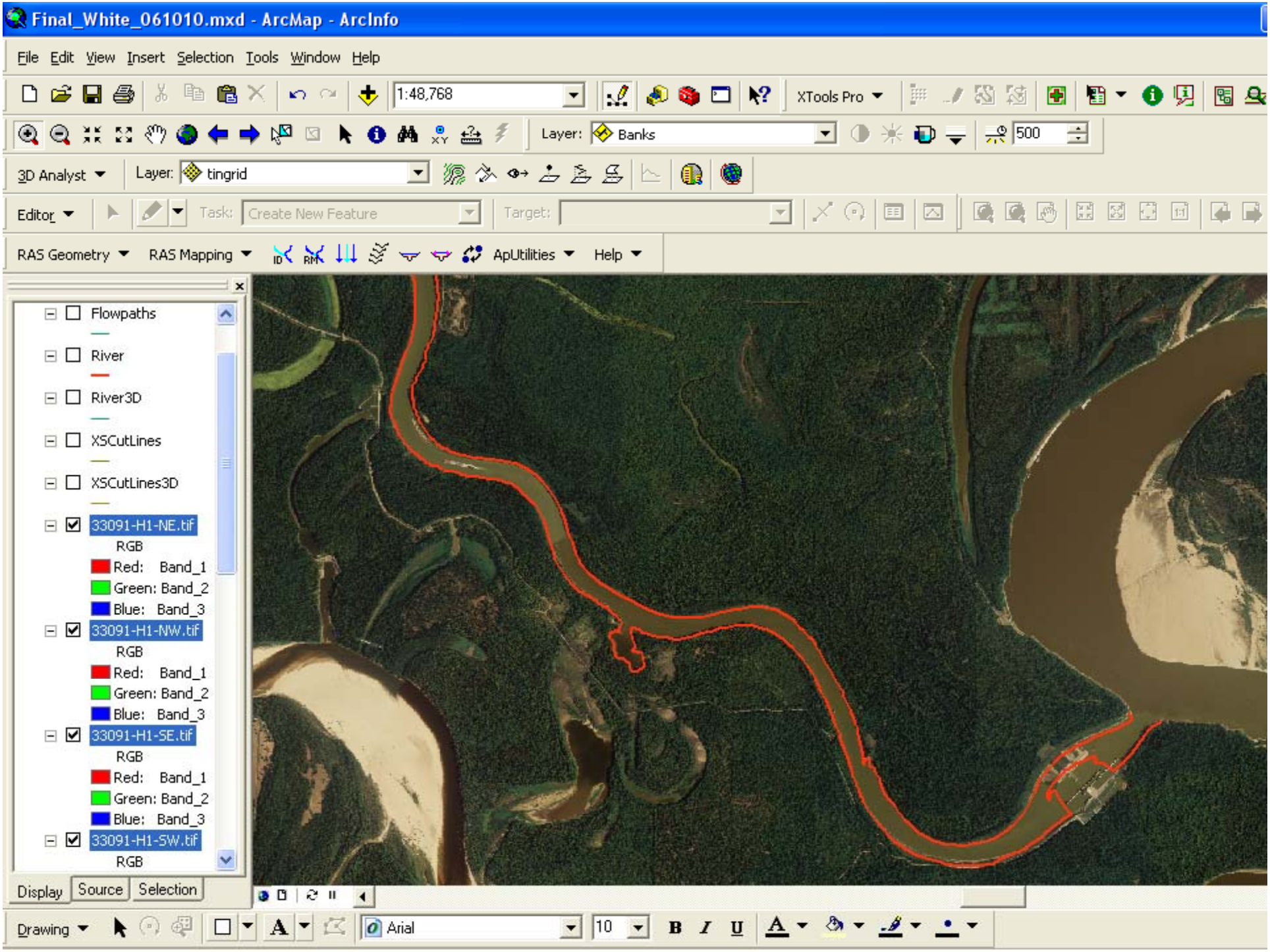
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33091-H1-NW.tif
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Red: Band_1
Green: Band_2
Blue: Band_3
33091-H1-SE.tif
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Green: Band_2
Blue: Band_3
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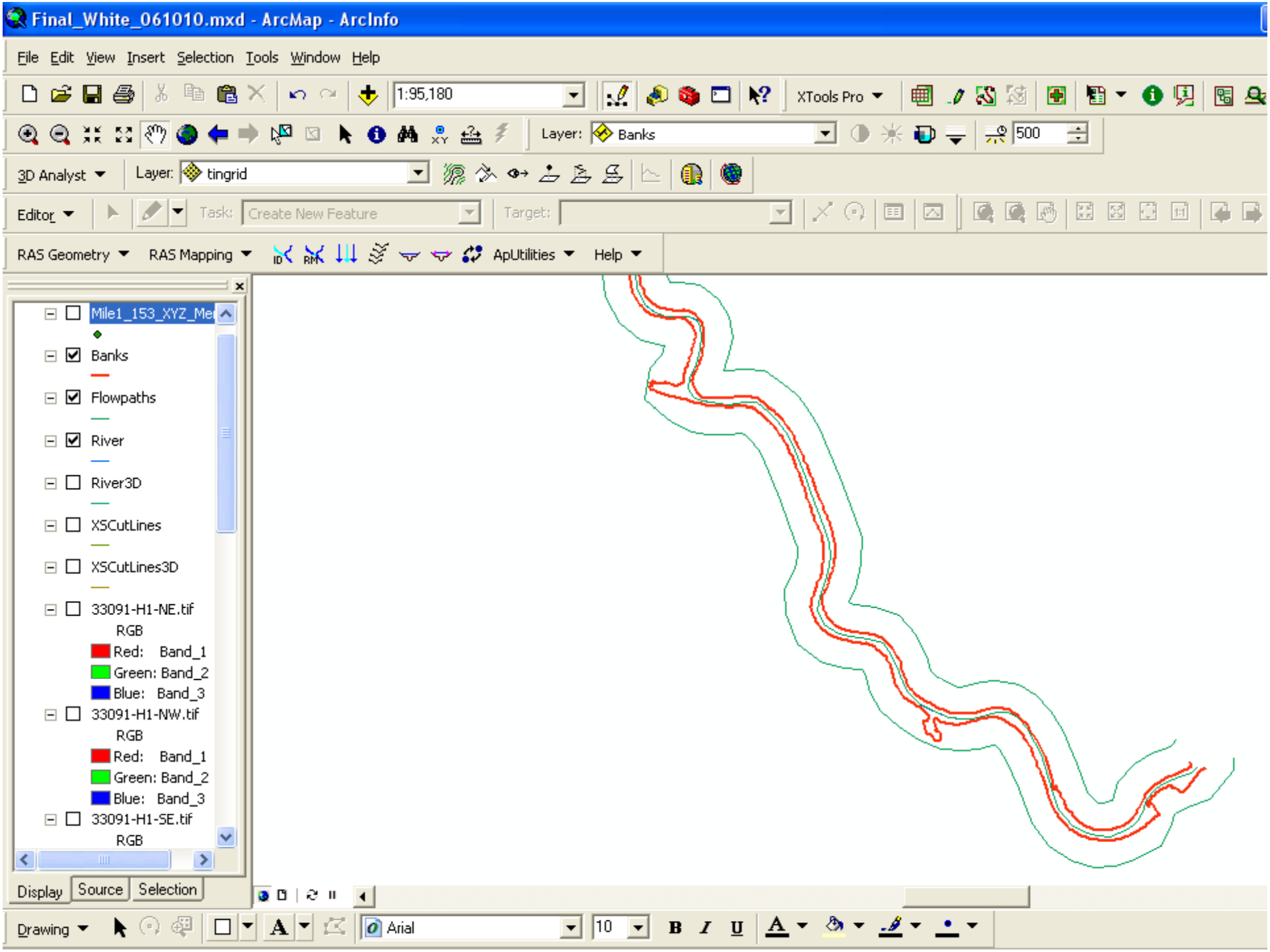
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XSCutLines
XSCutLines3D
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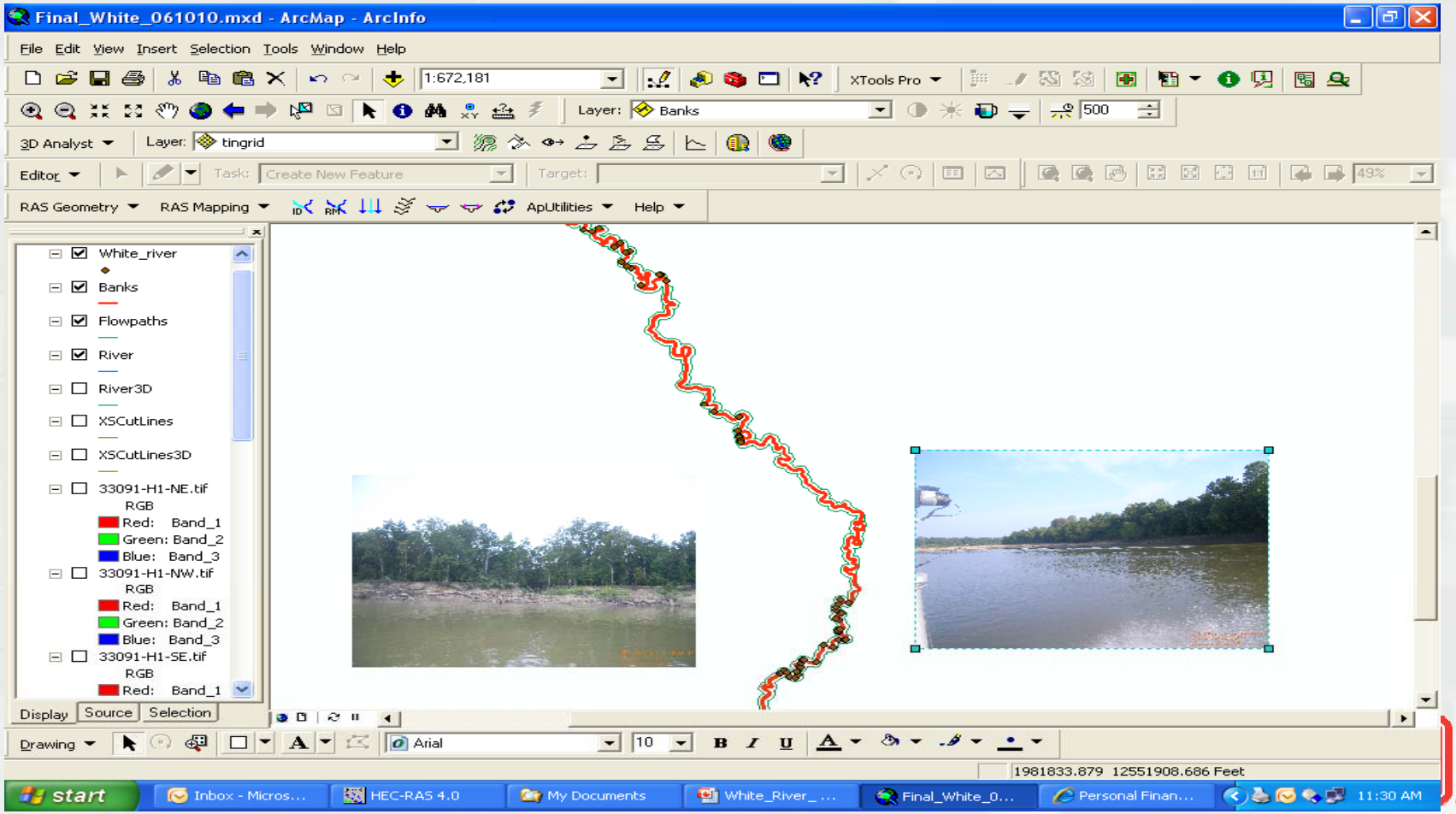
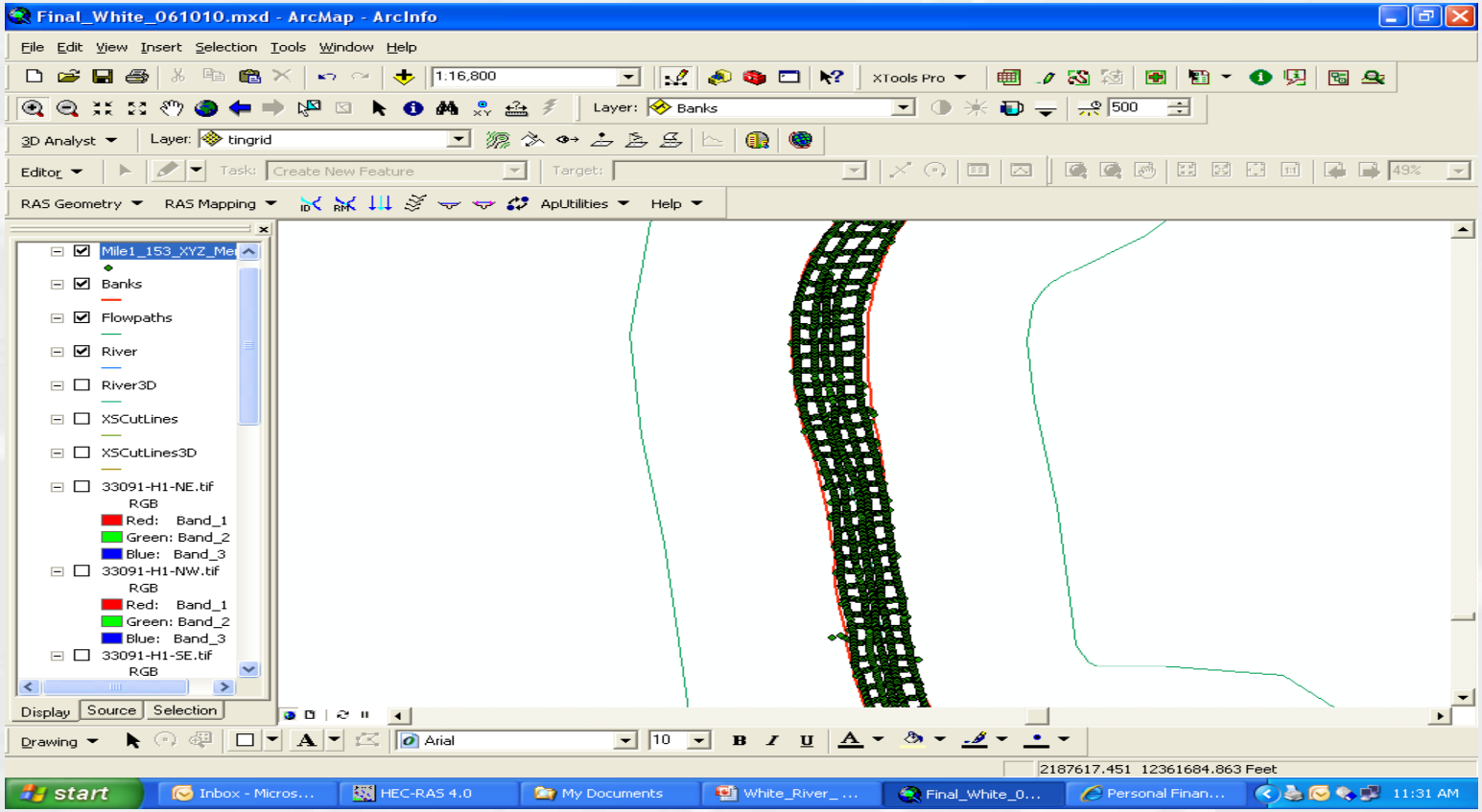
Red: Band_1
Green: Band_2
Blue: Band_3
33091-H1-NW.tif
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
33091-H1-SE.tif
RGB
Display
Source
Selection
Drawing
Arial
10

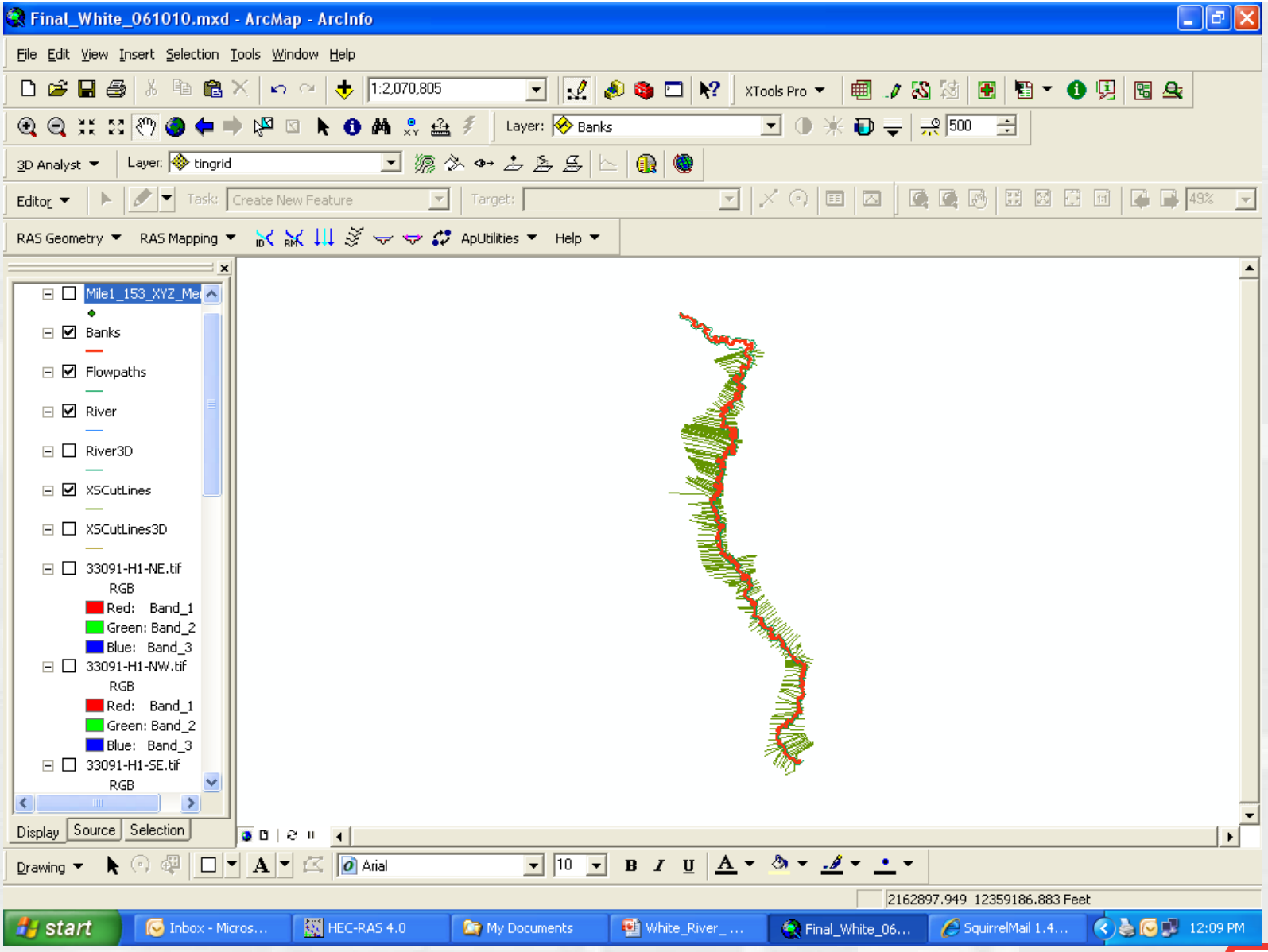
Field Study (2008-2009)



Hydro-Survey (2008-2009)



Add XYZ with Aerial Photo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Target:
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River
River3D
XSCutLines
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33091-H1-NE.tif
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Red: Band_1
Green: Band_2
Blue: Band_3
33091-H1-NW.tif
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
33091-H1-SE.tif
RGB
Display
Source
Selection
Drawing
Arial
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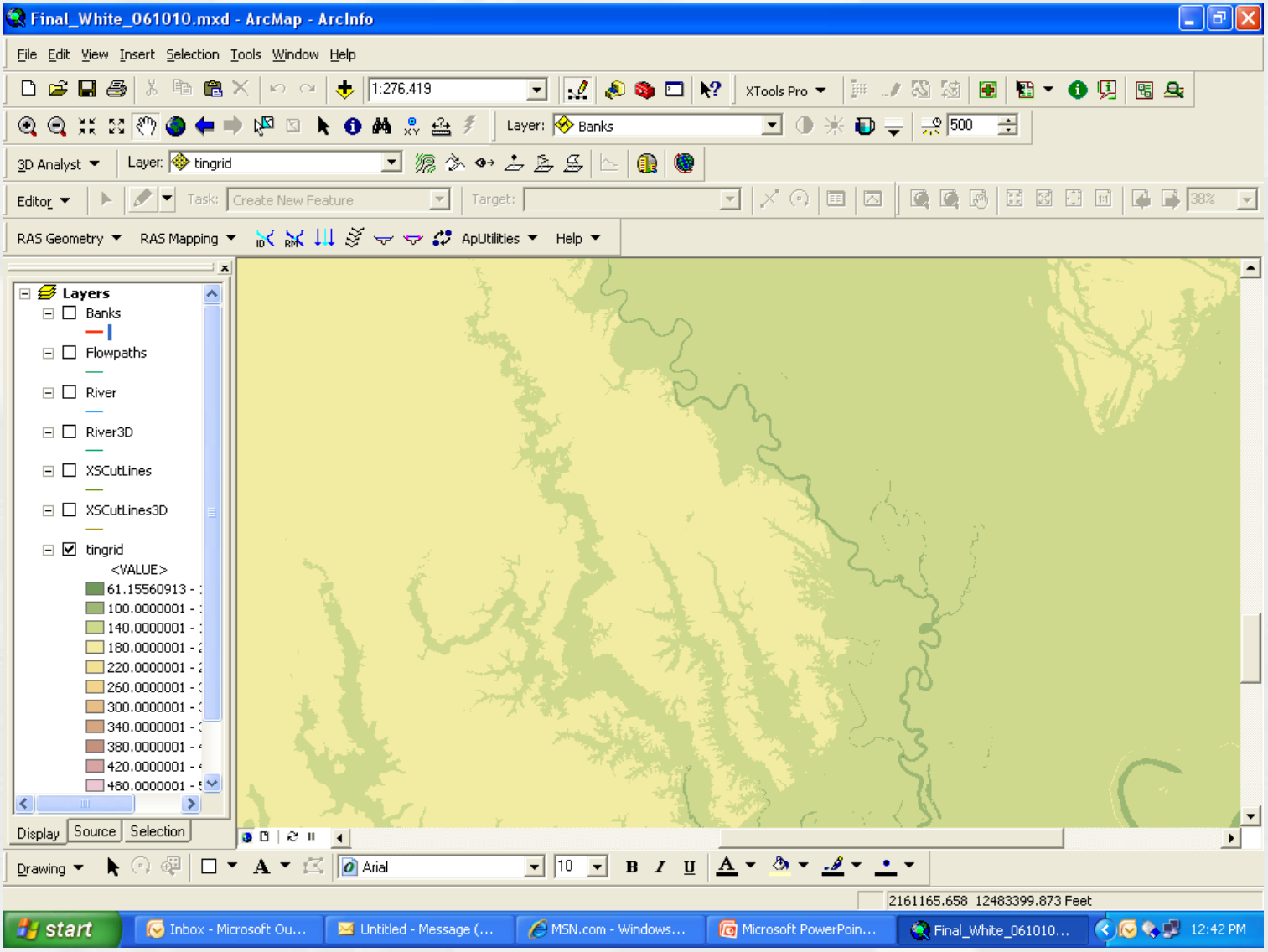
2162897.949 12359186.883 Feet
start
Inbox - Micros...
HEC-RAS 4.0
My Documents
White_River_...
Final_White_06...
SquirrelMail 1.4...
12:09 PM

Digital Elevation Model White River

- Convert Hydrologic Datum (Low Water Reference Plane) to Geodetic Datum (NGVD)
- Combine All Points in Accordance with Daily Gage Reading
- Create White River DEM

Create Master DEM

- Collect U.S.G.S DEM
- Compile White River DEM
- Mosaic both DEMs Using ArcInfo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Target:
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RAS Geometry
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Help
Layers
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Flowpaths
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XSCutLines3D
tingrid
<VALUE>
61.15560913 -
100.0000001 -
140.0000001 -
180.0000001 -
220.0000001 -
260.0000001 -
300.0000001 -
340.0000001 -
380.0000001 -
420.0000001 -
480.0000001 -
Display
Source
Selection
Drawing
Arial
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2161165.658 12483399.873 Feet
start
Inbox - Microsoft Ou...
Untitled - Message (...
MSN.com - Windows...
Microsoft PowerPoin...
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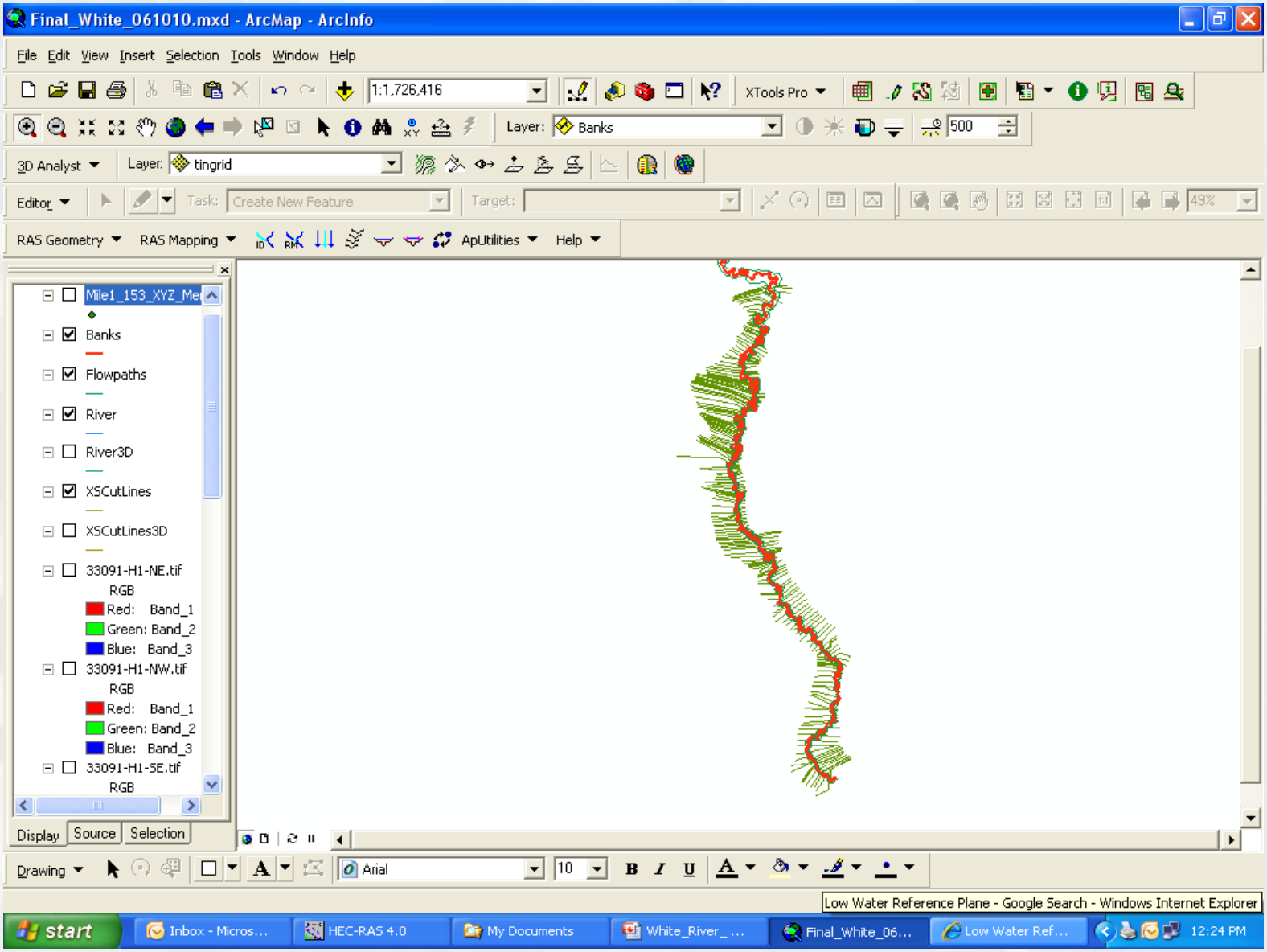
12:42 PM

Cross Sections

- Develop Cross Sections Including River Valley and Overland
- Present Water Flow through Channel and Overland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Flowpaths
River
River3D
XSCutLines
XSCutLines3D
33091-H1-NE.tif
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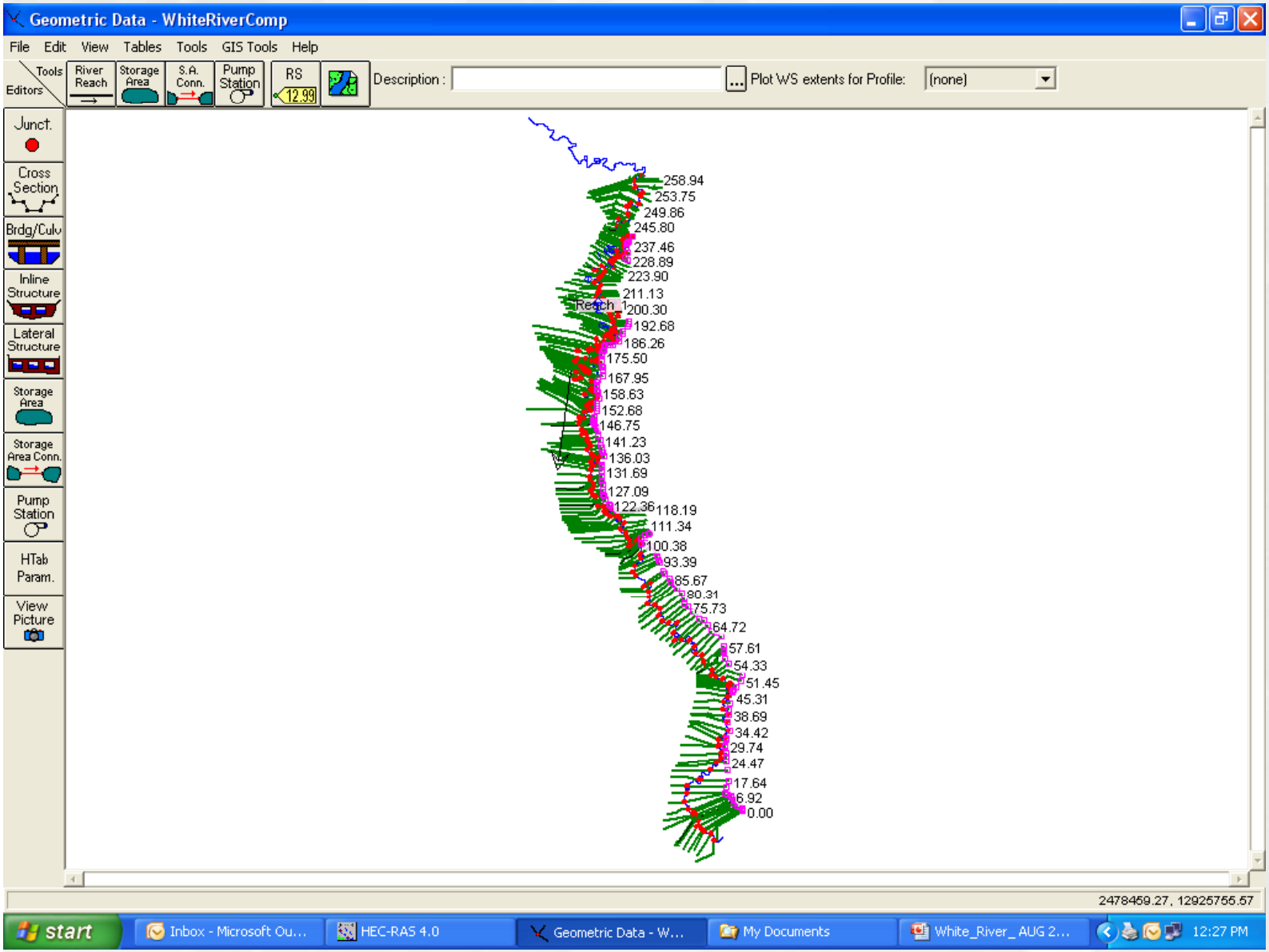
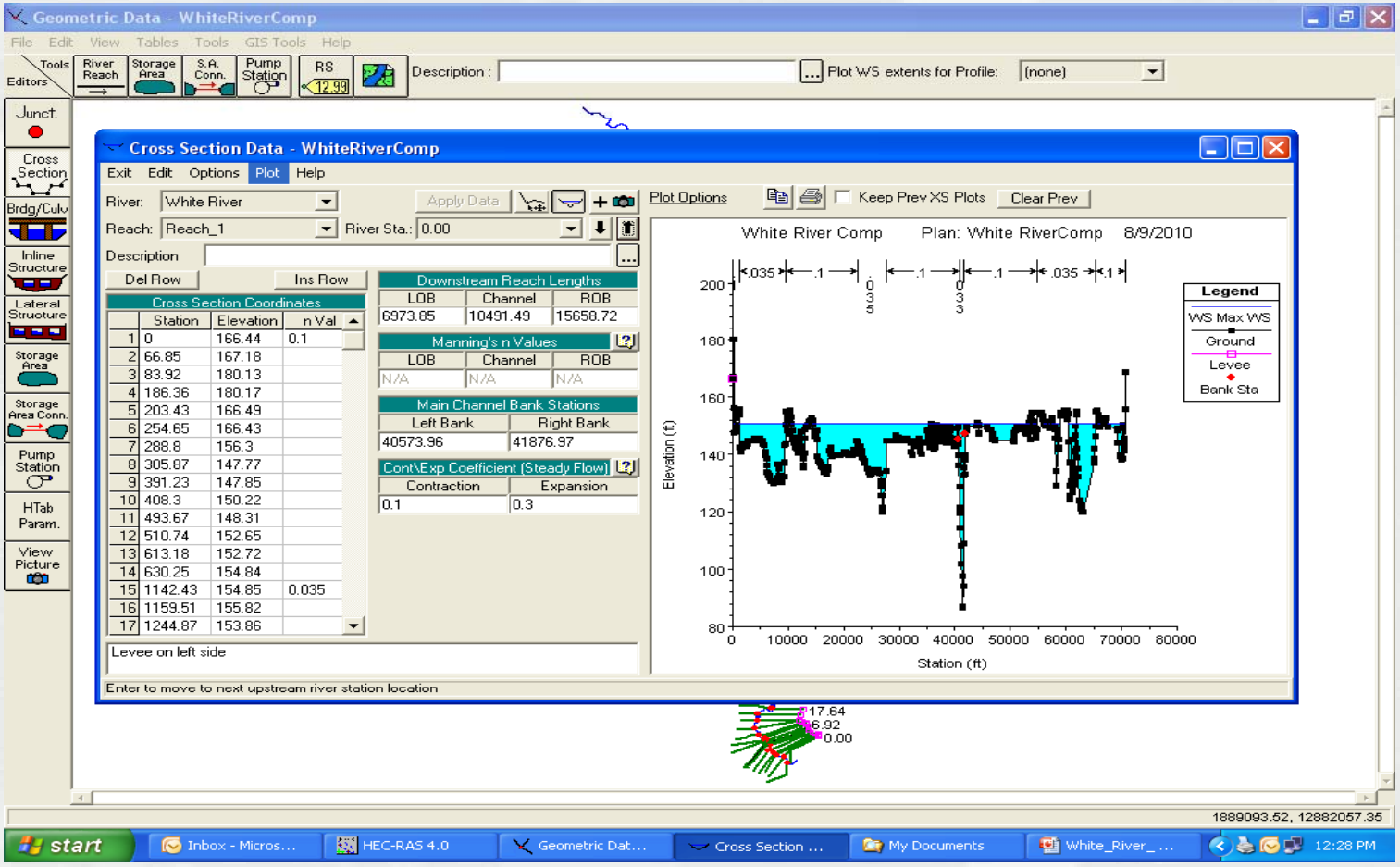
Red: Band_1
Green: Band_2
Blue: Band_3
33091-H1-NW.tif
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
33091-H1-SE.tif
RGB
Display
Source
Selection
Drawing
Arial
10
Low Water Reference Plane - Google Search - Windows Internet Explorer
start
Inbox - Micros...
HEC-RAS 4.0
My Documents
White_River_...
Final_White_06...
Low Water Ref...
12:24 PM

Geo-RAS Model

- Develop One-Dimensional Hydraulics Model for the White River
- Create XYZ in ArcInfor
- Export to RAS Model

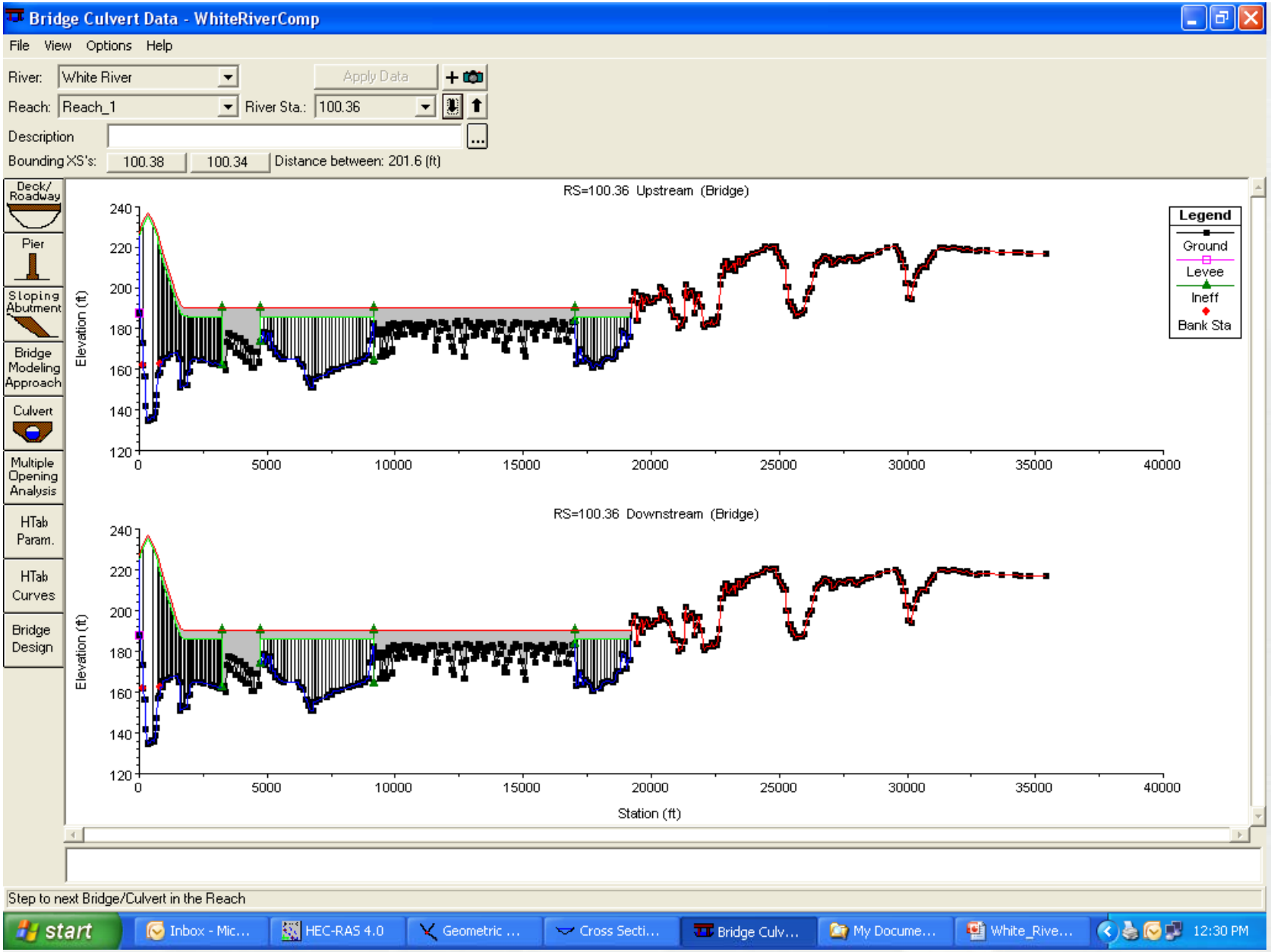


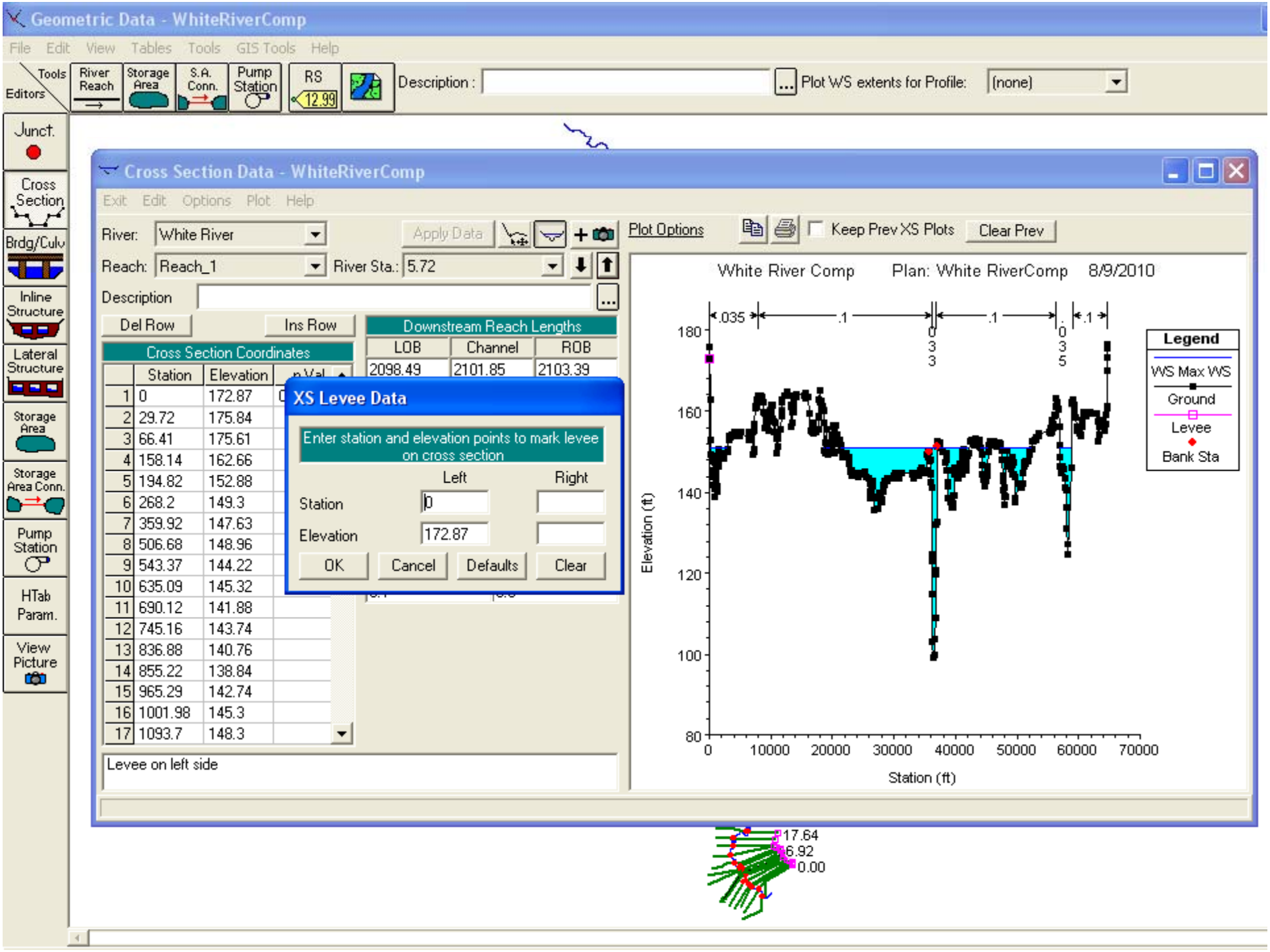
Cross Section Profile



Other Features

- Levee Systems
- Bridges
- Top Banks


Bridge Culvert Data - WhiteRiverComp
File View Options Help
River: White River
Apply Data
Reach: Reach_1
River Sta.: 100.36
Description
Bounding XS's: 100.38 100.34 Distance between: 201.6 (ft)
Deck/ Roadway
Pier
Sloping Abutment
Bridge Modeling Approach
Culvert
Multiple Opening Analysis
HTab Param.
HTab Curves
Bridge Design
RS=100.36 Upstream (Bridge)
RS=100.36 Downstream (Bridge)
Elevation (ft)
Station (ft)
Legend
Ground
Levee
Ineff
Bank Sta
Step to next Bridge/Culvert in the Reach
start
Inbox - Mic...
HEC-RAS 4.0
Geometric ...
Cross Secti...
Bridge Culv...
My Docume...
White_Rive...
12:30 PM


Geometric Data - WhiteRiverComp
File Edit View Tables Tools GIS Tools Help
Tools
Editors
River Reach
Storage Area
S.A. Conn.
Pump Station
RS
12.99
Description :
Plot WS extents for Profile:
(none)
Junct.
Cross Section
Brdg/Culv
Inline Structure
Lateral Structure
Storage Area
Storage Area Conn.
Pump Station
HTab Param.
View Picture
Cross Section Data - WhiteRiverComp
Exit Edit Options Plot Help
River: White River
Reach: Reach_1
River Sta.: 5.72
Apply Data
Description
Plot Options
Keep Prev XS Plots
Clear Prev
Del Row
Ins Row
Downstream Reach Lengths
LOB
Channel
ROB
2098.49
2101.85
2103.39
Cross Section Coordinates
Station
Elevation
1 0 172.87
2 29.72 175.84
3 66.41 175.61
4 158.14 162.66
5 194.82 152.88
6 268.2 149.3
7 359.92 147.63
8 506.68 148.96
9 543.37 144.22
10 635.09 145.32
11 690.12 141.88
12 745.16 143.74
13 836.88 140.76
14 855.22 138.84
15 965.29 142.74
16 1001.98 145.3
17 1093.7 148.3
Levee on left side
XS Levee Data
Enter station and elevation points to mark levee on cross section
Left
Right
Station
0
Elevation
172.87
OK
Cancel
Defaults
Clear
White River Comp
Plan: White RiverComp
8/9/2010
.035
.1
.1
.1
Legend
WS Max WS
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
180
160
140
120
100
80
0
10000
20000
30000
40000
50000
60000
70000
17.64
6.92
0.00

Frequency and Duration Analyses

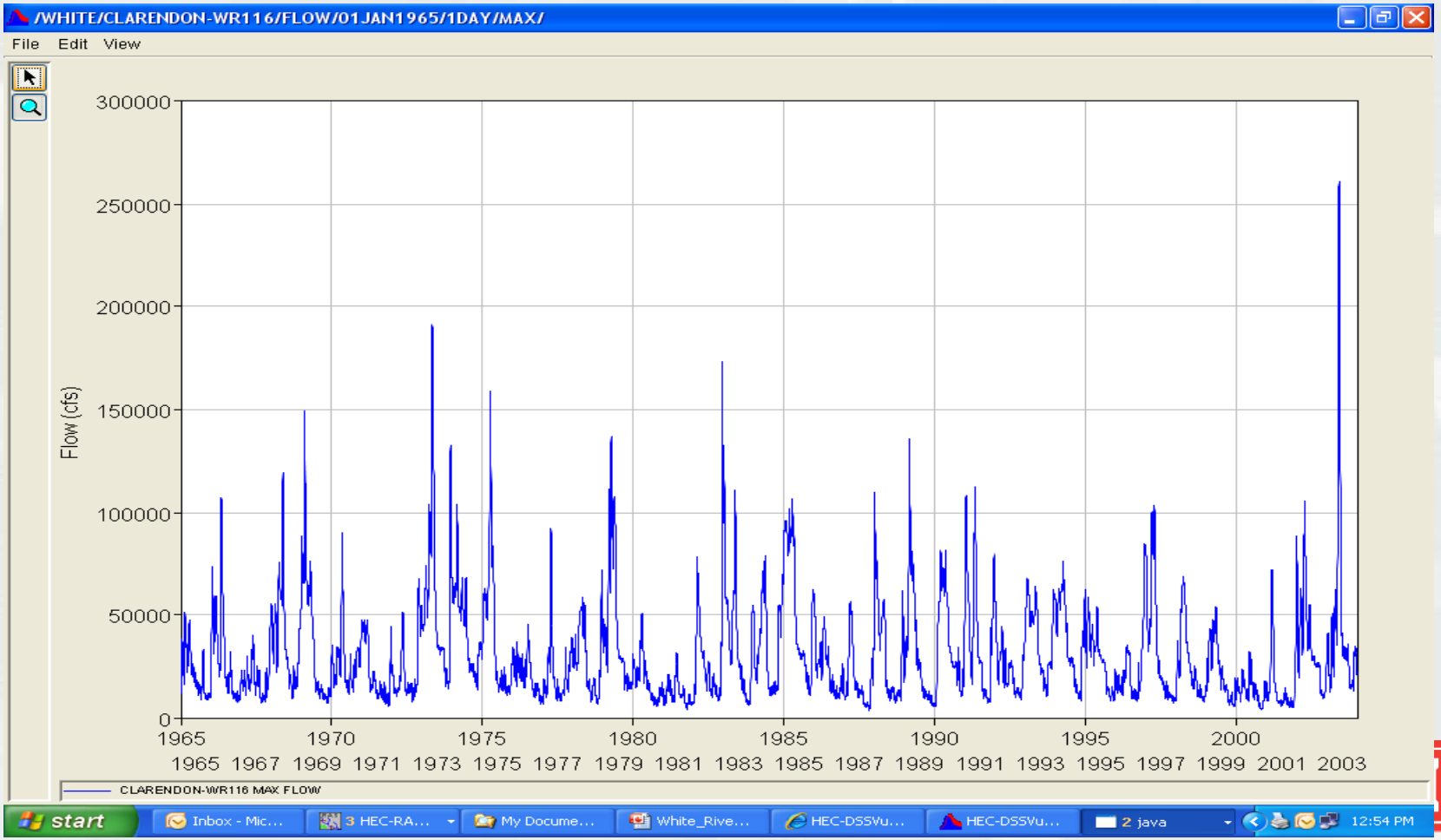
- Gage Data – Mississippi River Junction, Clarendon, DeVall Bluff, DesArc, Georgetown, Augusta, and Newport (1965-2009)

- Supermodel – Little Rock District (1940-2009)

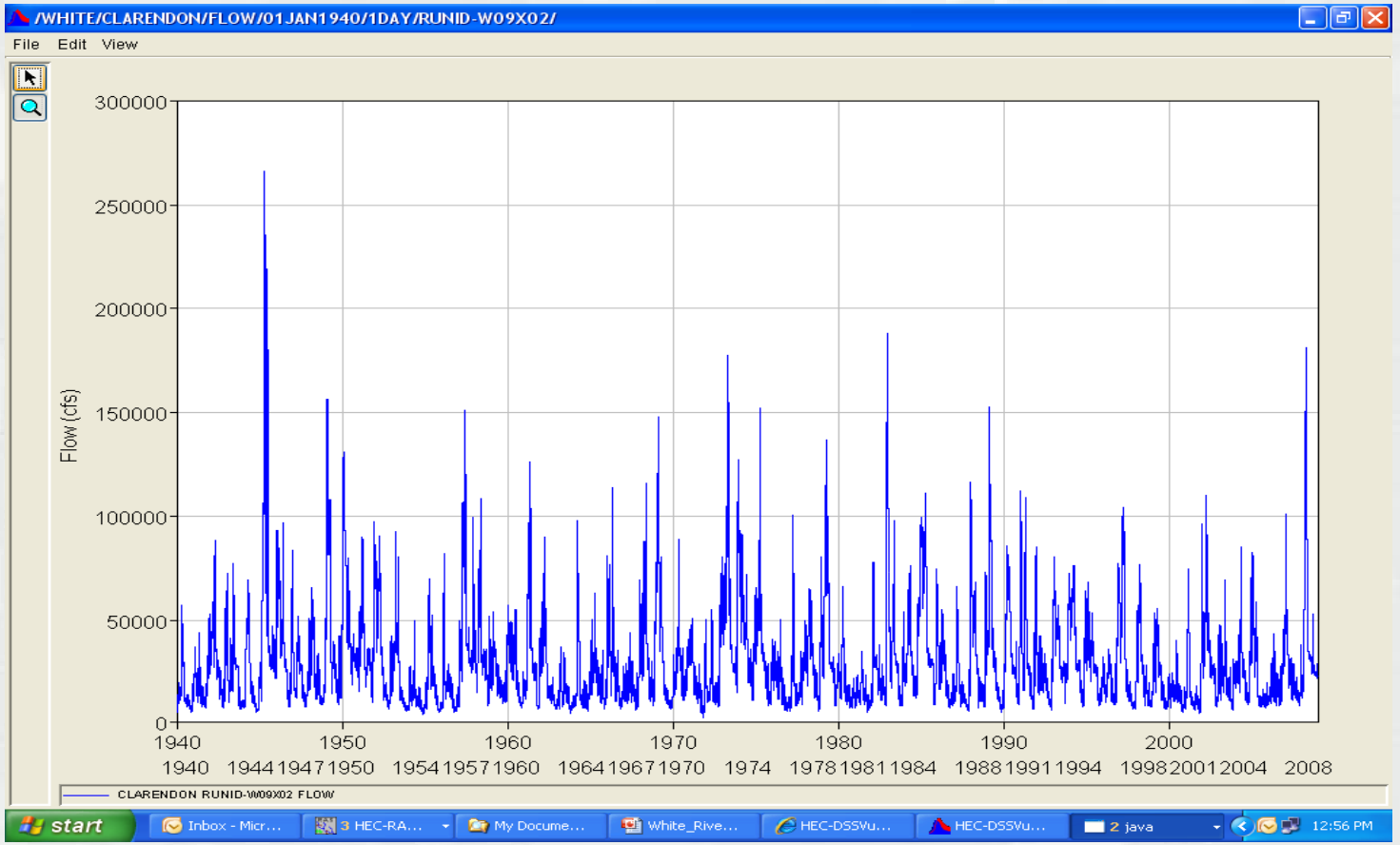
(Continued)

- 1, 2, 5, 10, 25, 50 and 100 Year Frequency
- Stage Analysis
- Statistical Software Package (Hec-SSP)
- Data Storage System, or HEC-DSSVue

Gage Data

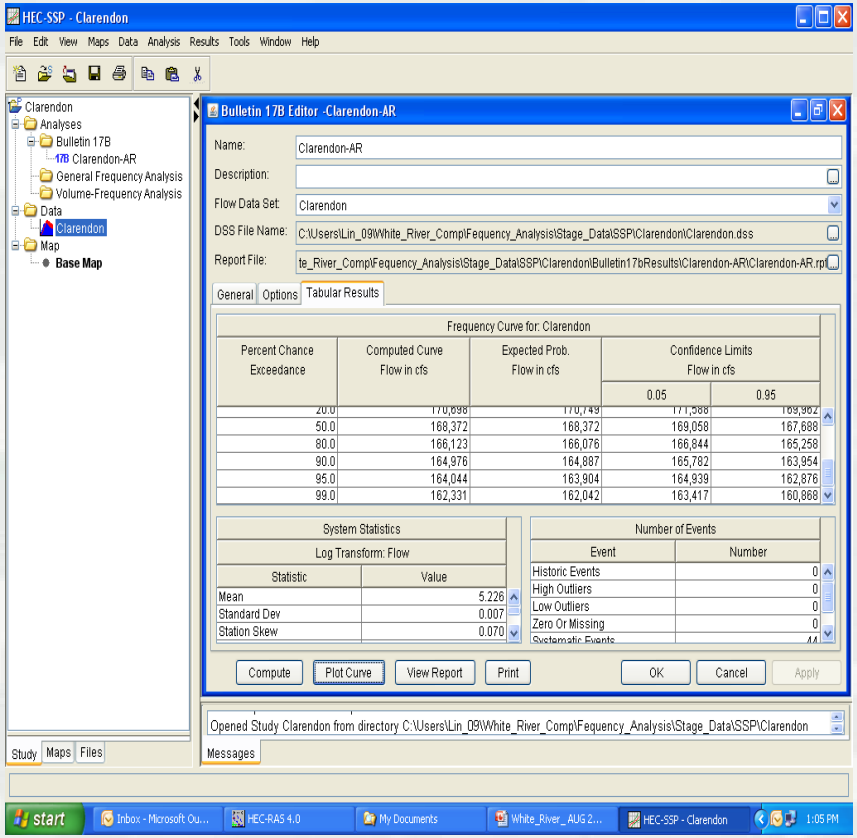

/WHITE/CLARENDON-WR116/FLOW/01JAN1965/1DAY/MAX/
File Edit View
300000
250000
200000
150000
100000
50000
0
Flow (cfs)
1965 1970 1975 1980 1985 1990 1995 2000
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003
CLARENDON-WR116 MAX FLOW
start
Inbox - Mic...
3 HEC-RA...
My Docume...
White_Rive...
HEC-DSSVu...
HEC-DSSVu...
2 java
12:54 PM

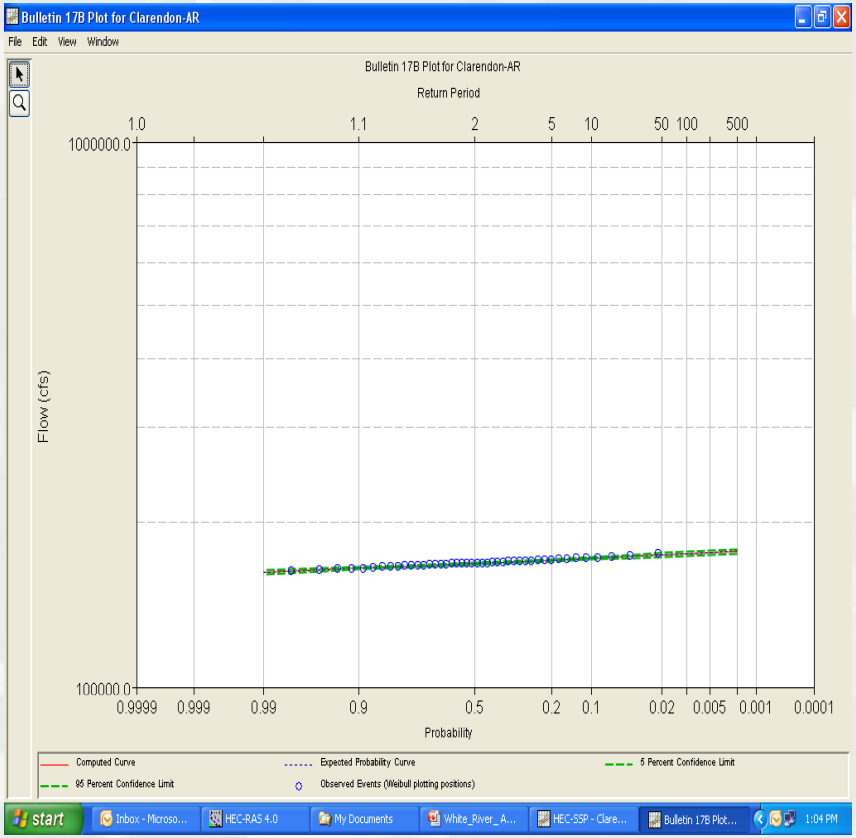
Supermodel



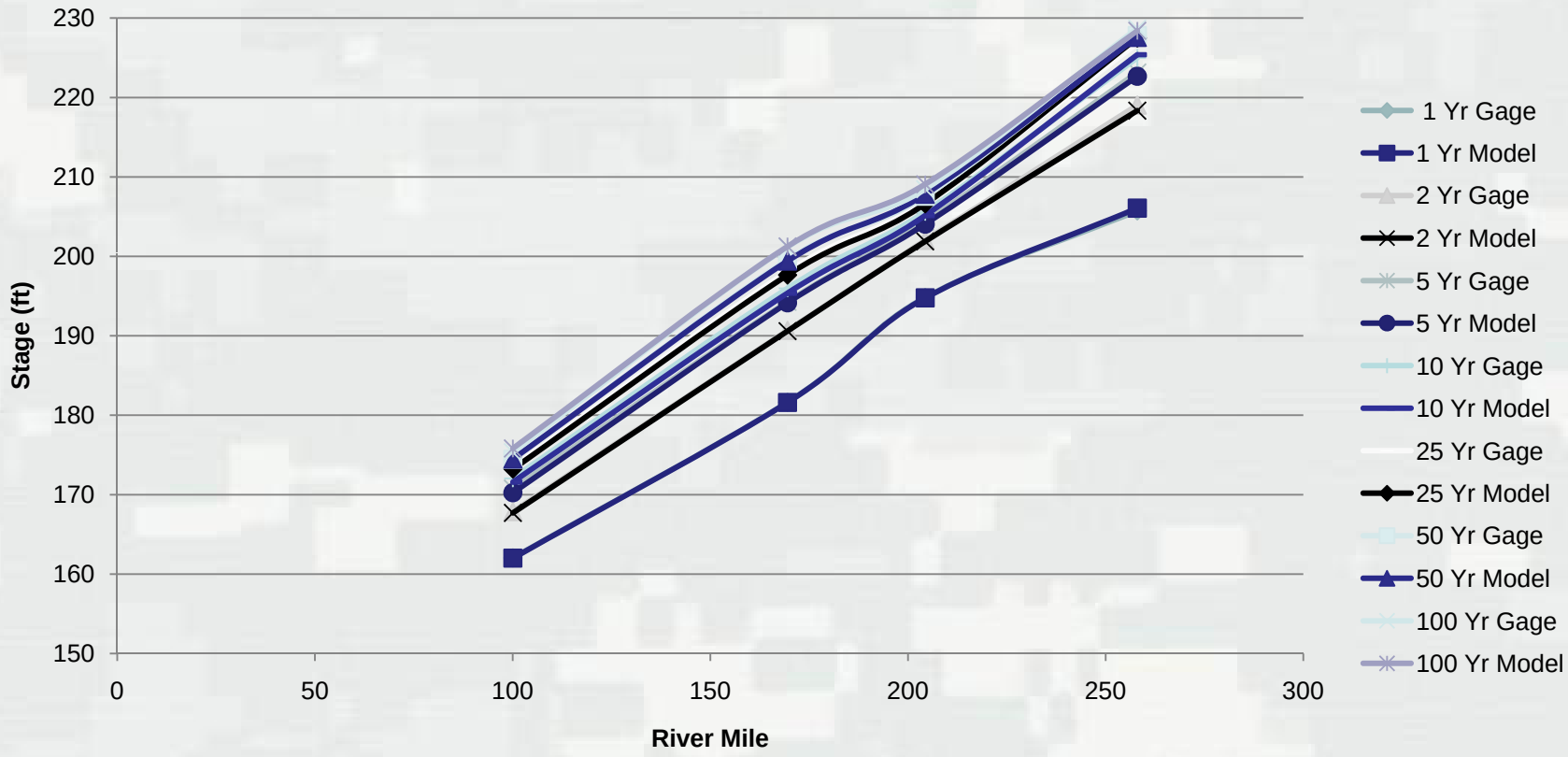

/WHITE RIVER/MRJ(RM 599.0)/ELEV/01JAN1982/1DAY/COMPUTED/
File Edit View
Elev (ft)
160
155
150
145
140
135
130
125
120
115
110
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
1982
1983

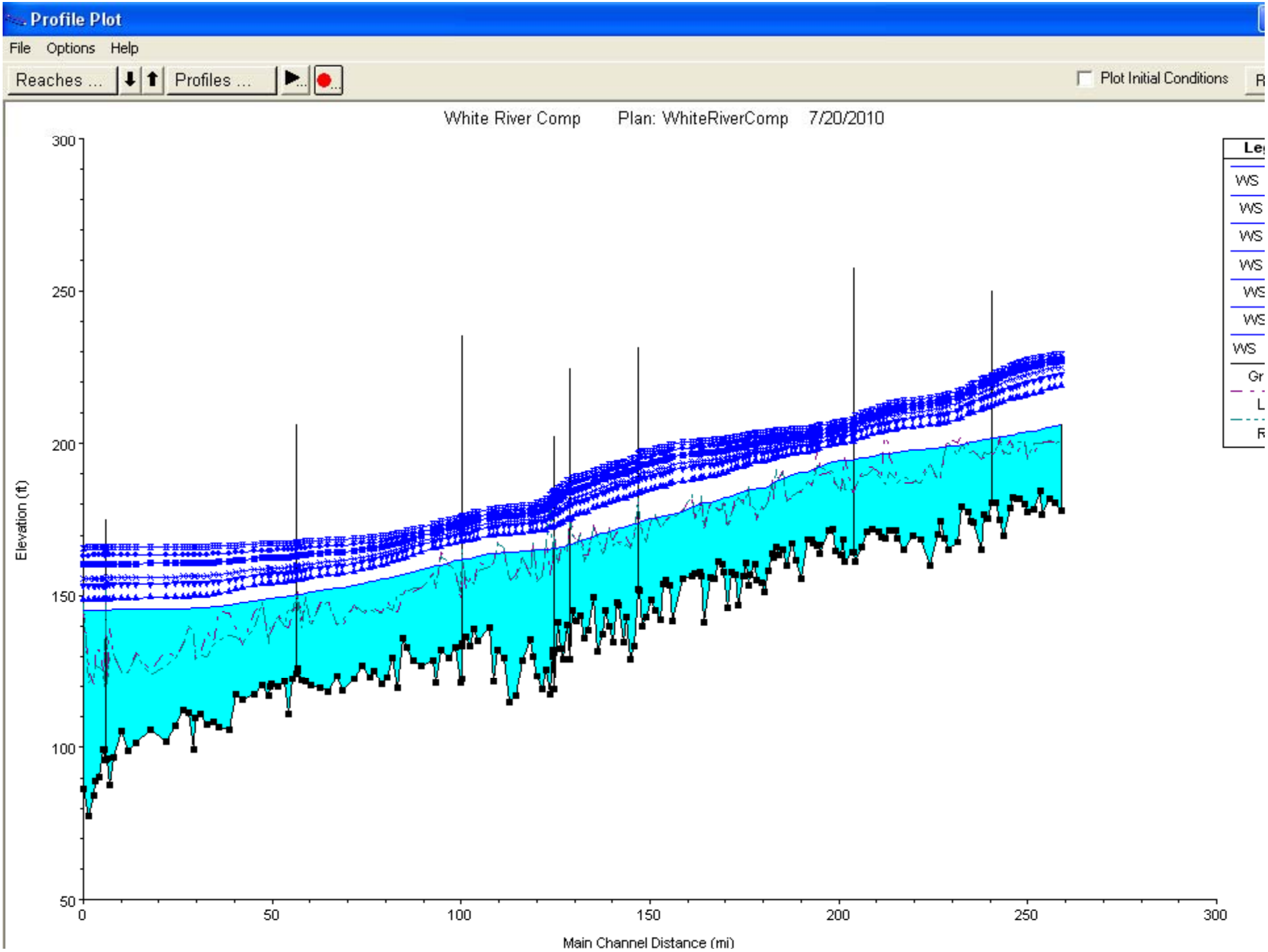
Frequency Analysis
Hec-SSP





Stage Calibration




Profile Plot
File Options Help
Reaches ...
Profiles ...
Plot Initial Conditions
White River Comp Plan: WhiteRiverComp 7/20/2010
Elevation (ft)
300
250
200
150
100
50
0
50
100
150
200
250
300
Main Channel Distance (mi)
WS
WS
WS
WS
WS
WS
WS
Gr

Comments and Question?