

HEC-RAS Mapper Results Visualization

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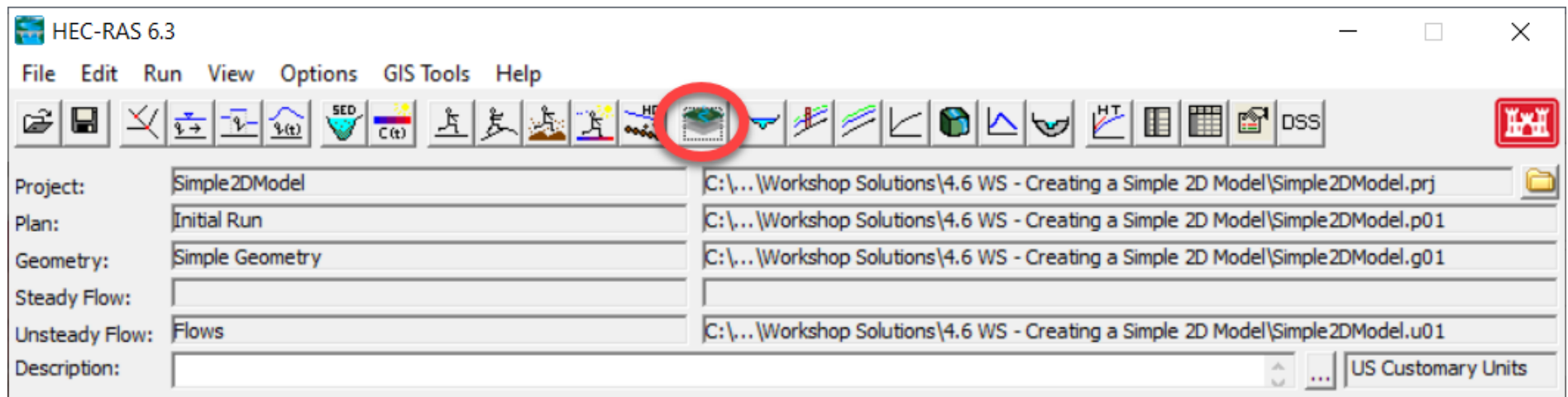
USACE, Institute for Water Resources, Hydrologic Engineering Center





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 map of a river system with a depth overlay. The interface is annotated with four red boxes and labels:

- View Tools:** A red box highlights the top toolbar containing navigation and map manipulation icons.
- Animation Controls:** A red box highlights the top right corner of the toolbar, containing play, stop, and refresh icons.
- Layers List:** A red box highlights the left-hand panel, which contains a tree view of layers. The 'Depth (Max)' layer is selected and highlighted in pink. Other visible layers include 'Profile Lines', 'Geometries', 'Event Conditions', 'Results', 'Map Layers', and 'Terrains'. A vertical color scale for the depth layer is visible to the right of the list.
- View Area:** A red box highlights a specific region on the map, indicating the current view area.

Additional interface elements include a menu bar (File, Project, Tools, Help), a status bar at the bottom showing coordinates and scale (2000 ft), and a 'Status Area' at the bottom left with options like 'US End of Levee', 'Left Split', 'Right Split', and 'Cross Section'.



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.

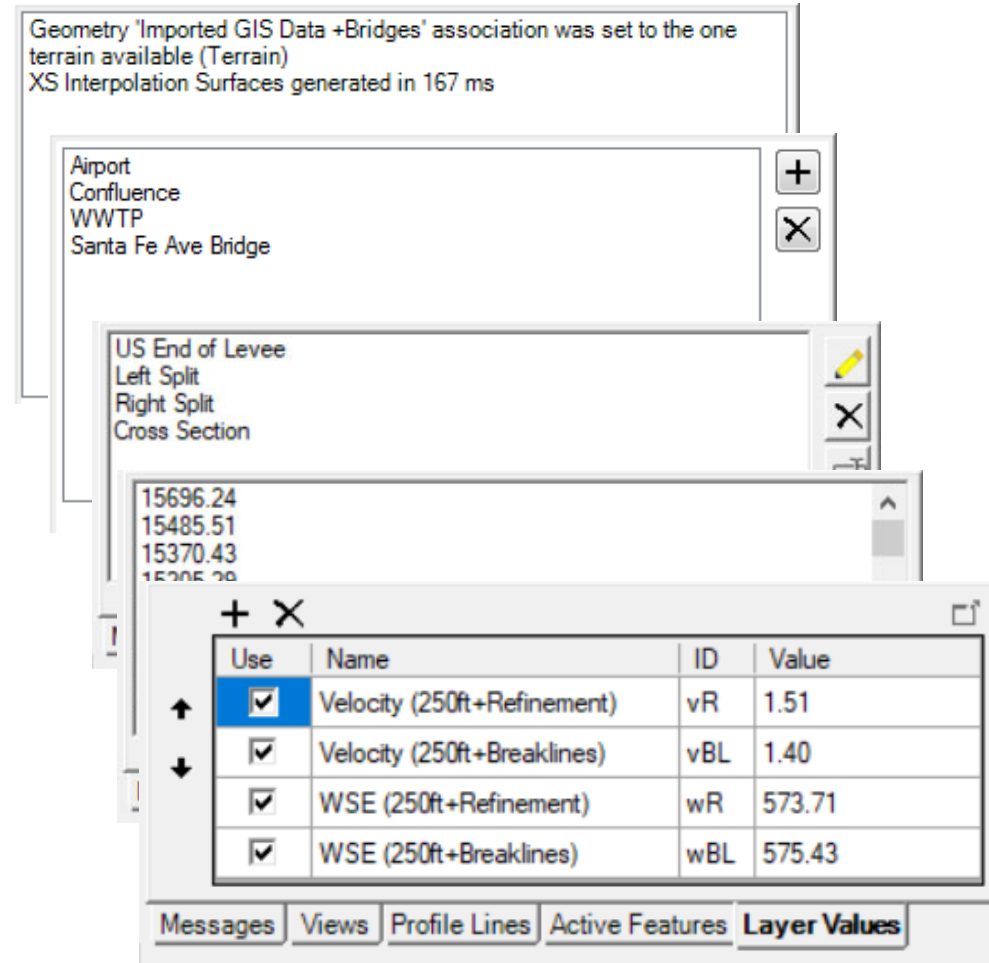


The selected layer is highlighted in magenta.



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

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**

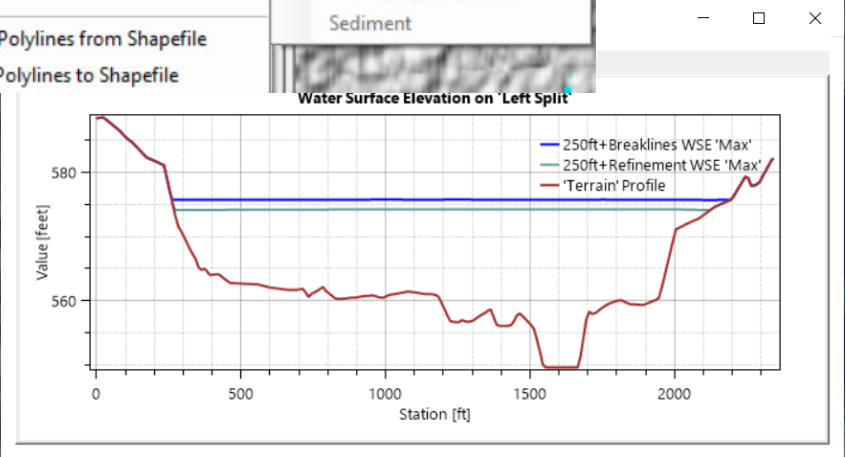


Profile Lines

- User-defined/editable features

Left Split
Right Split
Cross Section

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



Features

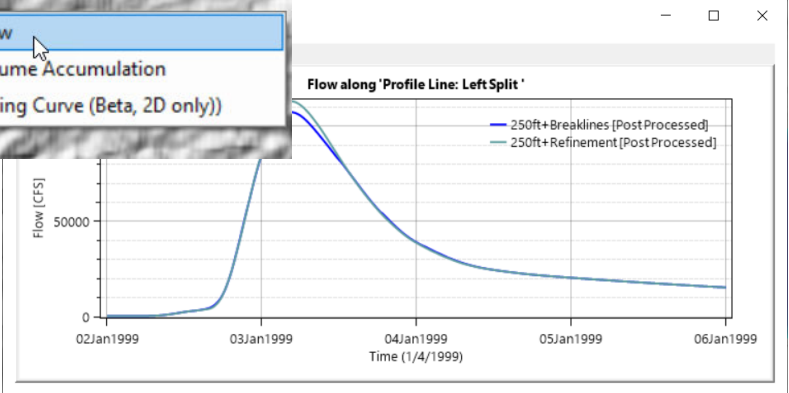
- Profile Lines
- Geometries
 - Simple Geometry
 - 250ft
 - 250ft+Breaklines
 - 250ft+Refinement
- Event Conditions
- Results
- Map Layers
 - CompareCellSize
 - Google Satellite
- Terrains
 - Terrain

US End of Levee
Left Split
Right Split
Cross Section

Messages Views Profile Lines Active Features Layer Values

US End of Levee
Left Split
Right Split
Cross Section

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





Active Features

RAS Mapper

File Project Tools Help

Selected Layer: Cross Sections

- SA2D 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
- Results Time Series

- WSE
- Velocity
- Depth



Watch Layers List



RAS Mapper

File Project Tools Help

Selected Layer: Velocity

02JAN1900 06:55:00

Selected: 'Velocity'

Layer Properties
Edit Map Parameters
Zoom to Layer
Add Watch to Layer Values

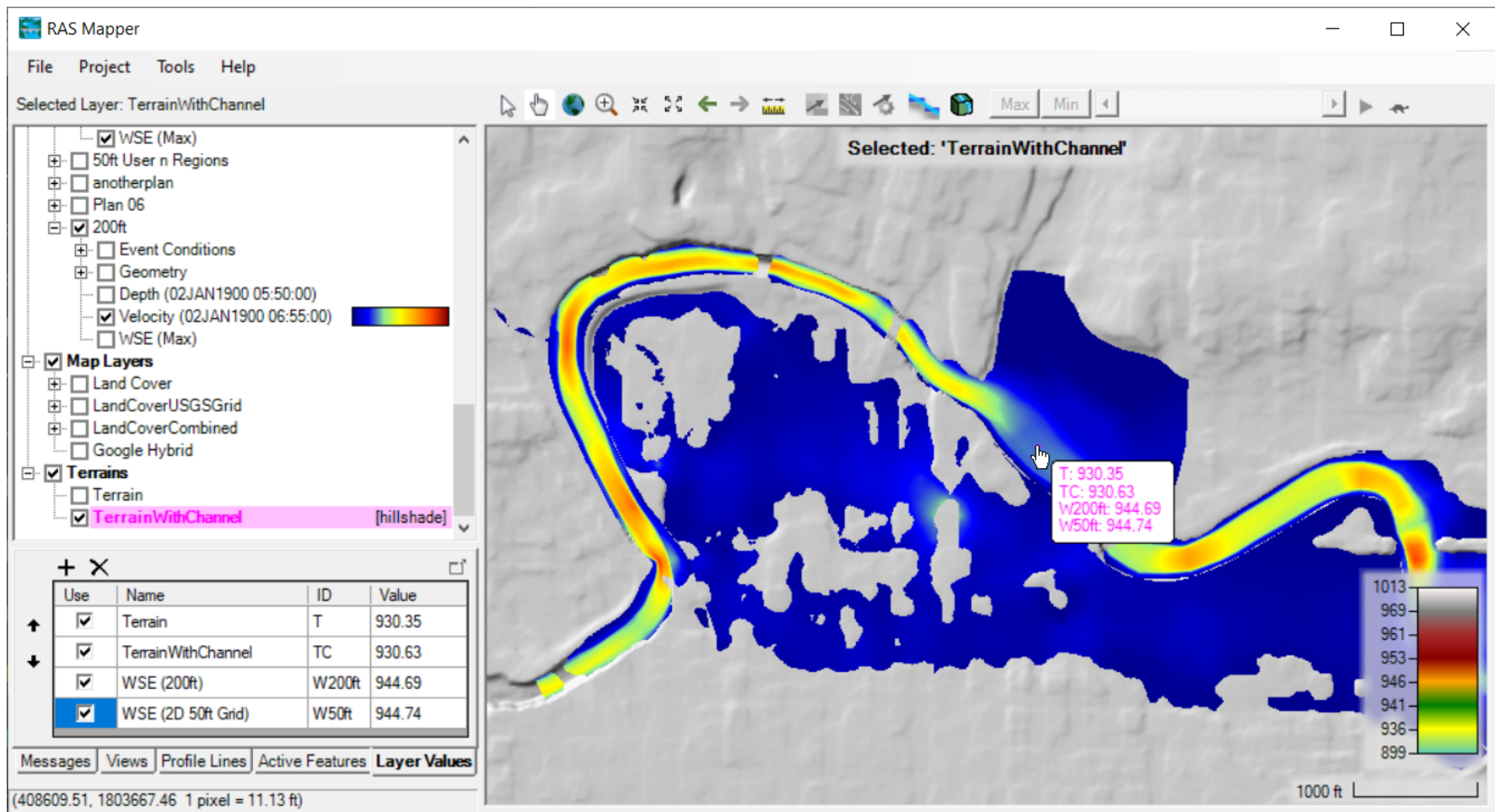
Use	Name	ID	Value
<input type="checkbox"/>	Terrain	T	930.59
<input type="checkbox"/>	TerrainWithChannel	TC	930.63
<input type="checkbox"/>	WSE (200ft)	W200ft	944.70
<input checked="" type="checkbox"/>	WSE (2D 50ft Grid)	W50ft	944.75

Messages Views Profile Lines Active Features Layer Values

(408665.18, 1803622.92 1 pixel = 11.13 ft)



Watch Layers List





Web Imagery

The screenshot shows the ArcGIS desktop environment. A 'Select WMS image server' dialog box is open on the left, listing various WMS servers. The main map window displays a satellite-style map of the Sacramento, CA area. A green shaded polygon is overlaid on the map, covering the Berryessa Highlands area. The dialog box has the following content:

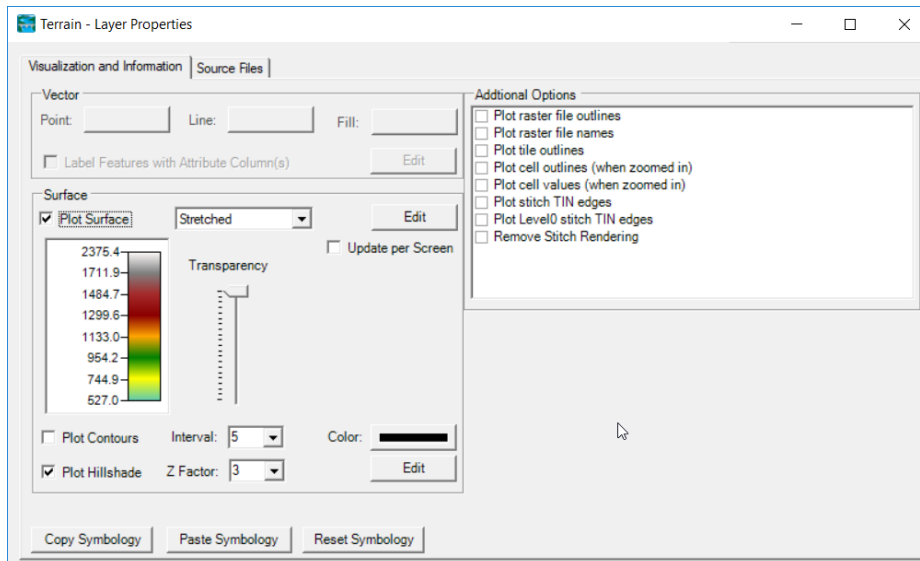
- Select WMS image server
- ArcGIS NatGeo World Map
- ArcGIS Ocean Basemap
- ArcGIS USA Topo Maps
- ArcGIS World Imagery
- ArcGIS World Physical Map
- ArcGIS World Shaded Relief
- ArcGIS World Street Map
- ArcGIS World Terrain Base
- ArcGIS World Topo Map
- Bing Satellite
- Google Hybrid
- Google Map
- Google Satellite
- Google Terrain Streets Water
- Google Terrain
- NSI_Test
- OpenStreetMaps
- USGS Imagery
- USGS Topo

At the bottom of the dialog, there is a 'Reprojection Resample Method' dropdown set to 'near' and 'OK' and 'Close' buttons.

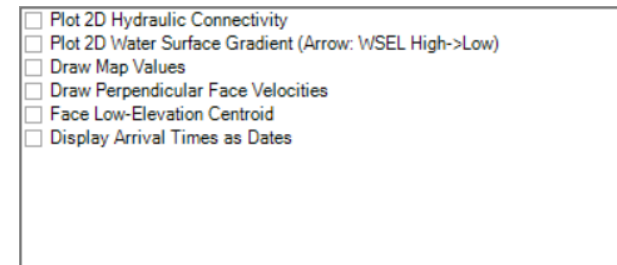


Plot Options – Layer Specific!

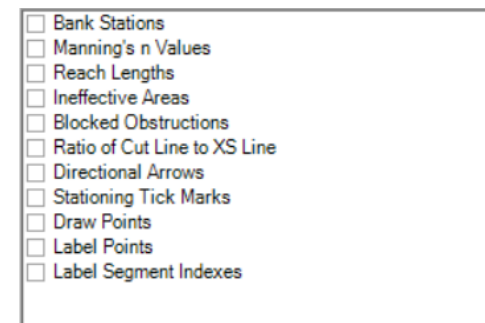
- Terrain



- Depth, WSE



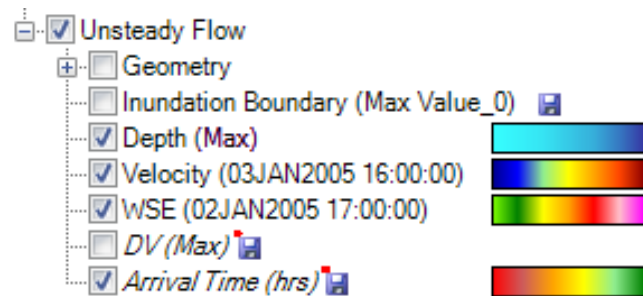
- River, Cross Sections





Results Mapping

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



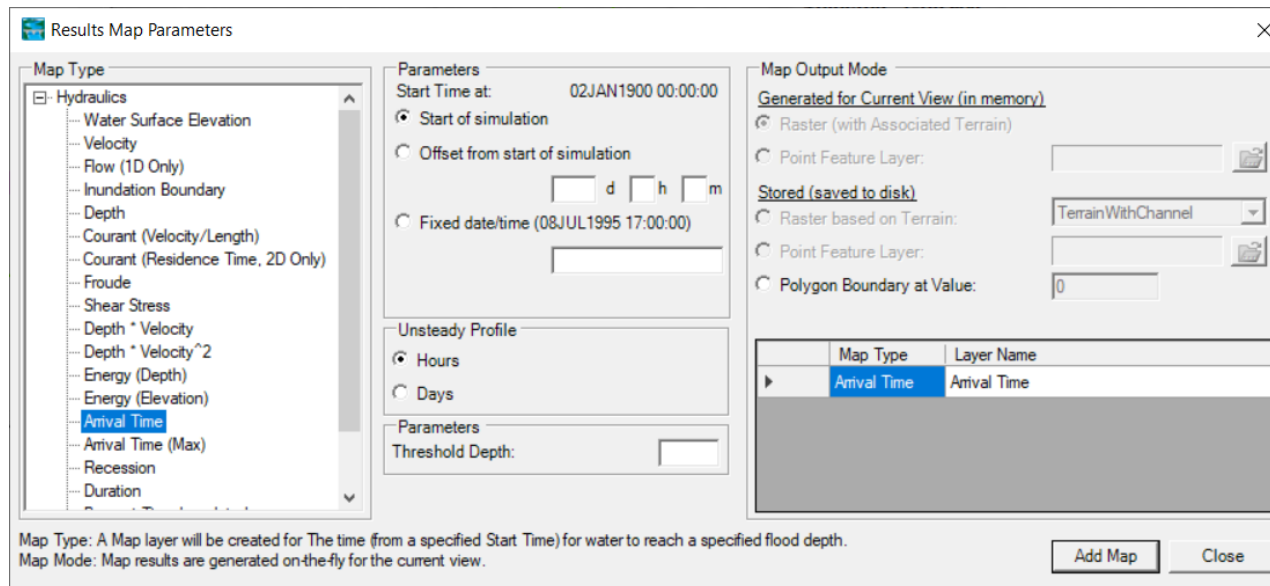
- Stored Maps – results written to file

* = *There was a problem reading data*



Results Mapping

Map Type | Profile/Parameter | Mode

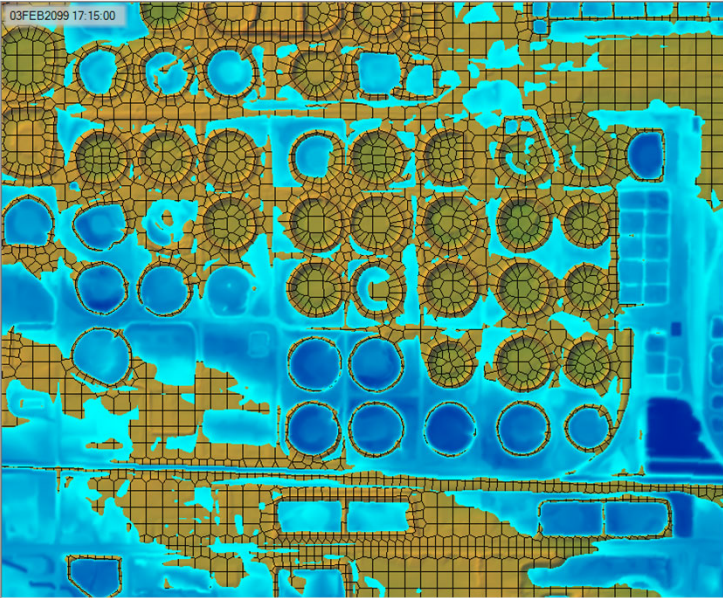


Default maps: Depth, Water Surface Elevation, Velocity

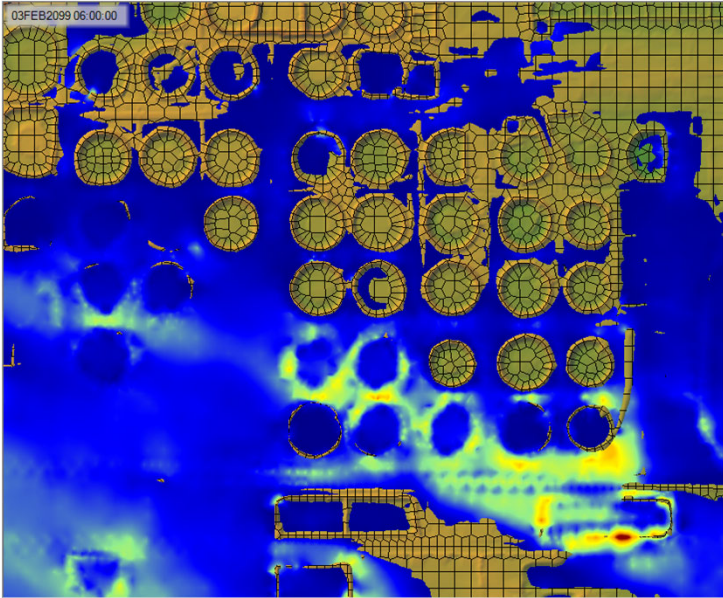


Example Maps

- Depth

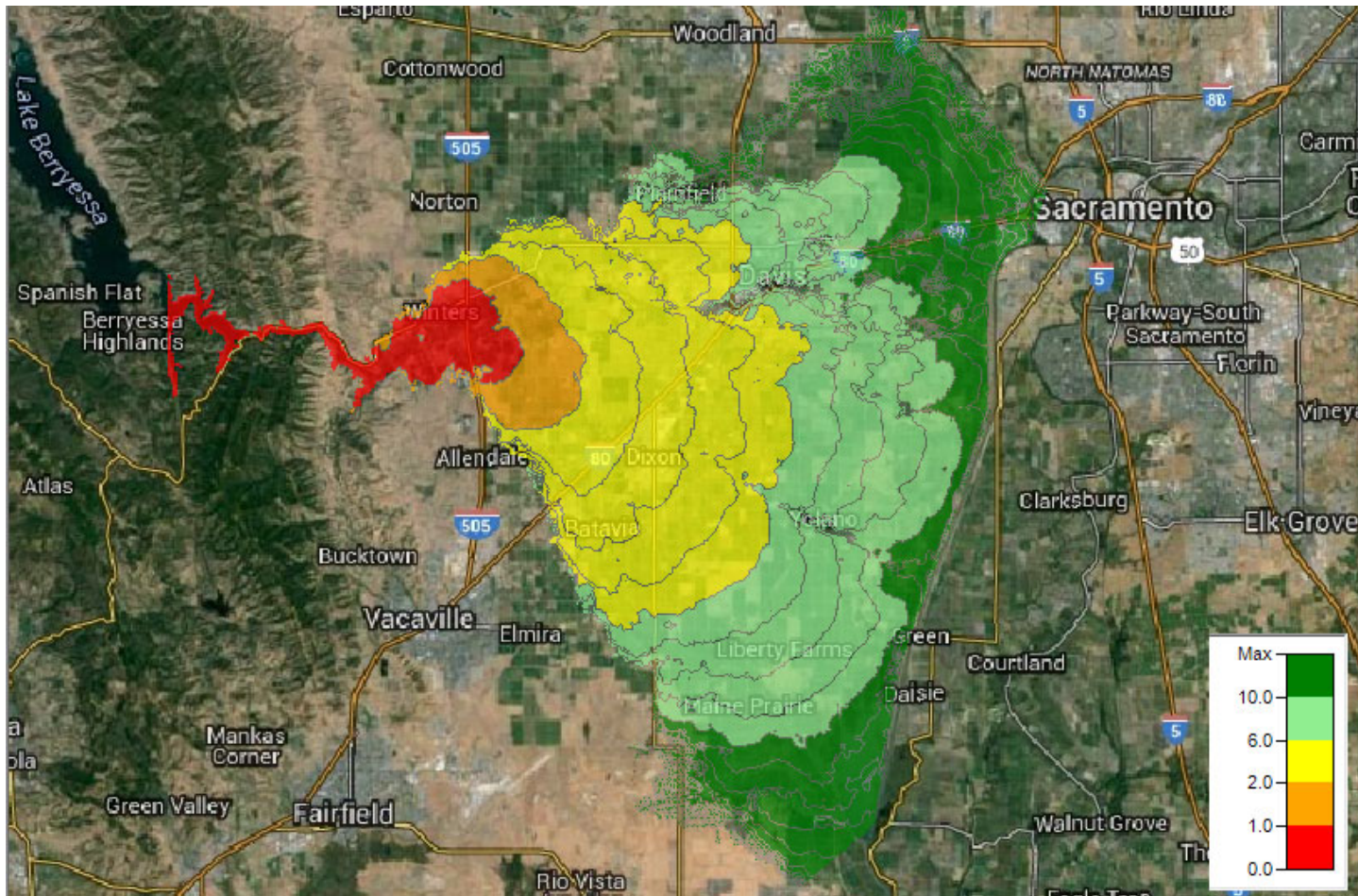


- Velocity



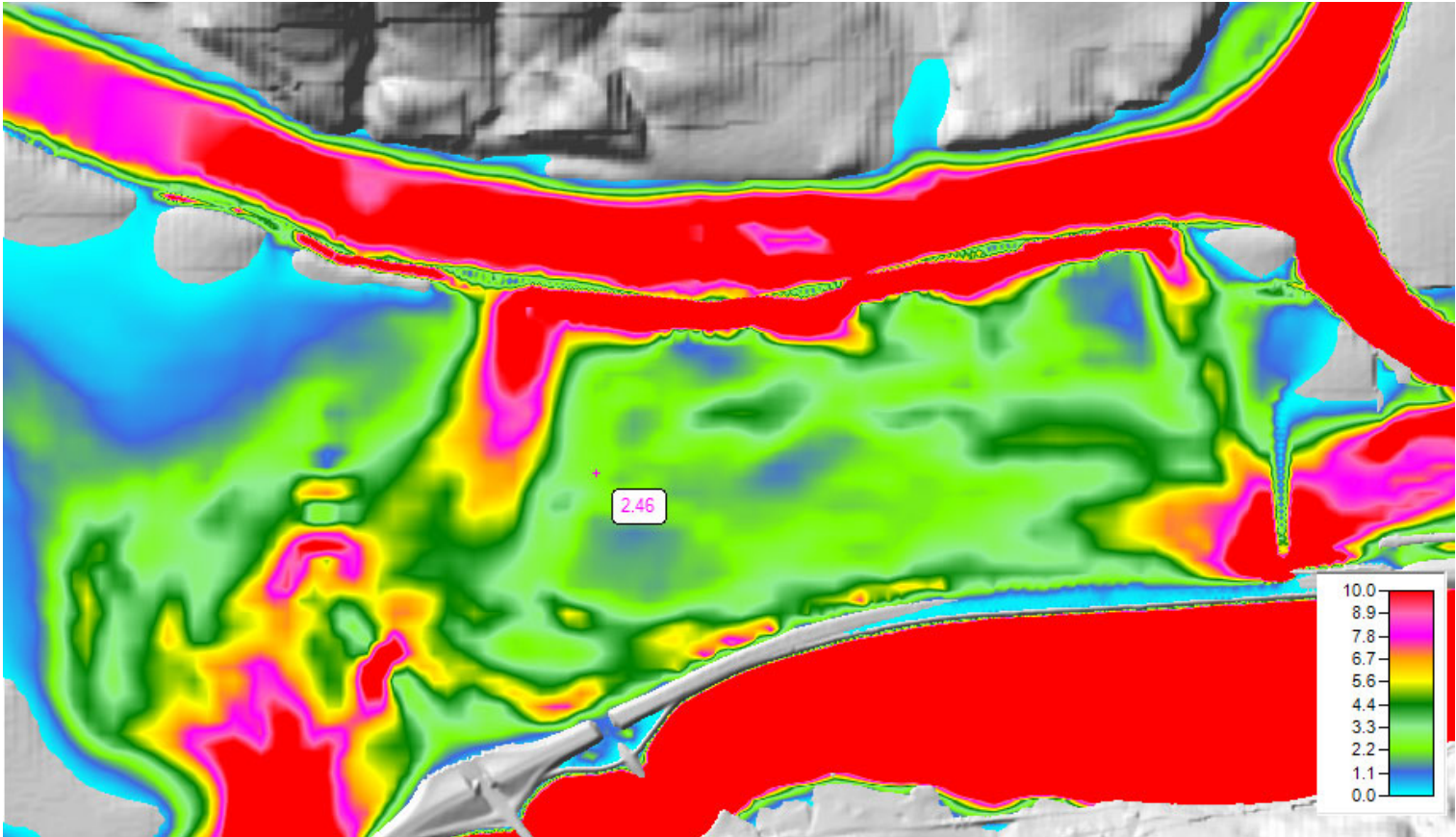


Arrival Time



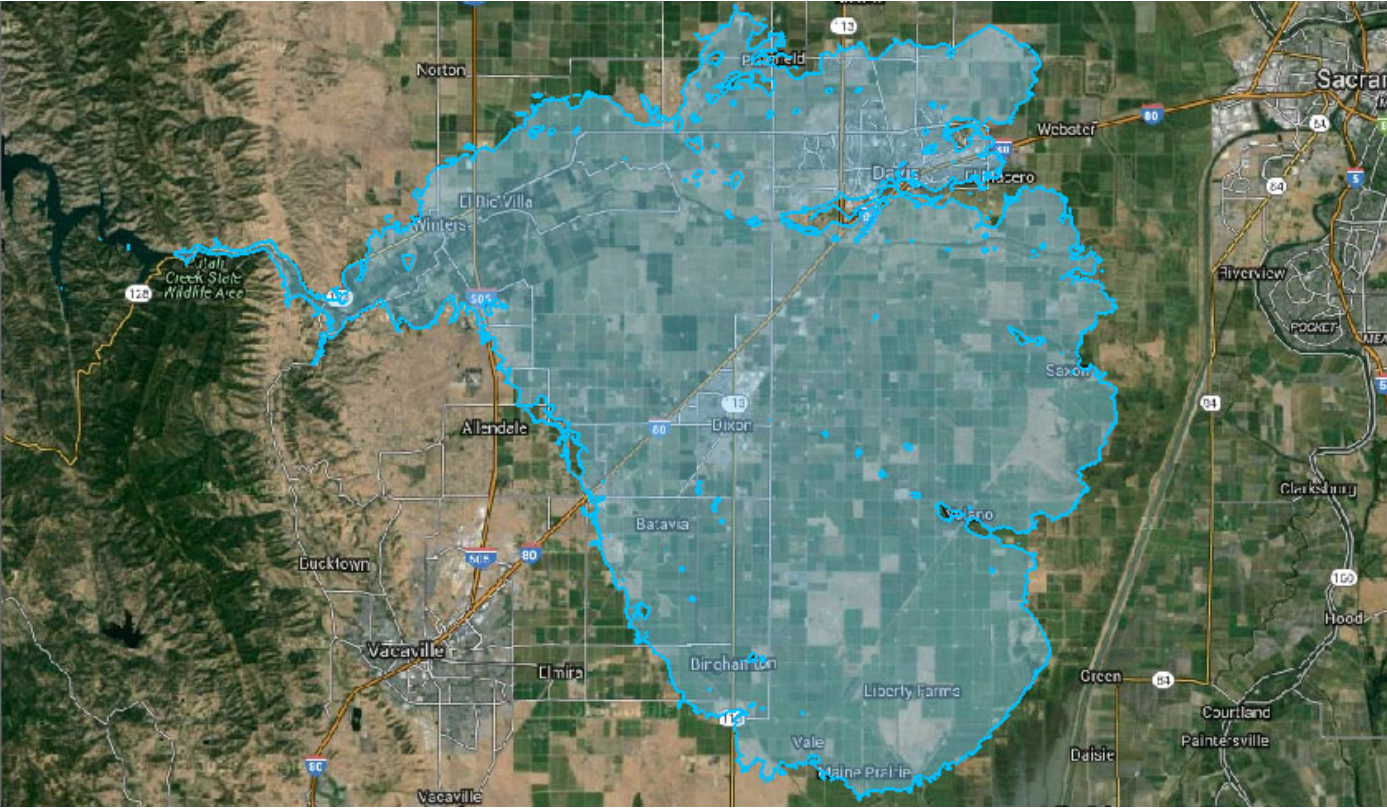


Hazard Mapping





Inundation Boundary





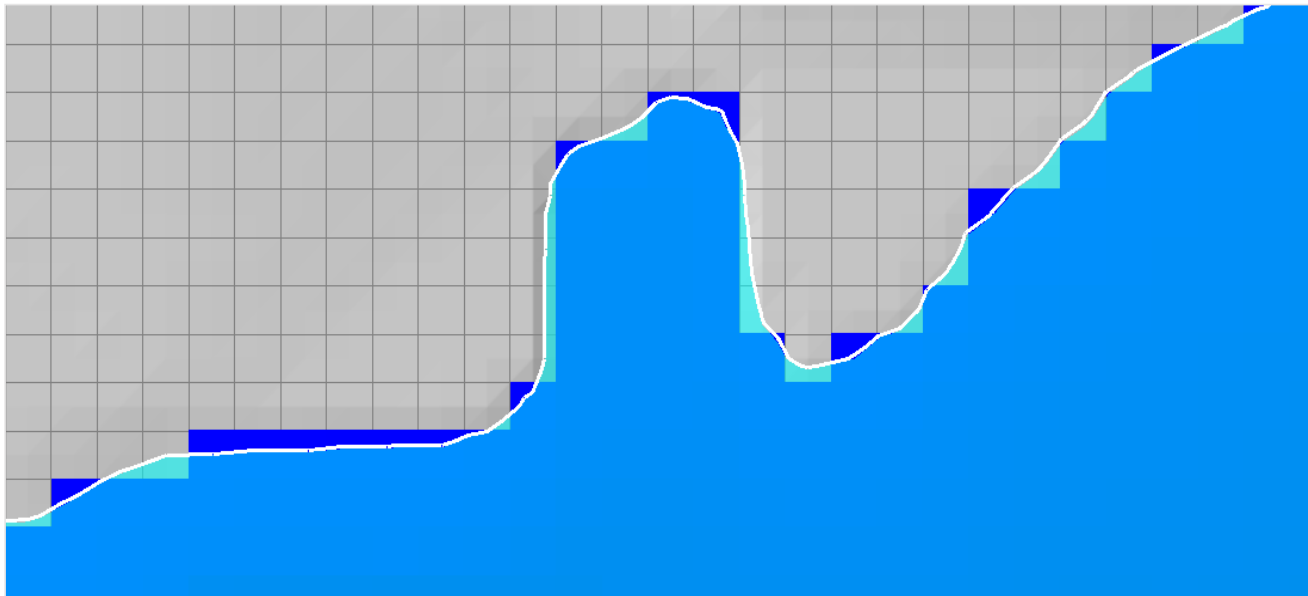
Map Types – Dynamic vs Stored

- **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

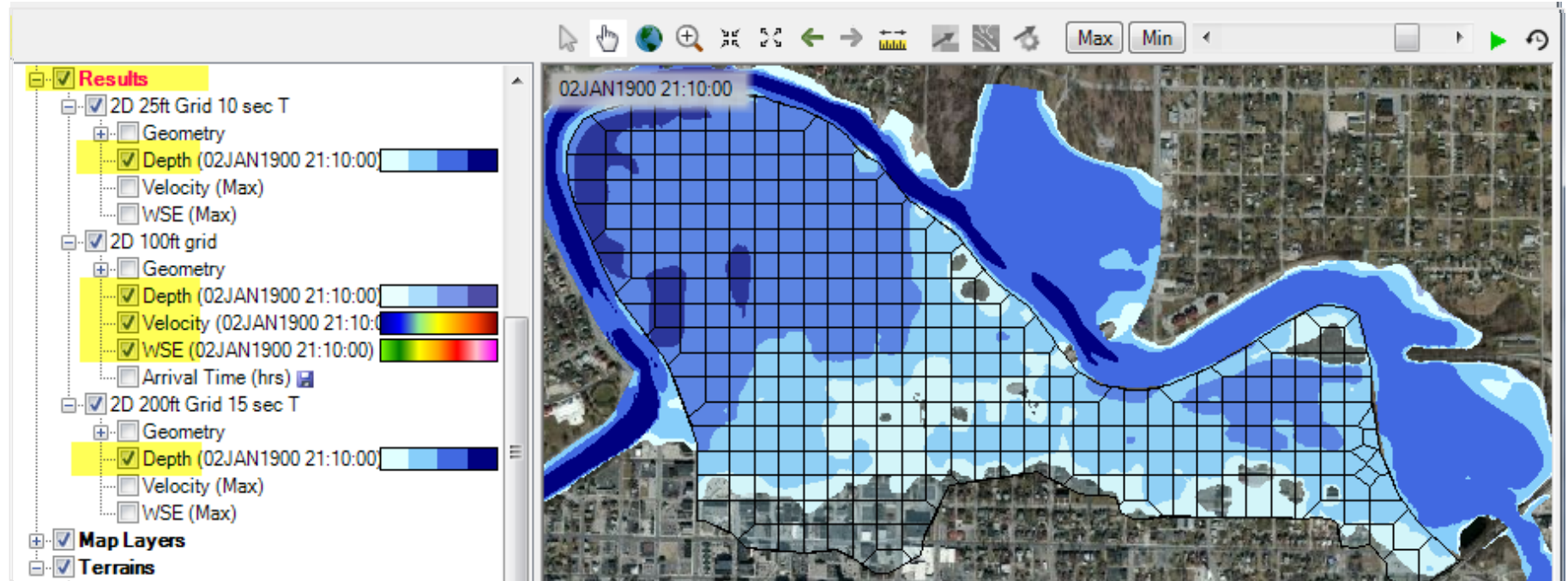
- Dynamic results plot values for the current pyramid level. Boundaries are defined based on interpolation.
- Stored results have a single value per cell.





Dynamic Mapping

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





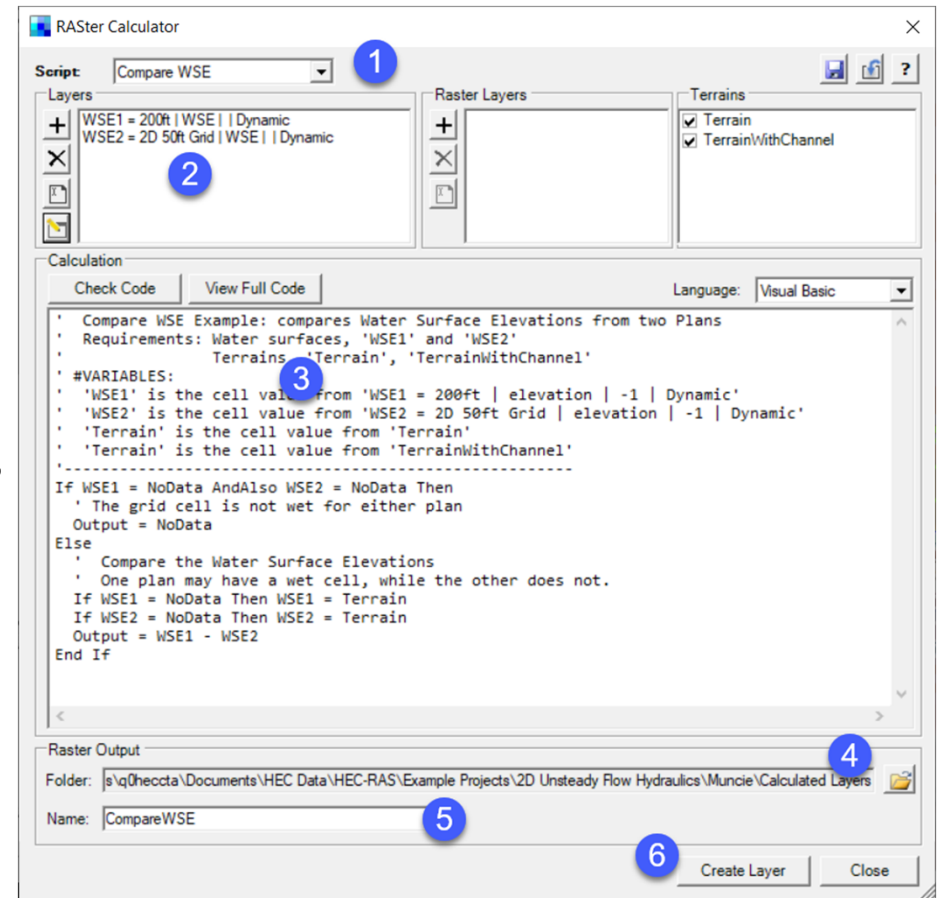
Dynamic Mapping - Animation





Calculated Layer

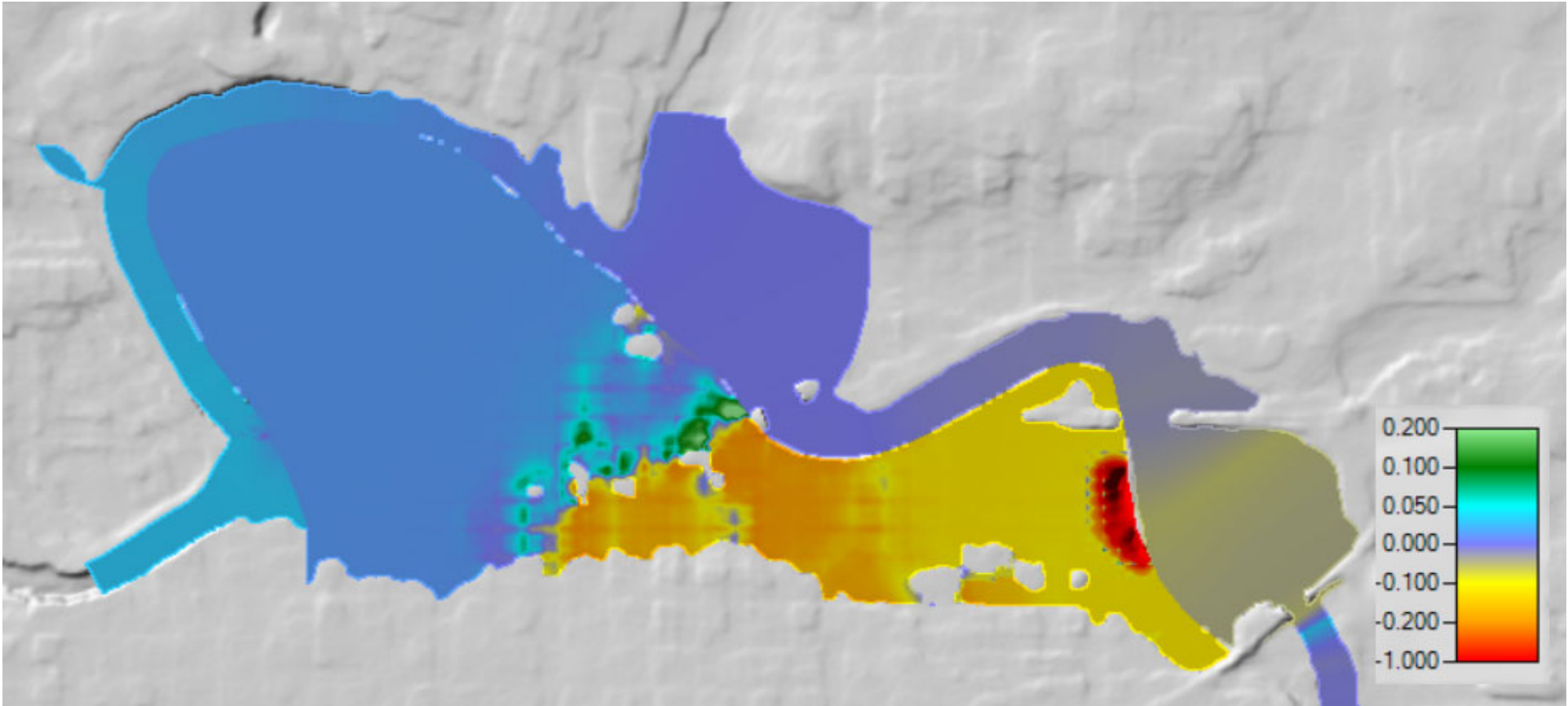
- RASter Calculator
- Custom scripting code to use multiple results
- Works with RAS Results and Terrains
- Works with Rasters on disk





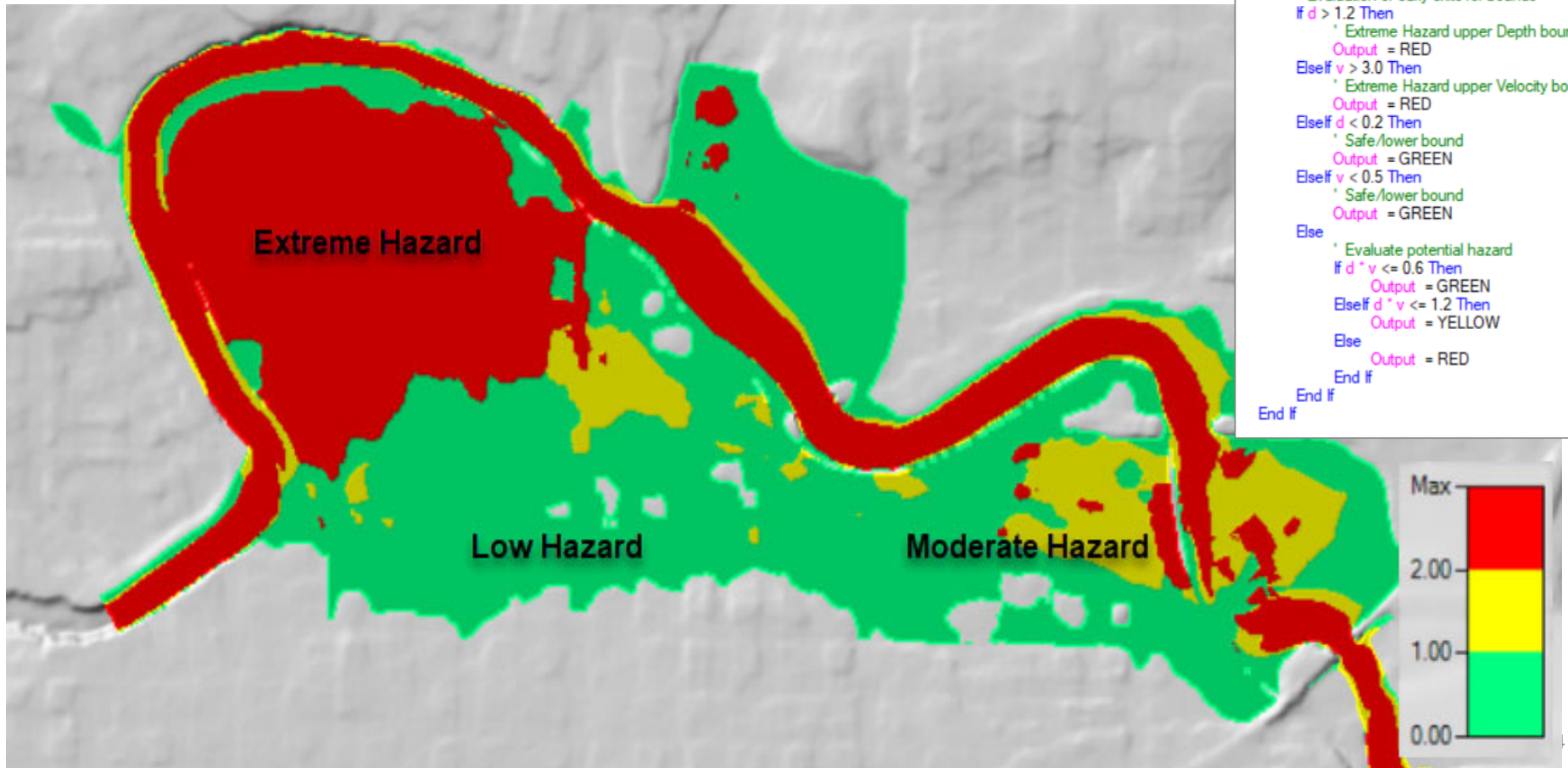
Water Surface Comparison

WSE_Mesh200ft - WSE_Mesh50ft





Hazard Evaluation



```
Const GREEN as Single = 0
Const YELLOW as Single = 1
Const RED as Single = 2

If d = NoData OrElse v = NoData Then
  Output = NoData
Else
  ' Conversion to metric assuming input variables are in feet
  d = d * 0.3048
  v = v * 0.3048
  ' Evaluation of early exits for bounds
  If d > 1.2 Then
    ' Extreme Hazard upper Depth bound
    Output = RED
  ElseIf v > 3.0 Then
    ' Extreme Hazard upper Velocity bound
    Output = RED
  ElseIf d < 0.2 Then
    ' Safe/lower bound
    Output = GREEN
  ElseIf v < 0.5 Then
    ' Safe/lower bound
    Output = GREEN
  Else
    ' Evaluate potential hazard
    If d * v <= 0.6 Then
      Output = GREEN
    ElseIf d * v <= 1.2 Then
      Output = YELLOW
    Else
      Output = RED
    End If
  End If
End If
```

Stored Maps

Manage Results Maps

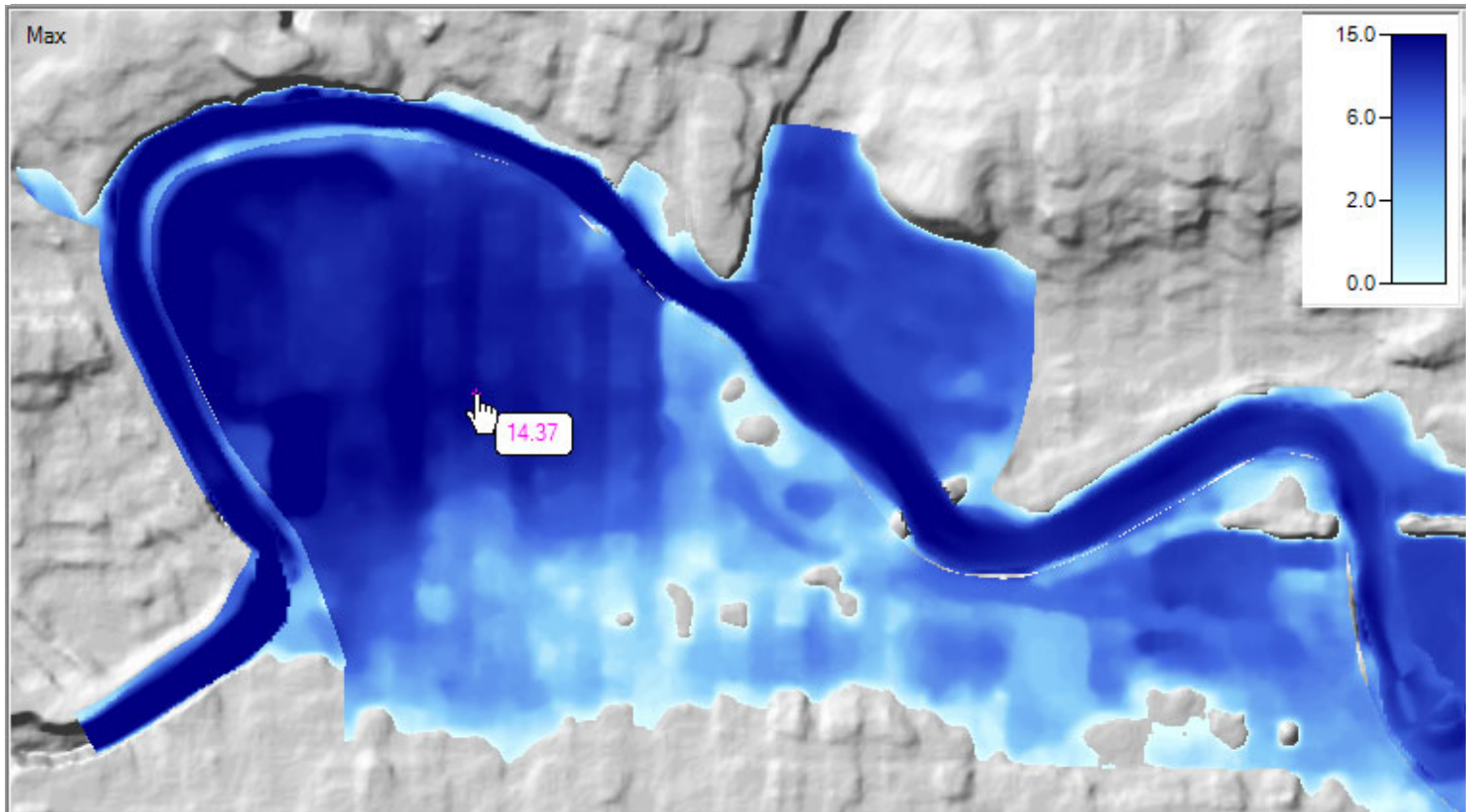
View Result Maps for: All Plan Results

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

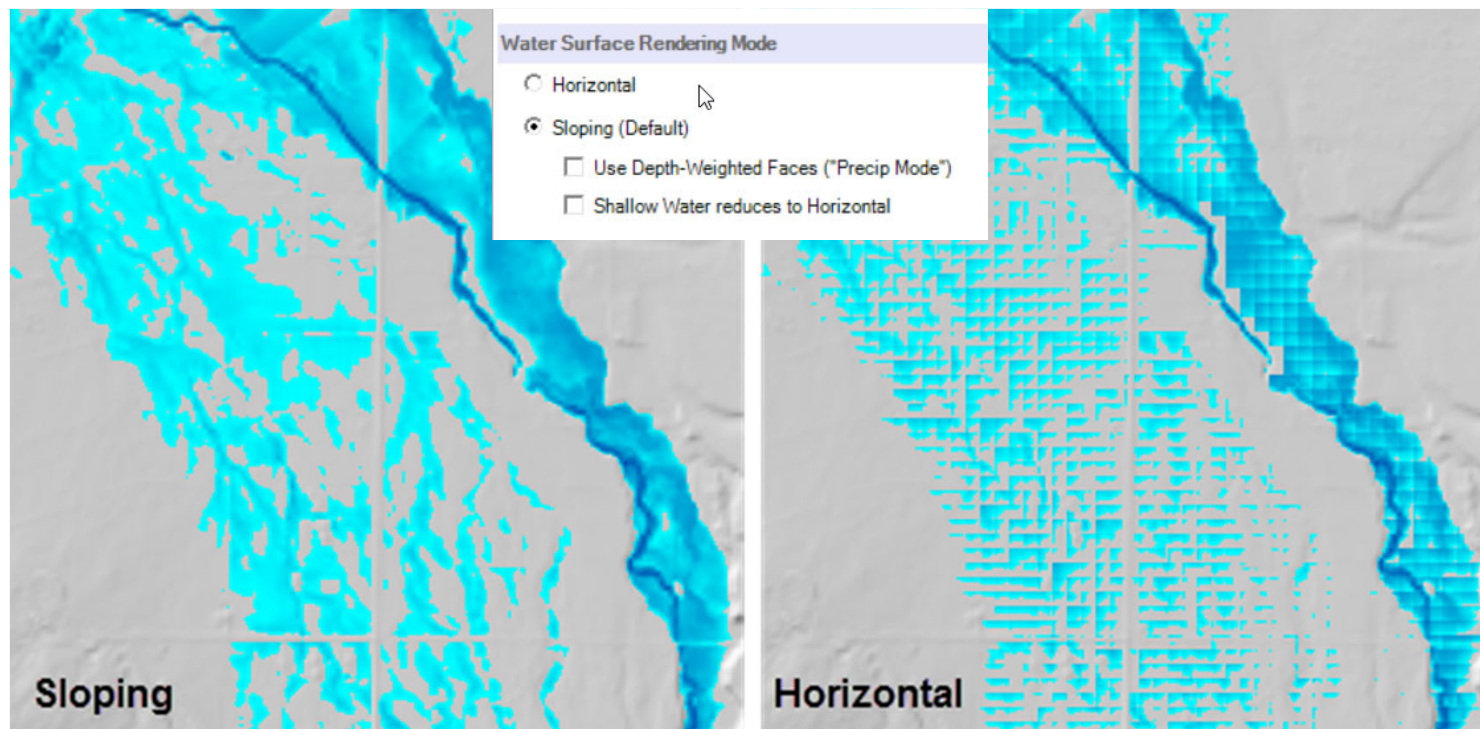


Results Visualization





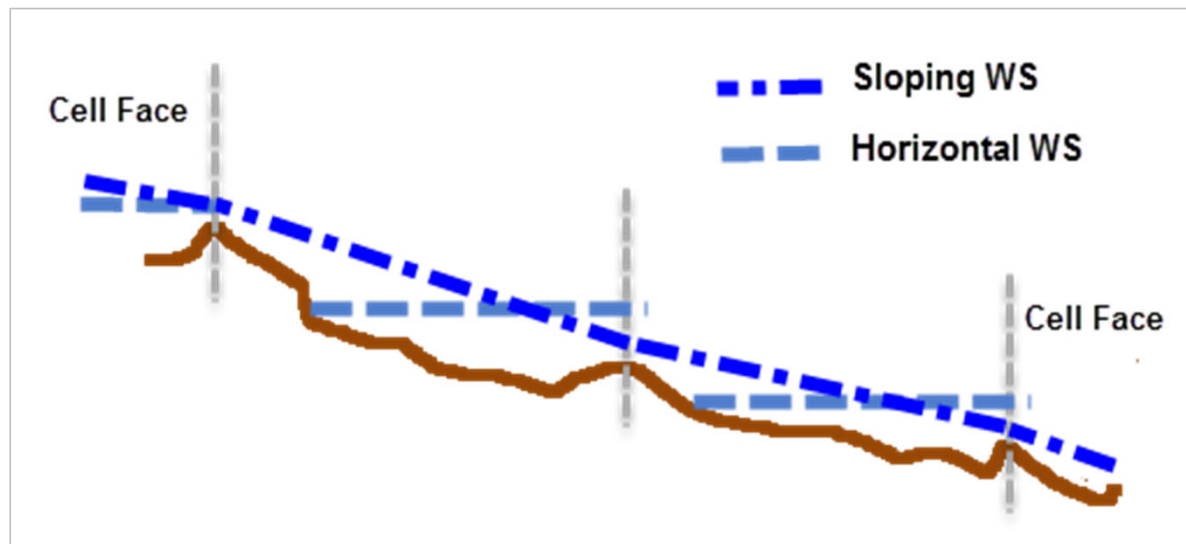
Render Mode Options





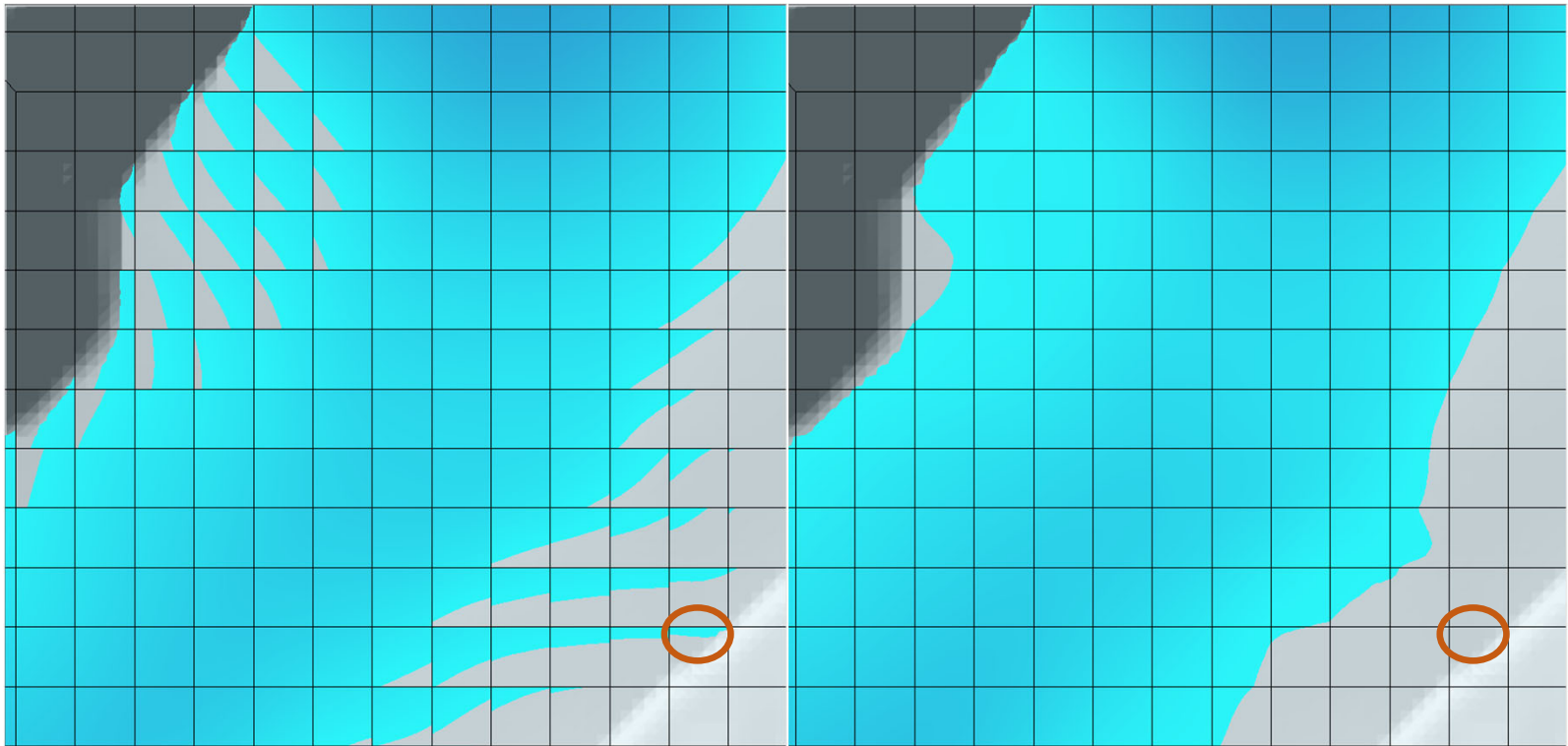
Results Interpolation

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



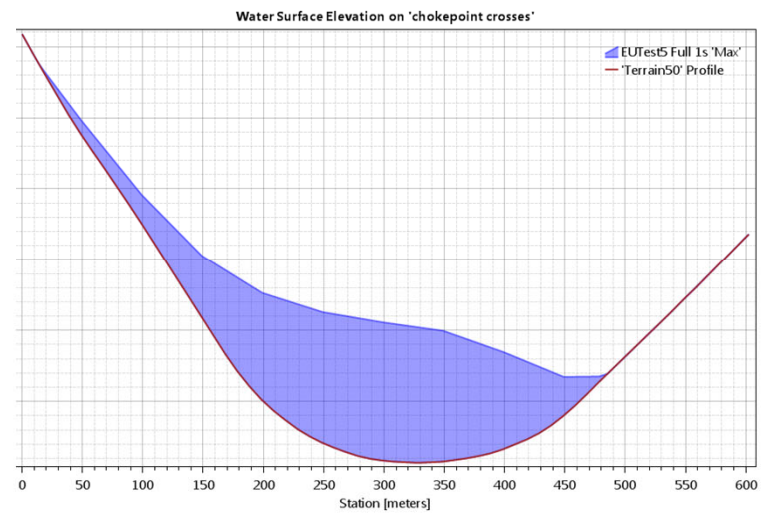
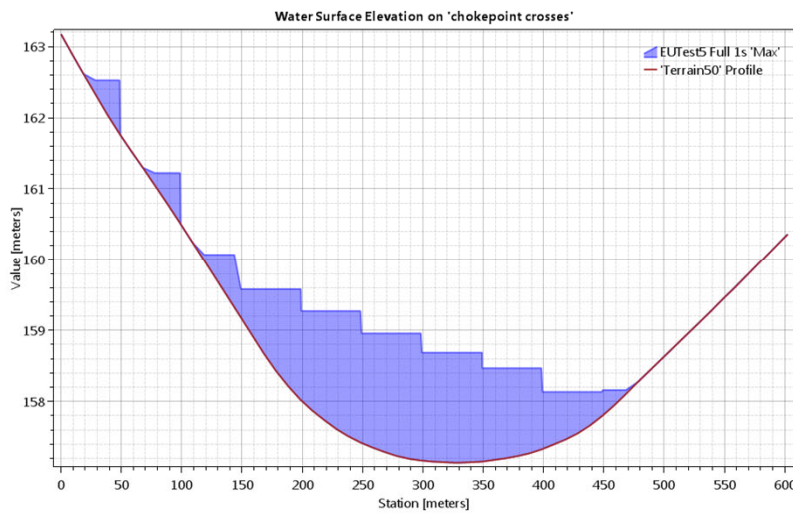


Horizontal vs Sloping Surface



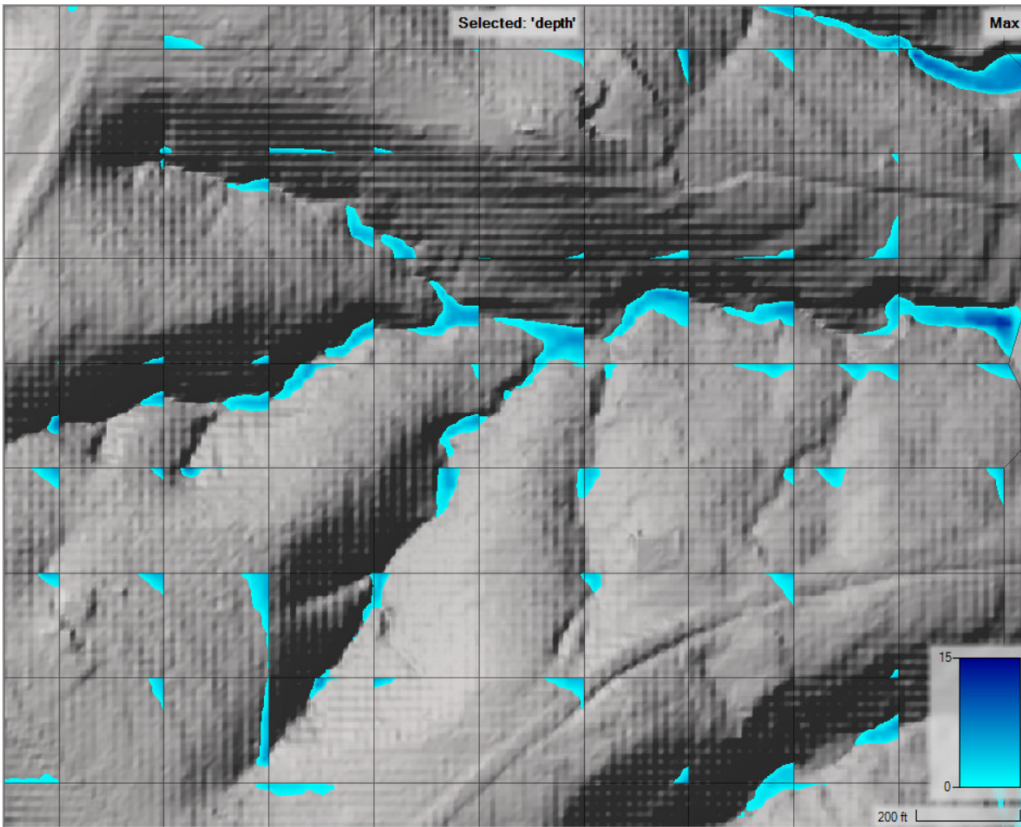


Horizontal vs Sloping Surface

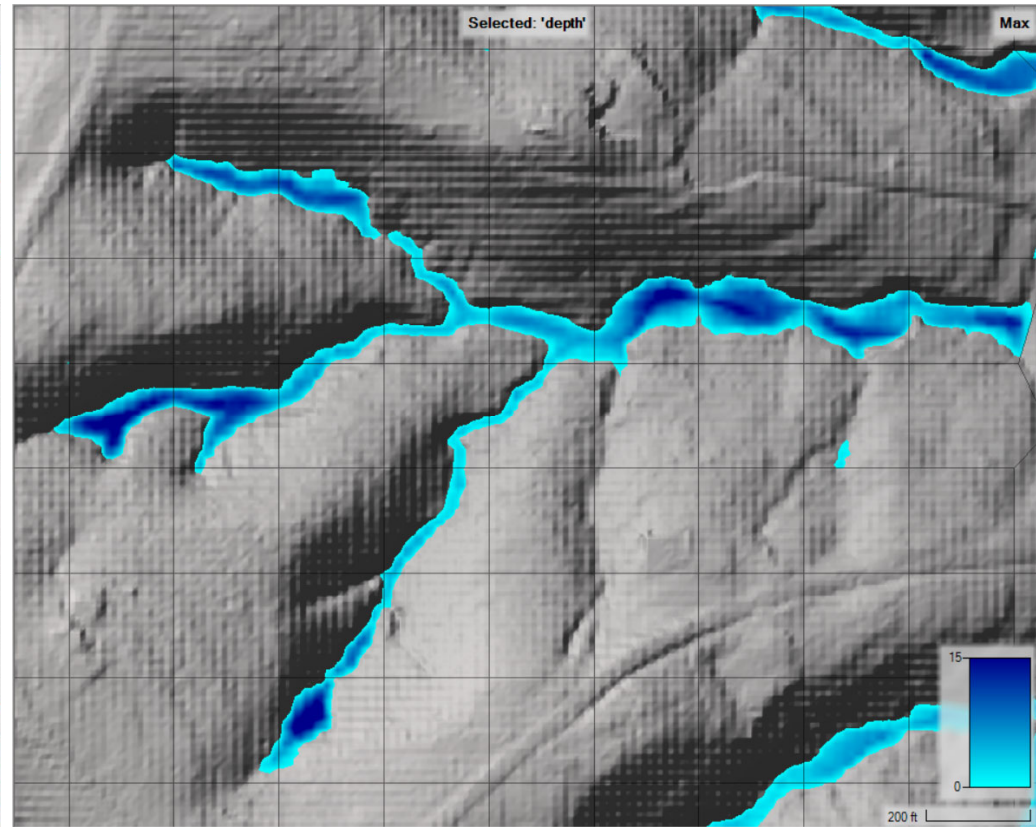




Sloping Surface Errors



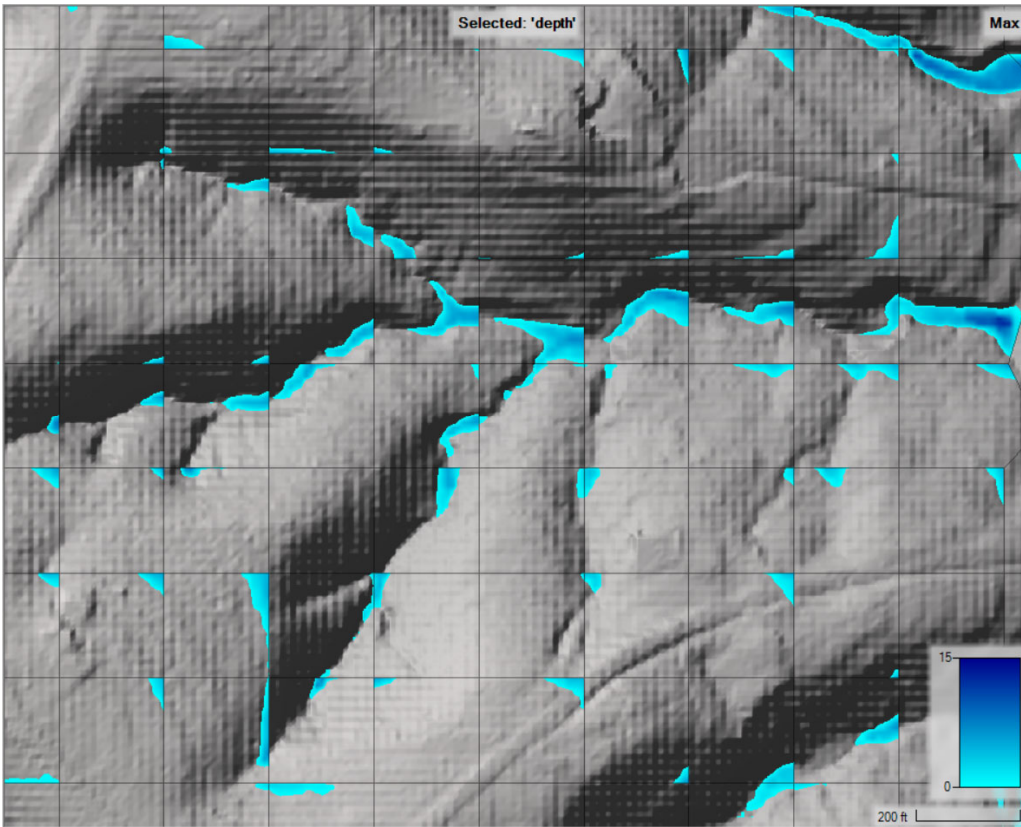
Horizontal



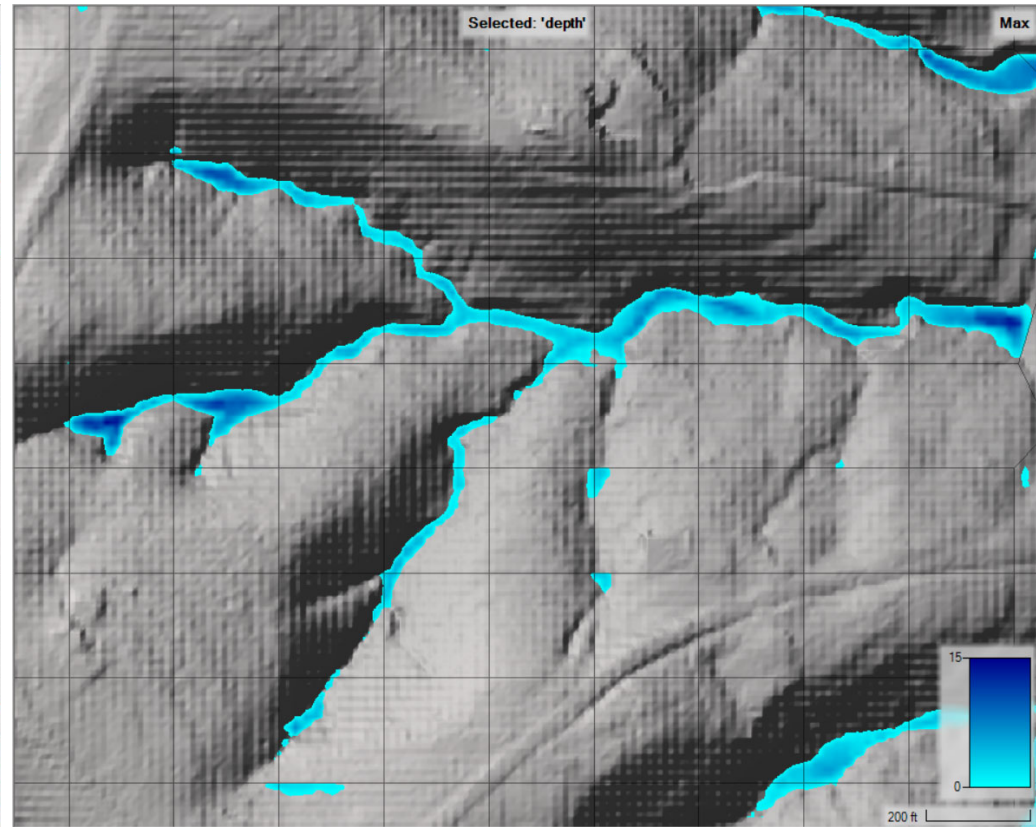
Sloping



Sloping Surface Errors



Horizontal

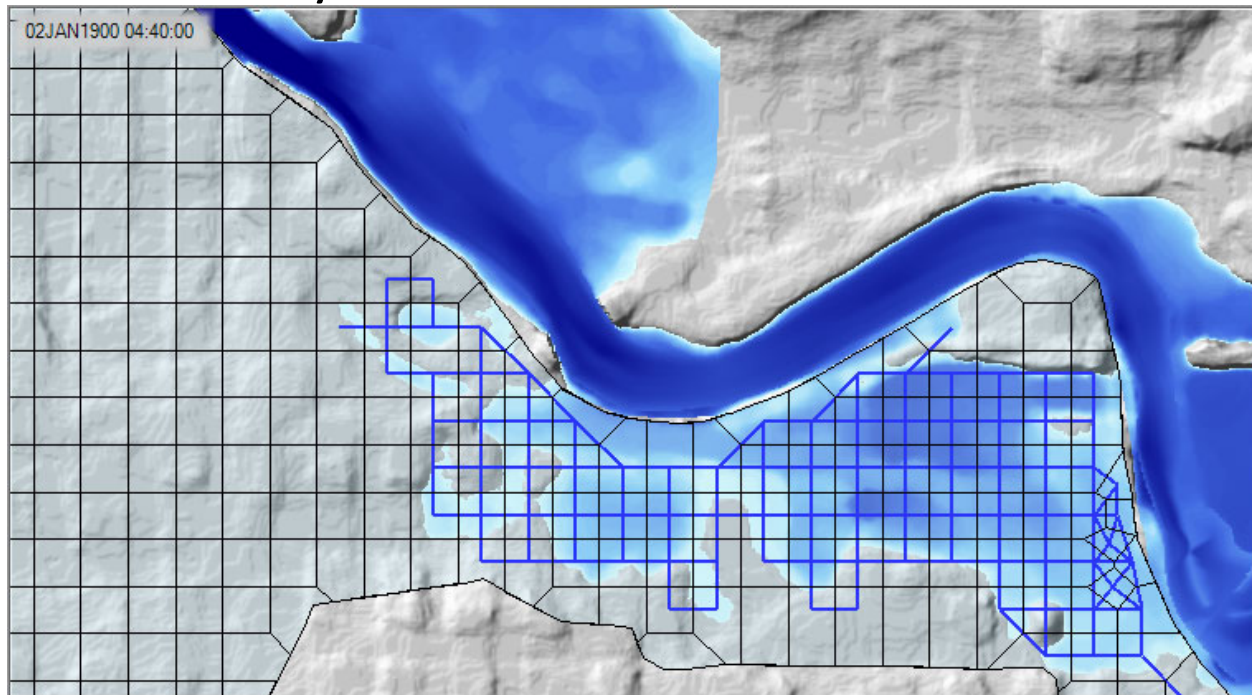


Precip Mode



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' tree shows the following structure:

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

Below the tree, the 'Map Layers' section includes 'Terrains' (checked) and 'WithChannel' (checked) with a '[hillshade]' label. A color scale legend is visible to the right of the tree.

The main map area shows a 2D flow area simulation over a terrain grid. A pink square highlights a specific cell. A context menu is open over this cell, showing 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'.



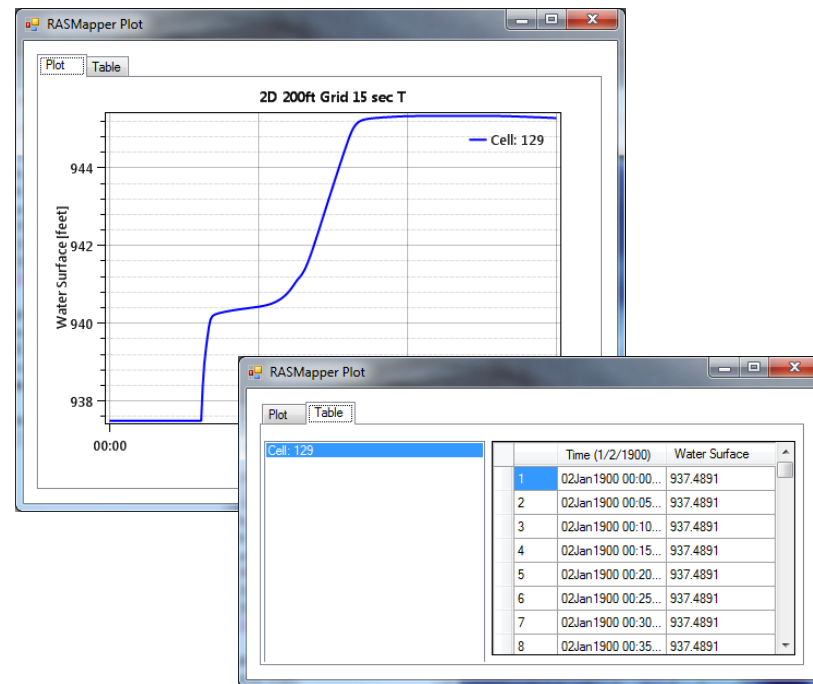
2D Flow Area Queries

- Hydraulic Properties

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

- Time Series

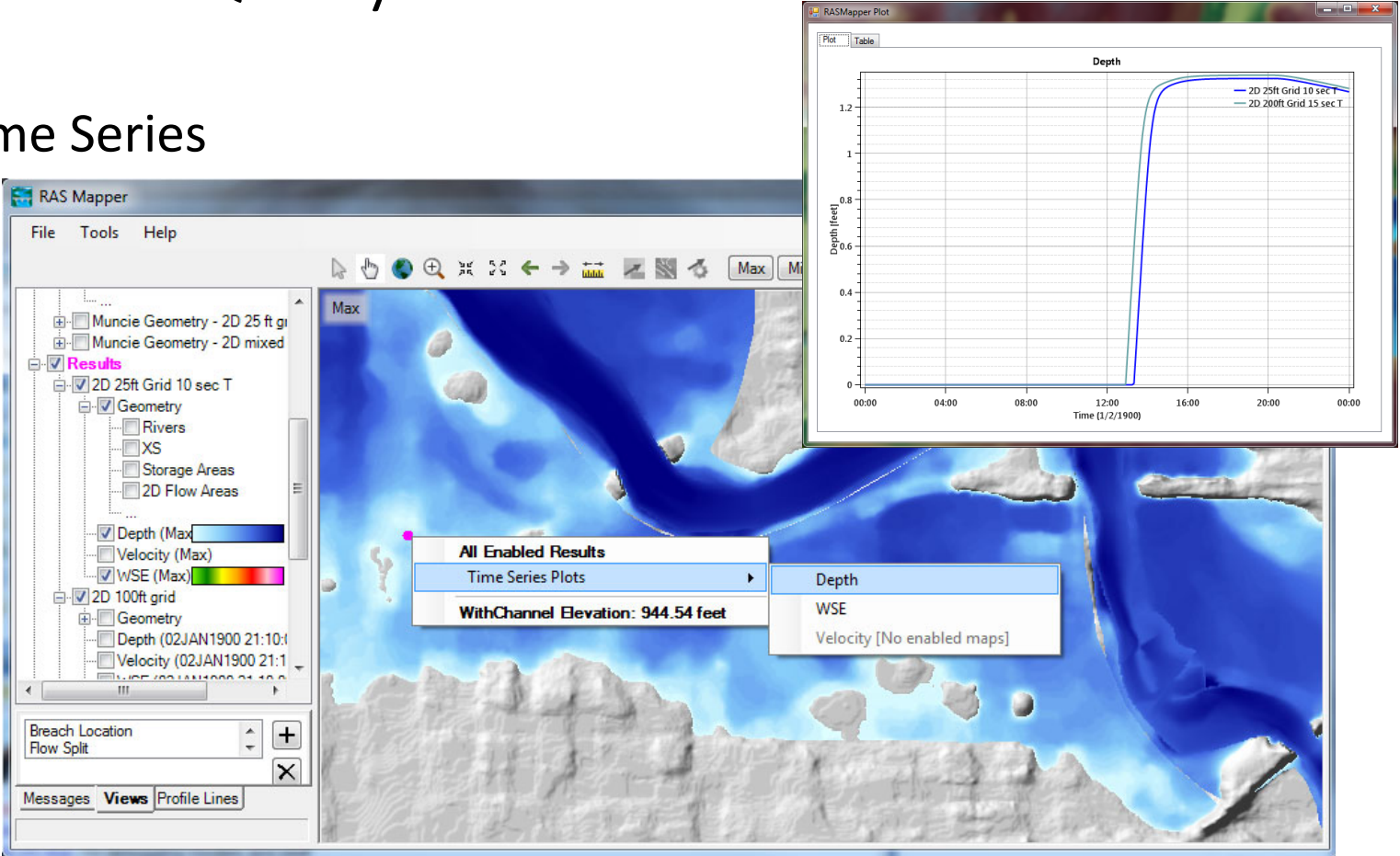
Cell: Water Surface
Cell: Depth
Cell: Shear Stress
Face Point: Velocity





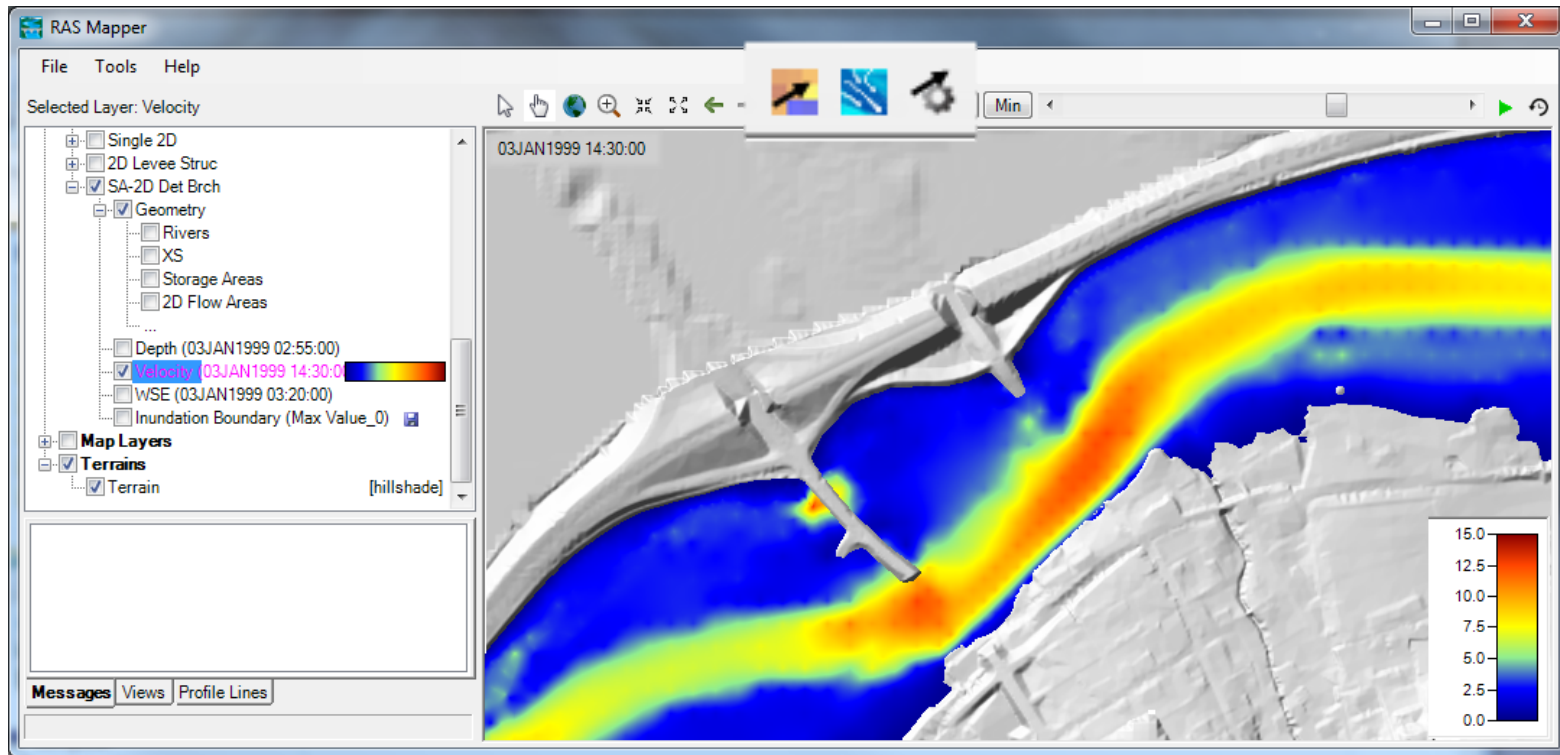
Results Query

- Time Series



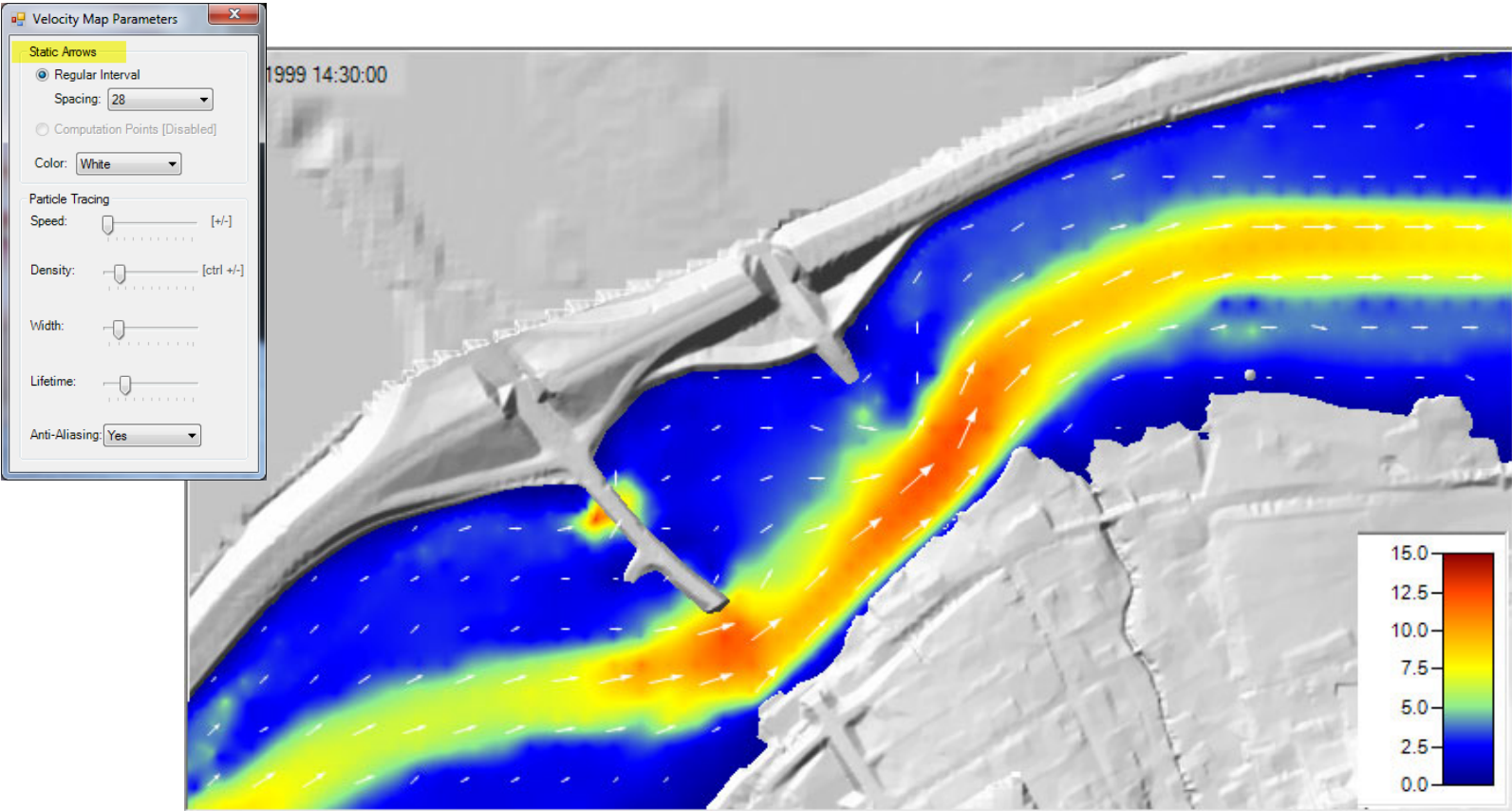


Velocity Results



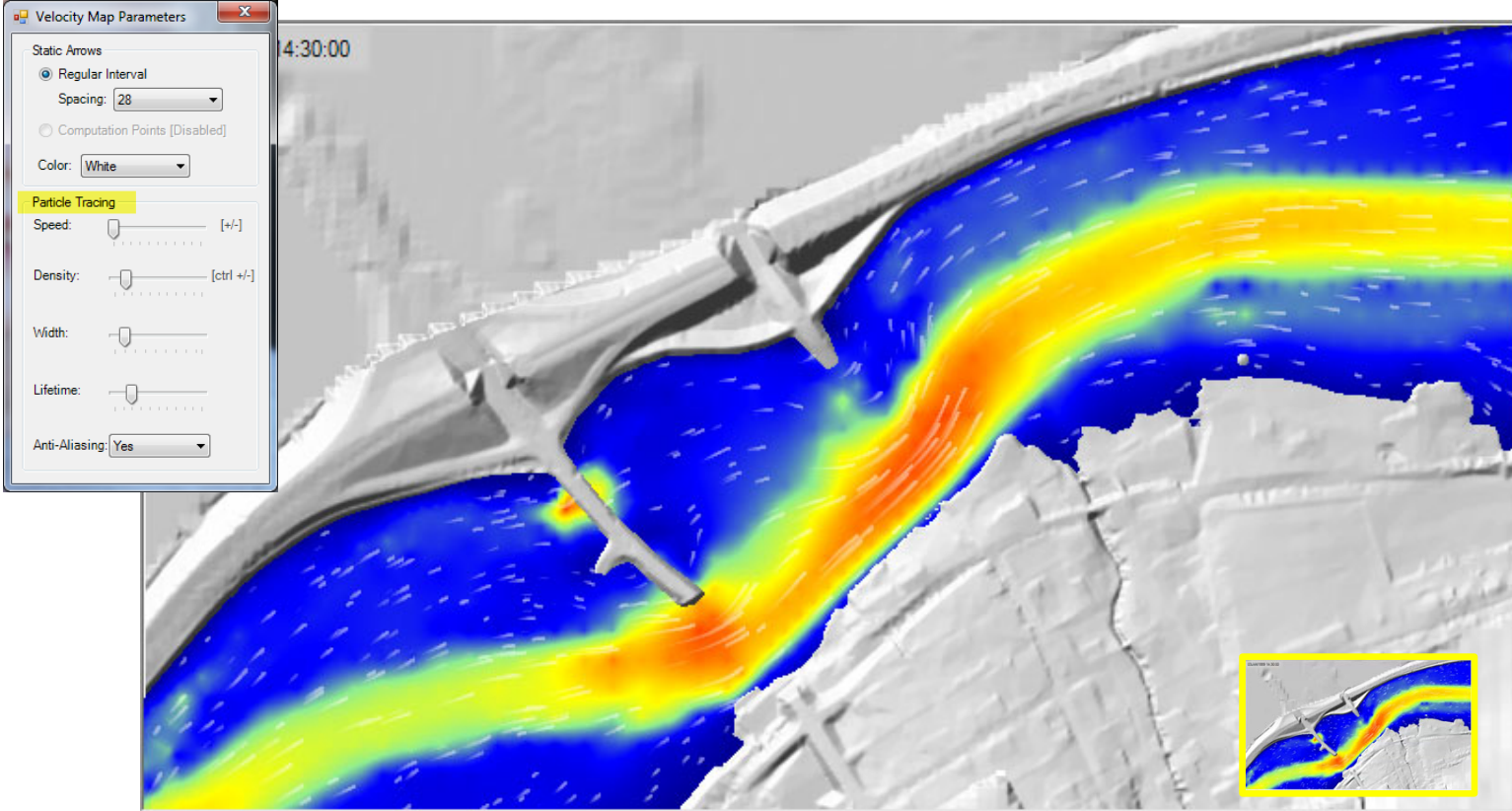


Velocity Arrows



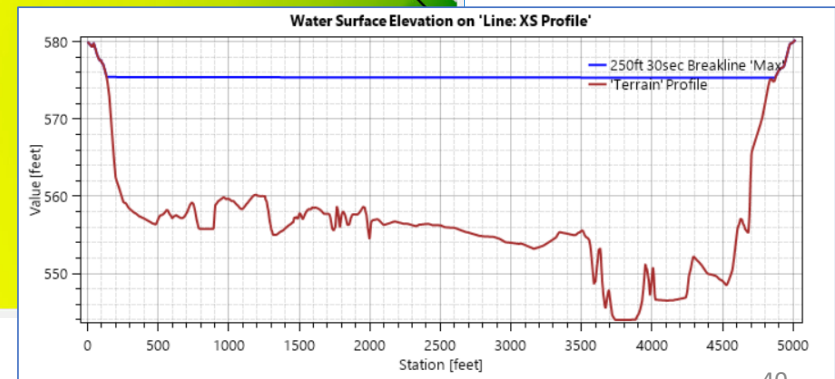
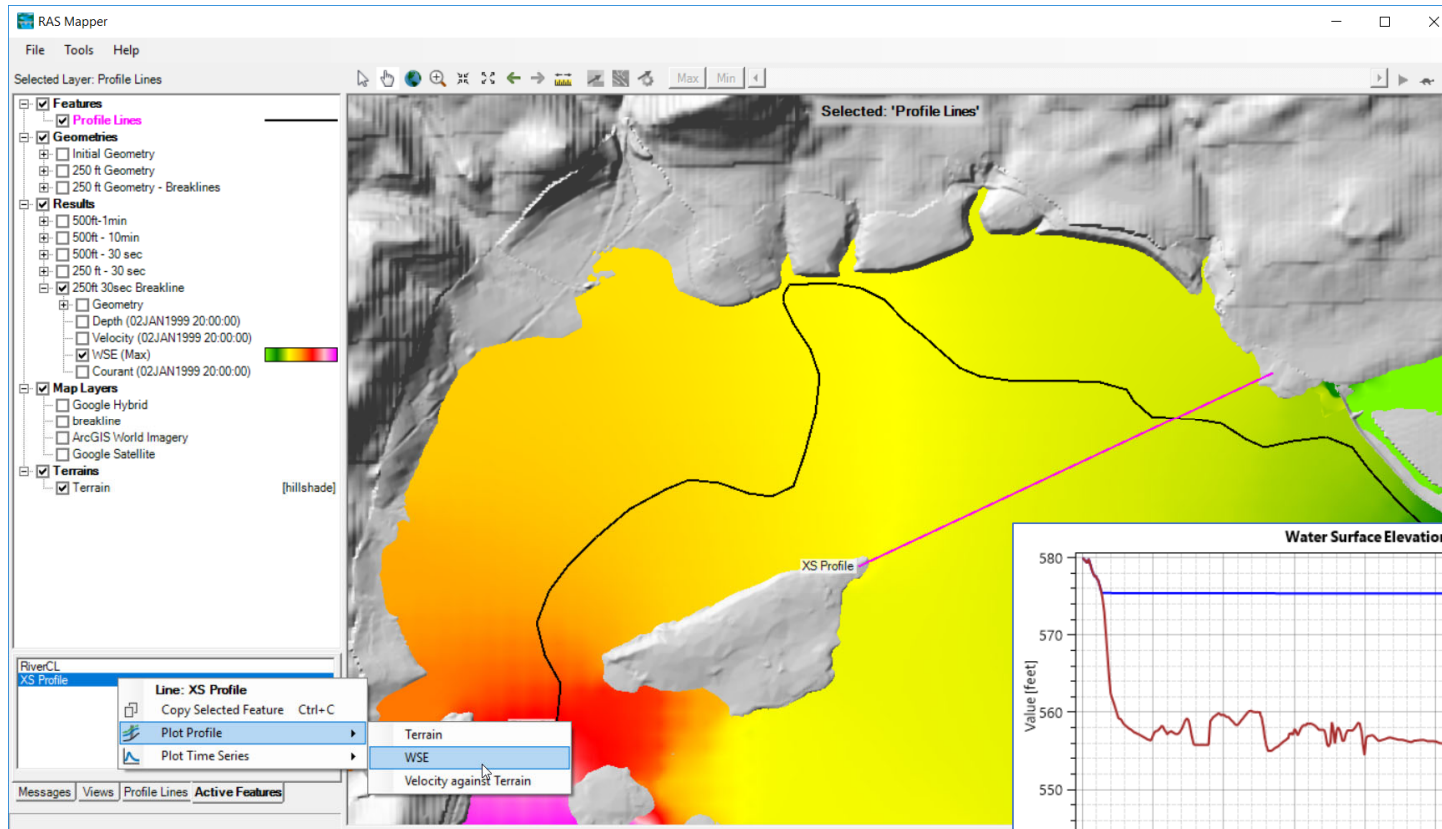


Velocity Tracing



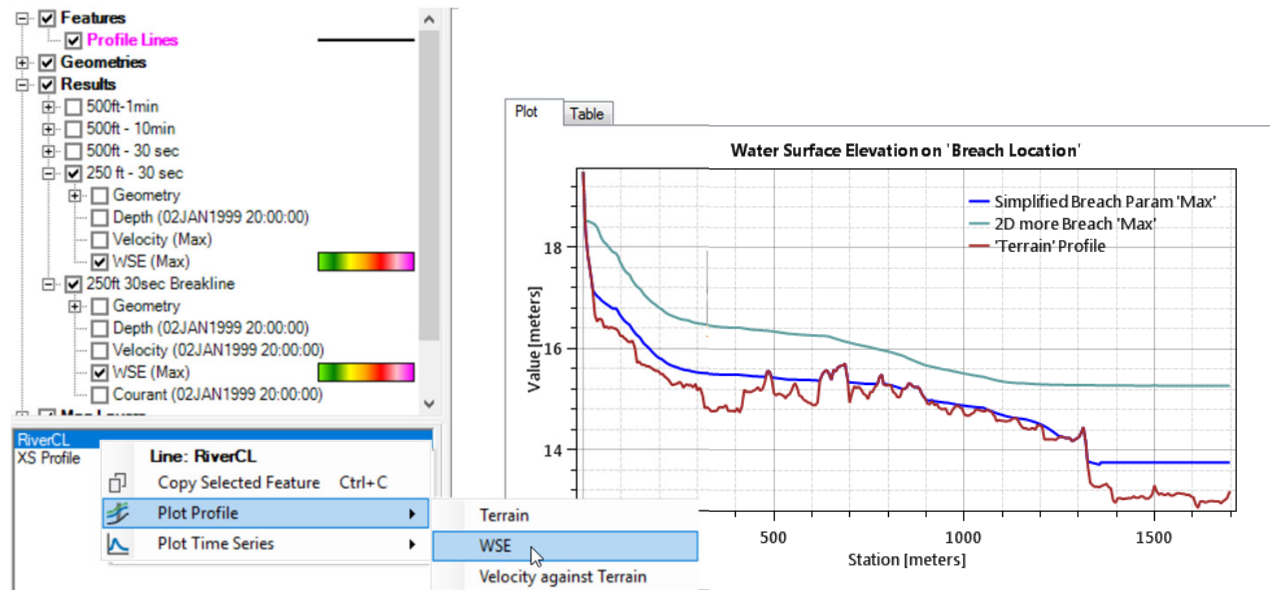


Profile Lines



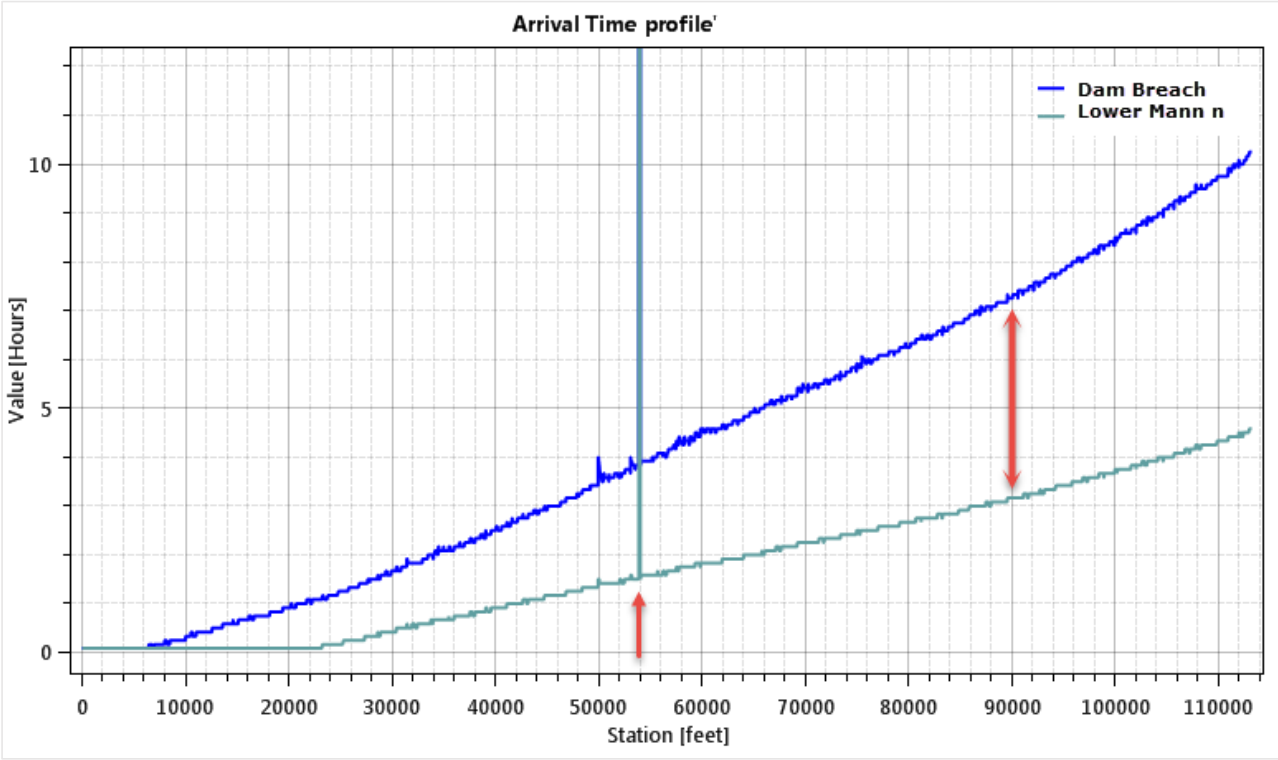
Profile Line - Comparison

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



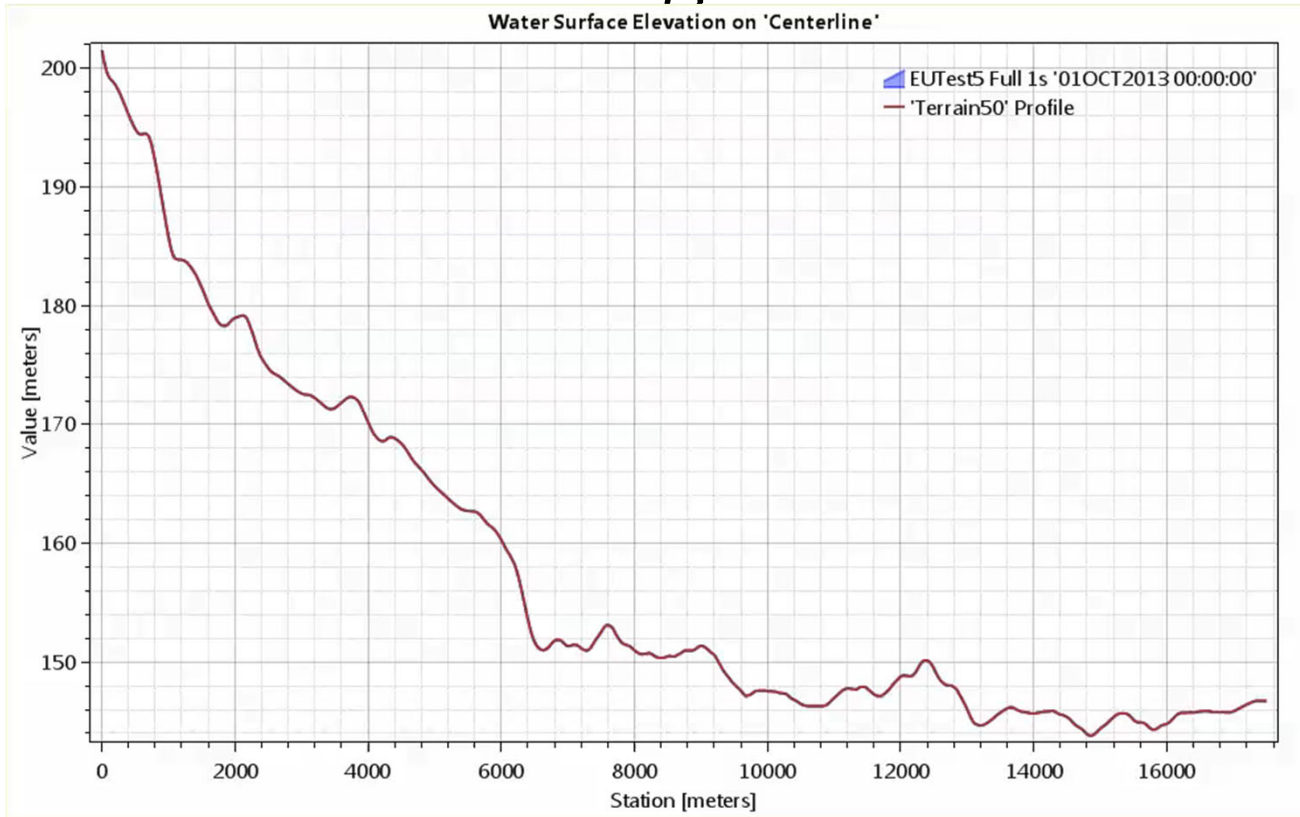


Profile Lines - Comparison



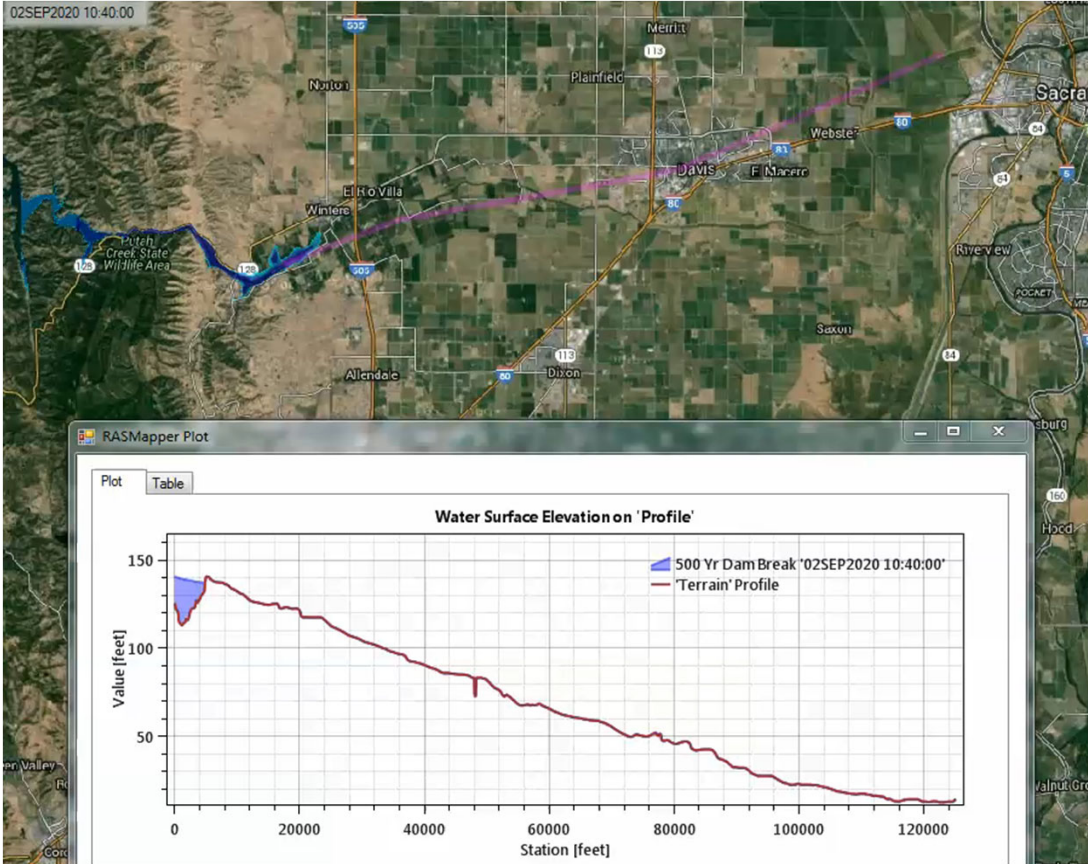


Profile Lines - Animating



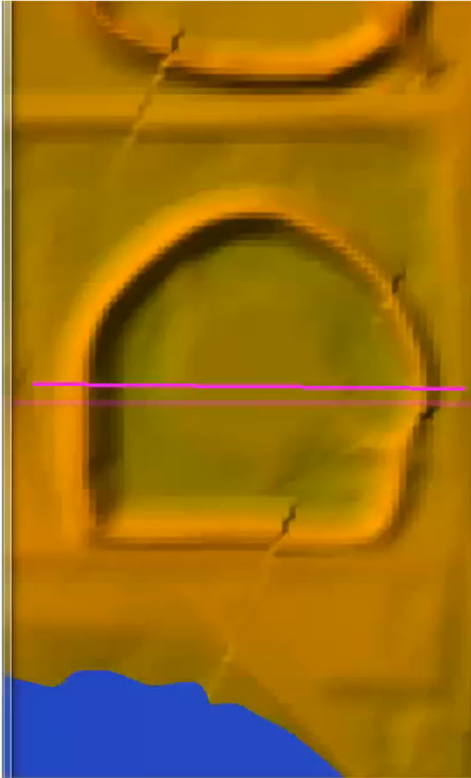
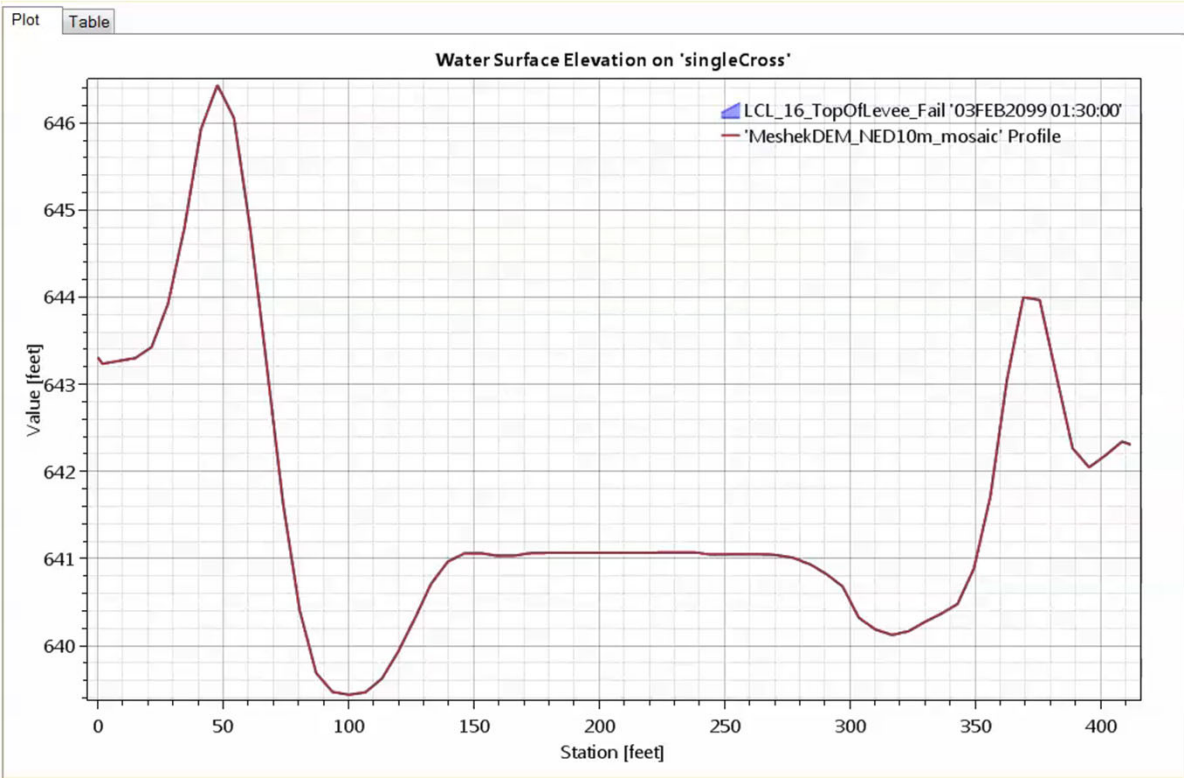


Profile Lines + Spatial Results





Profile Lines - Animating



03JAN1999 12:45:00

Questions?

