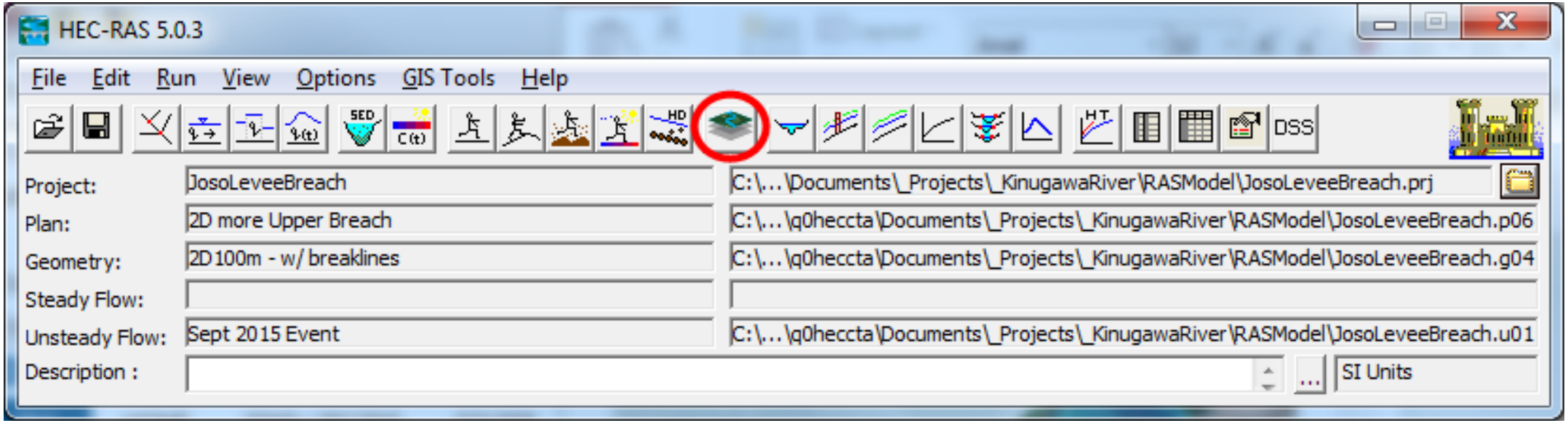
HEC-RAS Mapper Results Visualization

USACE, Institute for Water Resources, Hydrologic Engineering Center

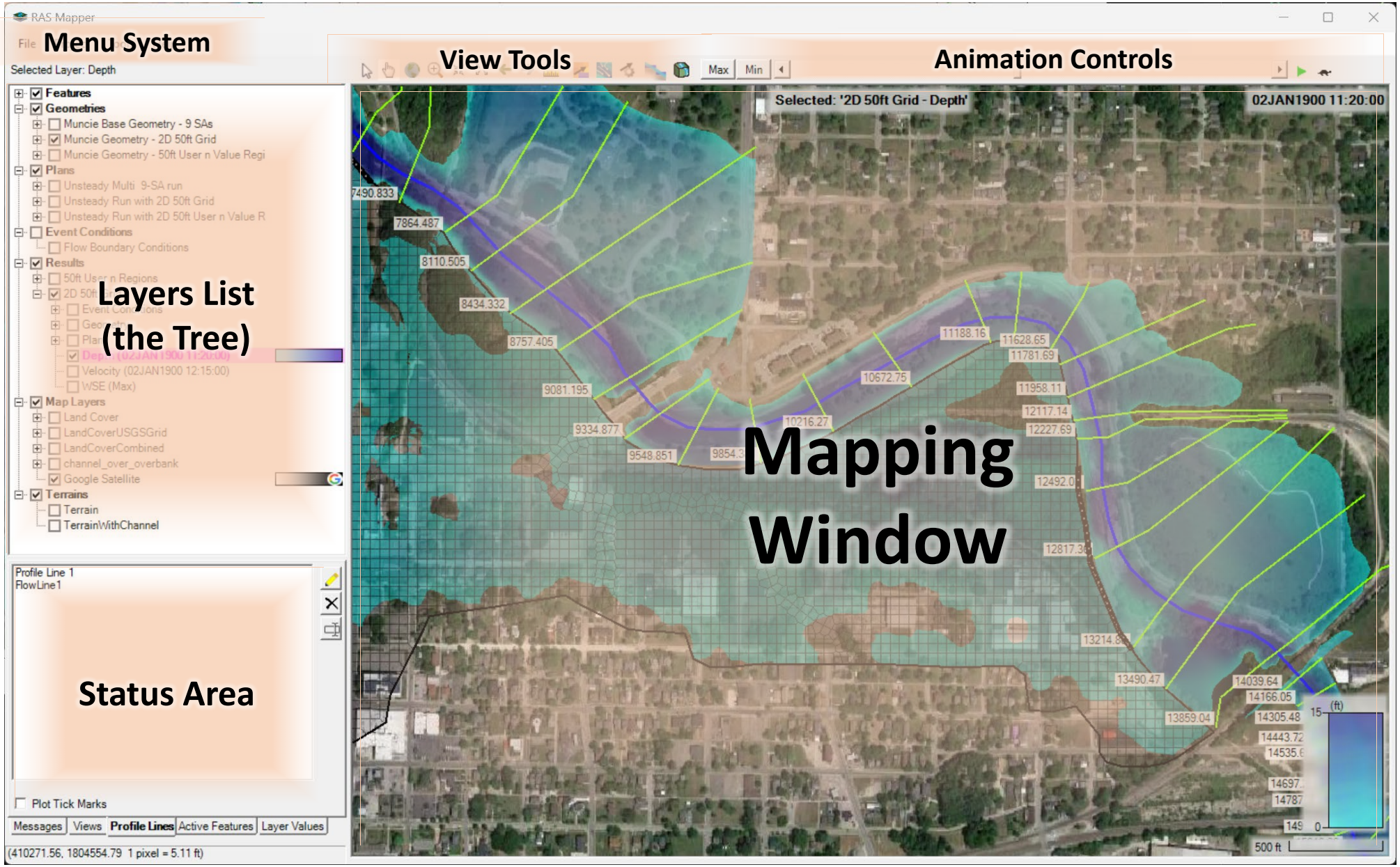
US Army Corps of Engineers

Overview

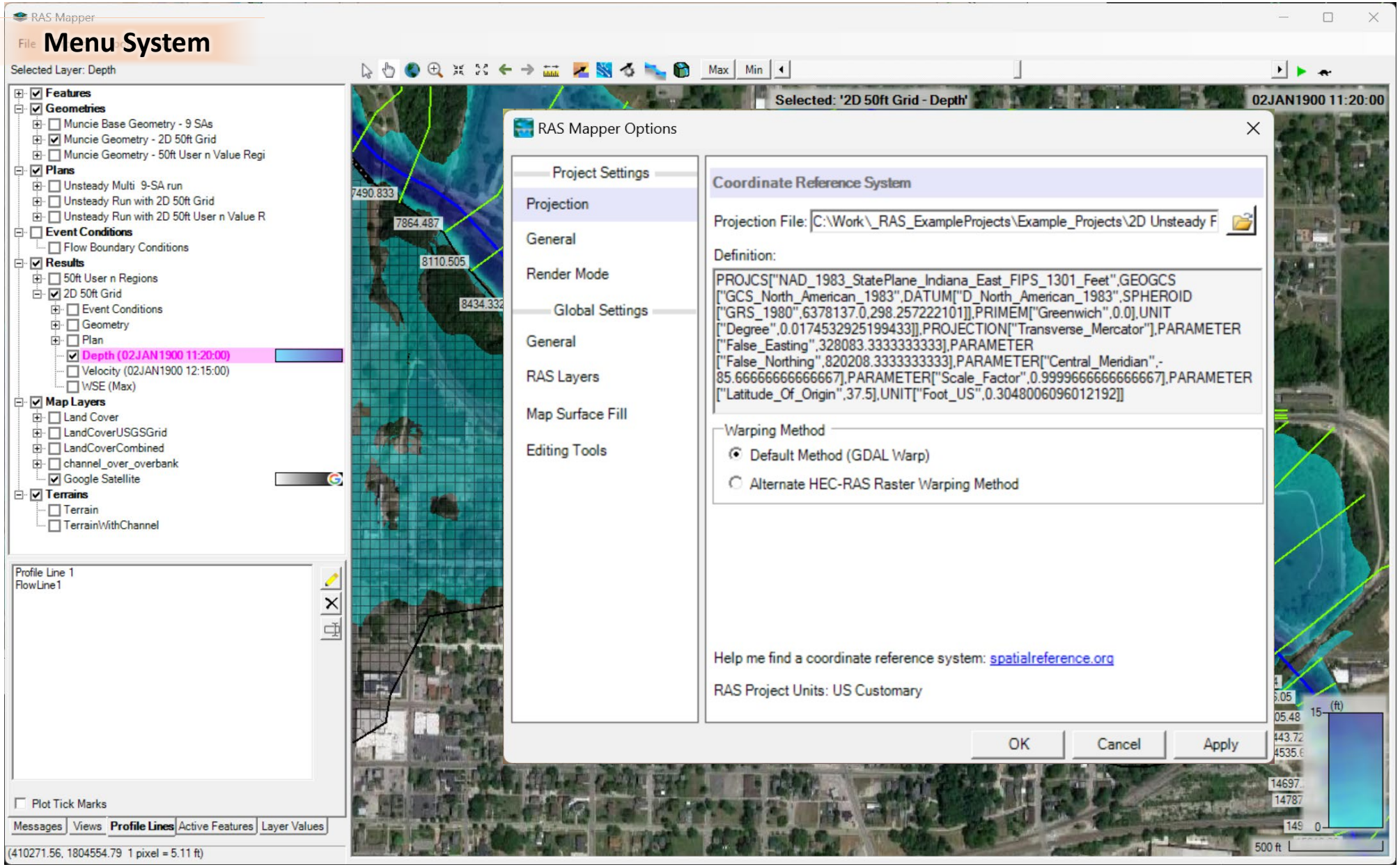
- How do we visualize RAS results?
- How do we debug our model?
- How do we compare different plans?
- How do we produce maps for publication?



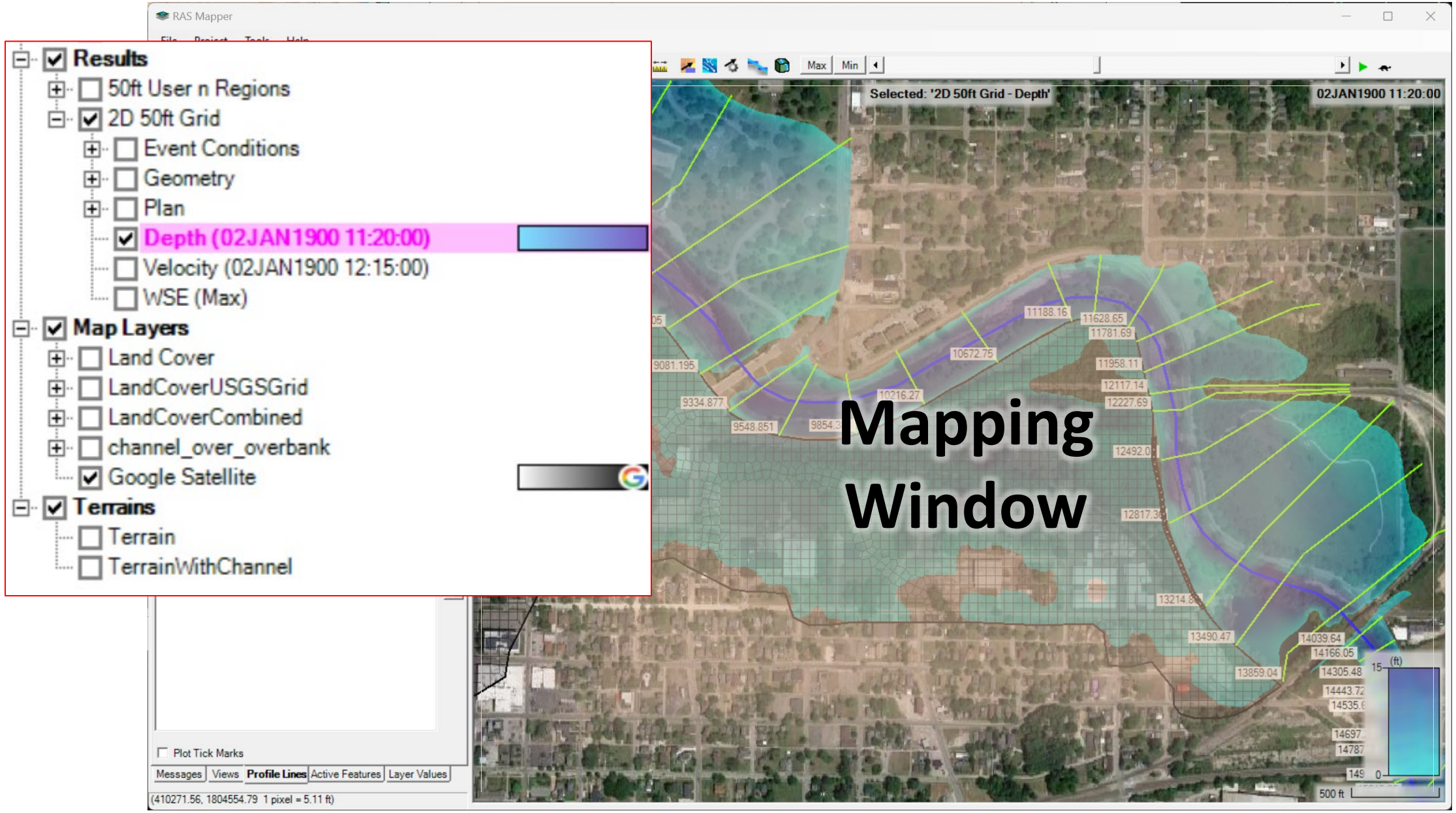
HEC-RAS Mapper Overview



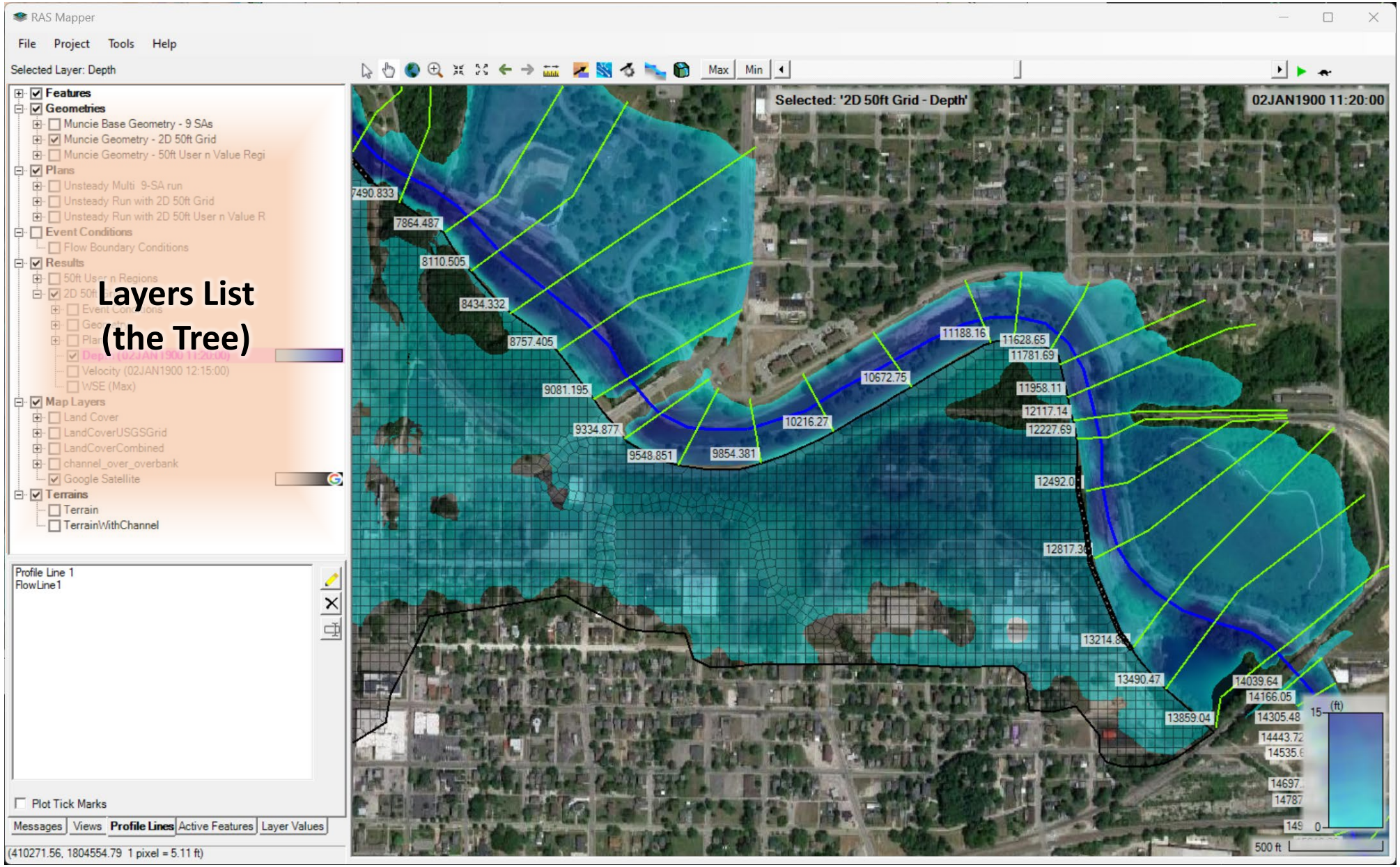
Menu System


RAS Mapper
File
Menu System
Selected Layer: Depth
Features
Geometries
Muncie Base Geometry - 9 SAs
Muncie Geometry - 2D 50ft Grid
Muncie Geometry - 50ft User n Value Regi
Plans
Unsteady Multi 9-SA run
Unsteady Run with 2D 50ft Grid
Unsteady Run with 2D 50ft User n Value R
Event Conditions
Flow Boundary Conditions
Results
50ft User n Regions
2D 50ft Grid
Event Conditions
Geometry
Plan
Depth (02JAN1900 11:20:00)
Velocity (02JAN1900 12:15:00)
WSE (Max)
Map Layers
Land Cover
LandCoverUSGSGrid
LandCoverCombined
channel_over_overbank
Google Satellite
Terrains
Terrain
TerrainWithChannel
Profile Line 1
FlowLine1
Plot Tick Marks
Messages
Views
Profile Lines
Active Features
Layer Values
(410271.56, 1804554.79 1 pixel = 5.11 ft)
Max
Min
Selected: '2D 50ft Grid - Depth'
02JAN1900 11:20:00
RAS Mapper Options
Project Settings
Projection
General
Render Mode
Global Settings
General
RAS Layers
Map Surface Fill
Editing Tools
Coordinate Reference System
Projection File: C:\Work_RAS_ExampleProjects\Example_Projects\2D Unsteady F
Definition:
PROJCS["NAD_1983_StatePlane_Indiana_East_FIPS_1301_Feet",GEOGCS
["GCS_North_American_1983",DATUM["D_North_American_1983",SPHEROID
["GRS_1980",6378137.0,298.257222101]],PRIMEM["Greenwich",0.0],UNIT
["Degree",0.0174532925199433]],PROJECTION["Transverse_Mercator"],PARAMETER
["False_Easting",328083.3333333333],PARAMETER
["False_Northing",820208.3333333333],PARAMETER["Central_Meridian",-
85.66666666666667],PARAMETER["Scale_Factor",0.9999666666666667],PARAMETER
["Latitude_Of_Origin",37.5],UNIT["Foot_US",0.3048006096012192]]
Warping Method
Default Method (GDAL Warp)
Alternate HEC-RAS Raster Warping Method
Help me find a coordinate reference system: spatialreference.org
RAS Project Units: US Customary
OK
Cancel
Apply
500 ft

Mapping Window



Layers List


RAS Mapper
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Selected Layer: Depth
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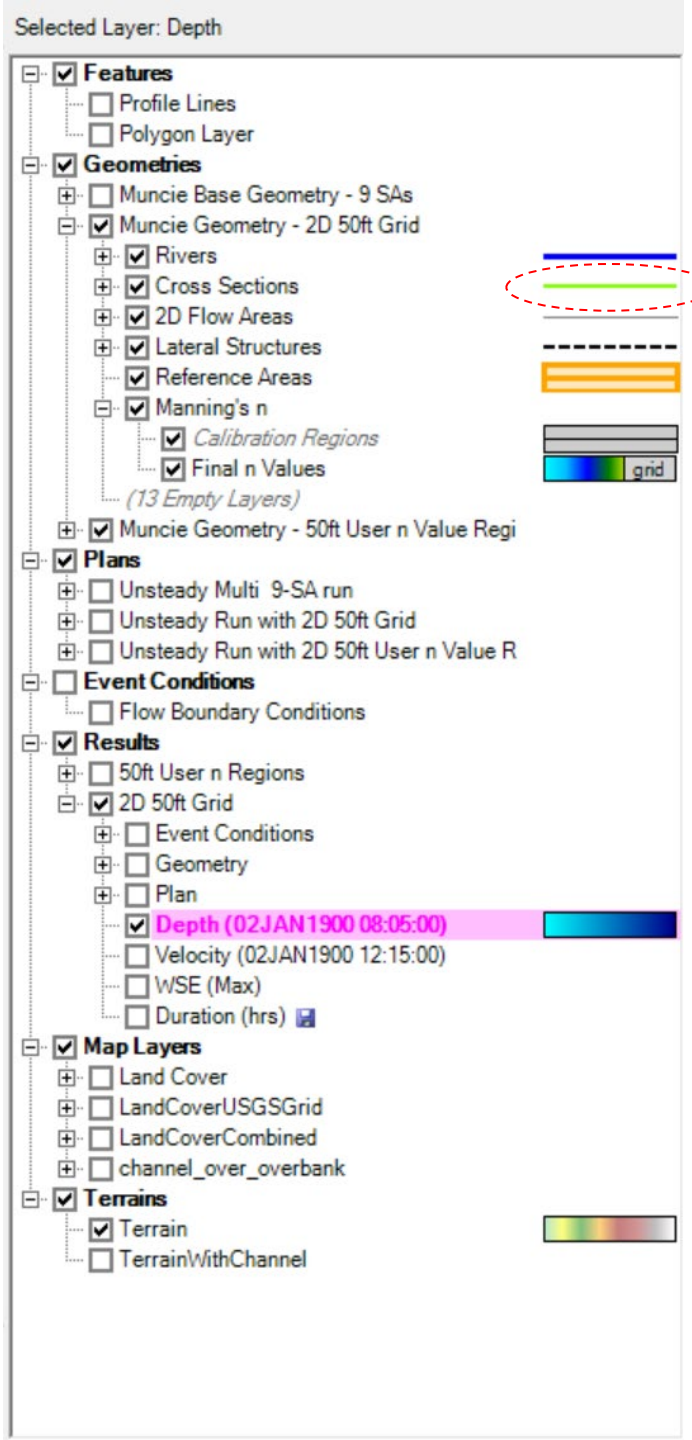
02JAN1900 11:20:00
7490.833
7864.487
8110.505
8434.332
8757.405
9081.195
9334.877
9548.851
9854.381
10216.27
10672.75
11188.16
11628.65
11781.69
11958.11
12117.14
12227.69
12492.0
13490.47
14039.64
14166.05
14305.48
13859.04
(ft)
500 ft

Layers List

Layer Order Dictates Visualization

- Features
  - Profile Lines
  - Custom User Layers (vector)
- Geometries
- Plans
- Event Conditions
- Results
- Map Layers
  - Land Cover/Soils/Infiltration and more
  - Web Imagery
  - Custom User Layers (vector and raster)
- Terrains



Symbology is shown to the right of any checked layers

The selected layer is highlighted in magenta

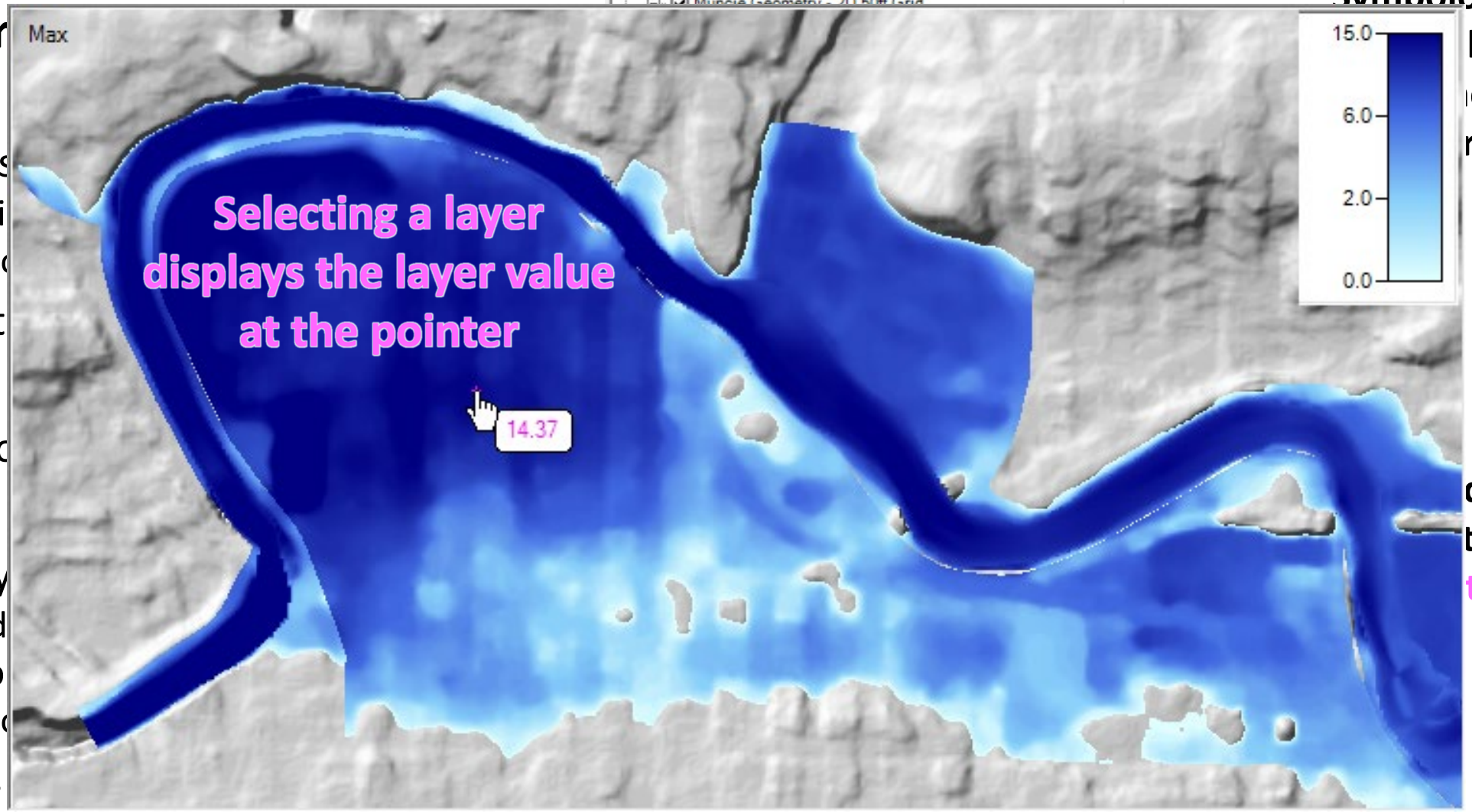
Layers List

Layer Or

- Features
  - Profi
  - Custo
- Geomet
- Plans
- Event Co
- Results
- Map Lay
  - Land
  - Web
  - Custo
- Terrains

Selected Layer: Depth

- Features
  - Profile Lines
  - Polygon Layer
- Geometries
  - Muncie Base Geometry - 9 SAs
  - Muncie Geometry - 2D 50ft Grid



Symbology is
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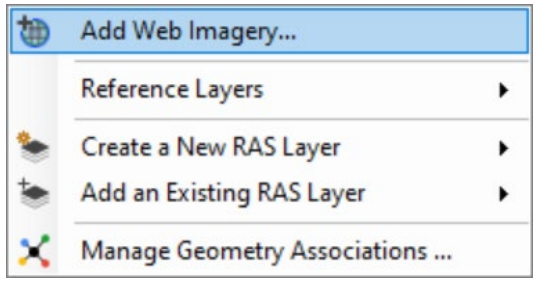
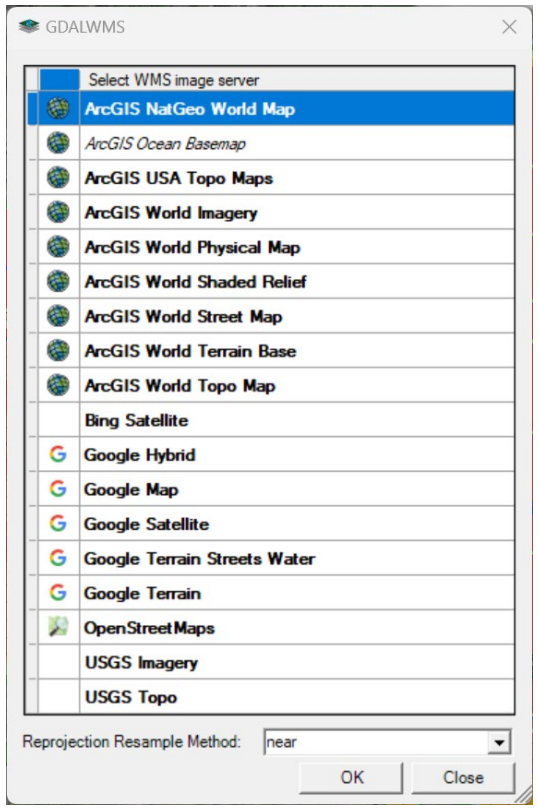
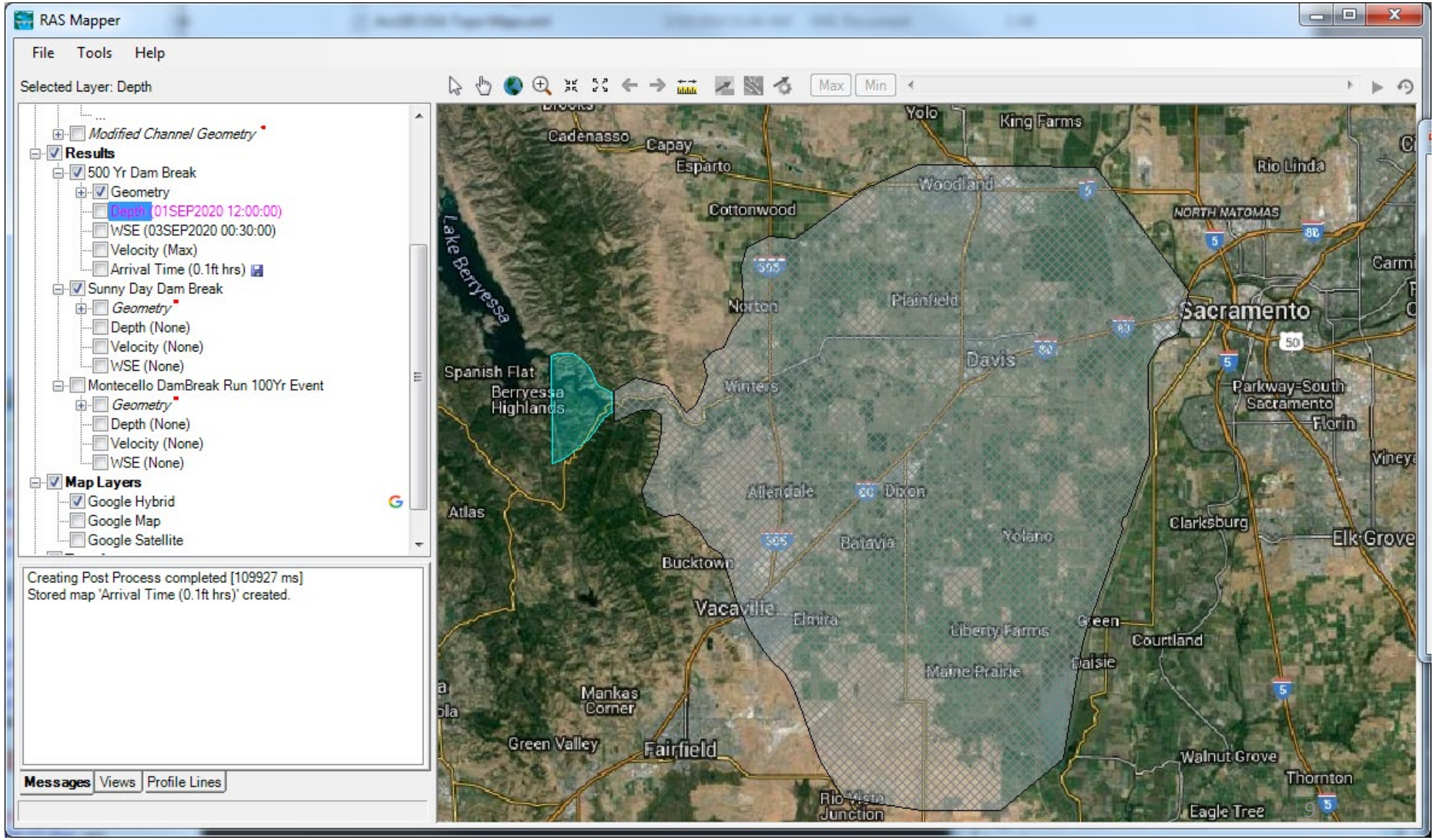
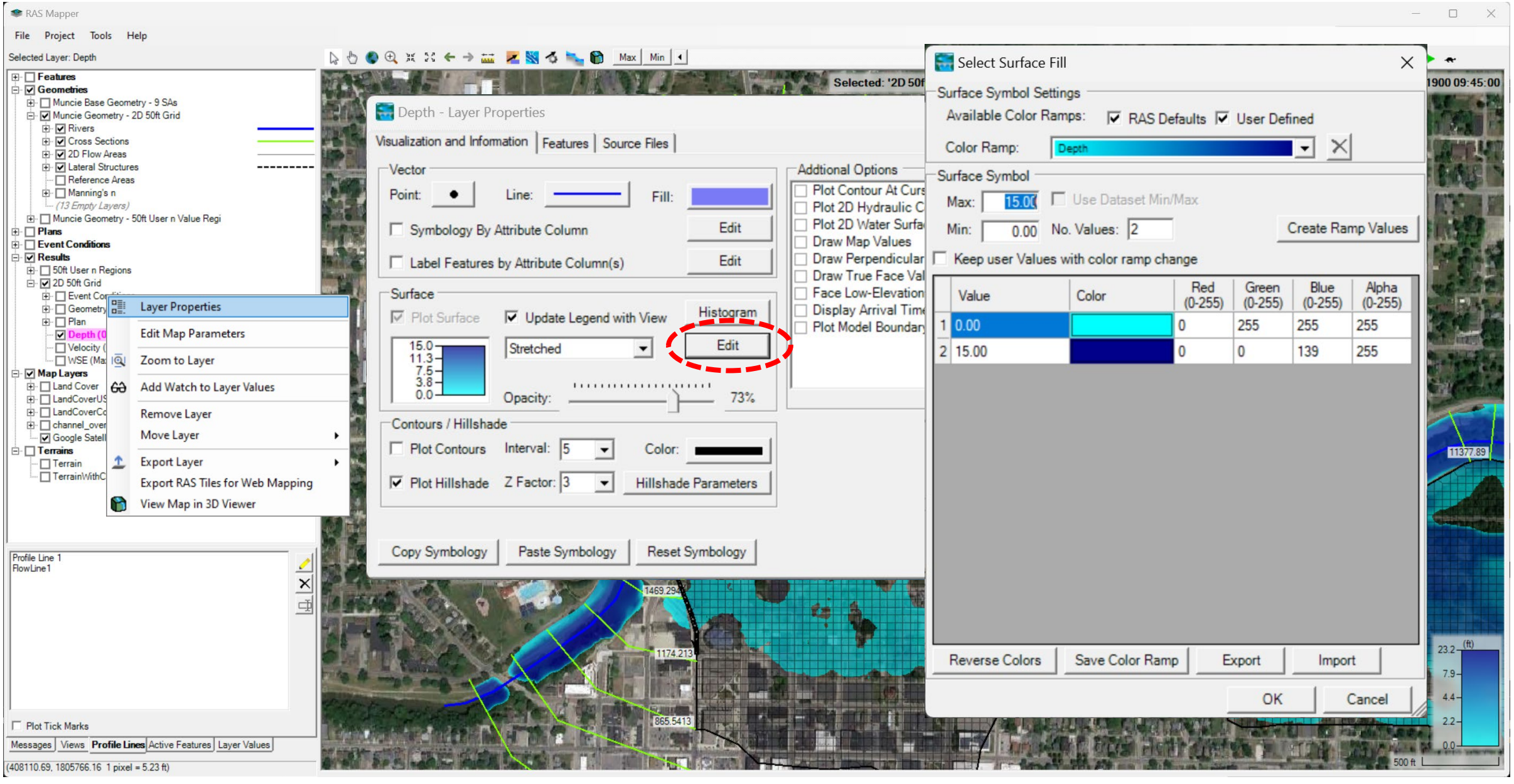
Layer List: Map Layer | Web Imagery



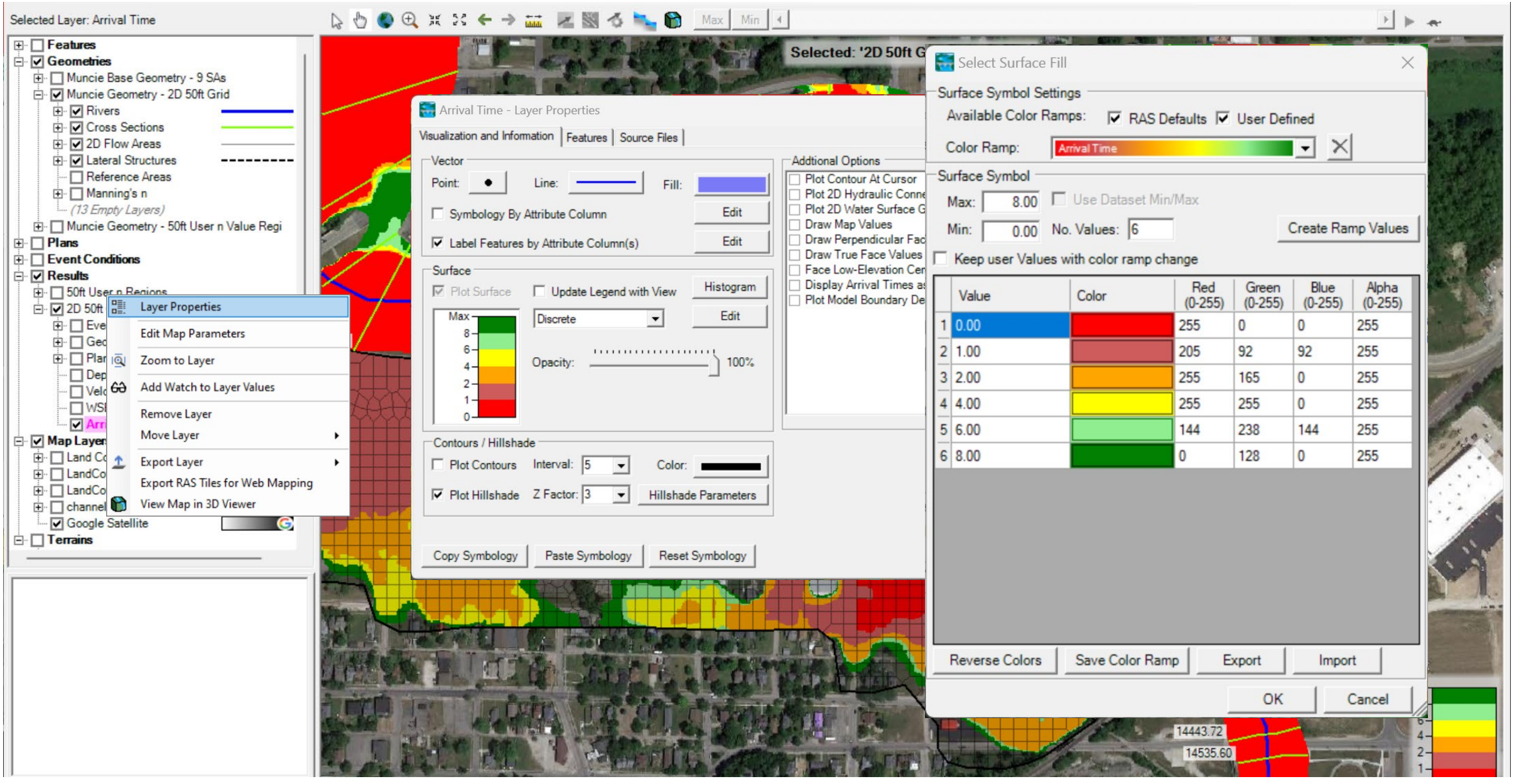




Results Visualization: Layer Properties

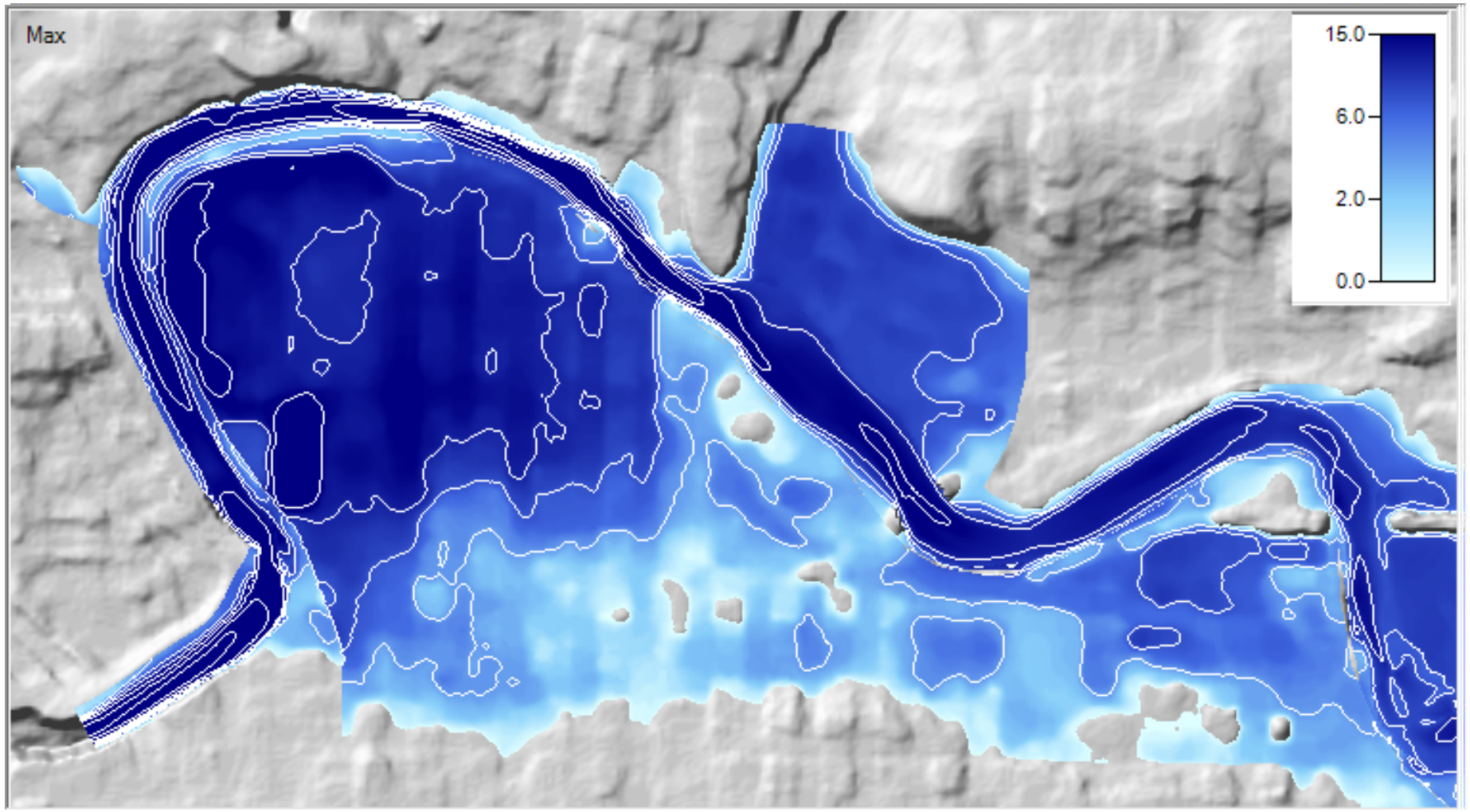


Results Visualization: Layer Properties

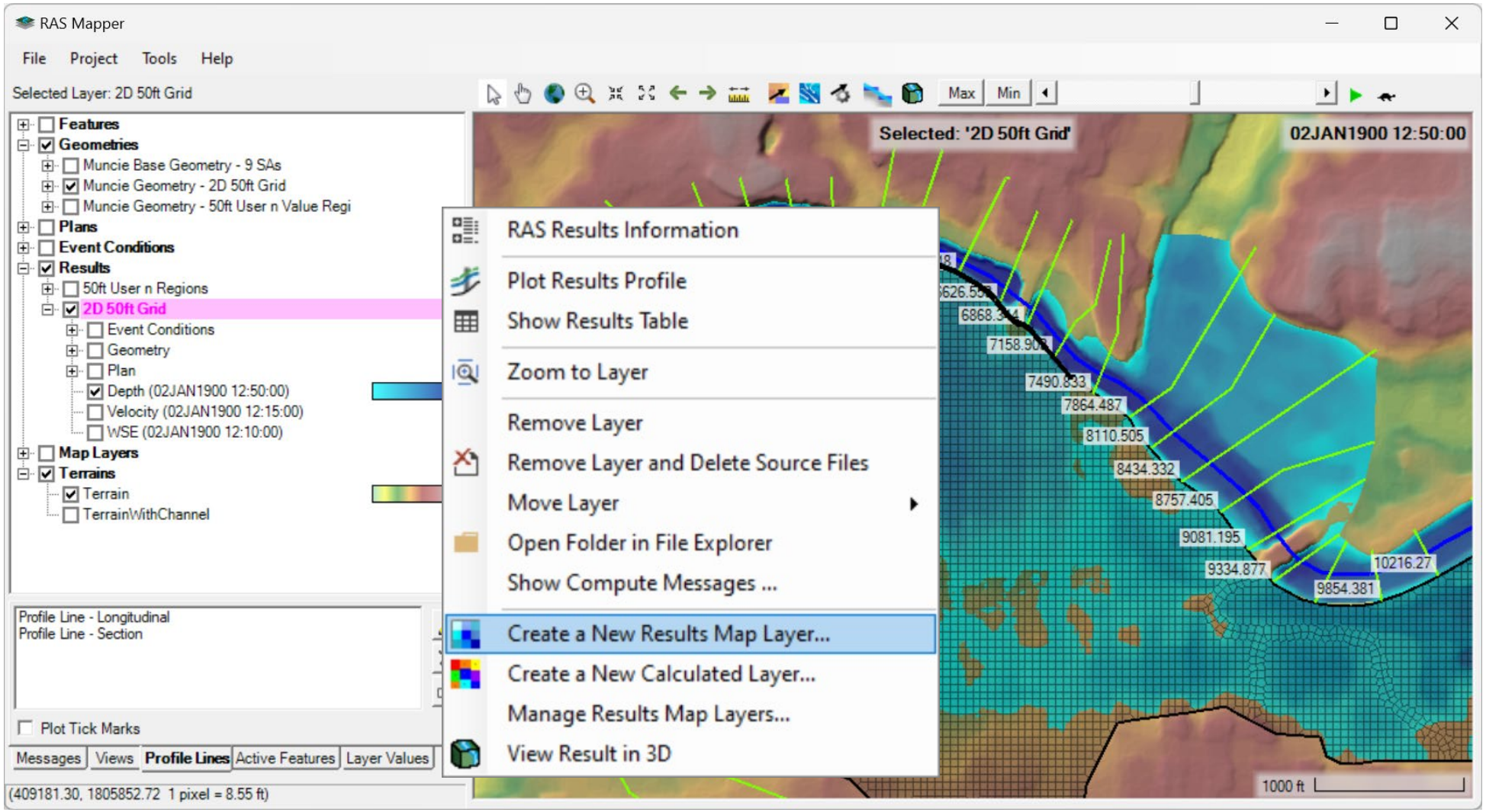


Results Visualization: Example

Stretched with Contours



Results Mapping: Adding a New Result Layer



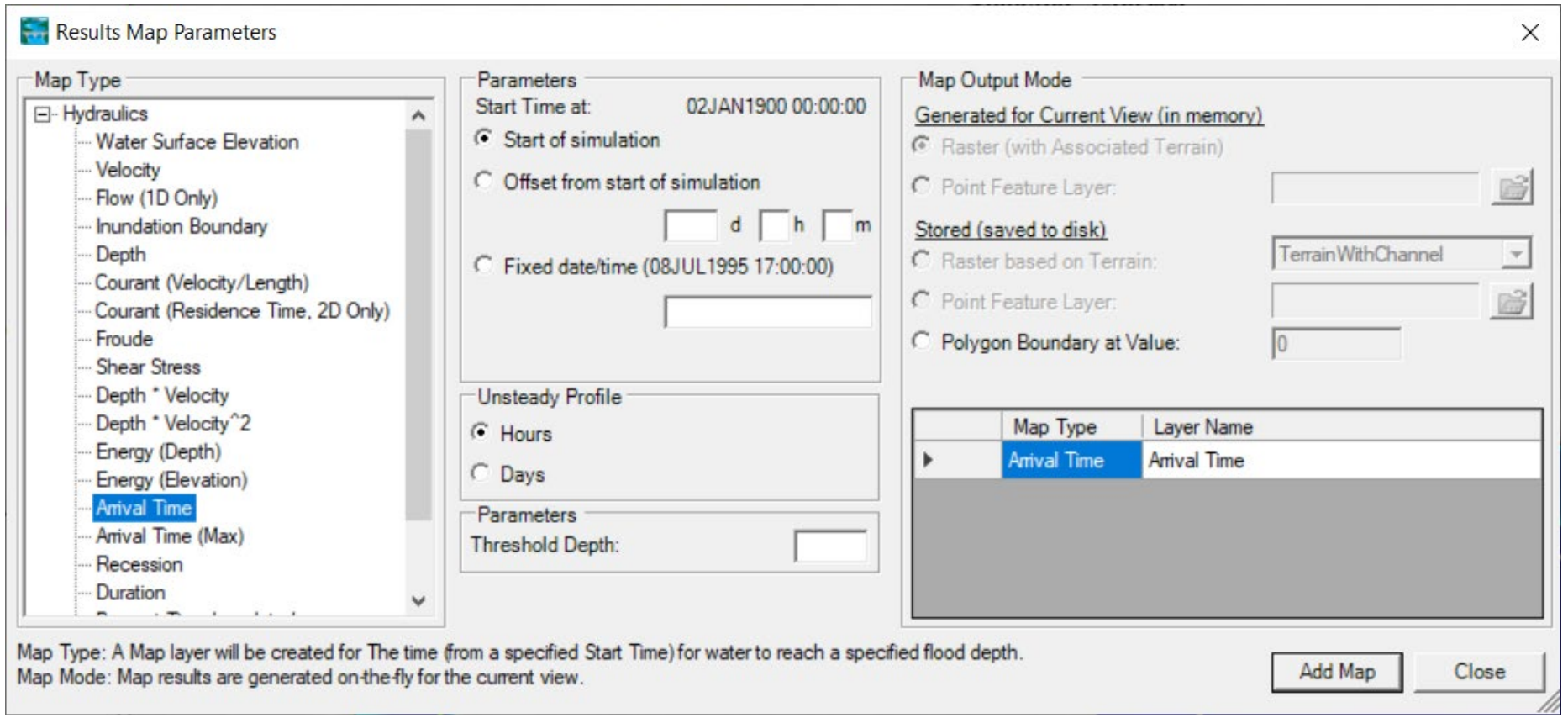
Default Maps: Depth, Velocity, and Water Surface Elevation

Results Mapping: Adding a New Result Layer

Map Type

Profile/ Parameter

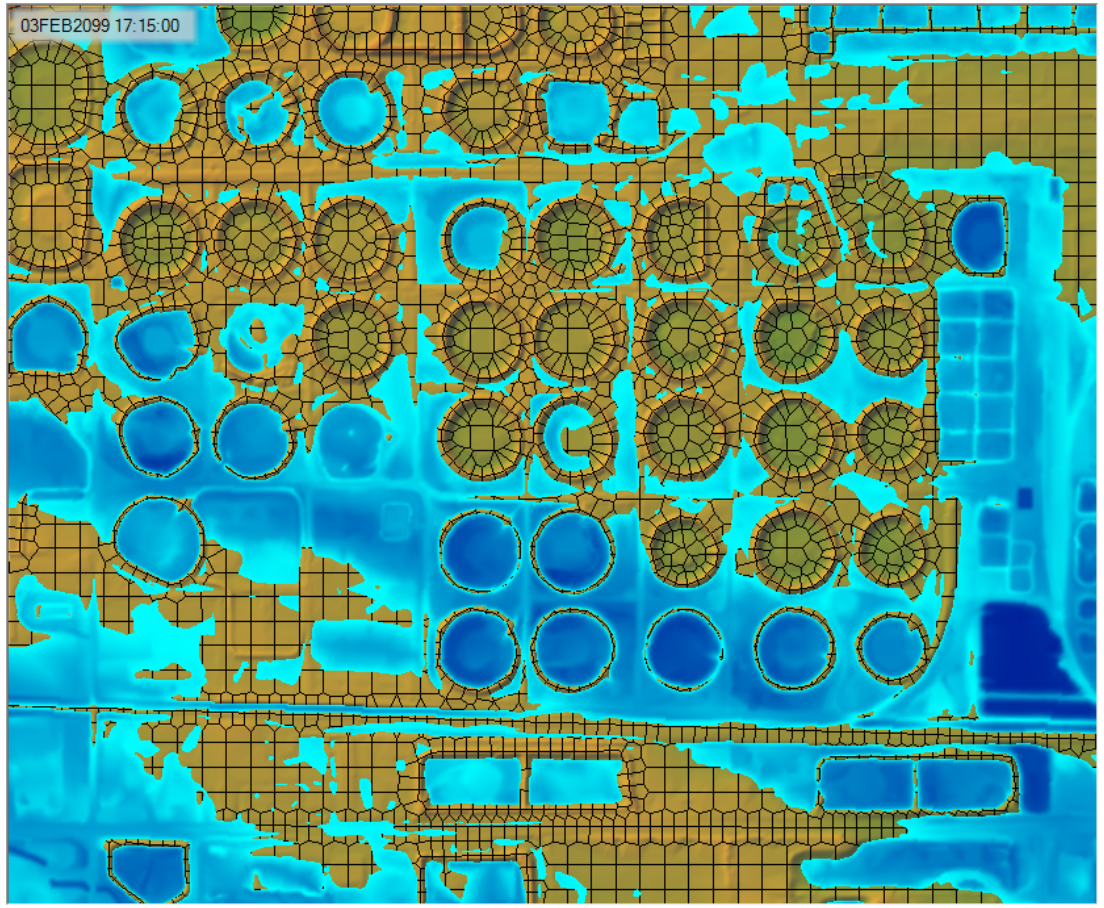
Output Mode



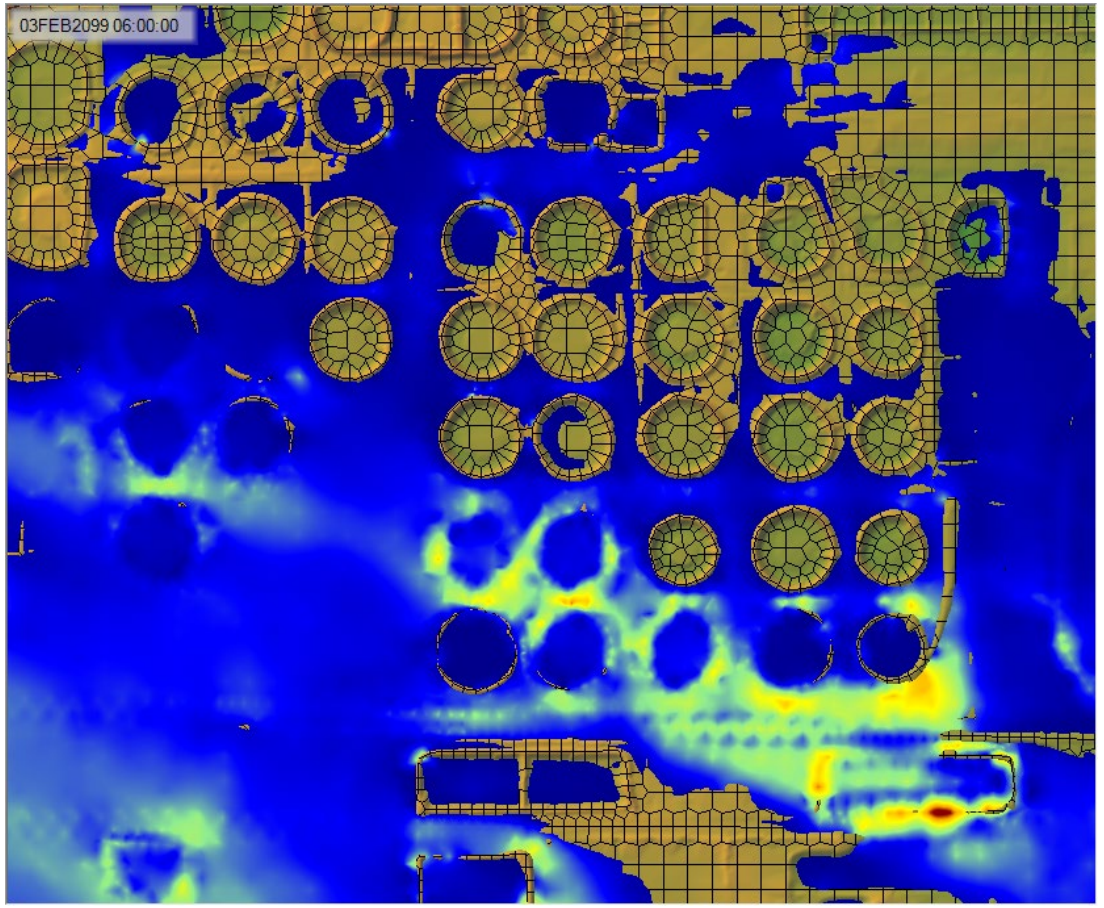
Default Maps: Depth, Velocity, and Water Surface Elevation

Example Maps: Depth and Velocity

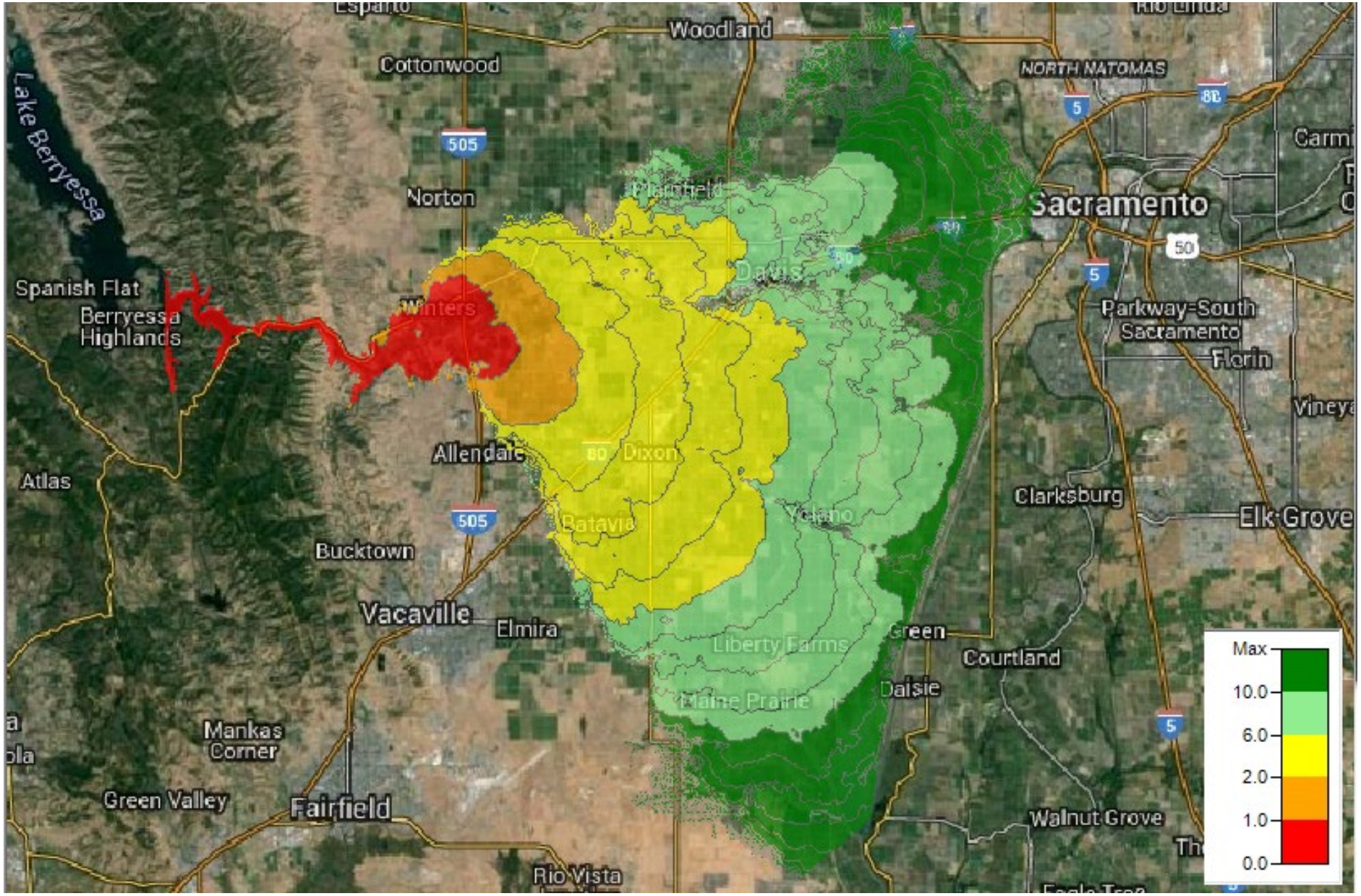
- Depth



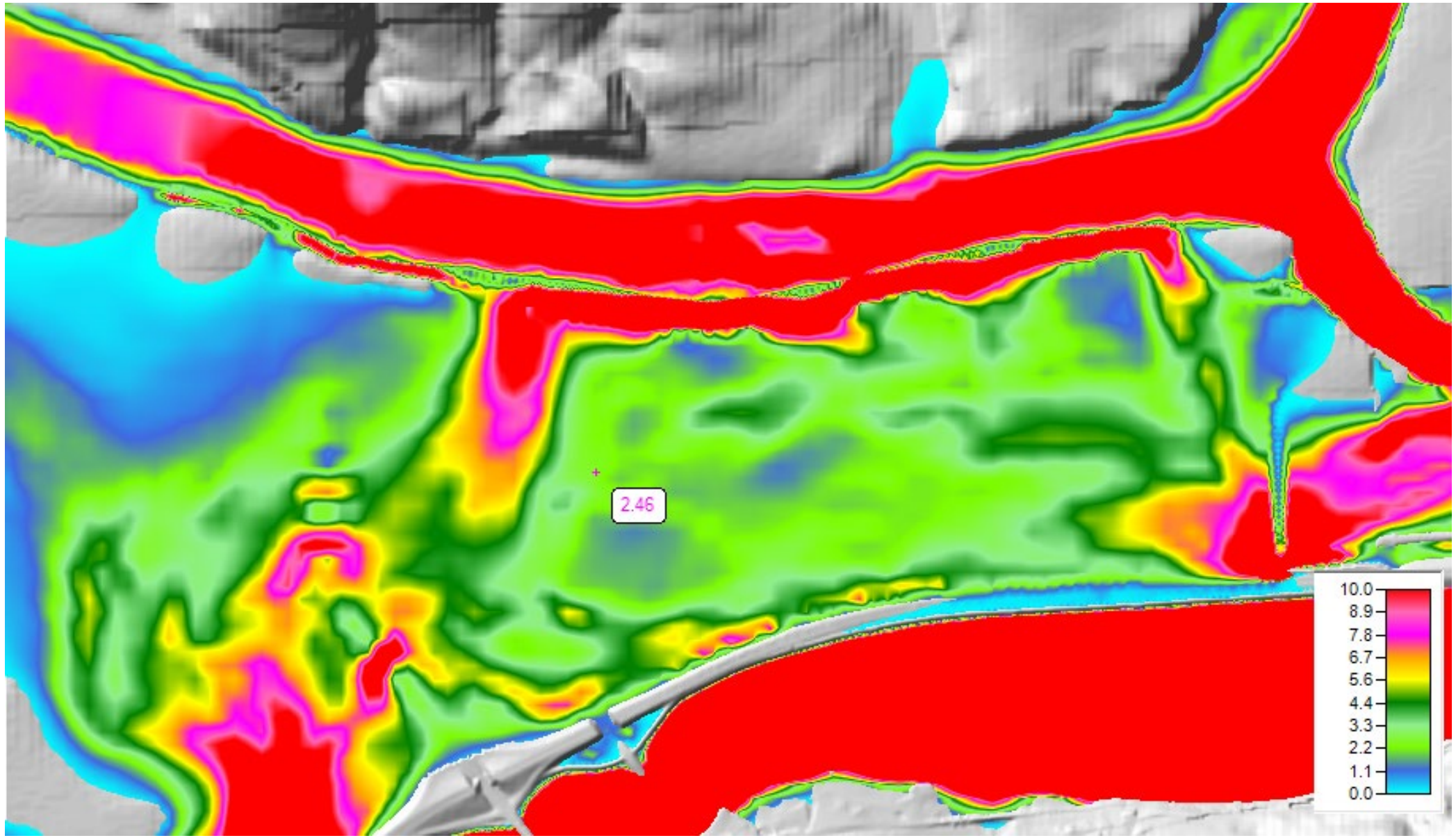
- Velocity



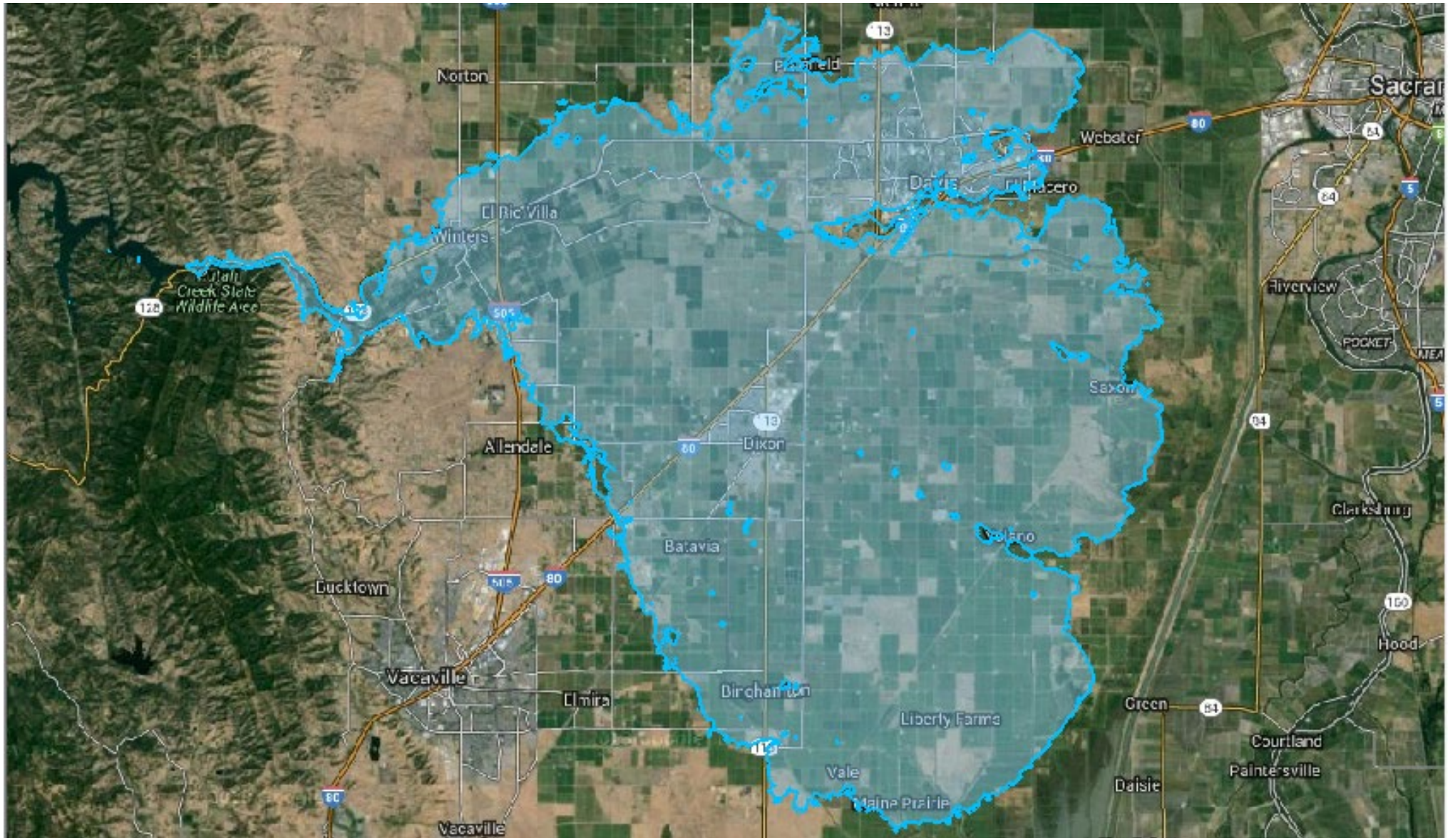
Example Maps: Arrival Time



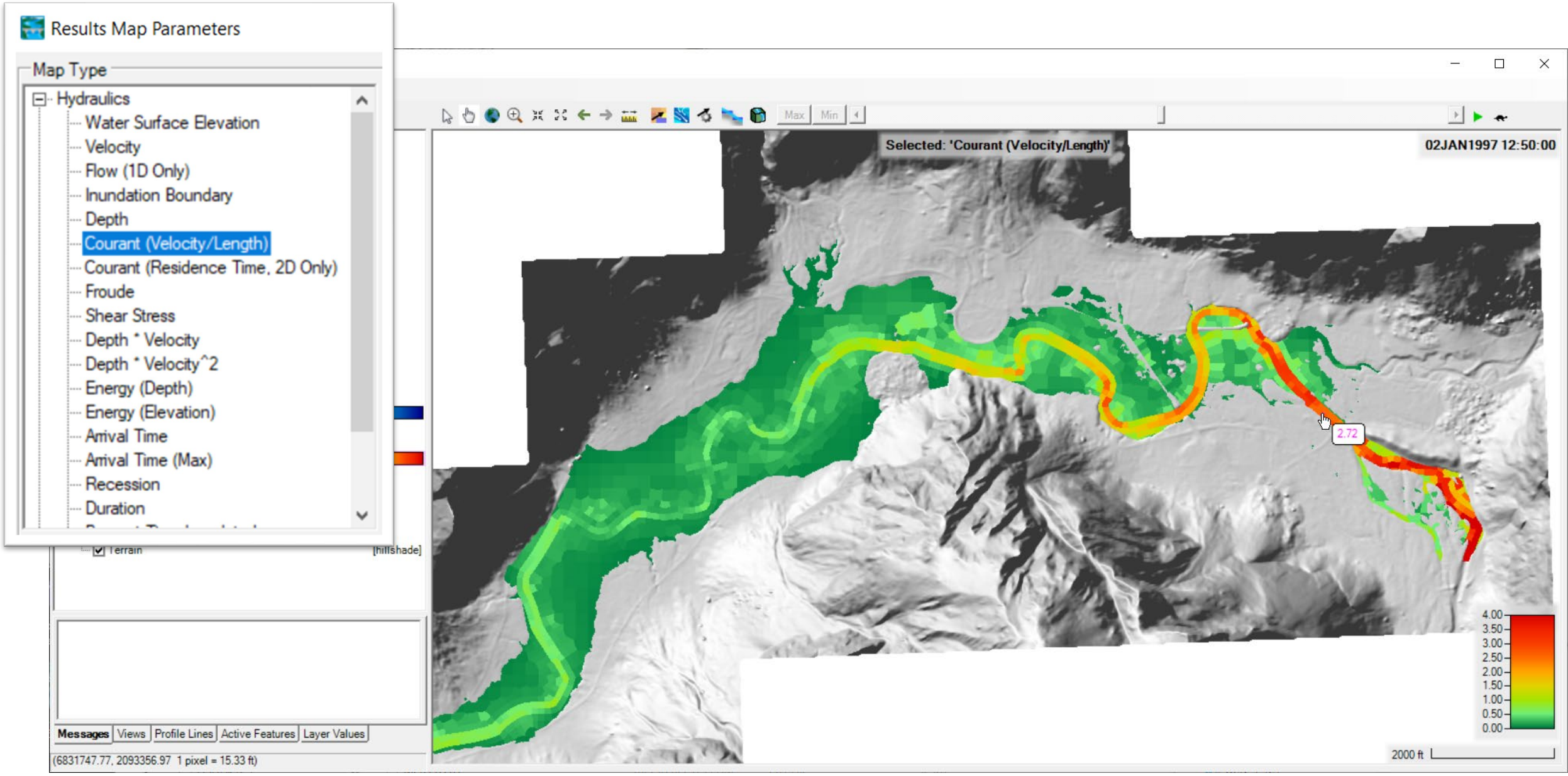
Example Maps: Hazard Mapping



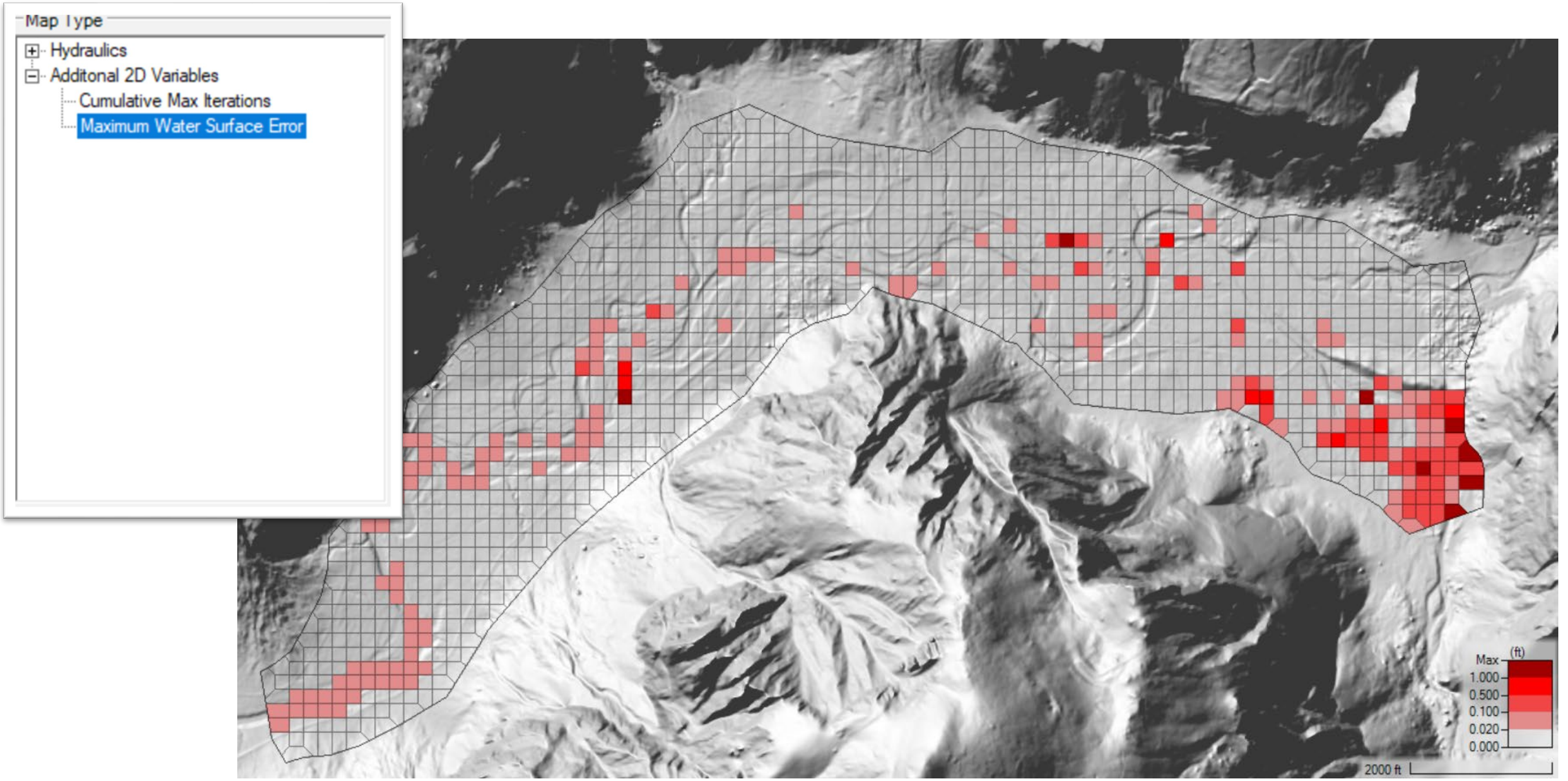
Example Maps: Inundation Boundary



Example Maps: Courant Number Map

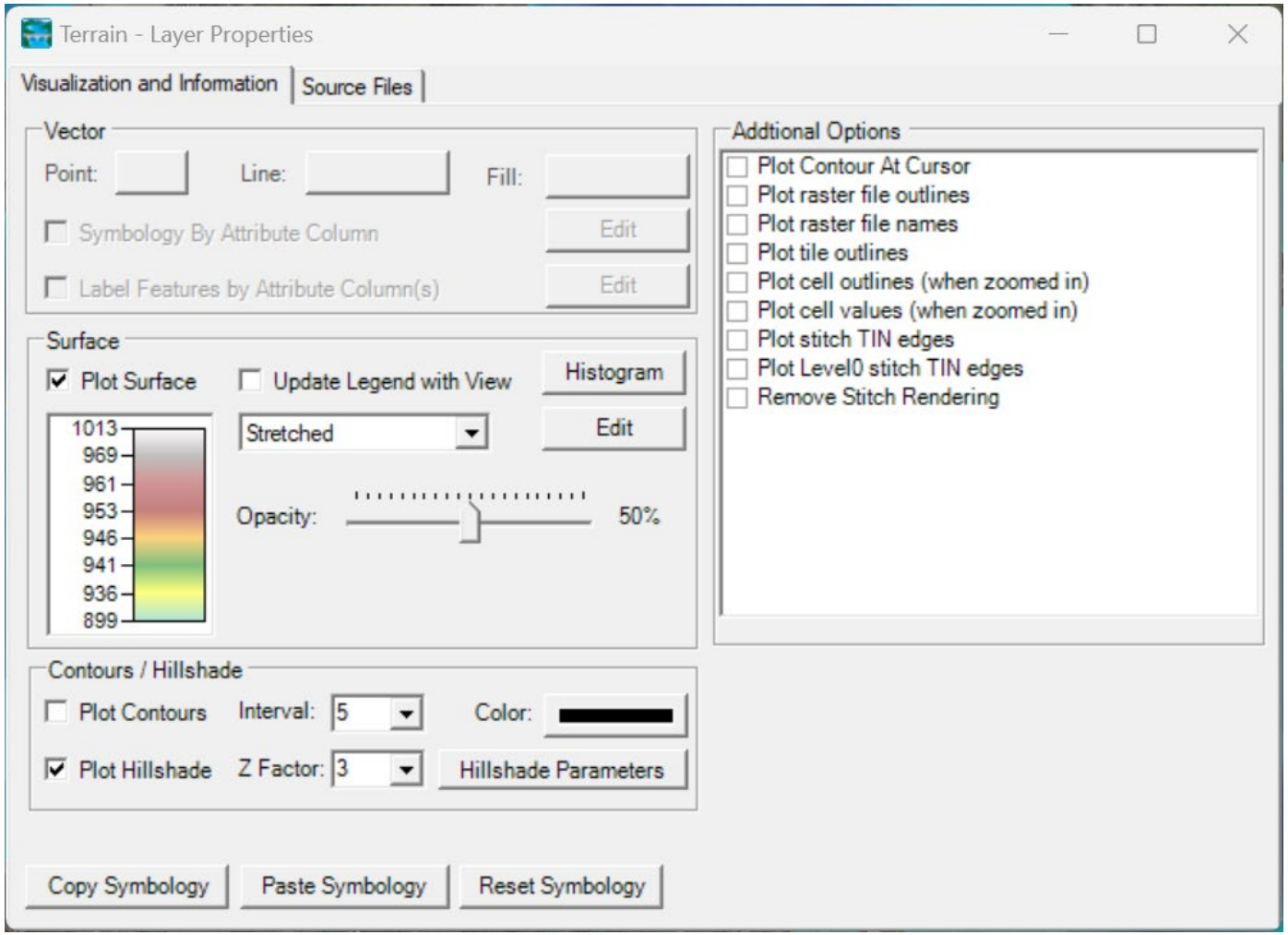


Example Maps: Maximum Water Surface Error

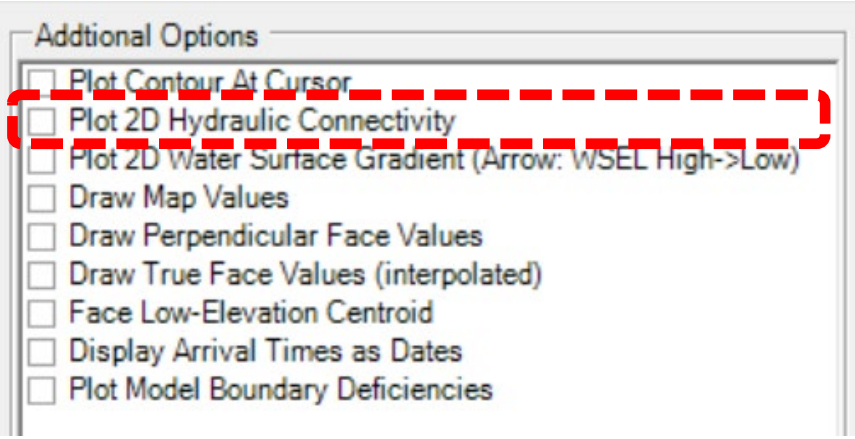


Additional Options

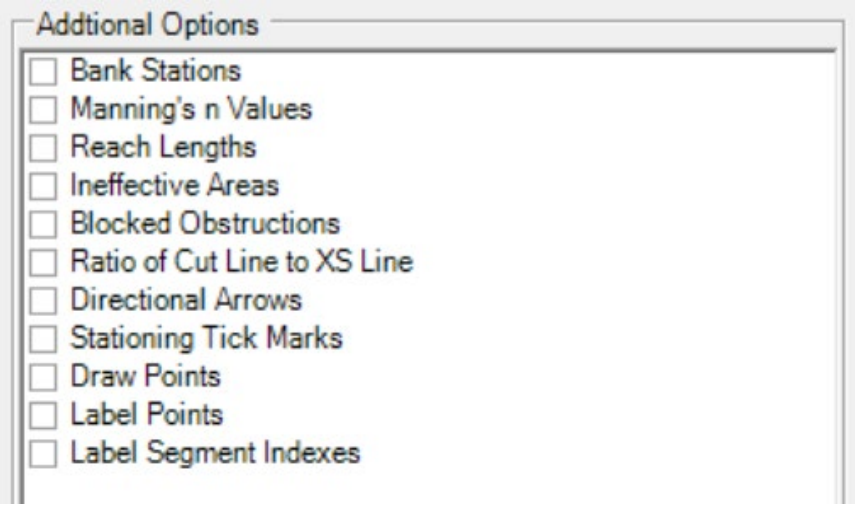
- Terrain



- Depth, WSE

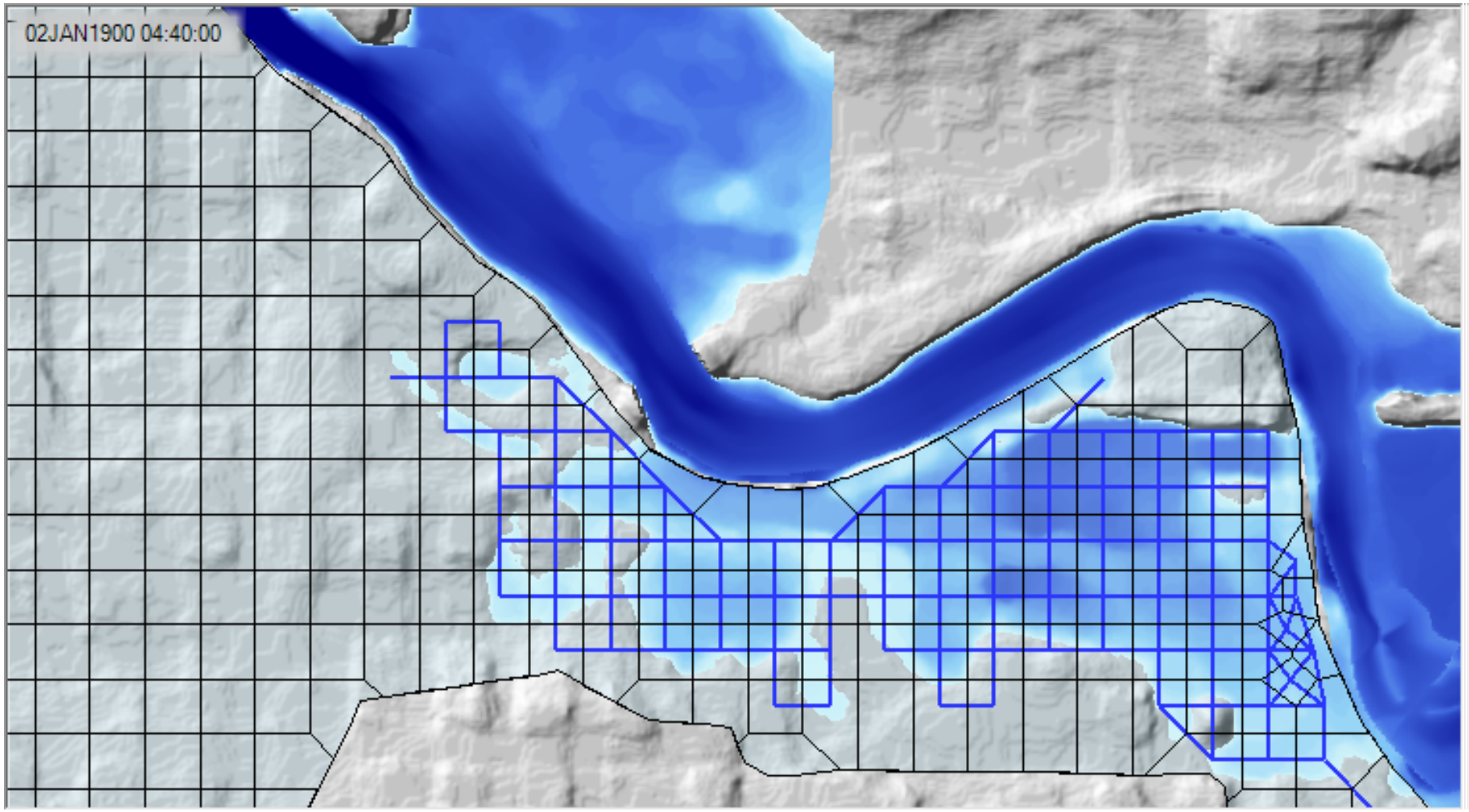


- River, Cross Sections

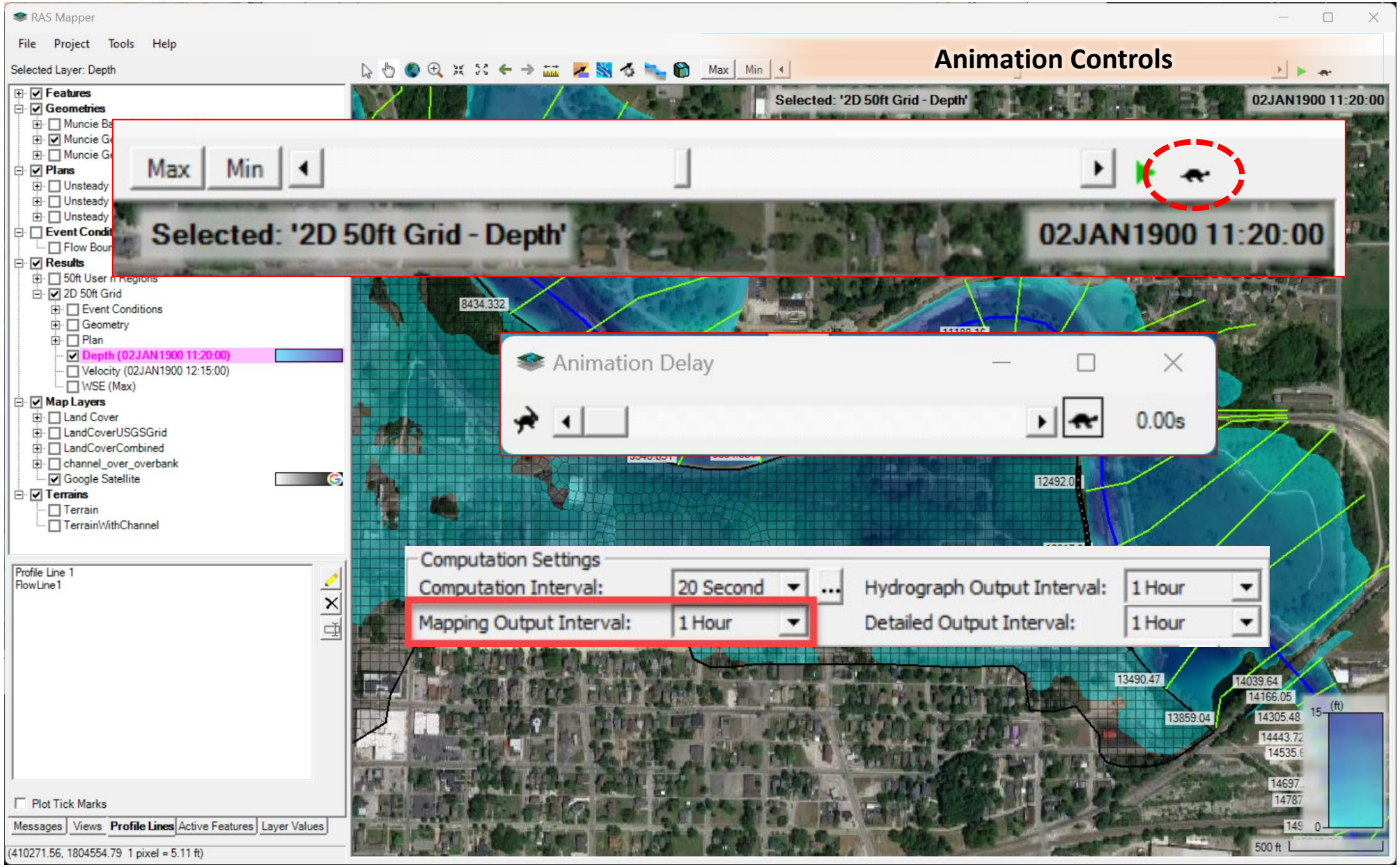


Additional Options Depth Results

- Hydraulic Connectivity from Mesh



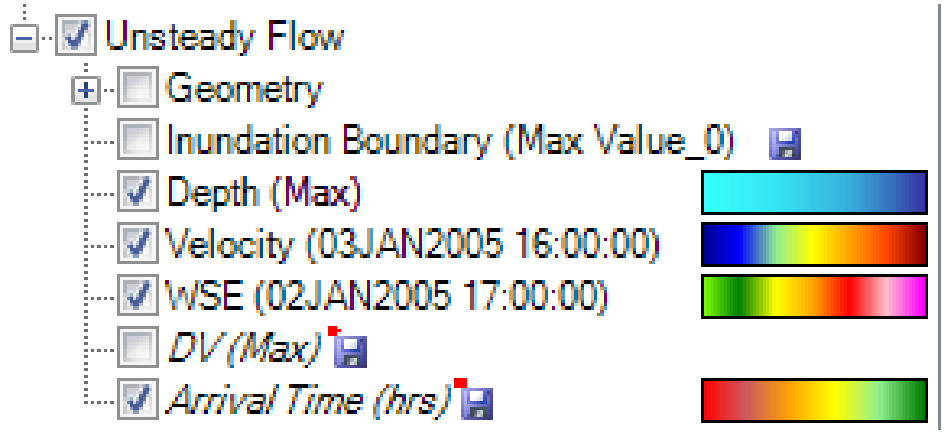
Animation Controls



Animation: Dynamic Mapping Example

Map Types: Dynamic vs Stored

- Dynamic: Computed On-The-Fly
  - Animation of results without waiting
  - Smooth: Computes to screen-resolution
  - Doesn't use disk space
- Stored: Computed to Terrain Resolution
  - Stored to disk
  - These maps can be exported and shared
  - Faster rendering for slow map types



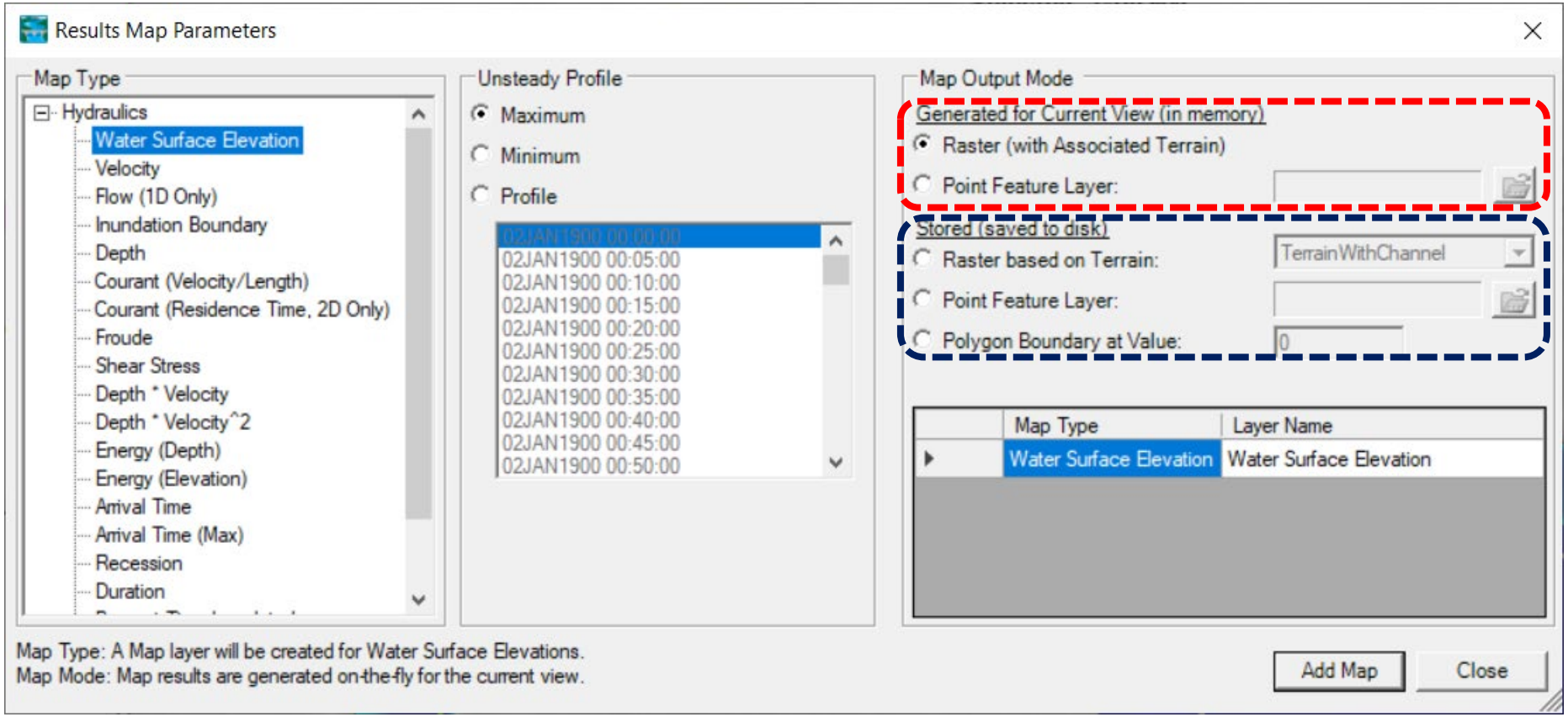
* = *There was a problem reading data*

Map Types: Dynamic vs Stored

Map Type

Profile/ Parameter

Output Mode



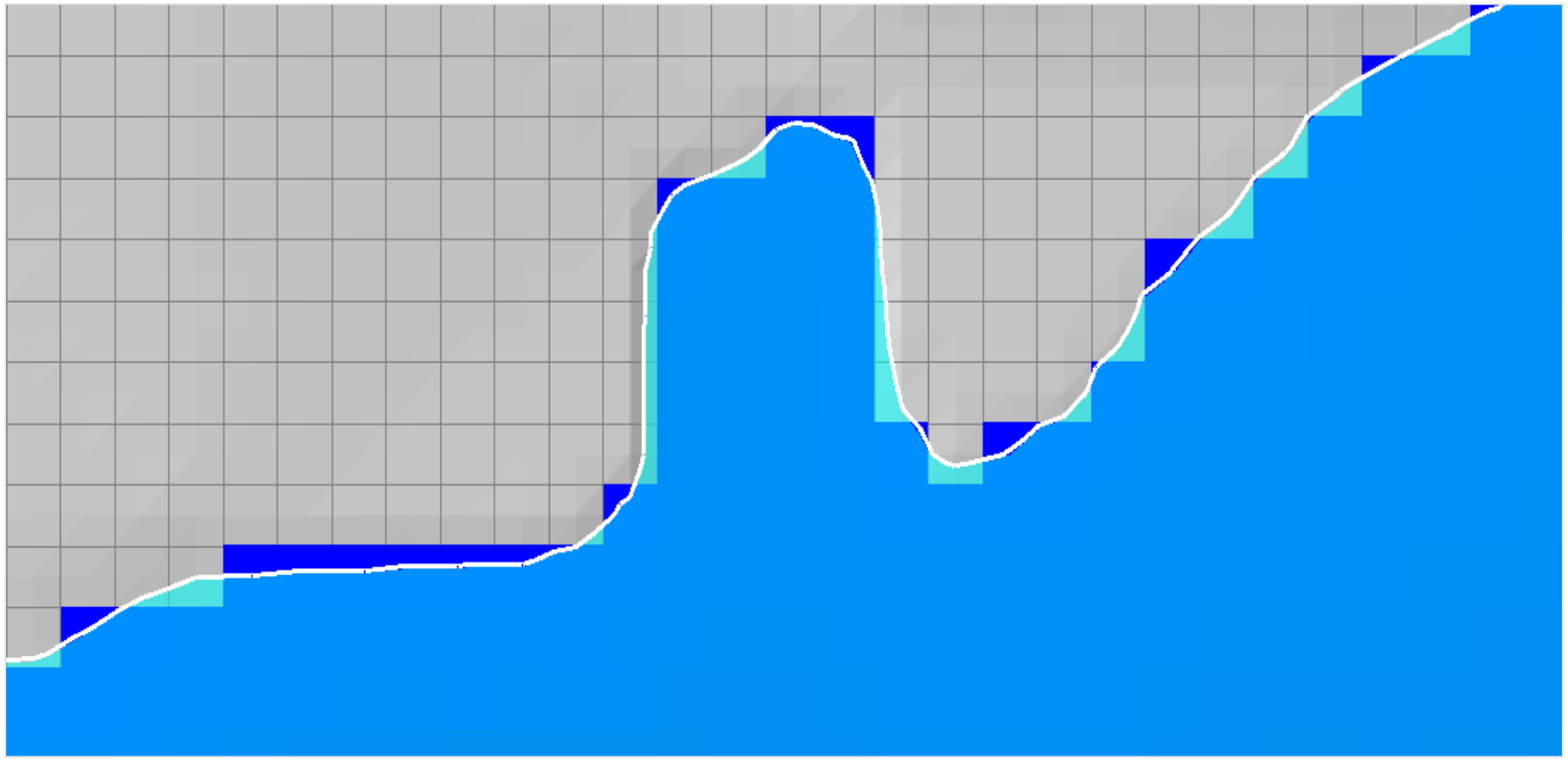
⇦ Dynamic Maps

⇦ Stored Maps

Default maps: Depth, Water Surface Elevation, Velocity ⇦ Default Maps are Dynamic Maps

Map Types: Dynamic vs Stored

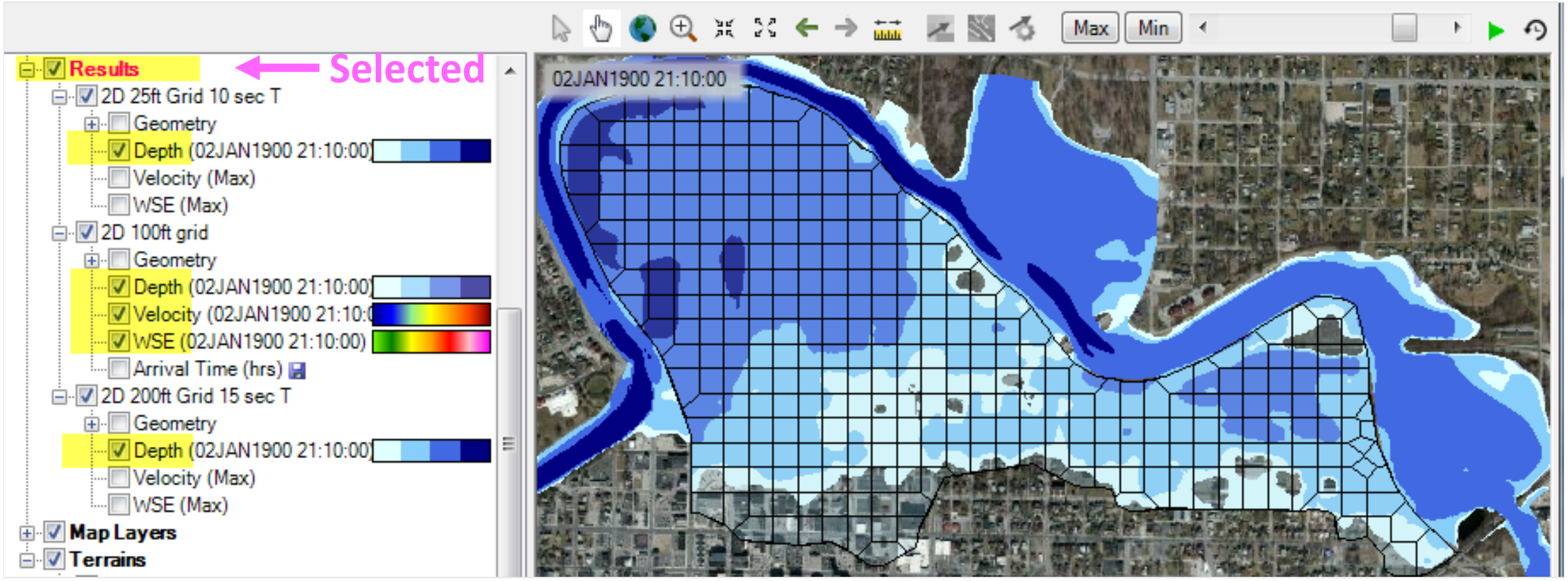
- Dynamic results plot values for the current pyramid level. Boundaries are defined based on interpolation.
- Stored results have a single value per cell.



Map Types: Dynamic Maps

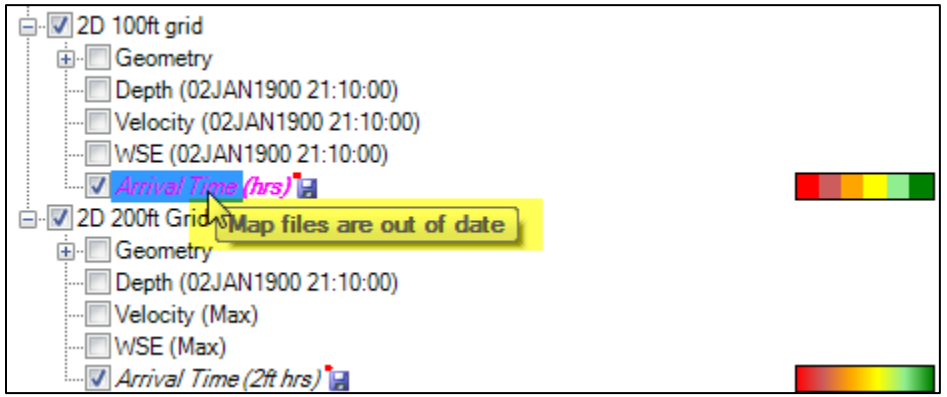
Animation Toolbar works on a selected layer

… or group layers and sync the timestep



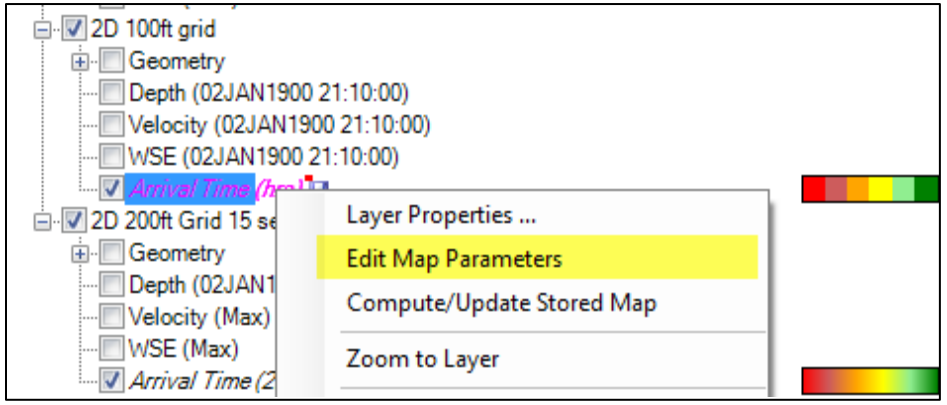
Map Types: Stored Maps

- Map status message on cursor tool tip

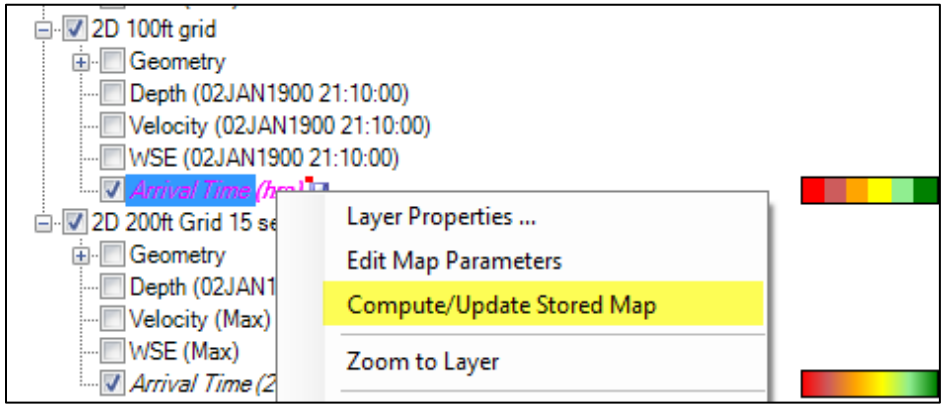


Right-click options:

- Edit Map Parameters

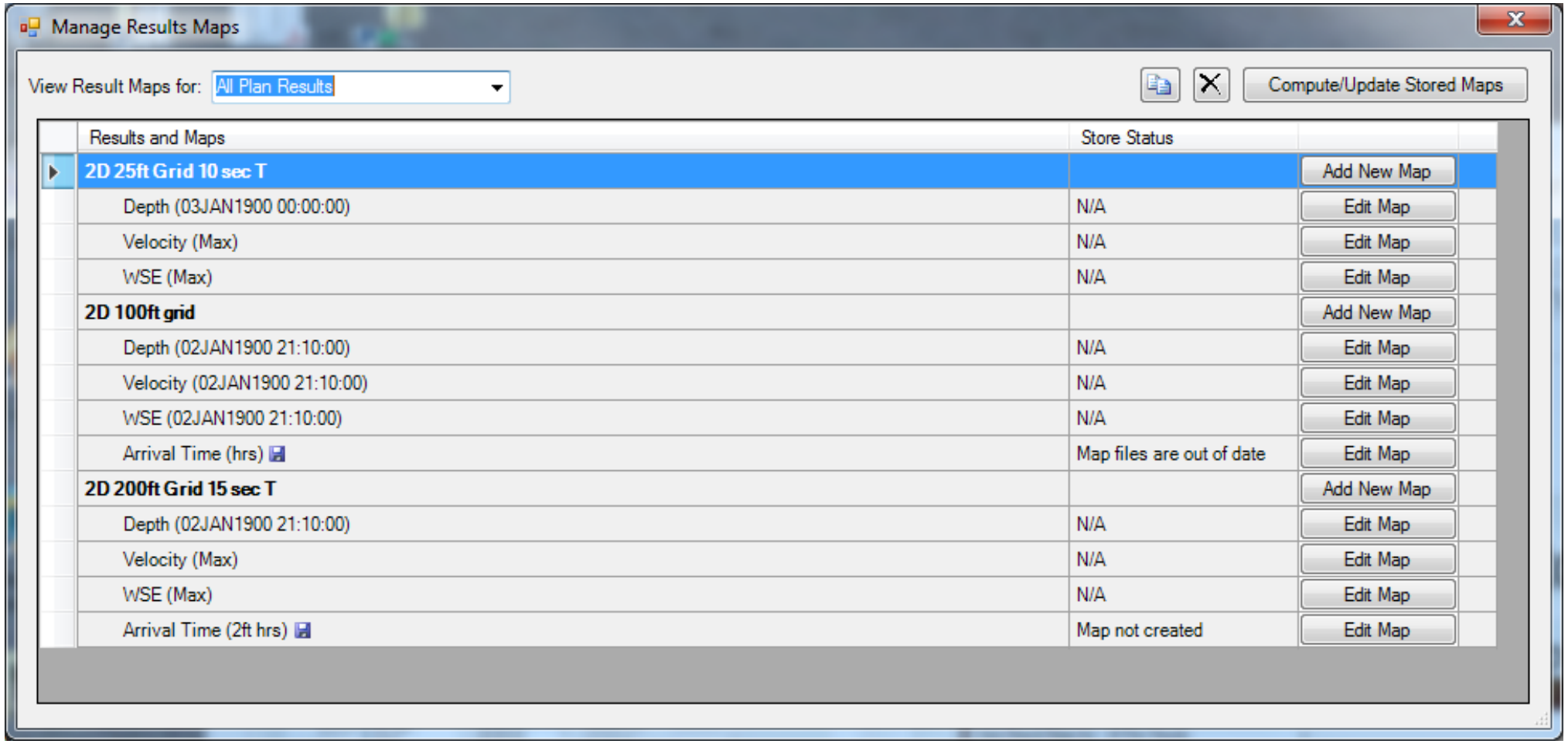


- Compute Map



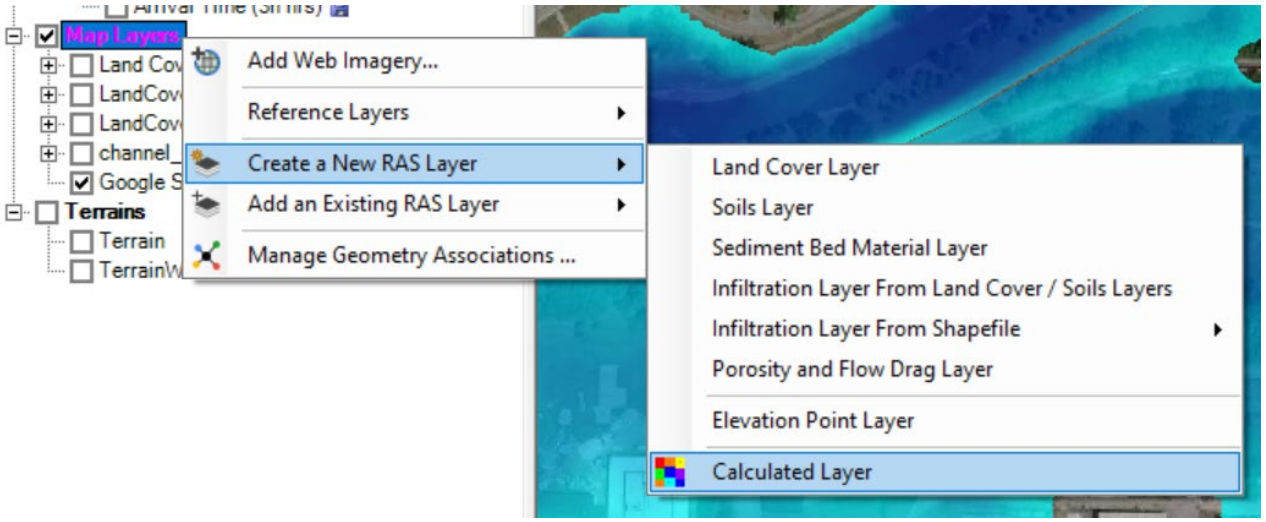
* = *There was a problem reading data*

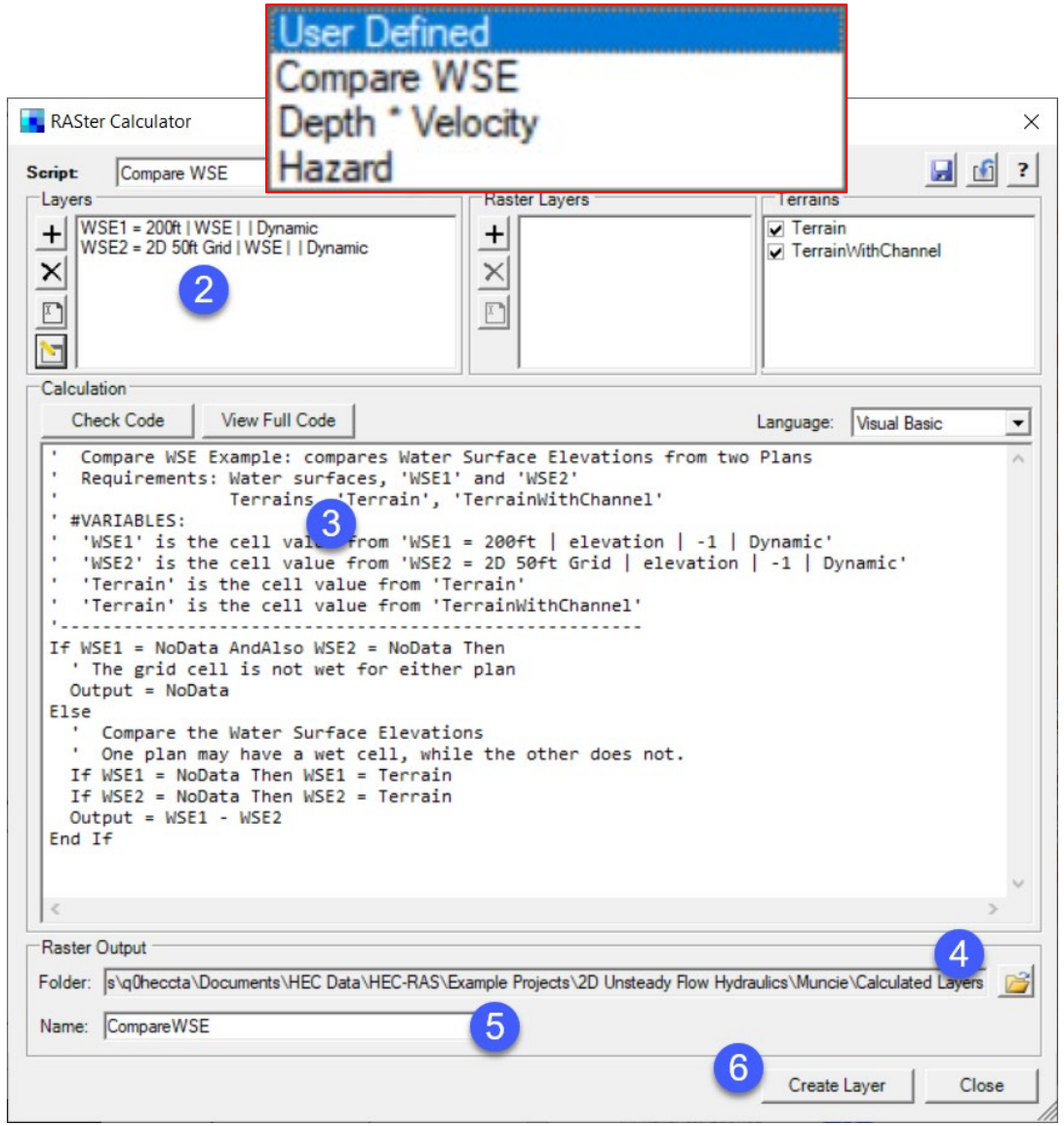
Map Types: Manage Results Maps



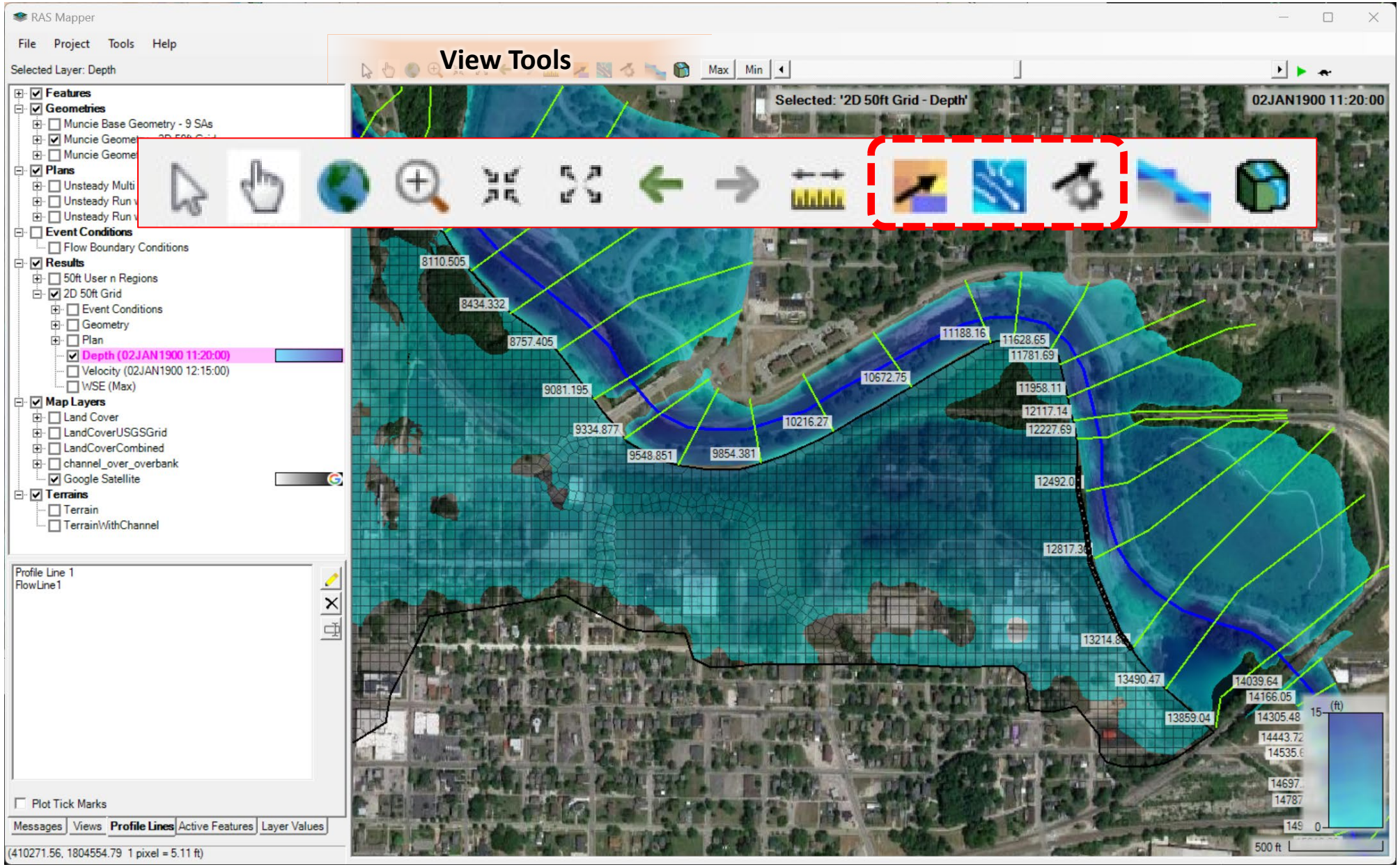
Calculated Layer: User Defined Dynamic or Static

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





View Tools


RAS Mapper
File
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View Tools
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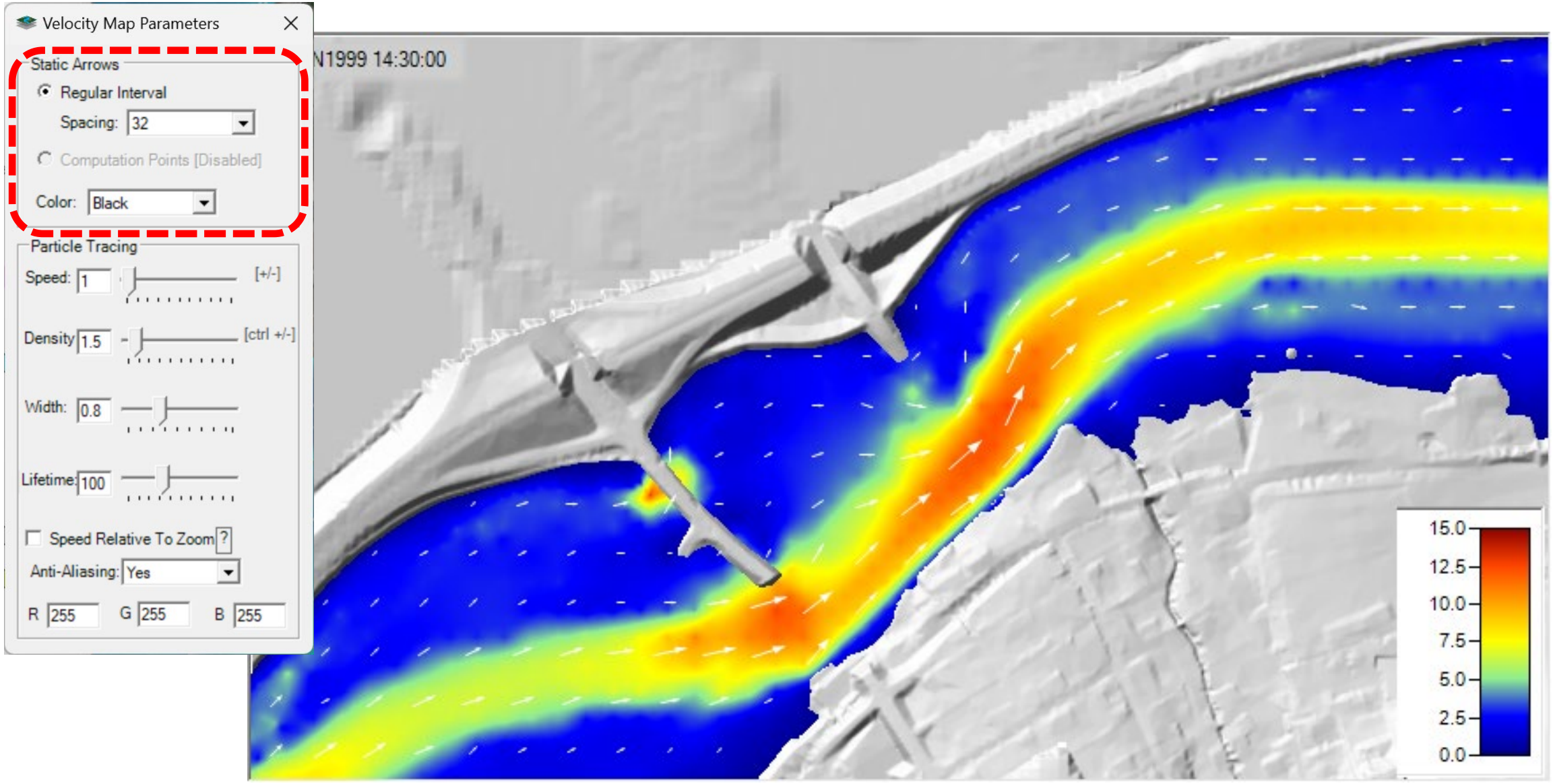
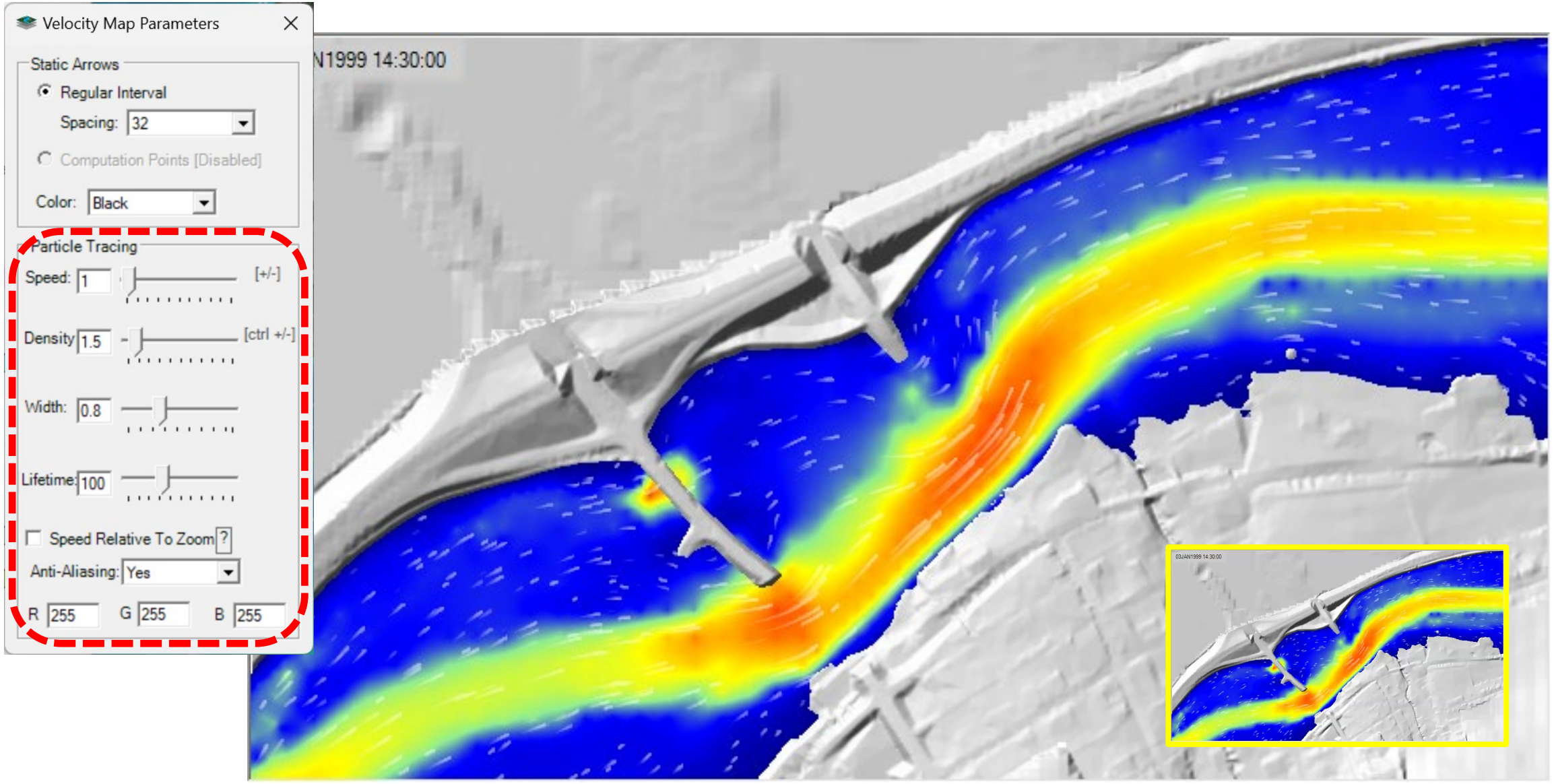
11781.69
11958.11
12117.14
12227.69
12492.0
13490.47
13859.04
14039.64
14166.05
14305.48
(ft)
500 ft

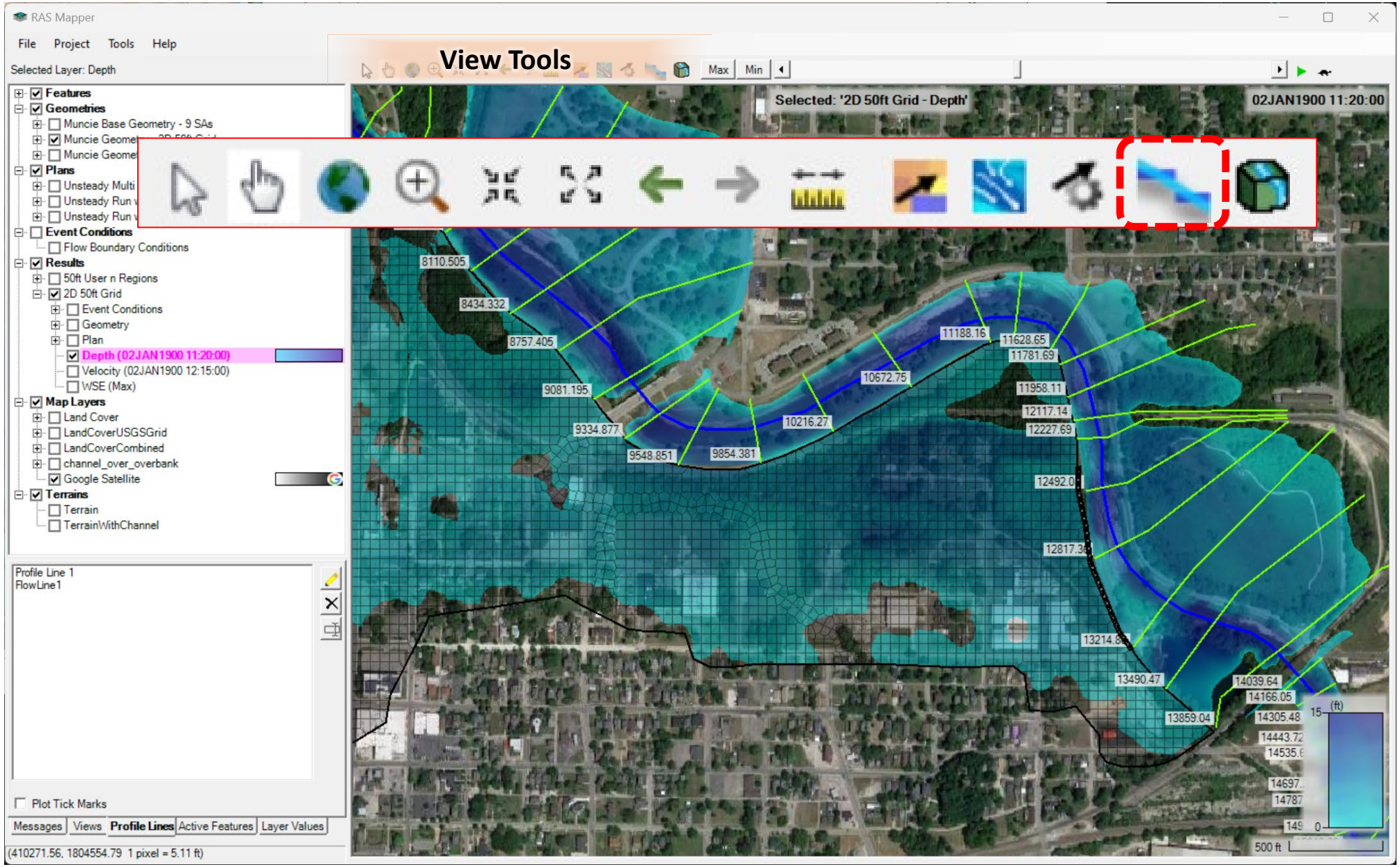
View Tools: Velocity Map Static Arrows



View Tools: Velocity Map Particle Tracing

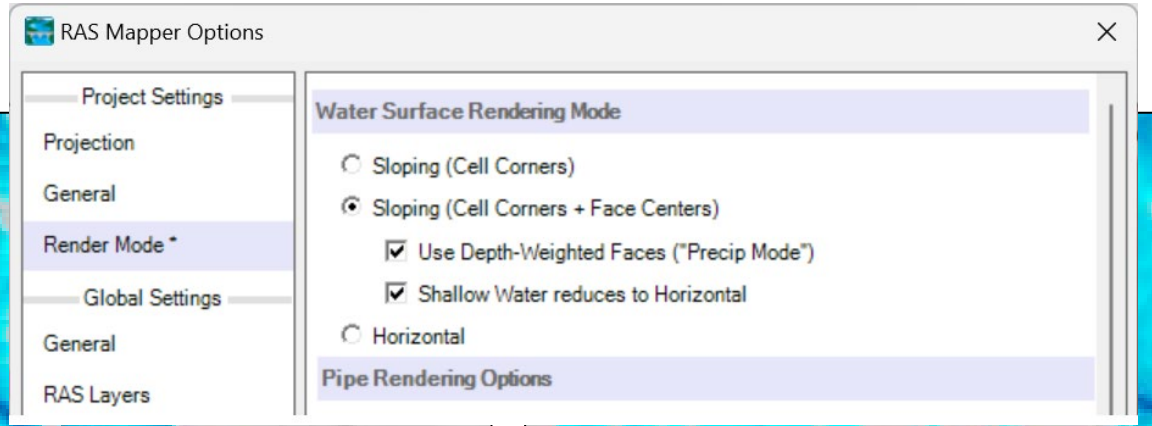


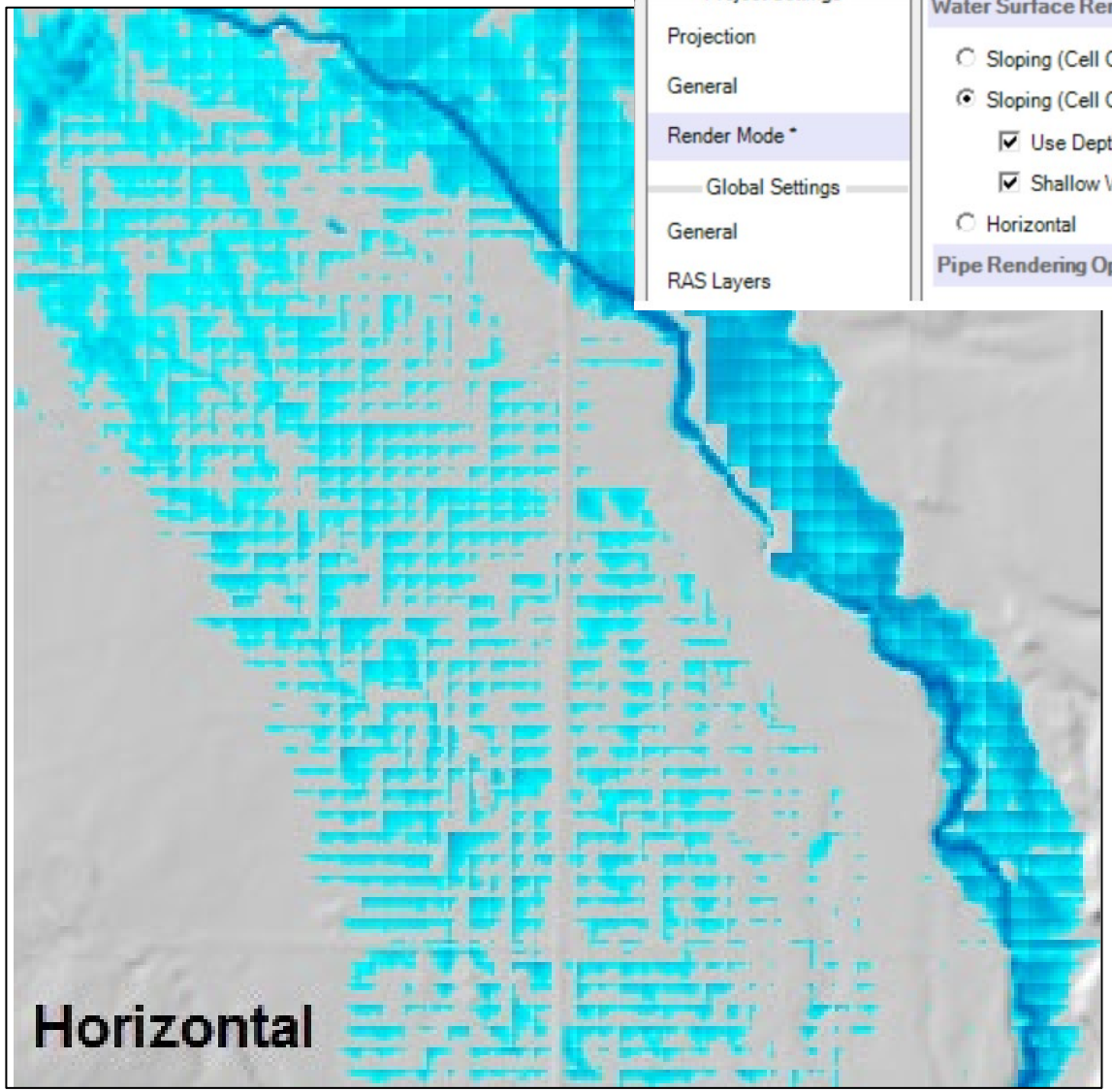
View Tools: Render Mode

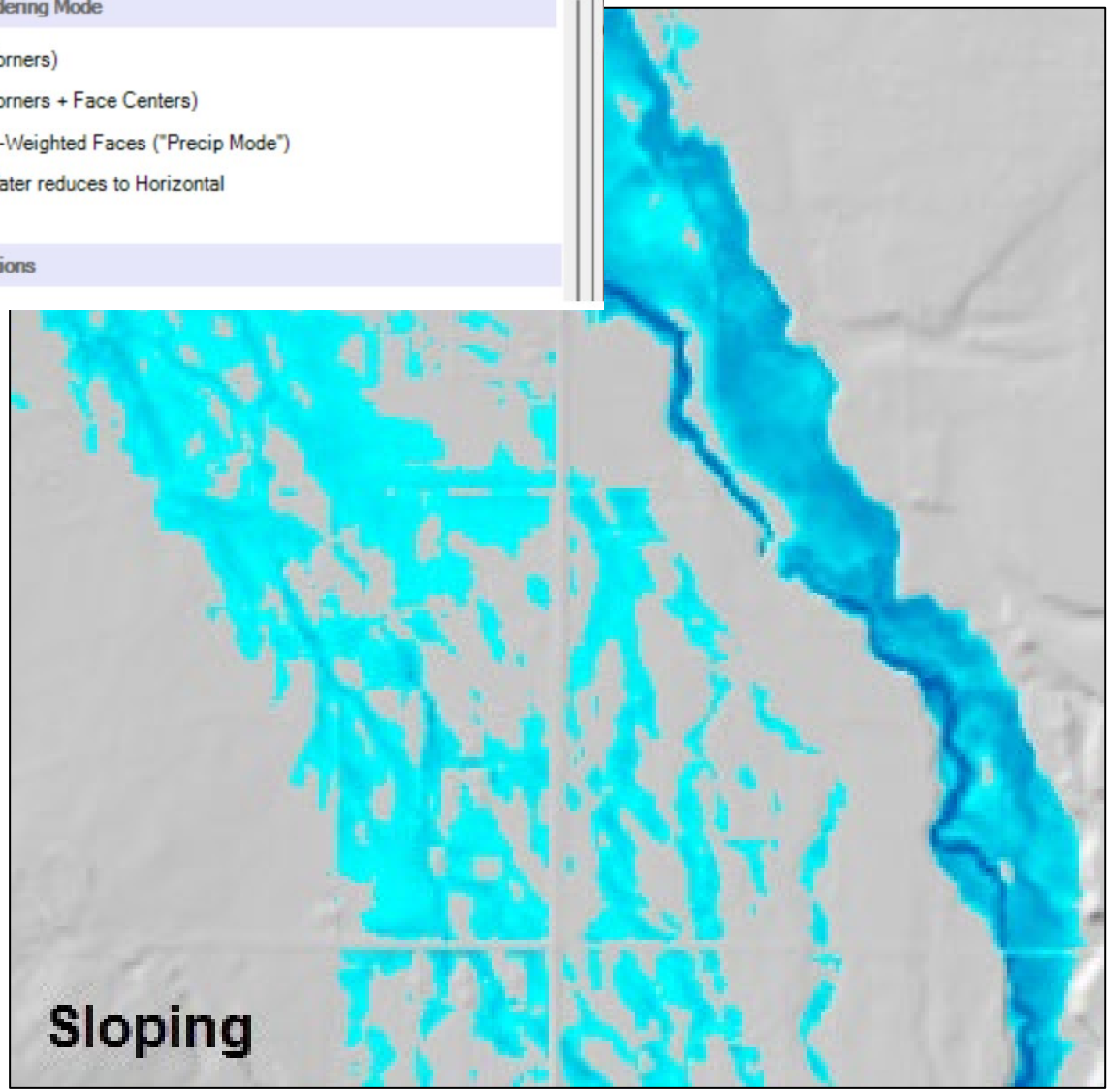


Render Mode: Options

Tools | Options



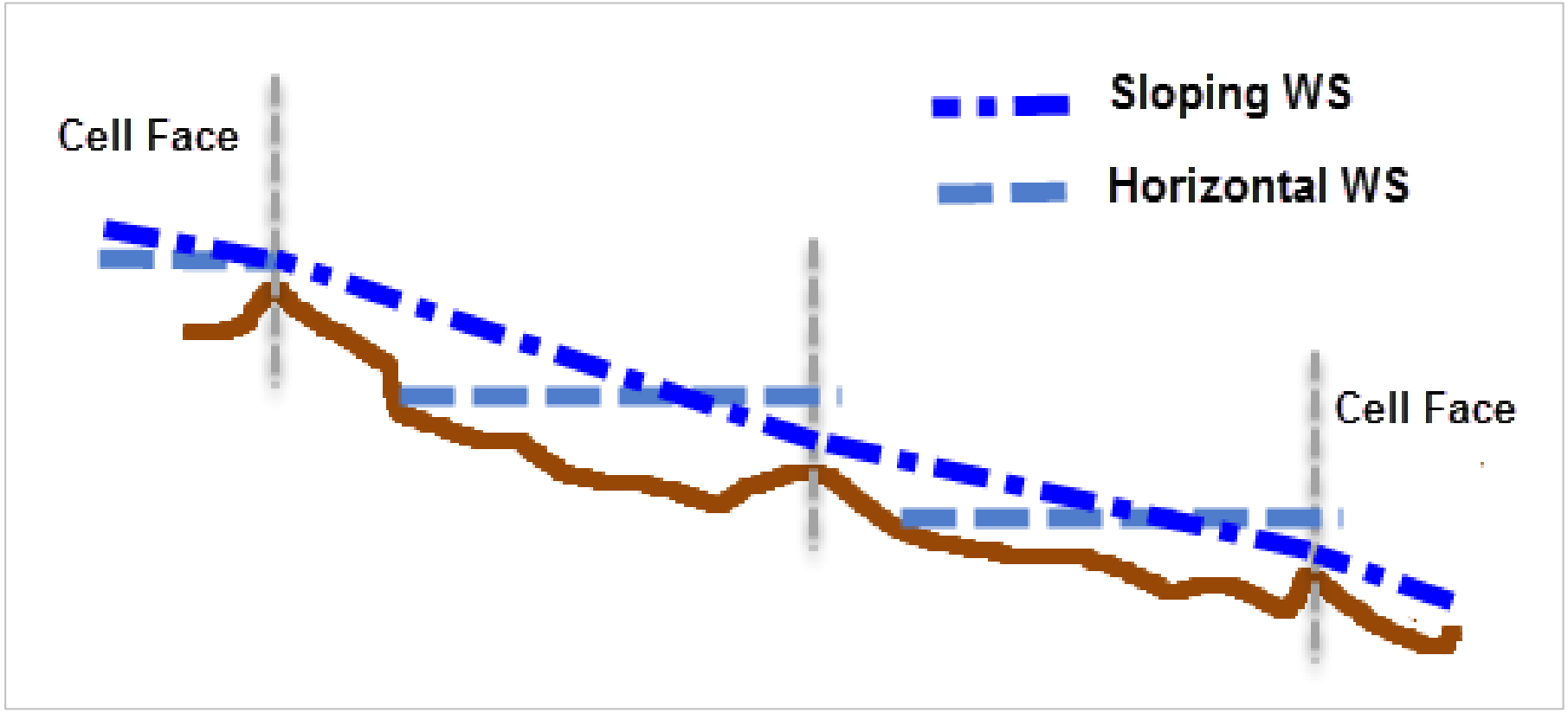




Render Mode: Results Interpolation

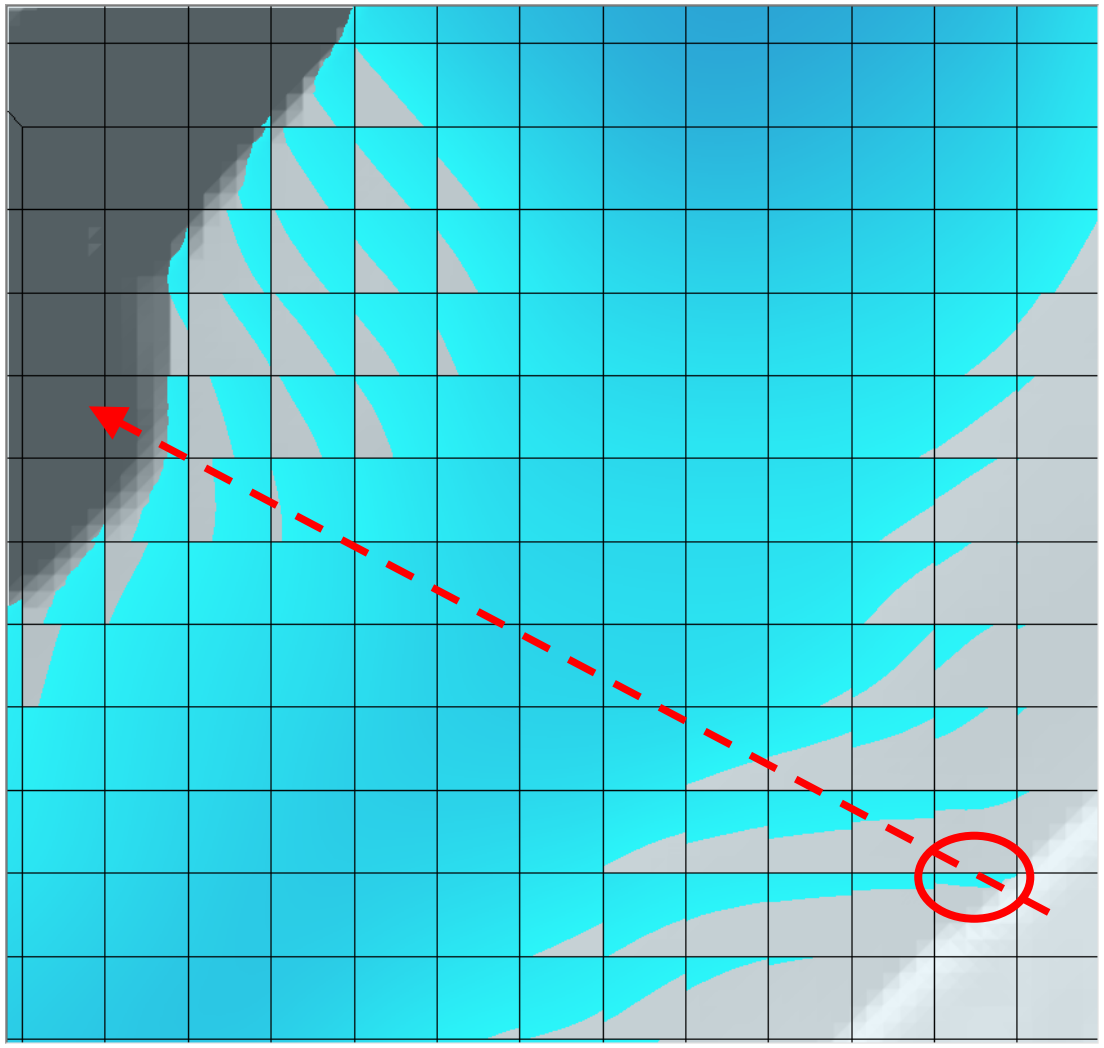
- Render mode options allow for plotting a single water surface elevation per cell **or** interpolation of water surface elevation values
- Which method best represents the computation?

  Horizontal The compute engine only solves for one elevation per cell

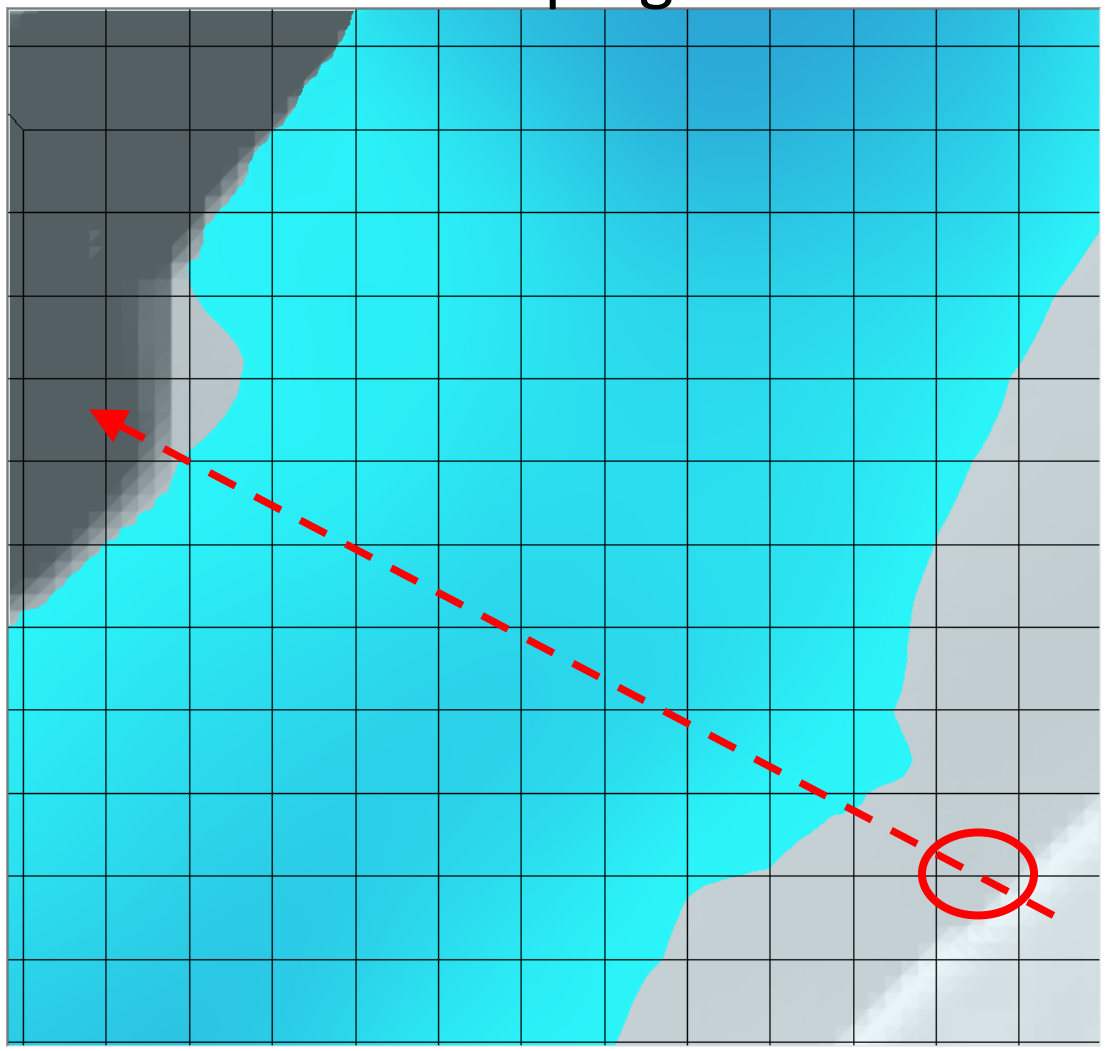


Render Mode: Sloping vs Horizontal Surface

Horizontal

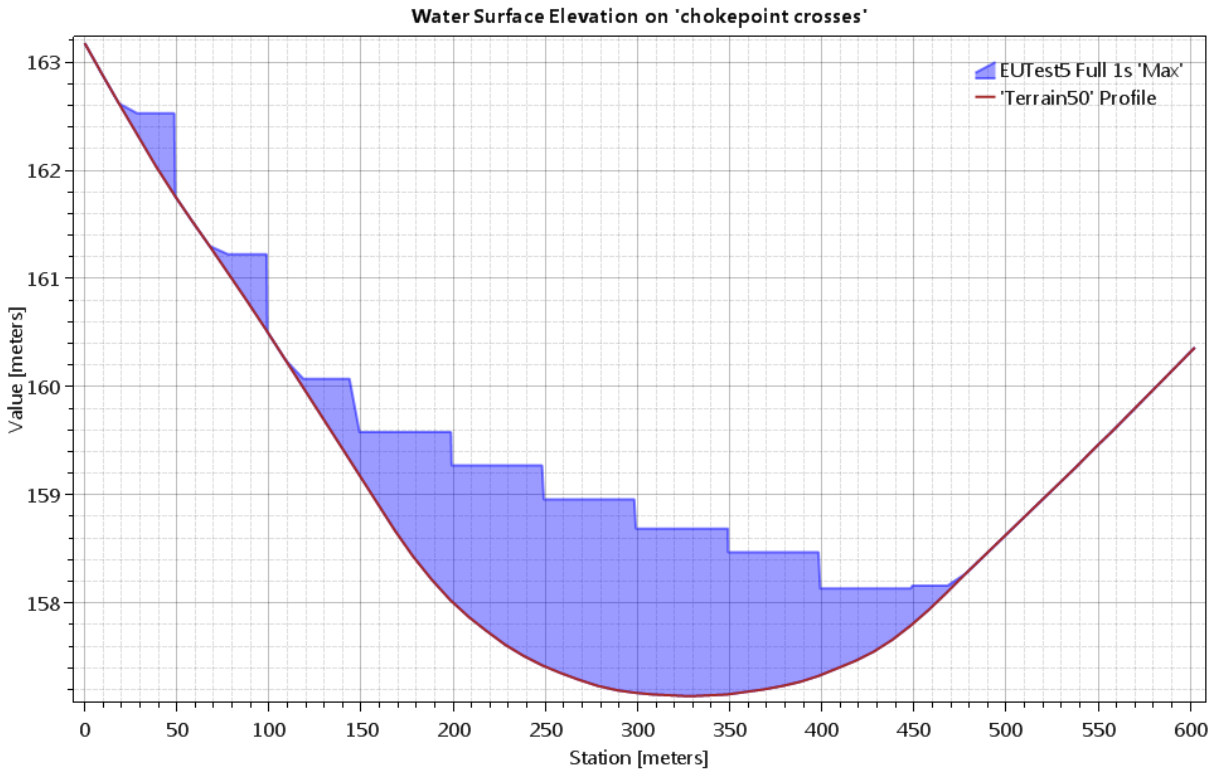


Sloping

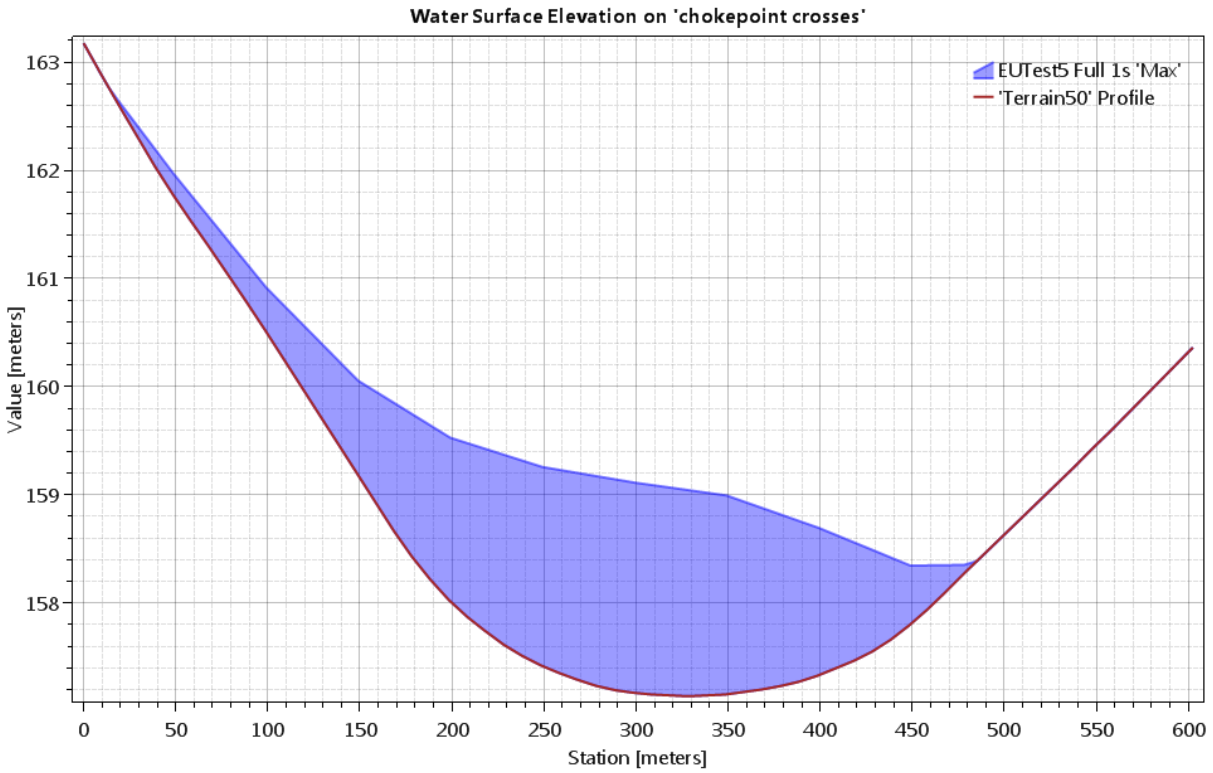


Render Mode: Sloping vs Horizontal Surface

Horizontal

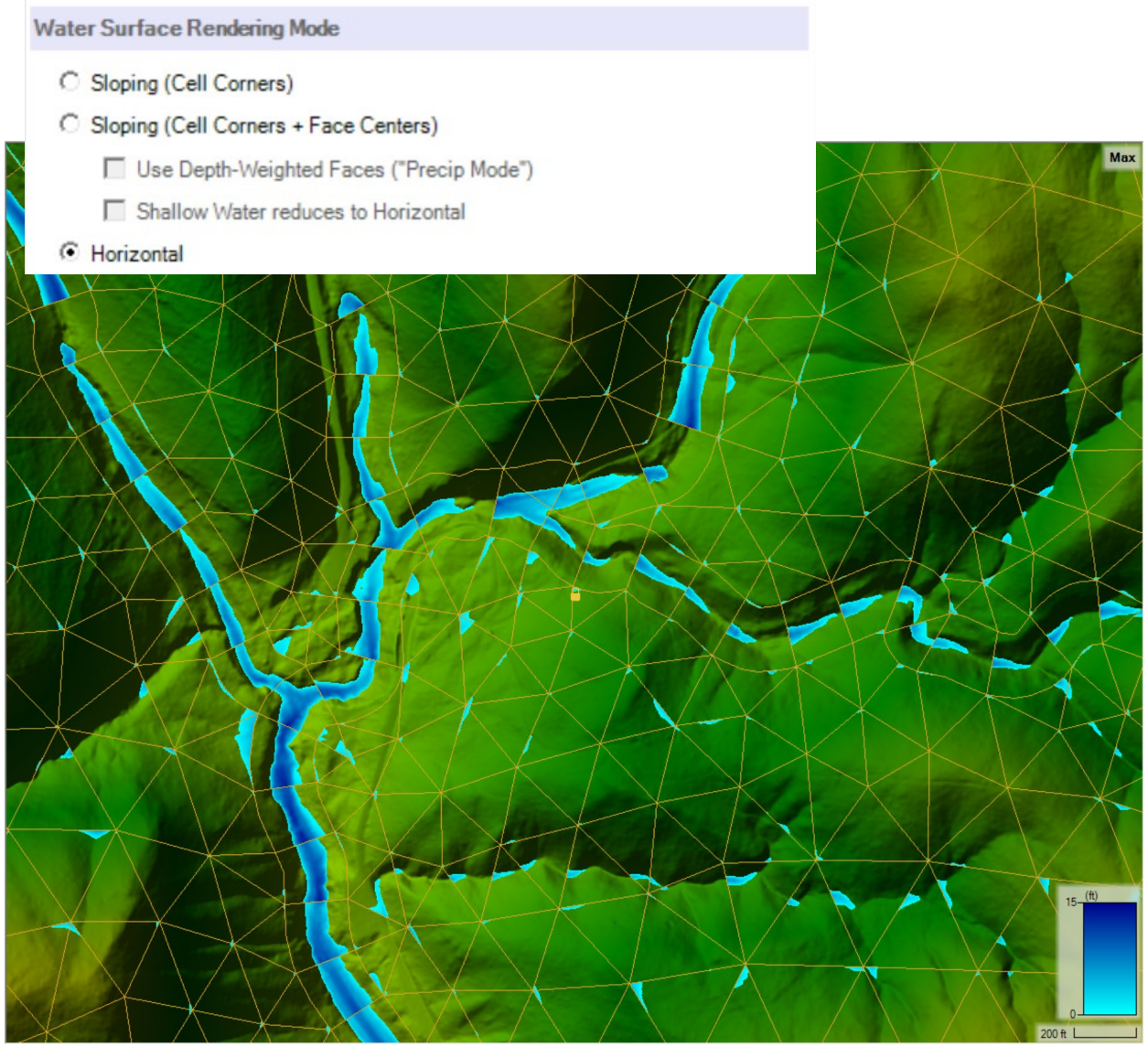


Sloping

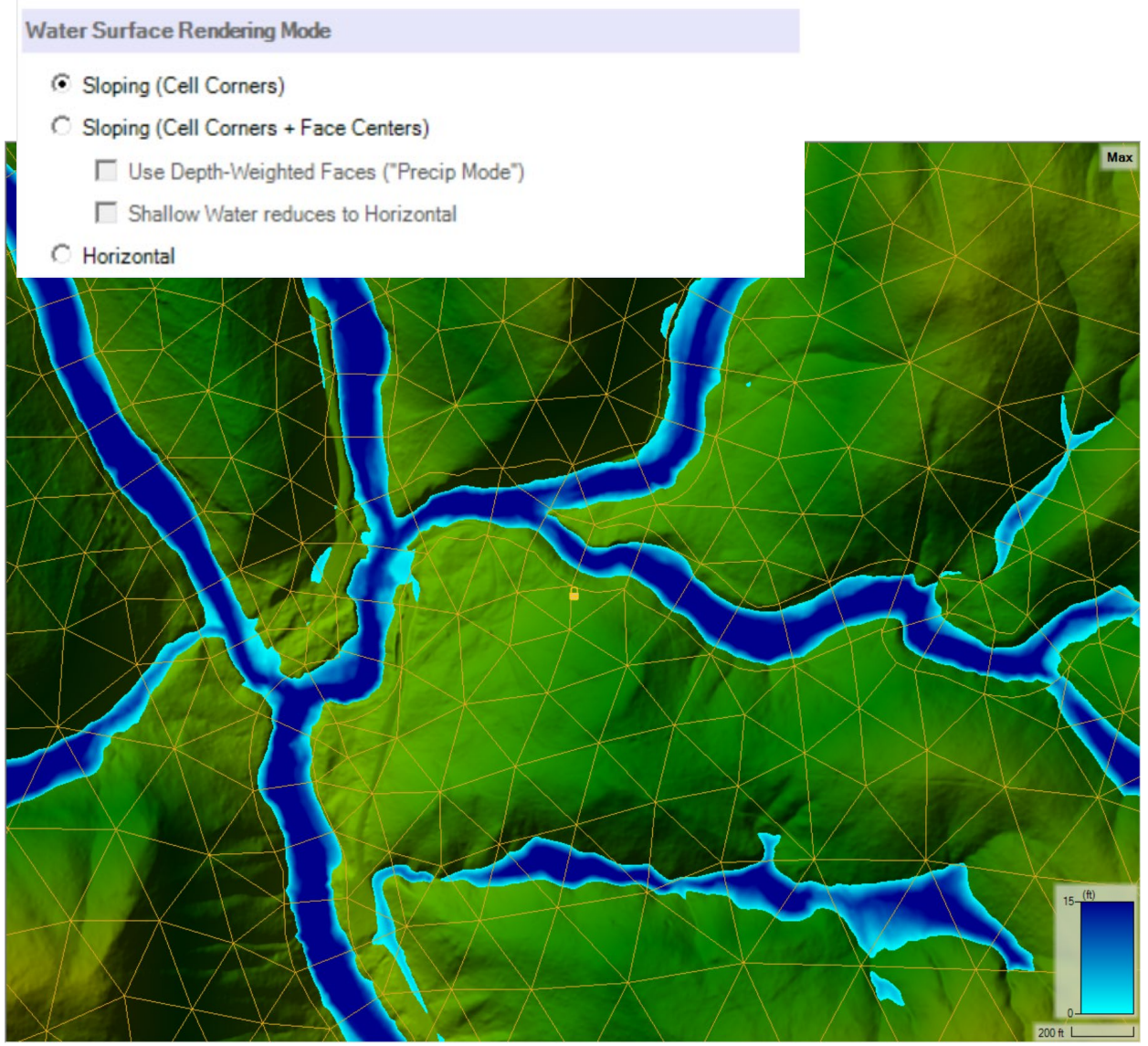


Render Mode: Sloping Surface Errors

Horizontal

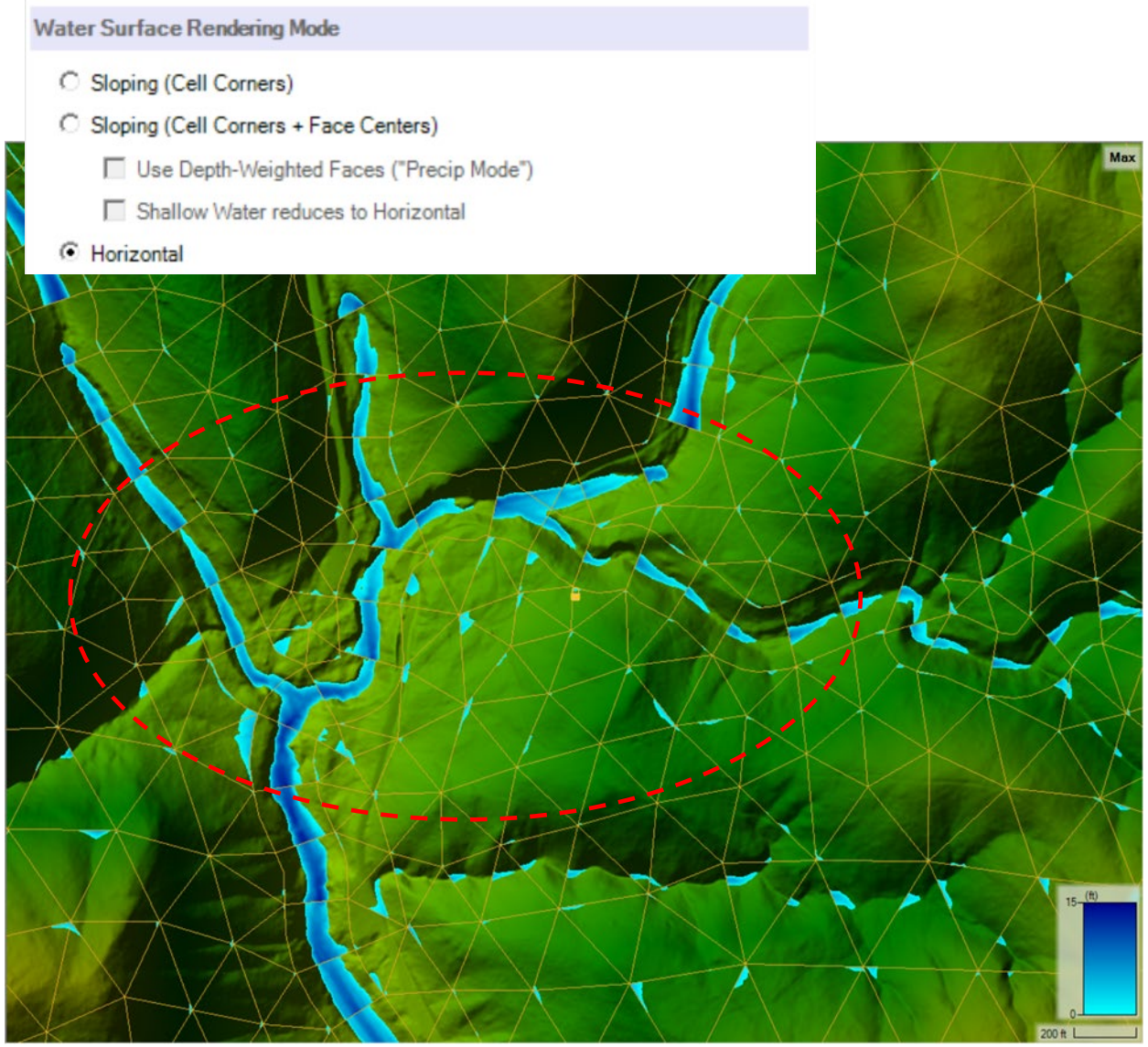


Sloping Basic



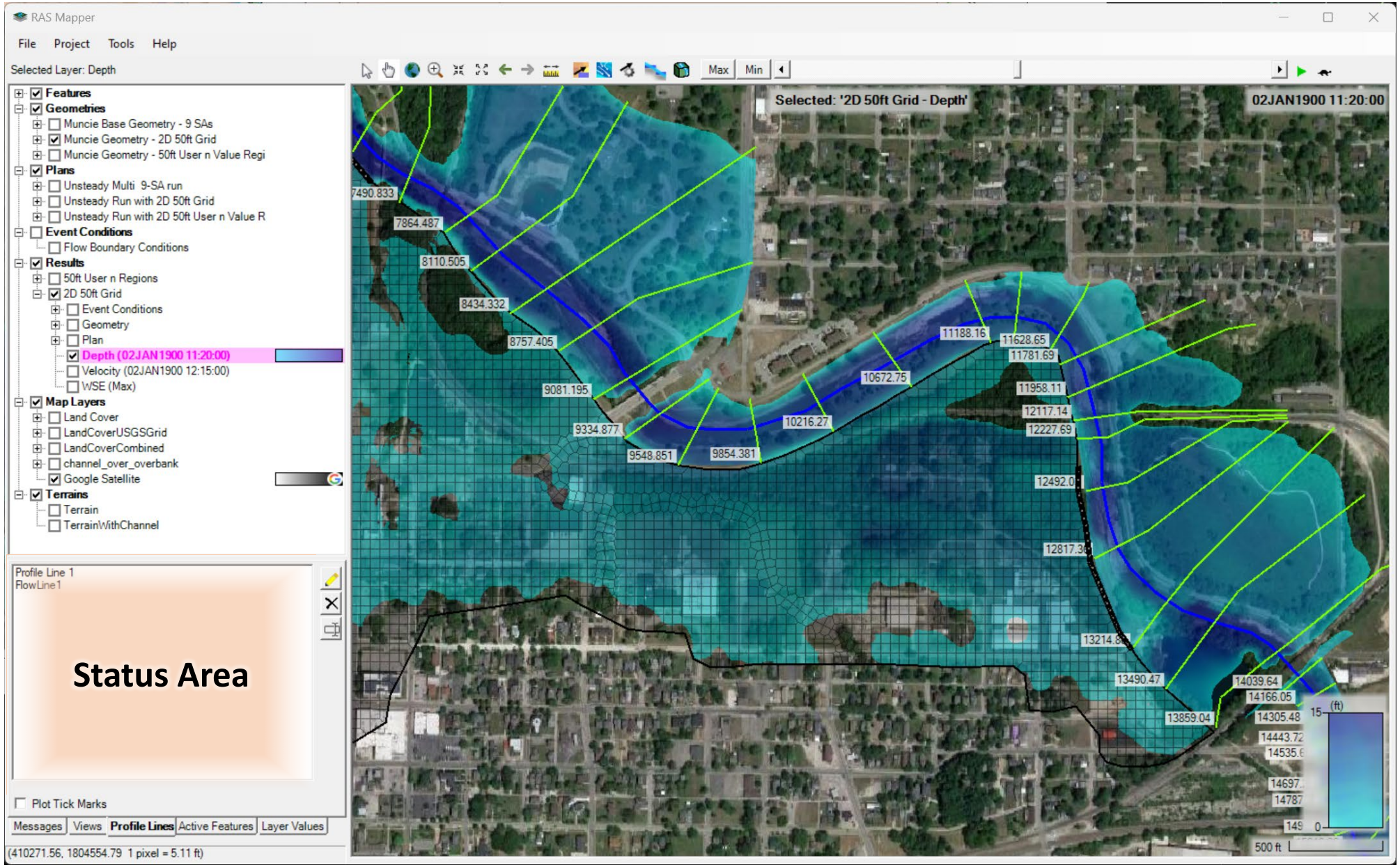
Render Mode: Sloping Surface Errors

Horizontal



Sloping Precip Mode

Status Area


RAS Mapper
File
Project
Tools
Help
Selected Layer: Depth
Features
Geometries
Muncie Base Geometry - 9 SAs
Muncie Geometry - 2D 50ft Grid
Muncie Geometry - 50ft User n Value Regi
Plans
Unsteady Multi 9-SA run
Unsteady Run with 2D 50ft Grid
Unsteady Run with 2D 50ft User n Value R
Event Conditions
Flow Boundary Conditions
Results
50ft User n Regions
2D 50ft Grid
Event Conditions
Geometry
Plan
Depth (02JAN1900 11:20:00)
Velocity (02JAN1900 12:15:00)
WSE (Max)
Map Layers
Land Cover
LandCoverUSGSGrid
LandCoverCombined
channel_over_overbank
Google Satellite
Terrains
Terrain
TerrainWithChannel
Profile Line 1
FlowLine1
Status Area
Plot Tick Marks
Messages
Views
Profile Lines
Active Features
Layer Values
(410271.56, 1804554.79 1 pixel = 5.11 ft)
Max
Min
Selected: '2D 50ft Grid - Depth'
02JAN1900 11:20:00
7490.833
7864.487
8110.505
8434.332
8757.405
9081.195
9334.877
9548.851
9854.381
10216.27
10672.75
11188.16
11628.65
11781.69
11958.11
12117.14
12227.69
12492.0
13490.47
13859.04
14039.64
14166.05
14305.48
(ft)
500 ft

Status Area Tabs

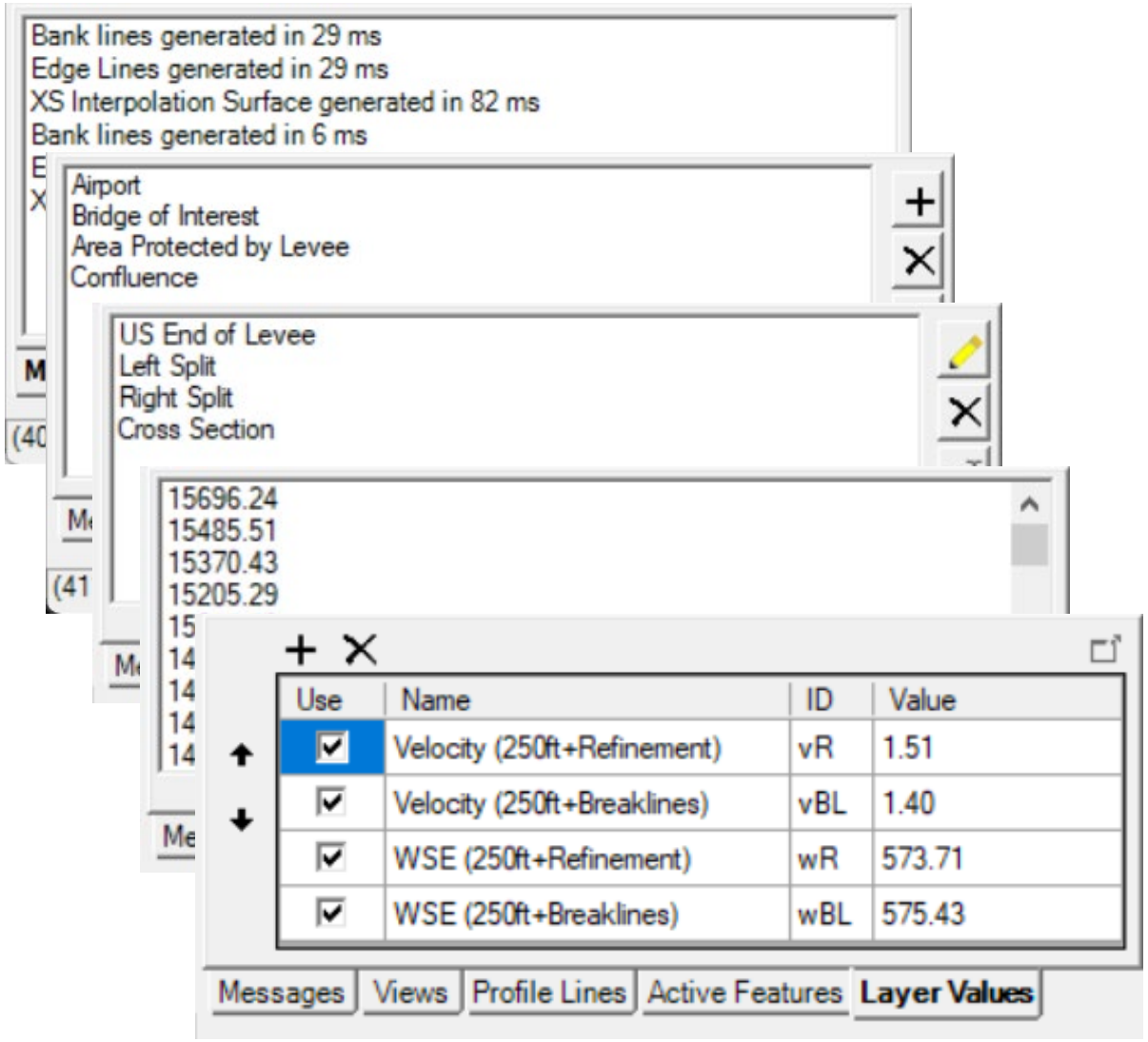
Messages: What just happened

Views: Quickly zoom to predefined areas

Profile Lines: Access results at specific locations

Active Features: Quick access to features in layer

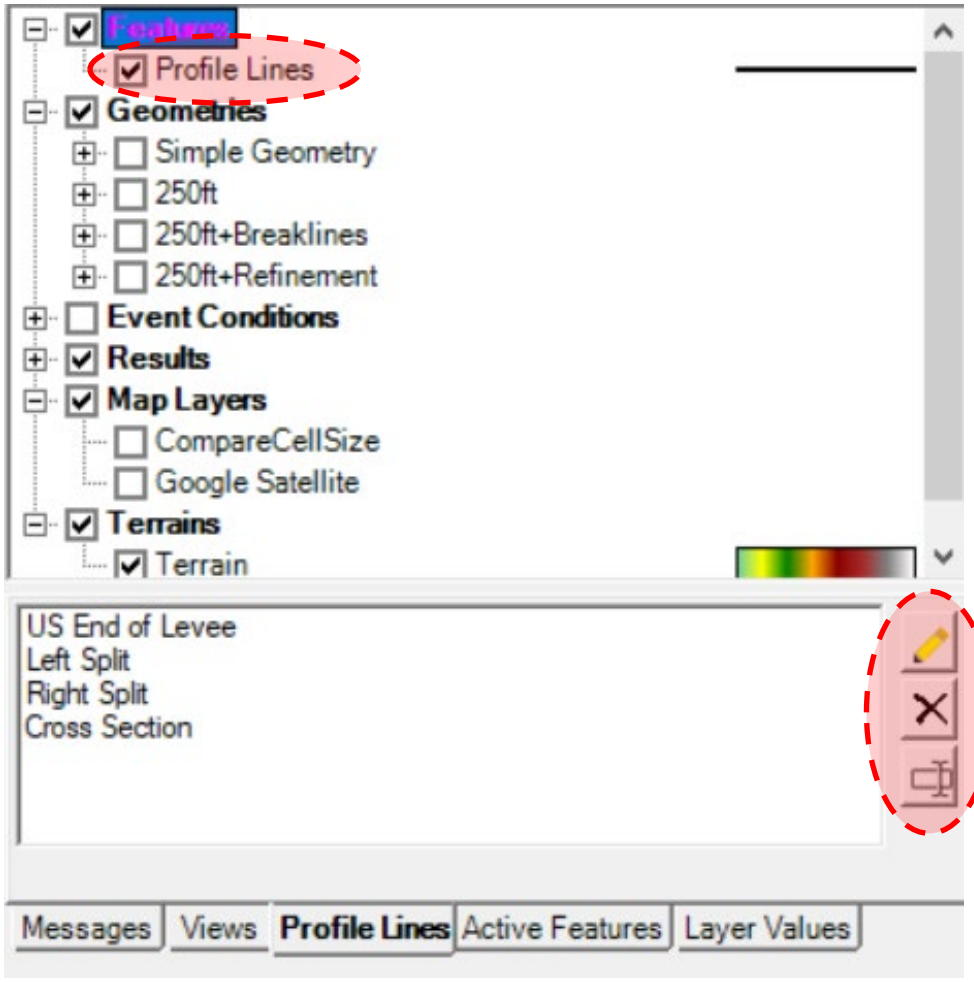
Layer Values: Watch values for multiple results

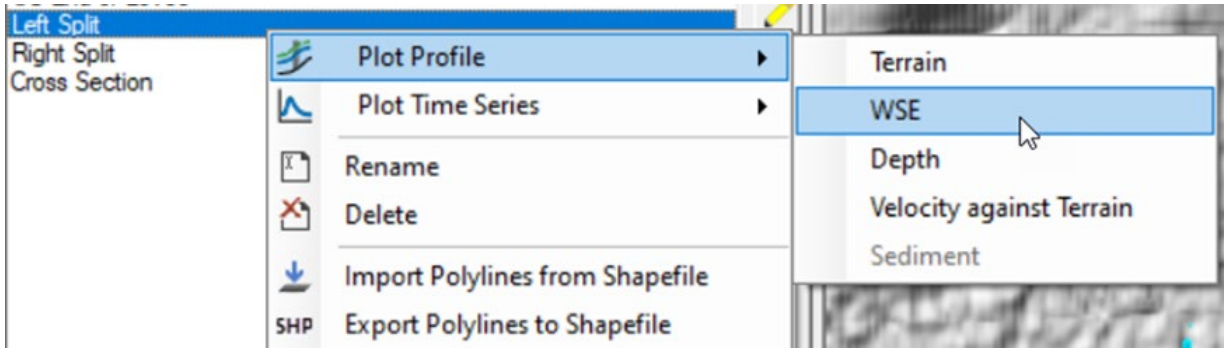


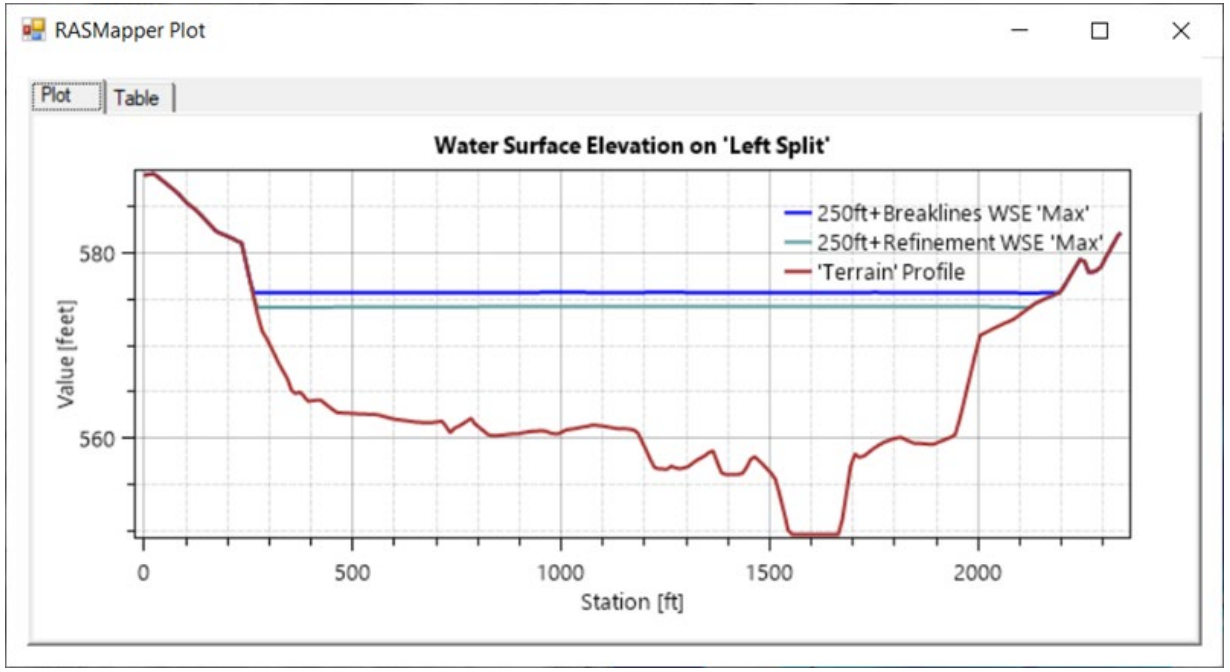
Status Area: Profile Lines

User-defined/editable linear features

2 plotting options, **Profiles** and **Time Series**



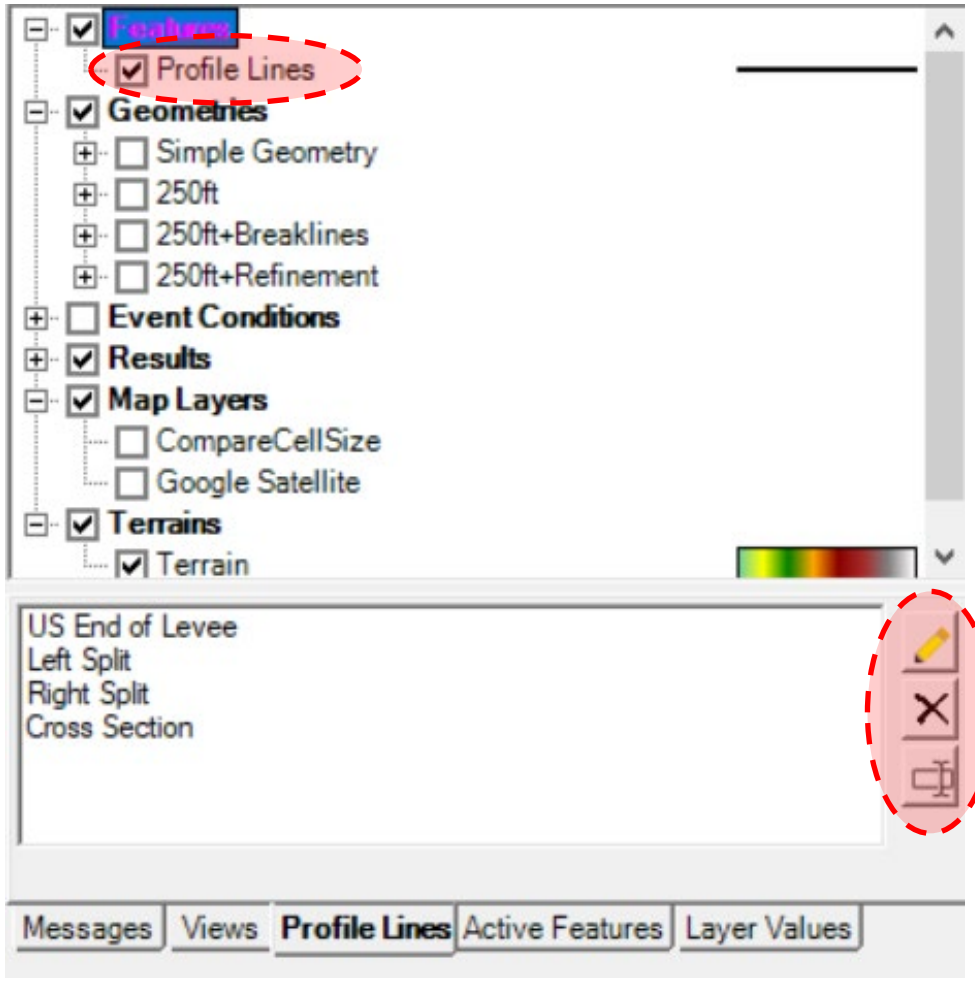


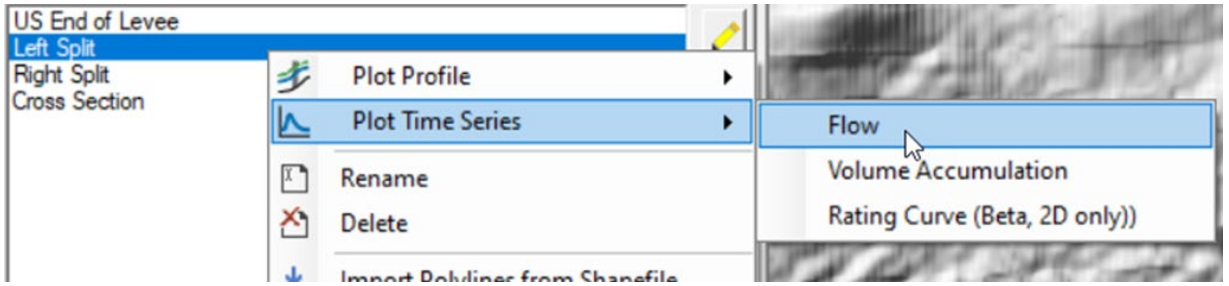


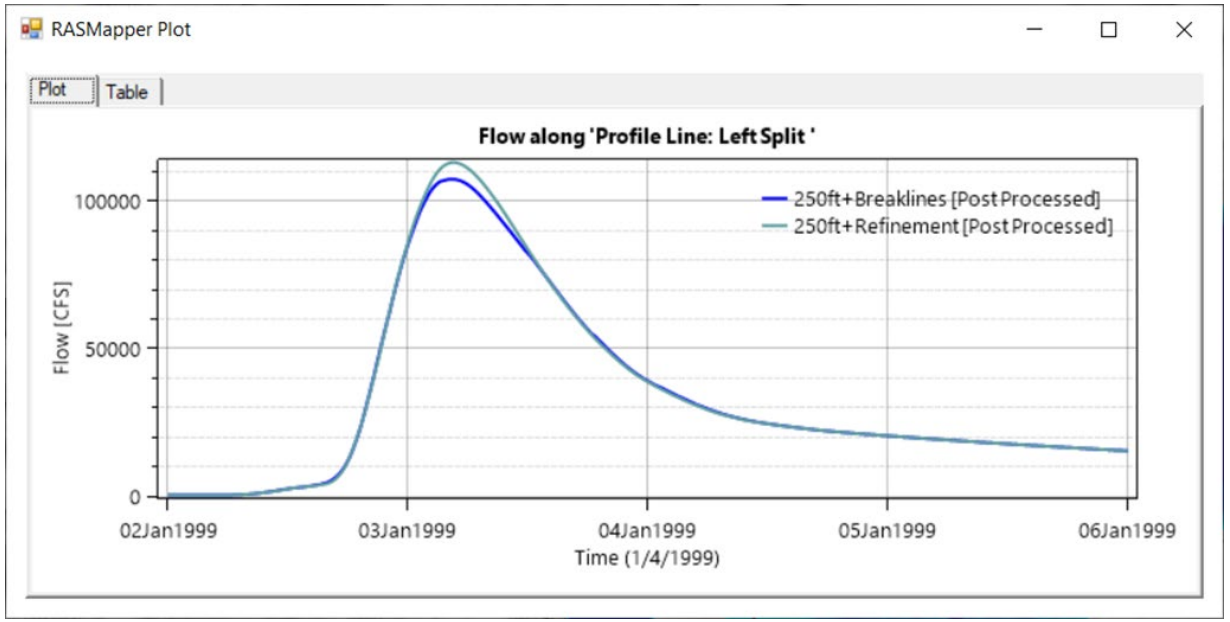
Status Area: Profile Lines

User-defined/editable linear features

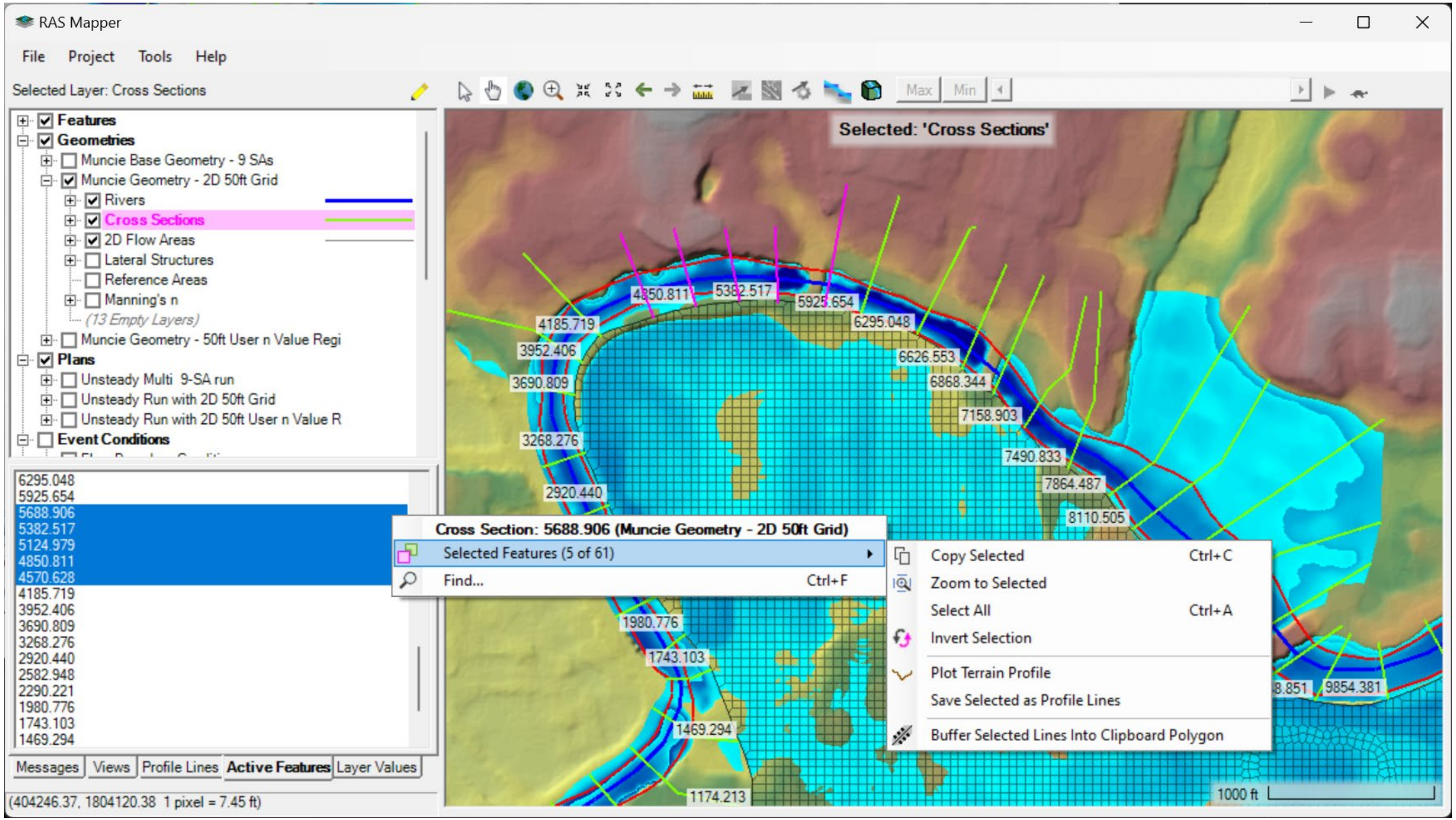
Direction of **flow** depends on how the profile line was drawn. Left to right, looking downstream is positive flow





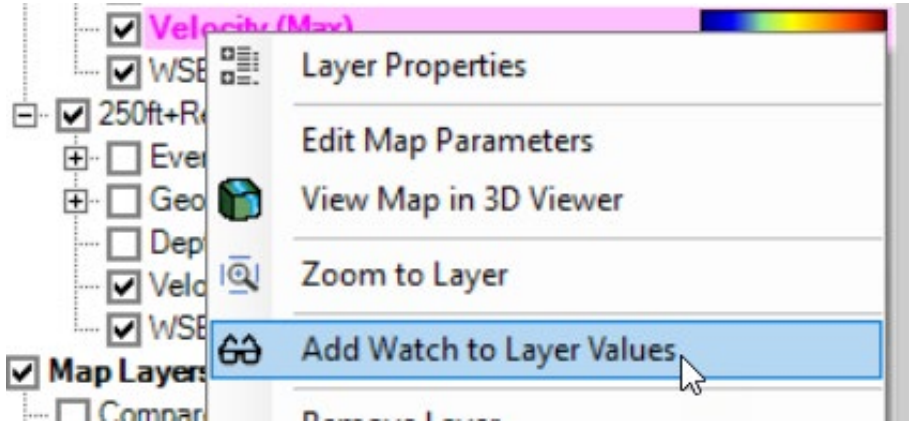


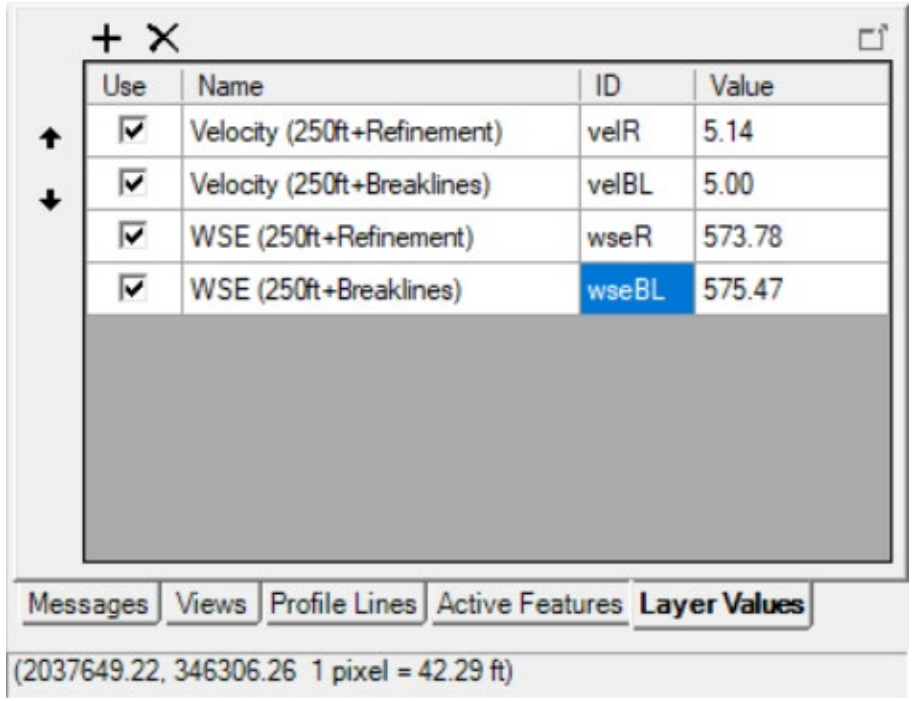
Status Area: Active Features

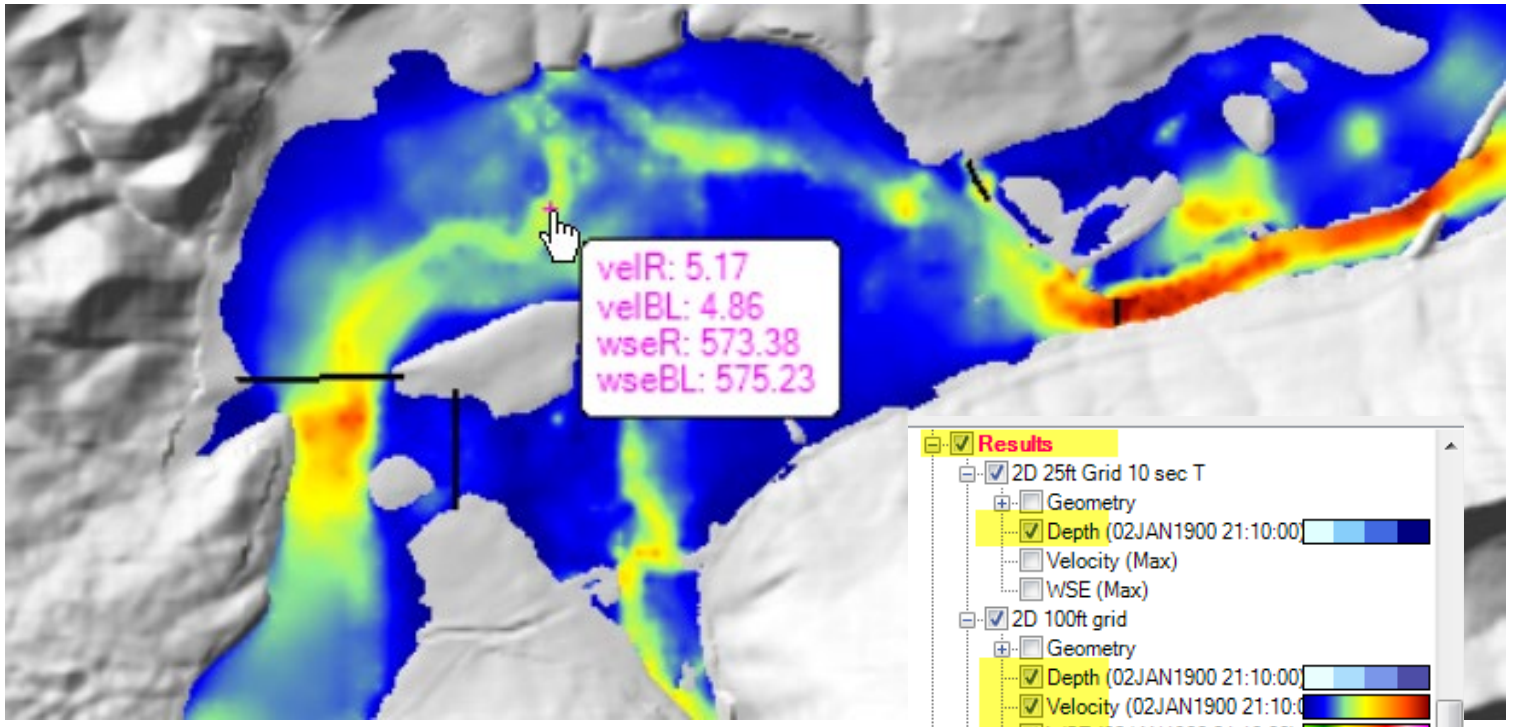


Status Area: Watch Layer Values

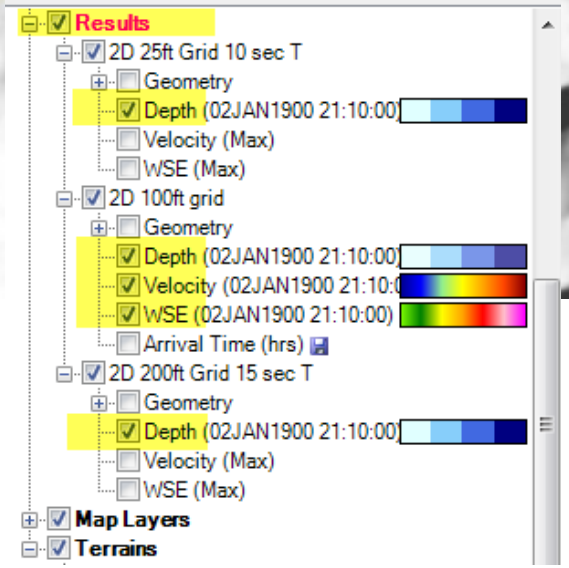
View Values from multiple layers simultaneously







Remember that you can sync datasets!



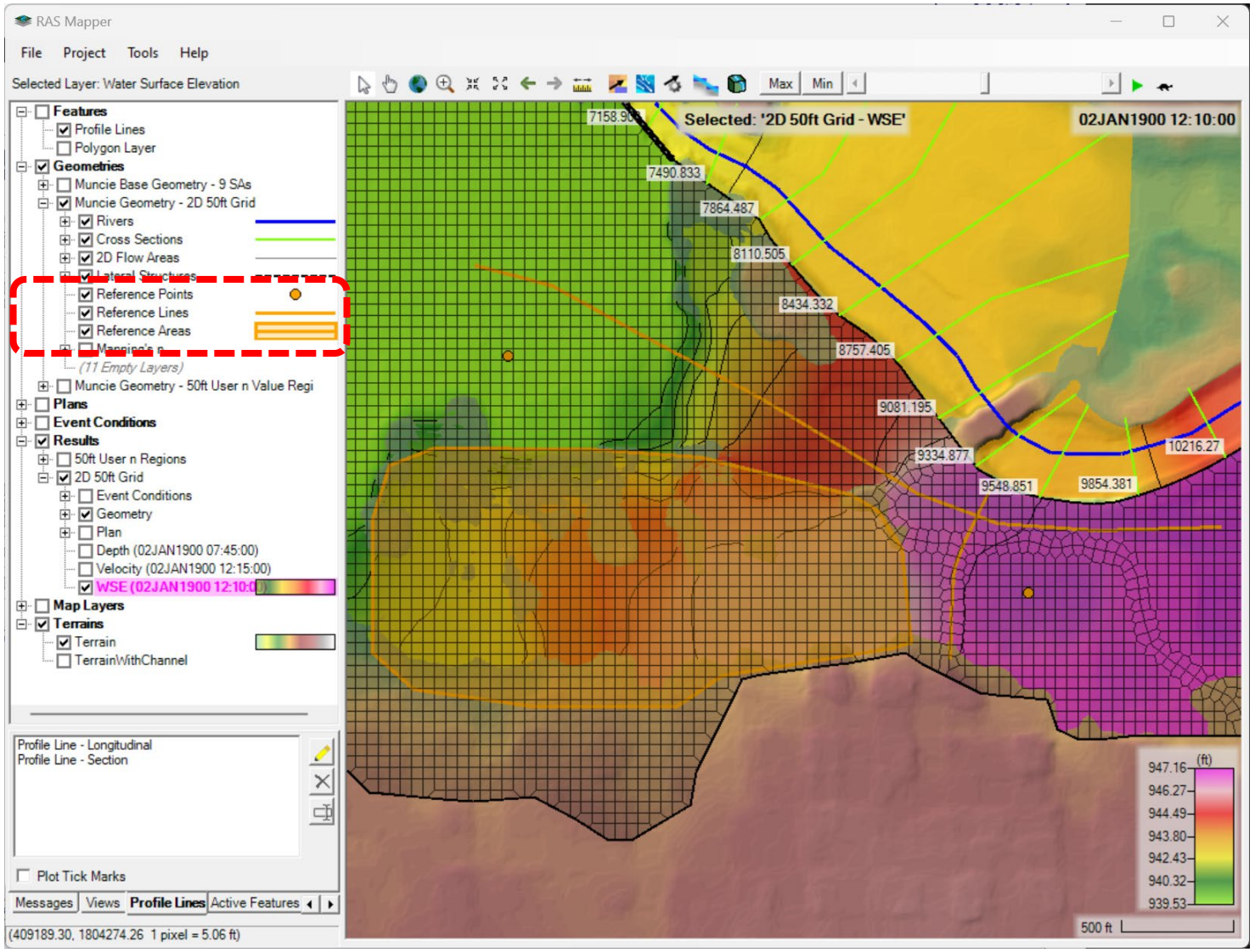
Profiles and Tabular Data

There are multiple ways to extract charts and tabular data from RAS

- Compute Engine Data (generally)
  - Reference Locations (points, lines and areas)
  - 2D Flow Area Queries (points, cells and cell faces)
- Rendered Data (generally)
  - Profile Lines
  - Polygon and Polyline Features

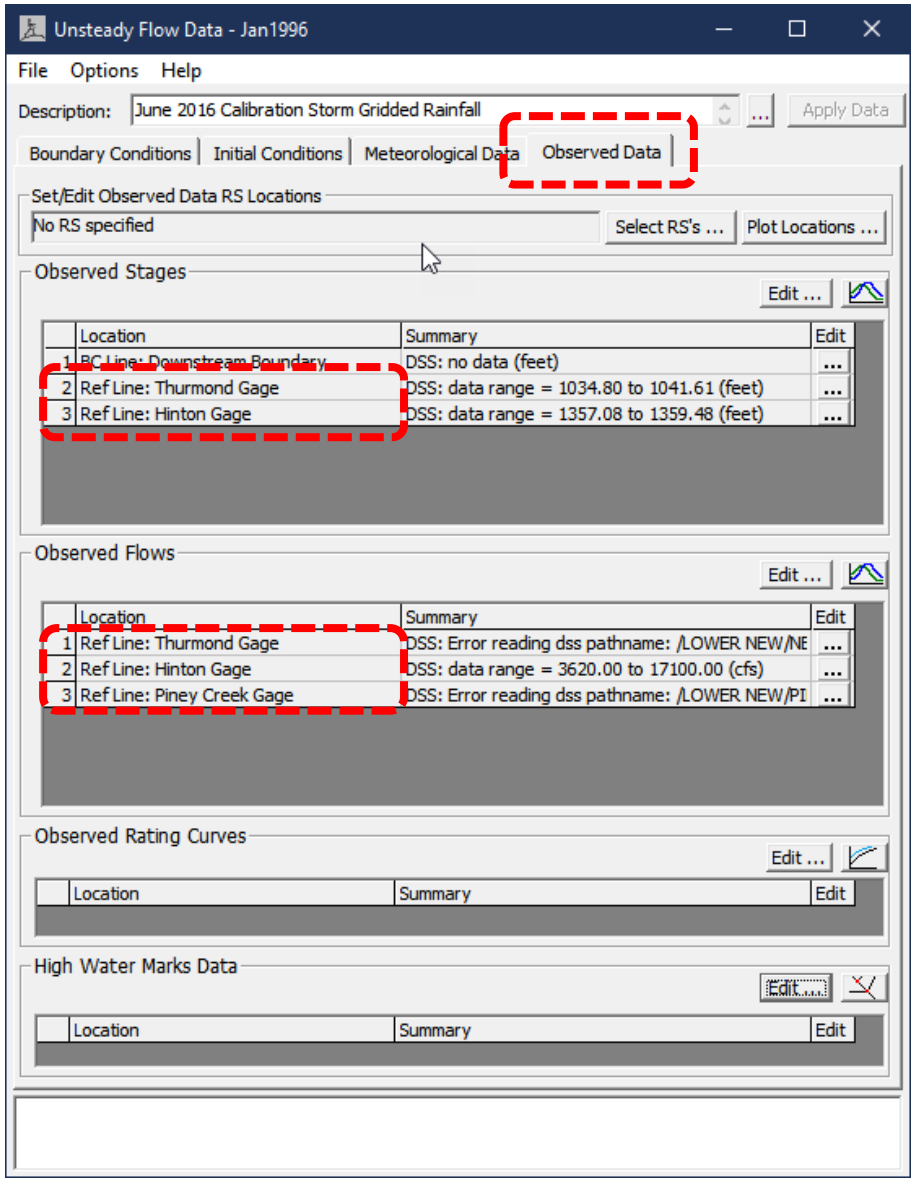
Reference Locations

- Reference Points
  - Stage (good for HWM)
  - Velocity
- Reference Lines
  - Stage (Weighted-Ave)
  - Velocity (Weighted-Ave)
  - Flow
  - Rating Curves
- Reference Areas
  - Volume
  - Inflow/Outflow



Reference Locations: Data Visualization

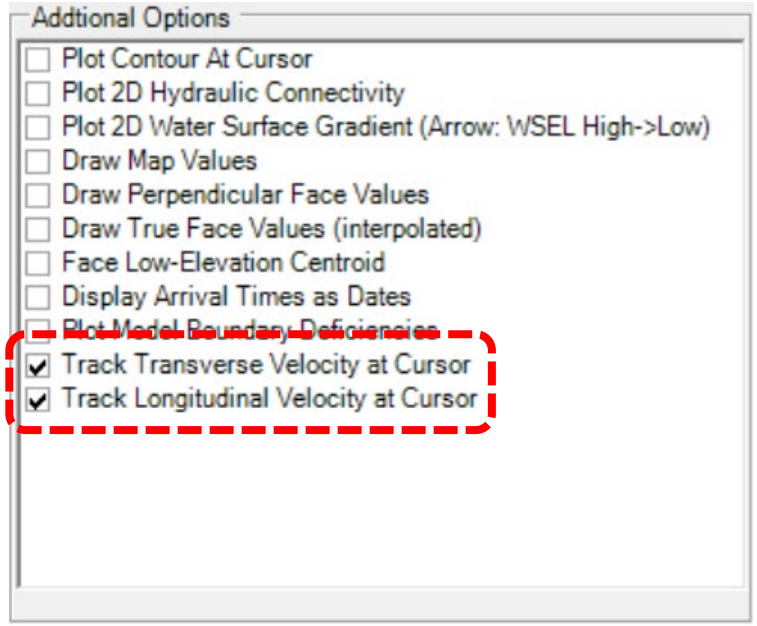
- Reference Locations must be established prior to compute. Data is generated during the compute.
- Reference Locations are the recommended data extraction method for calibration. Data is computed directly in the compute engine.
- Reference Locations can be associated with observed data.

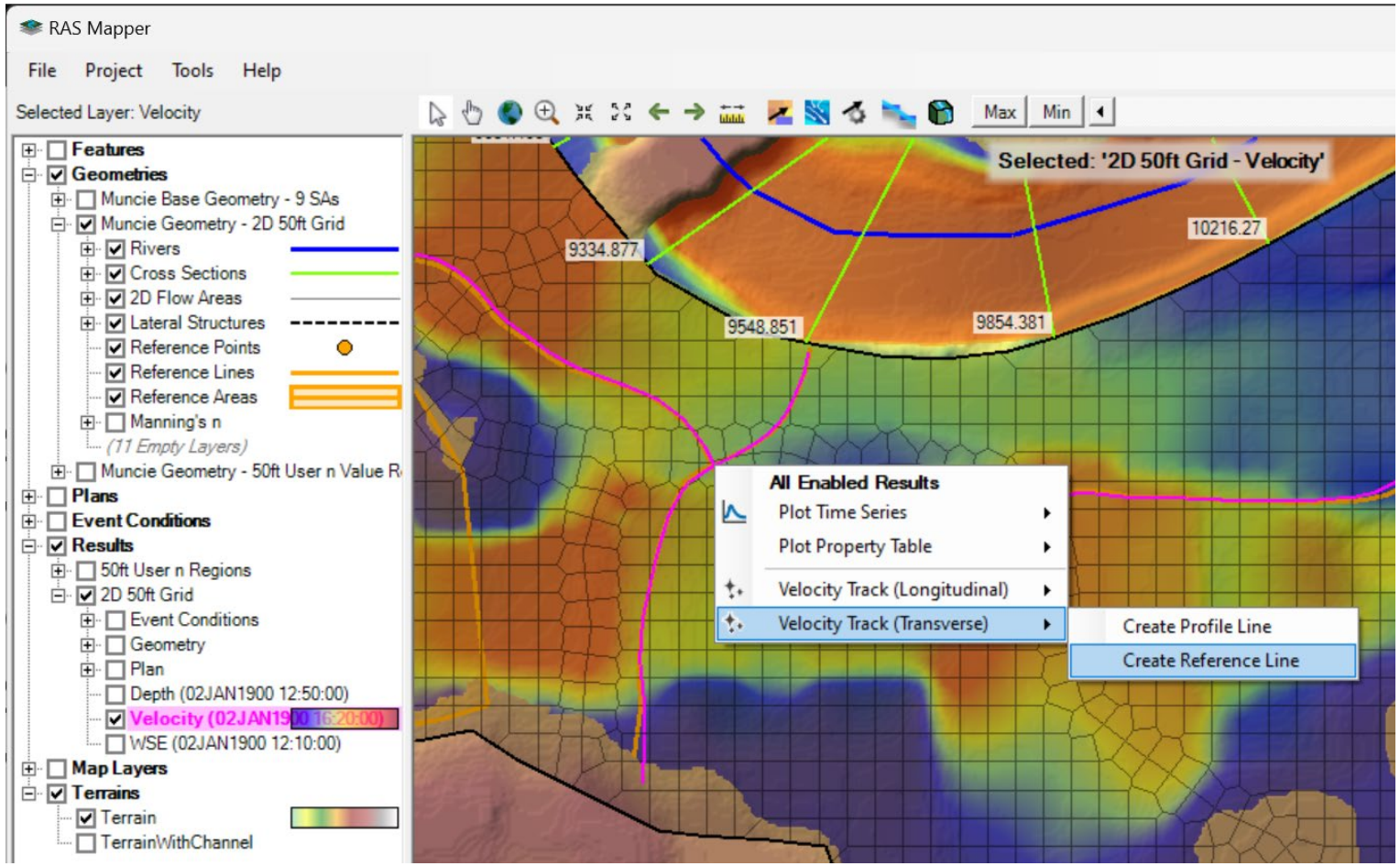


Reference Locations

Optional Method for Creating Reference Lines

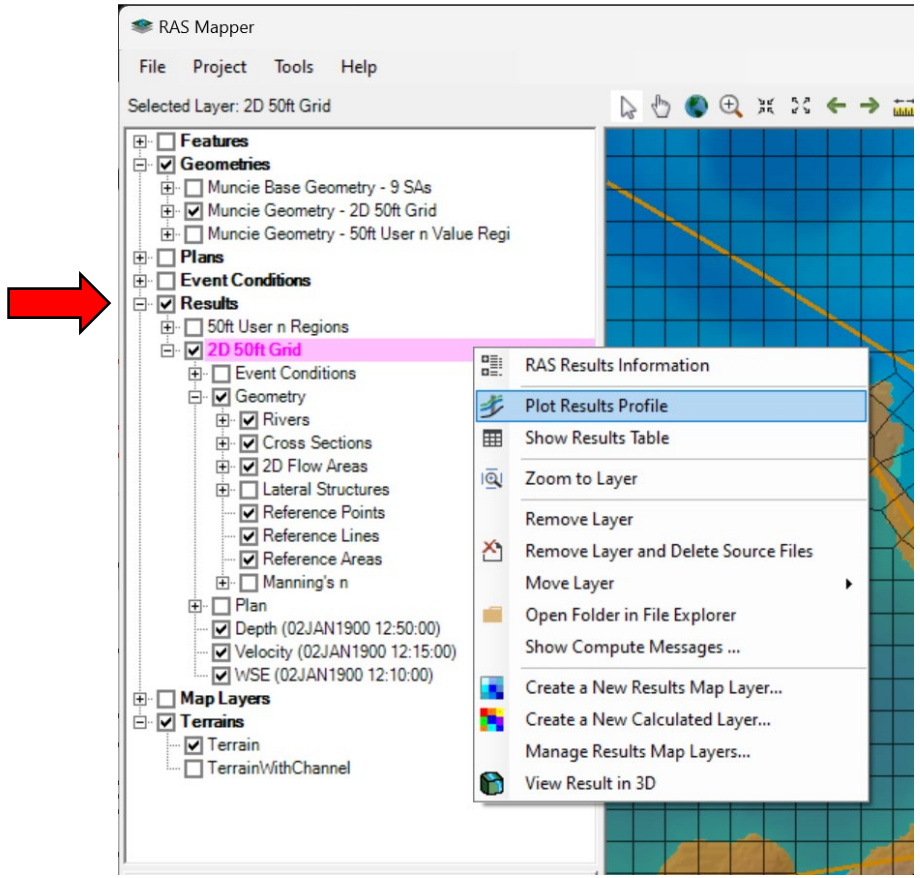
Velocity Layer Additional Properties

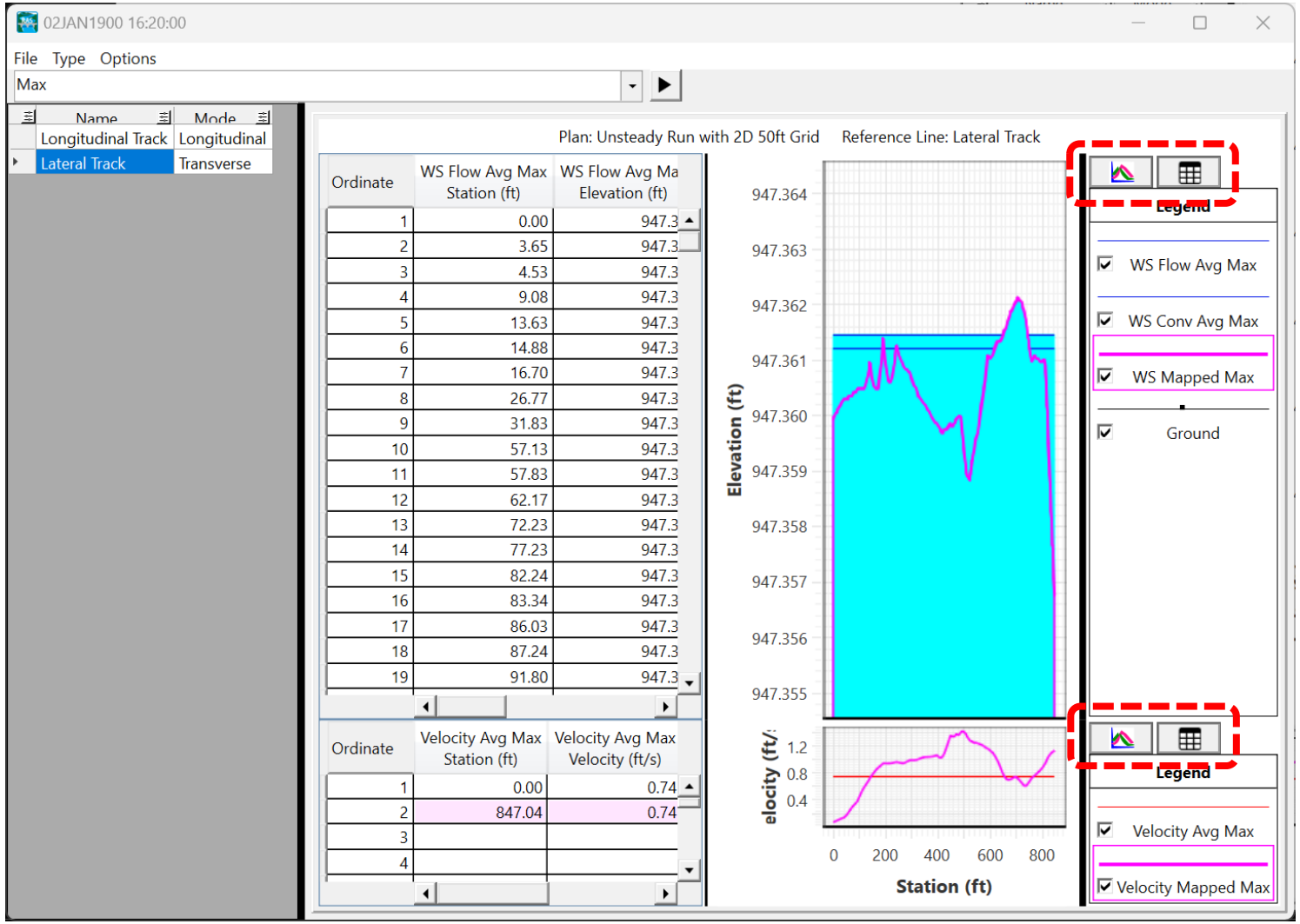




Reference Locations: Data Visualization

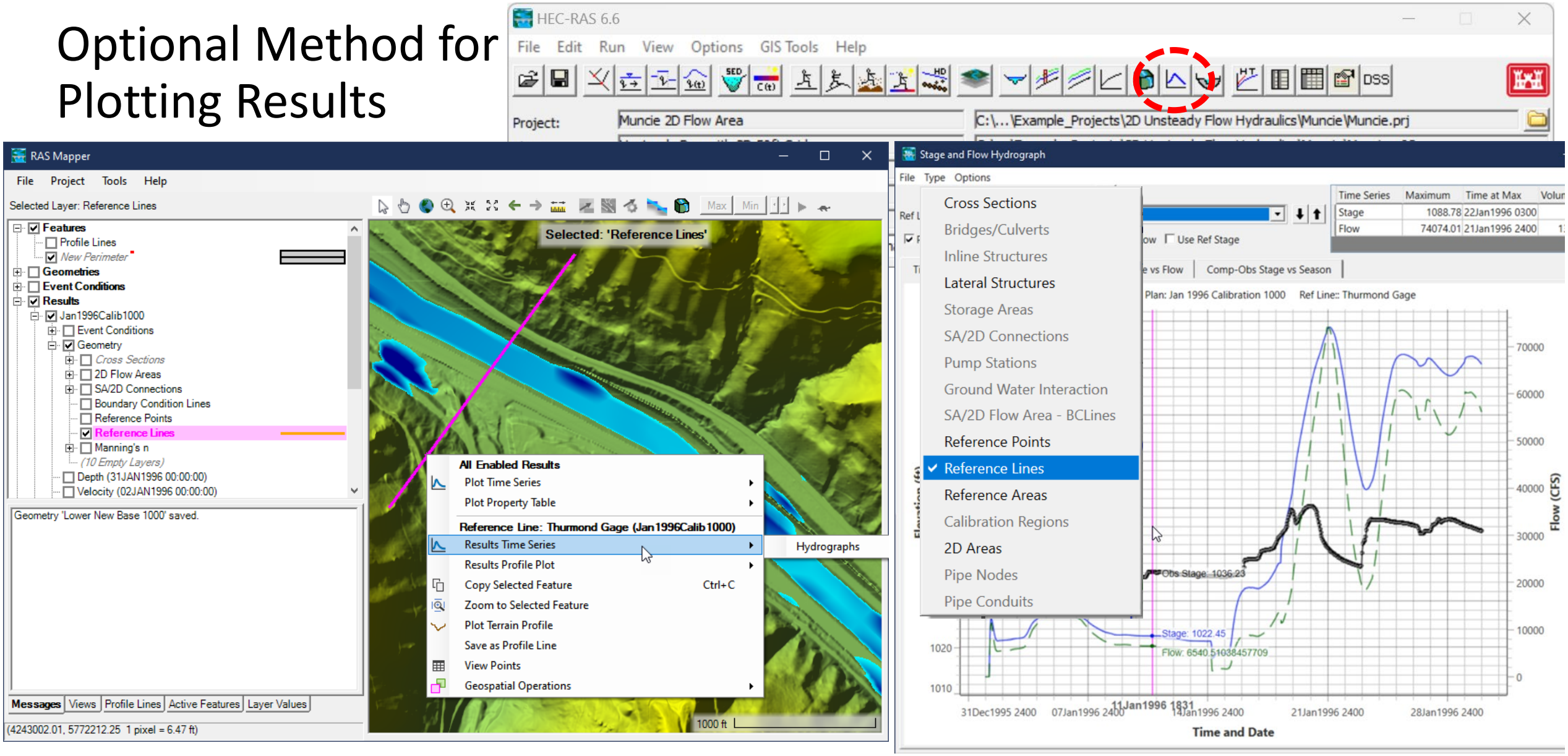
Optional Method for Plotting Results





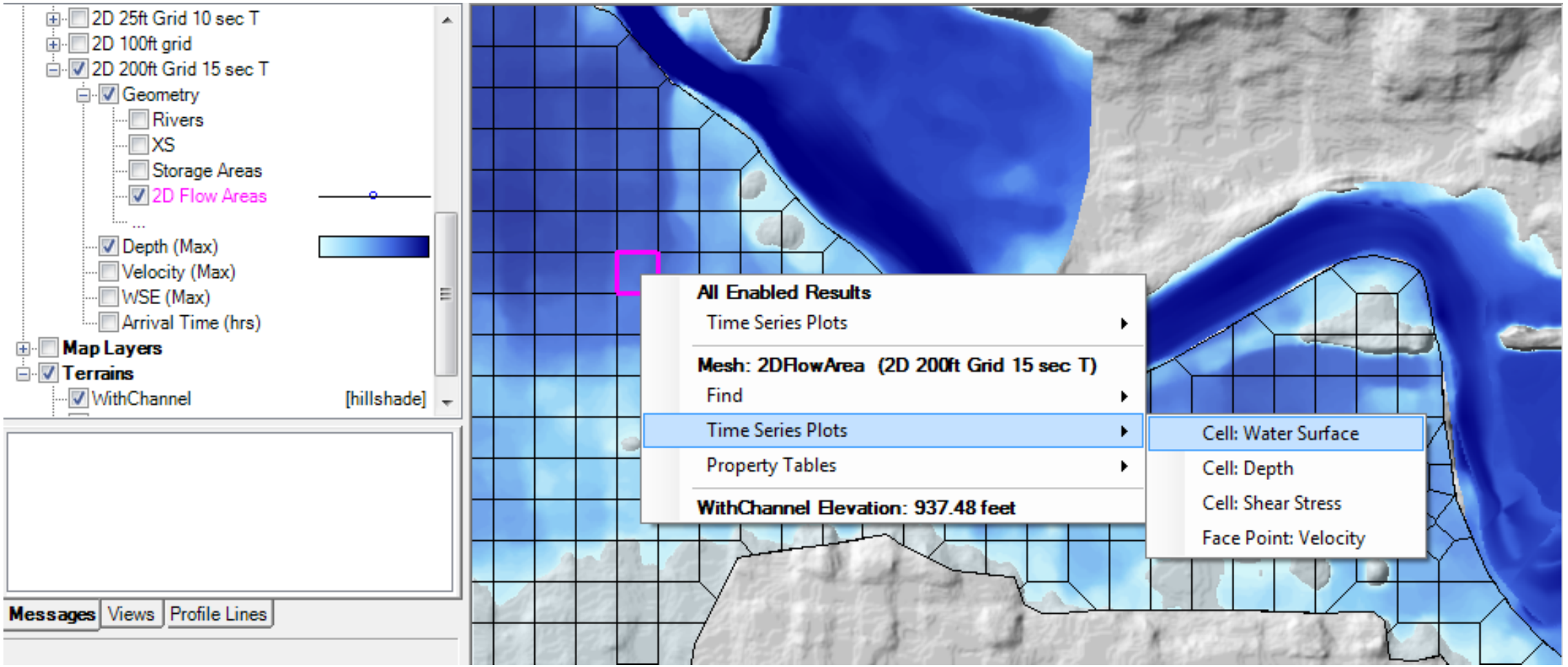
Reference Locations: Data Visualization

Optional Method for Plotting Results



2D Flow Area Queries

- Data can be queried from cells, cell faces, and point locations



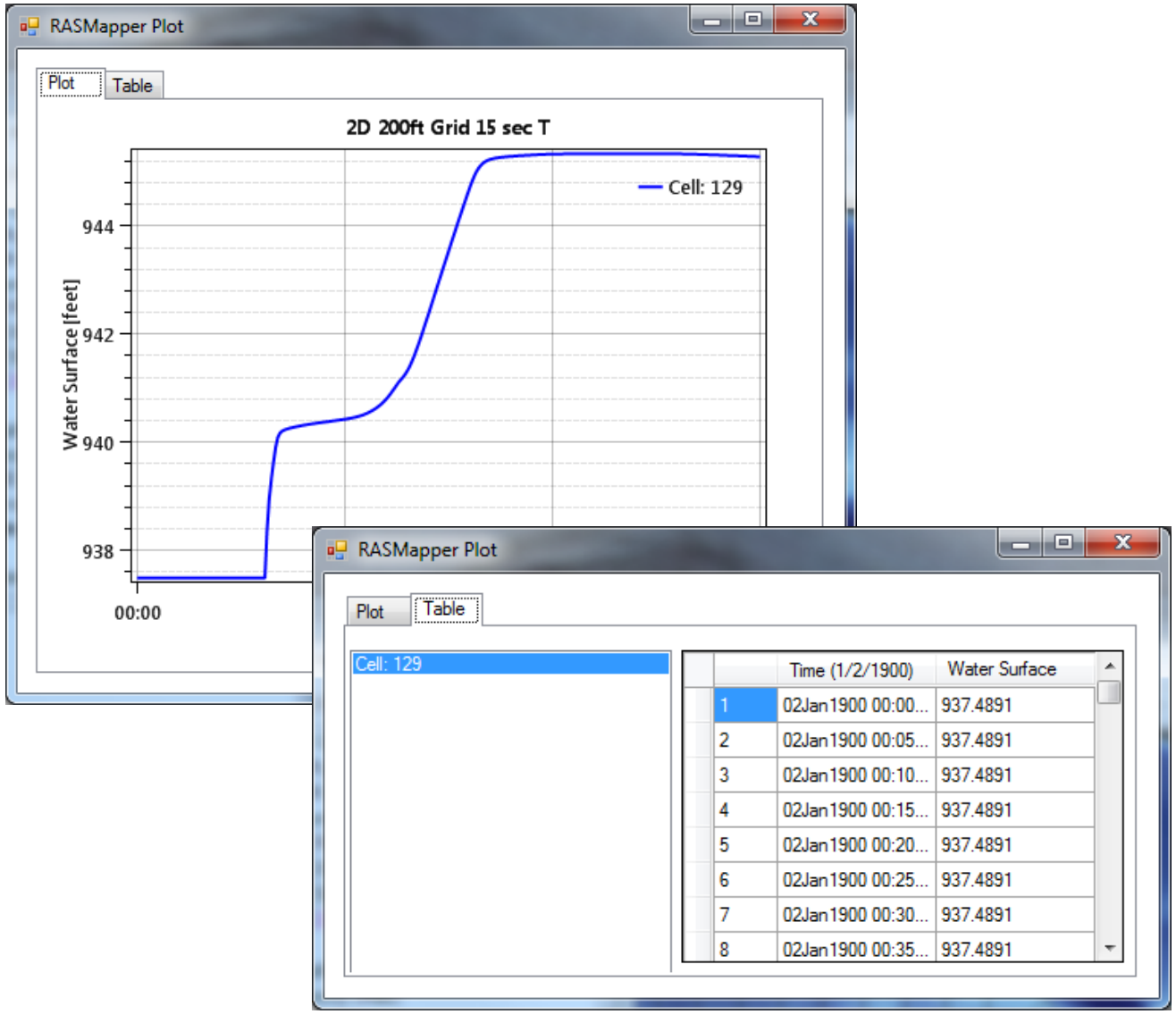
2D Flow Area Queries

- Hydraulic Properties

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

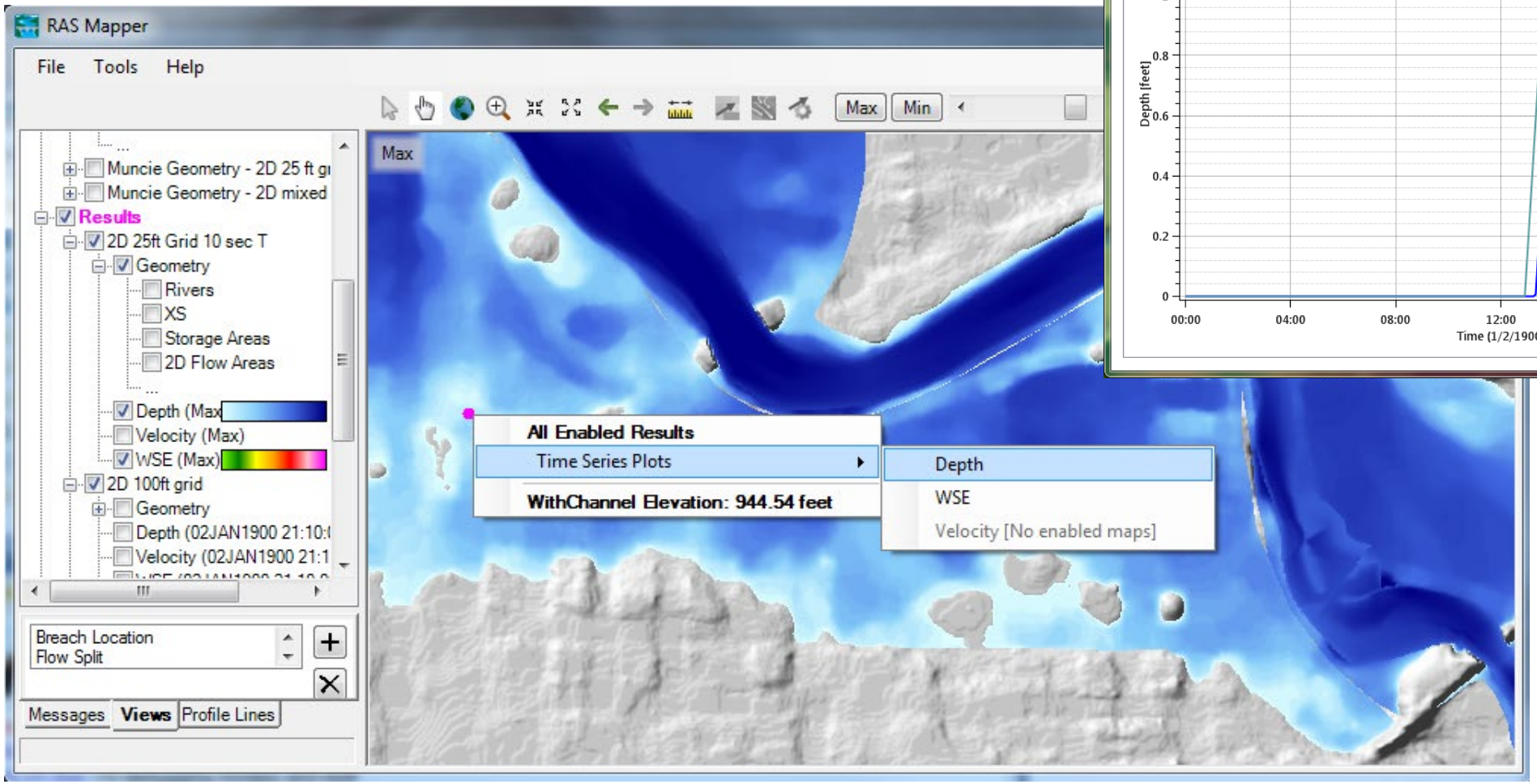
- Time Series

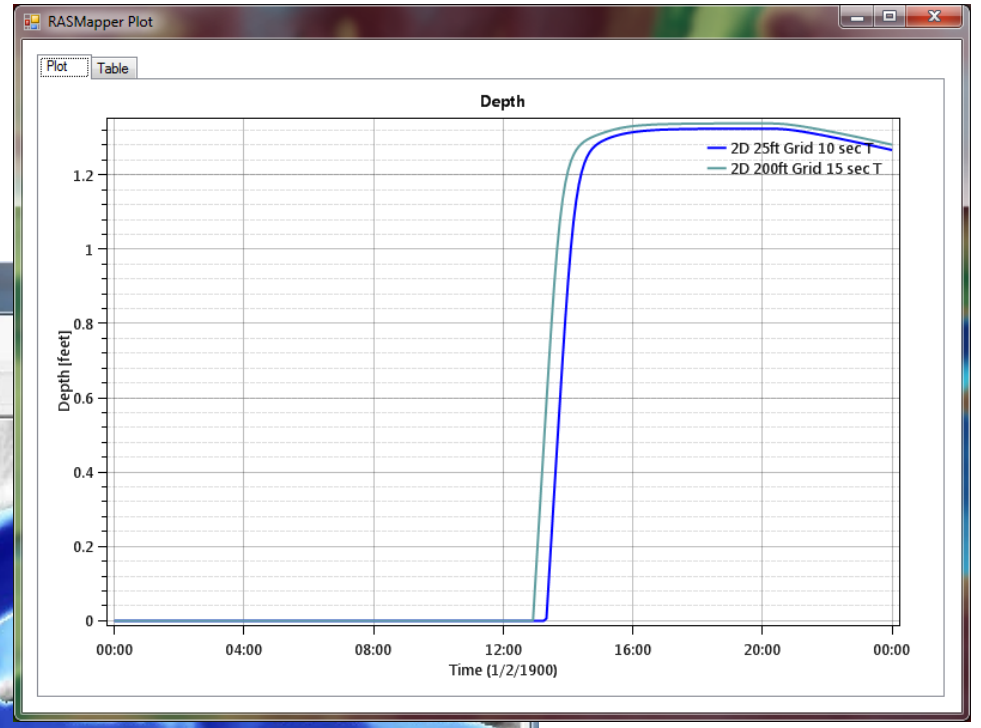
  - Cell: Water Surface
  - Cell: Depth
  - Cell: Shear Stress
  - Face Point: Velocity



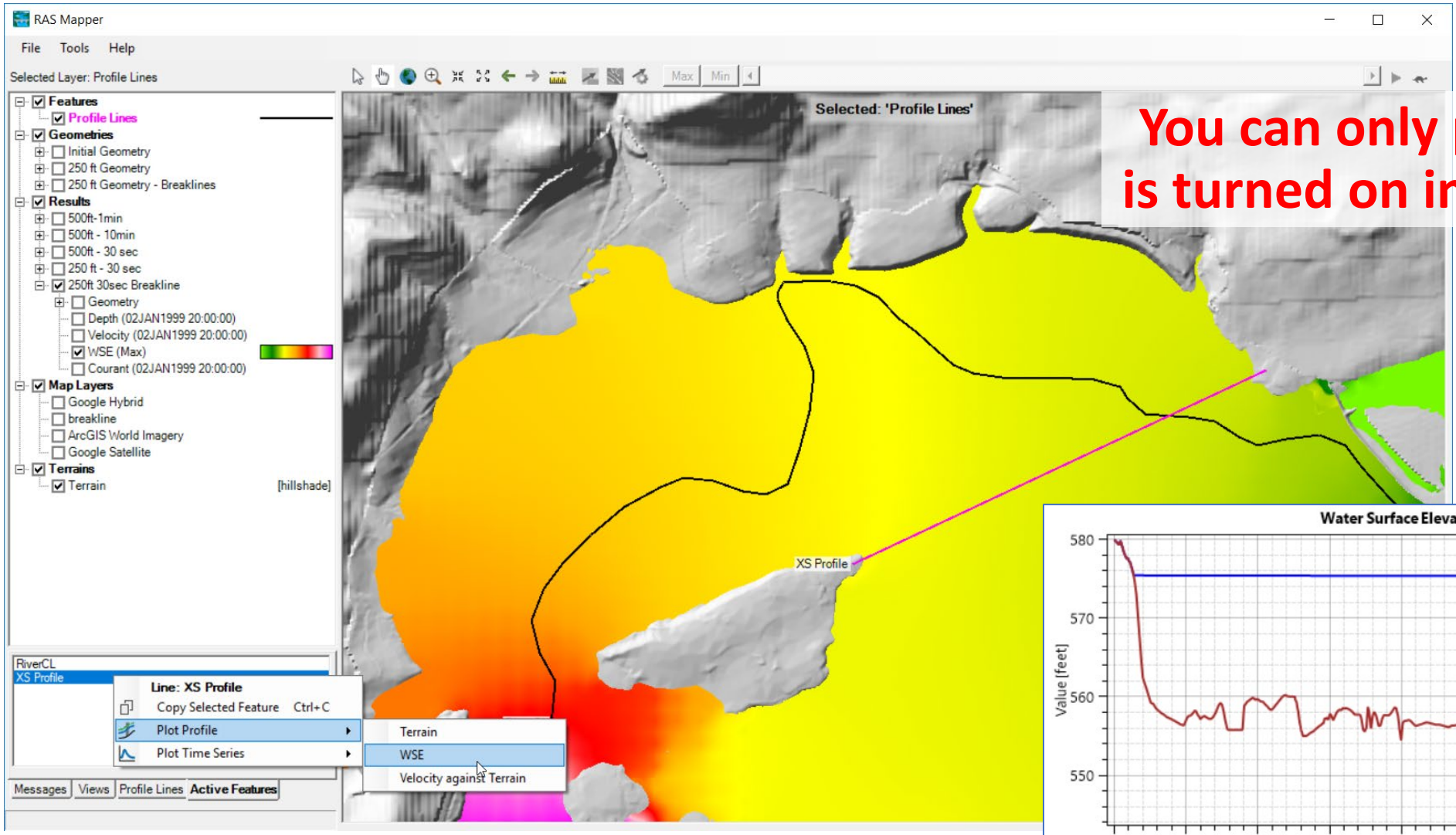
2D Flow Area Queries

- Time Series Plot from a Point

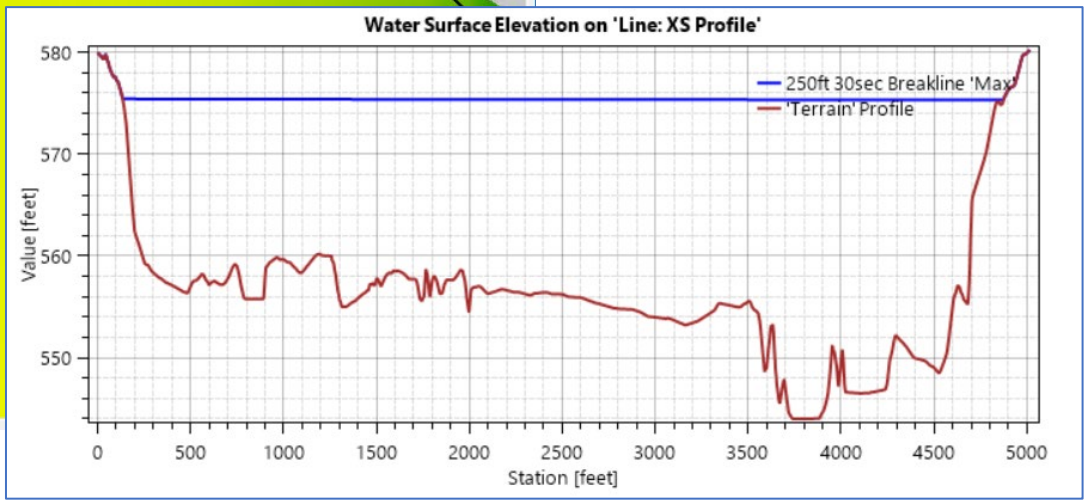




Profile Lines

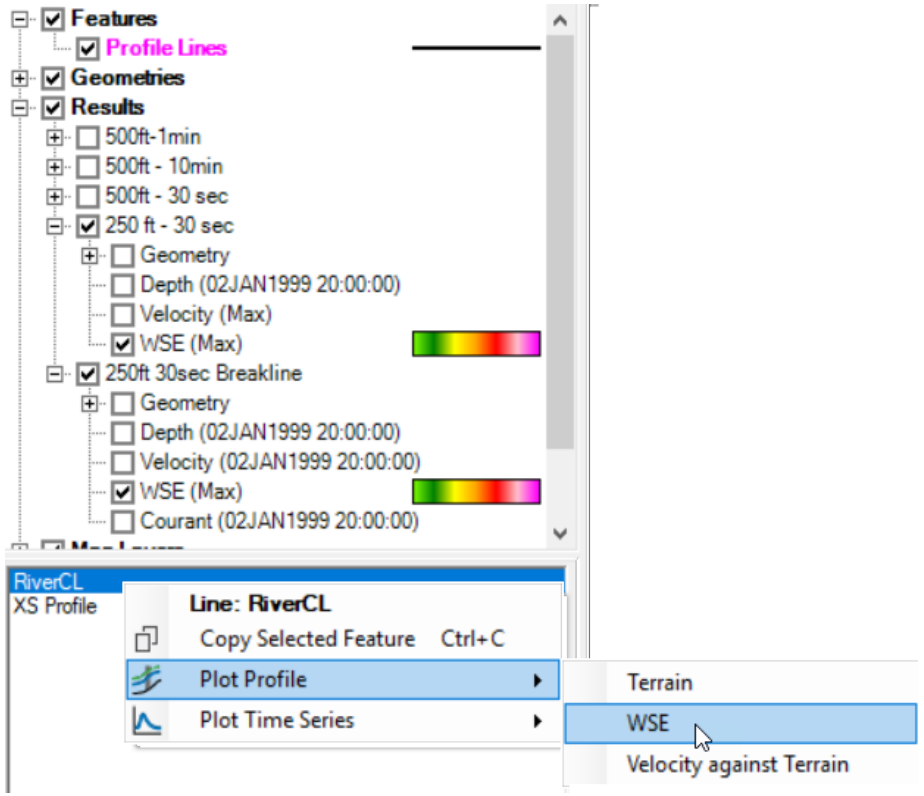


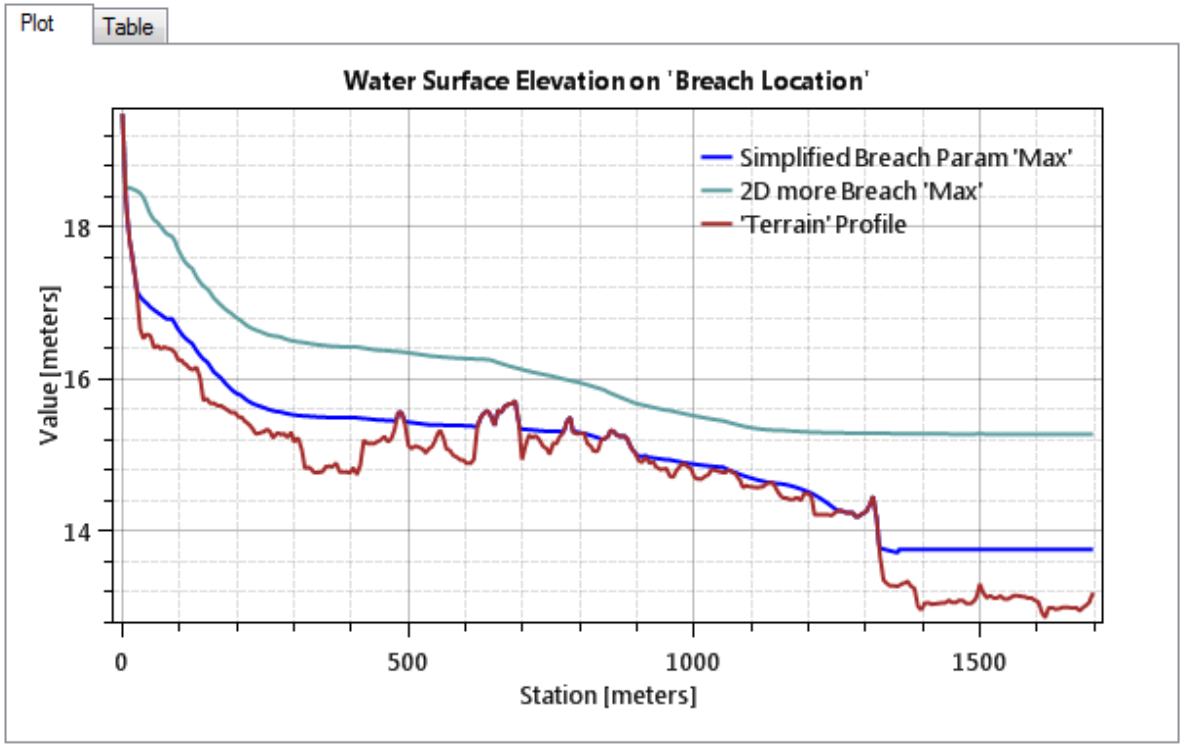
You can only plot data that is turned on in the Layer List



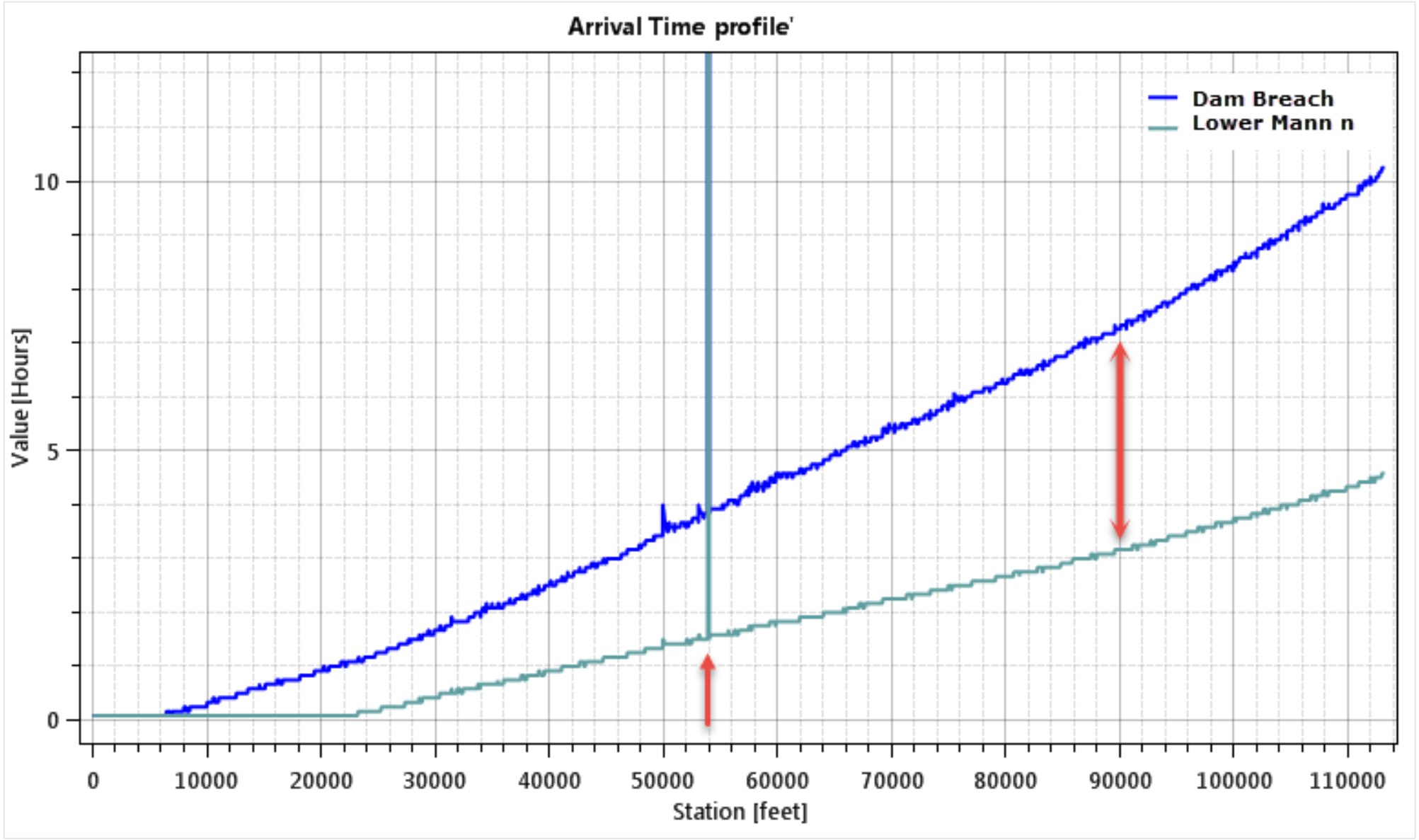
Profile Line: Result Comparison

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

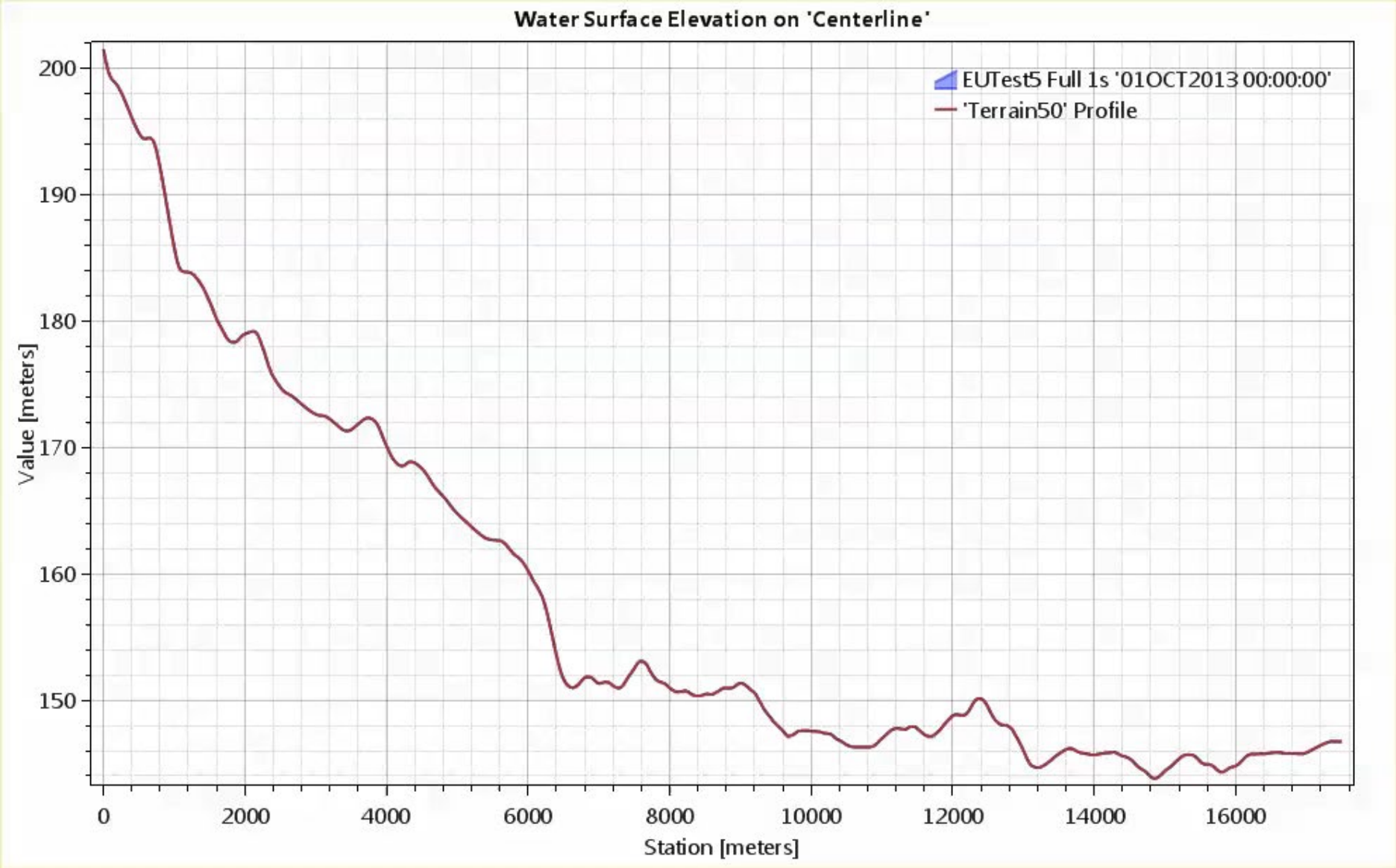




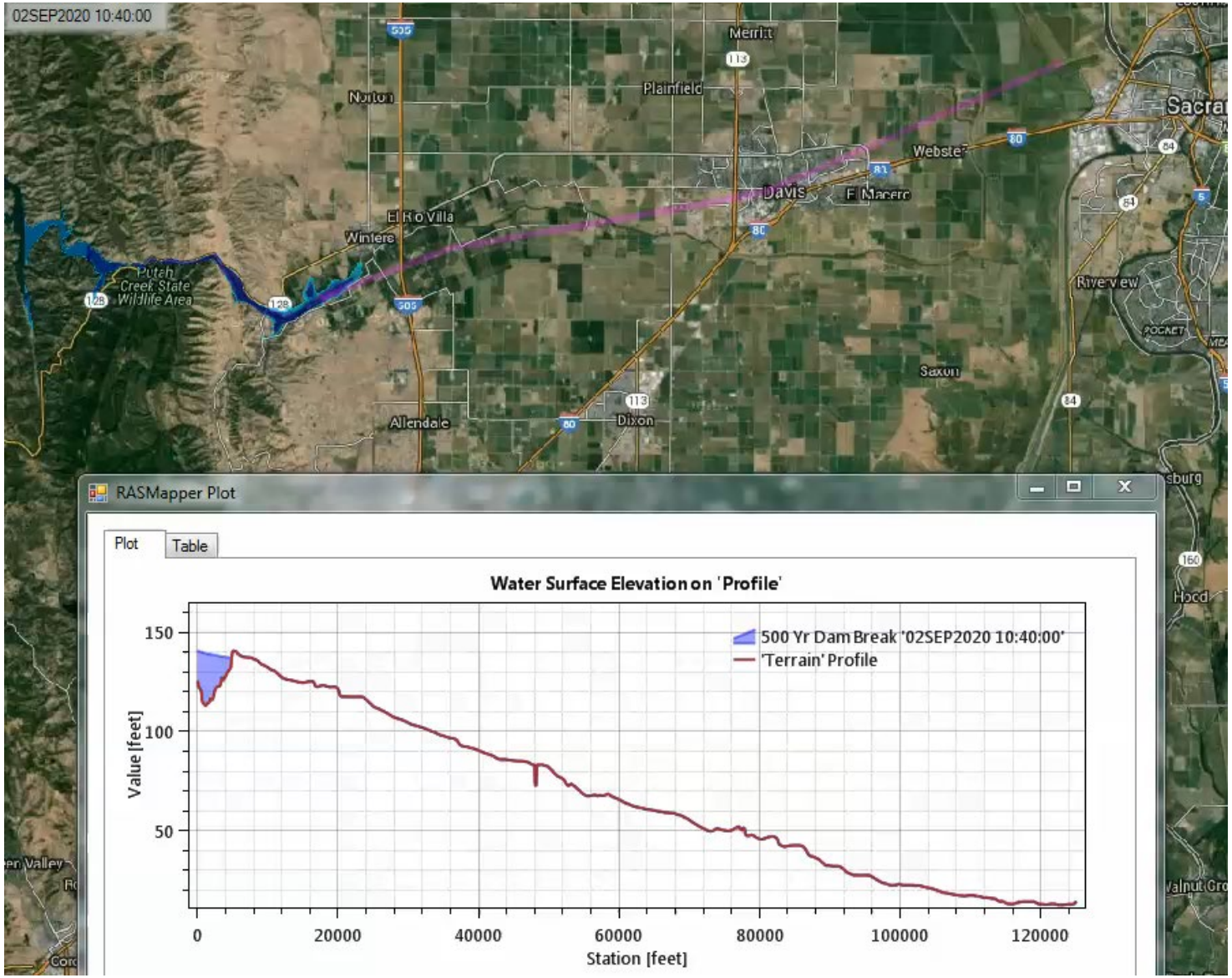
Profile Lines: Comparison of Calculated Data



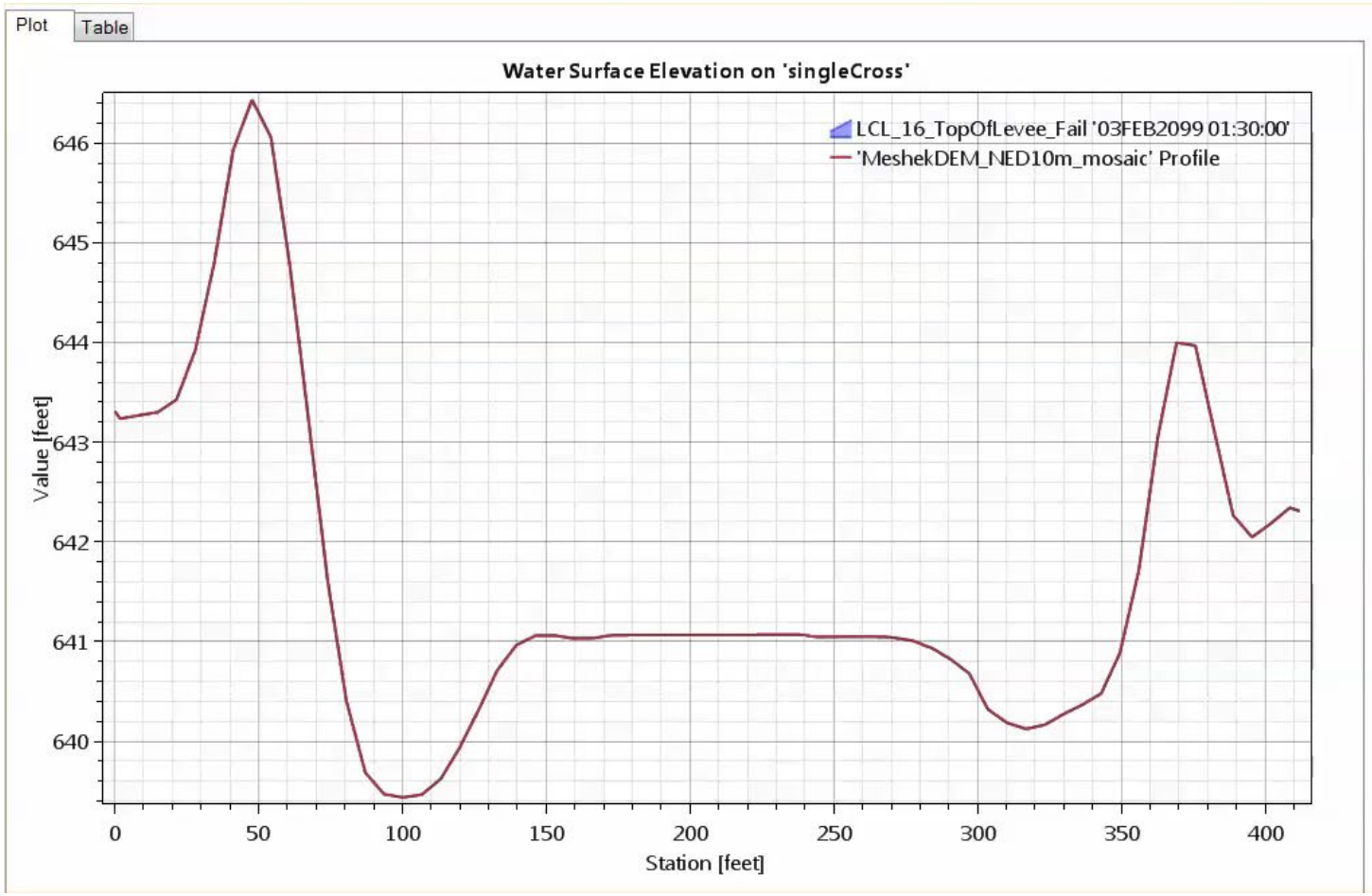
Profile Lines: Animating

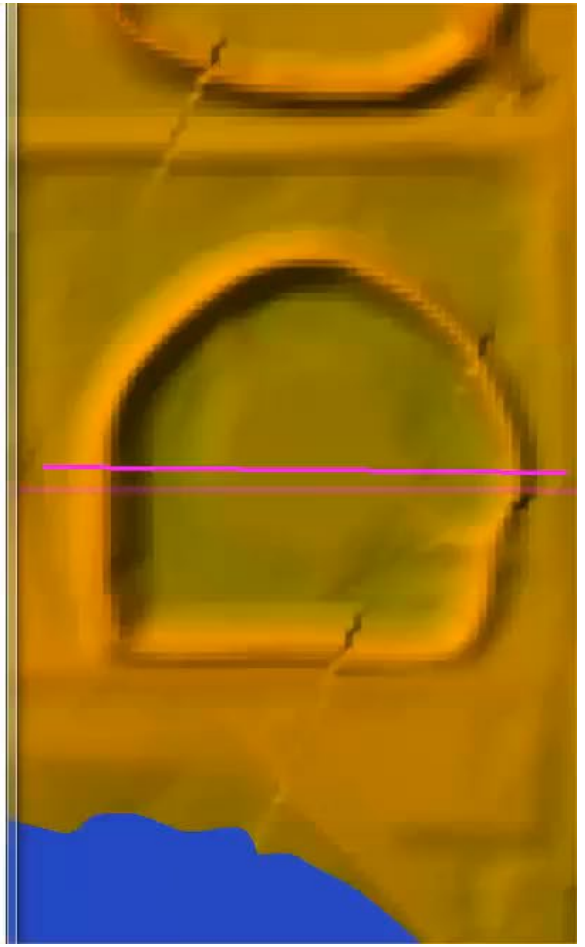


Profile Lines: Sync Animation with Spatial Results

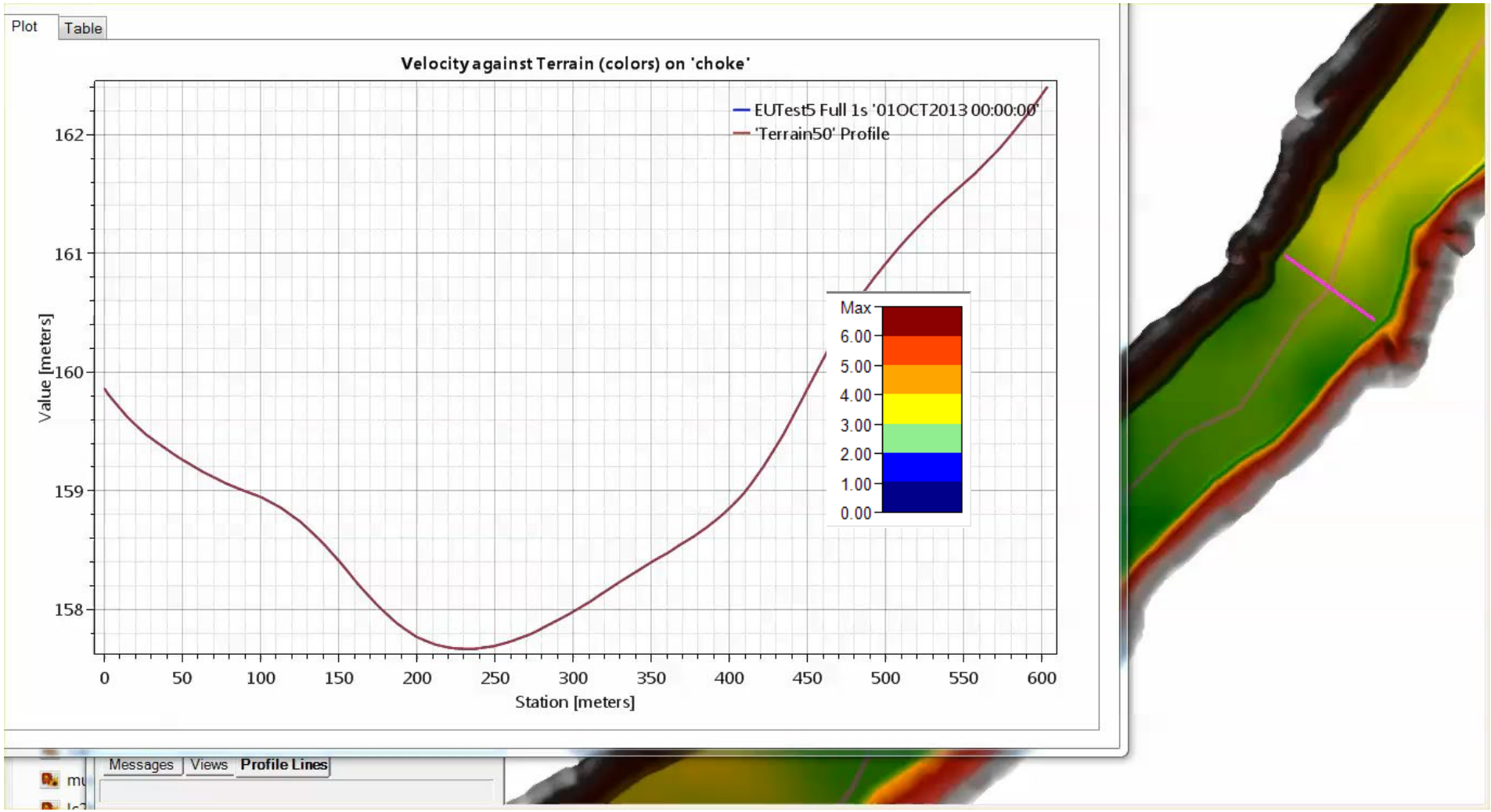


Profile Lines: Sync Animation with Spatial Results





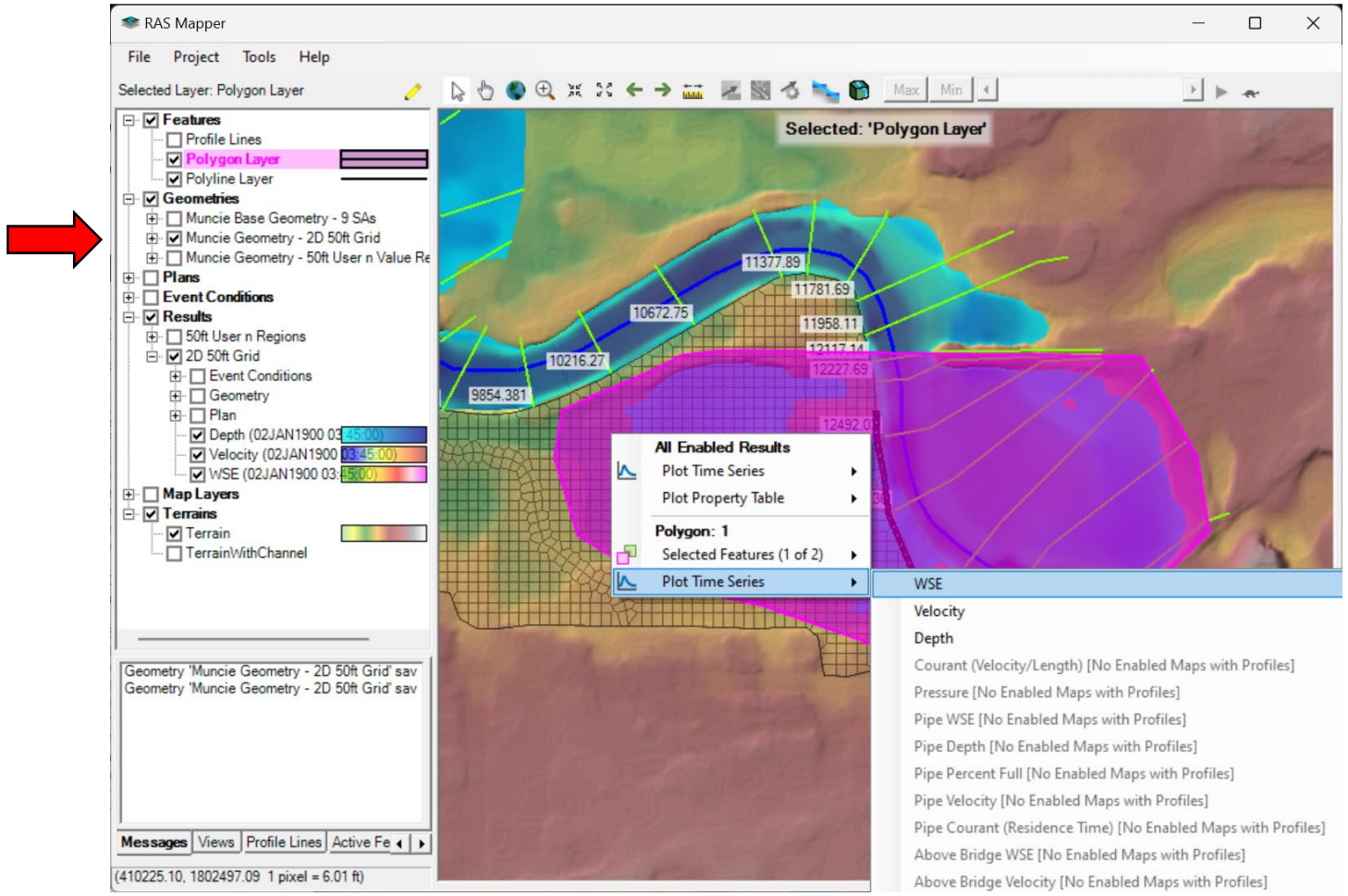
Profile Lines: Velocity Animation

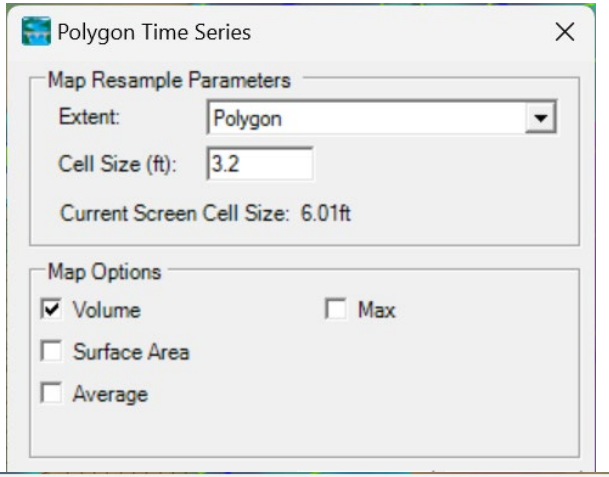


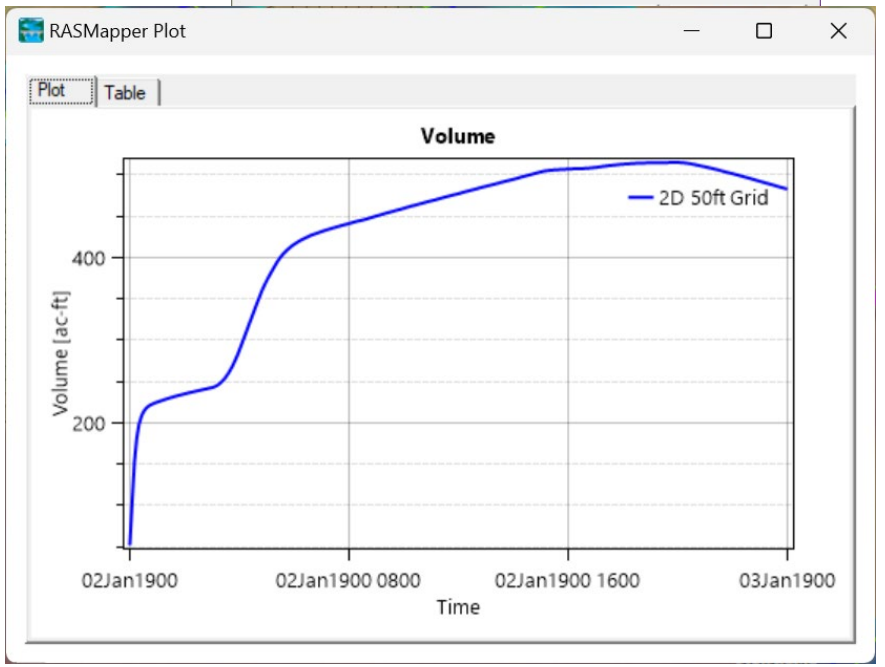
Polygon and Polyline Features

Ability to extract data across combined 1D and 2D domains

Use with Caution!







Questions?

US Army Corps of Engineers