

HEC-RAS Mapper Results Visualization

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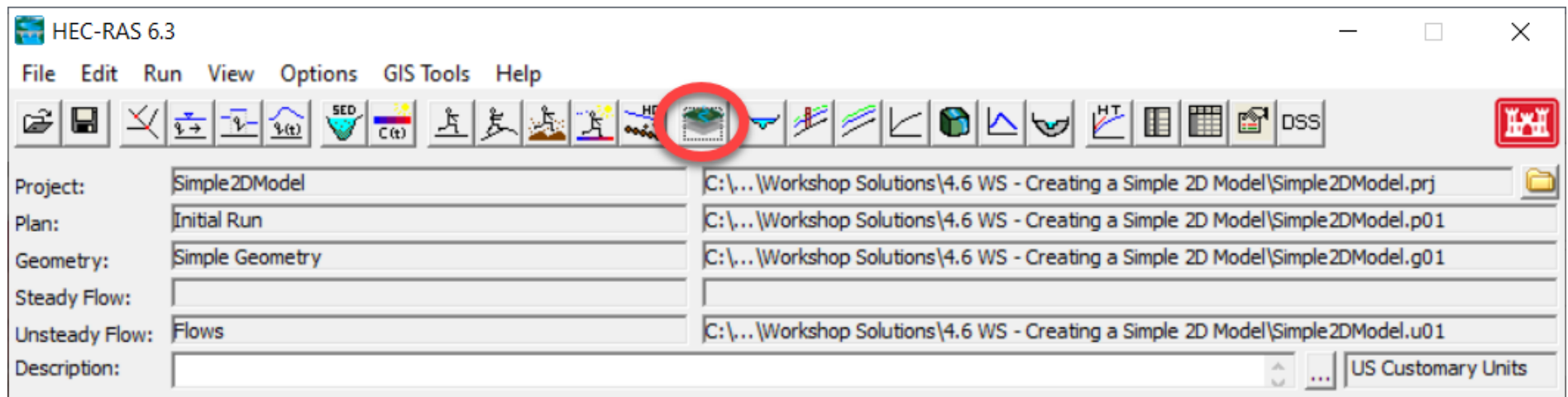
USACE, Institute for Water Resources, Hydrologic Engineering Center





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 map of a river system with water depth overlaid in shades of blue and cyan. The interface is annotated with four red boxes:

- View Tools:** A toolbar at the top center containing icons for navigation and map manipulation.
- Animation Controls:** A toolbar at the top right containing play, stop, and refresh icons for simulation control.
- Layers List:** A vertical panel on the left side containing a tree view of simulation layers. The 'Depth (Max)' layer is highlighted with a pink bar.
- Status Area:** A panel at the bottom left showing simulation status and options like 'US End of Levee', 'Left Split', 'Right Split', and 'Cross Section'.

Additional interface elements include a menu bar (File, Project, Tools, Help), a toolbar with a red border, a 'Selected Layer: Depth' indicator, a 'View Area' label over the map, a 'Status Area' label, and a status bar at the bottom with coordinates and a scale of 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.

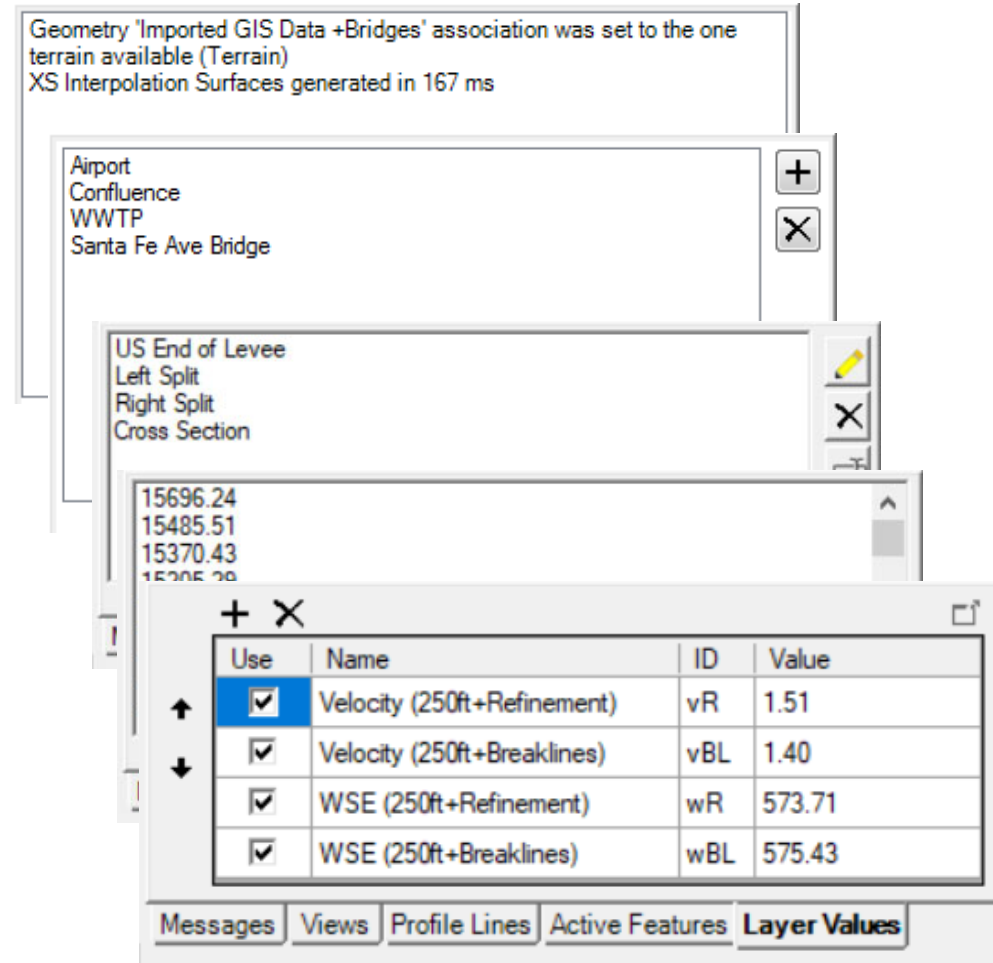


The selected layer is highlighted in magenta.



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

15696.24
15485.51
15370.43
15205.20

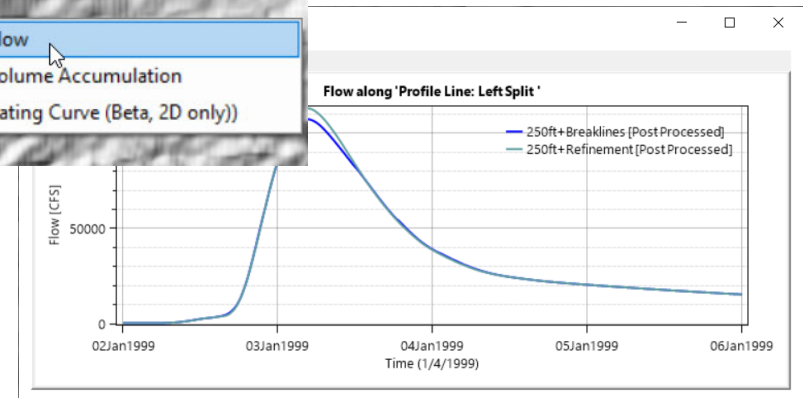
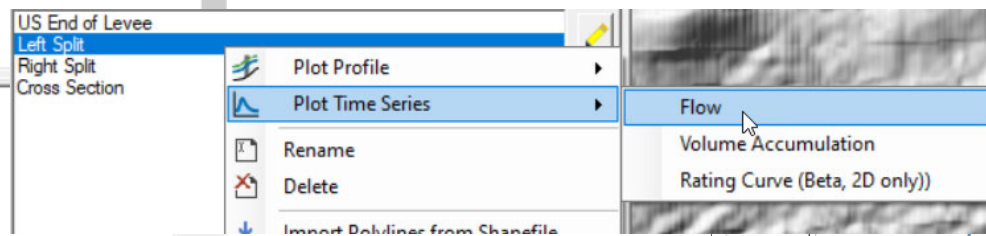
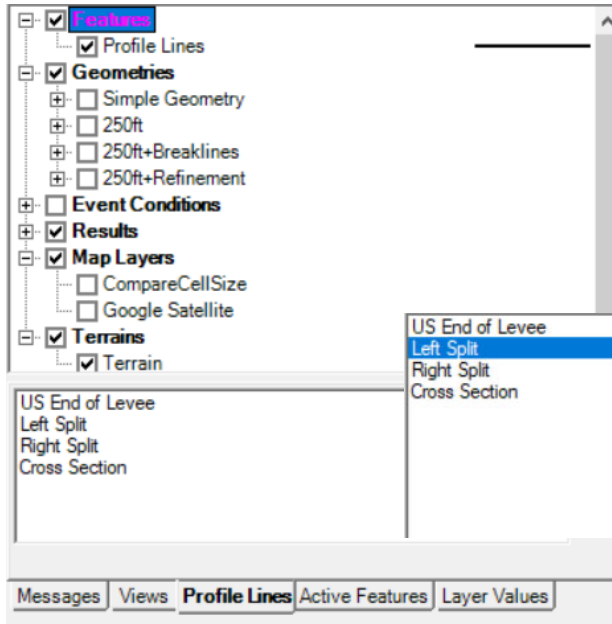
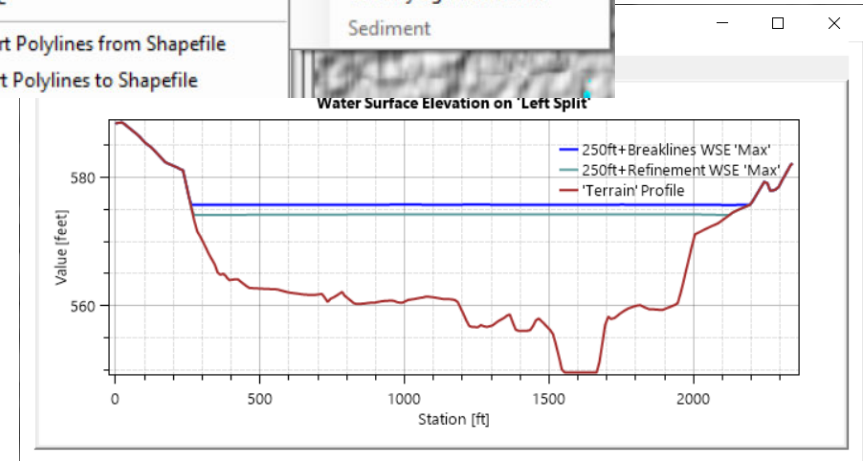
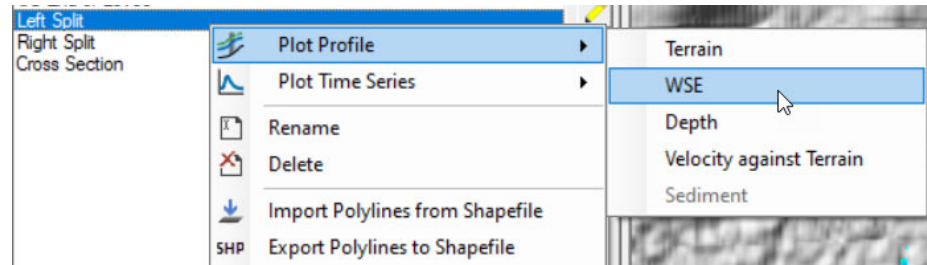
| Use | Name | ID | Value |
|-------------------------------------|-----------------------------|-----|--------|
| <input checked="" type="checkbox"/> | Velocity (250ft+Refinement) | vR | 1.51 |
| <input checked="" type="checkbox"/> | Velocity (250ft+Breaklines) | vBL | 1.40 |
| <input checked="" type="checkbox"/> | 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





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

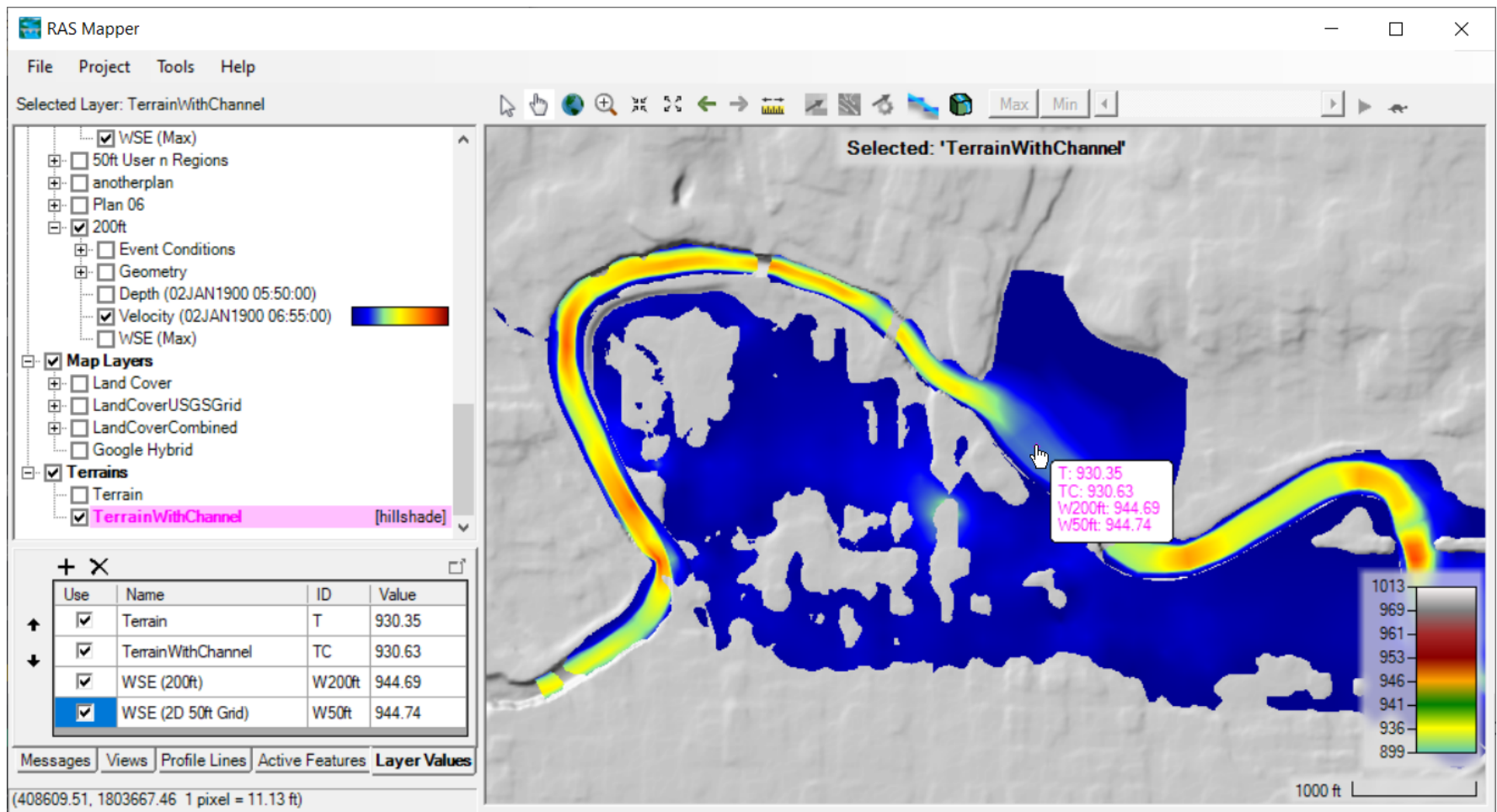
| Use | Name | ID | Value |
|-------------------------------------|--------------------|--------|--------|
| <input type="checkbox"/> | Terrain | T | 930.59 |
| <input type="checkbox"/> | TerrainWithChannel | TC | 930.63 |
| <input type="checkbox"/> | WSE (200ft) | W200ft | 944.70 |
| <input checked="" 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 displays the ArcGIS interface with a 'Select WMS image server' dialog box. The dialog lists the following servers:

- 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

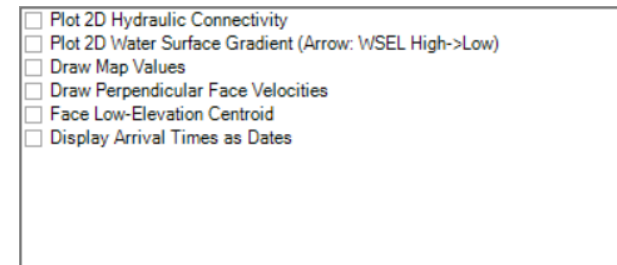
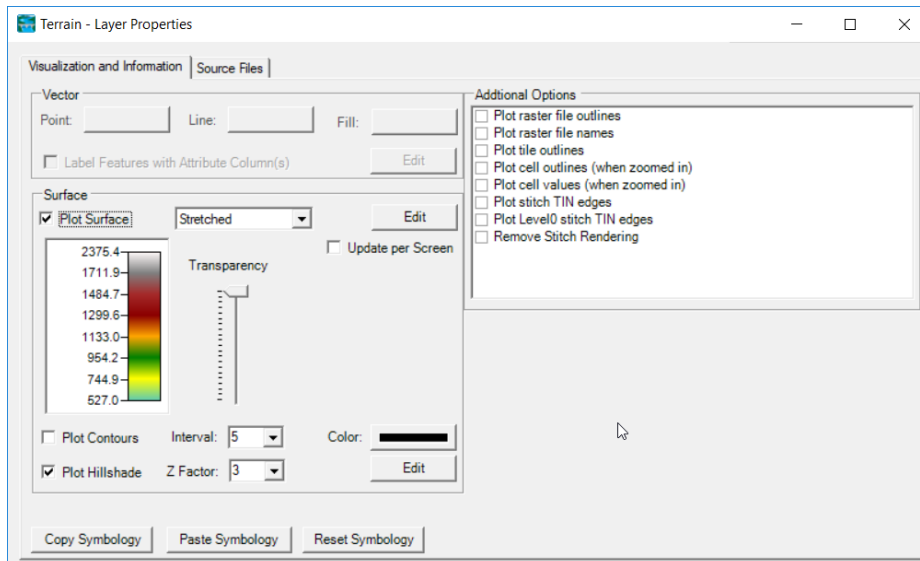
At the bottom of the dialog, the 'Reprojection Resample Method' is set to 'near'. The main map window shows a satellite view of the Sacramento, CA area, with a green shaded polygon highlighting a region near Spanish Flat and Berryessa Highlands. The map includes labels for various cities and towns such as Sacramento, Davis, Vacaville, and Fairfield, as well as major roads like I-5 and SR-99.



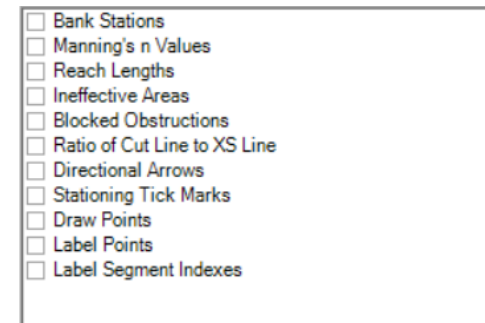
Plot Options – Layer Specific!

- Terrain

- Depth, WSE



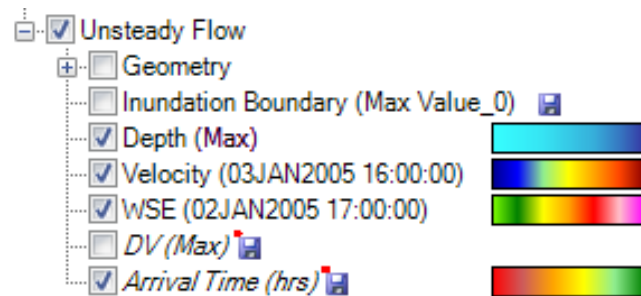
- River, Cross Sections





Results Mapping

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



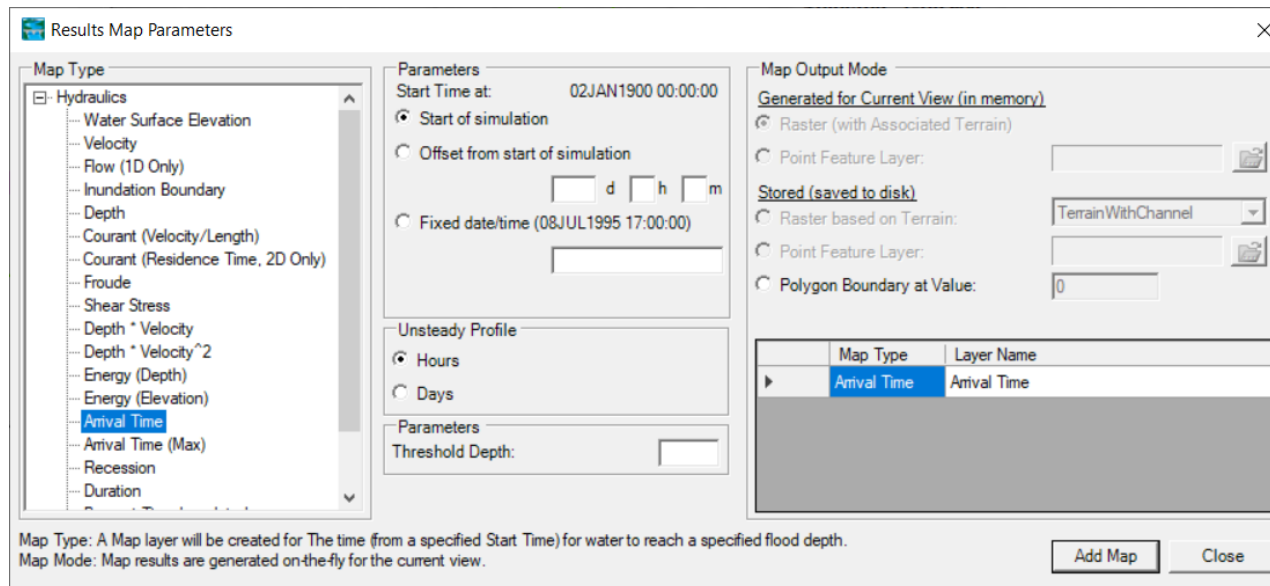
- Stored Maps – results written to file

* = *There was a problem reading data*



Results Mapping

Map Type | Profile/Parameter | Mode

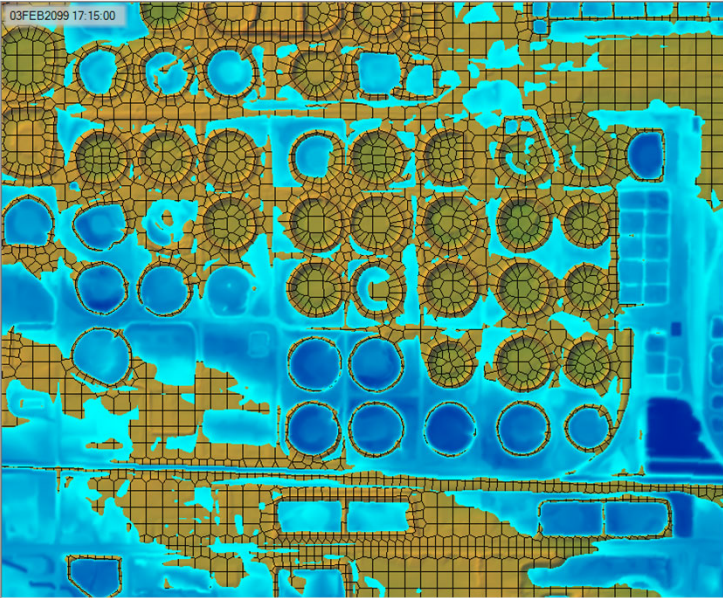


Default maps: Depth, Water Surface Elevation, Velocity

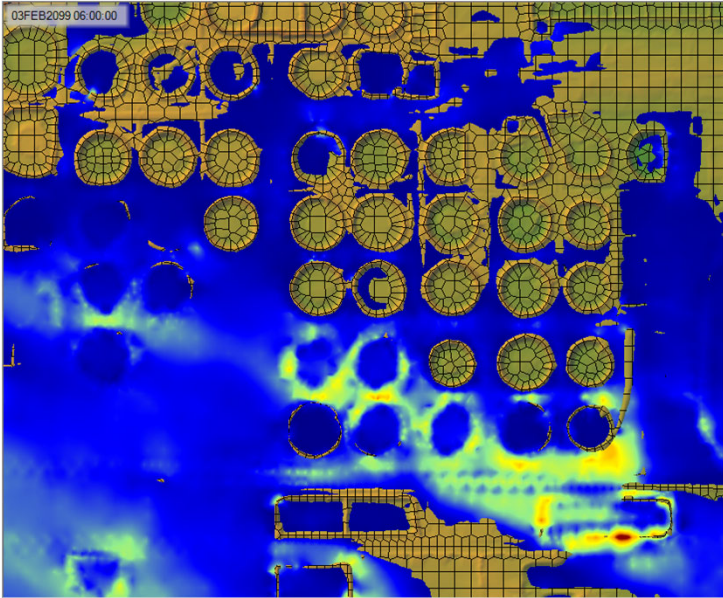


Example Maps

- Depth

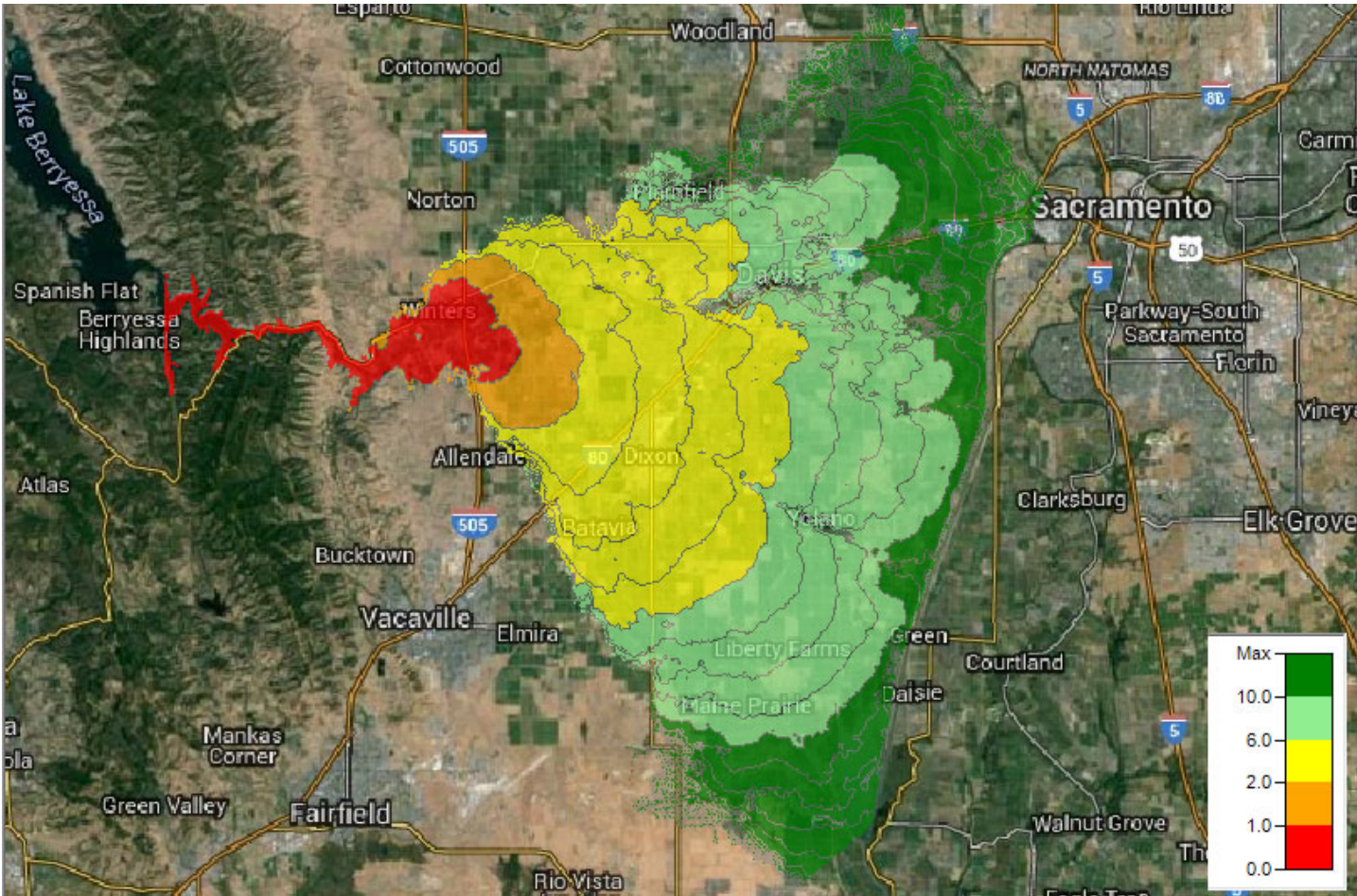


- Velocity



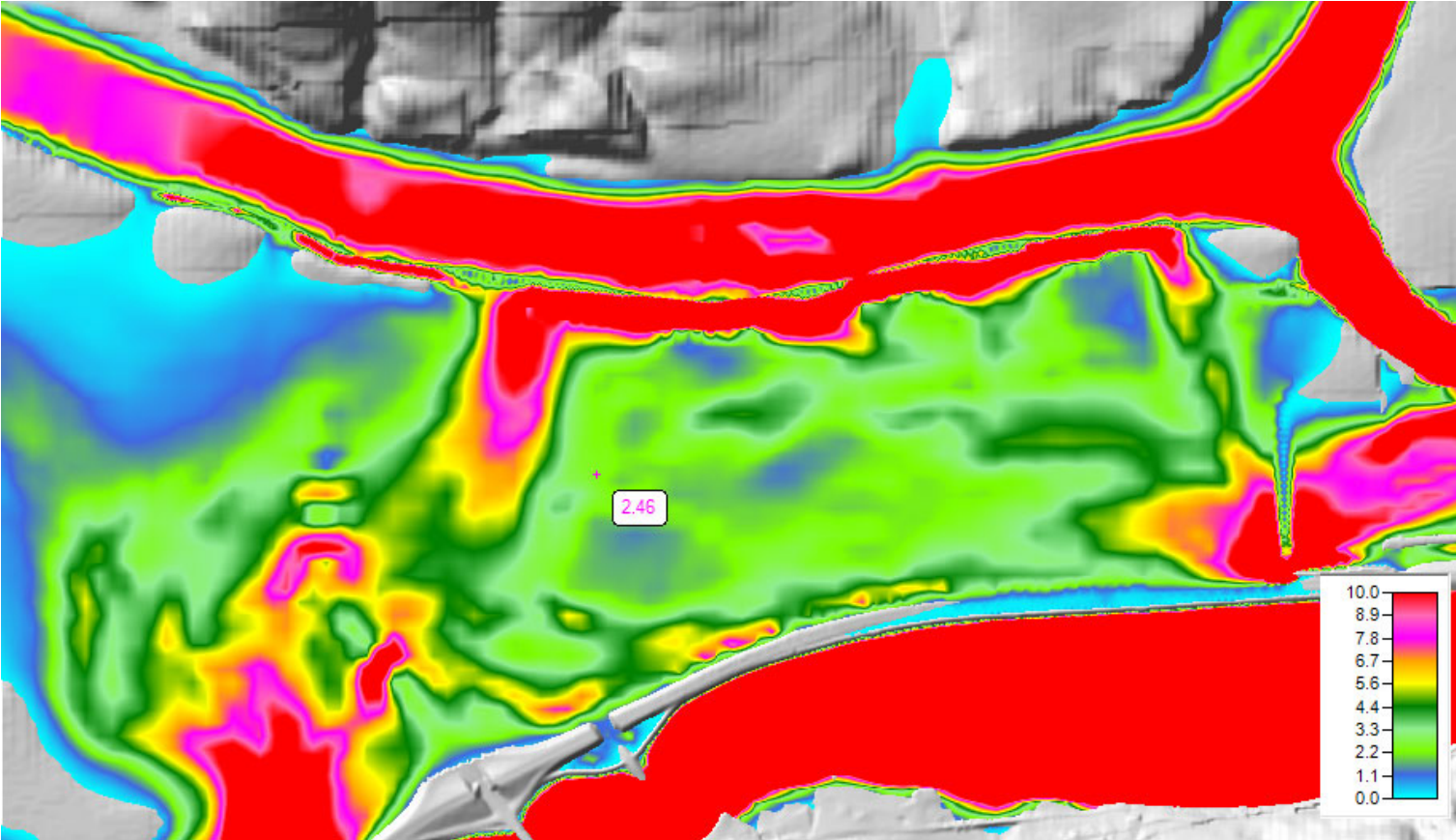


Arrival Time



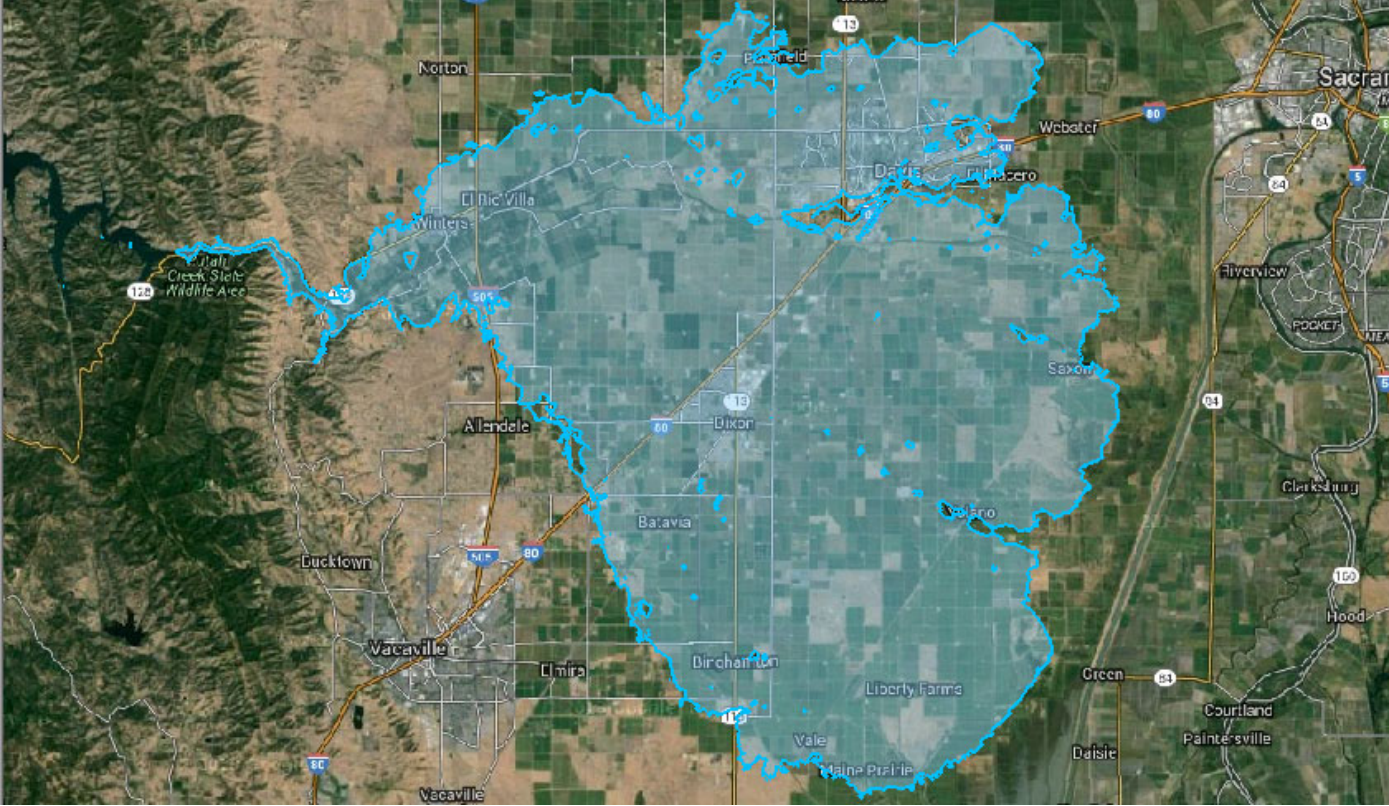


Hazard Mapping





Inundation Boundary





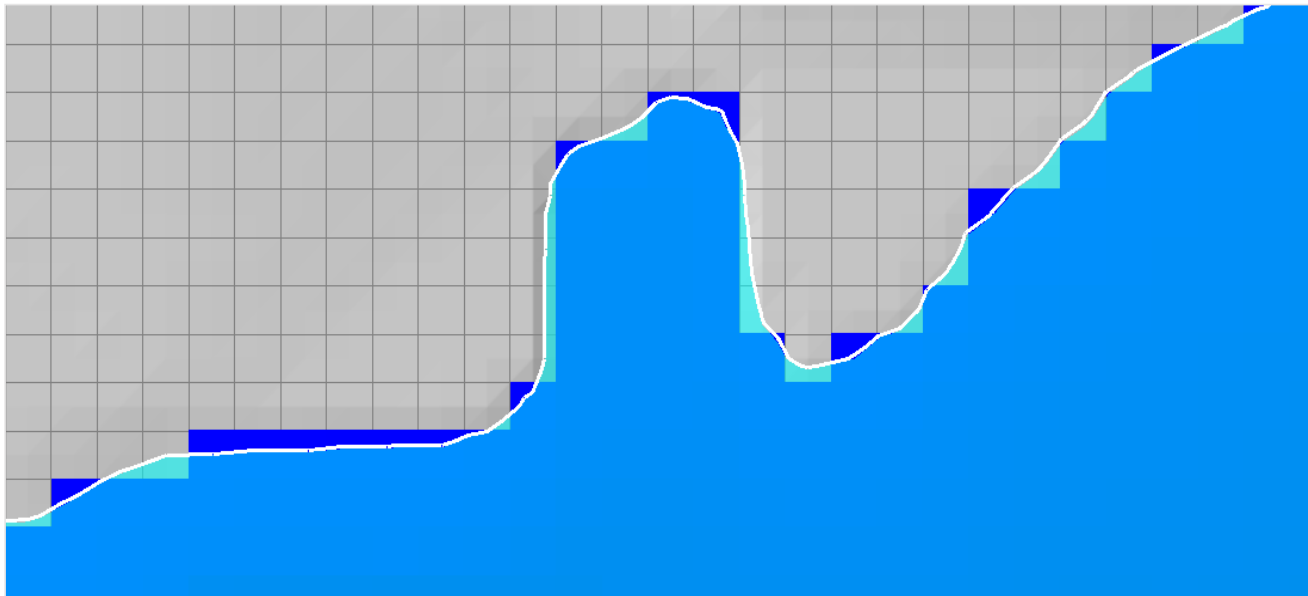
Map Types – Dynamic vs Stored

- **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

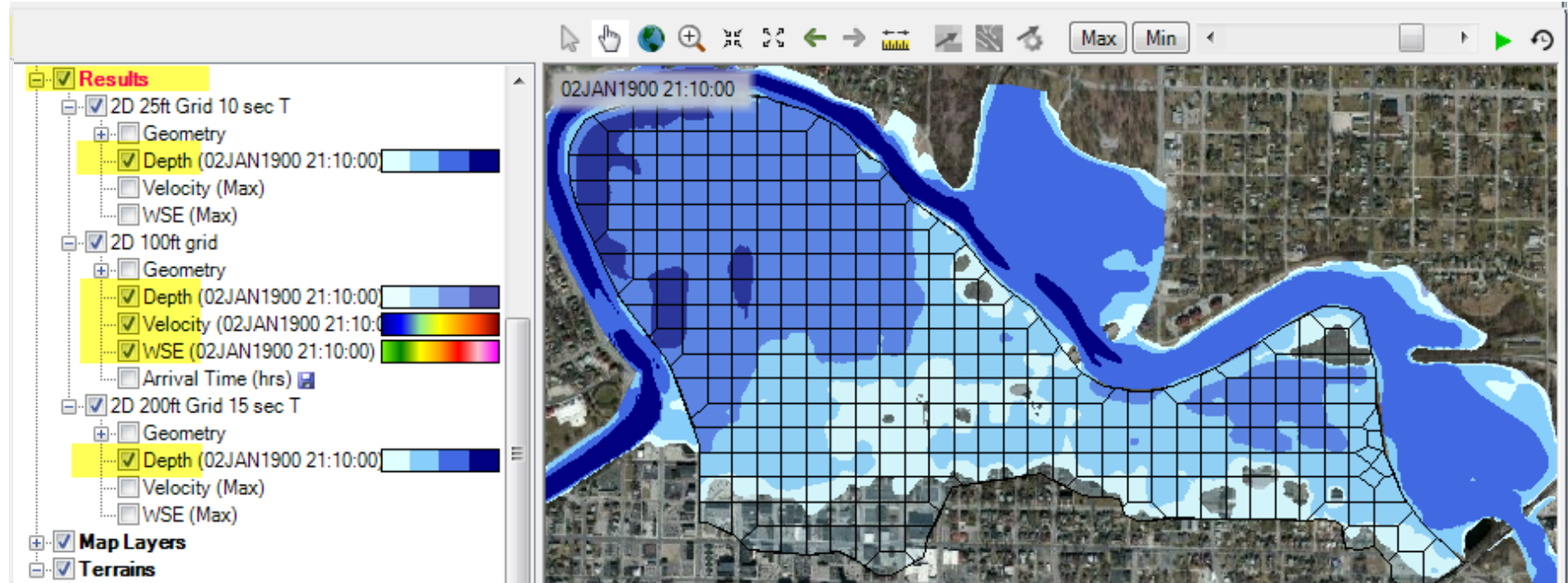
- Dynamic results plot values for the current pyramid level. Boundaries are defined based on interpolation.
- Stored results have a single value per cell.





Dynamic Mapping

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





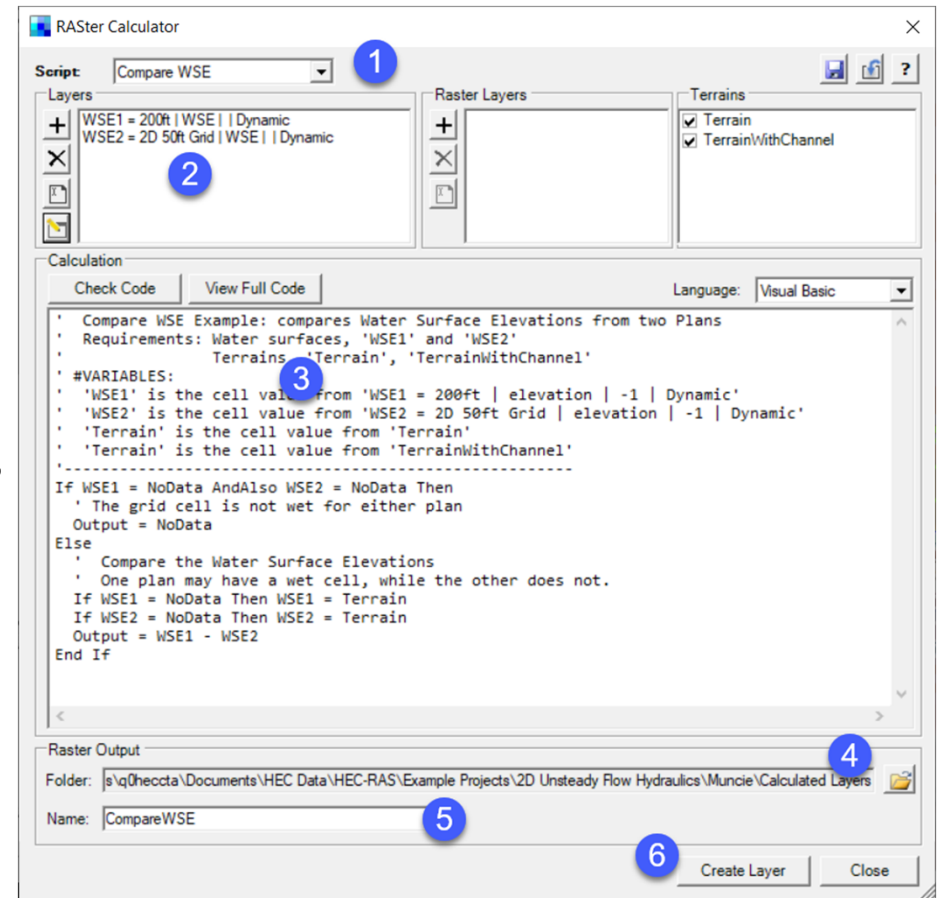
Dynamic Mapping - Animation





Calculated Layer

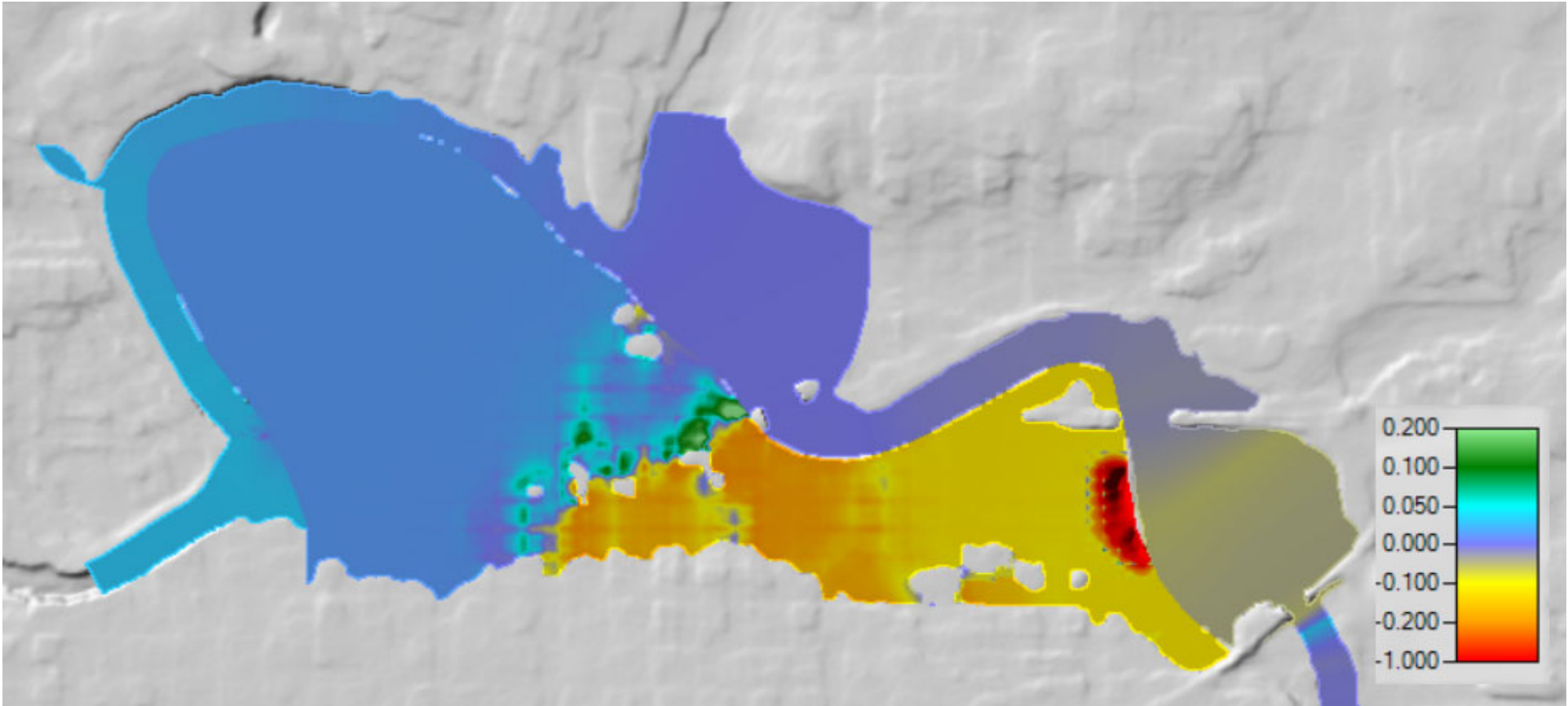
- RASter Calculator
- Custom scripting code to use multiple results
- Works with RAS Results and Terrains
- Works with Rasters on disk





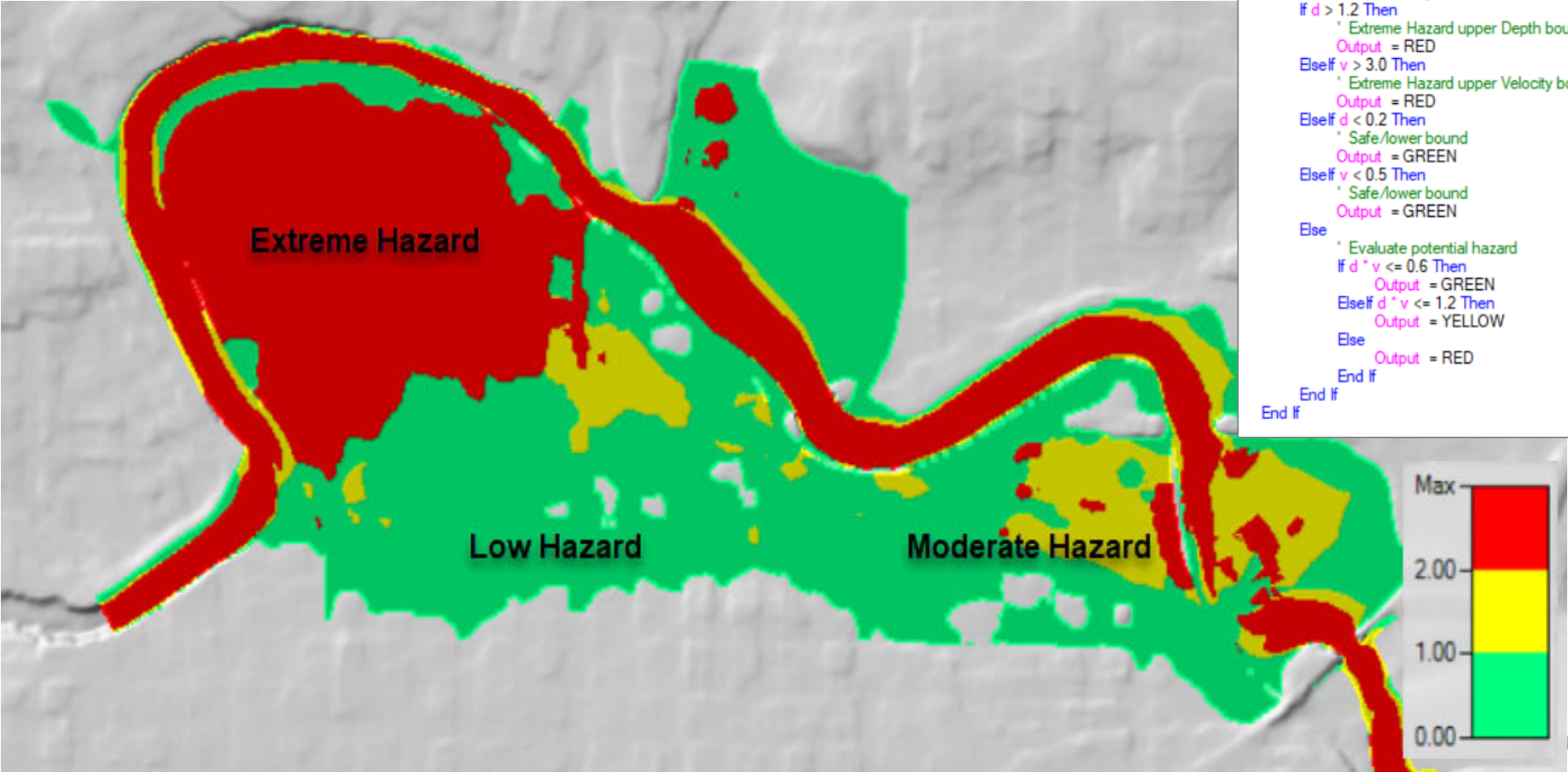
Water Surface Comparison

WSE_Mesh200ft - WSE_Mesh50ft





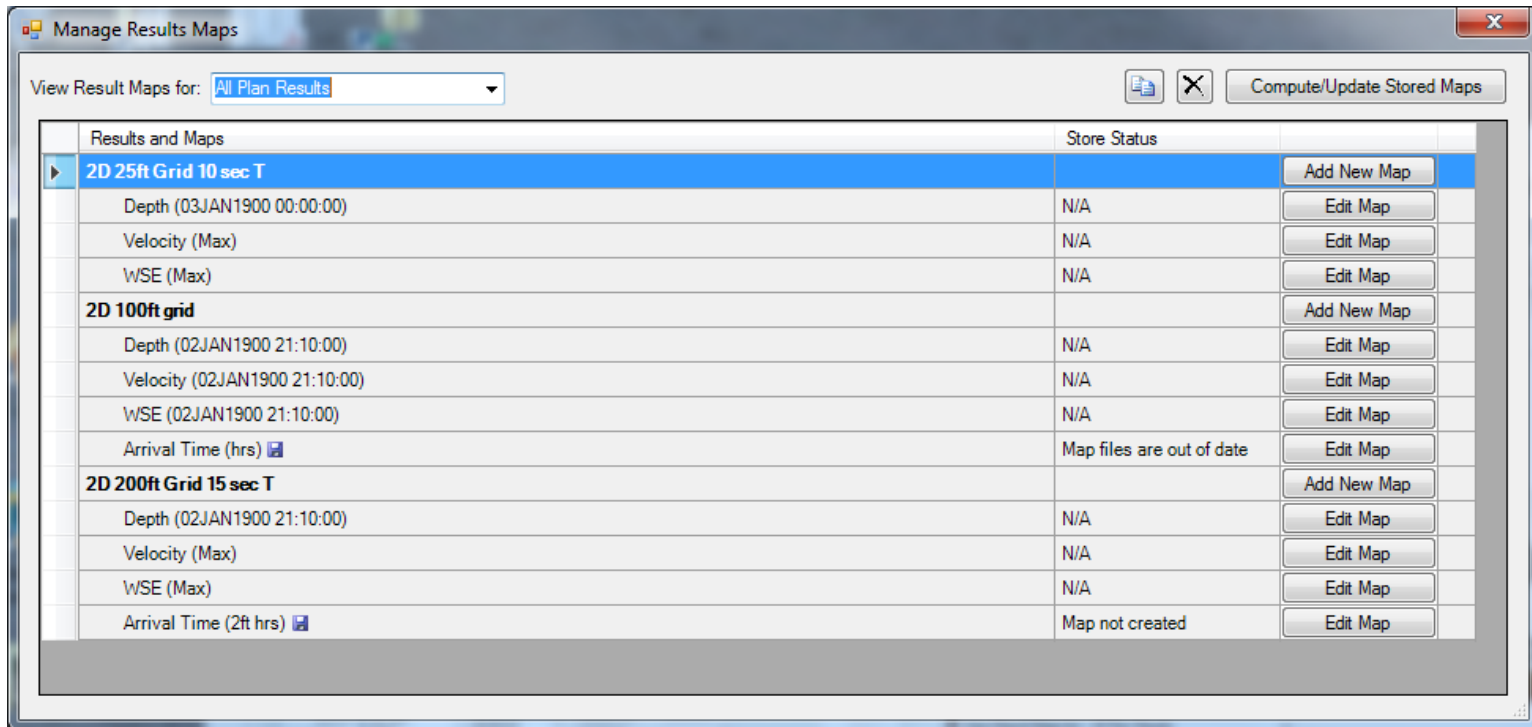
Hazard Evaluation



```
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

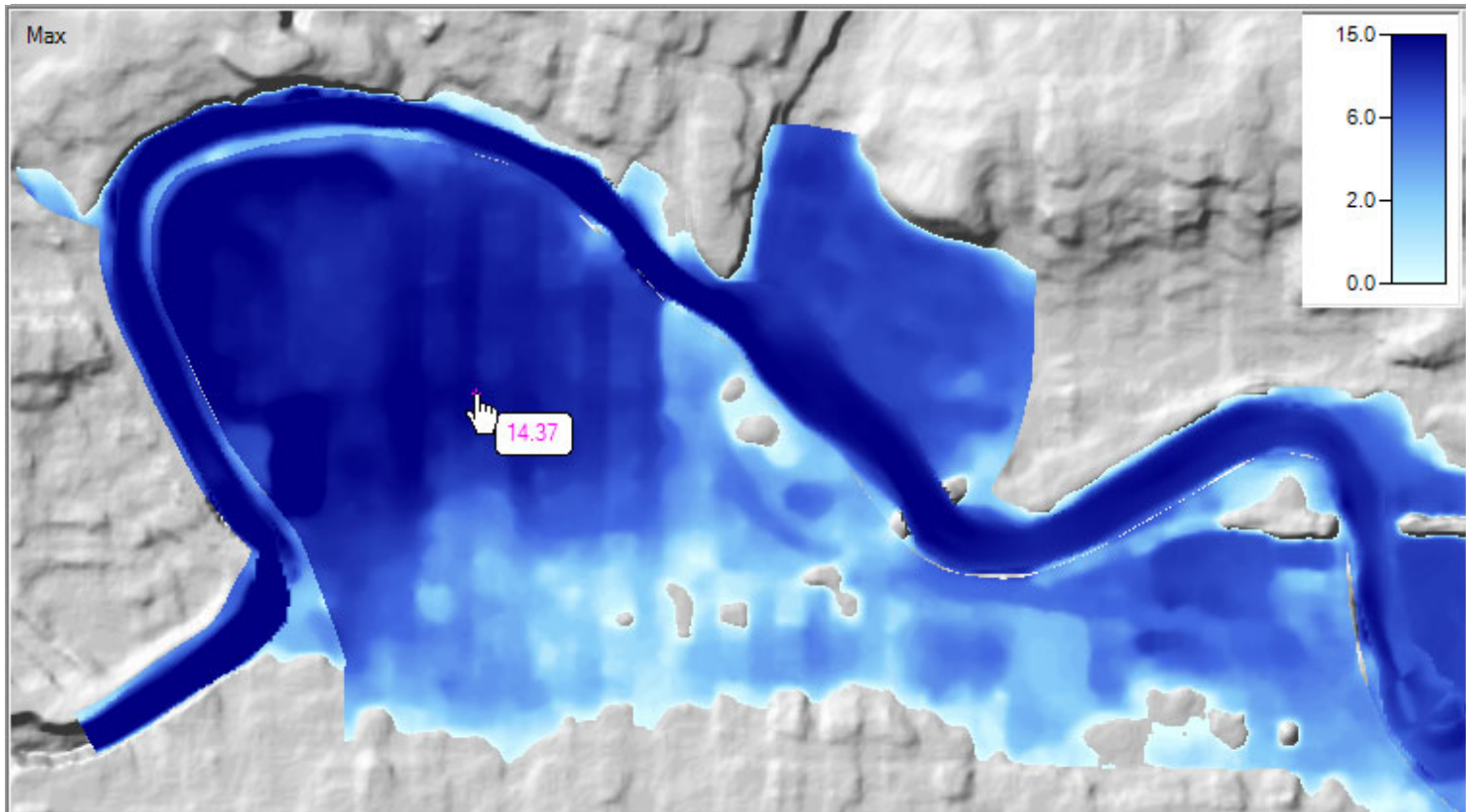
View Result Maps for: All Plan Results

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 |

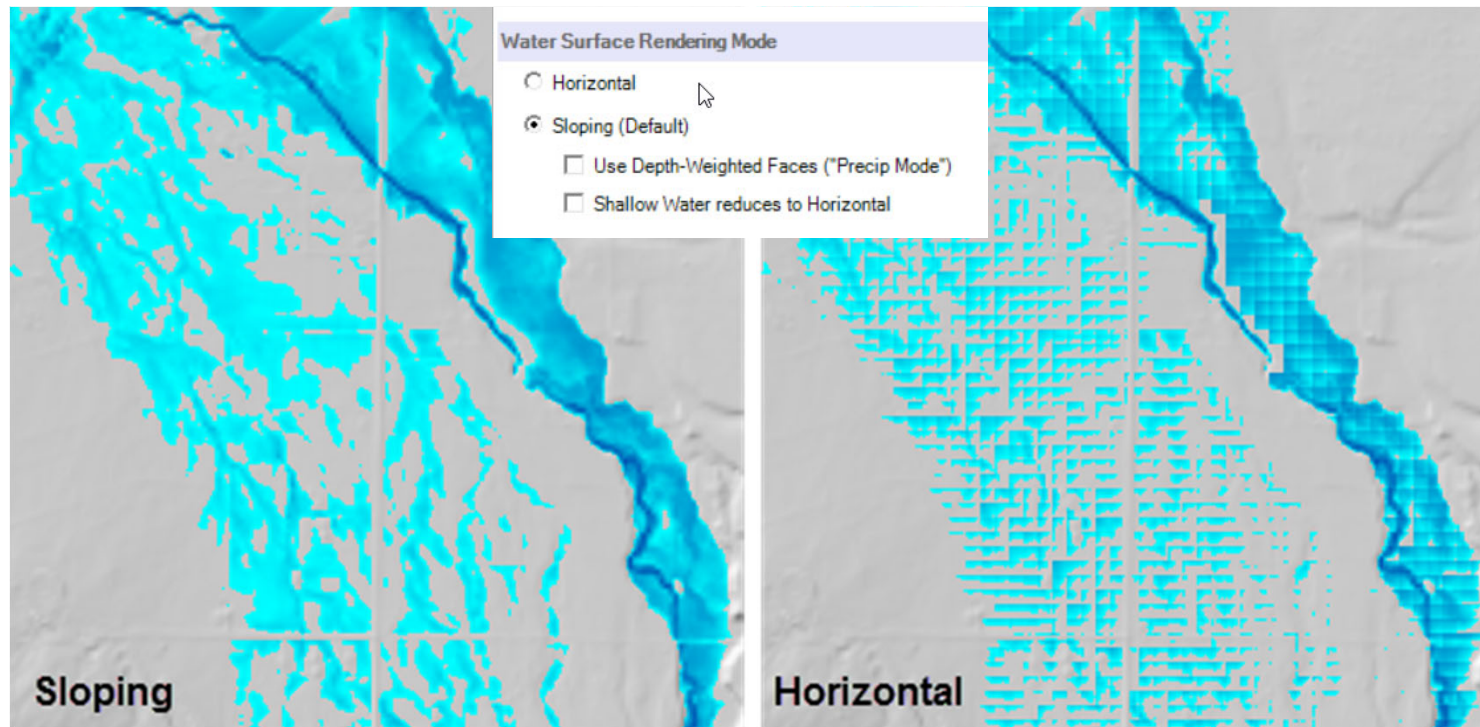


Results Visualization





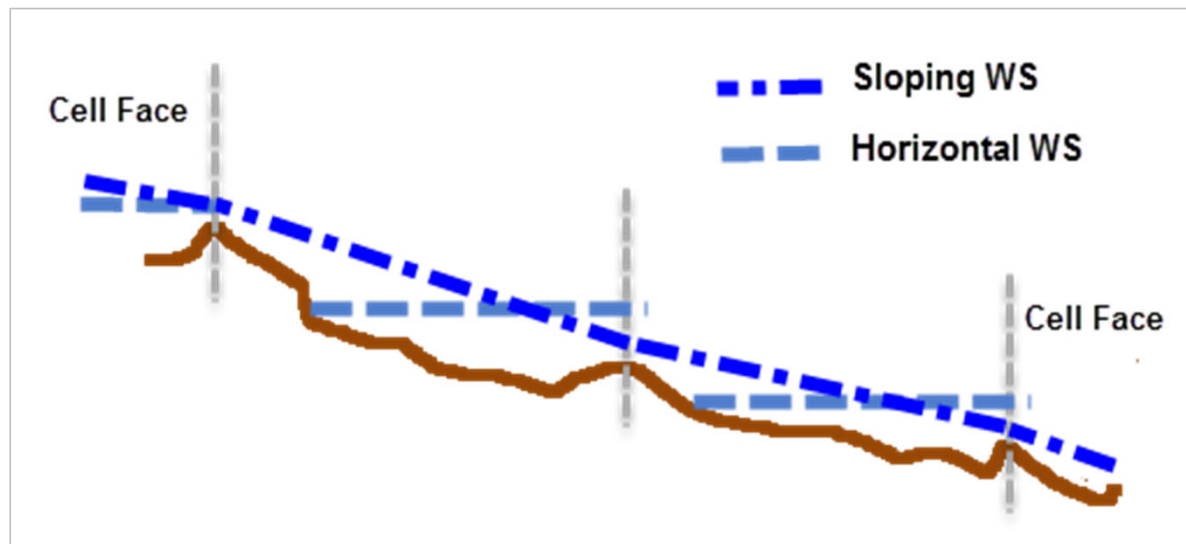
Render Mode Options





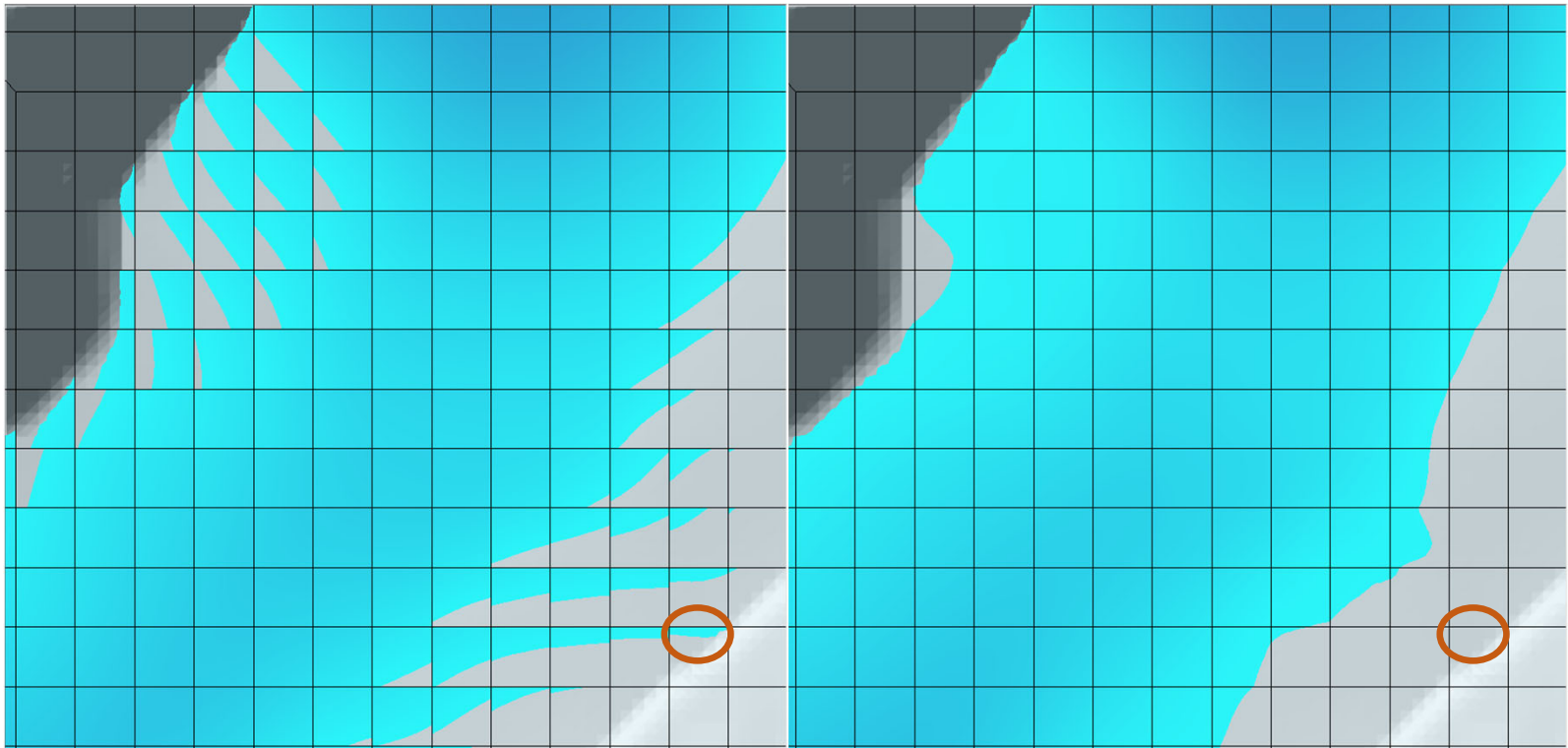
Results Interpolation

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



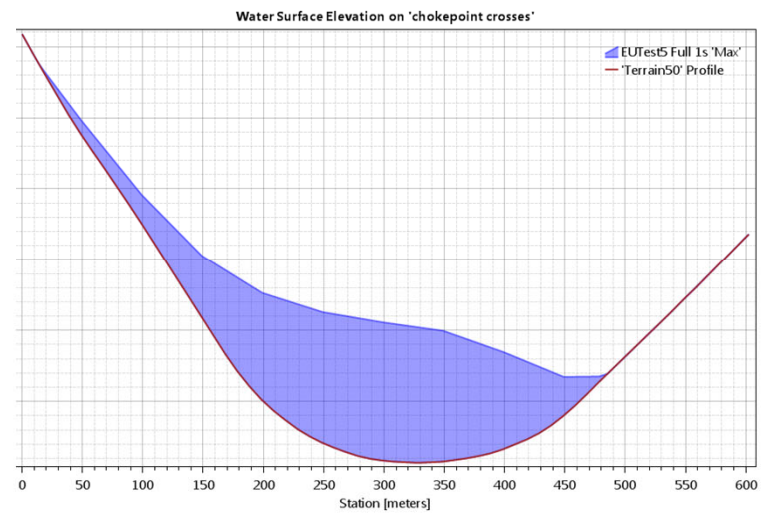
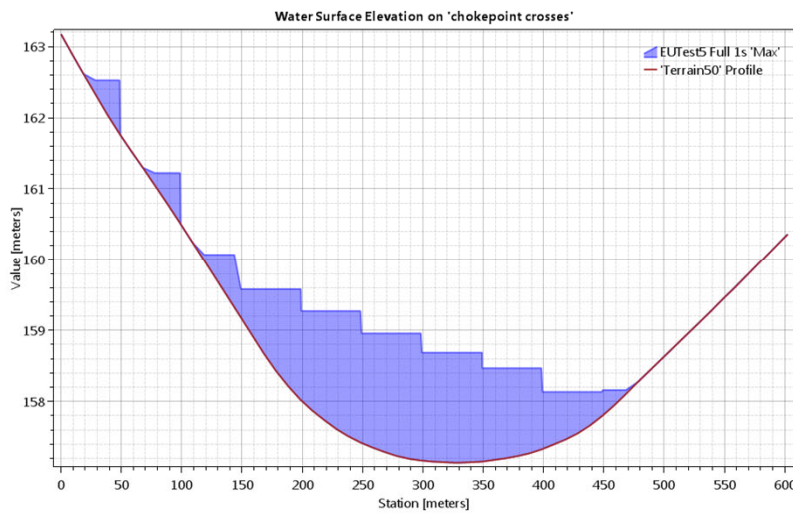


Horizontal vs Sloping Surface



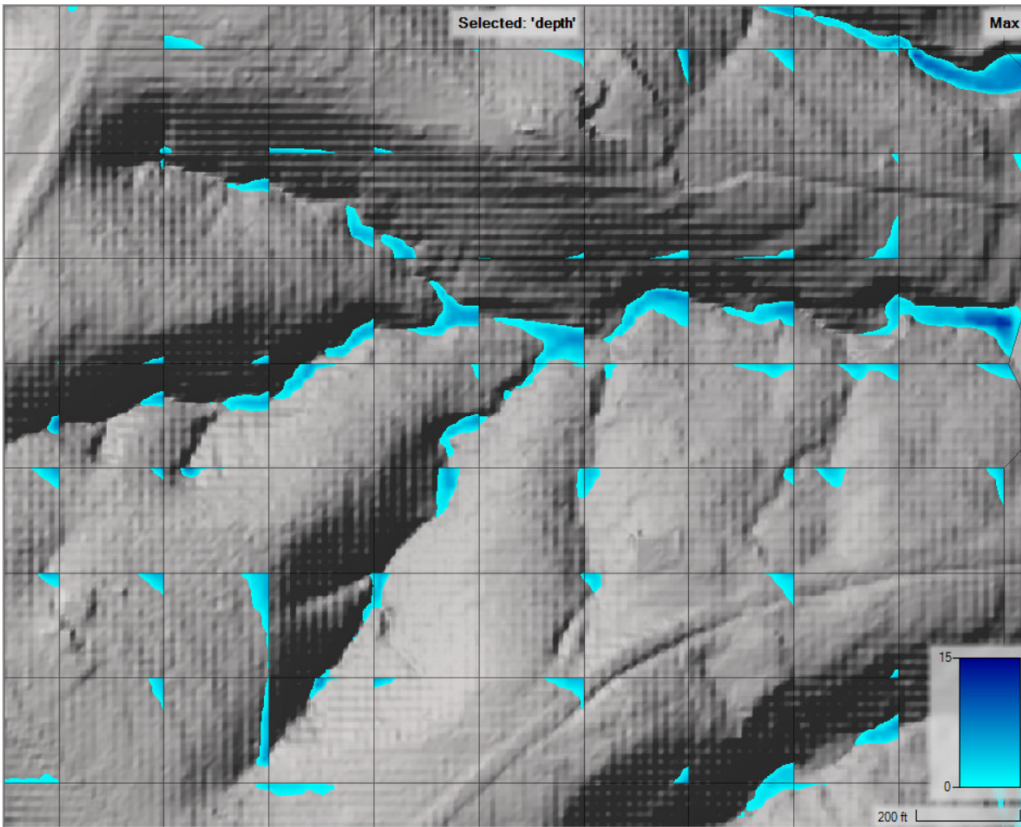


Horizontal vs Sloping Surface

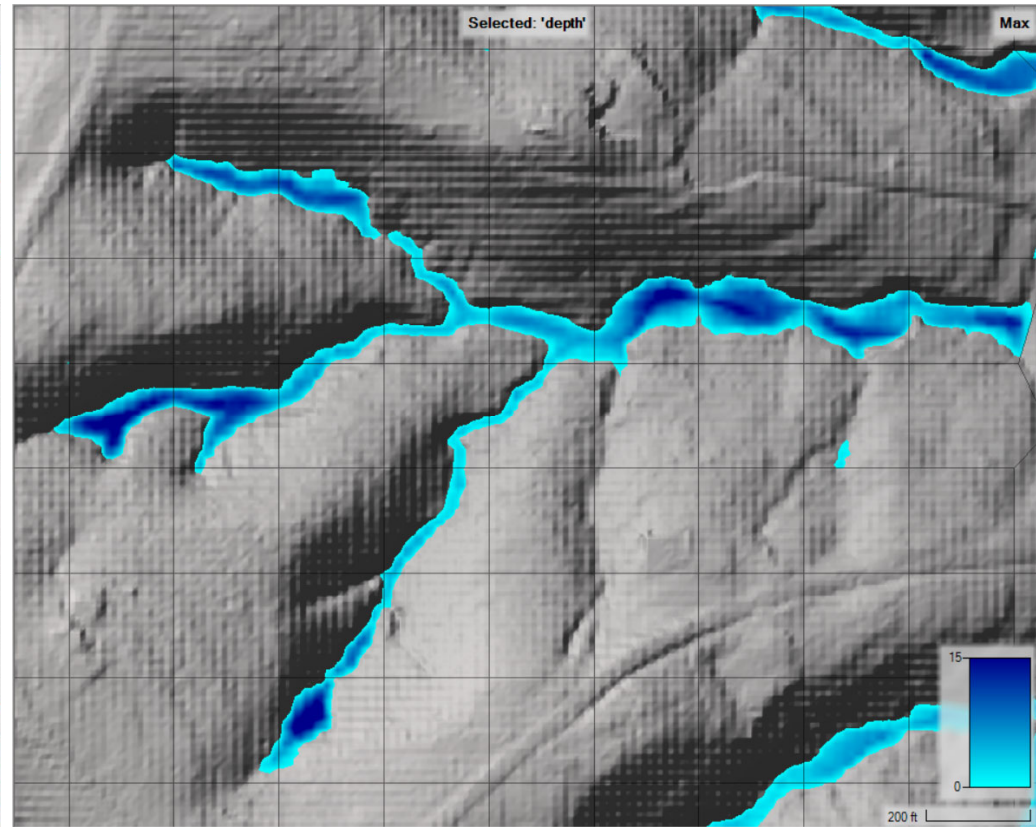




Sloping Surface Errors



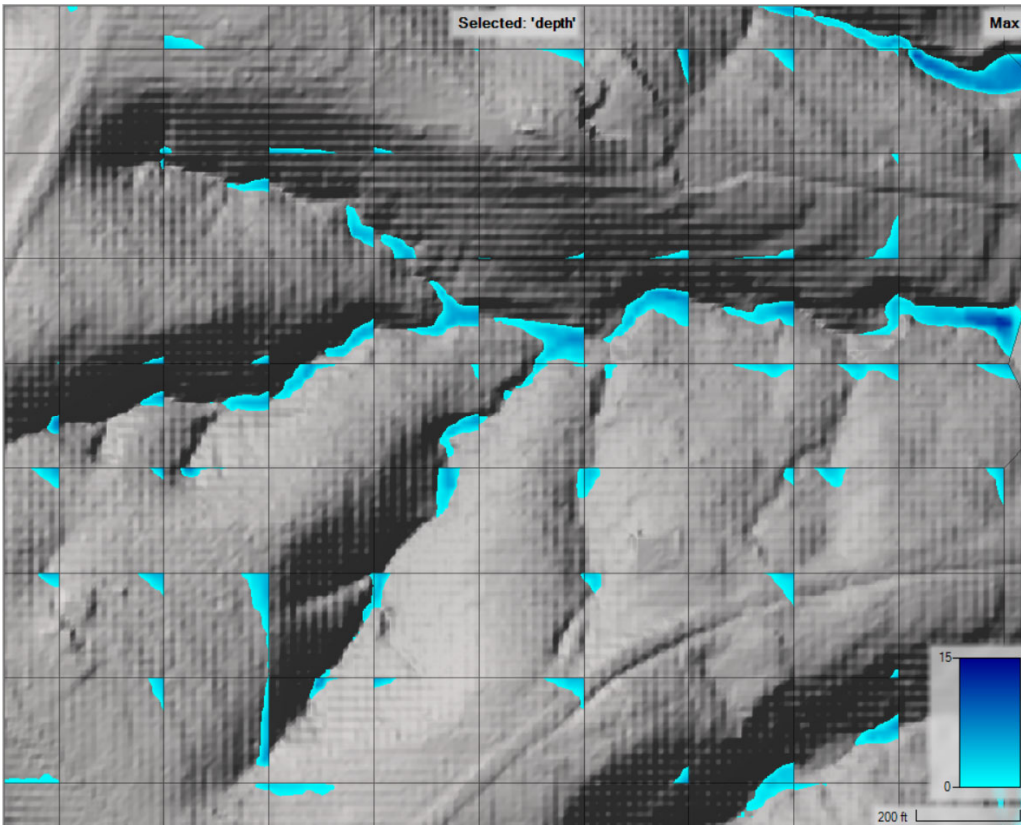
Horizontal



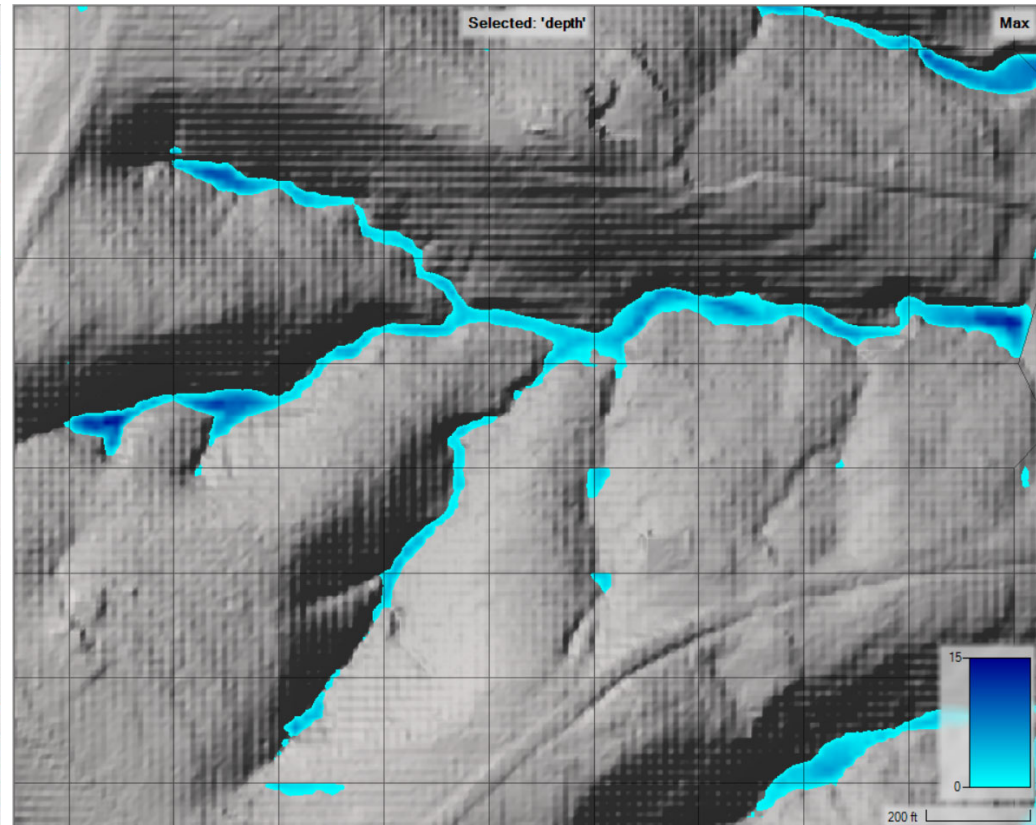
Sloping



Sloping Surface Errors



Horizontal

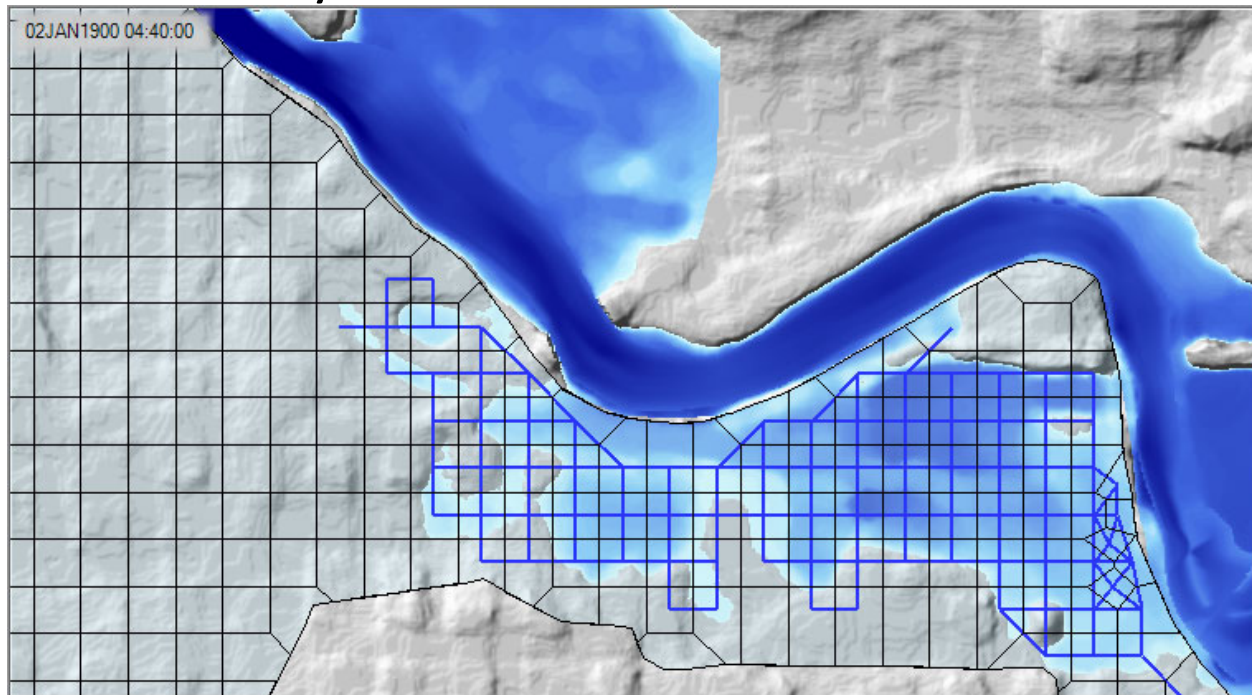


Precip Mode



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)

The 'Map Layers' section also includes 'Terrains' (checked) and 'WithChannel' (checked) with a '[hillshade]' option. A color scale legend is visible next to the '2D Flow Areas' layer.

The main map area shows a 2D flow area simulation over a terrain grid. A specific cell is highlighted with a pink square, and a context menu is open over it. The menu contains the following items:

- All Enabled Results
- Time Series Plots
- Mesh: 2DFlowArea (2D 200ft Grid 15 sec T)
- Find
- Time Series Plots (highlighted)
- Property Tables
- WithChannel Elevation: 937.48 feet

The 'Time Series Plots' sub-menu is open, showing the following options:

- Cell: Water Surface (highlighted)
- Cell: Depth
- Cell: Shear Stress
- Face Point: Velocity

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



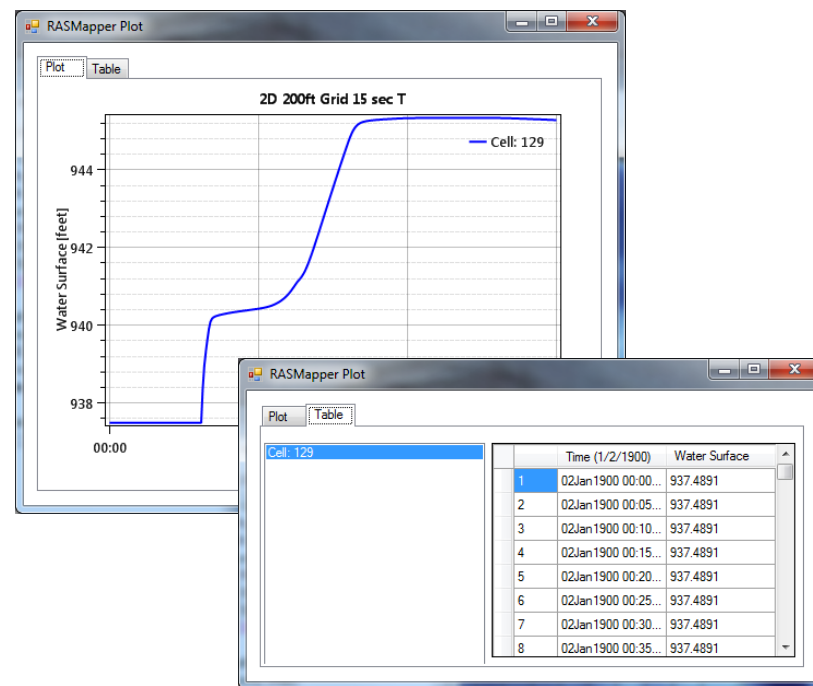
2D Flow Area Queries

- Hydraulic Properties

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

- Time Series

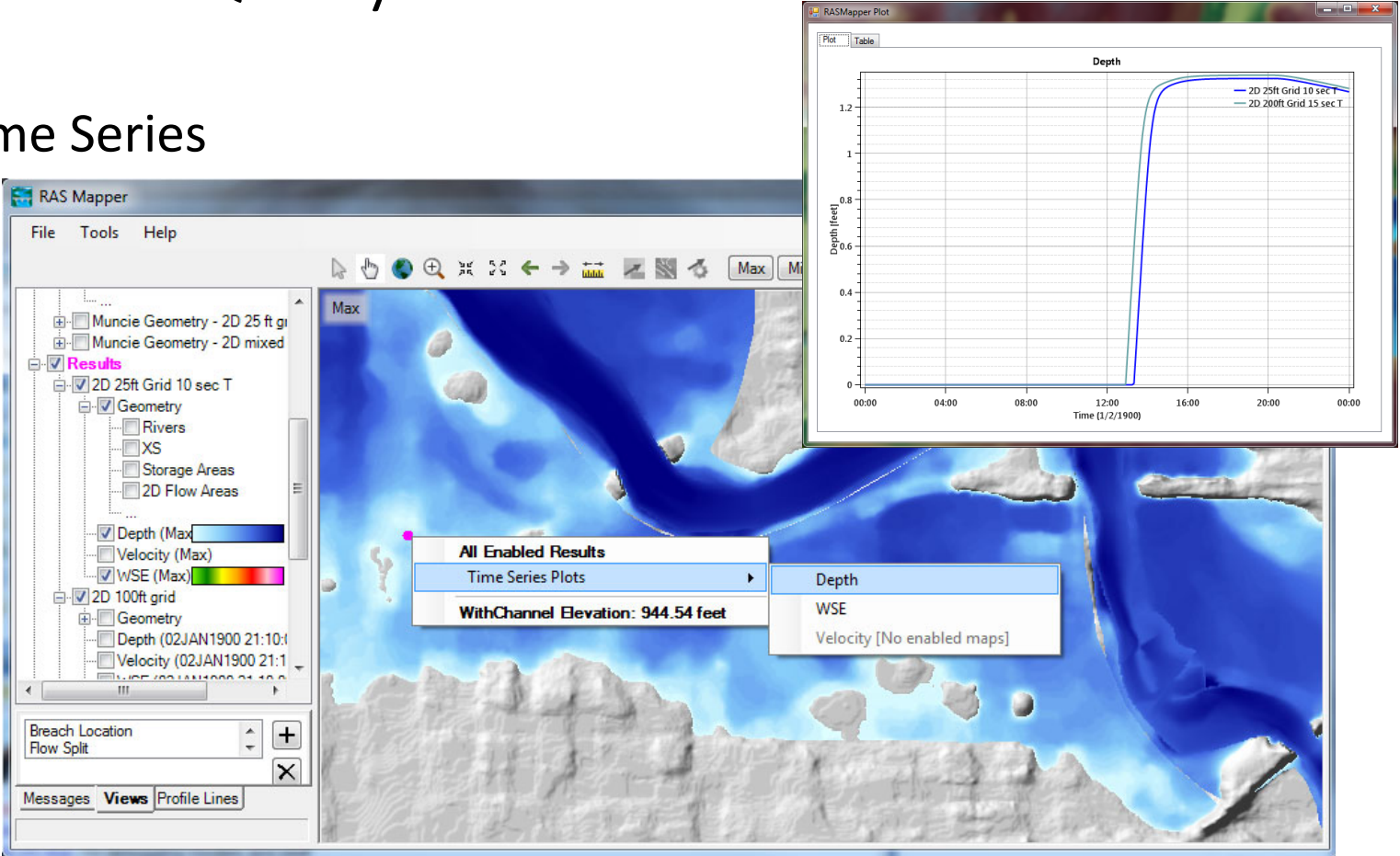
- Cell: Water Surface
- Cell: Depth
- Cell: Shear Stress
- Face Point: Velocity





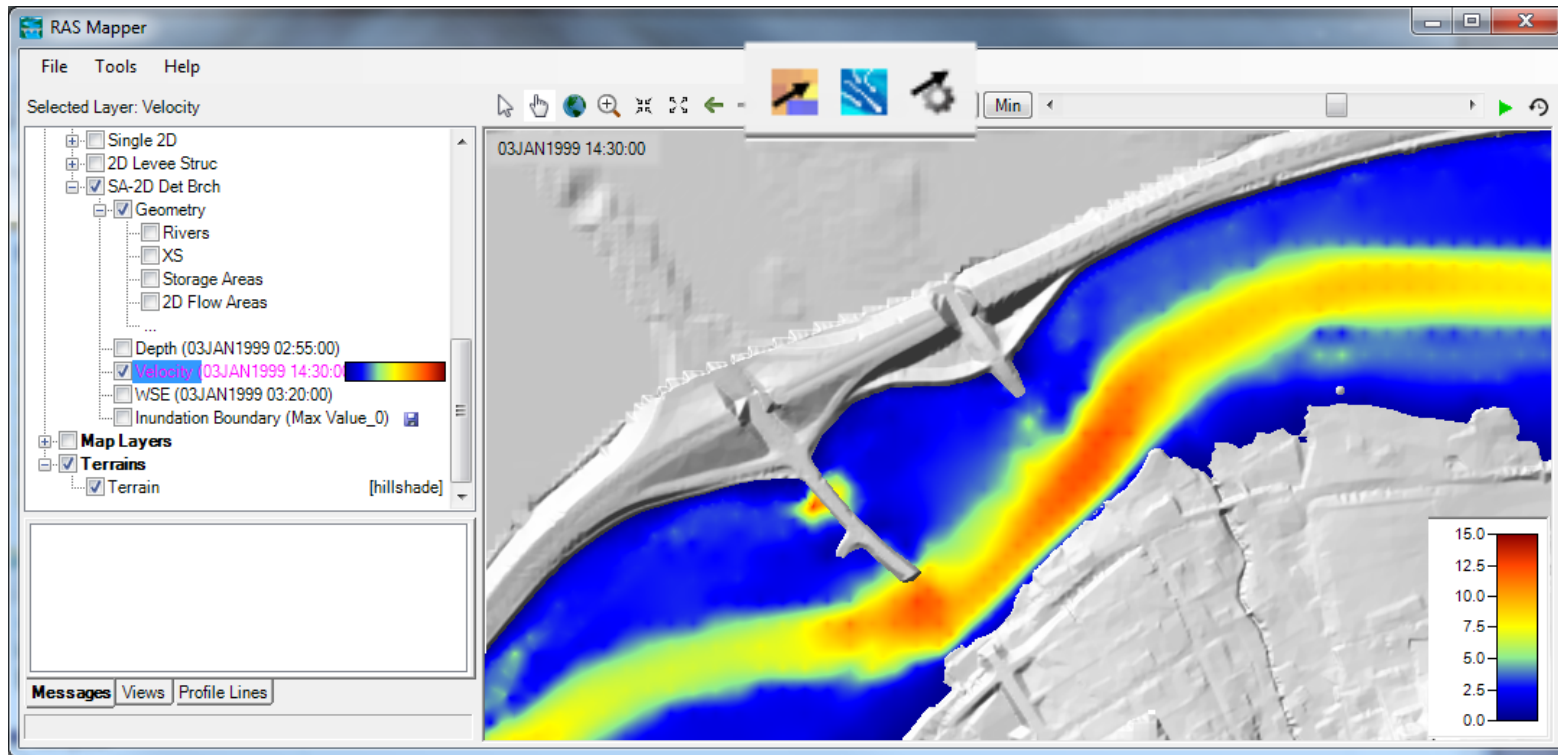
Results Query

- Time Series



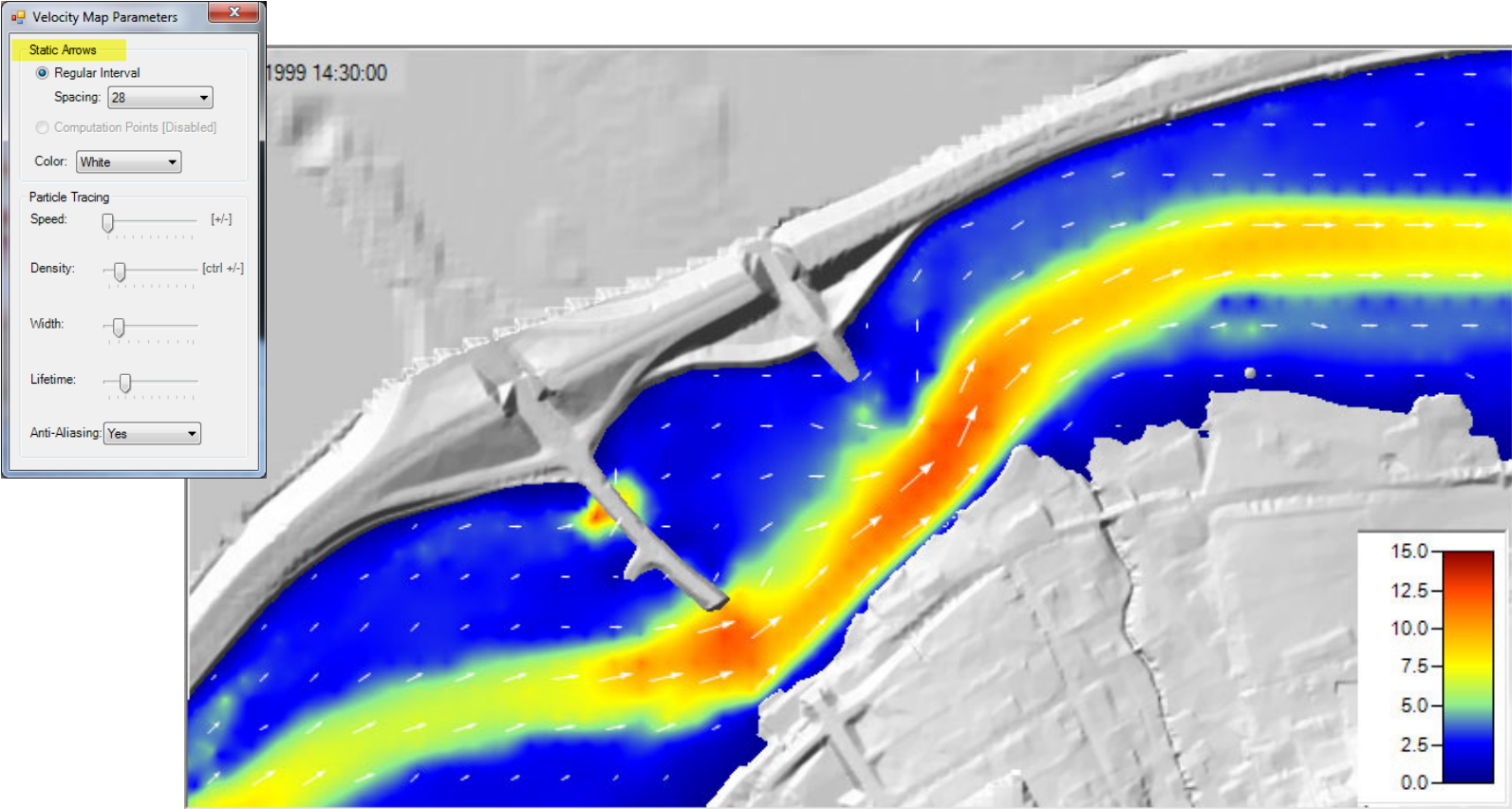


Velocity Results



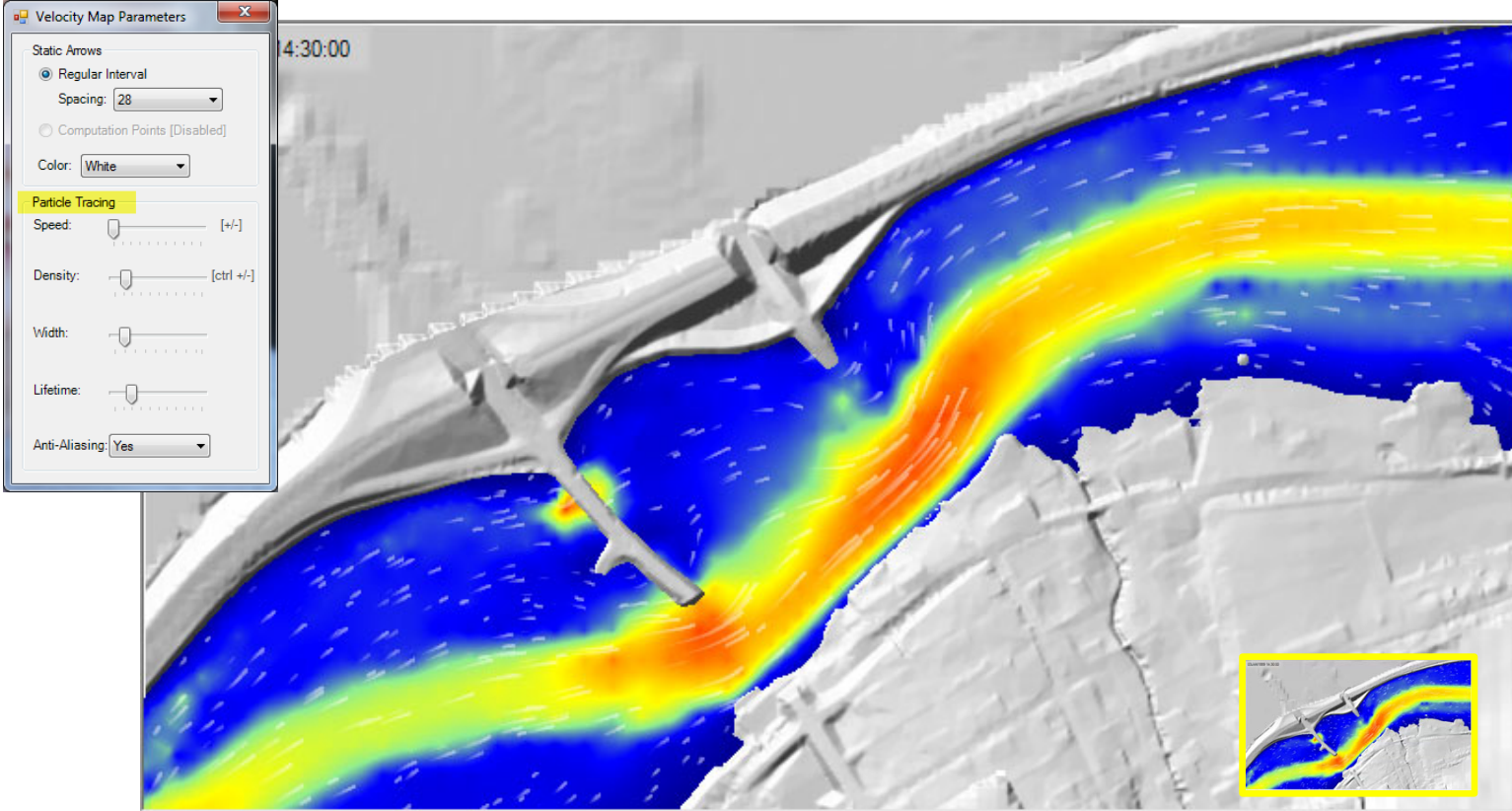


Velocity Arrows



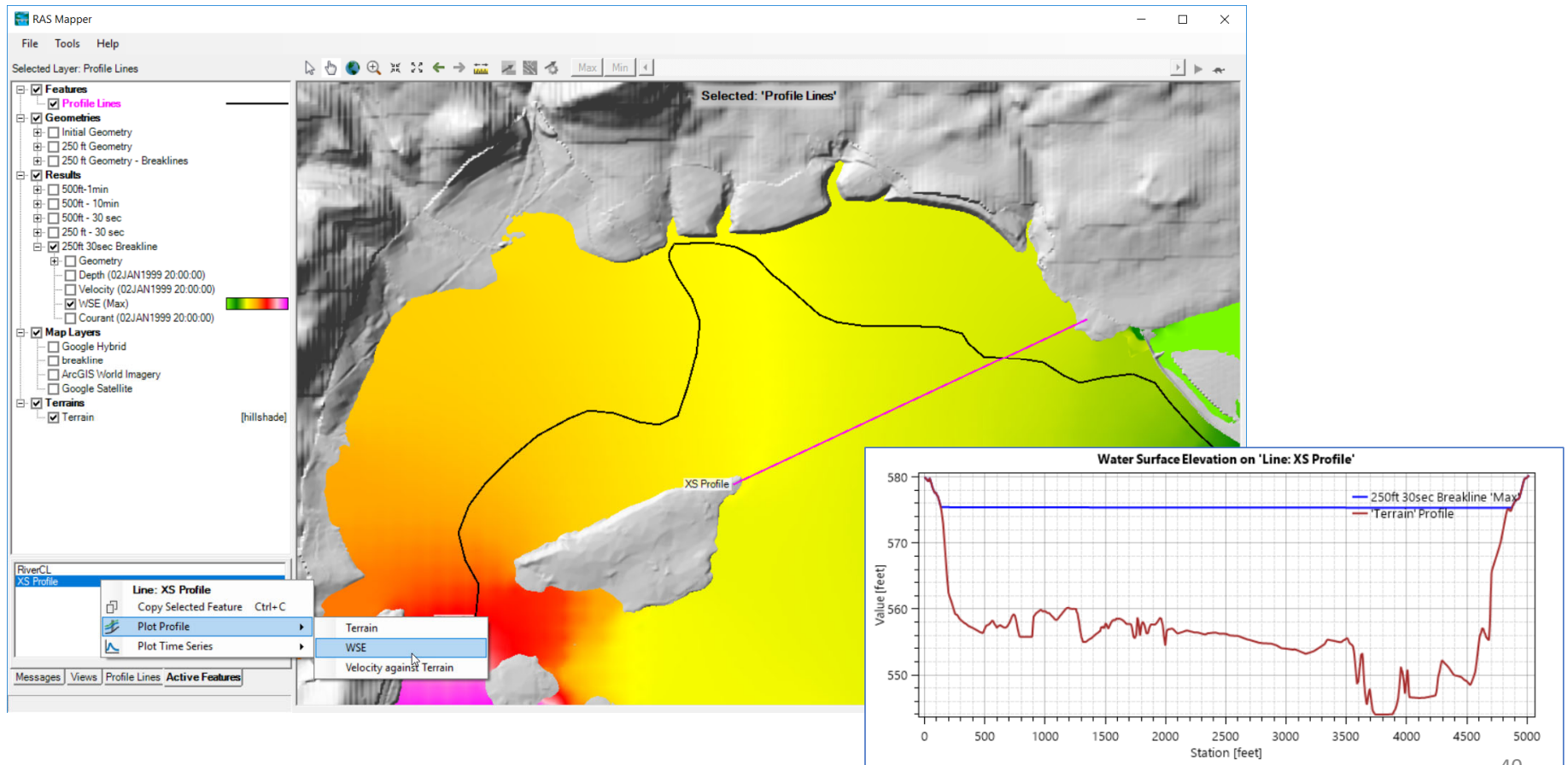


Velocity Tracing



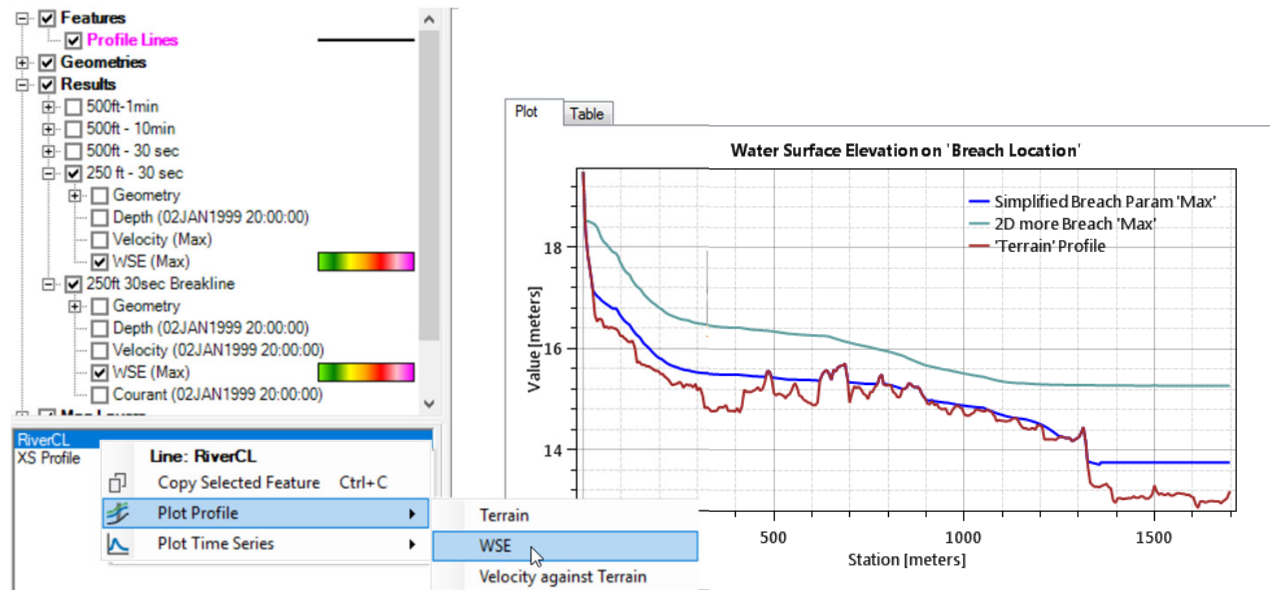


Profile Lines



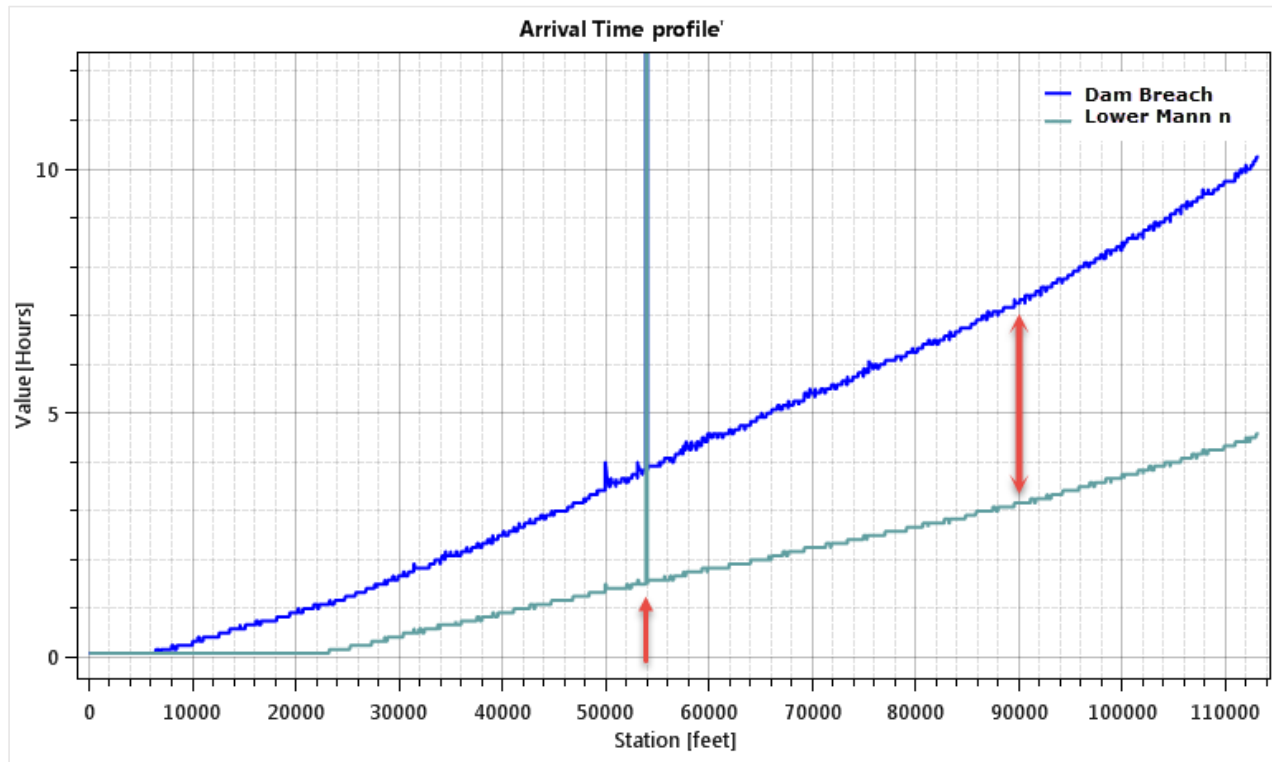
Profile Line - Comparison

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



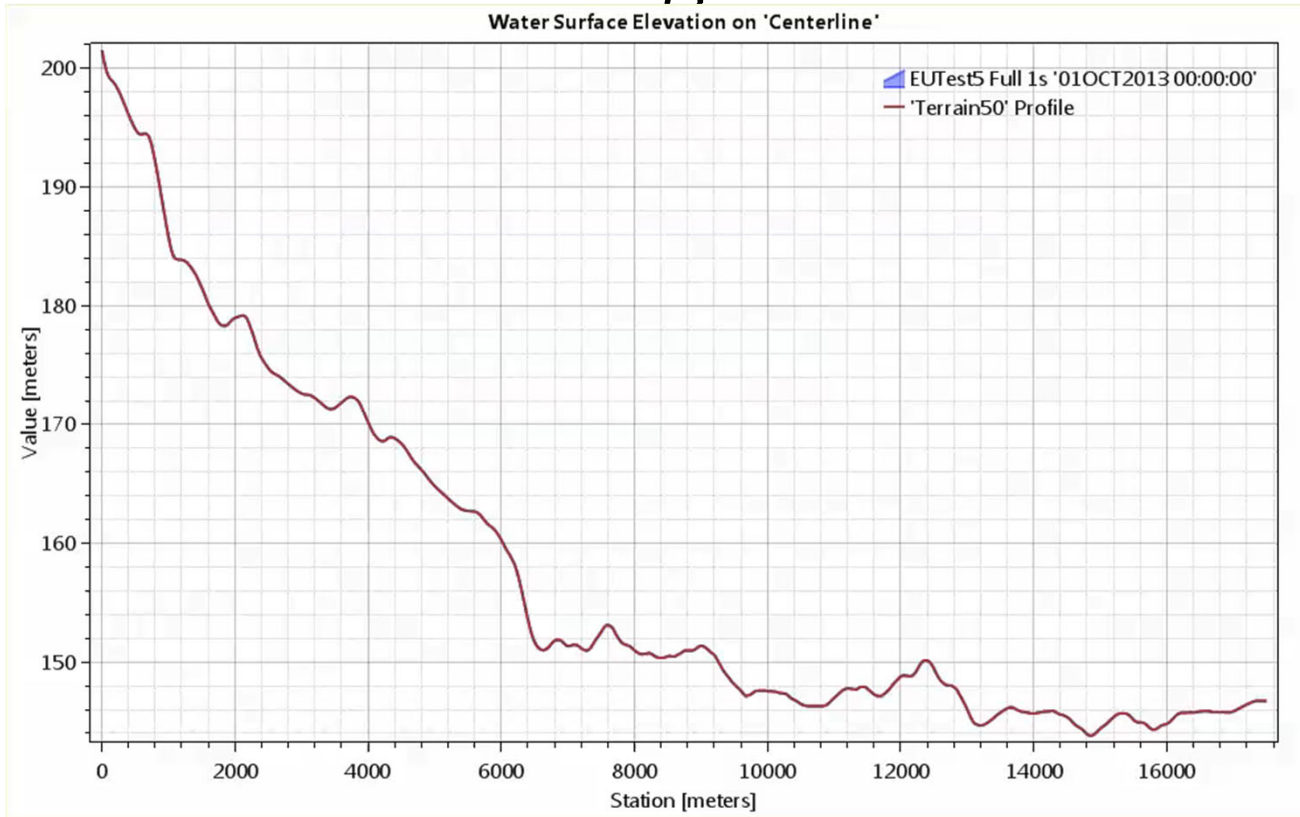


Profile Lines - Comparison



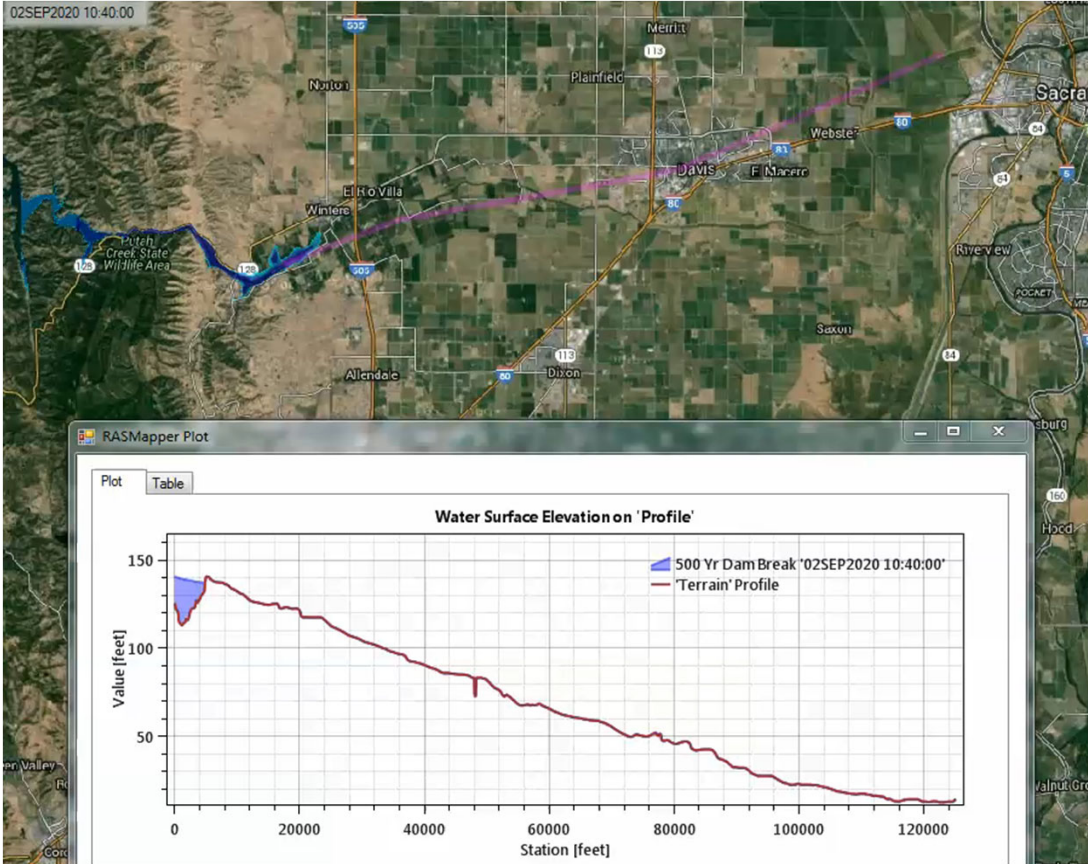


Profile Lines - Animating



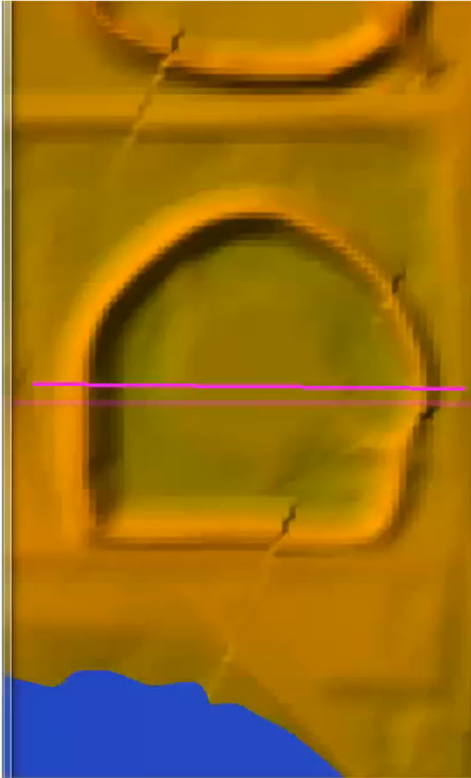
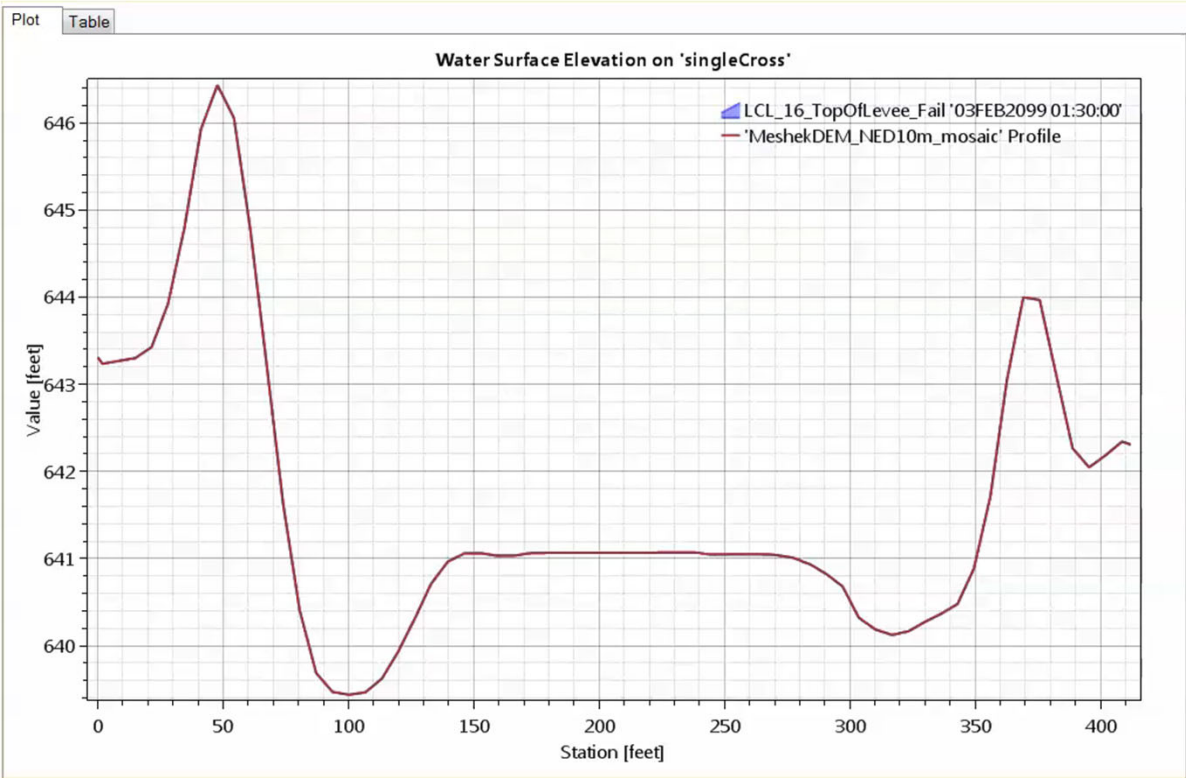


Profile Lines + Spatial Results





Profile Lines - Animating



03JAN1999 12:45:00

Questions?

