

HEC-RAS Mapper Results Visualization

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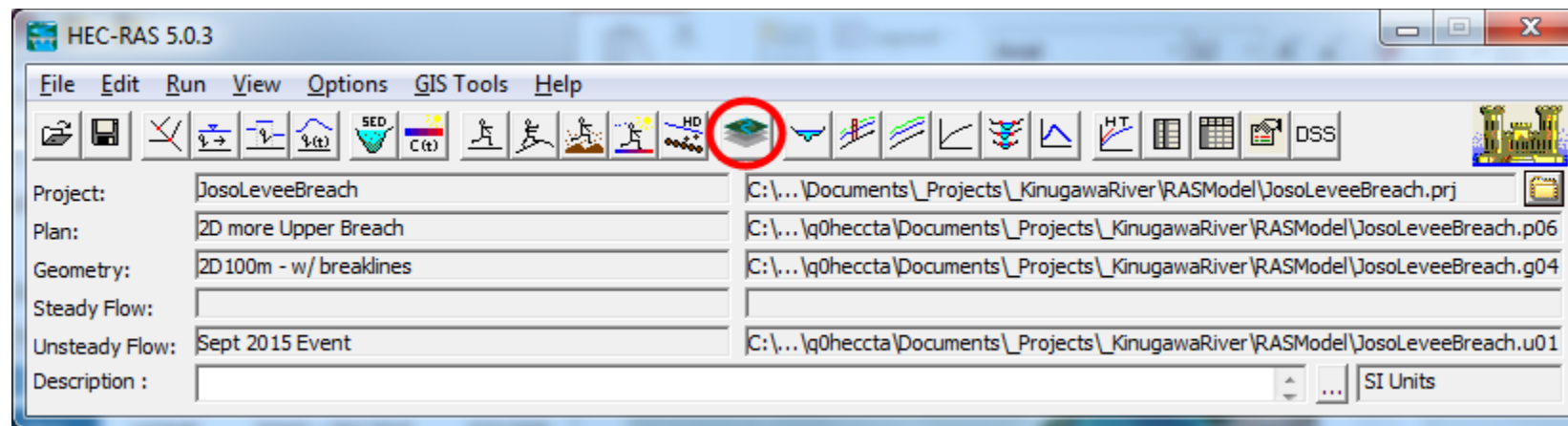
USACE, Institute for Water Resources, Hydrologic Engineering Center





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 application window. The interface is divided into several key areas:

- View Tools:** A toolbar at the top center, highlighted with a red box, containing icons for navigation (pan, zoom, pan up/down), display (toggle layers, 3D view), and animation (play, stop, refresh).
- Animation Controls:** A set of controls at the top right, also highlighted with a red box, including play, stop, and refresh buttons.
- Layers List:** A panel on the left side showing a hierarchical tree of layers. The 'Depth (Max)' layer is selected and highlighted in pink. Other layers include Features, Geometries, Event Conditions, Results, Map Layers, and Terrains.
- View Area:** The central map area showing a 3D visualization of a river channel with depth contours overlaid on a satellite-style terrain background. A red box highlights a specific section of the river.
- Status Area:** A panel at the bottom left showing the current view status, including 'US End of Levee', 'Left Split', 'Right Split', and 'Cross Section'.










At the bottom of the window, there are tabs for 'Messages', 'Views', 'Profile Lines', 'Active Features', and 'Layer Values'. The status bar at the very bottom shows coordinates and a scale: '(2036985.82, 346945.58 1 pixel = 19.94 ft)'. A scale bar in the bottom right corner indicates 2000 feet.



Layers List

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

Selected Layer: Depth

- 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

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

15696.24
15485.51
15370.43
15205.20

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



Profile Lines

- User-defined/editable features

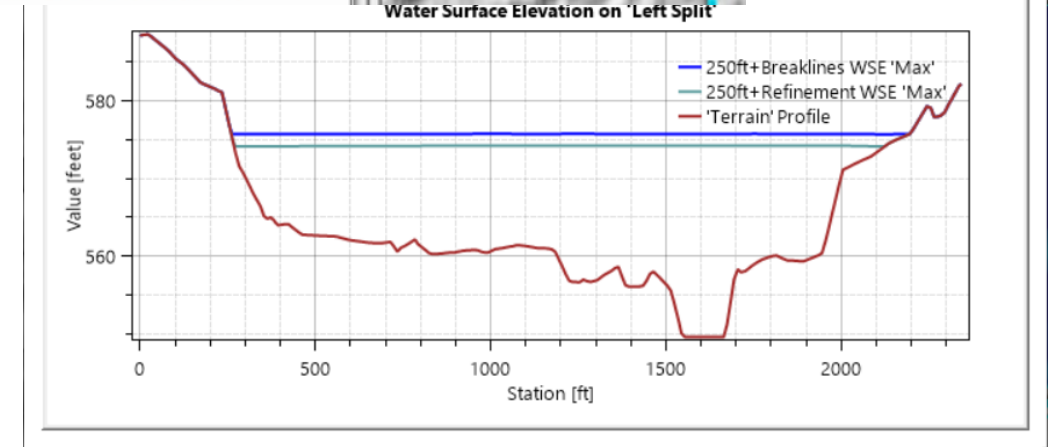
The interface shows a tree view of features with the following settings:

- 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.

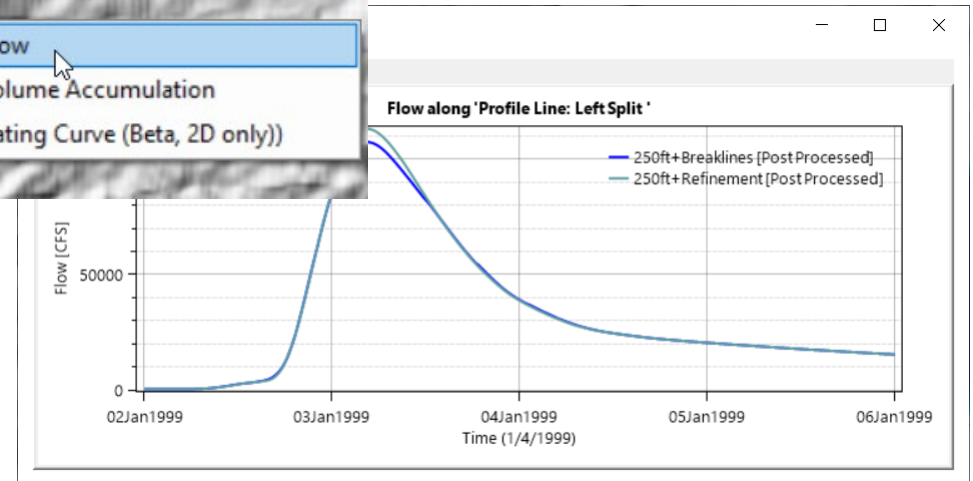
Context menu for 'Left Split' profile line:

- Plot Profile
 - Terrain
 - WSE
 - Depth
 - Velocity against Terrain
 - Sediment
- Plot Time Series
- Rename
- Delete
- Import Polygons from Shapefile
- Export Polygons to Shapefile



Context menu for 'US End of Levee' profile line:

- Plot Profile
- Plot Time Series
 - Flow
 - Volume Accumulation
 - Rating Curve (Beta, 2D only)
- Rename
- Delete
- Import Polygons from Shapefile





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'

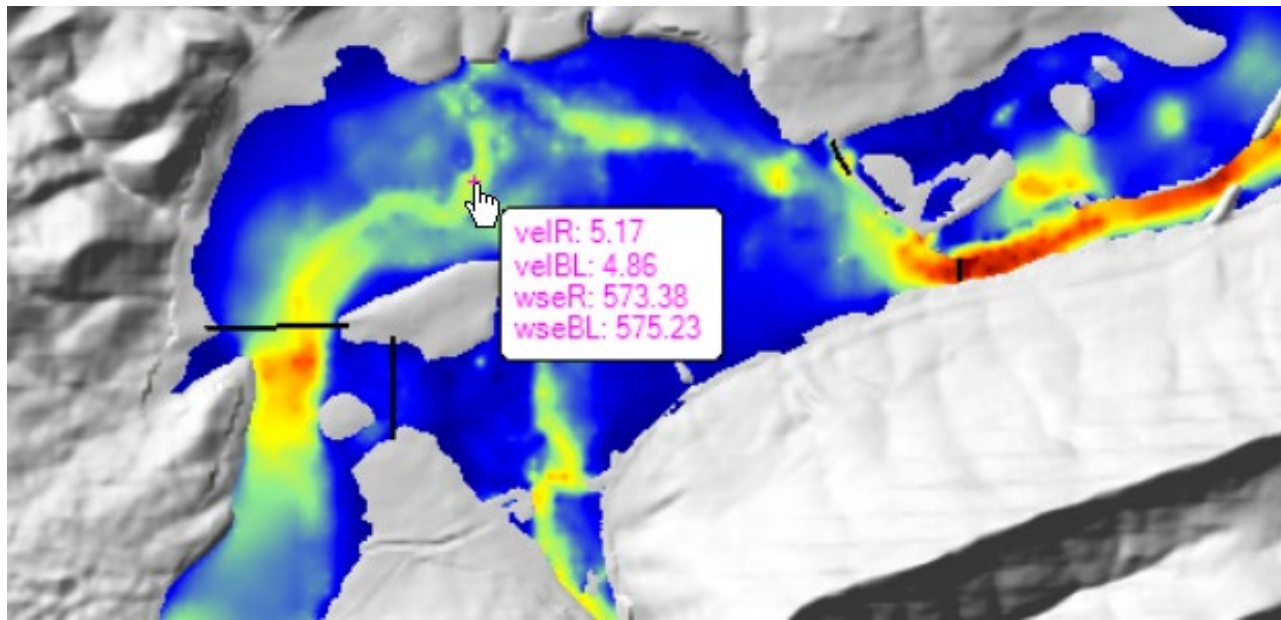
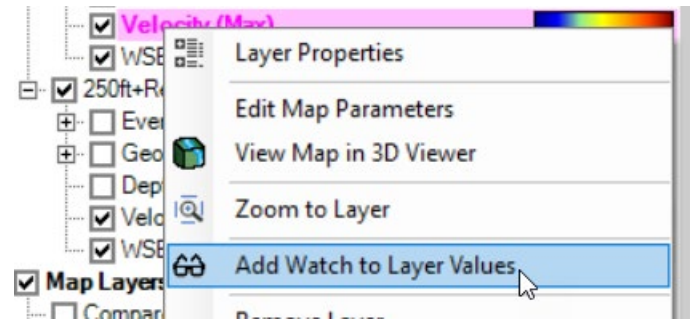
Max Min

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



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

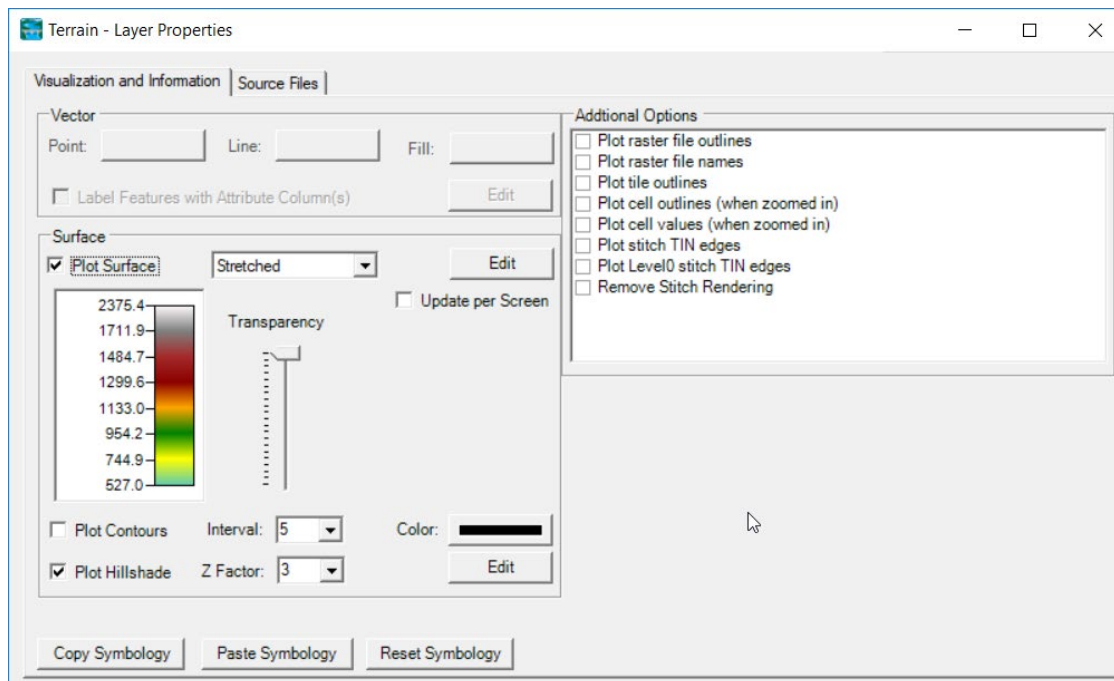


Plot Options

- Terrain

- Depth, WSE

- River, Cross Sections



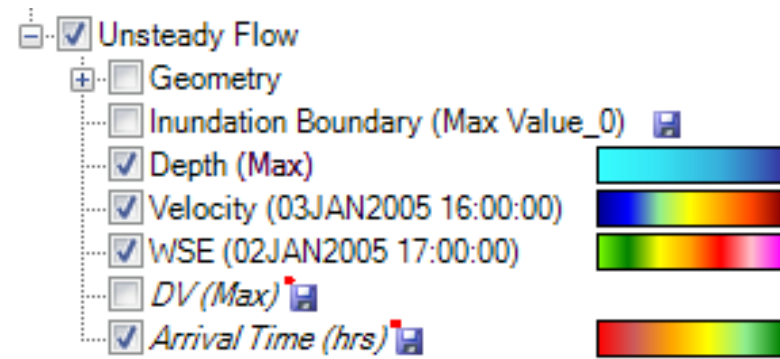
- Plot 2D Hydraulic Connectivity
- Plot 2D Water Surface Gradient (Arrow: WSEL High->Low)
- Draw Map Values
- Draw Perpendicular Face Velocities
- Face Low-Elevation Centroid
- Display Arrival Times as Dates

- 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

Results Map Parameters

Map Type

- Hydraulics
 - Water Surface Elevation
 - Velocity
 - Flow (1D Only)
 - Inundation Boundary
 - Depth
 - Courant (Velocity/Length)
 - Courant (Residence Time, 2D Only)
 - Froude
 - Shear Stress
 - Depth * Velocity
 - Depth * Velocity²
 - Energy (Depth)
 - Energy (Elevation)
 - Arrival Time**
 - Arrival Time (Max)
 - Recession
 - Duration

Parameters

Start Time at: 02JAN1900 00:00:00

Start of simulation

Offset from start of simulation

d h m

Fixed date/time (08JUL1995 17:00:00)

Unsteady Profile

Hours

Days

Parameters

Threshold Depth:

Map Output Mode

Generated for Current View (in memory)

Raster (with Associated Terrain)

Point Feature Layer:

Stored (saved to disk)

Raster based on Terrain: TerrainWithChannel

Point Feature Layer:

Polygon Boundary at Value:

Map Type	Layer Name
Arrival Time	Arrival Time

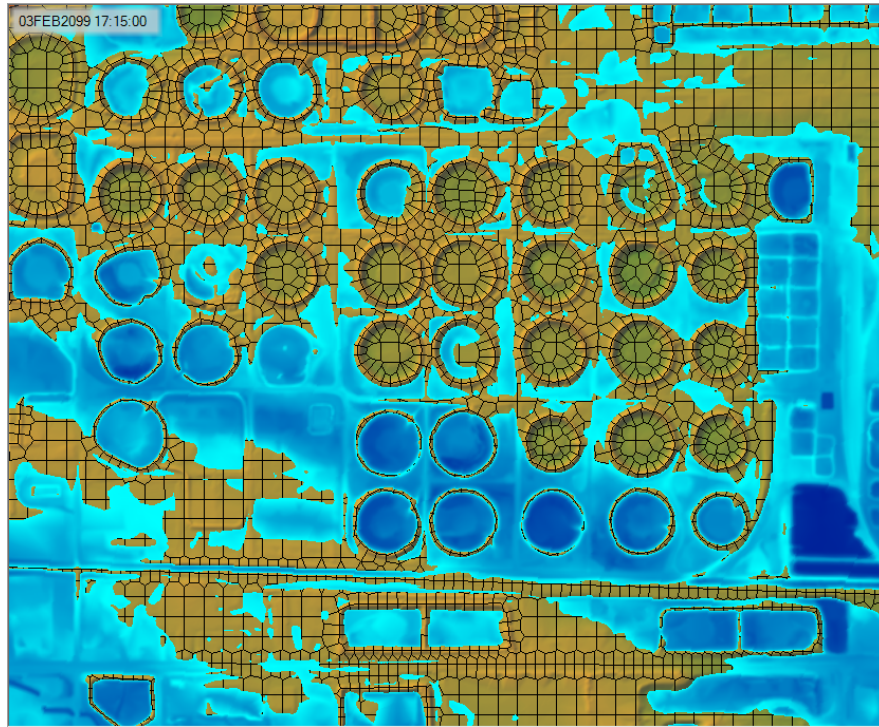
Map Type: A Map layer will be created for The time (from a specified Start Time) for water to reach a specified flood depth.
 Map Mode: Map results are generated on-the-fly for the current view.

Default maps: Depth, Water Surface Elevation, Velocity

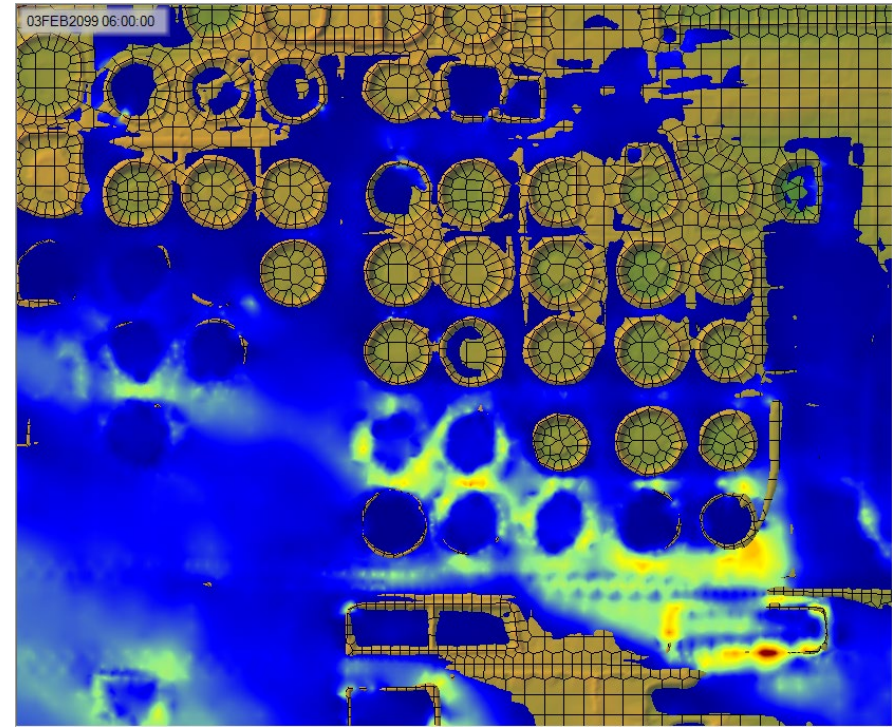


Example Maps

- Depth

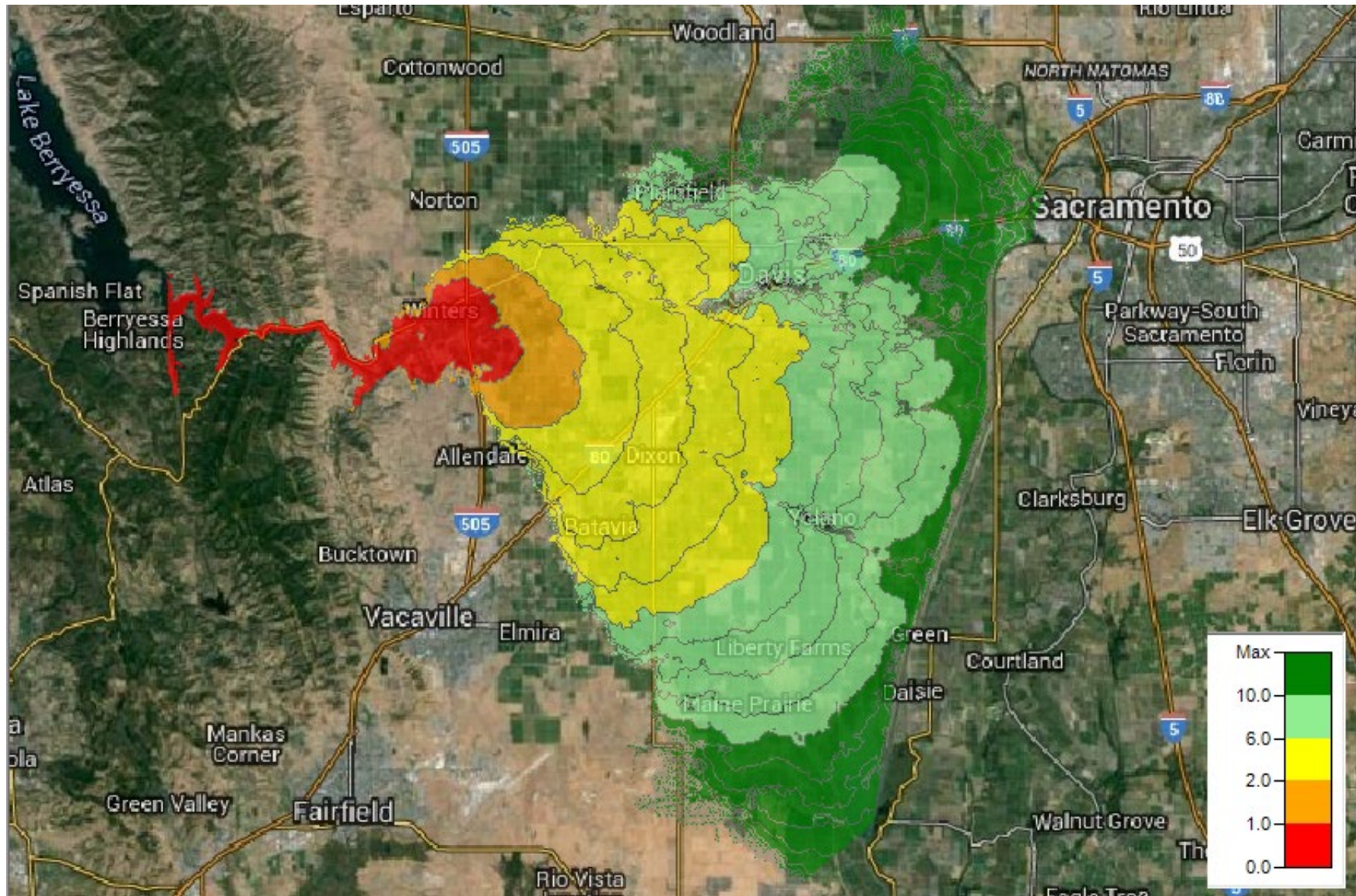


- Velocity



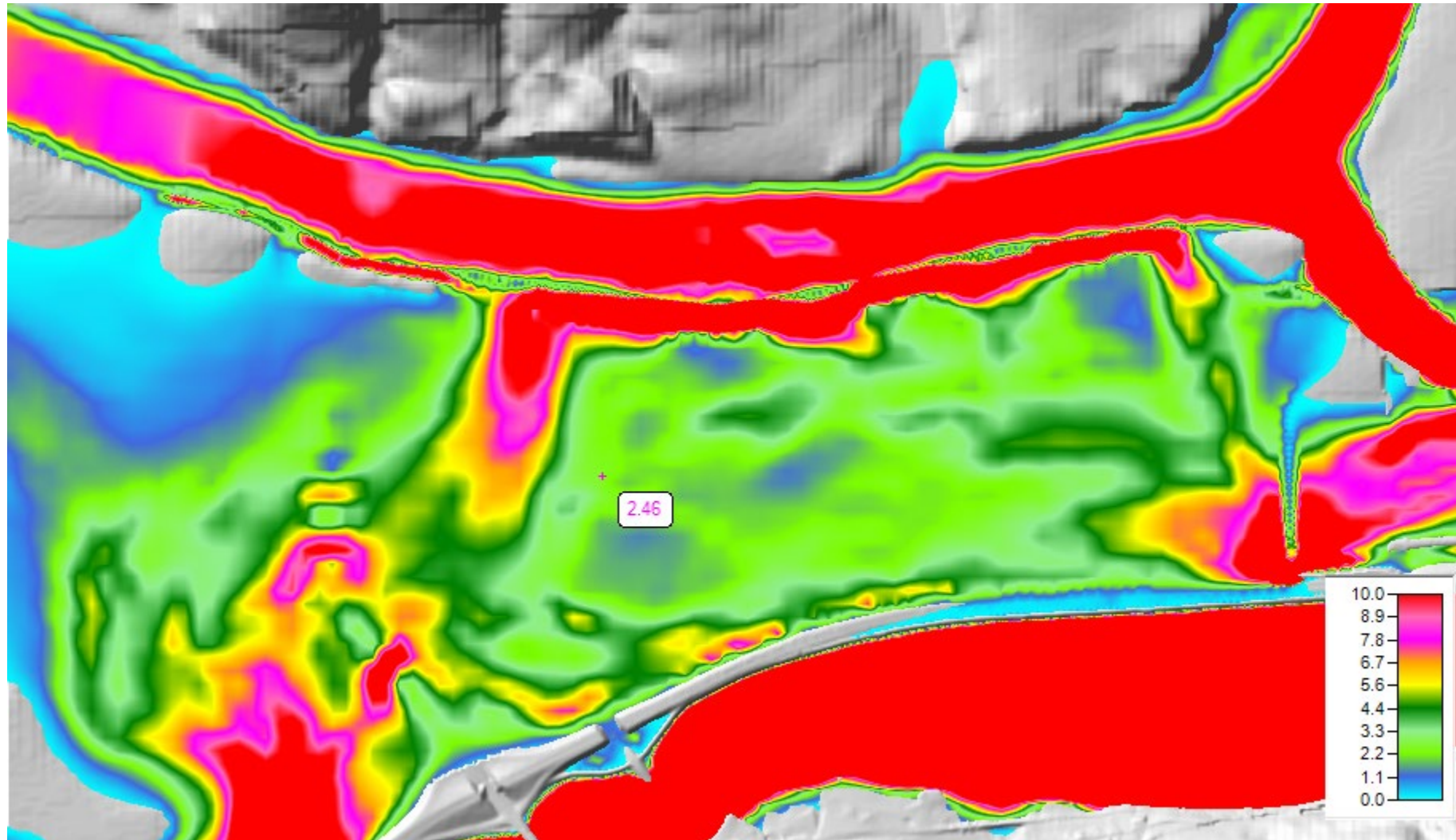


Arrival Time



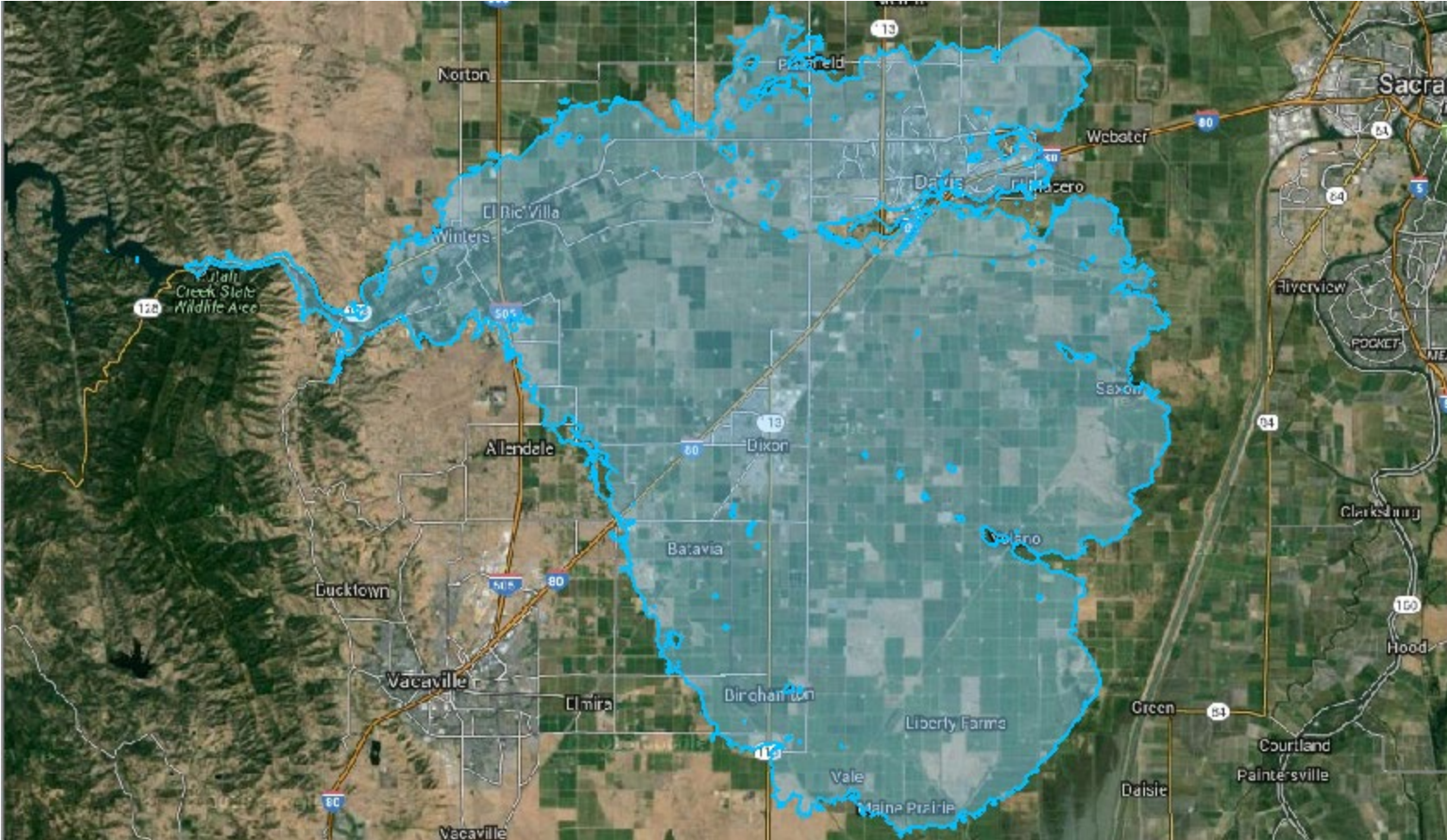


Hazard Mapping





Inundation Boundary





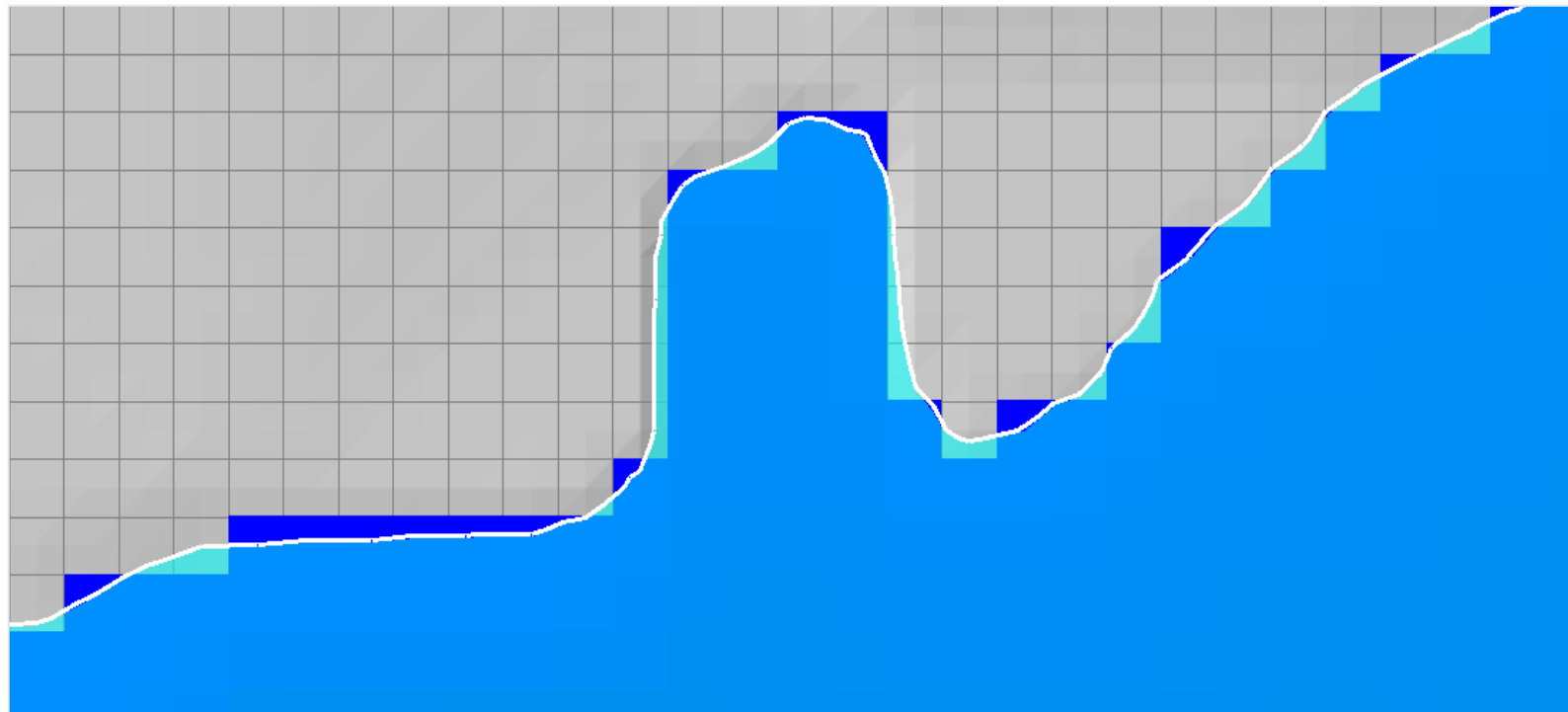
Map Types – Dynamic vs Stored

- **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

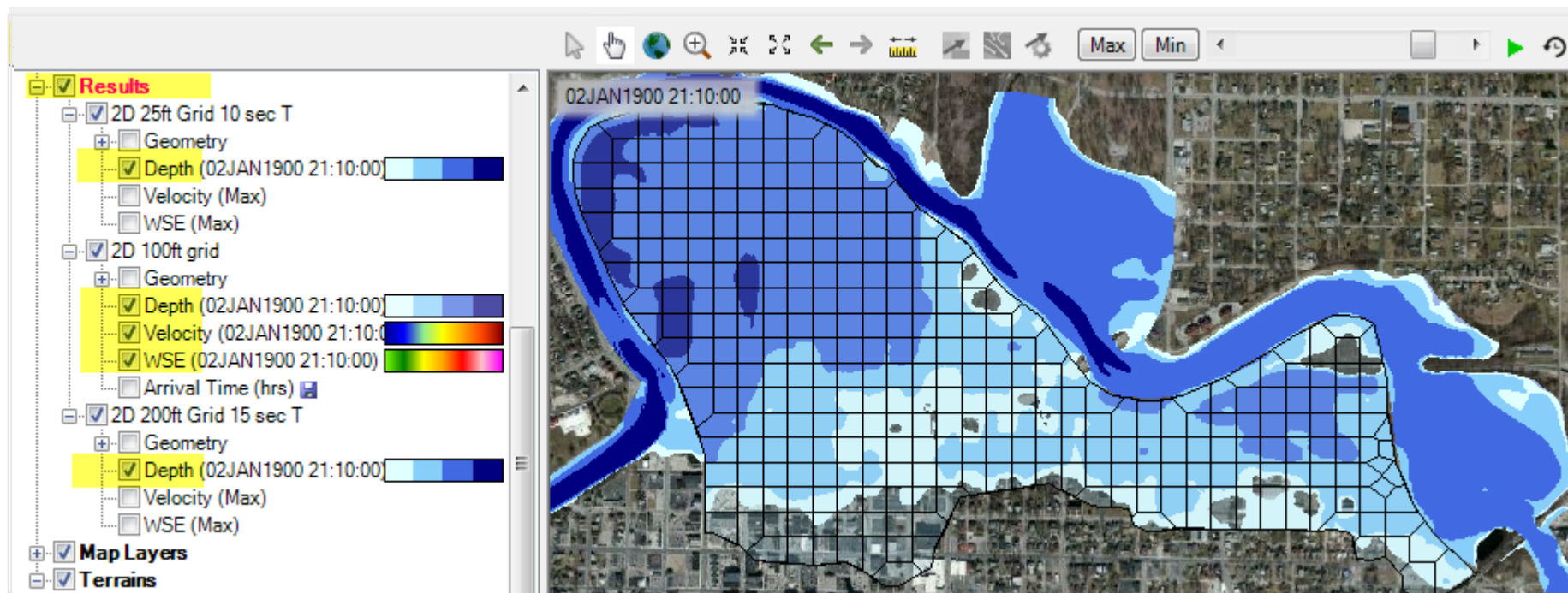
- Dynamic results plot values for the current pyramid level. Boundaries are defined based on interpolation.
- Stored results have a single value per cell.





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 WSE values.
- 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	
2D 25ft Grid 10 sec T		Add New Map
Depth (03JAN1900 00:00:00)	N/A	Edit Map
Velocity (Max)	N/A	Edit Map
WSE (Max)	N/A	Edit Map
2D 100ft grid		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
2D 200ft Grid 15 sec T		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

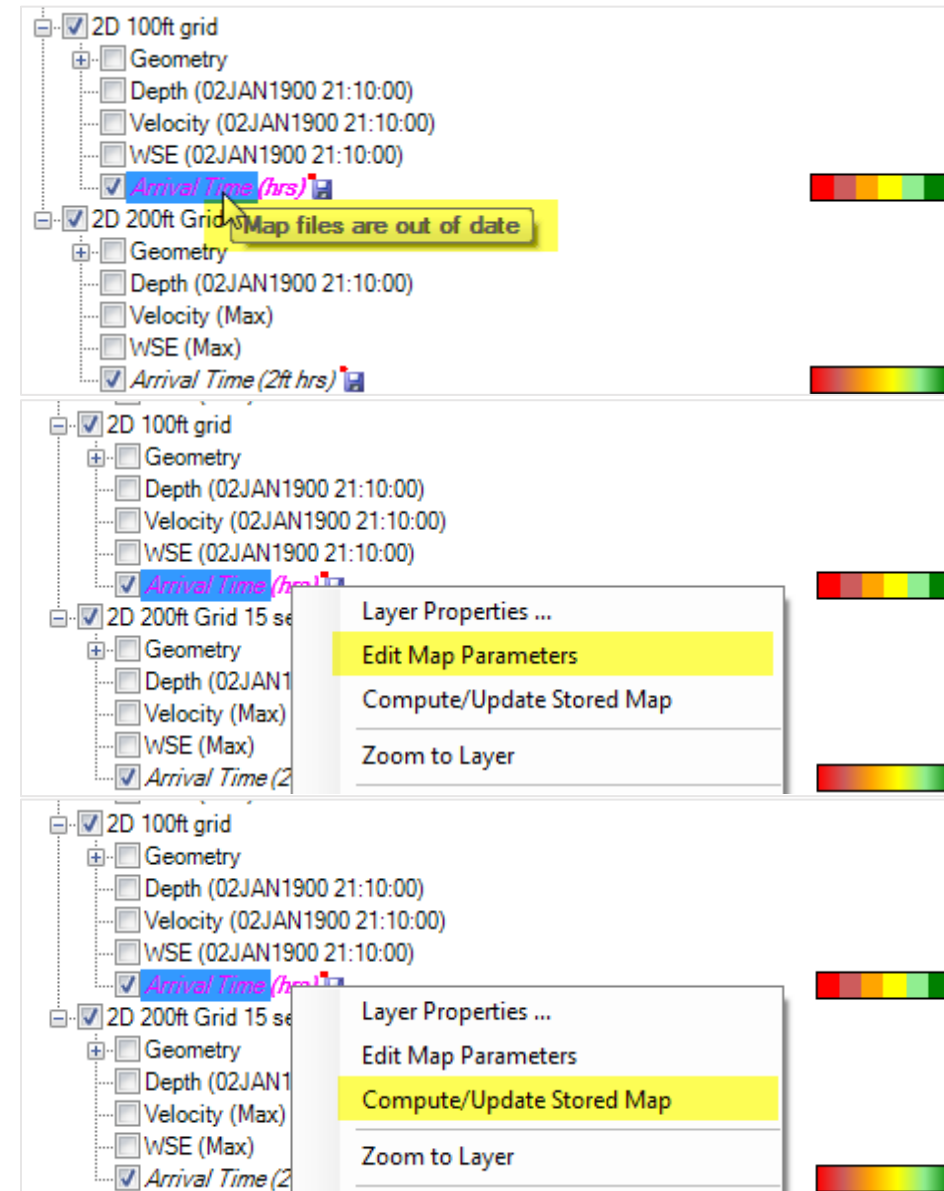


Stored Maps

- Map status message on cursor tool tip

Right-click options:

- Edit Map Parameters
- Compute Map





Results Layer Properties

The screenshot displays the HEC-RAS interface with the 'arrival time - Layer Properties' dialog box open. The 'Visualization and Information' tab is active, showing options for 'Vector' and 'Surface' visualization. The 'Surface' section is checked, and the 'Plot Surface' option is set to 'Discrete'. A color ramp legend is visible, showing a gradient from red (0.0) to green (16.0). The 'Additional Options' tab is also open, showing the 'Select Surface Fill' dialog box. This dialog box has 'Surface Symbol Settings' with 'Color Ramp' set to 'Arrival Time' and 'Keep user values with color ramp change' checked. The 'Surface Symbol' section has 'Max' set to 16.00, 'Interval Type' set to 'Linear', and 'Min' set to 0.00. A table below the dialog box shows the color ramp values:

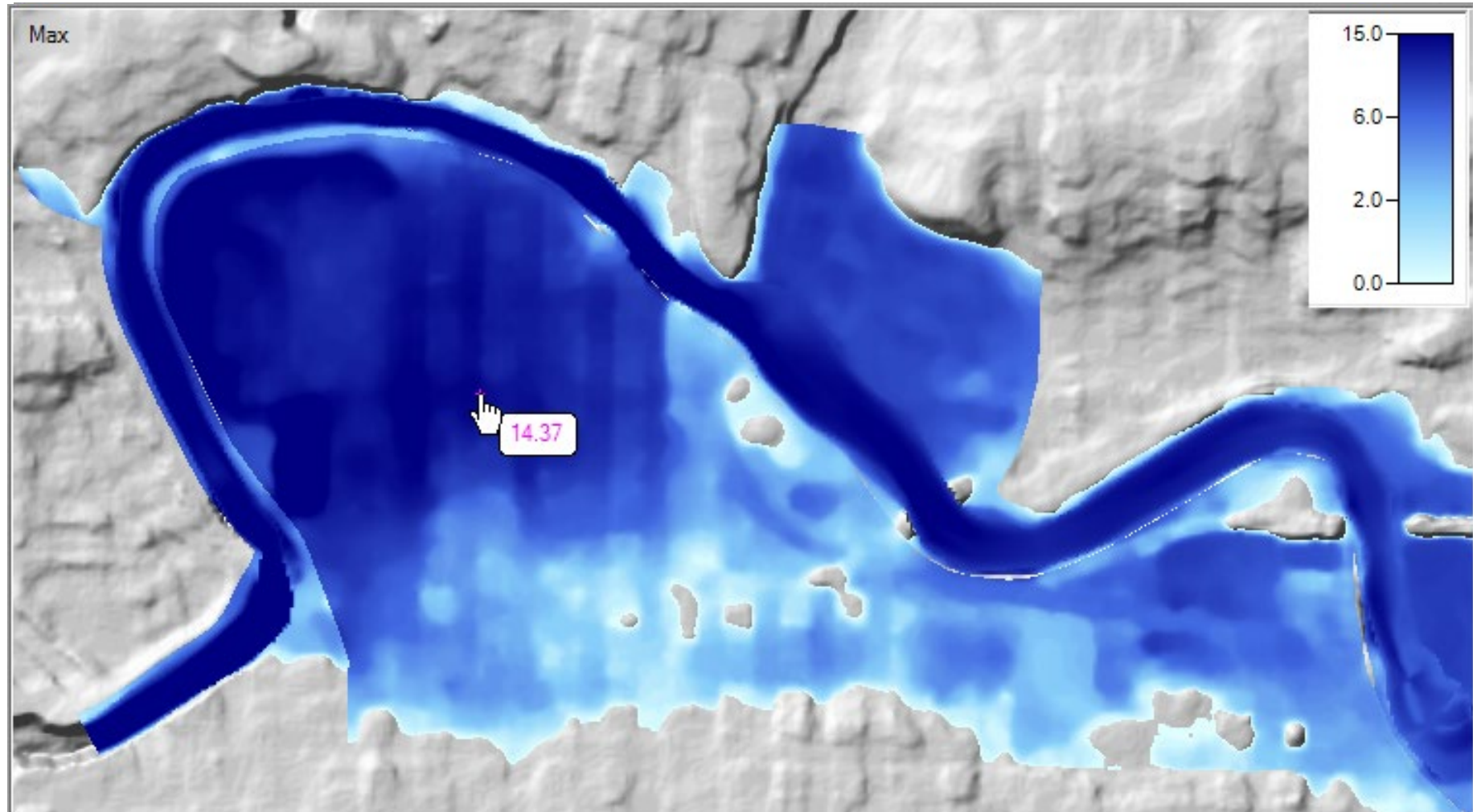
Value	Color	Red (0-255)	Green (0-255)	Blue (0-255)
0.00	Red	255	0	0
2.00	Red-Orange	205	92	92
4.00	Orange	255	165	0
8.00	Yellow	255	255	0
12.00	Light Green	144	238	144
16.00	Green	0	128	0

The background map shows a topographic view with a color-coded overlay representing arrival time. The overlay shows a river channel and surrounding areas, with colors ranging from red (low arrival time) to green (high arrival time). The 'Messages' window at the bottom left shows the following text:

```
Creating Post Process completed [65 ms]  
Stored map 'Arrival Time (hrs)' created.  
Stored map 'Arrival Time (2ft hrs)' created.
```

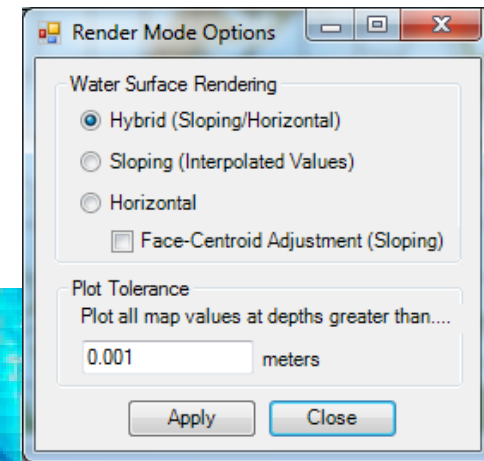
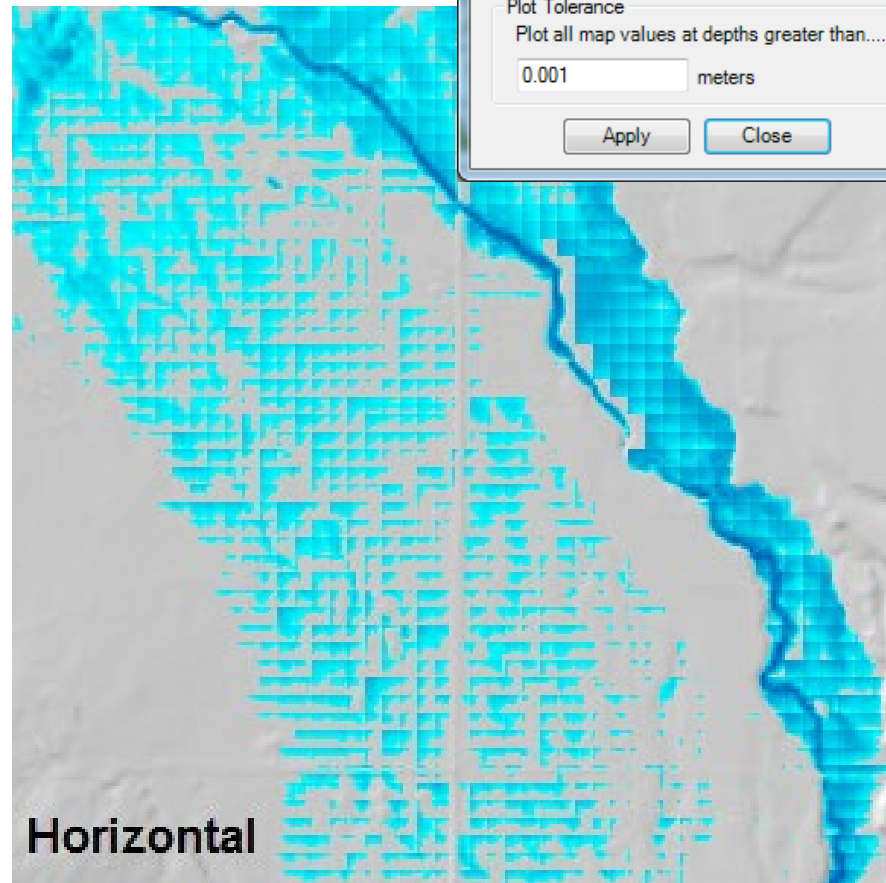
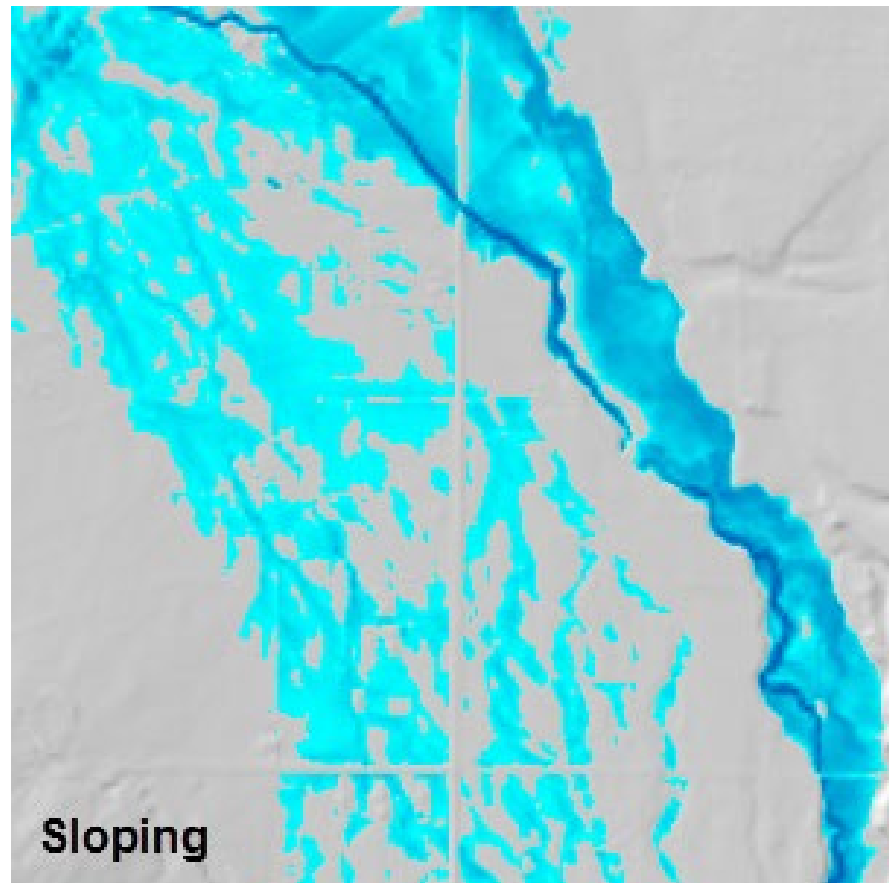



Results Visualization





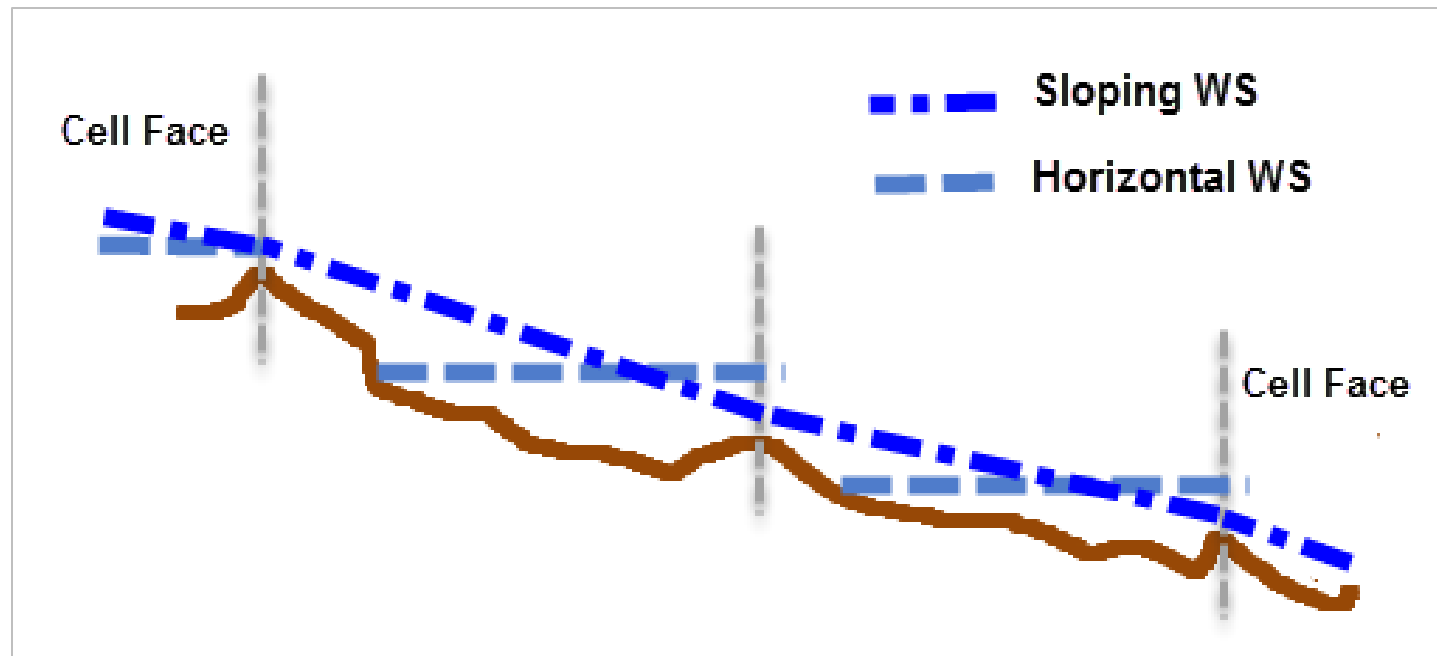
Render Mode Options





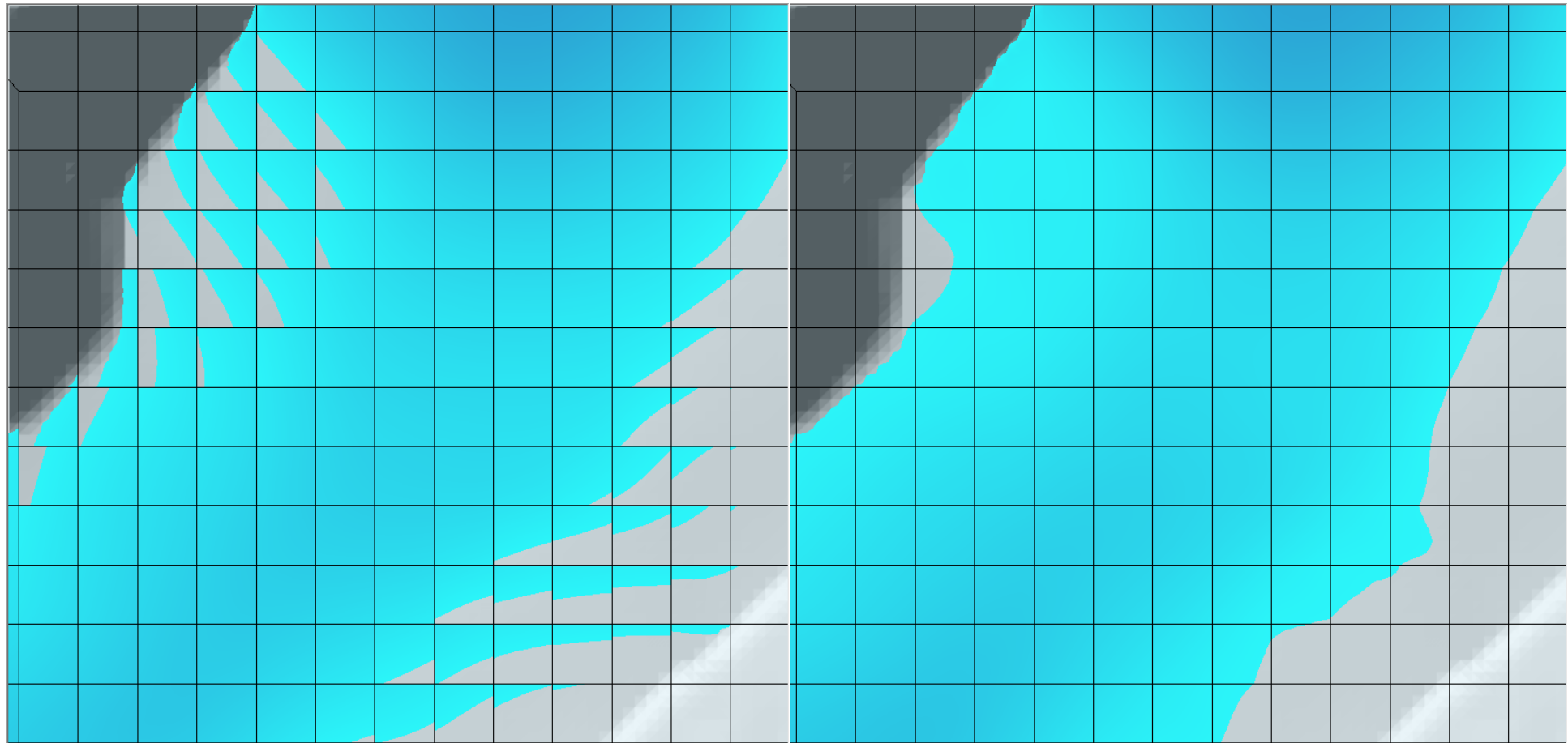
Results Interpolation

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



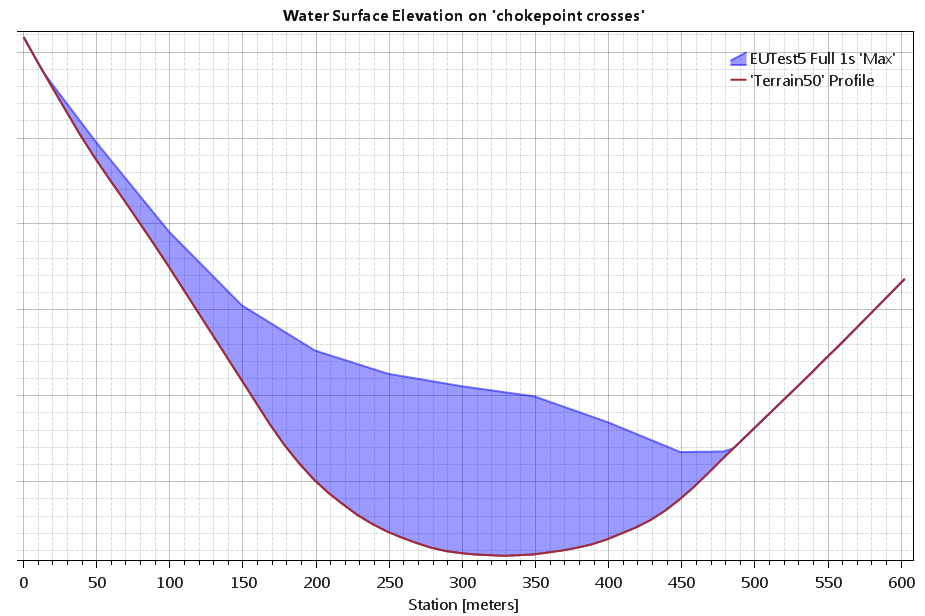
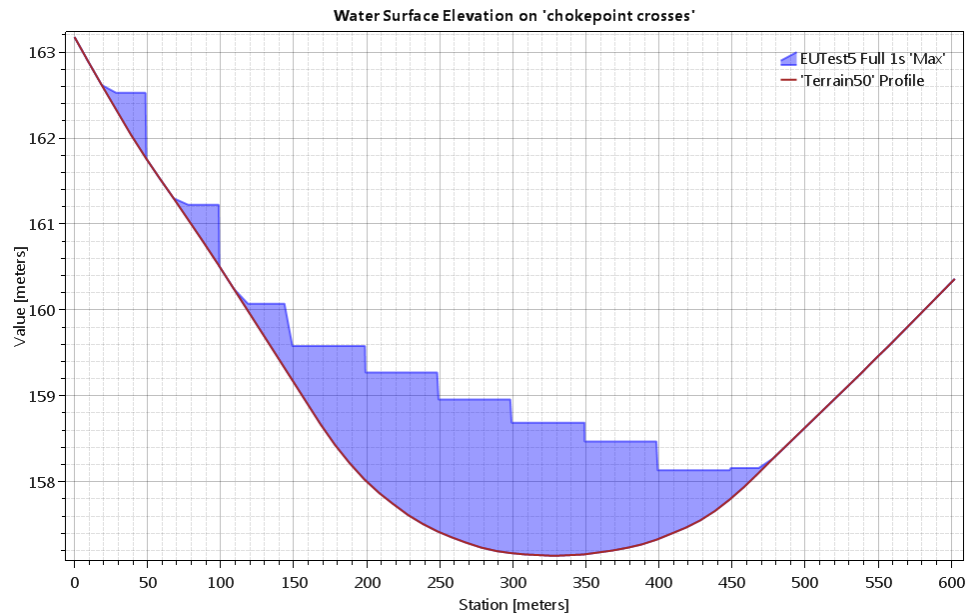


Horizontal vs Sloping Surface



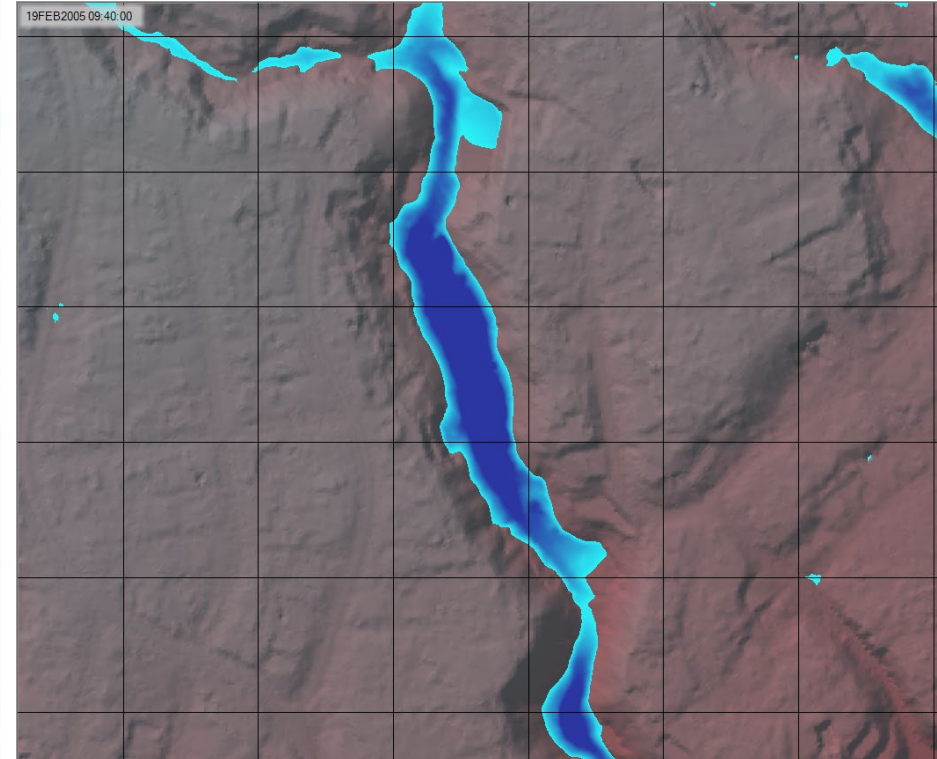
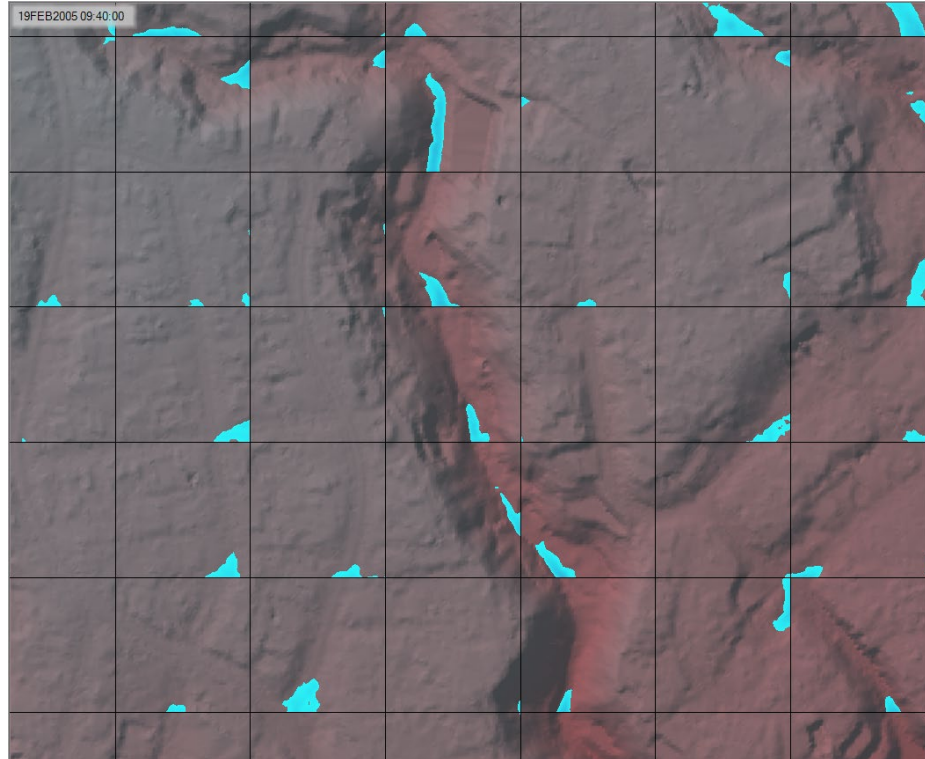


Horizontal vs Sloping Surface





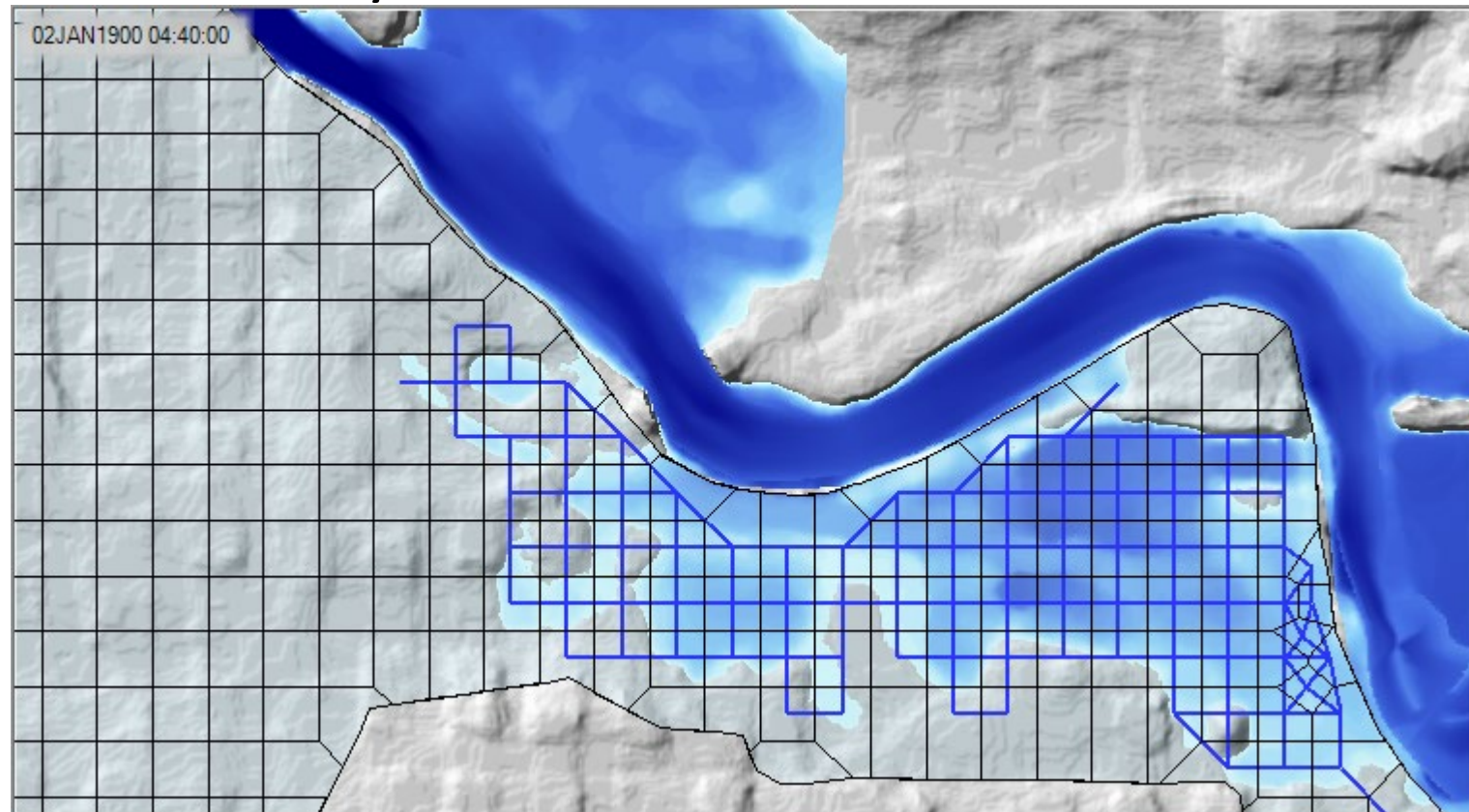
Sloping Surface Errors





Depth Results

- Hydraulic connectivity from mesh





Results Query

- 2D Flow Area query

The screenshot displays a software interface for a 2D flow area query. On the left, a tree view shows the following layers:

- 2D 25ft Grid 10 sec T
- 2D 100ft grid
- 2D 200ft Grid 15 sec T (checked)
- Geometry
 - Rivers
 - XS
 - Storage Areas
 - 2D Flow Areas (checked)
- Depth (Max) (checked)
- Velocity (Max)
- WSE (Max)
- Arrival Time (hrs)

Below the tree view, there are checkboxes for 'Map Layers' and 'Terrains', and a 'WithChannel' checkbox with a '[hillshade]' label. A color scale legend is visible to the right of the tree view.

The central map area shows a 2D flow area (blue) overlaid on a grid. A pink square highlights a specific cell. 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 (selected)
 - Property Tables
- WithChannel Elevation: 937.48 feet
 - Cell: Water Surface (selected)
 - Cell: Depth
 - Cell: Shear Stress
 - Face Point: Velocity

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



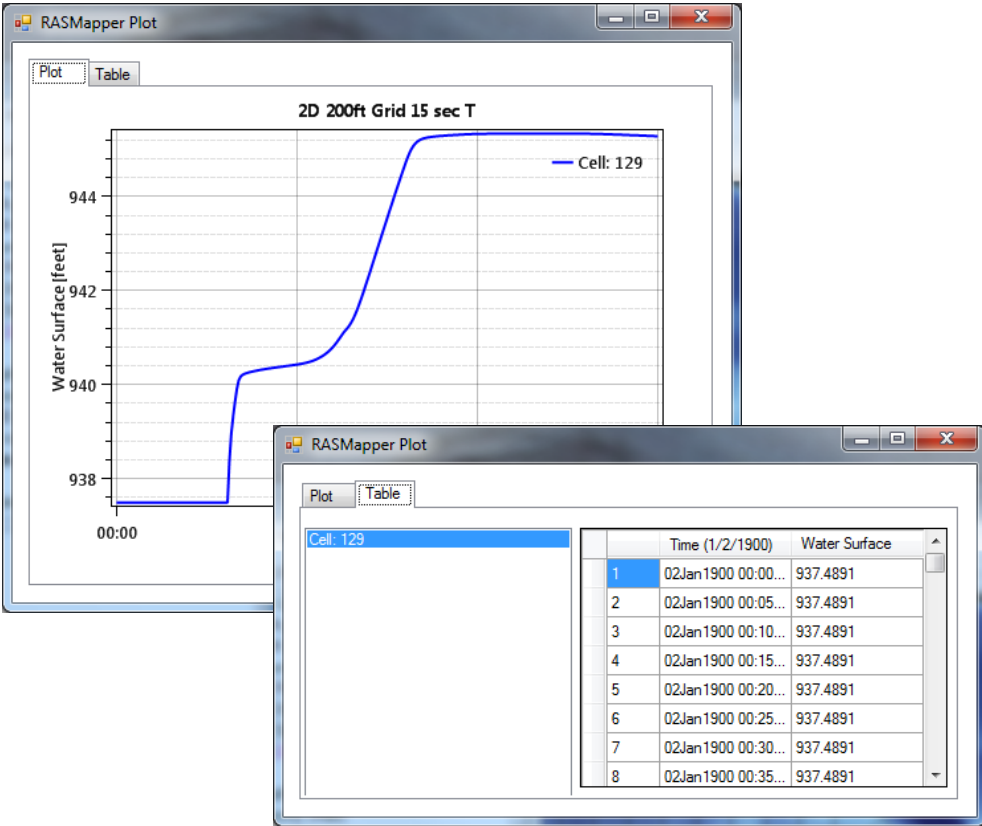
2D Flow Area Queries

- Hydraulic Properties

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

- Time Series

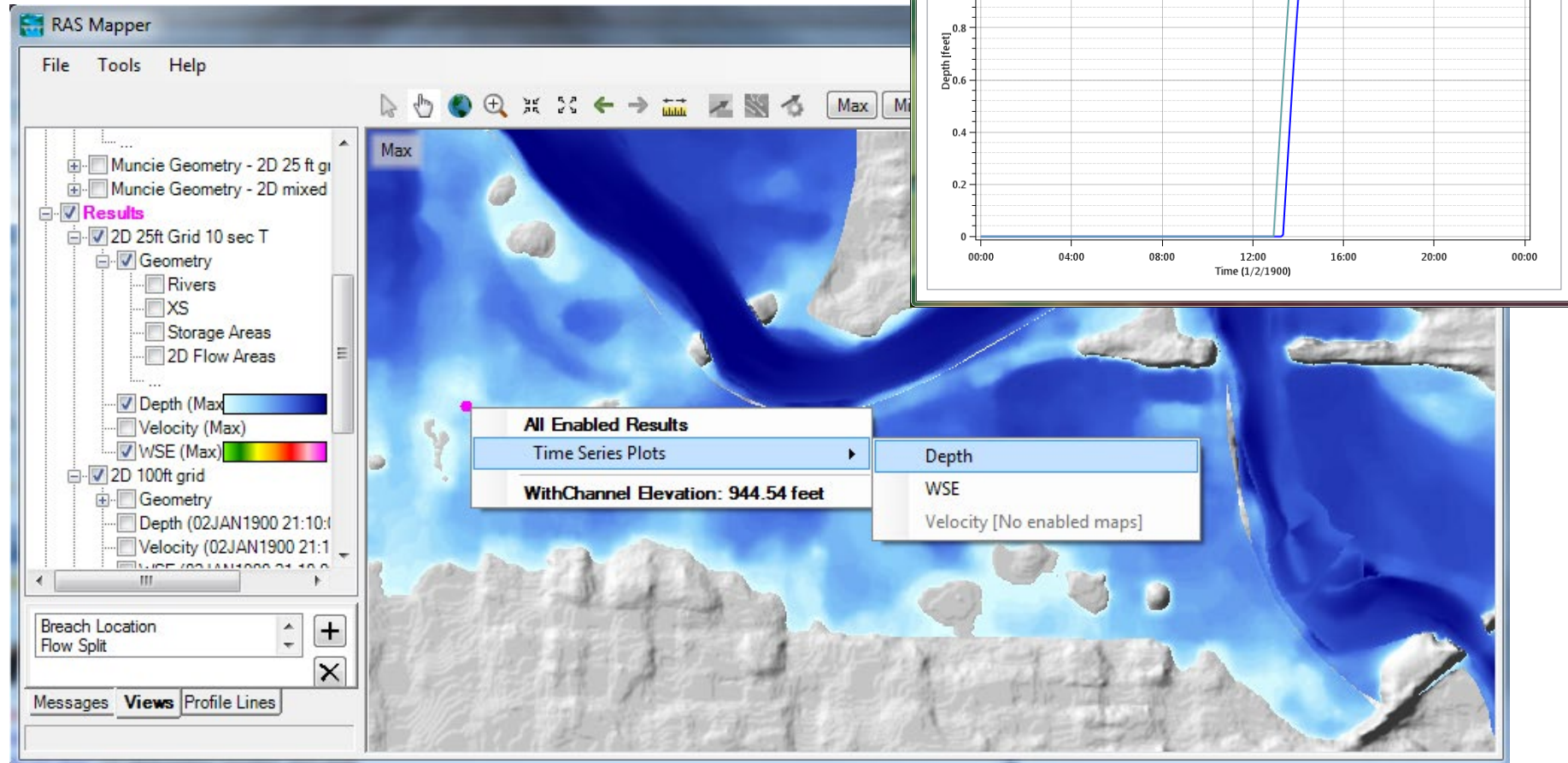
- Cell: Water Surface
- Cell: Depth
- Cell: Shear Stress
- Face Point: Velocity





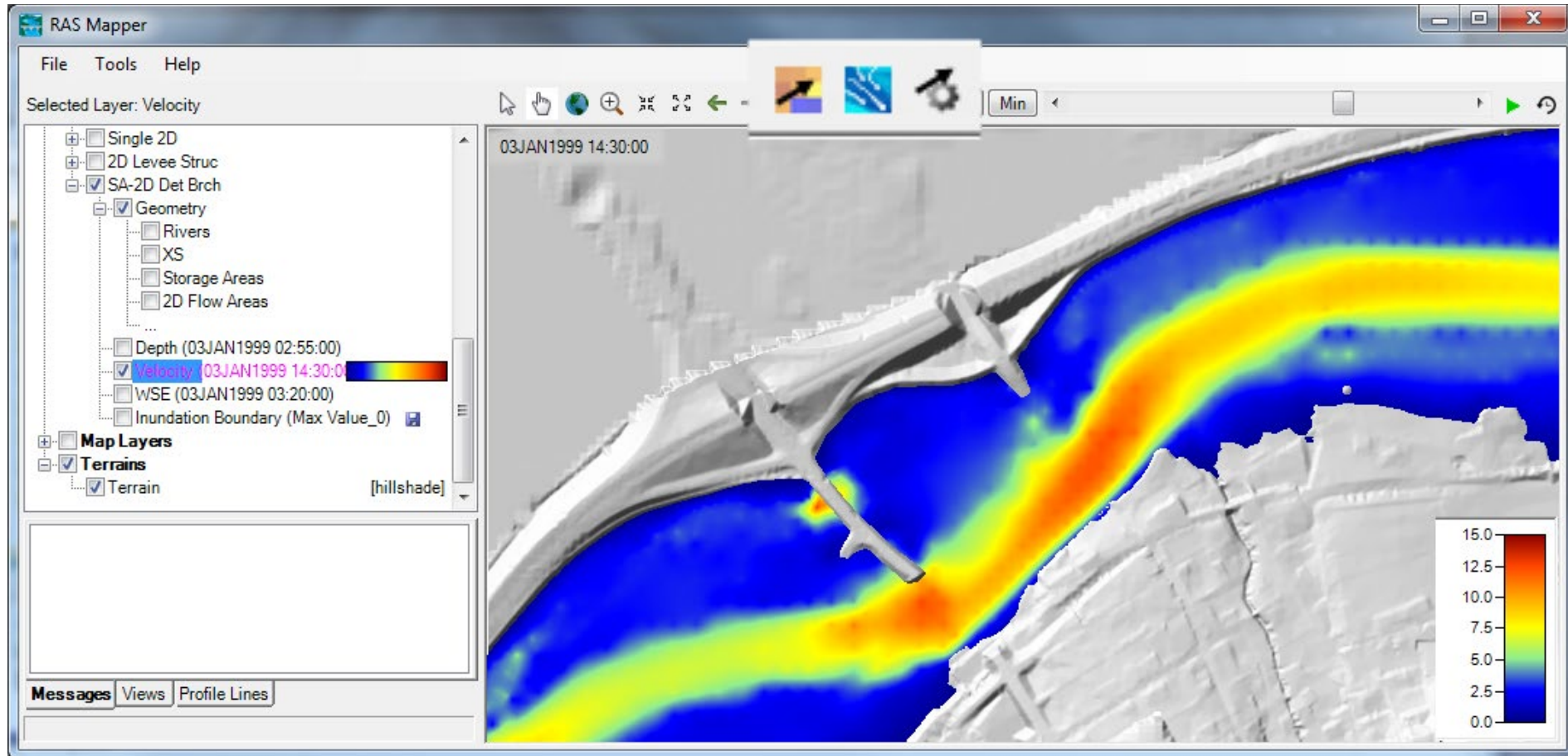
Results Query

- Time Series





Velocity Results





Velocity Arrows

Velocity Map Parameters

Static Arrows

Regular Interval
Spacing: 28

Computation Points [Disabled]

Color: White

Particle Tracing

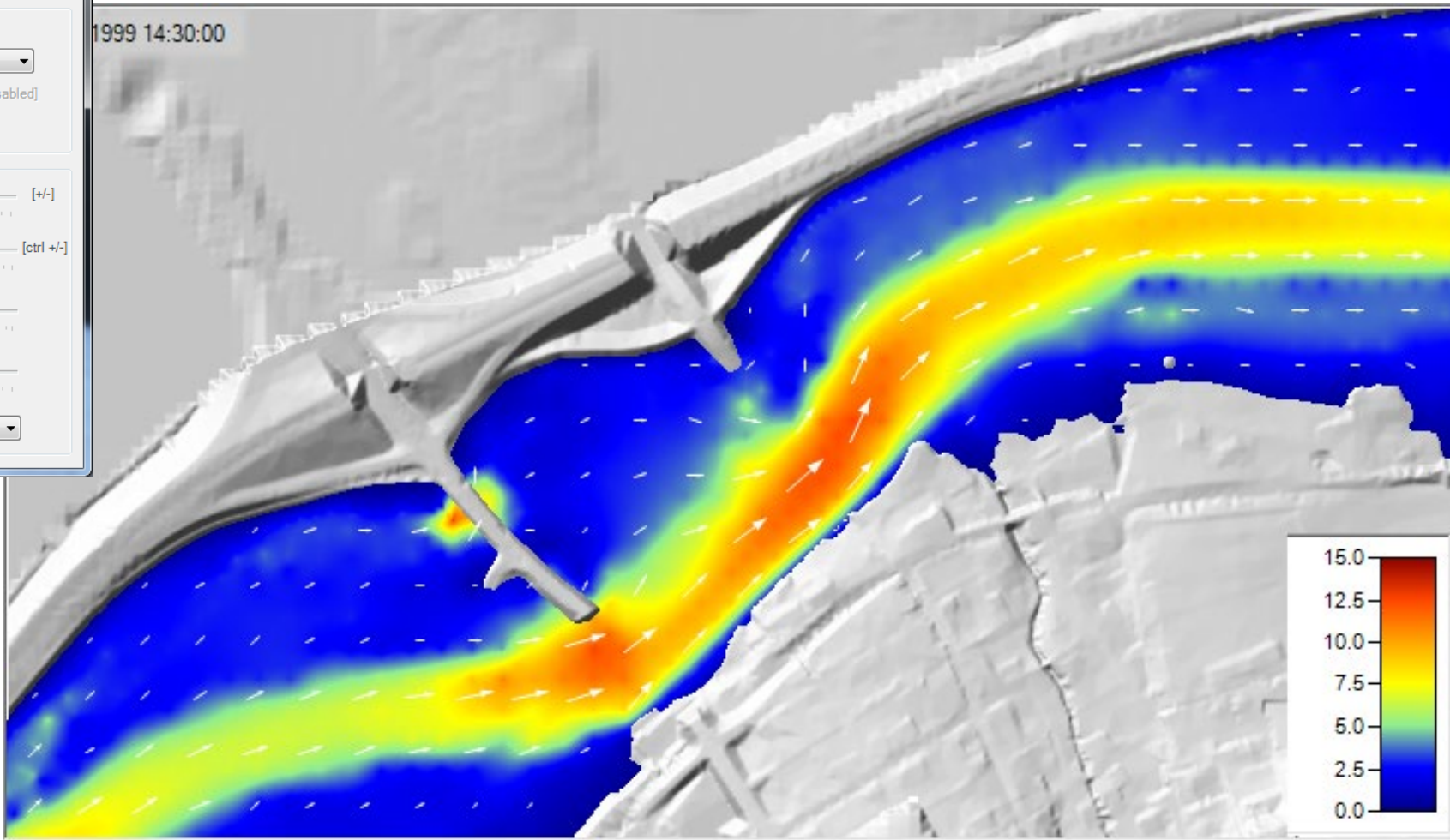
Speed: [Slider] [+/-]

Density: [Slider] [ctrl +/-]

Width: [Slider]

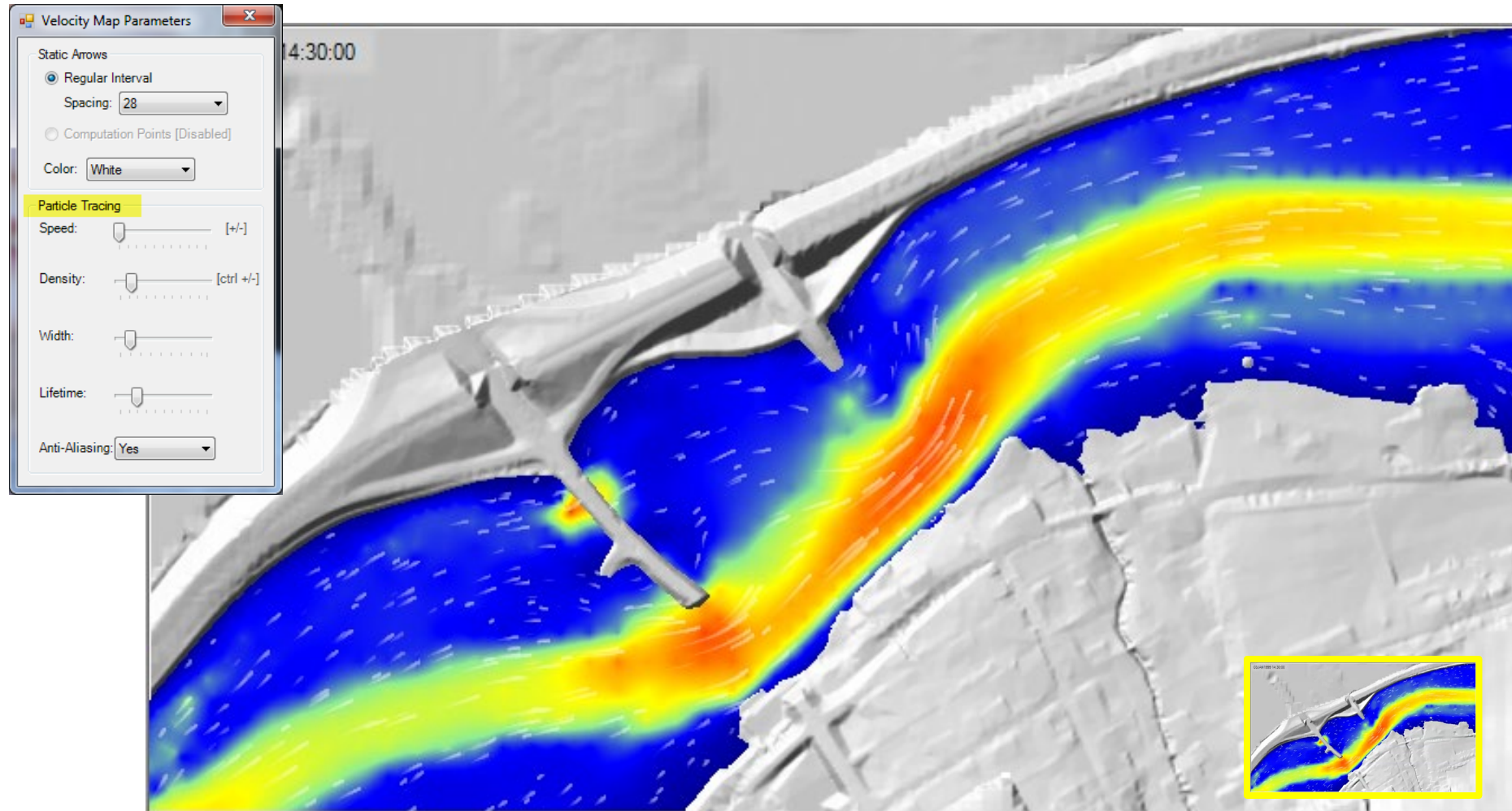
Lifetime: [Slider]

Anti-Aliasing: Yes



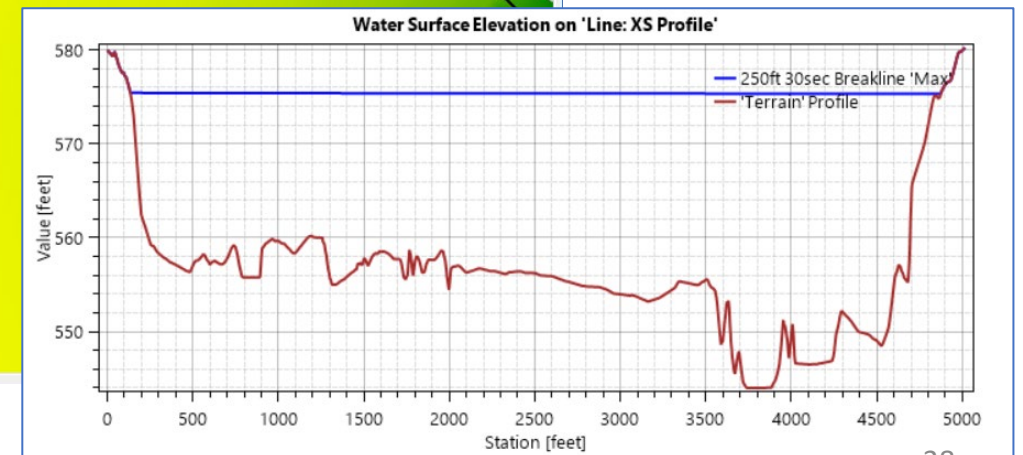
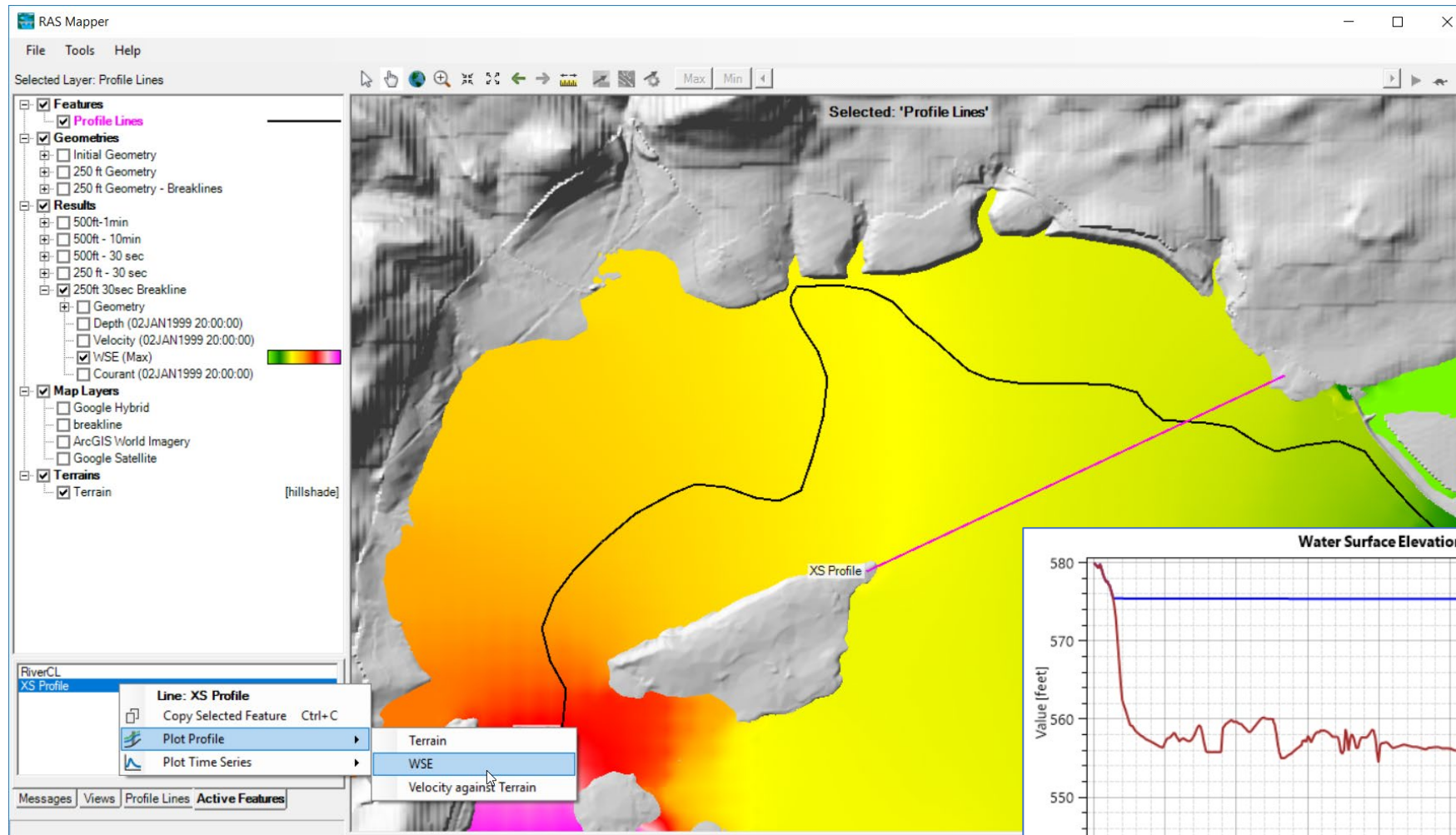


Velocity Tracing





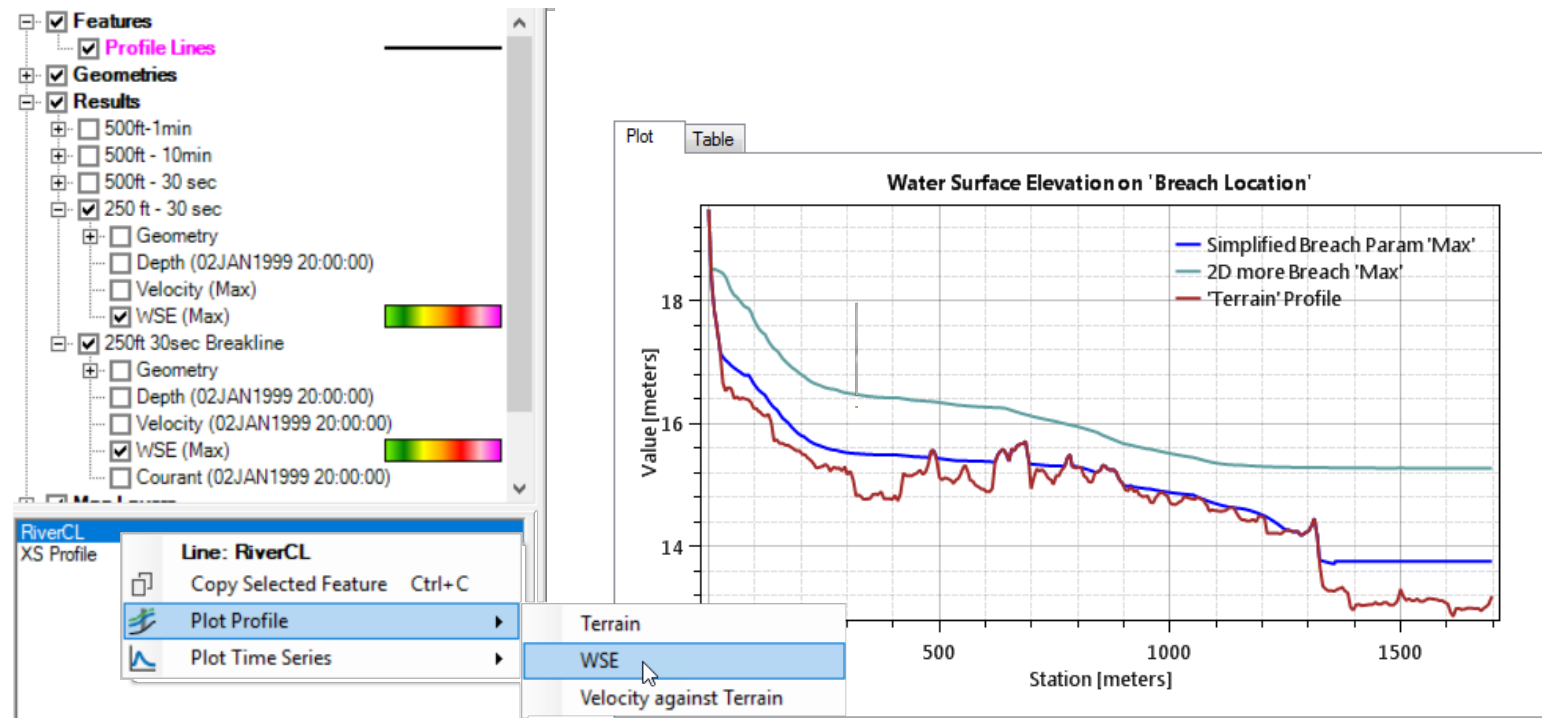
Profile Lines





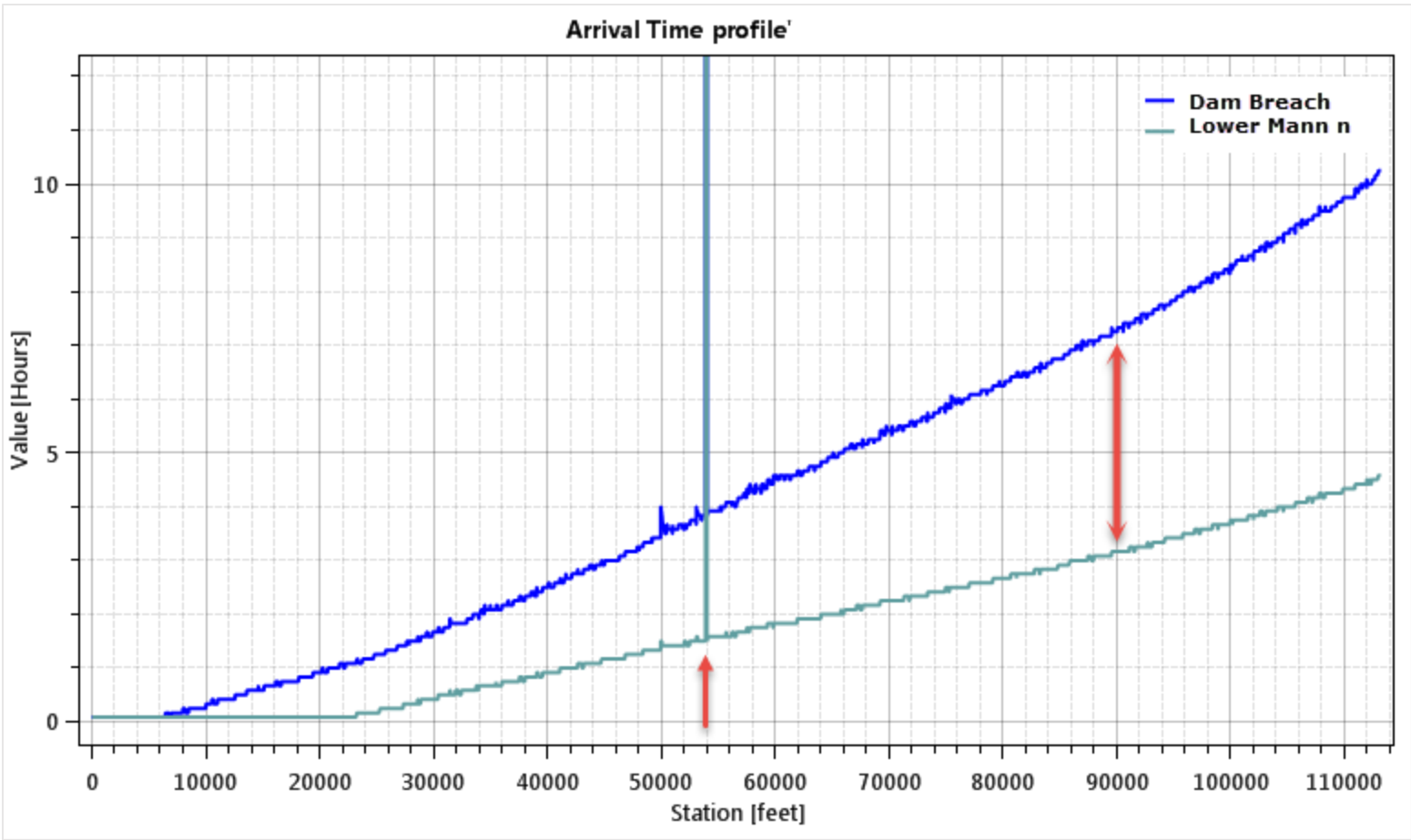
Profile Line - Comparison

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



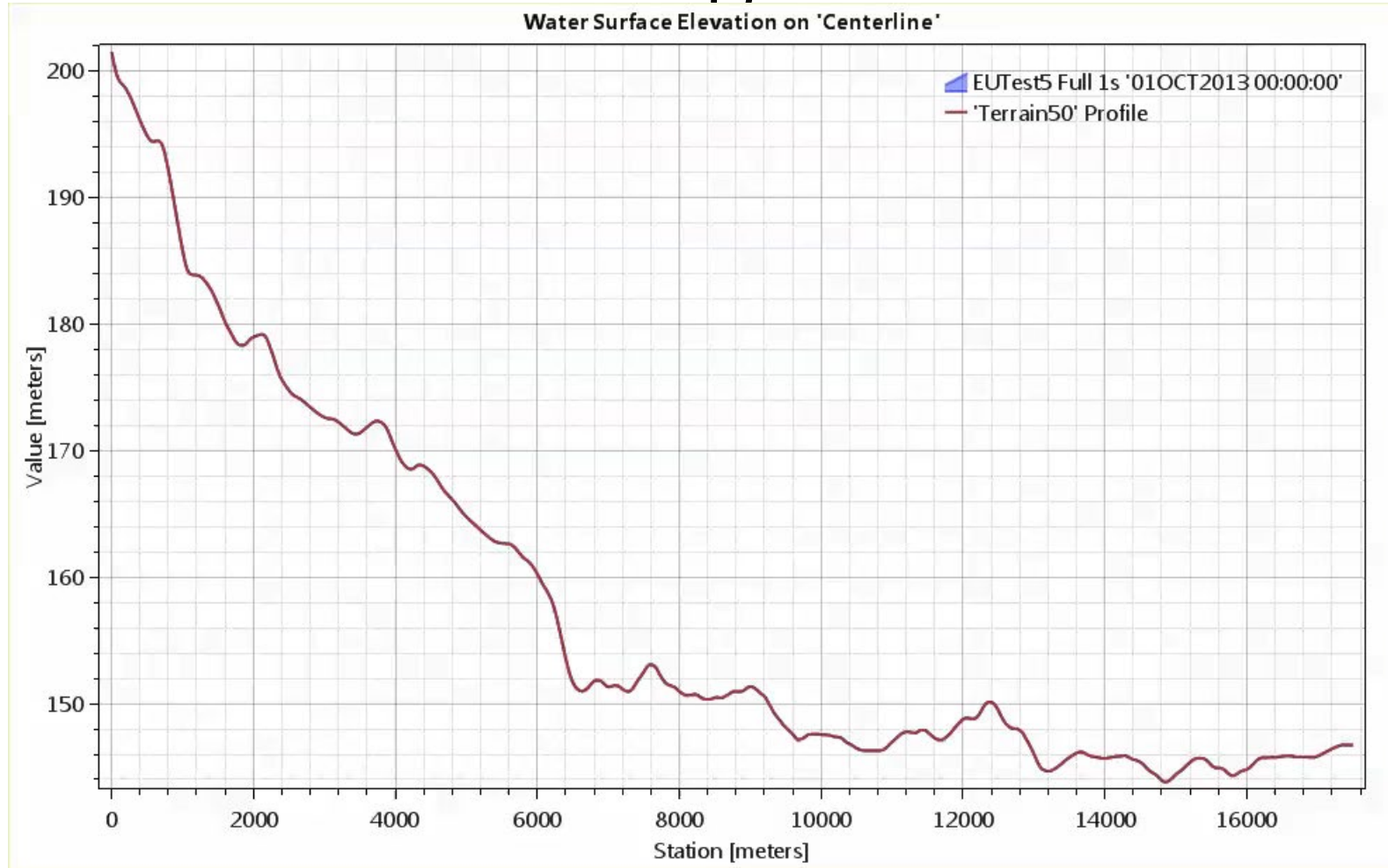


Profile Lines - Comparison



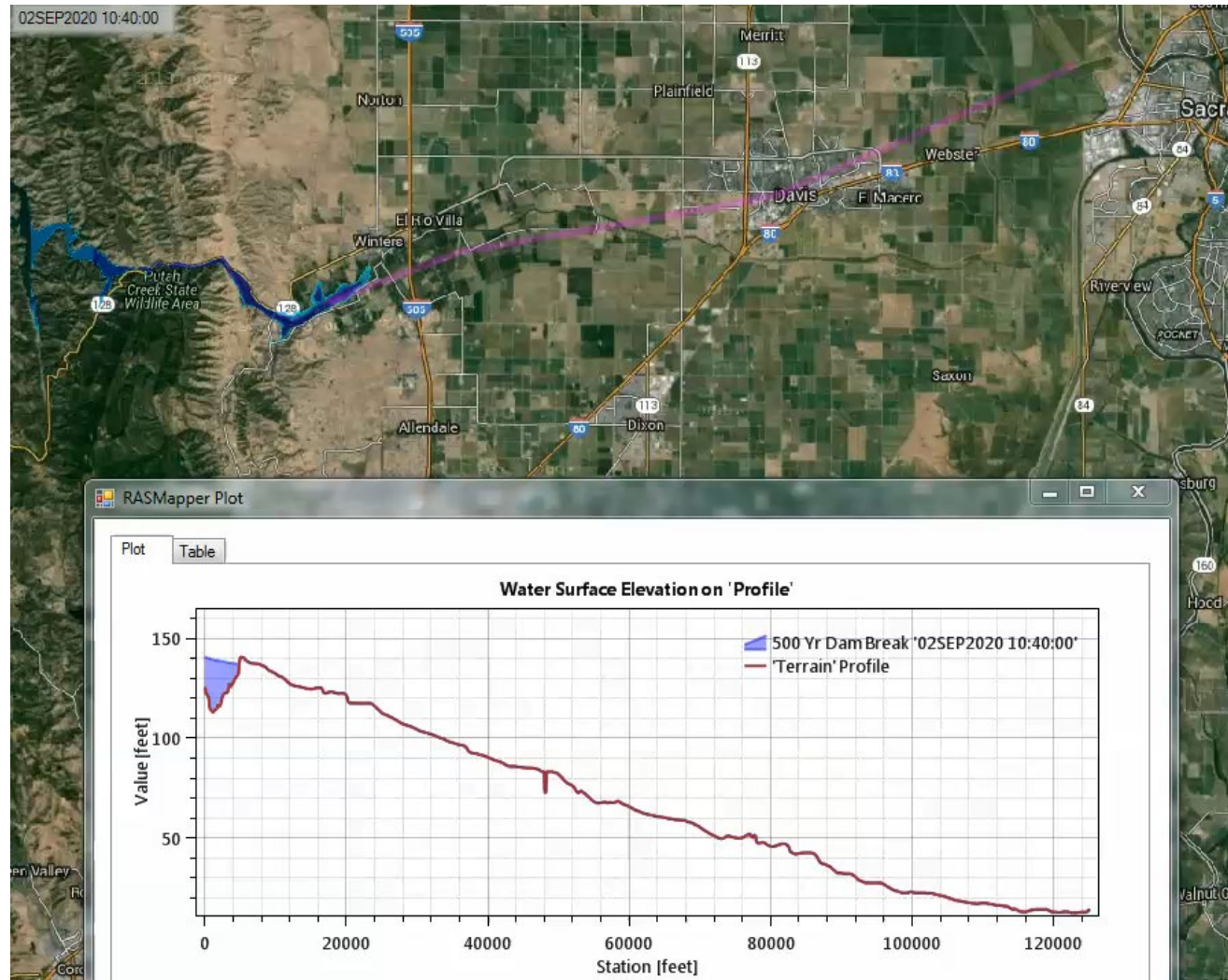


Profile Lines - Animating



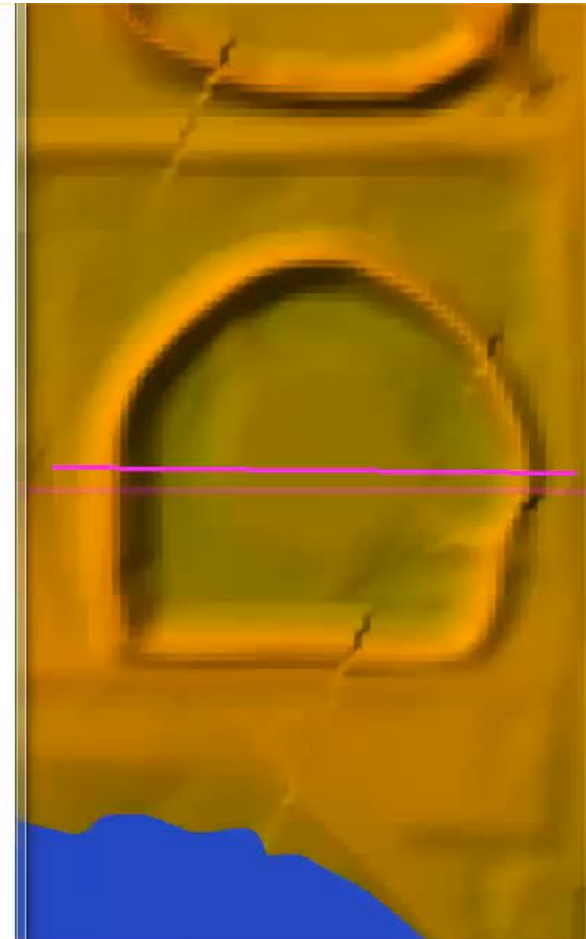


Profile Lines + Spatial Results



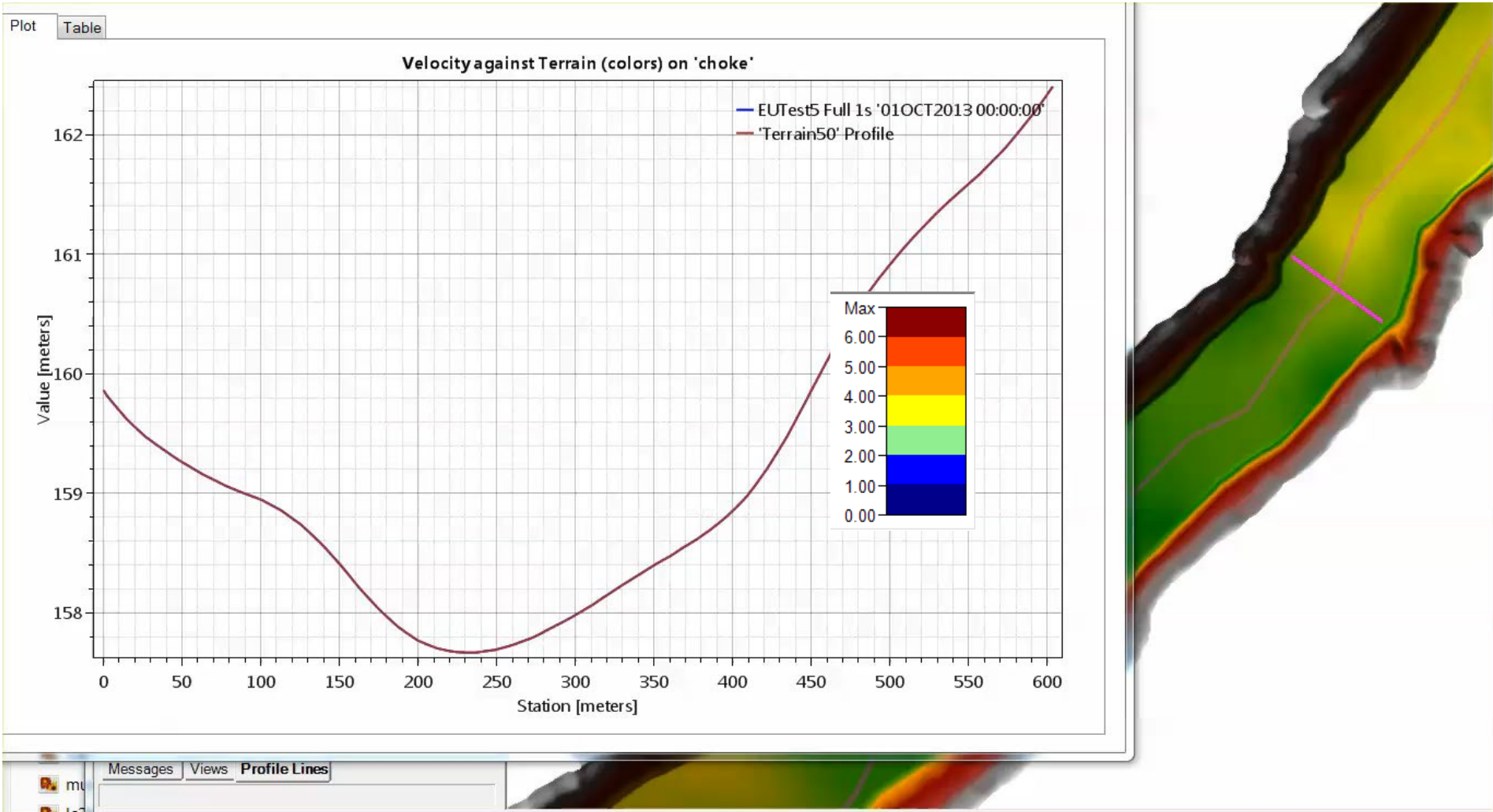


Profile Lines - Animating



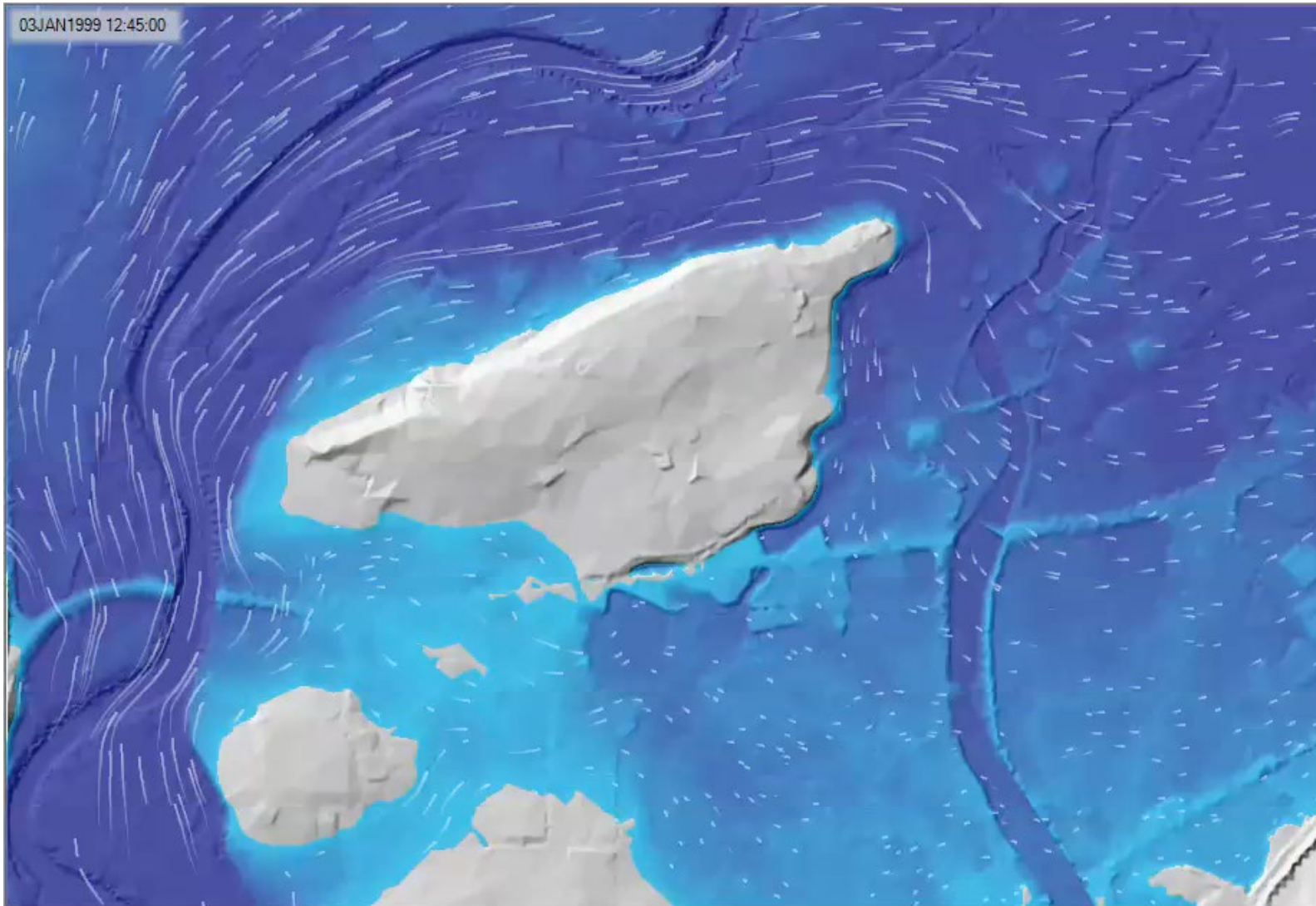


Profile Lines – Velocity





Velocity Trace Animation



Questions?