

# HEC-RAS Mapper Results Visualization

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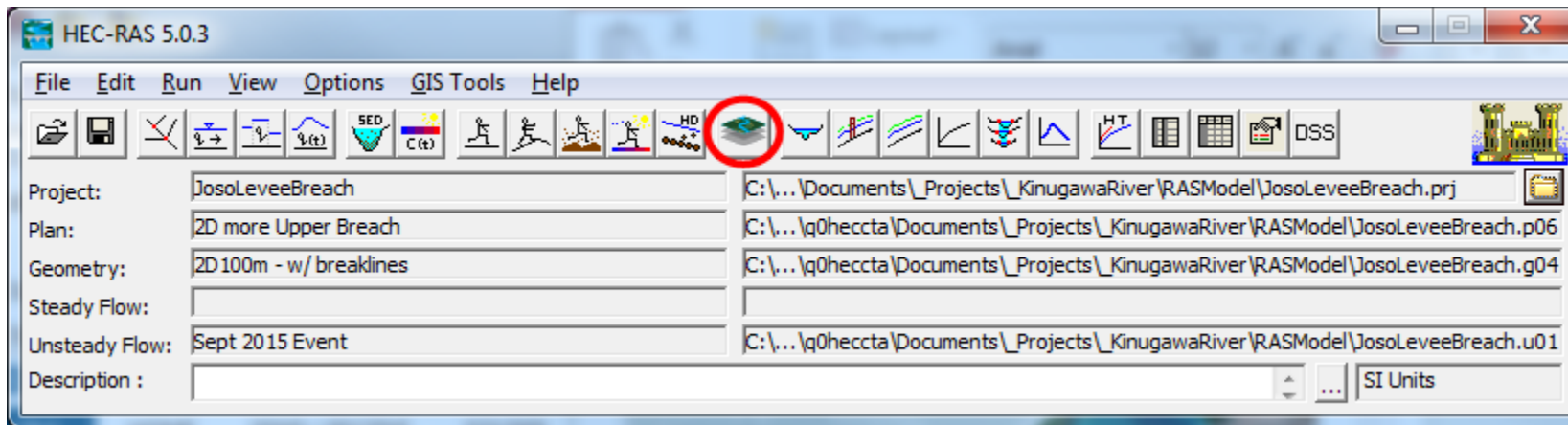
USACE, Institute for Water Resources, Hydrologic Engineering Center





# Overview

- How do we visualize RAS results?
- How do we debug our model?
- How do we compare different plans?





# HEC-RAS Mapper

The screenshot displays the HEC-RAS Mapper software interface. The main window shows a 3D visualization of a river channel with water depth contours overlaid on a satellite map. The interface includes a menu bar (File, Project, Tools, Help), a toolbar with various navigation and analysis tools, and a left-hand panel for layer management. The 'Layers List' panel is expanded to show the 'Results' section, where 'Depth (Max)' is selected. A 'Status Area' at the bottom left shows the current view settings. A red box highlights the 'View Tools' and 'Animation Controls' sections of the toolbar. A red box also highlights the 'View Area' on the map. A scale bar at the bottom right indicates 2000 feet.

**View Tools**

**Animation Controls**

**Layers List**

- Selected Layer: Depth
- Features
  - Profile Lines
- Geometries
  - Simple Geometry
  - 250ft
  - 250ft+Breaklines
  - 250ft+Refinement
- Event Conditions
  - Results
  - Initial Run - 10min
  - 2min
  - 1min
  - Adaptive Time Step
  - 250ft
  - 250ft+Breaklines
  - 250ft+Refinement
    - Event Conditions
    - Geometry
    - Depth (Max)
    - Velocity (Max)
    - WSE (Max)

- Map Layers
- CompareCellSize
- Google Satellite
- Terrains
- Terrain

**Status Area**

US End of Levee  
Left Split  
Right Split  
Cross Section

Messages Views Profile Lines Active Features Layer Values

(2036985.82, 346945.58 1 pixel = 19.94 ft)

2000 ft



# Layers List

- Profile Lines
- Geometries
- Results
- Map Layers
- Terrains

Selected Layer: Depth

Layers List:

- Features**
  - Profile Lines
- Geometries**
  - Grid 50ft
  - grid200ft
  - Grid400ft
    - Rivers
    - Cross Sections
    - Storage Areas
    - 2D Flow Areas
    - Bridges/Culverts
    - Inline Structures
    - Lateral Structures
    - SA/2D Connections
    - Pump Stations
    - BC Lines
  - Manning's n
  - Infiltration
  - Percent Impervious
  - Reference Points
  - Errors
- Event Conditions**
- Results**
  - Grid 50ft
    - Event Conditions
    - Geometry
    - Depth (02JAN1900 02:45:00)**
    - Velocity (02JAN1900 05:00:00)
    - WSE (02JAN1900 00:00:00)
    - Inundation Boundary (Max Value\_0)
    - Depth (Max)
  - Grid 200ft
  - Grid 400ft
- Map Layers**
  - LandCover
    - Classification Polygons
  - VOD\_LC
  - Google Satellite
- Terrains**
  - Terrain
  - TerrainWithChannel



Symbology is shown to the right of any checked layers.



The selected layer is highlighted in magenta.



# Status Area

- Messages – What just happened
- View – Quickly zoom to predefined areas
- Profile Lines – Access results at specific locations
- Active Features – Quick access to features in layer
- Layer Values – Watch values for multiple results

Geometry 'Imported GIS Data +Bridges' association was set to the one terrain available (Terrain)  
XS Interpolation Surfaces generated in 167 ms

Airport  
Confluence  
WWTP  
Santa Fe Ave Bridge

US End of Levee  
Left Split  
Right Split  
Cross Section

15696.24  
15485.51  
15370.43  
15205.20

Use	Name	ID	Value
<input checked="" type="checkbox"/>	Velocity (250ft+Refinement)	vR	1.51
<input checked="" type="checkbox"/>	Velocity (250ft+Breaklines)	vBL	1.40
<input checked="" type="checkbox"/>	WSE (250ft+Refinement)	wR	573.71
<input checked="" type="checkbox"/>	WSE (250ft+Breaklines)	wBL	575.43

Messages Views Profile Lines Active Features **Layer Values**



# Profile Lines

- User-defined/editable features

The interface shows a tree view of features with the following settings:

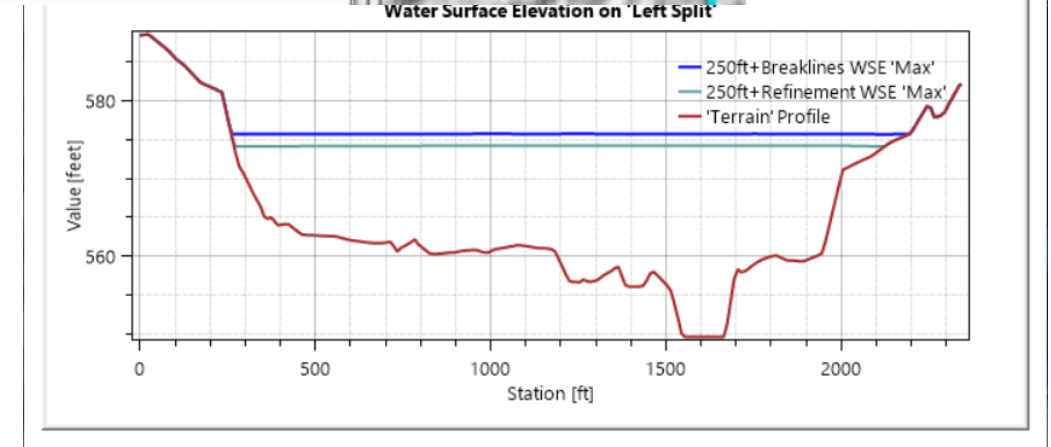
- Features
  - Profile Lines
- Geometries
  - Simple Geometry
  - 250ft
  - 250ft+Breaklines
  - 250ft+Refinement
- Event Conditions
- Results
- Map Layers
  - CompareCellSize
  - Google Satellite
- Terrains
  - Terrain

At the bottom, there are tabs for Messages, Views, Profile Lines (selected), Active Features, and Layer Values.

A context menu is open over a profile line. The menu items are:

- Plot Profile
- Plot Time Series
- Rename
- Delete
- Import Polygons from Shapefile
- Export Polygons to Shapefile

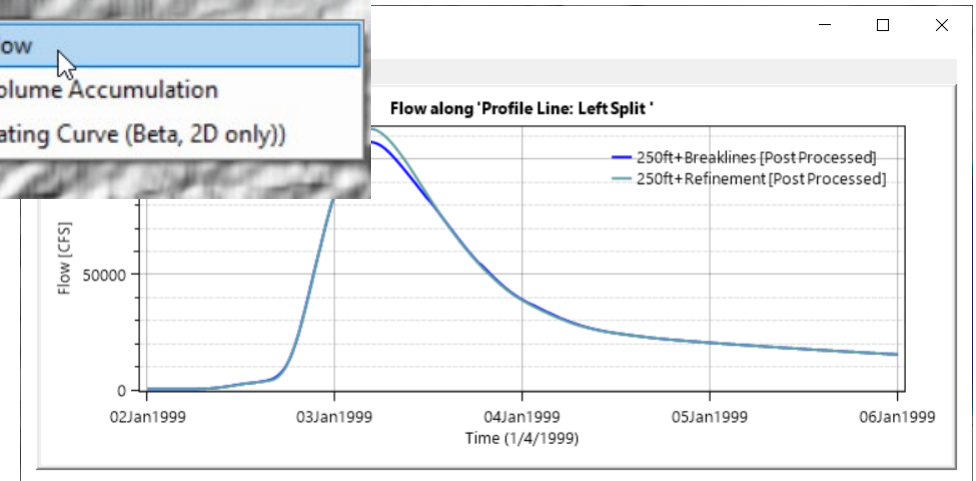
The 'Plot Profile' sub-menu is open, showing options: Terrain, WSE (highlighted), Depth, Velocity against Terrain, and Sediment.



A context menu is open over a profile line. The menu items are:

- Plot Profile
- Plot Time Series
- Rename
- Delete
- Import Polygons from Shapefile

The 'Plot Time Series' sub-menu is open, showing options: Flow (highlighted), Volume Accumulation, and Rating Curve (Beta, 2D only).





# Active Features

RAS Mapper

File Project Tools Help

Selected Layer: Cross Sections

- SA/2D Connections
- Pump Stations
- BC Lines
- Manning's n
- Infiltration
- Percent Impervious
- Reference Points
- Errors
- Depth (02JAN1900 02:45:00)
- Velocity (02JAN1900 05:00:00)
- WSE (02JAN1900 00:00:00)
- Inundation Boundary (Max Value\_0)
- Depth (Max)

Grid 200ft  
 Grid 400ft  
 Event Conditions  
 Geometry  
 Depth (02JAN1900 05:40:00)

9081.195  
8757.405  
8434.332  
8110.505  
7864.487  
7490.833  
7158.903  
6868.344  
6626.553  
6295.048  
5925.654  
5688.906

Messages Views Profile Lines **Active Features** Layer

(408602.96, 1803059.32 1 pixel = 8.14 ft)

Selected: 'Cross Sections'

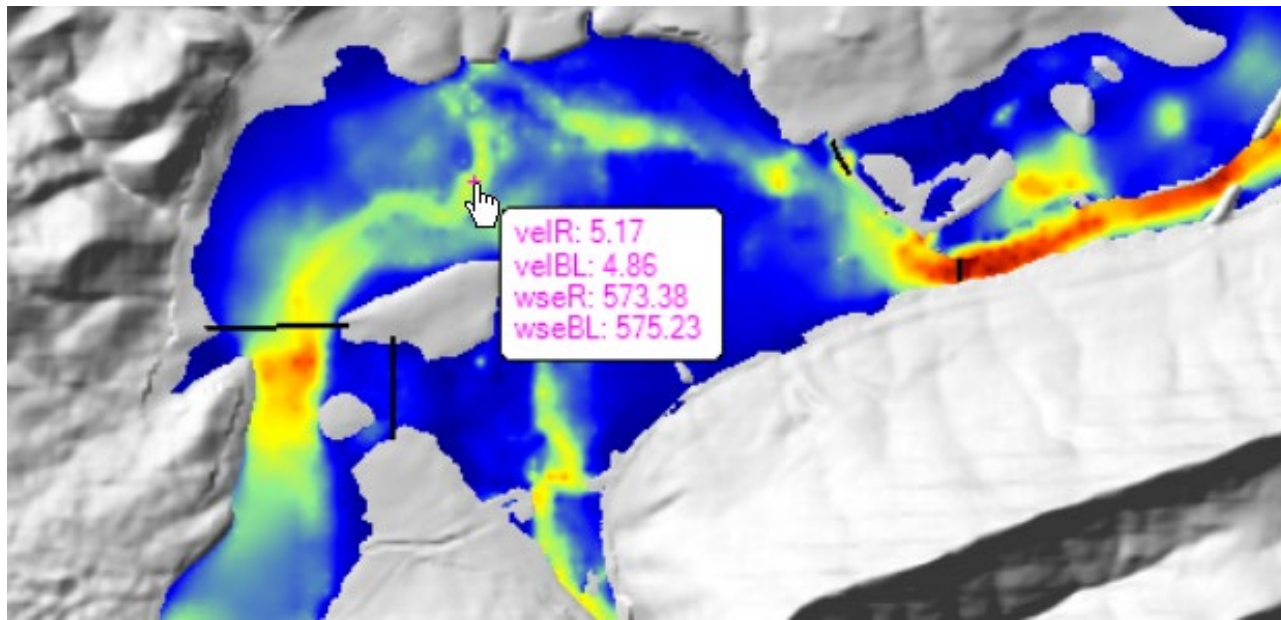
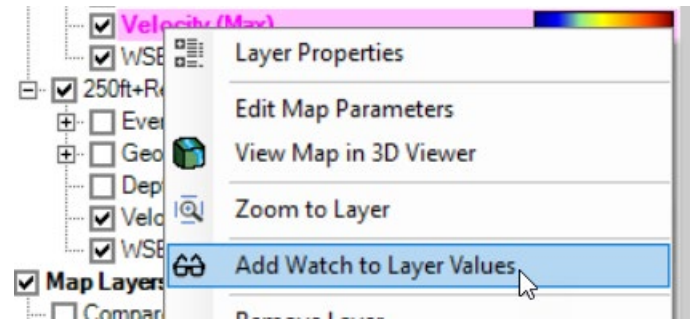
Cross Sections: 8434.332 (Grid 50ft) (Results)

- Copy Selected Feature Ctrl+C
- Plot Terrain Profile
- Save as Profile Line
- View Points
- Results Profile Plot
  - WSE
  - Velocity
  - Depth
- Results Time Series

The image shows the RAS Mapper software interface. The main window displays a 2D hydraulic model of a river channel. The channel is colored in shades of blue and cyan, representing water depth. Several green lines are drawn across the channel, representing cross-sections. A context menu is open over one of these cross-sections, showing options for 'Results Profile Plot' and 'Results Time Series'. The 'Results Profile Plot' option is expanded, showing sub-options for 'WSE', 'Velocity', and 'Depth'. The left sidebar shows a list of layers, with 'Depth (02JAN1900 02:45:00)', 'Velocity (02JAN1900 05:00:00)', and 'WSE (02JAN1900 00:00:00)' checked. The bottom status bar shows the current coordinates and a scale of 1 pixel = 8.14 ft.



# Watch Layer Values



Use	Name	ID	Value
<input checked="" type="checkbox"/>	Velocity (250ft+Refinement)	velR	5.14
<input checked="" type="checkbox"/>	Velocity (250ft+Breaklines)	velBL	5.00
<input checked="" type="checkbox"/>	WSE (250ft+Refinement)	wseR	573.78
<input checked="" type="checkbox"/>	WSE (250ft+Breaklines)	wseBL	575.47

Messages Views Profile Lines Active Features **Layer Values**

(2037649.22, 346306.26 1 pixel = 42.29 ft)





# Web Imagery

GDALWMS

Select WMS image server

- ArcGIS NatGeo World Map
- ArcGIS Ocean Basemap
- ArcGIS USA Topo Maps
- ArcGIS World Imagery
- ArcGIS World Physical Map
- ArcGIS World Shaded Relief
- ArcGIS World Street Map
- ArcGIS World Terrain Base
- ArcGIS World Topo Map
- Bing Satellite
- Google Hybrid
- Google Map
- Google Satellite
- Google Terrain Streets Water
- Google Terrain
- NSI\_Test
- OpenStreetMaps
- USGS Imagery
- USGS Topo

Reprojection Resample Method: near

OK Close

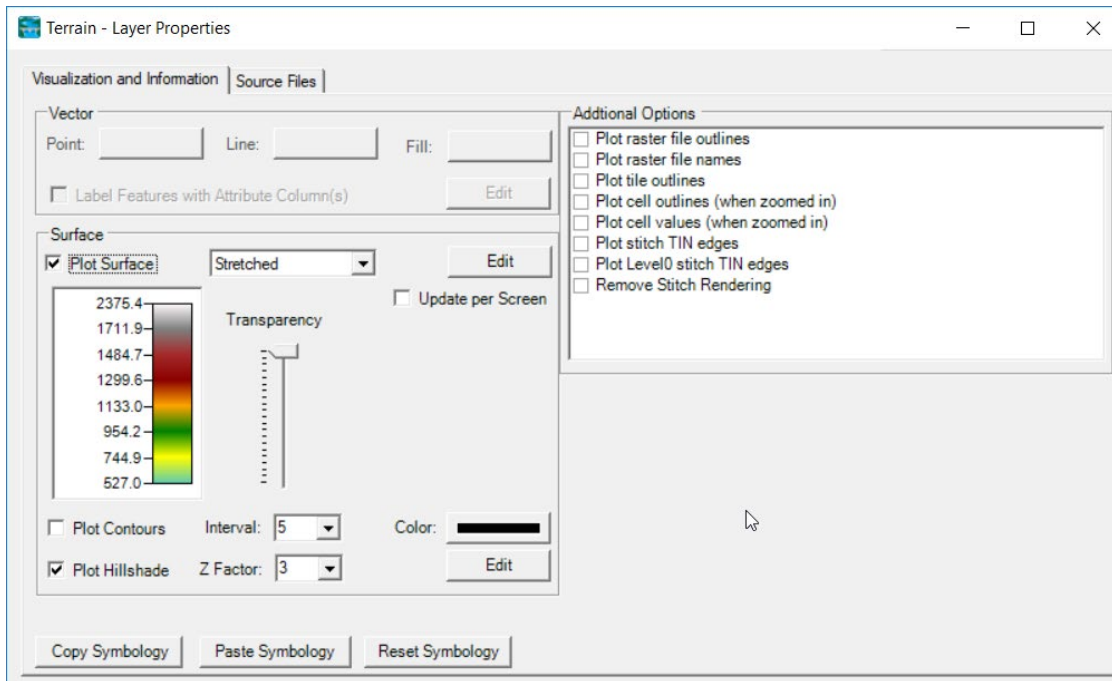


# Plot Options

- Terrain

- Depth, WSE

- River, Cross Sections



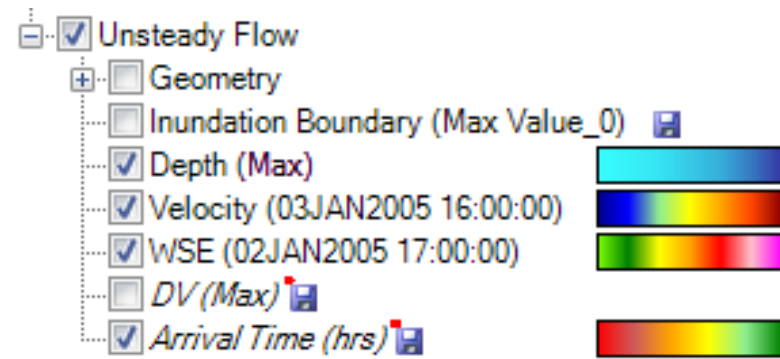
- Plot 2D Hydraulic Connectivity
- Plot 2D Water Surface Gradient (Arrow: WSEL High->Low)
- Draw Map Values
- Draw Perpendicular Face Velocities
- Face Low-Elevation Centroid
- Display Arrival Times as Dates

- Bank Stations
- Manning's n Values
- Reach Lengths
- Ineffective Areas
- Blocked Obstructions
- Ratio of Cut Line to XS Line
- Directional Arrows
- Stationing Tick Marks
- Draw Points
- Label Points
- Label Segment Indexes



# Results Mapping

- Dynamic Mapping – on-the-fly mapping
  - Animation of results without waiting



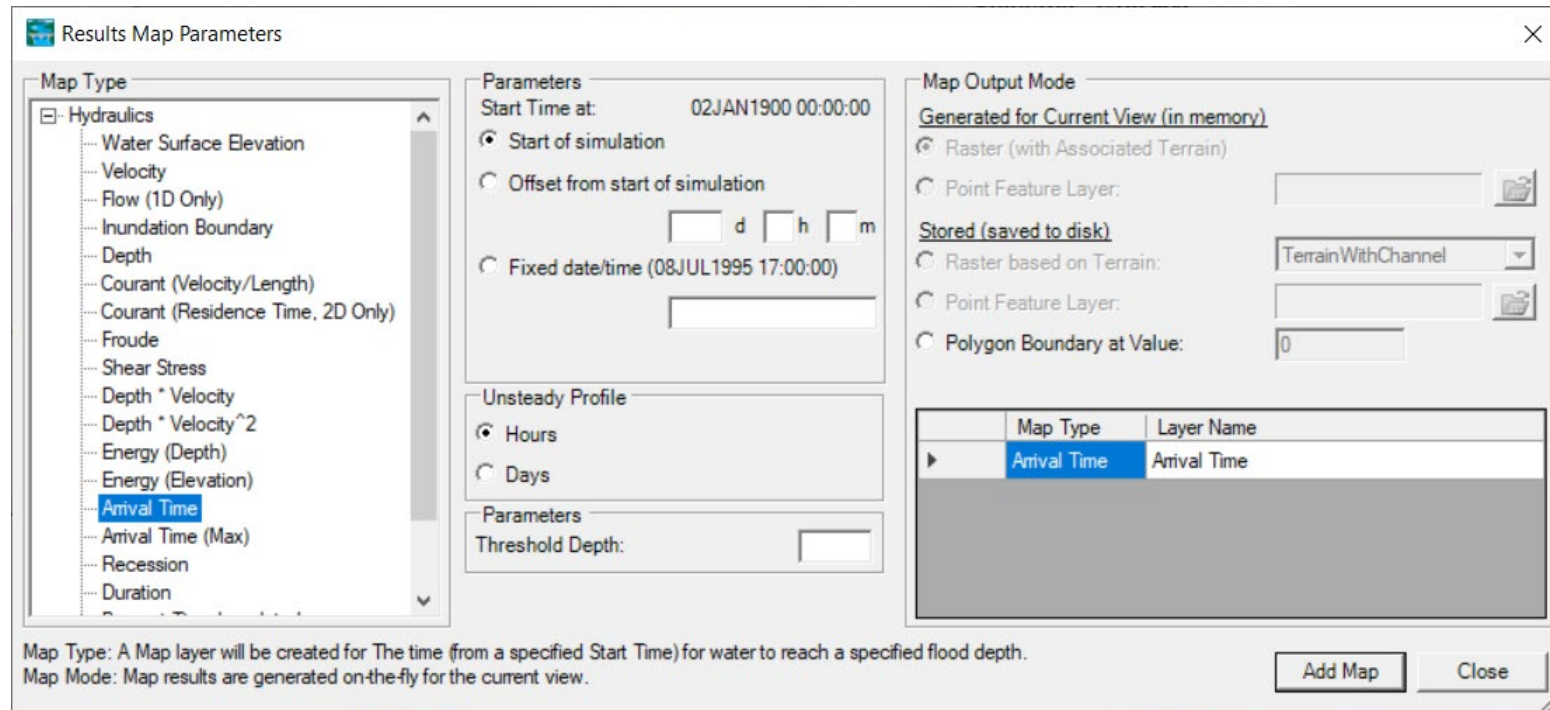
- Stored Maps – results written to file

\* = *There was a problem reading data*



# Results Mapping

Map Type | Profile/Parameter | Mode

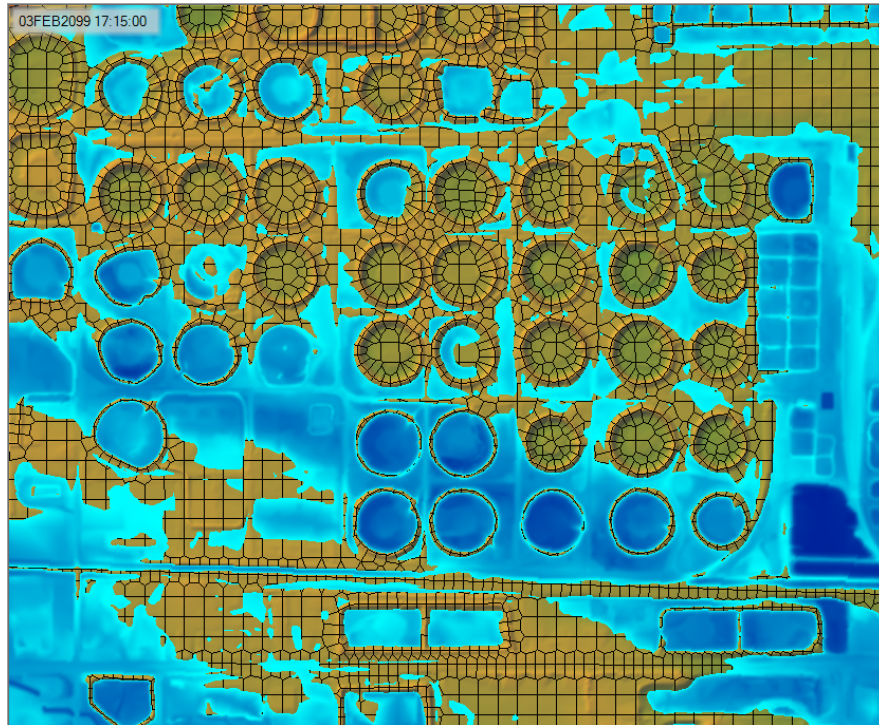


Default maps: Depth, Water Surface Elevation, Velocity

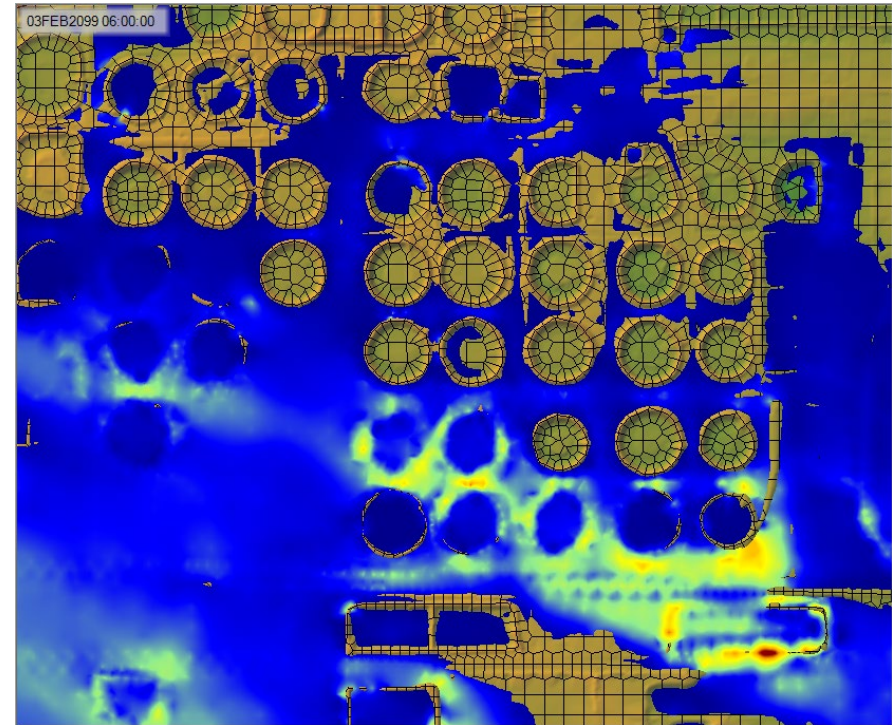


# Example Maps

- Depth

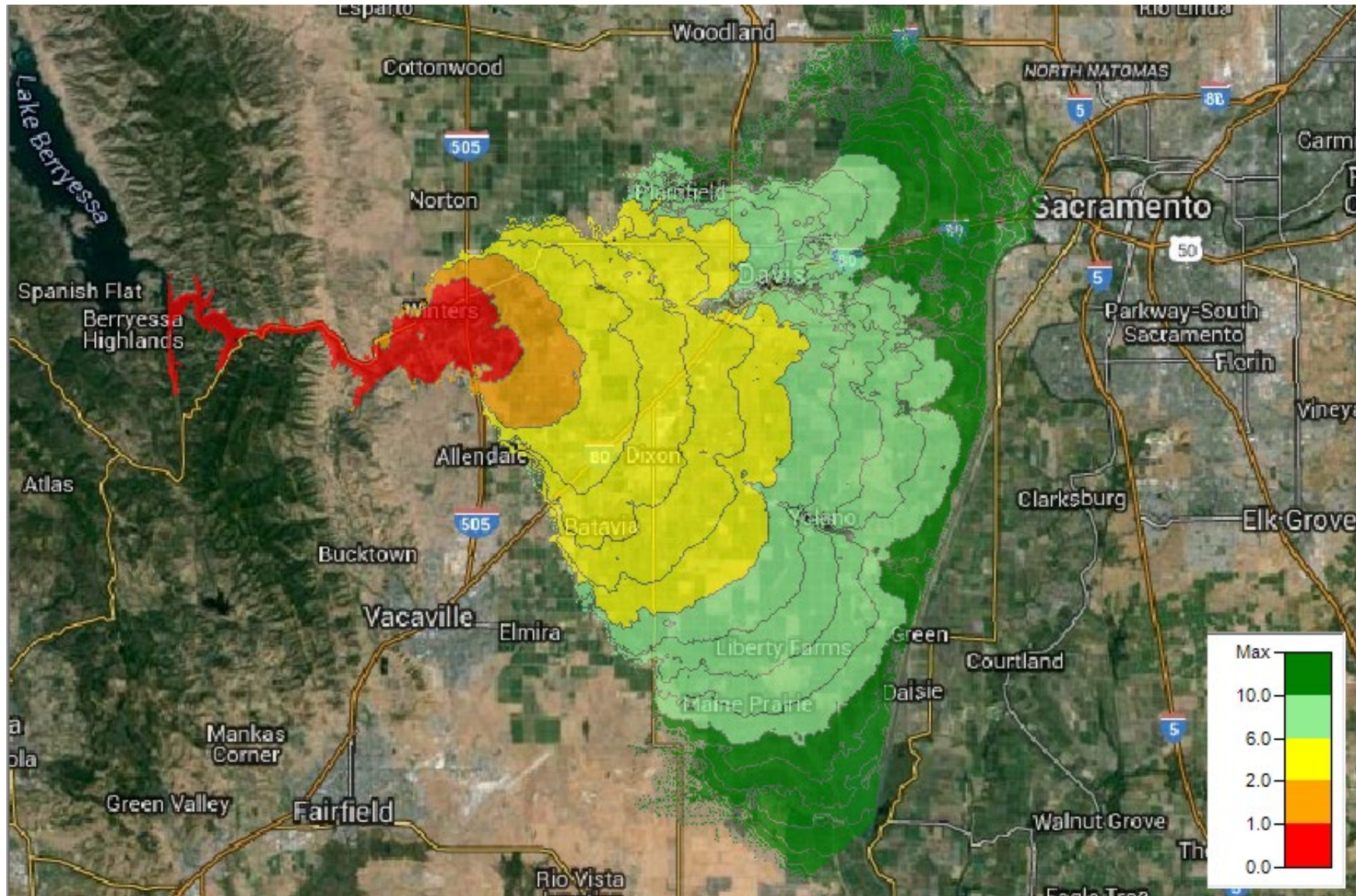


- Velocity



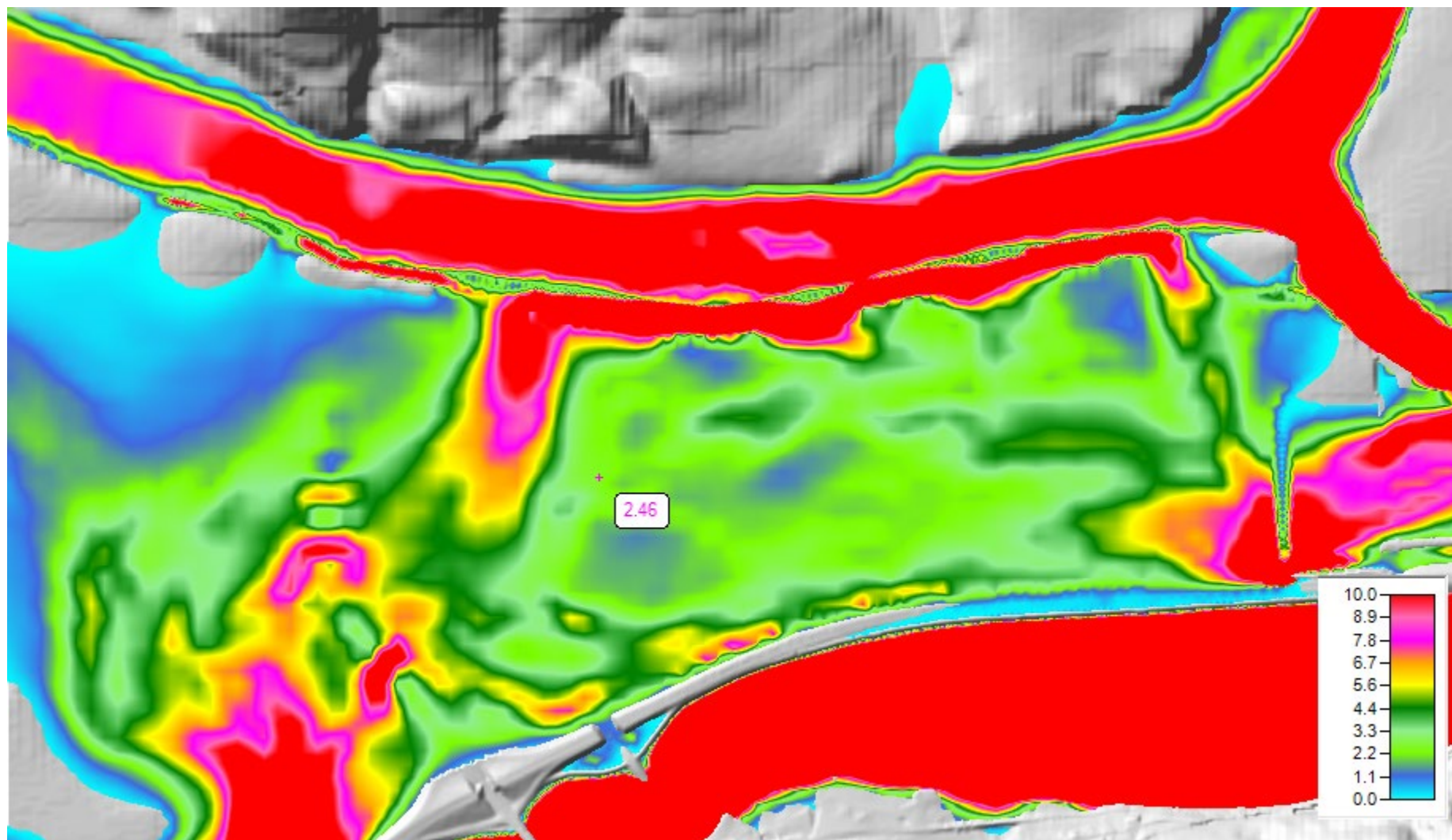


# Arrival Time



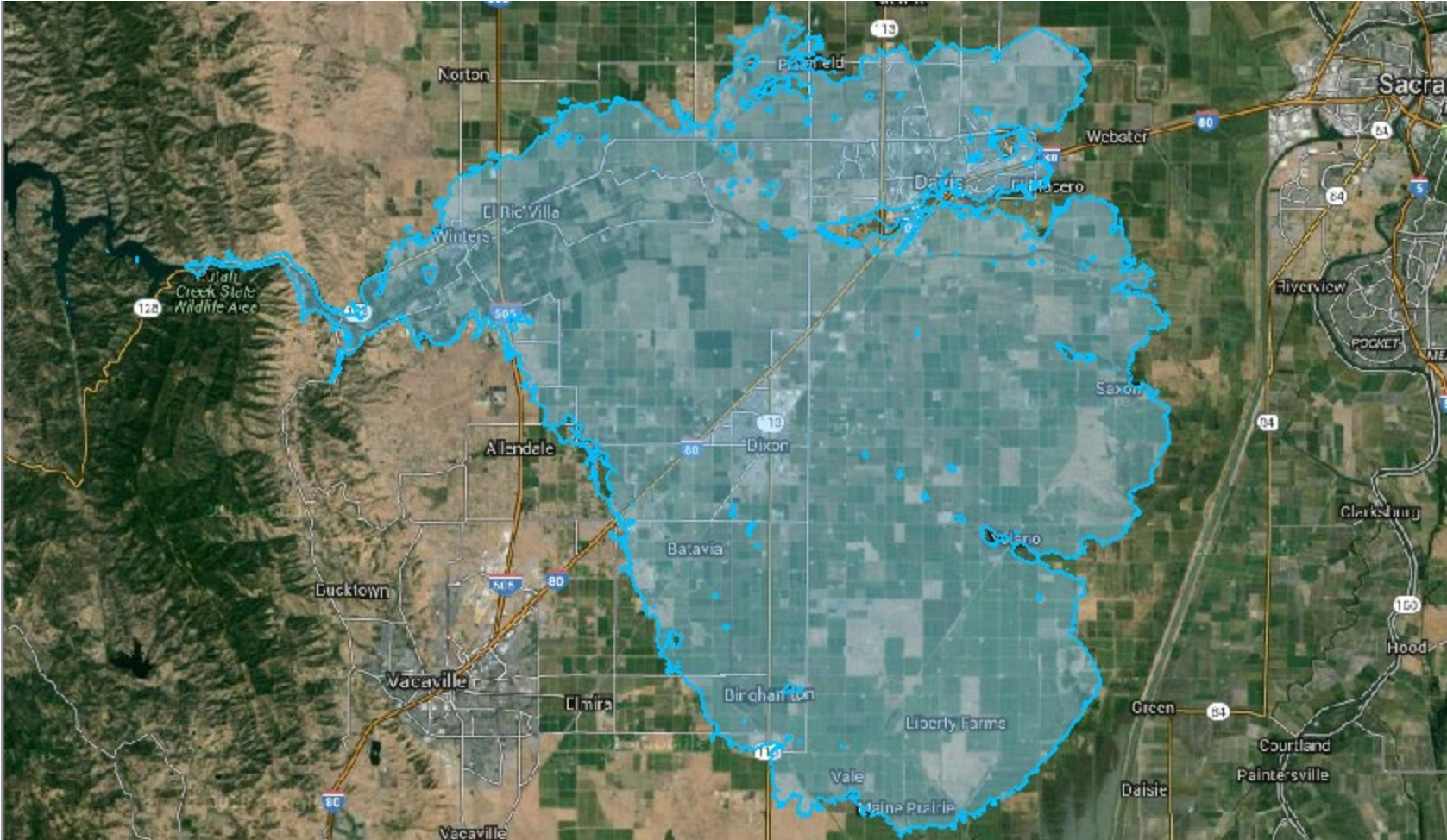


# Hazard Mapping





# Inundation Boundary







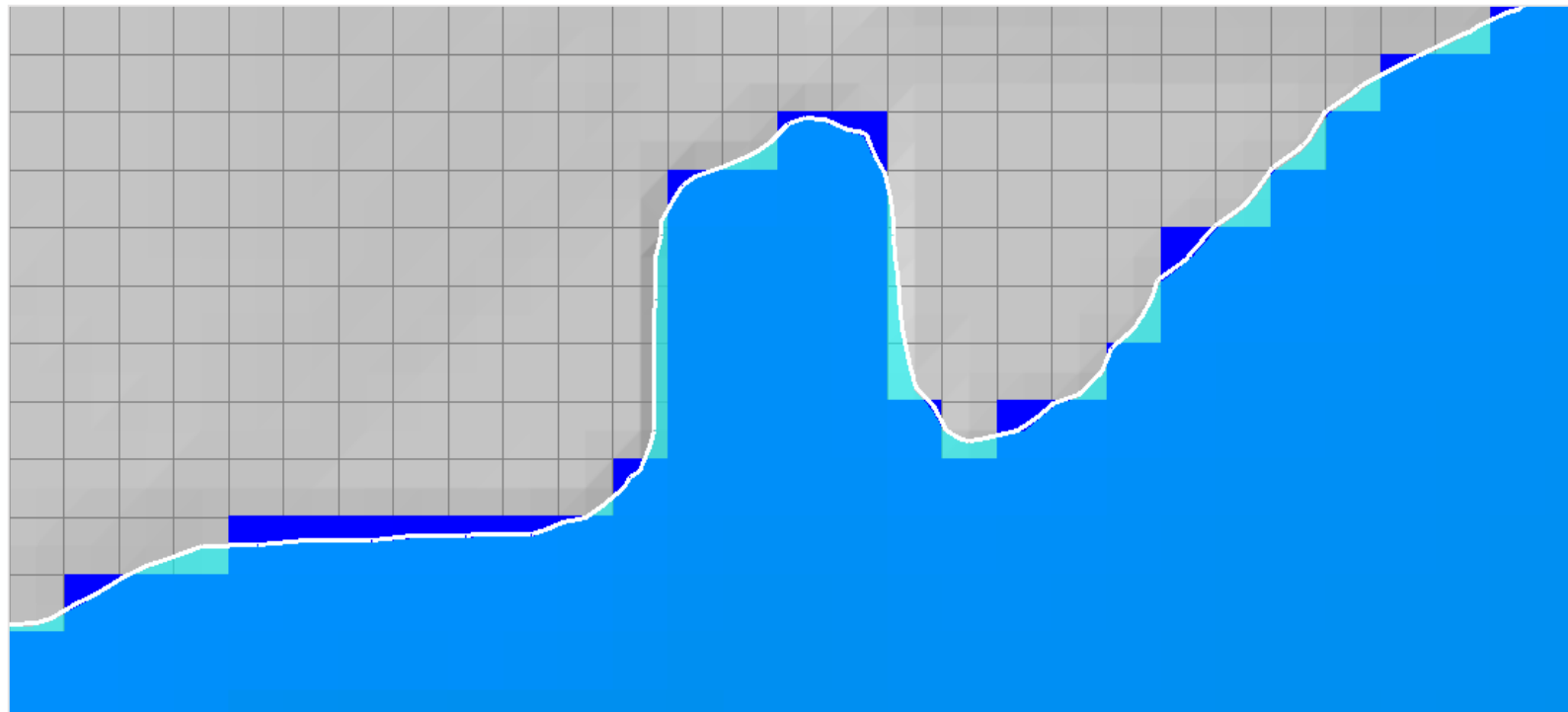
# Map Types – Dynamic vs Stored

- Dynamic: Computed on-the-fly
  - Smooth: Computes to screen-resolution
  - Doesn't use disk space
- Stored: Computed to terrain resolution
  - Stored to disk
  - Faster rendering for slow map types



# Dynamic vs Stored Results

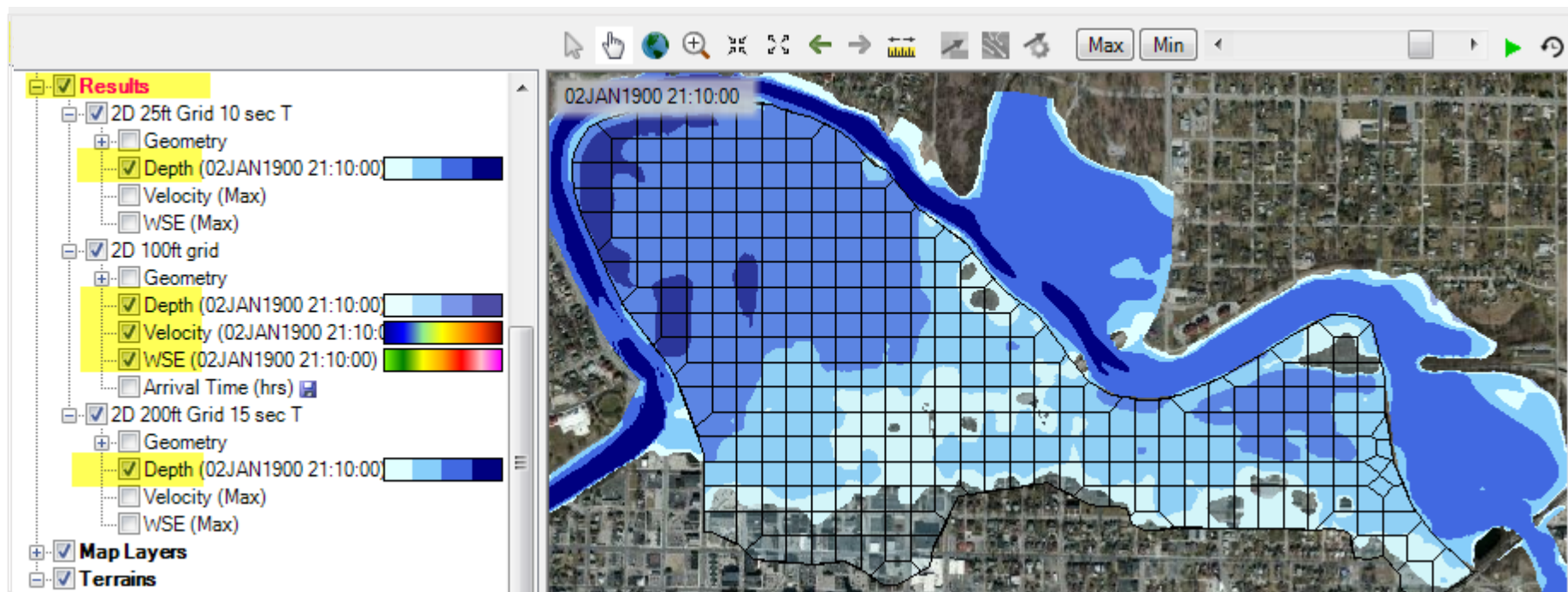
- Dynamic results plot values for the current pyramid level. Boundaries are defined based on interpolation.
- Stored results have a single value per cell.





# Dynamic Mapping

- Animation Toolbar – works on selected layer or group and syncs the timestep





# Dynamic Mapping - Animation





# Calculated Layer

- RASter Calculator
- Custom scripting code to use multiple results
- Works with RAS Results and Terrains
- Works with Rasters on disk

The screenshot shows the RASter Calculator window with the following components and callouts:

- 1**: Script dropdown menu set to "Compare WSE".
- 2**: Layers list containing "WSE1 = 200ft | WSE | | Dynamic" and "WSE2 = 2D 50ft Grid | WSE | | Dynamic".
- 3**: Calculation code editor showing Visual Basic script for comparing water surface elevations.
- 4**: Raster Output folder path: "s:\q\heccta\Documents\HEC Data\HEC-RAS\Example Projects\2D Unsteady Flow Hydraulics\Muncie\Calculated Layers".
- 5**: Raster Output Name field set to "CompareWSE".
- 6**: "Create Layer" button.

```
' Compare WSE Example: compares Water Surface Elevations from two Plans
' Requirements: Water surfaces, 'WSE1' and 'WSE2'
' Terrains: 'Terrain', 'TerrainWithChannel'
#VARIABLES:
' 'WSE1' is the cell value from 'WSE1 = 200ft | elevation | -1 | Dynamic'
' 'WSE2' is the cell value from 'WSE2 = 2D 50ft Grid | elevation | -1 | Dynamic'
' 'Terrain' is the cell value from 'Terrain'
' 'Terrain' is the cell value from 'TerrainWithChannel'
-----
If WSE1 = NoData AndAlso WSE2 = NoData Then
' The grid cell is not wet for either plan
Output = NoData
Else
' Compare the Water Surface Elevations
' One plan may have a wet cell, while the other does not.
If WSE1 = NoData Then WSE1 = Terrain
If WSE2 = NoData Then WSE2 = Terrain
Output = WSE1 - WSE2
End If
```



# Stored Maps

Manage Results Maps

View Result Maps for: All Plan Results

Compute/Update Stored Maps

Results and Maps	Store Status	
<b>2D 25ft Grid 10 sec T</b>		Add New Map
Depth (03JAN1900 00:00:00)	N/A	Edit Map
Velocity (Max)	N/A	Edit Map
WSE (Max)	N/A	Edit Map
<b>2D 100ft grid</b>		Add New Map
Depth (02JAN1900 21:10:00)	N/A	Edit Map
Velocity (02JAN1900 21:10:00)	N/A	Edit Map
WSE (02JAN1900 21:10:00)	N/A	Edit Map
Arrival Time (hrs)	Map files are out of date	Edit Map
<b>2D 200ft Grid 15 sec T</b>		Add New Map
Depth (02JAN1900 21:10:00)	N/A	Edit Map
Velocity (Max)	N/A	Edit Map
WSE (Max)	N/A	Edit Map
Arrival Time (2ft hrs)	Map not created	Edit Map



# Stored Maps

- Map status message on cursor tool tip

## Right-click options:

- Edit Map Parameters
- Compute Map

The image displays three sequential screenshots of a software interface, likely a GIS or hydraulic modeling application, showing a list of map layers and their properties. The layers are organized into two main groups: '2D 100ft grid' and '2D 200ft Grid'. Each group contains sub-layers for 'Geometry', 'Depth', 'Velocity', 'WSE', and 'Arrival Time'. The 'Arrival Time' layers are highlighted in blue and have a color scale legend to their right. A yellow tooltip message 'Map files are out of date' is visible over the 'Arrival Time (hrs)' layer in the top screenshot. In the middle and bottom screenshots, a right-click context menu is open over the 'Arrival Time (hrs)' layer, showing options: 'Layer Properties ...', 'Edit Map Parameters', 'Compute/Update Stored Map', and 'Zoom to Layer'. The 'Edit Map Parameters' and 'Compute/Update Stored Map' options are highlighted in yellow.



# Results Layer Properties

The screenshot displays the HEC-RAS software interface. On the left is the Project Explorer tree, showing a hierarchy of layers including 'Results' and 'Map Layers'. The 'Results' folder is expanded to show '2D 25ft Grid 10 sec T', which is further expanded to show 'Arrival Time (hrs)'. The 'Map Layers' folder is also expanded to show 'Arrival Time (hrs)'. A message window at the bottom left indicates that the post-process was completed and maps were created.

The main window shows a map of a river reach with a color-coded arrival time overlay. The colors range from red (low arrival time) to green (high arrival time). Two dialog boxes are open over the map:

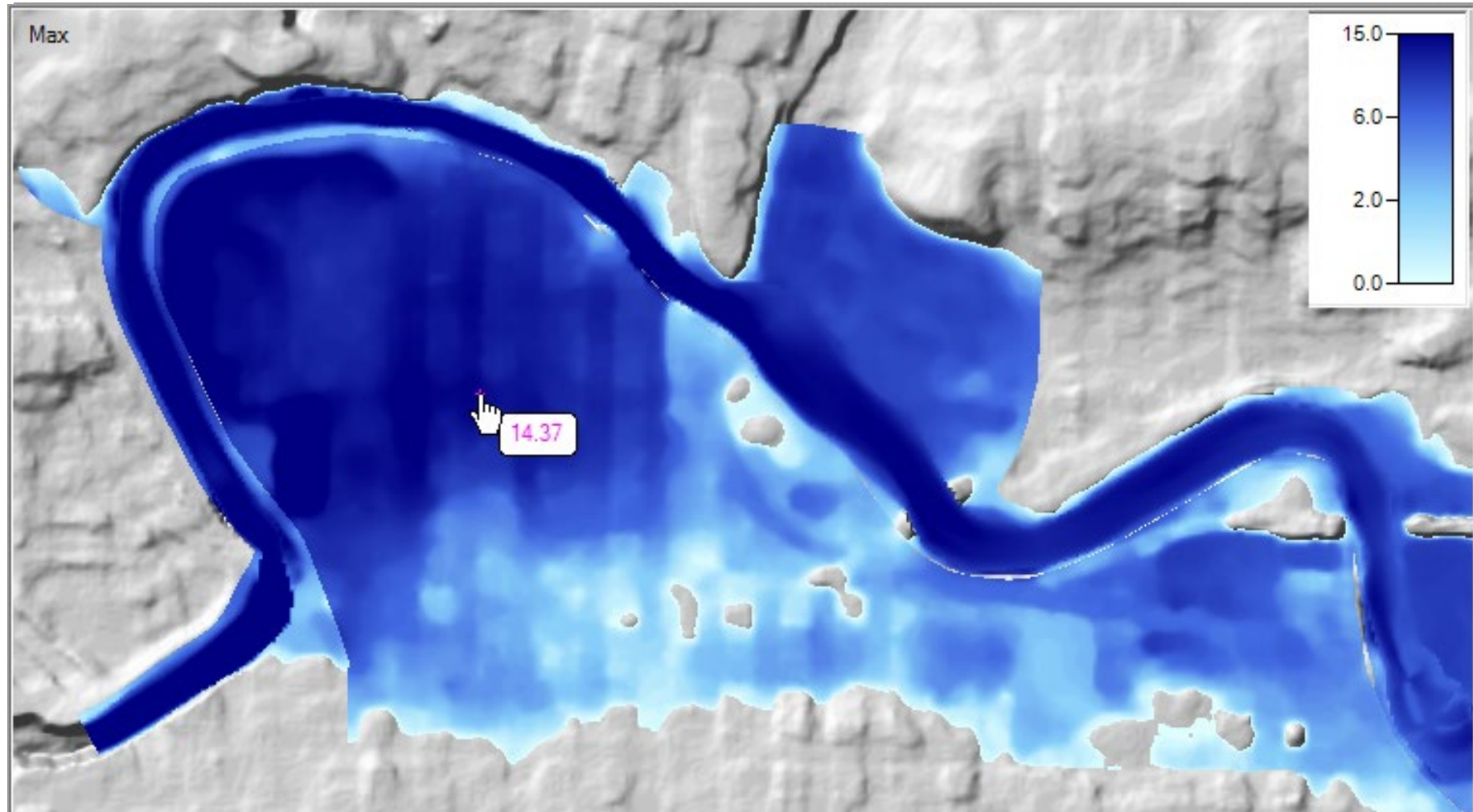
- arrival time - Layer Properties**: This dialog box has two tabs: 'Visualization and Information' and 'Additional Options'. The 'Visualization and Information' tab is active, showing options for 'Vector' (Point, Line, Fill) and 'Surface' (Plot Surface, Discrete, Edit). The 'Surface' section includes a color ramp legend with values from 0.0 to 16.0, a transparency slider, and options for 'Plot Contours' (Interval: 5) and 'Plot Hillshade' (Z Factor).
- Select Surface Fill**: This dialog box is used to define the surface fill settings. It shows 'Surface Symbol Settings' with a 'Color Ramp' set to 'Arrival Time' and 'Keep user values with color ramp change' checked. The 'Surface Symbol' section shows 'Max: 16.00', 'Interval Type: Linear', 'Min: 0.00', and 'No. Values: 6'. A table below shows the color ramp values:

Value	Color	Red (0-255)	Green (0-255)	Blue (0-255)
0.00	Red	255	0	0
2.00	Red-Orange	205	92	92
4.00	Orange	255	165	0
8.00	Yellow	255	255	0
12.00	Light Green	144	238	144
16.00	Dark Green	0	128	0



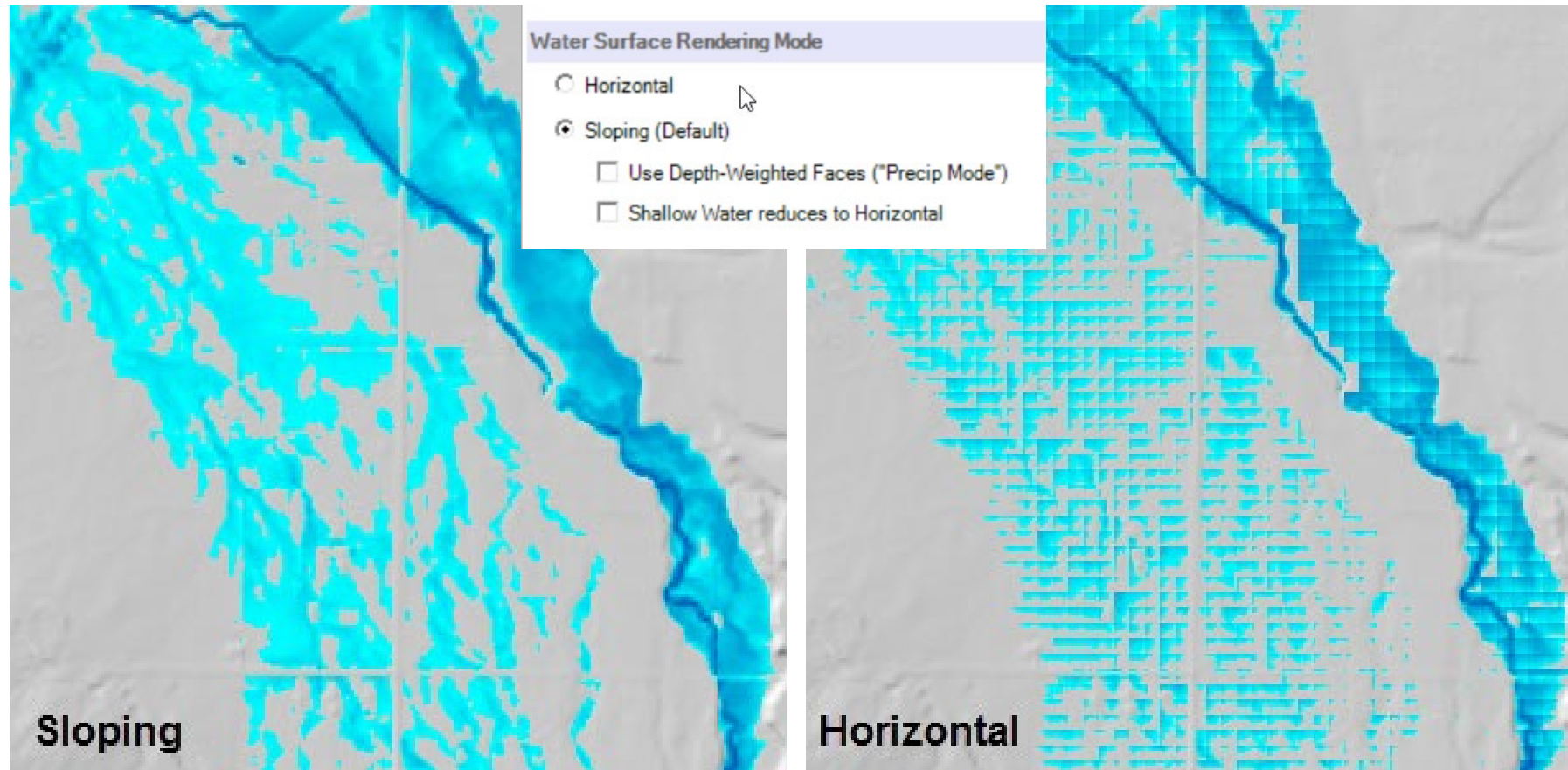


# Results Visualization





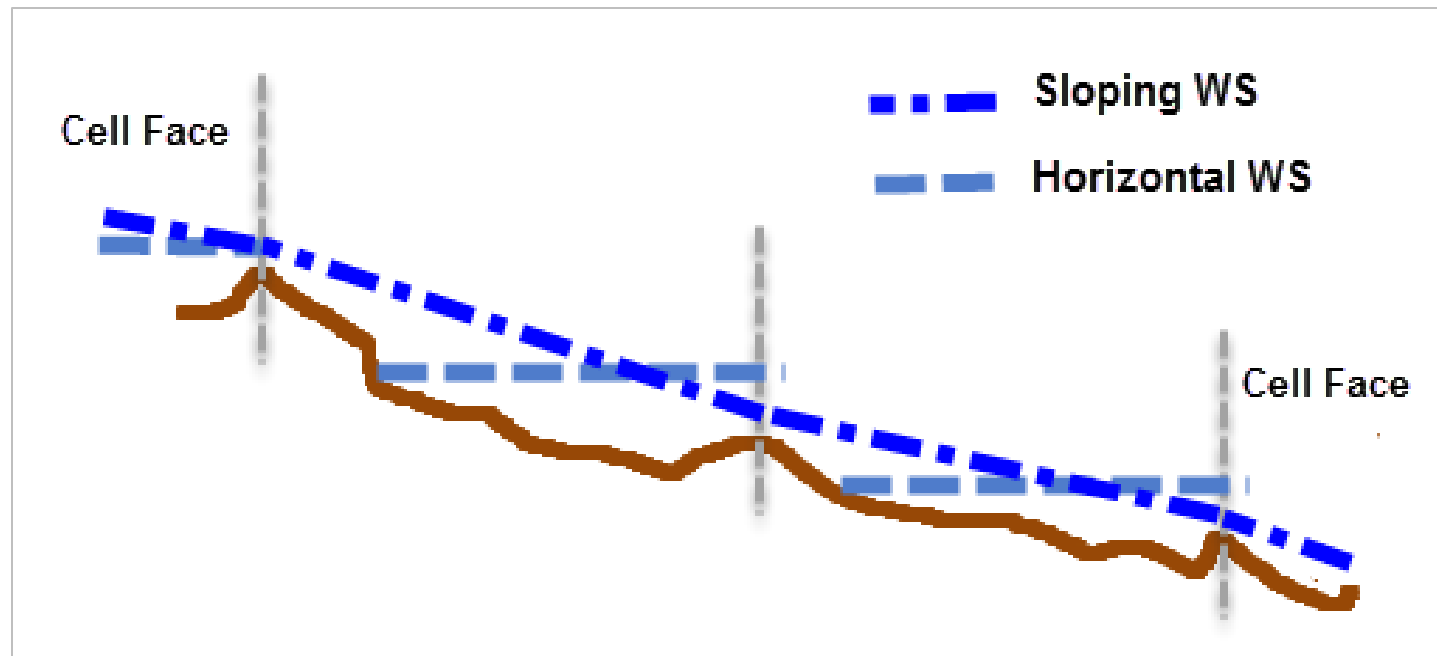
# Render Mode Options





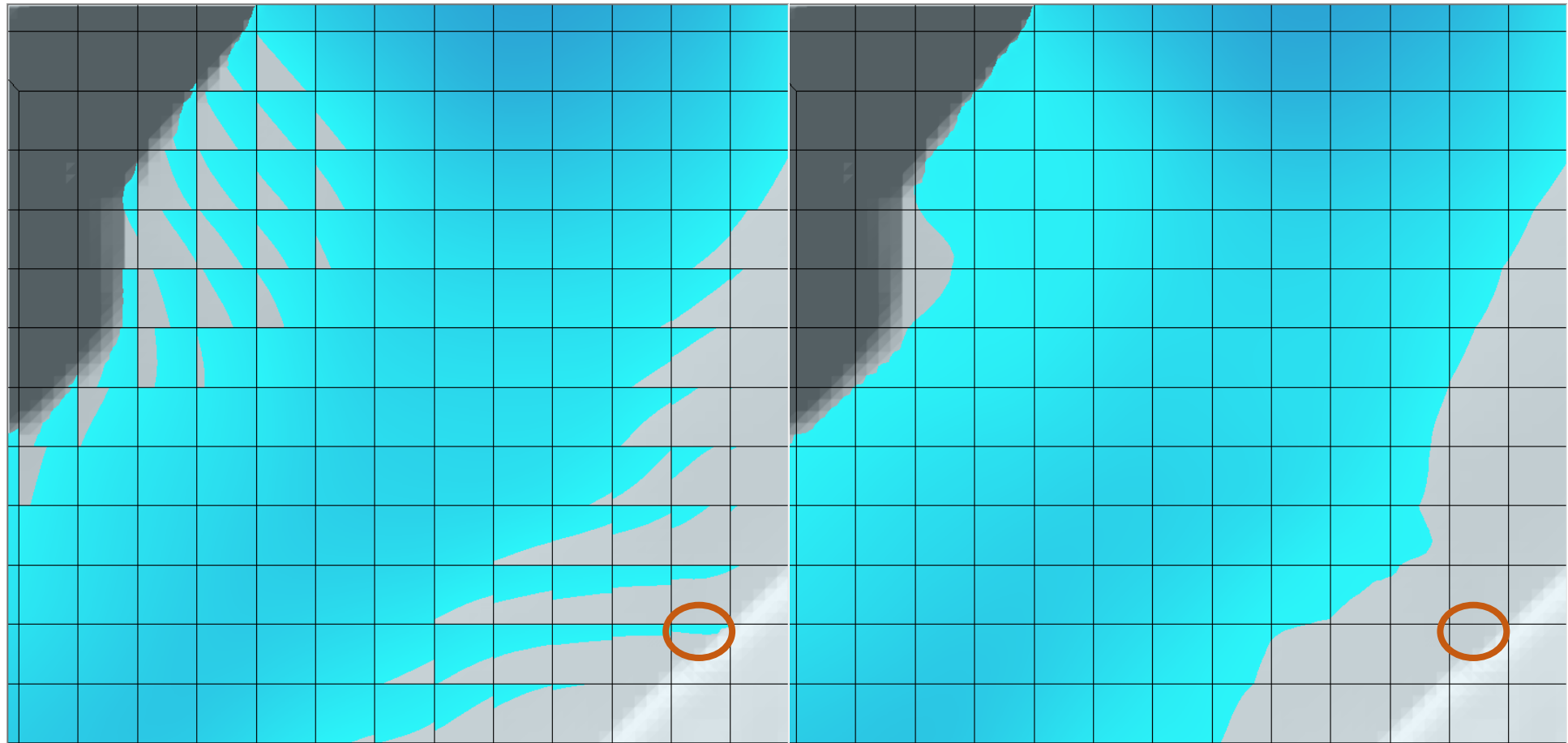
# Results Interpolation

- Render mode options allow for interpolation of water surface elevation values or plotting values at the cell centers.



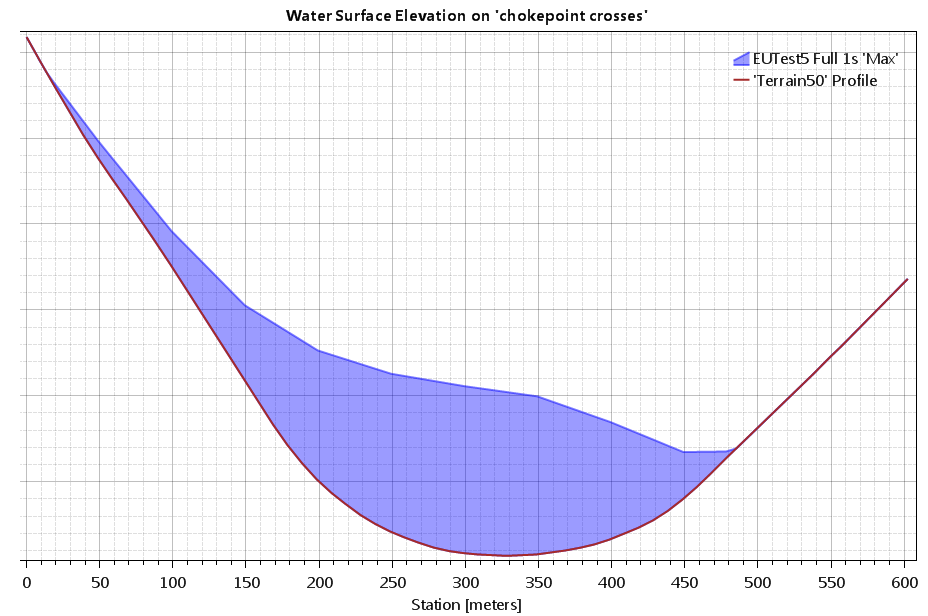
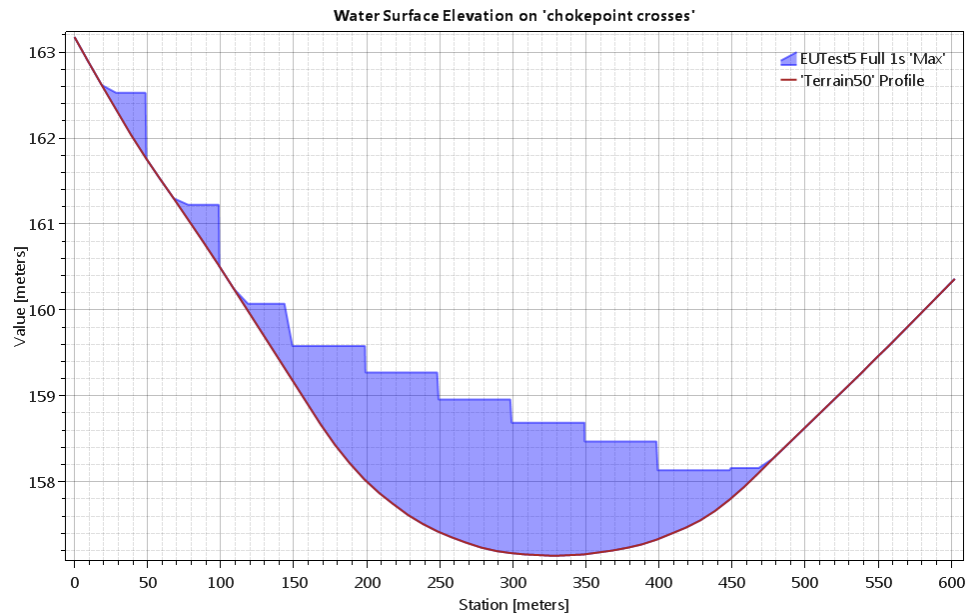


# Horizontal vs Sloping Surface



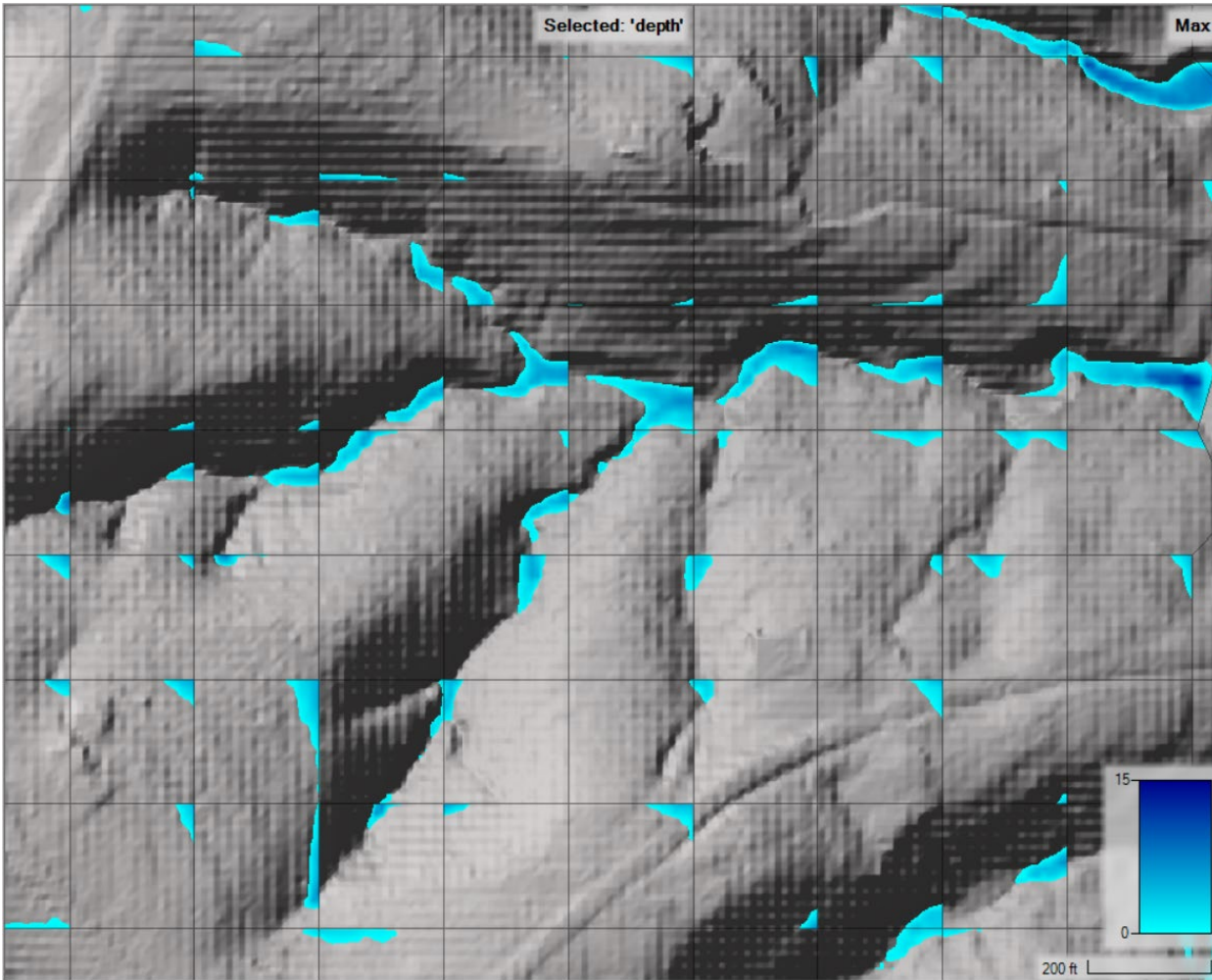


# Horizontal vs Sloping Surface

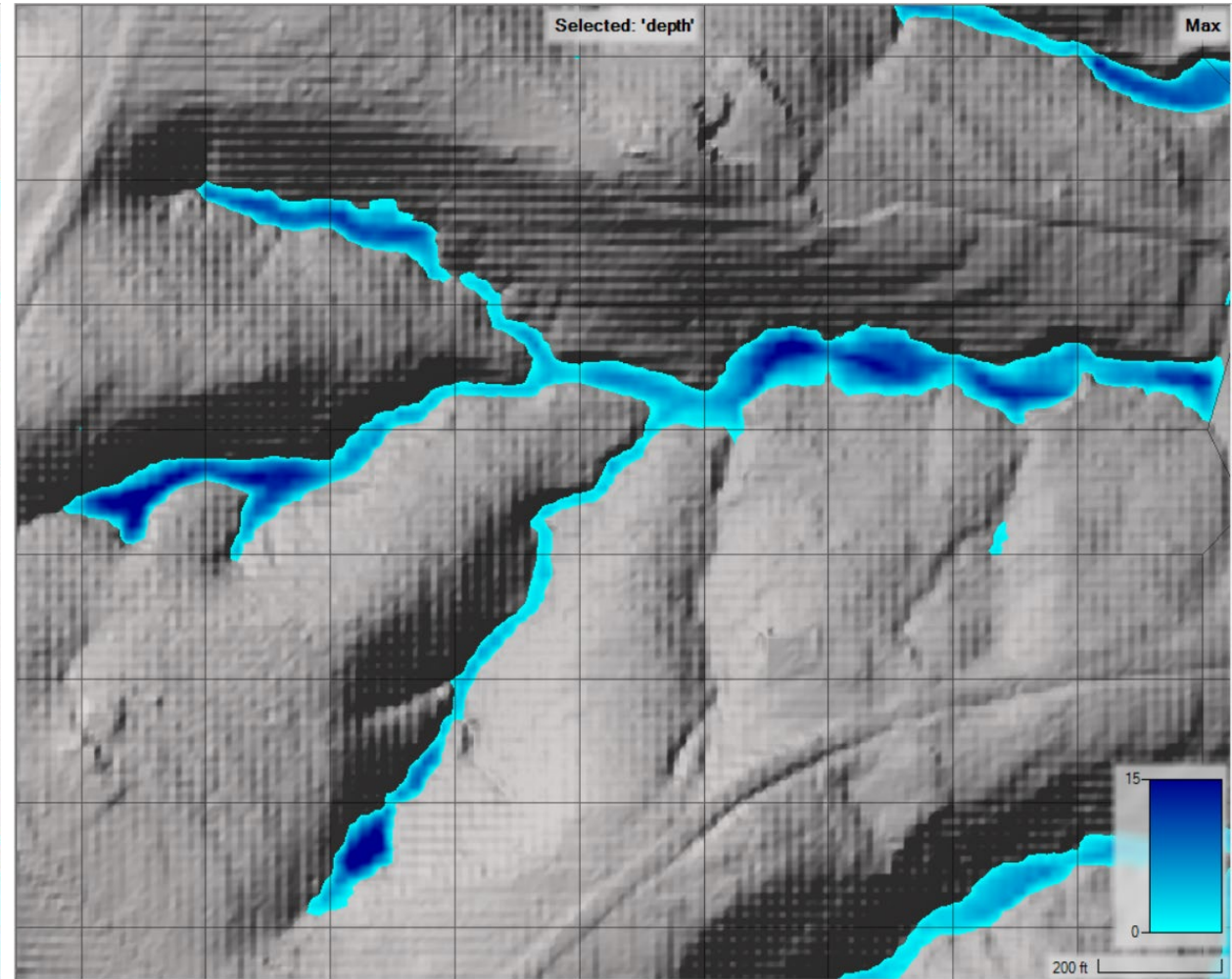




# Sloping Surface Errors



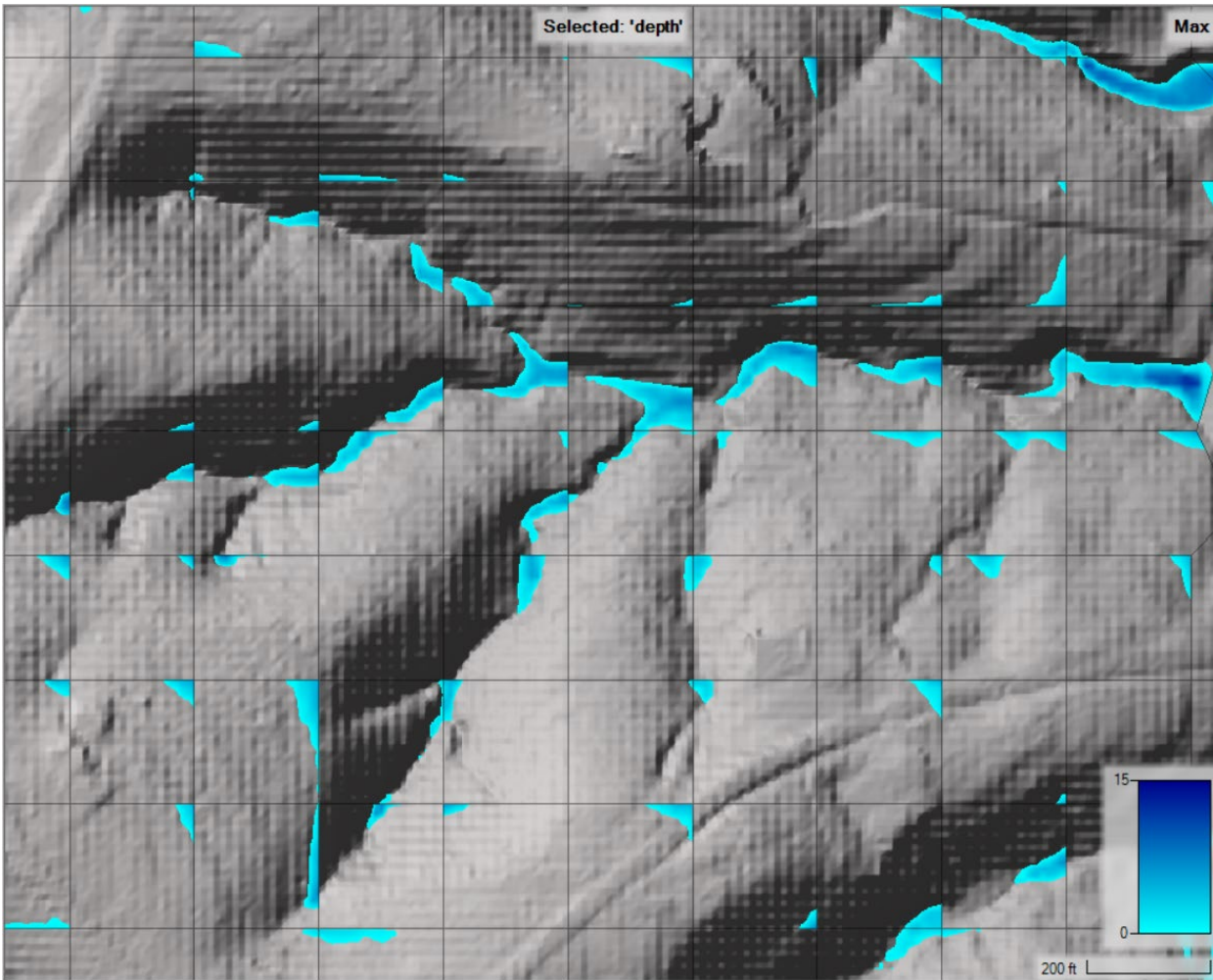
Horizontal



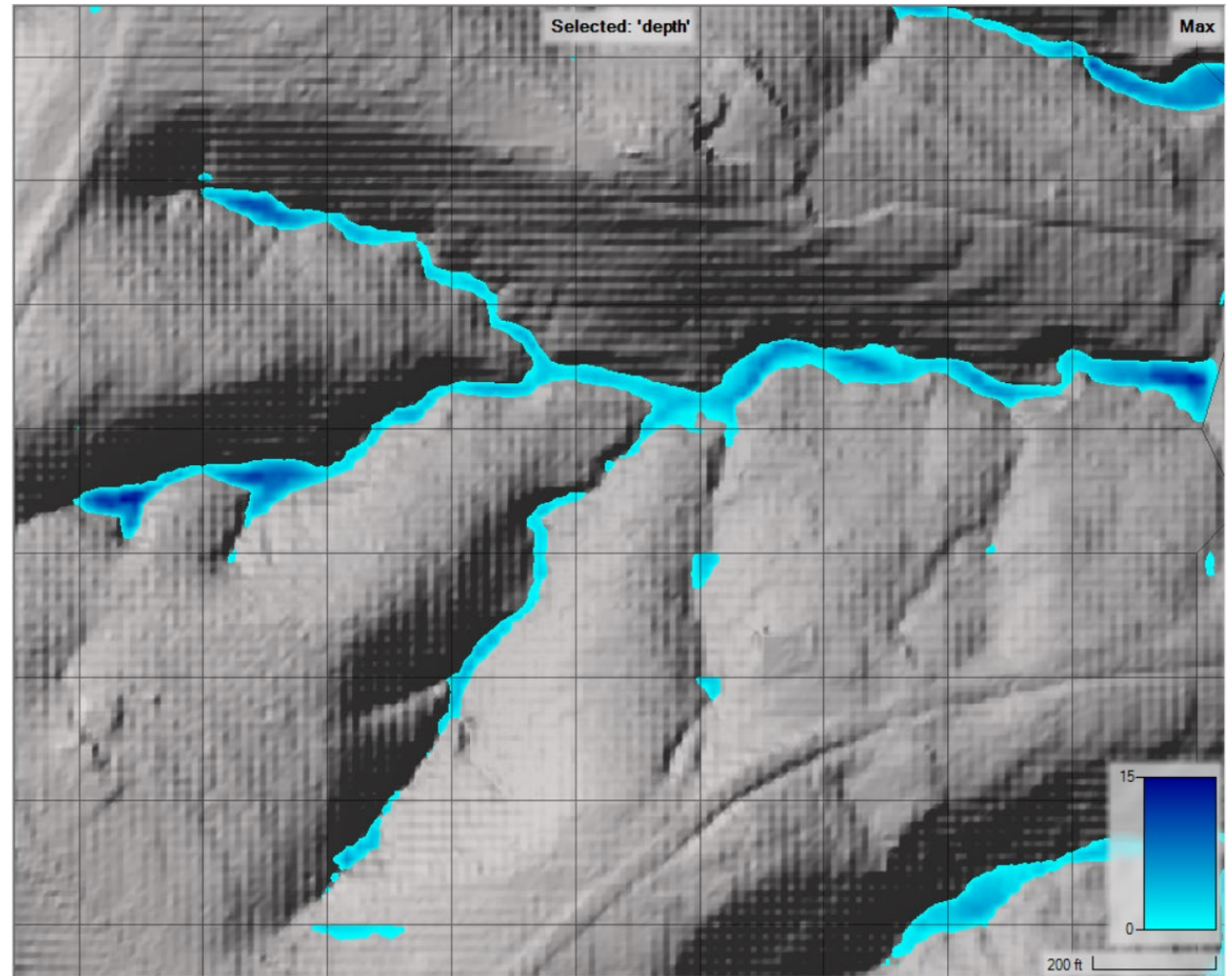
Sloping



# Sloping Surface Errors



Horizontal

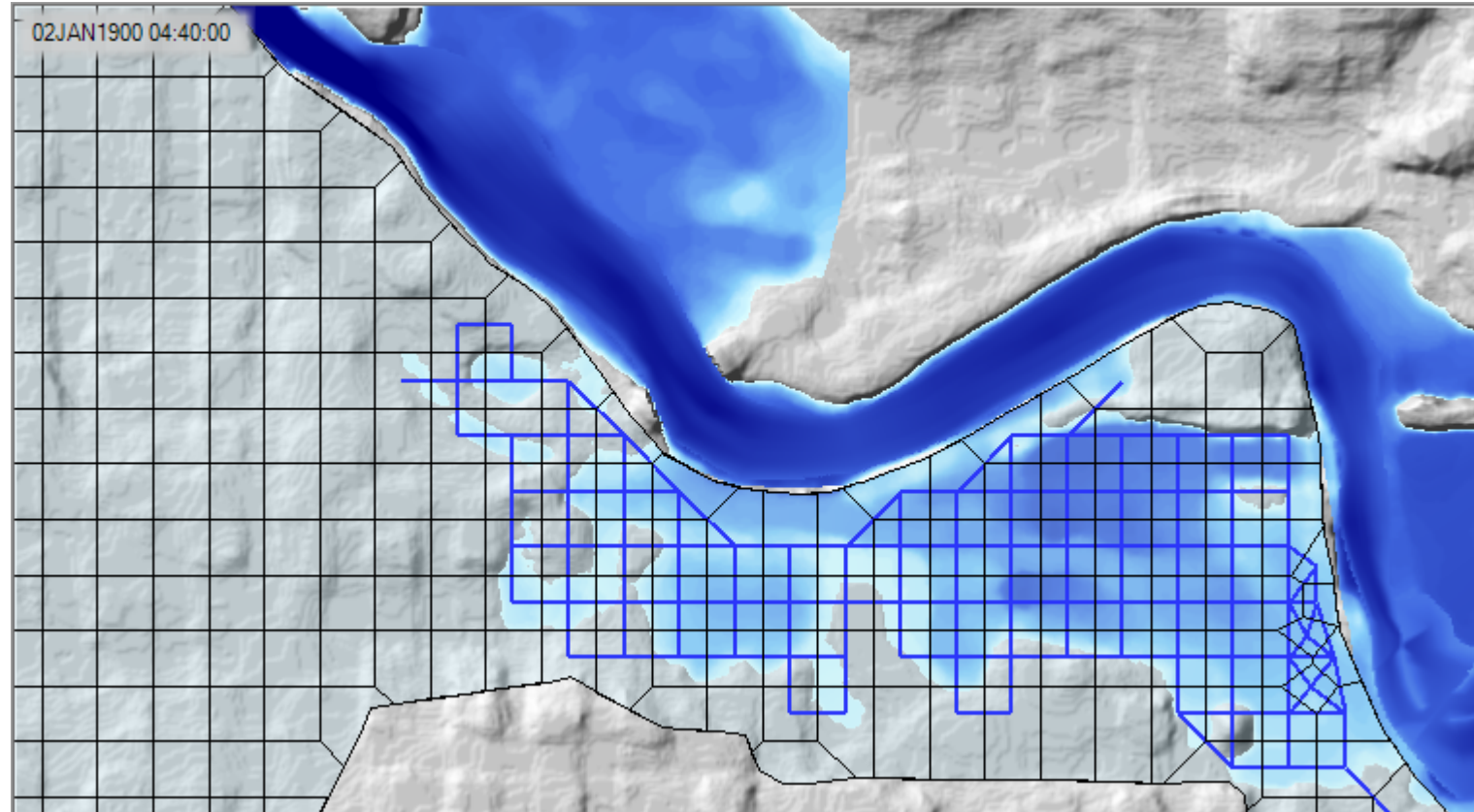


Precip Mode



# Depth Results

- Hydraulic connectivity from mesh







# Results Query

- 2D Flow Area query

The screenshot displays the HEC-RAS software interface. On the left, the 'Map Layers' panel is visible, showing a tree view of the project data. The '2D 200ft Grid 15 sec T' layer is expanded, and '2D Flow Areas' is checked. Other layers include 'Depth (Max)', 'Velocity (Max)', 'WSE (Max)', and 'Arrival Time (hrs)'. The 'Terrains' layer is also checked, with 'WithChannel' set to 'hillshade'. A color scale legend is shown next to the '2D Flow Areas' layer.

The central map view shows a 2D flow area query. A pink square highlights a specific cell in the grid. A context menu is open over this cell, displaying the following options:

- All Enabled Results
  - Time Series Plots
- Mesh: 2DFlowArea (2D 200ft Grid 15 sec T)
  - Find
  - Time Series Plots
  - Property Tables
- WithChannel Elevation: 937.48 feet
  - Cell: Water Surface
  - Cell: Depth
  - Cell: Shear Stress
  - Face Point: Velocity

At the bottom of the interface, there are tabs for 'Messages', 'Views', and 'Profile Lines'.



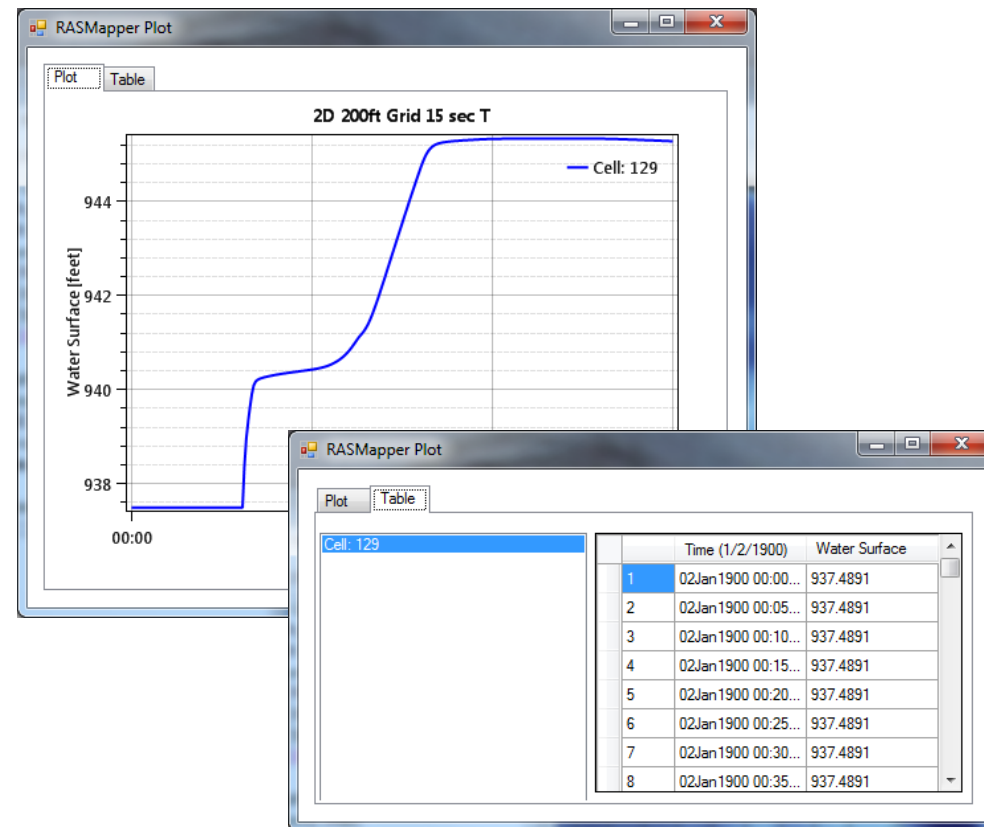
# 2D Flow Area Queries

- Hydraulic Properties

- Cell: Volume - Elevation
- Face: Area - Elevation
- Face: Wetted Perimeter - Elevation
- Face: Manning's n - Elevation
- Face: Profile

- Time Series

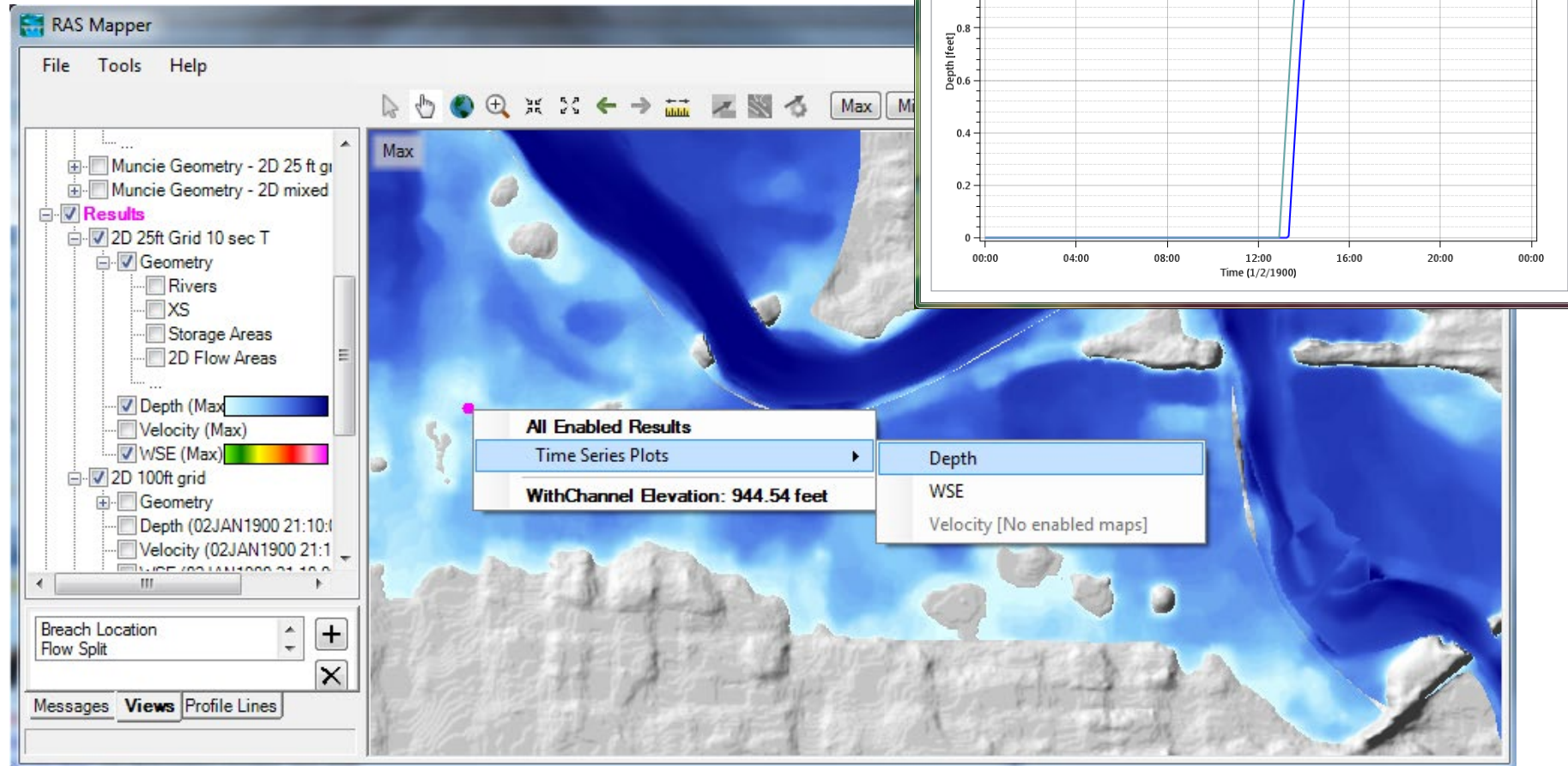
- Cell: Water Surface
- Cell: Depth
- Cell: Shear Stress
- Face Point: Velocity





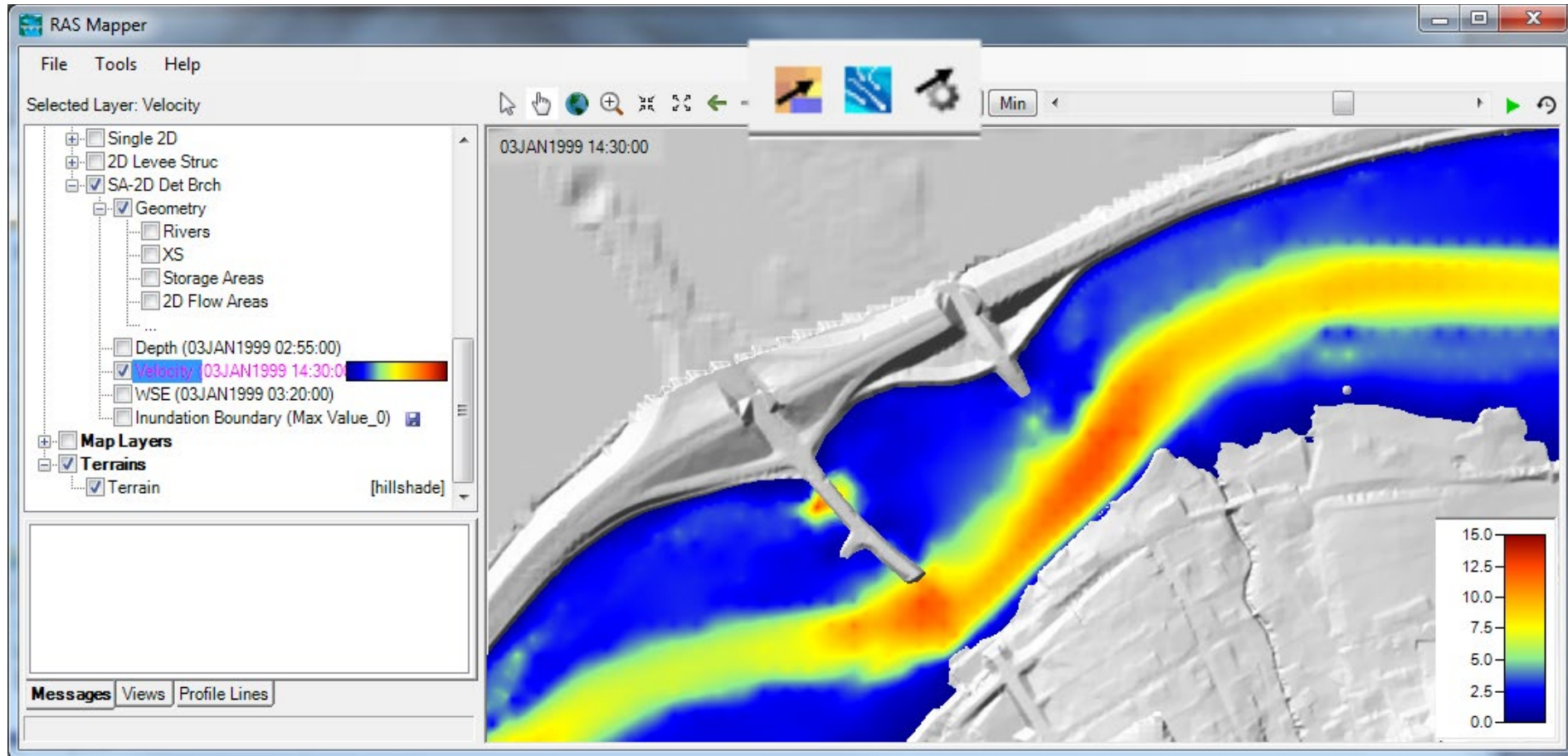
# Results Query

- Time Series





# Velocity Results





# Velocity Arrows

Velocity Map Parameters

**Static Arrows**

Regular Interval  
Spacing: 28

Computation Points [Disabled]

Color: White

**Particle Tracing**

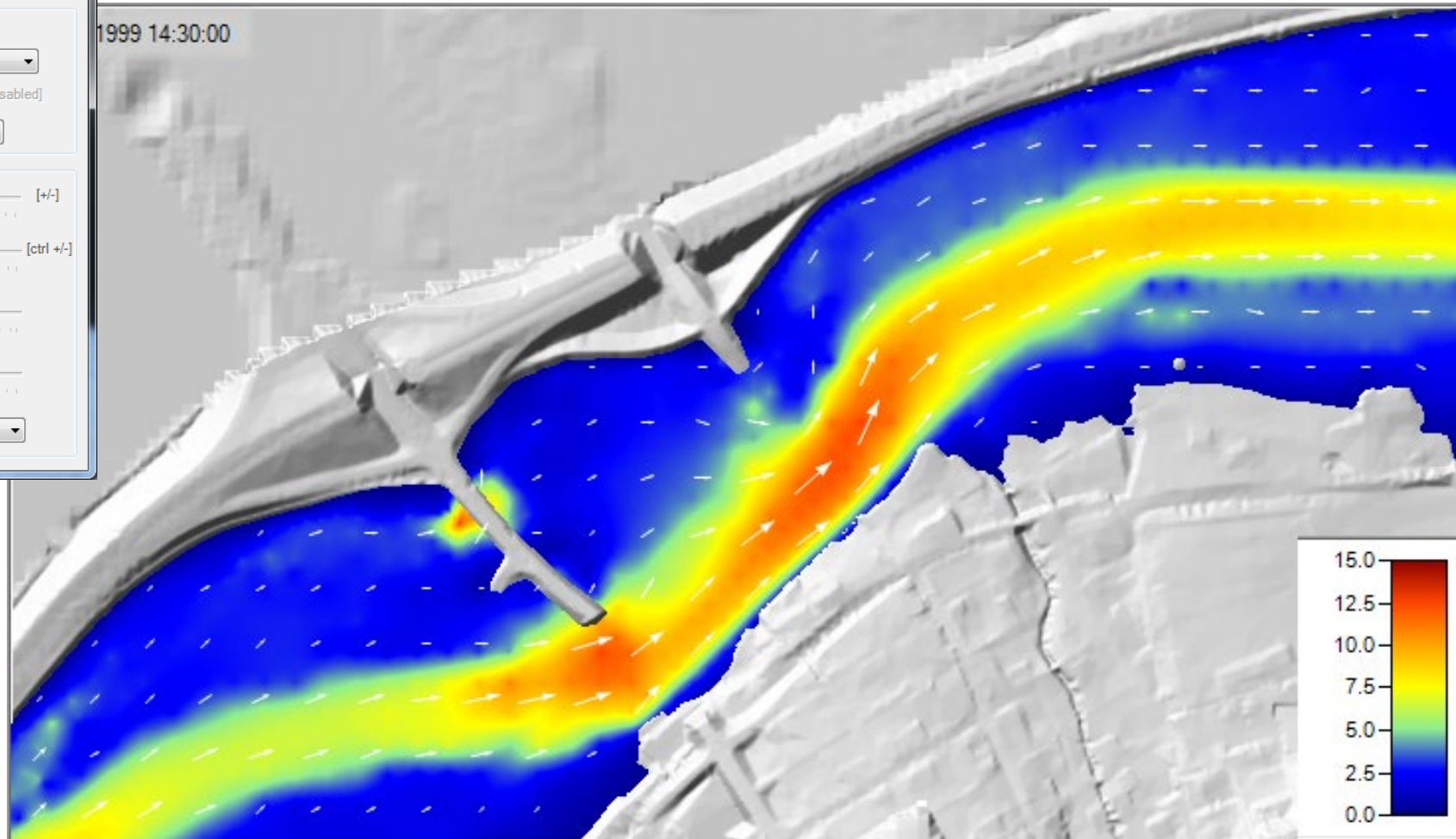
Speed: [Slider] [+/-]

Density: [Slider] [ctrl +/-]

Width: [Slider]

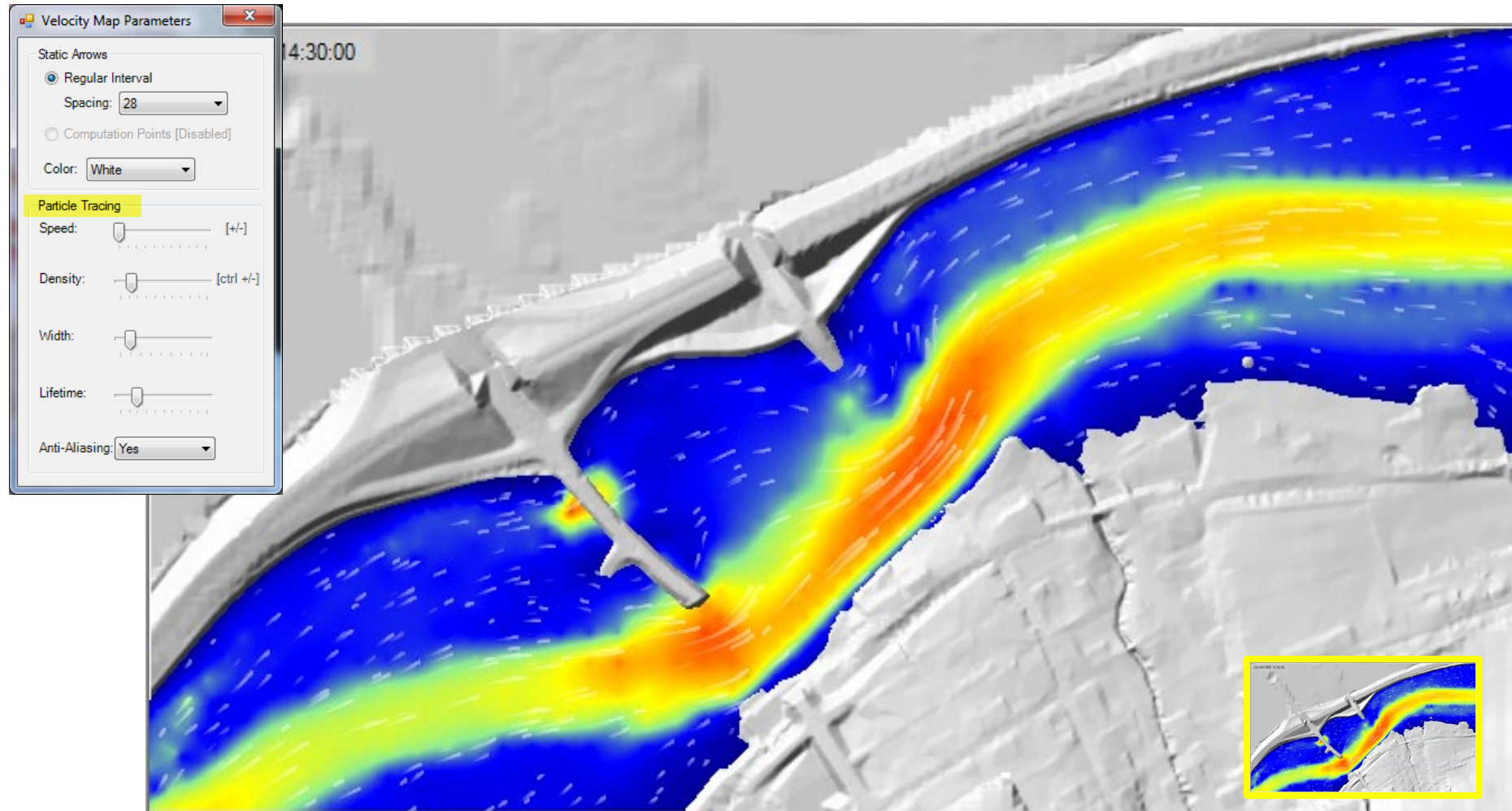
Lifetime: [Slider]

Anti-Aliasing: Yes



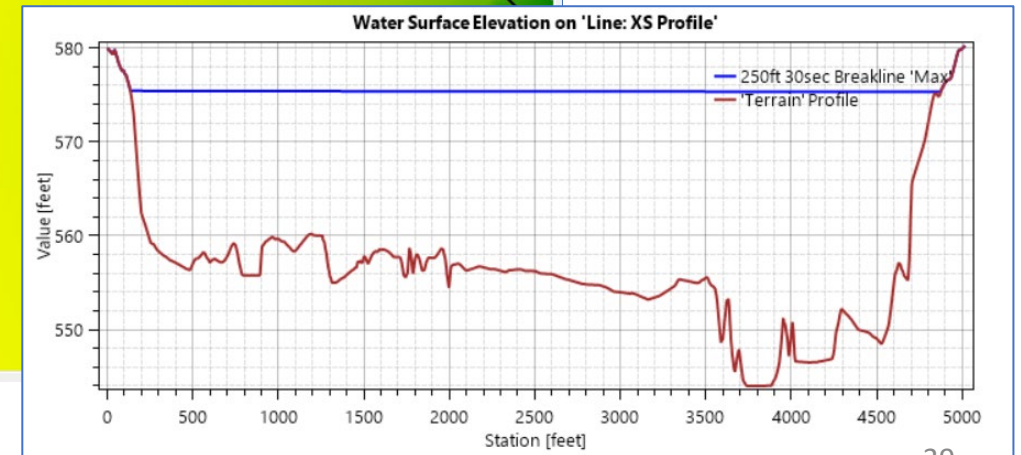
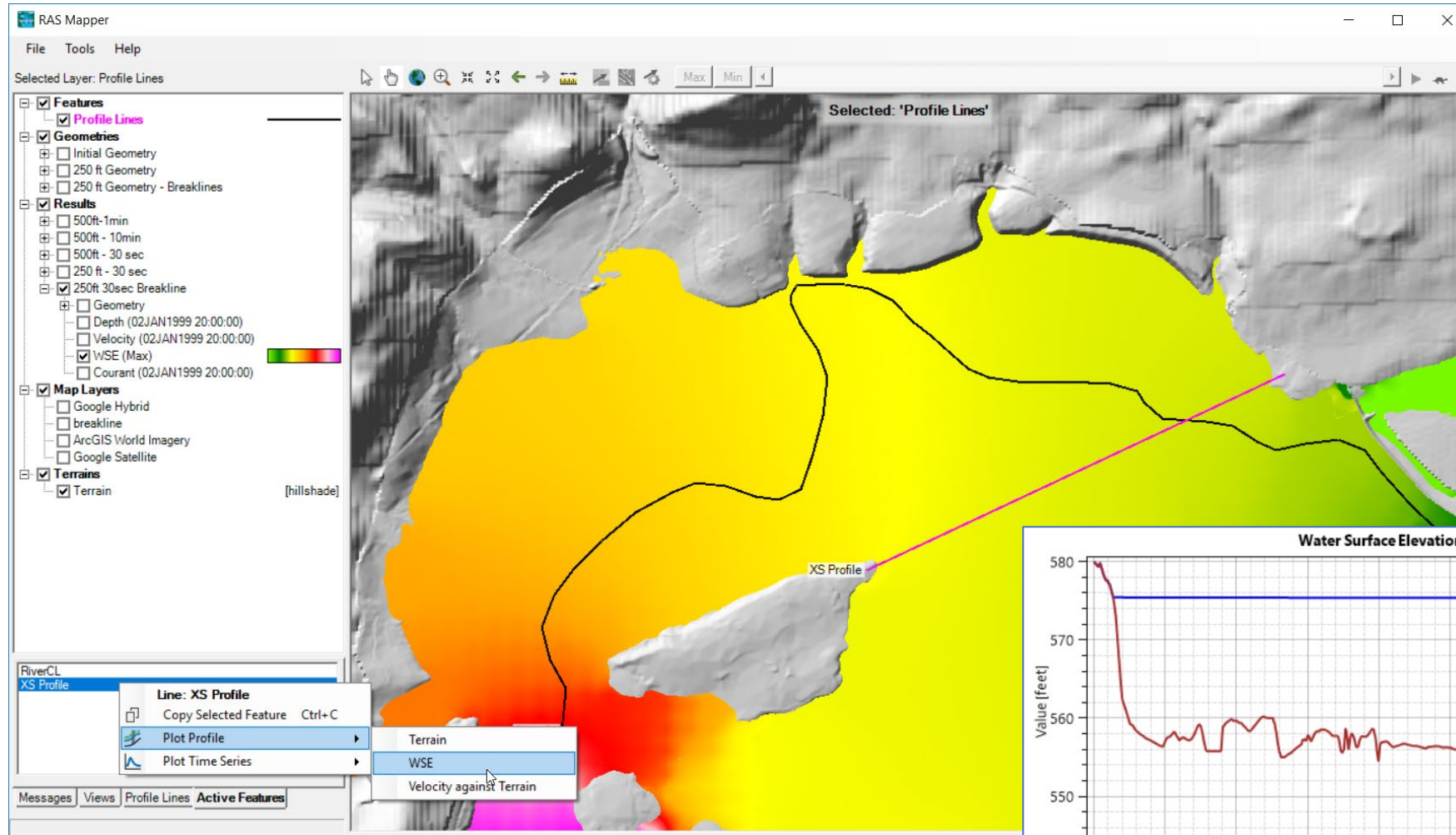


# Velocity Tracing





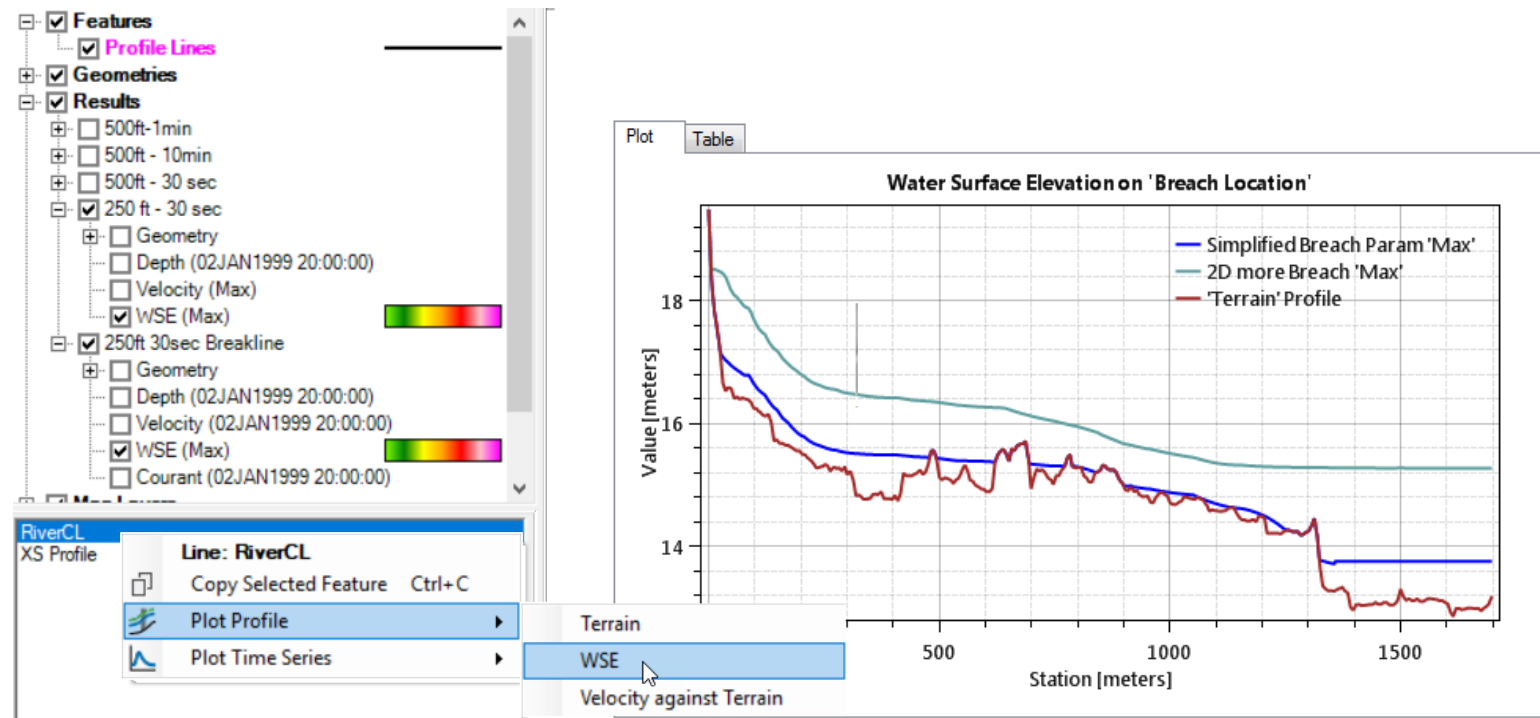
# Profile Lines





# Profile Line - Comparison

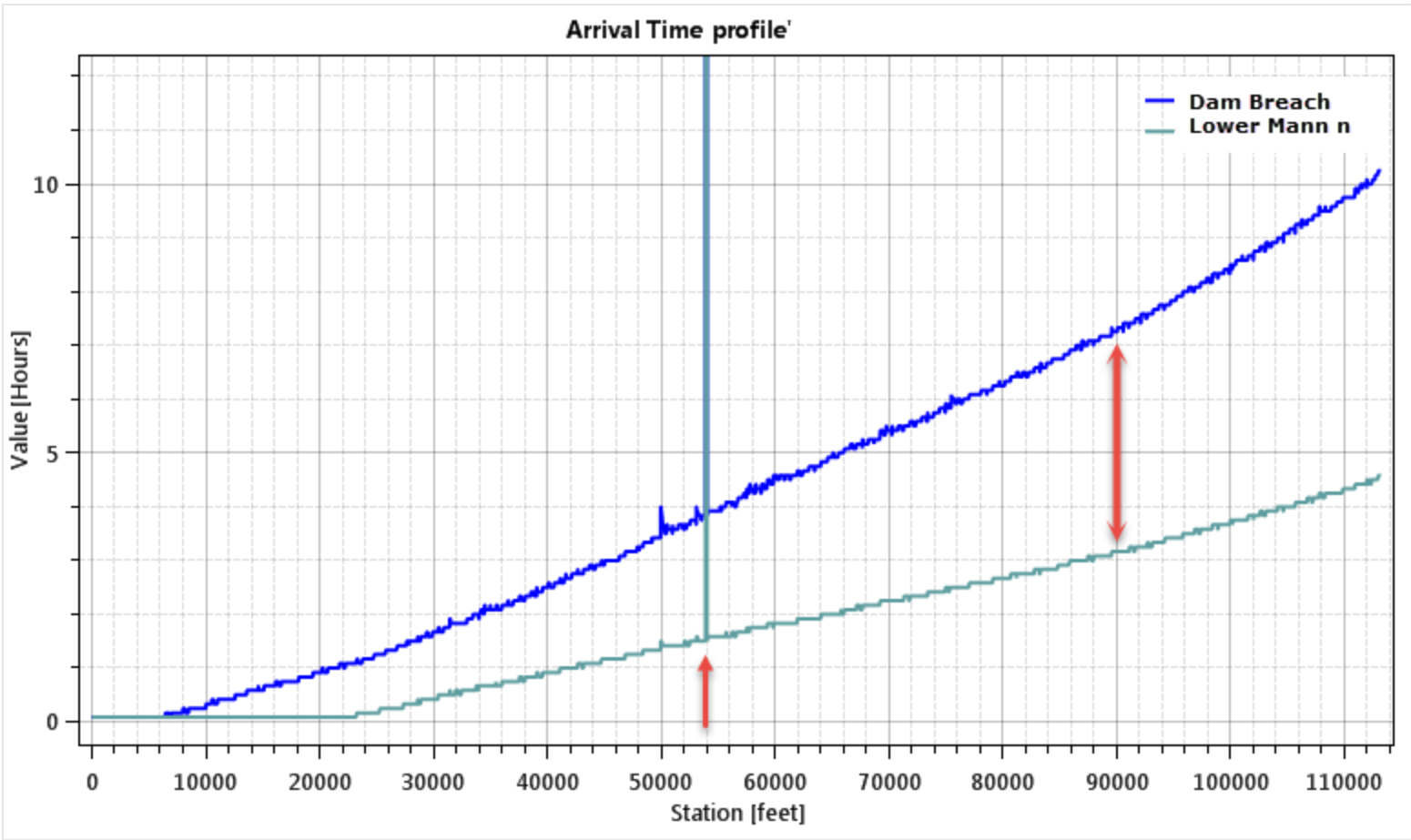
- Turn on multiple result maps
- Choose a Profile (i.e. 'Max')
- Choose **Plot Time Series** or **Plot Profile**





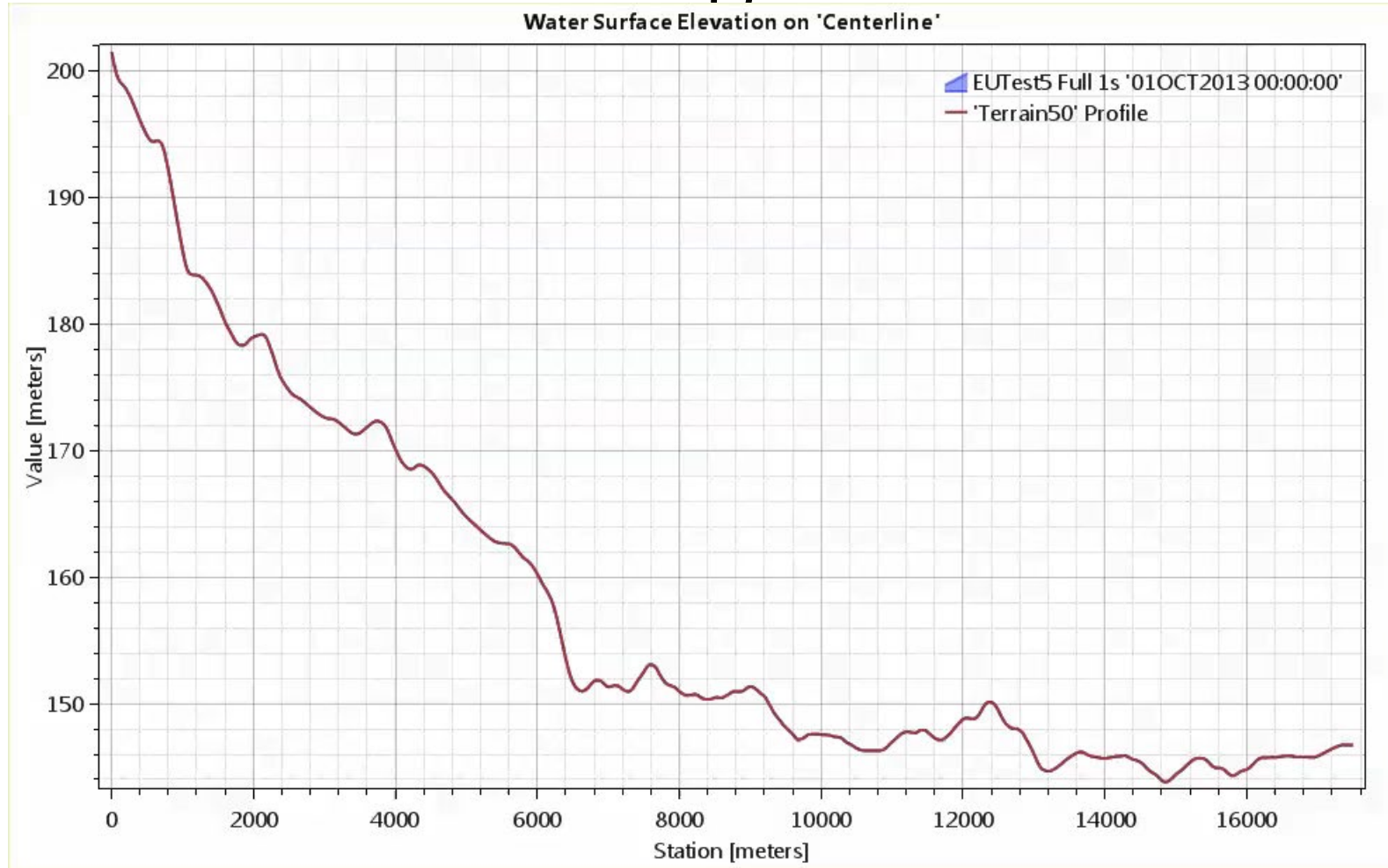


# Profile Lines - Comparison



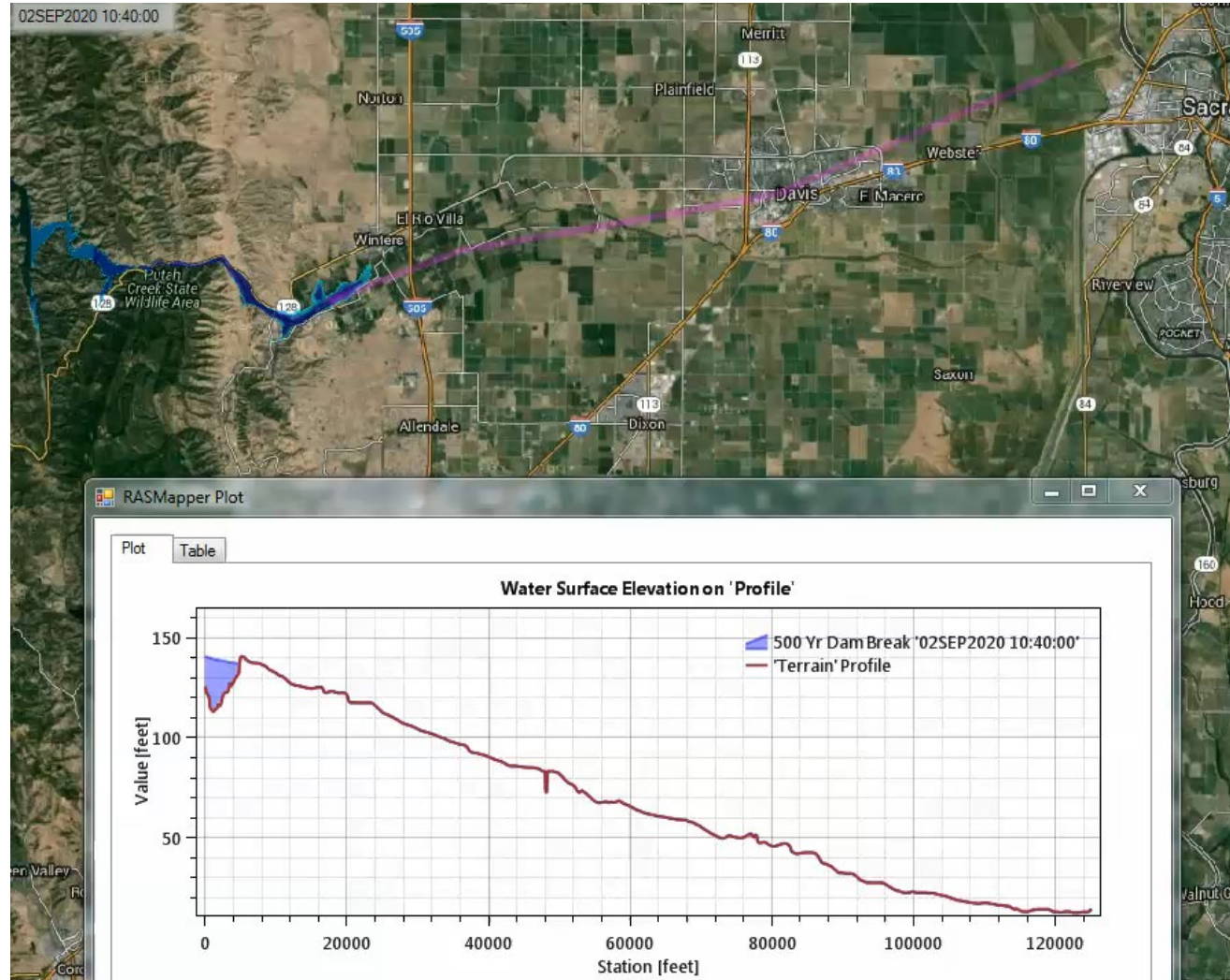


# Profile Lines - Animating



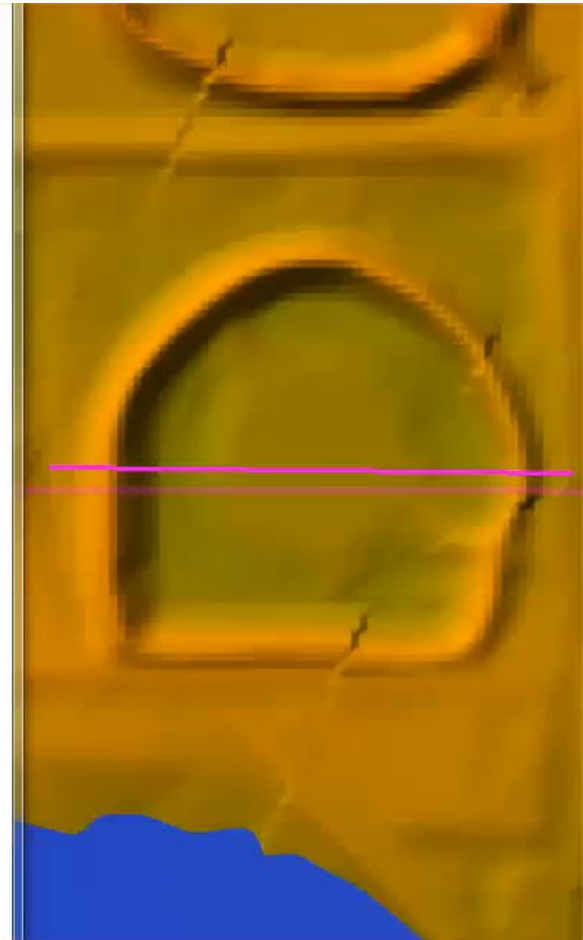
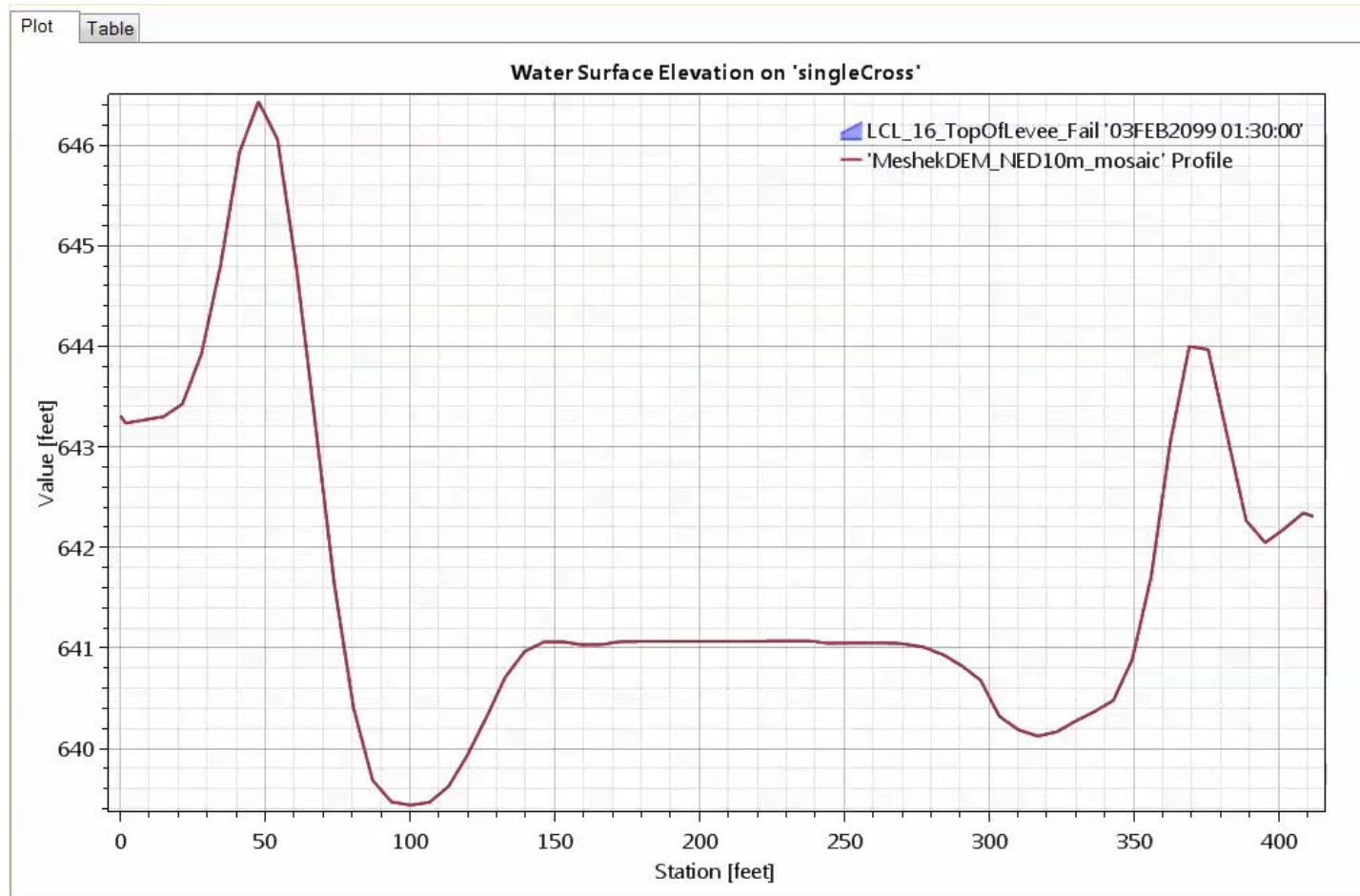


# Profile Lines + Spatial Results



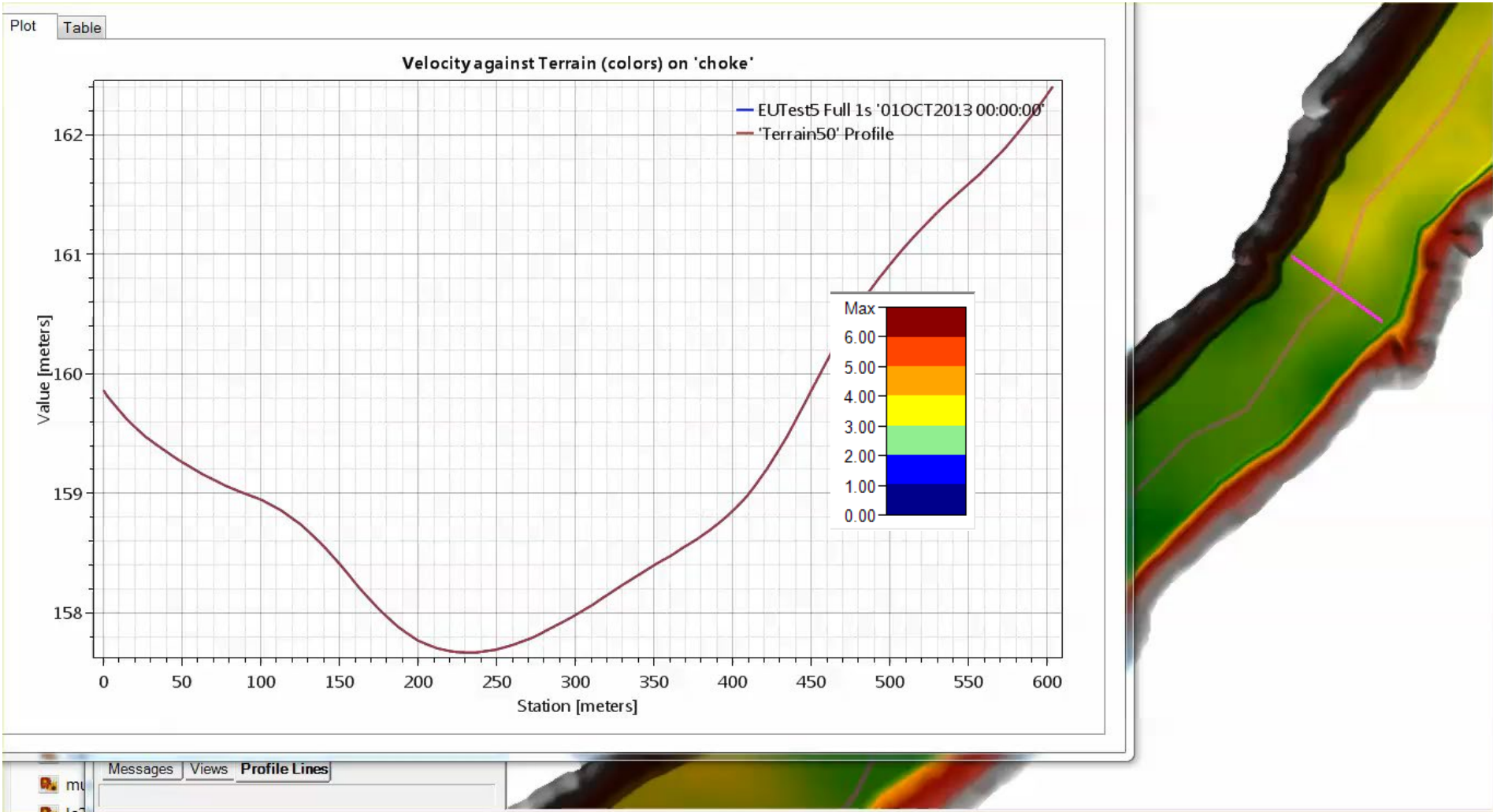


# Profile Lines - Animating



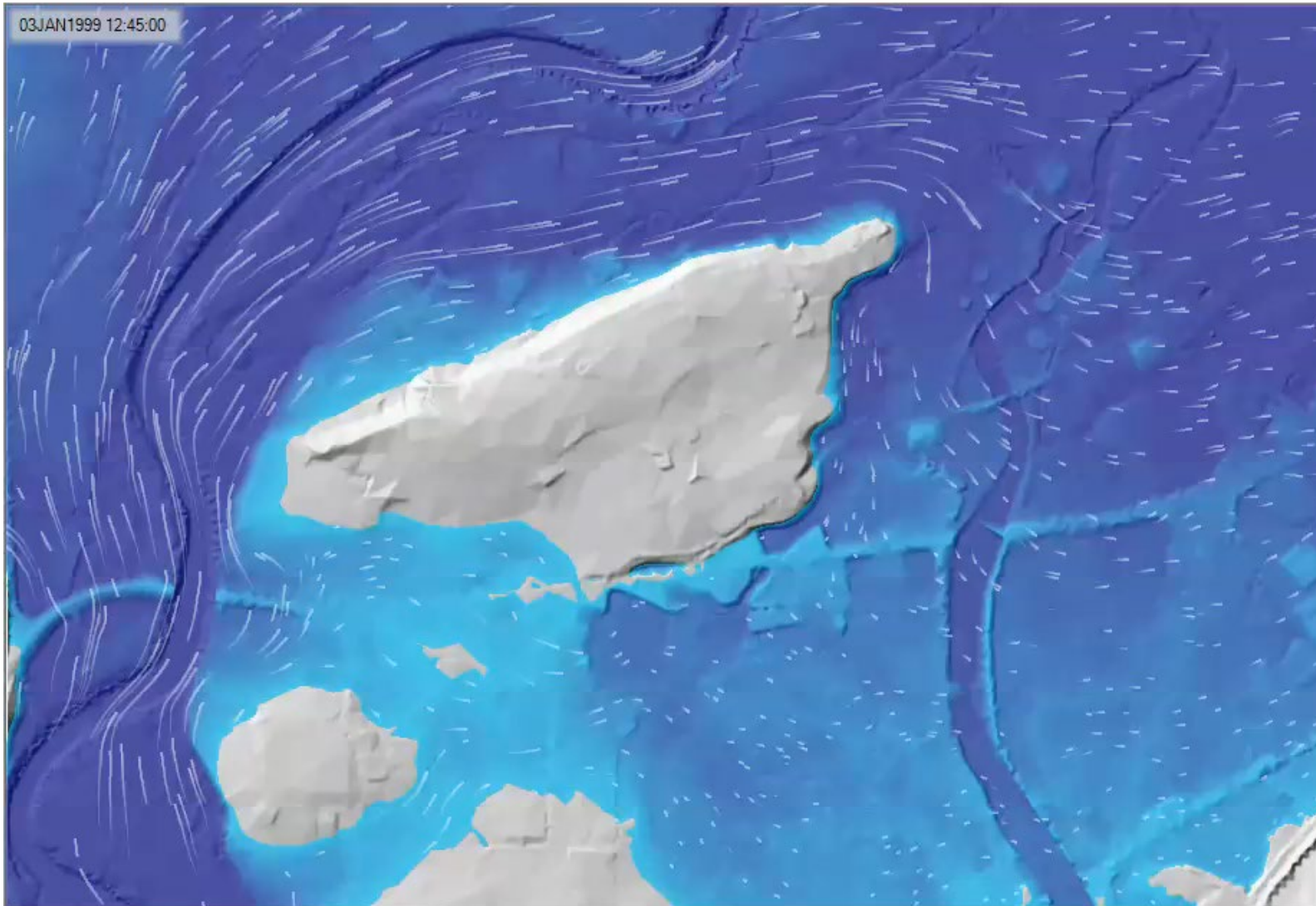


# Profile Lines – Velocity





# Velocity Trace Animation



# Questions?