2D Hydraulic Modeling Webinar Series

Modeling Multiple Barrel 2D Culverts in SRH-2D/SMS

November 13, 2025

AQUAVEO®

TRANSPORTATION HYDRAULICS SOLUTIONS

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Transportation Hydraulics Solutions

Expert Support for 2D Hydraulic Modeling & Bridge Scour Challenges

- Advanced SRH-2D & HEC-RAS 1D/2D Modeling
- Bridge Scour Evaluations & Risk Reduction
- Scour Countermeasure Design & Review
- Training, Technical Support, and Project QA/QC

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TRANSPORTATION HYDRAULICS SOLUTIONS

2D Hydraulic Modeling Webinar Series Objectives

- Highlight best practices in 2D modeling for transportation hydraulics
- Showcase new features and capabilities in SMS/SRH-2D
- Share examples of 2D modeling applications
- Compare SRH-2D and HEC-RAS 2D modeling approaches
- Provide an open forum for questions and other insights

Agenda

- Housekeeping
- 2D Hydraulic Modeling Webinar Series Mailing List
- 2D Hydraulic Modeling Resources page 

- SMS 13.4 updates
- When to use 2D vs. 1D culverts
- **Modeling Multi-Barrel 2D Culverts in SRH-2D/SMS**
- Tips and Tricks

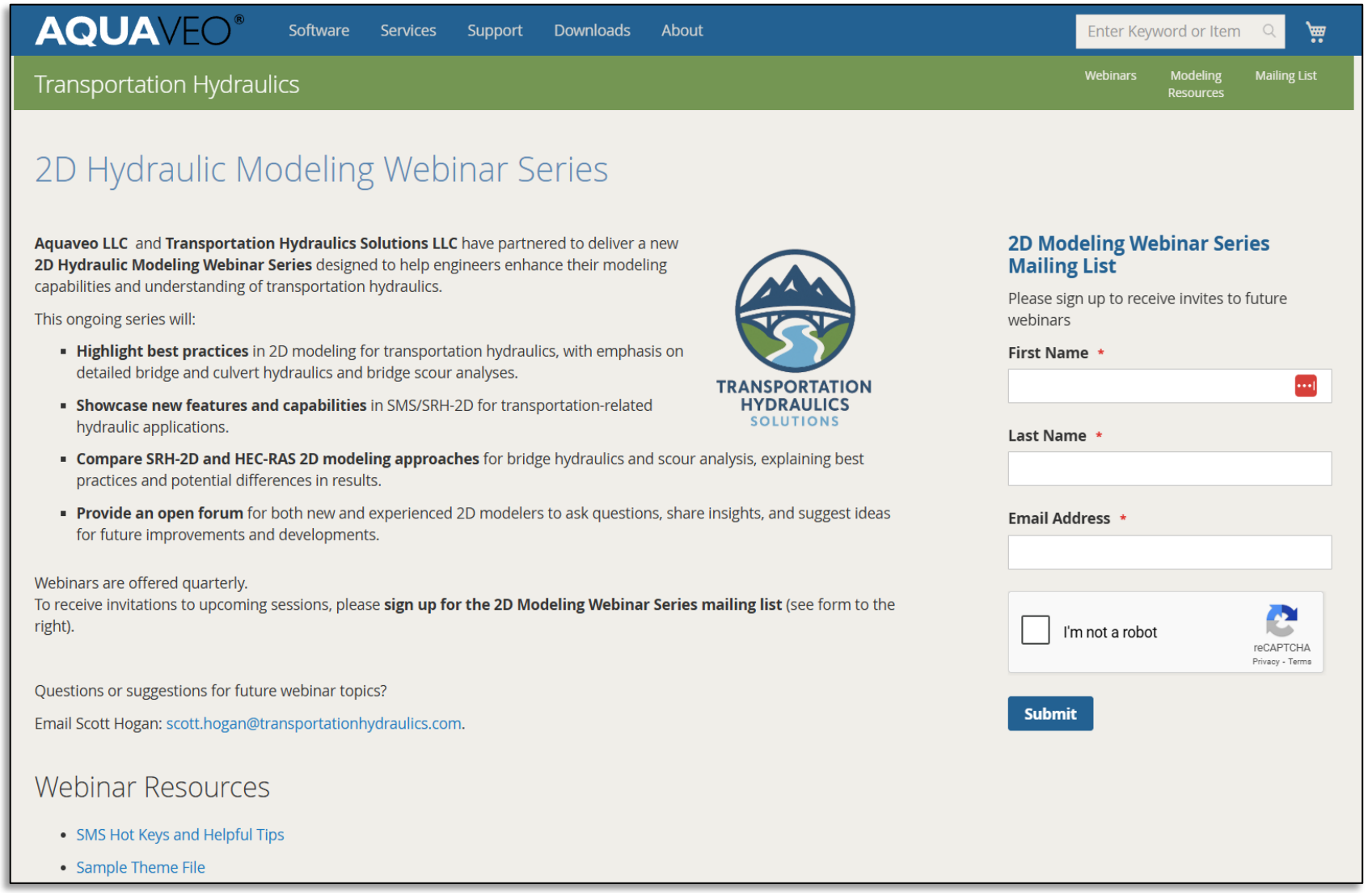
Housekeeping

- Please stay muted and off camera unless asking a question
- Please post any questions in the Chat Pod
- PDF file of presentation slides available on the Aquaveo 2D Hydraulic Modeling Webinar Series Page
- Recording link and PDH certificate will be sent out to all on the mailing list

2D Hydraulic Modeling Webinar Series Mailing List

Sign up to receive future webinar invites

- Register to participate
- Recording links and PDH certificate will be send to mailing list



2D Hydraulic Modeling Resources

- New 2D Hydraulic Modeling Resources page
  - SMS Quick References and Sample Files
  - Software download and licensing
  - FHWA 2D Hydraulic Modeling Reference Document
  - Training links
  - SMS wiki page
  - Tutorials
  - You Tube Videos
  - Past FHWA 2D Hydraulic Modeling User's Forum Videos
  - Additional resources

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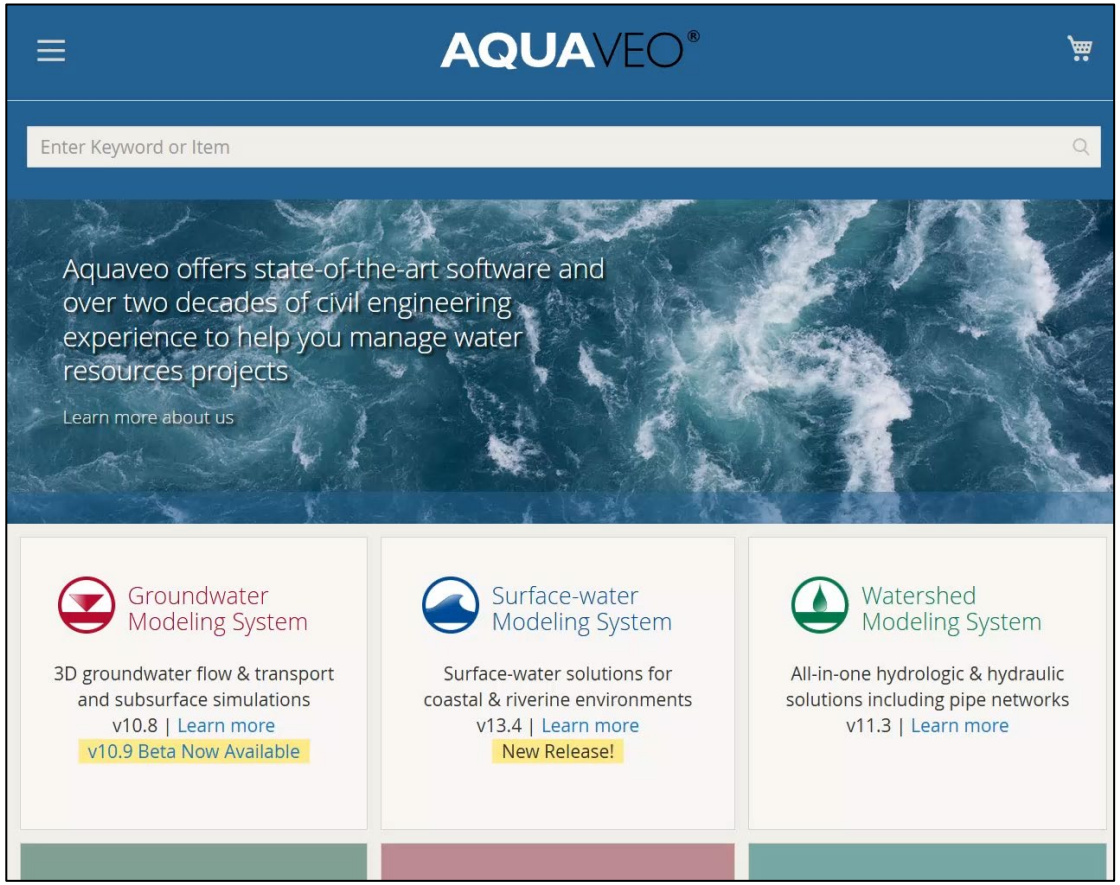


2D Hydraulic Modeling Resources

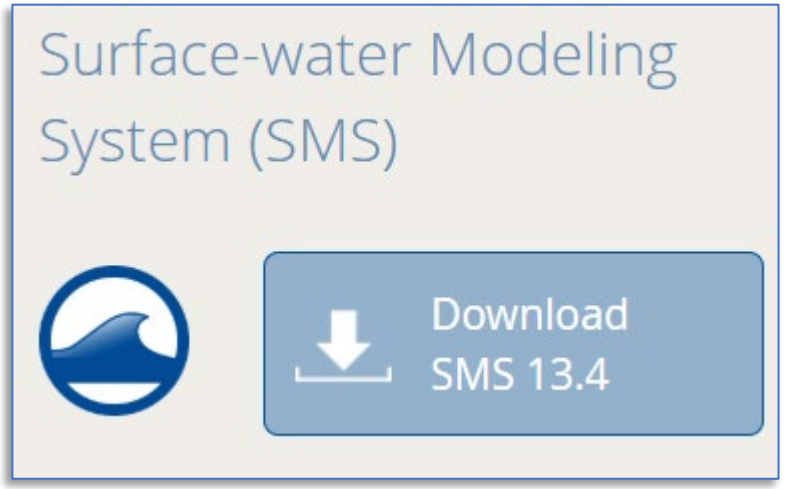
- SMS wiki: SMS 3D Structure (Workflows)
- Recommended Tutorials: 3D Structures (1, 2, & 3)
- 2D Modeling Forum: September 28, 2023 – *Modeling 1D and 2D Culverts in SRH-2D SMS* (Recording / Handout / Demo)

SRH-2D Model Tutorials

Category	Title	SMS 13.4
SRH-2D	*SRH-2D*	PDF Data
	SRH-2D Boundary Conditions	PDF Data
	SRH-2D Bridge Pressure Flow	PDF Data
	SRH-2D Culvert Structures	
	SRH-2D Culvert Structures with HY-8	PDF Data
	SRH-2D DIP File	PDF Data
	SRH-2D Gates	PDF Data
	SRH-2D Obstructions	PDF Data
	SRH-2D Post-Processing	PDF Data
	3D Structures 1	PDF Data
	3D Structures 2	PDF Data
	3D Structures 3	PDF Data
	SRH-2D Pressure Flow with 3D Bridges	
	SRH-2D Reports	PDF Data
	SRH-2D Simulations	PDF Data
	SRH-2D Adv. Simulations – Calibration	PDF Data
	SRH-2D Adv. Simulations – Calibration Mannings	PDF Data
	SRH-2D Adv. Simulations – Scenarios	PDF Data

SMS 13.4 Current Release

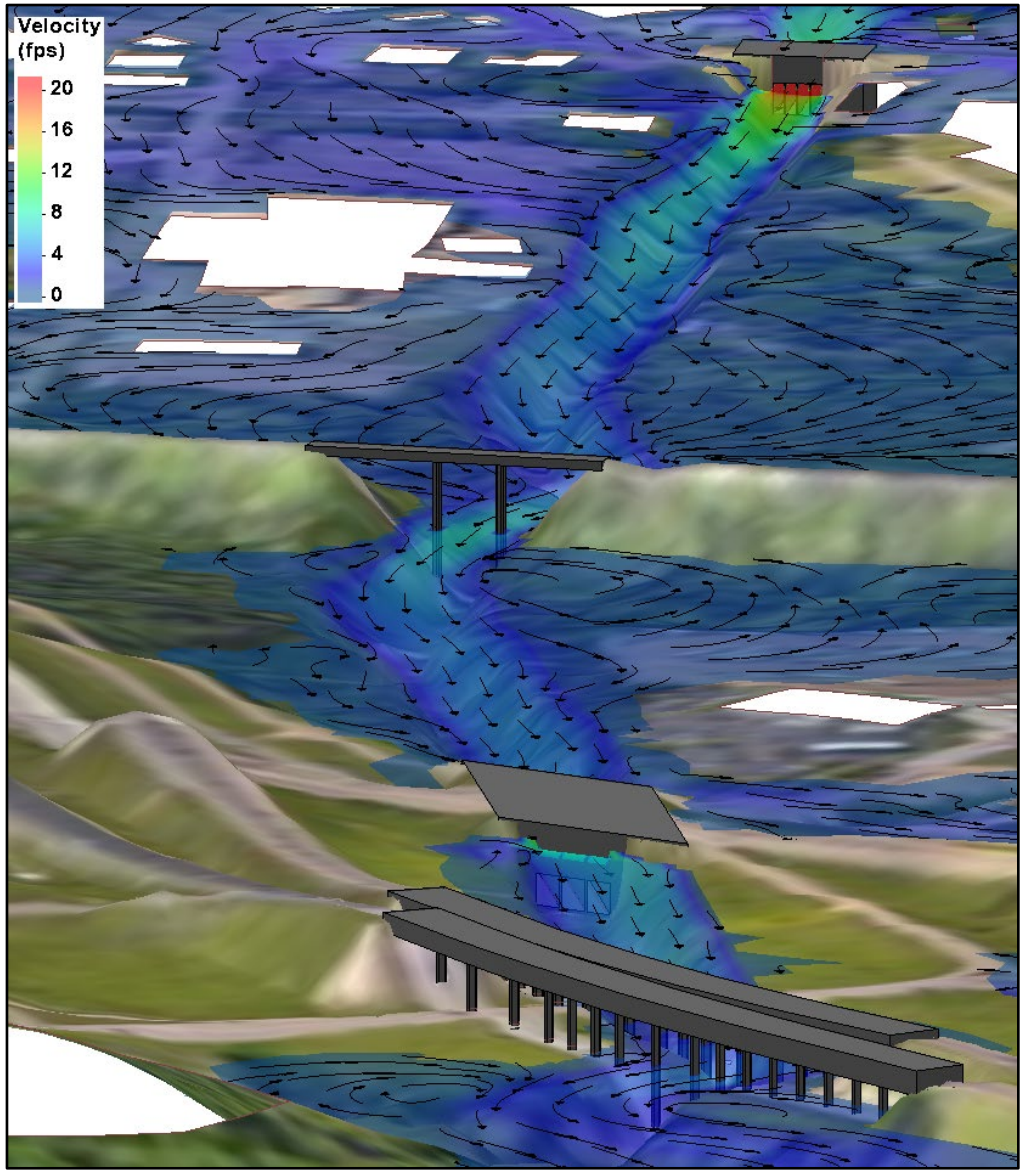
- Current version: SMS 13.4.8
- Build date: November 5, 2025
- Several revisions/bug fixes relating to:
  - 3D Structures summary
  - 3D Structure culverts
  - UGrid contour options/crashes
  - Compare datasets tool error
  - Bridge scour dataset updates
  - Other misc. bug reports



Modeling Multi-Barrel 2D Culverts in SRH-2D/SMS

Feature Highlights

- Box and circular culverts
- Other shapes may be modeled as bridges
- Multiple identical barrels
- Culvert embedment
- Culvert mesh is auto-generated
- Overtopping is computed as 1D weir flow (just above the barrels)

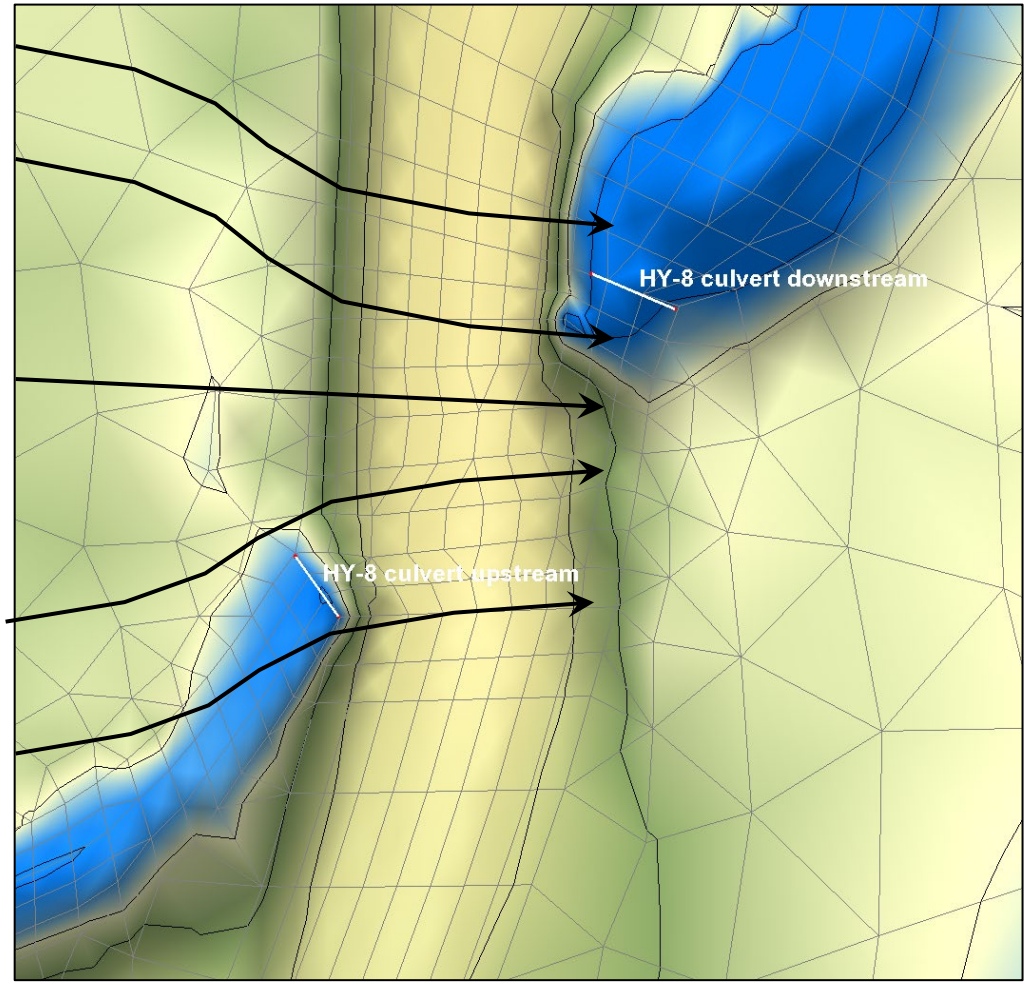


Why use 2D Culverts?

- Better representation of hydraulic losses for mainline structures
- Affects of approach angle of flow are considered
- Approach velocity and momentum are considered (skewed and lateral structures)
- Variable flow distribution (i.e. around bends) is represented
- Detailed hydraulic parameters available within barrel and at outlet
- Outlet velocities are more representative
- Sediment transport through structures

When are 1D Culverts Still Recommended?

- Secondary / relief culverts
- Smaller culverts
- Scenarios where the culvert inlet is inundated (low approach velocity)
- Skewed culvert scenarios where the overtopping is the predominant flow.



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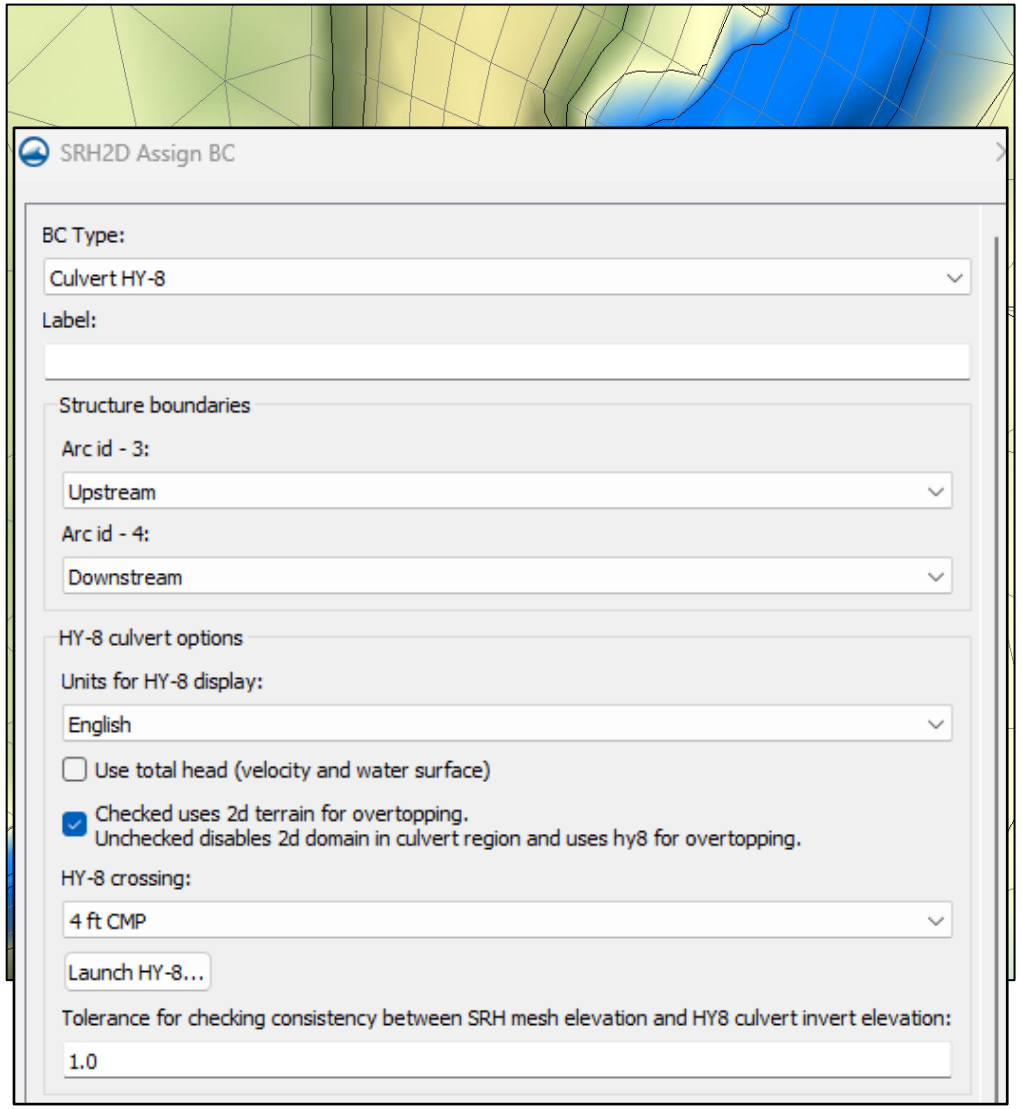
- Skewed culvert scenarios where the overtopping is the predominant flow.

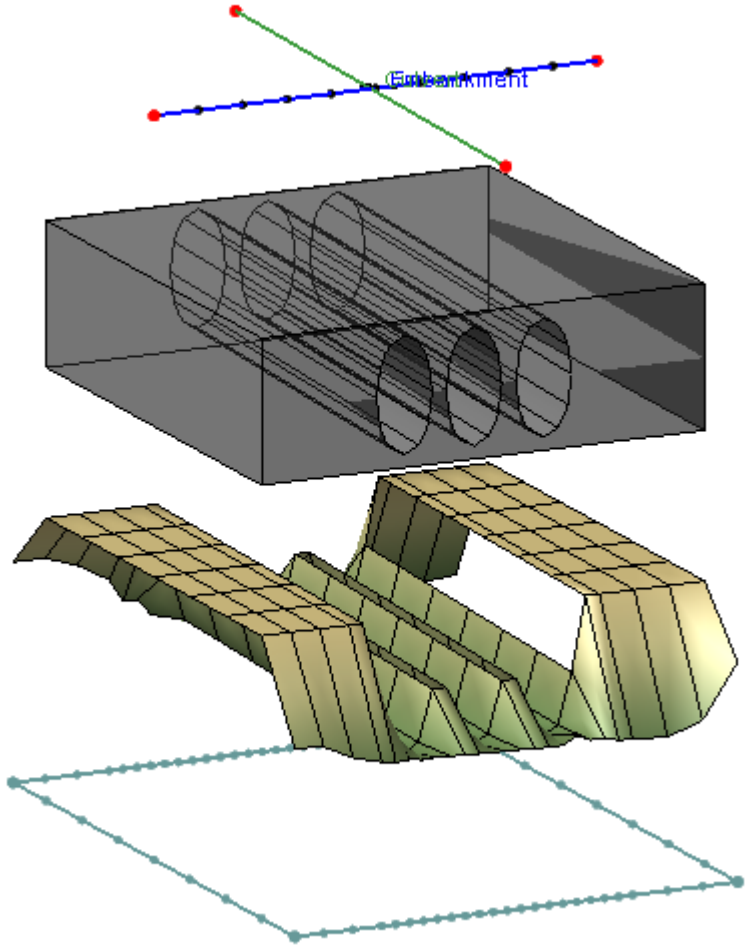
** For overtopping flow that is parallel with the culvert, use the 1D HY-8 overtopping

** For non-parallel or other conditions, check the option to compute 2D overtopping.



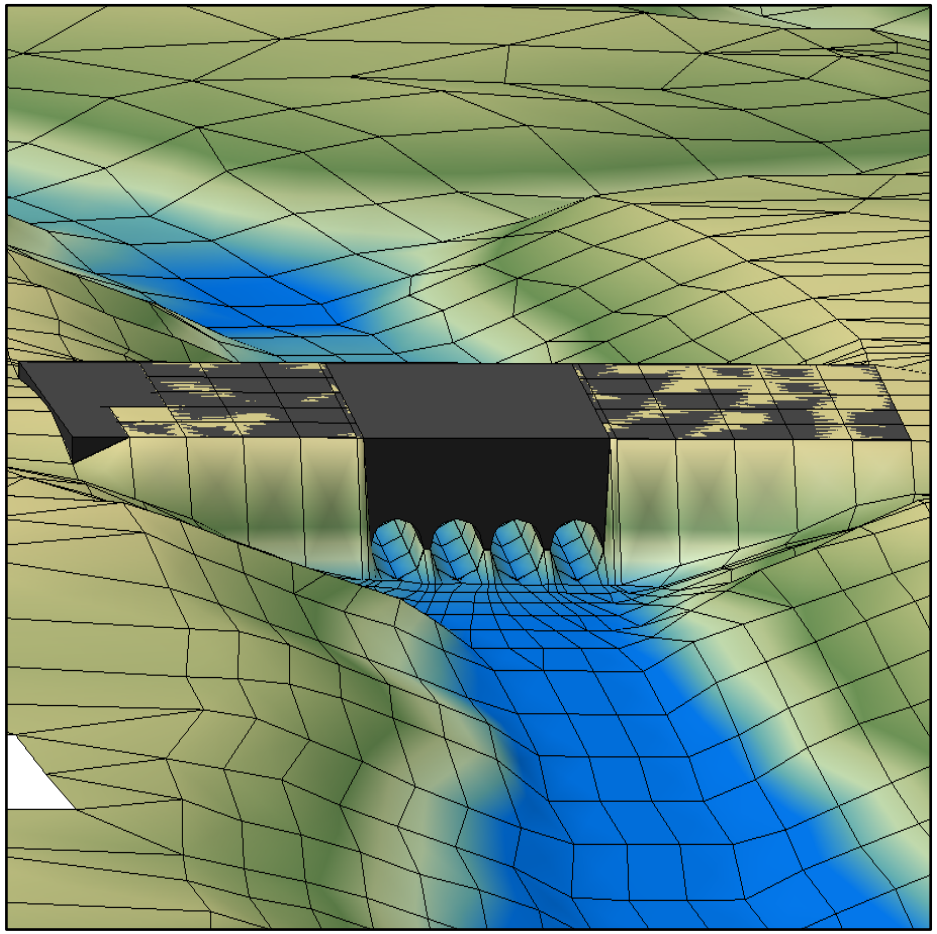
3D Structures Tool Application For Culverts

- User defines embankment and culvert group centerlines.
- User enters culvert geometric data
- A 3D framework for the culvert group is auto-generated
- The mesh for the culvert inverts is auto-generated (overwrites terrain)
- A footprint of the structure mesh is auto-generated for insertion into the mesh generator coverage



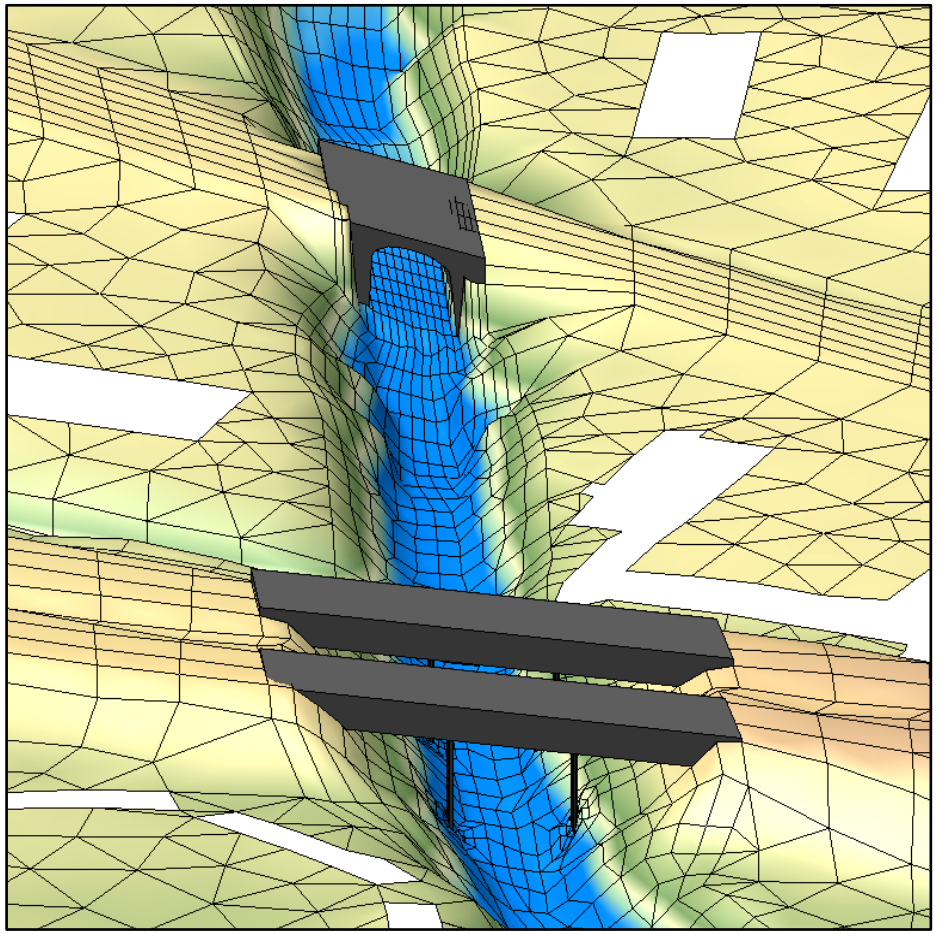
3D Structures – Culverts vs. Bridges

Culverts



Culvert invert elevations are stamped into an automatically generated mesh

Bridges



Channel bed, bridge sloping abutments, and pier pile caps are represented in the terrain data (scatter set or raster)

Workflow for Using 3D Structure Culverts

- Generate a new 3D Structure coverage
- Add road centerline arc, culvert group centerline arc, and abutment arcs (optional for skewed alignments)
- Add vertices along road centerline arc to define the number of elements
- Edit 3D Structure – Select Culvert type
- Enter crest profile
- Enter culvert properties
- Define overtopping parameters
- Preview mesh and edit parameters as needed
- Select options to:
  - *Add 3D Culvert UGRID*
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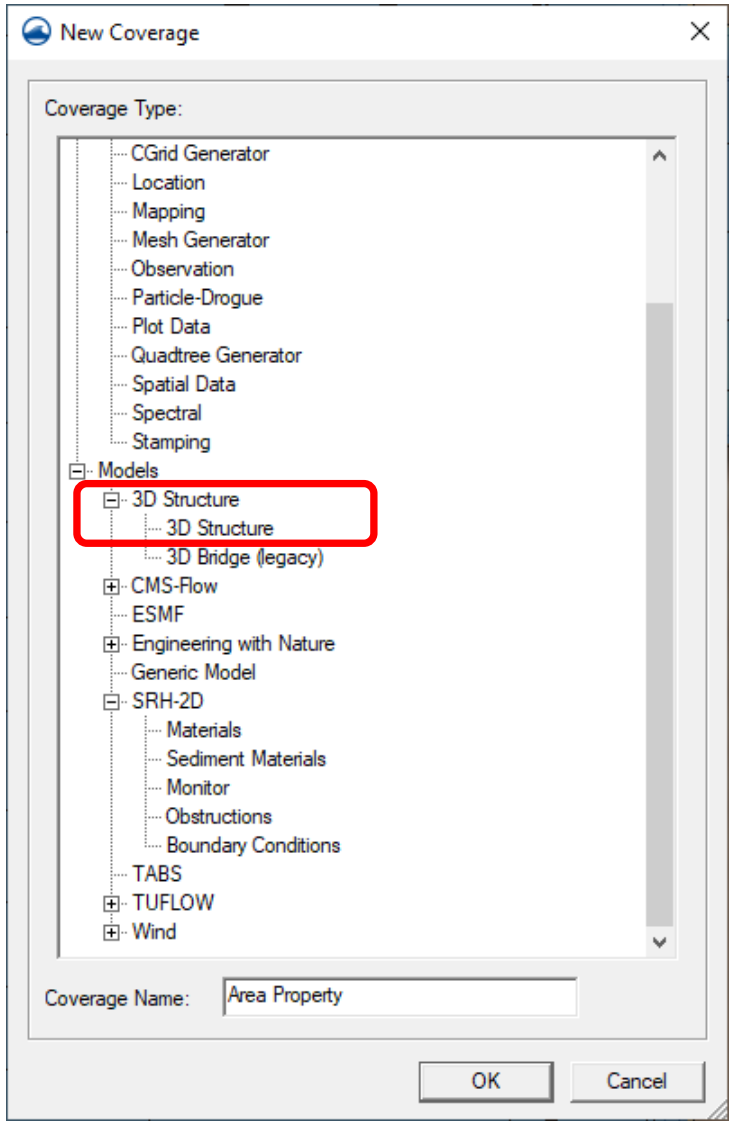

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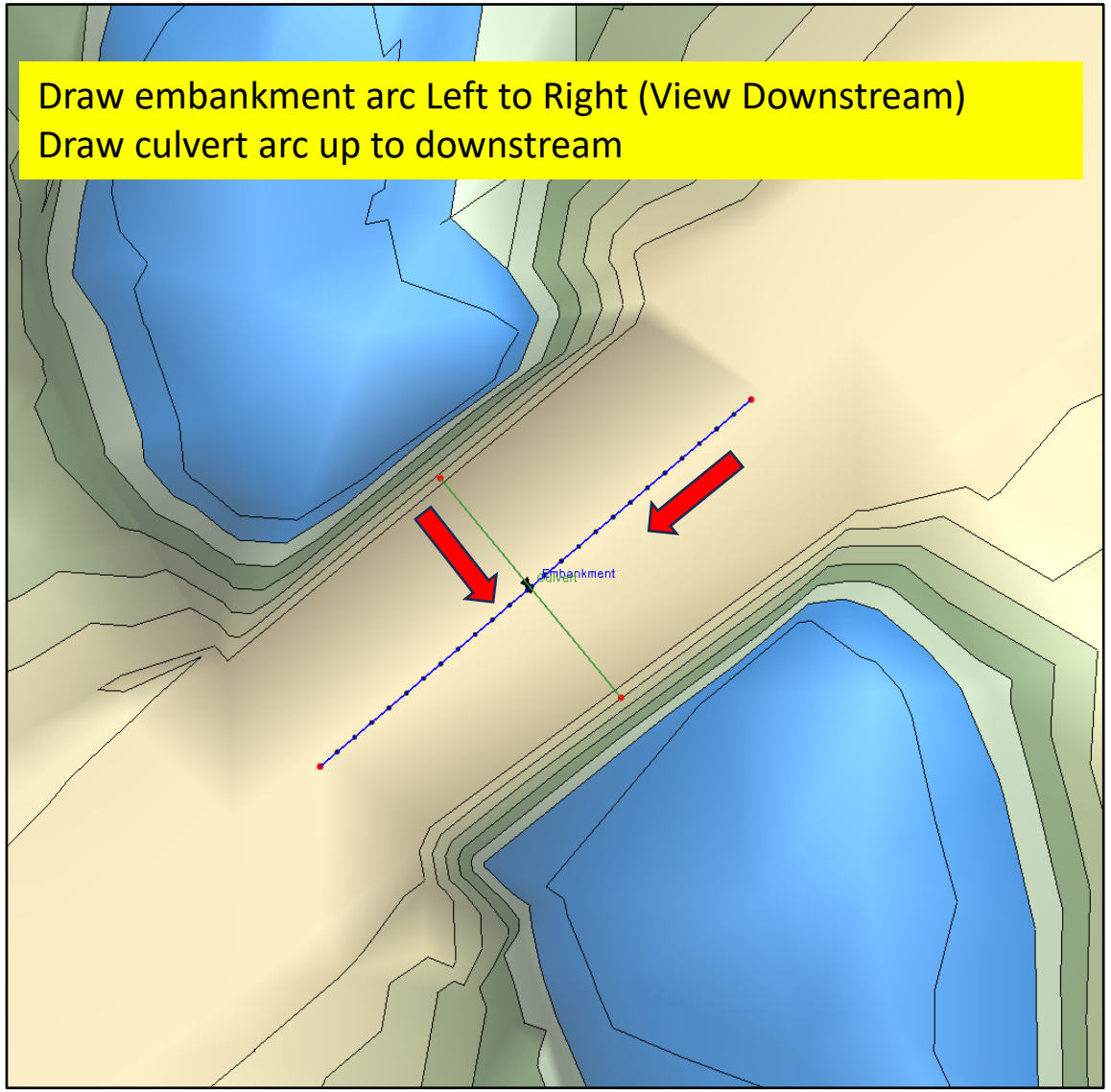

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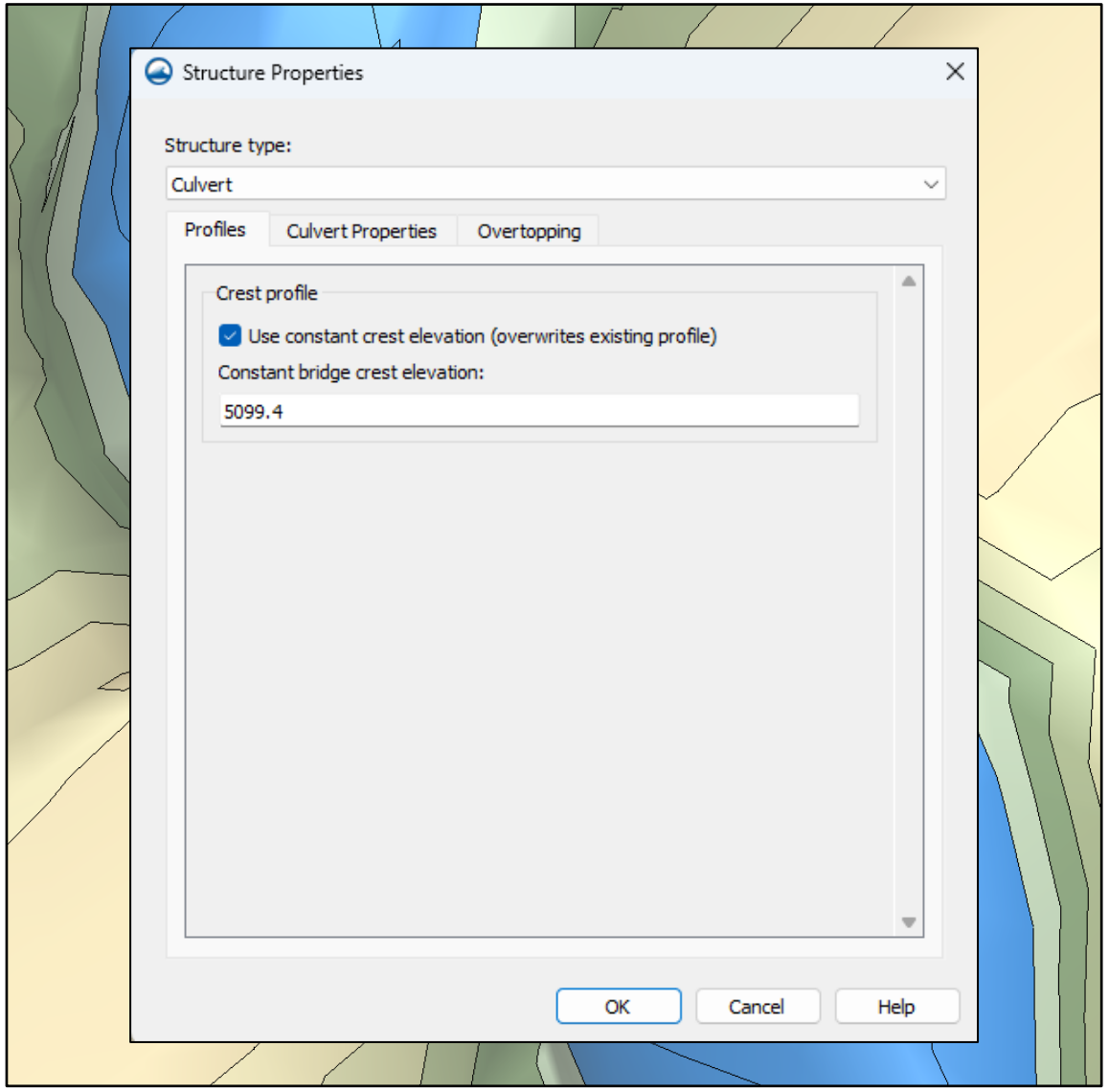

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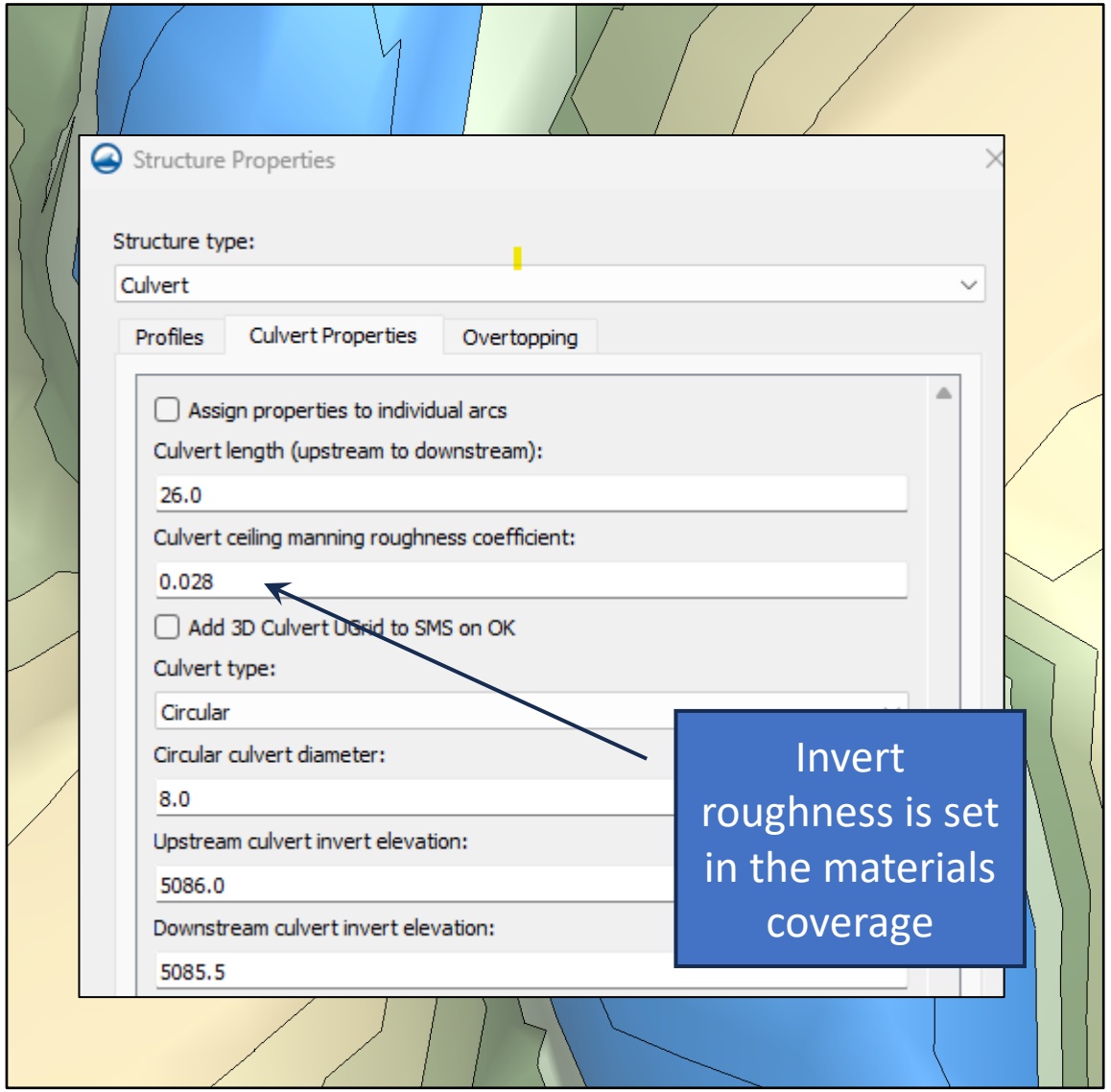

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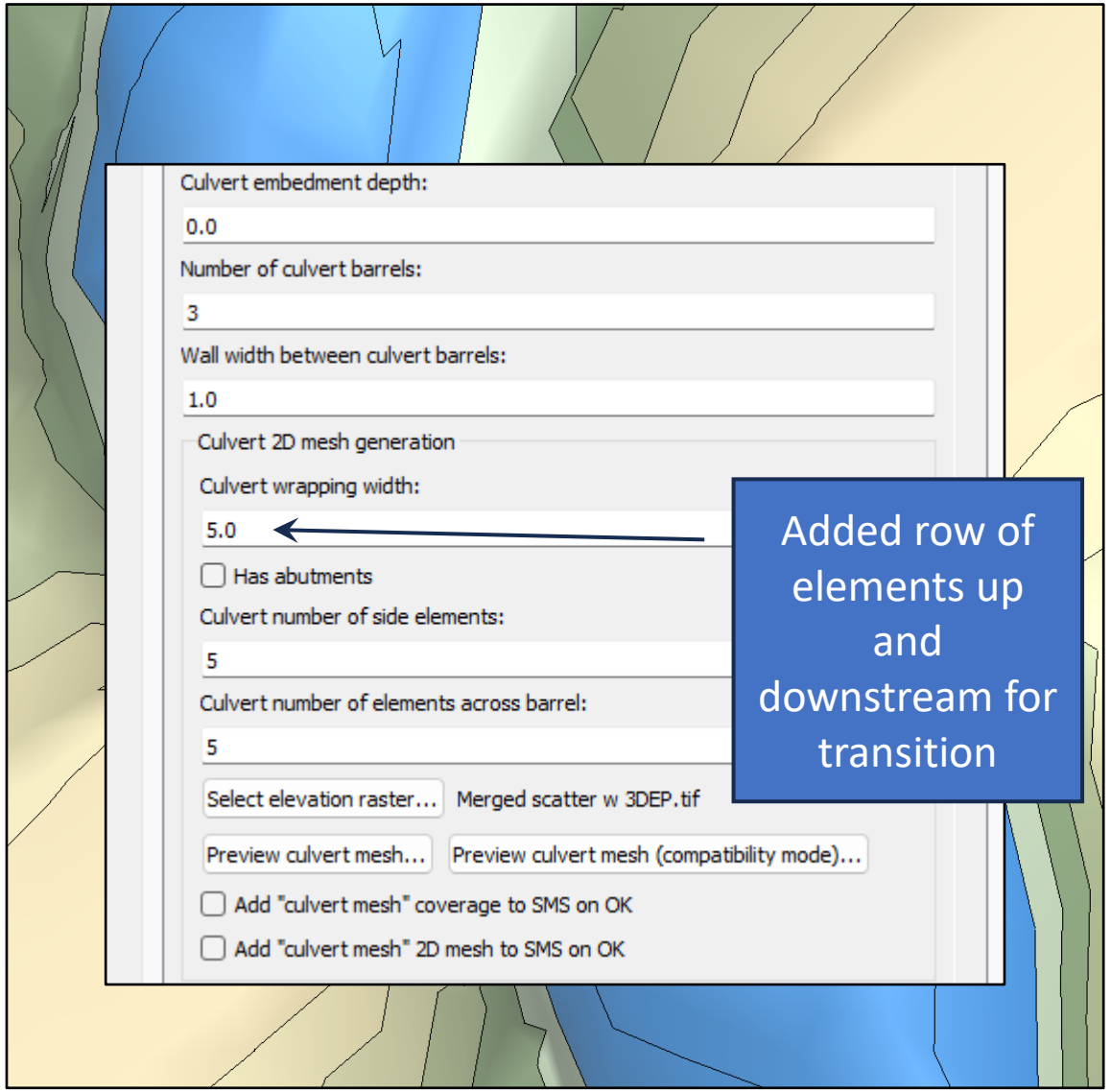

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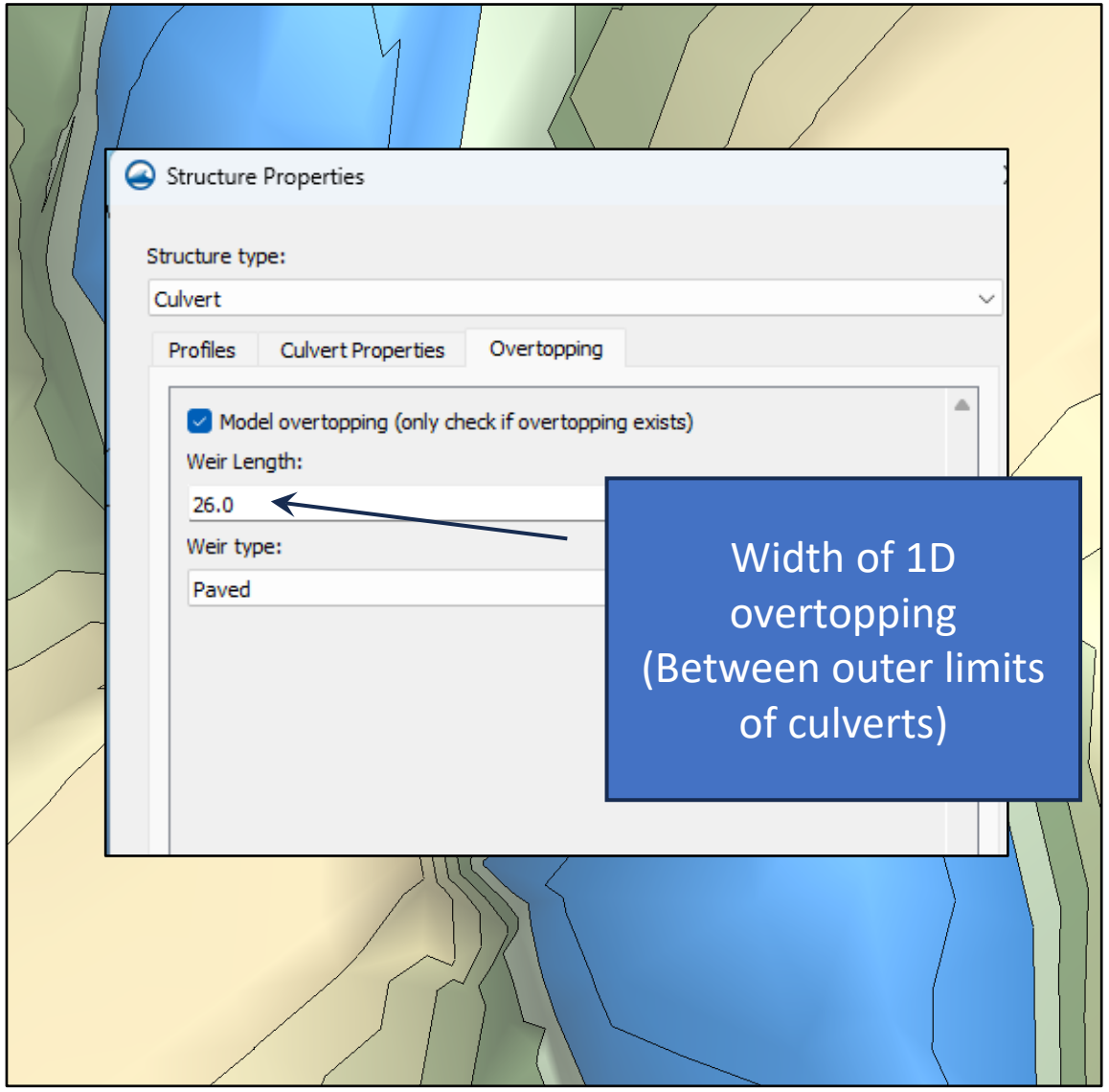

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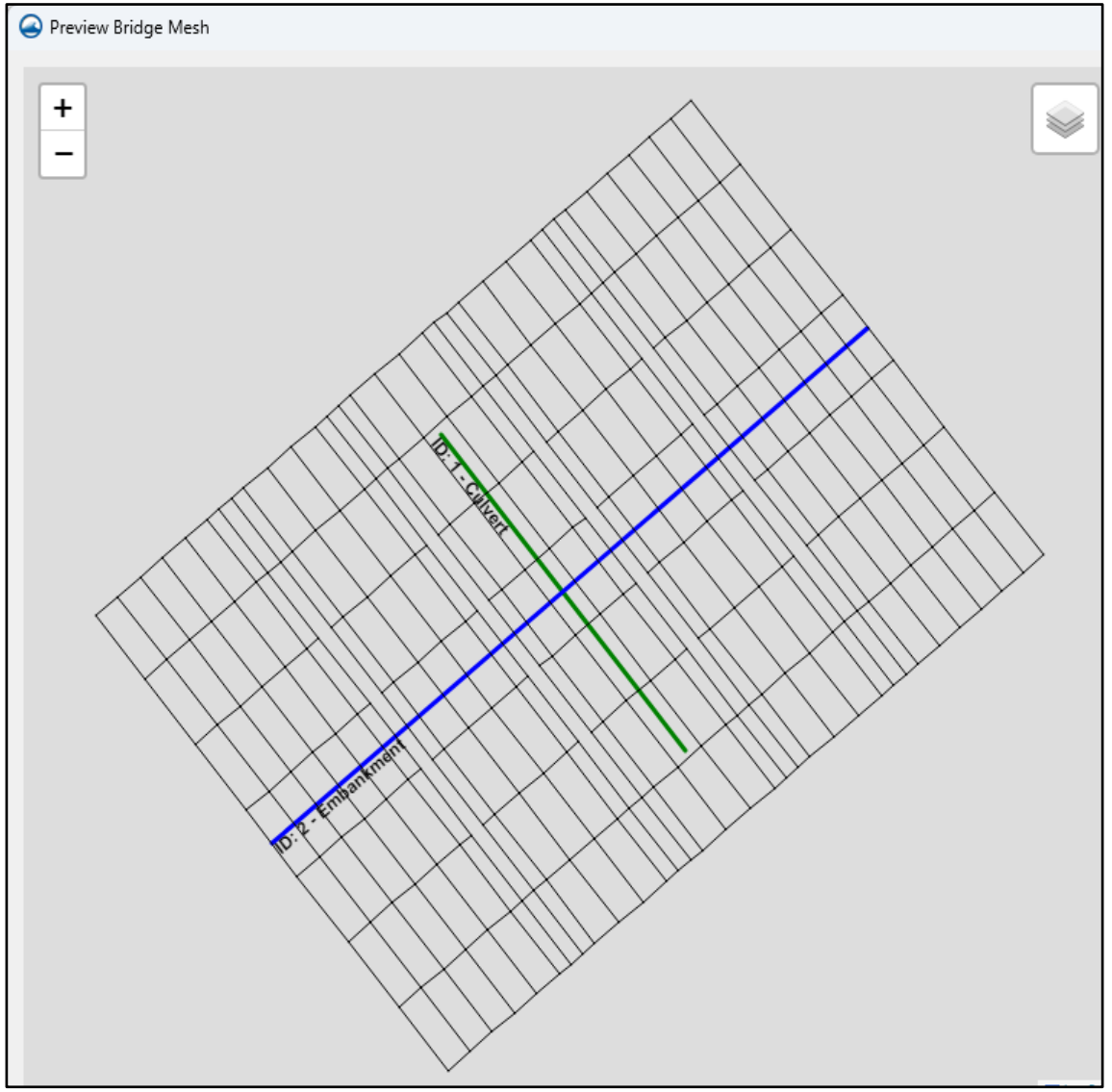

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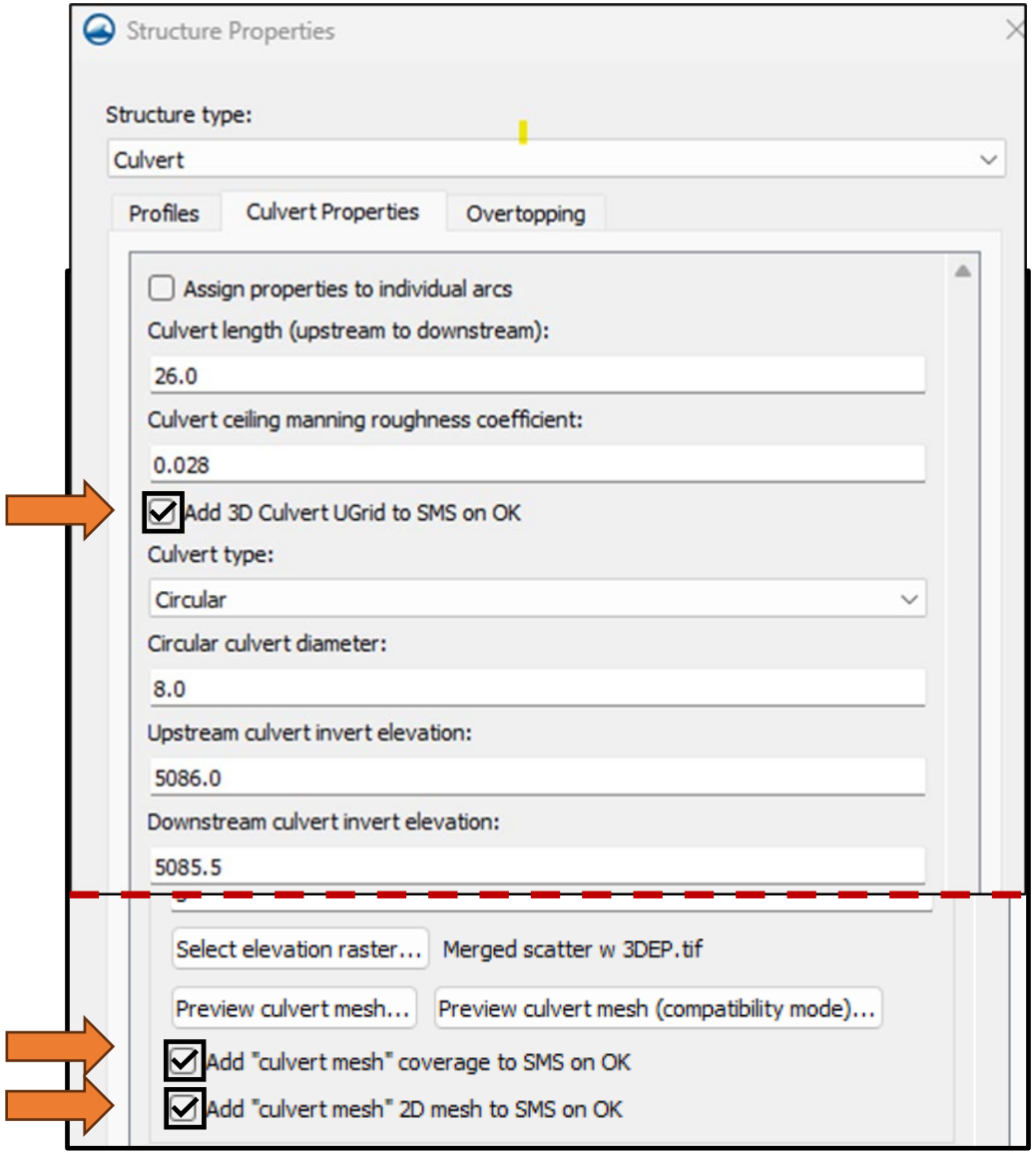

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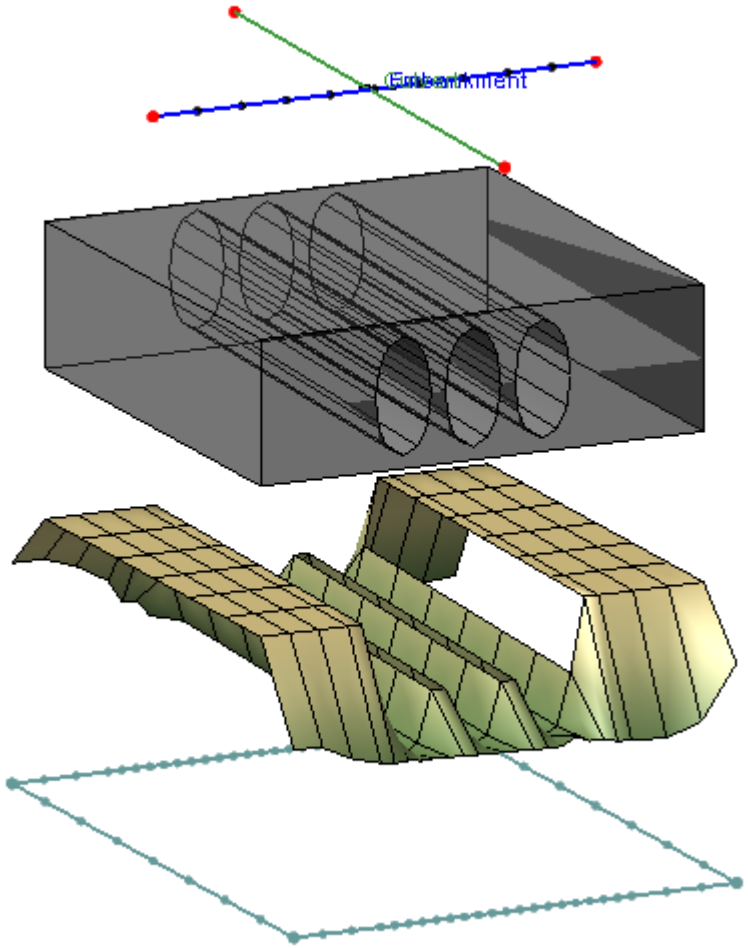


Additional Notes

- Currently limited to box culvert and circular culverts
- More complex shapes (e.g. arch culverts) may be modeled as bridges
- Culvert Invert elevations are automatically generated with the mesh
- Culvert crown elevations are represented by the 3D structure ‘framework’ (UGRID)
- Holes are added in the mesh to represent the culvert walls

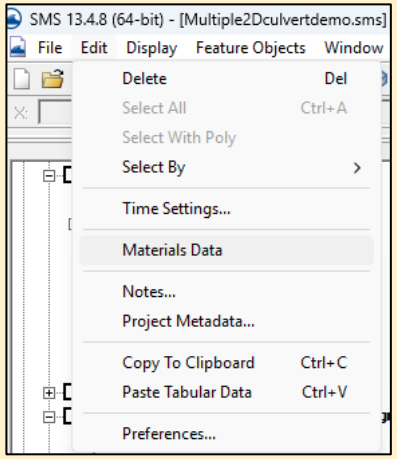
Workflow for Using 3D Structure Culverts

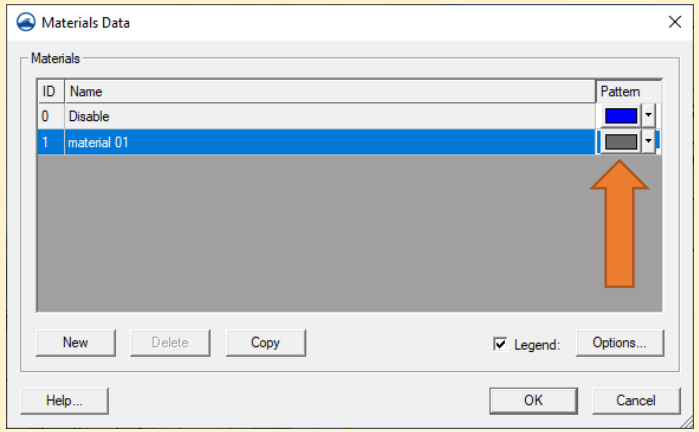
Next Steps…

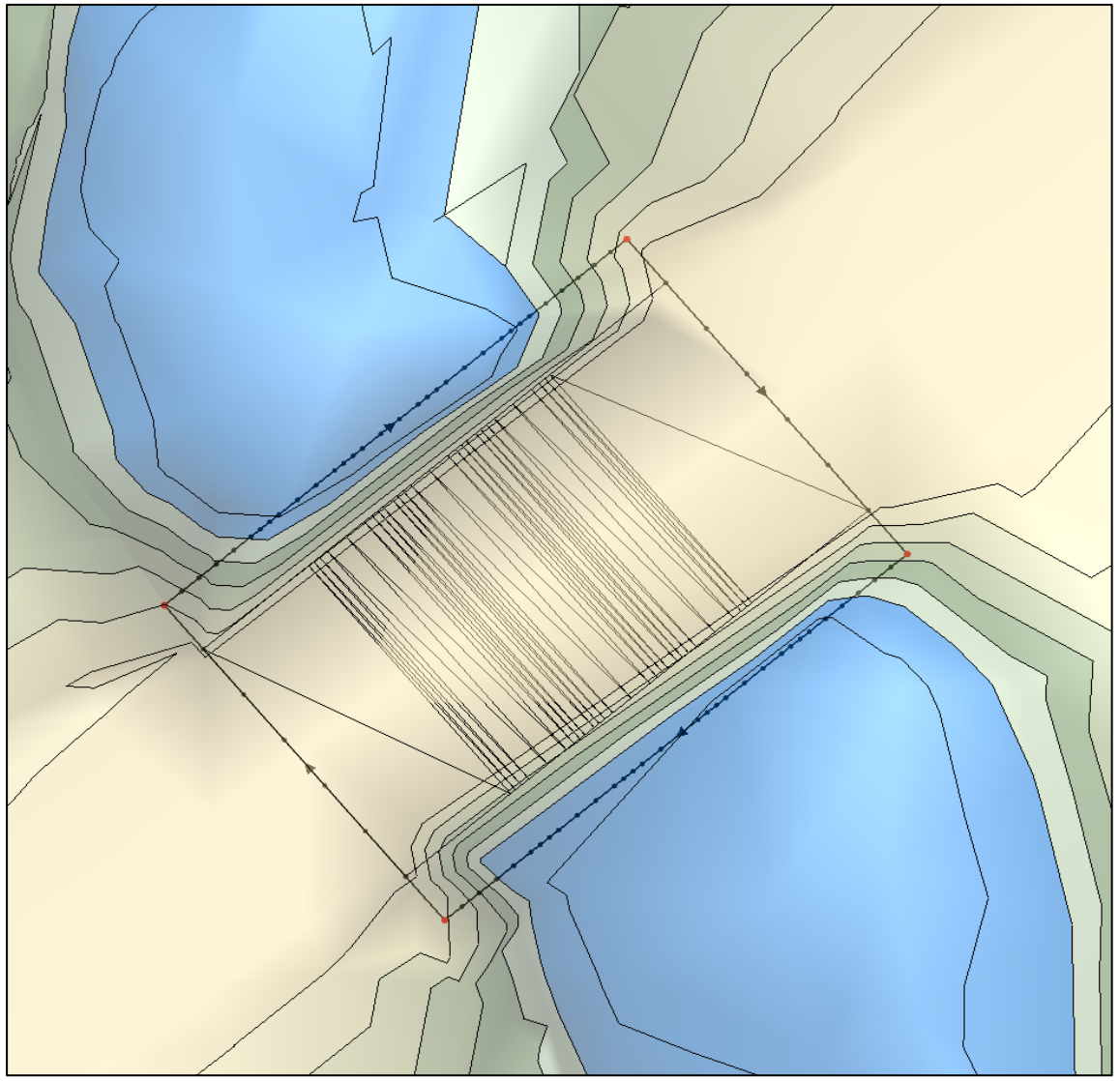
- Set UGRID parameters to view 3D culvert framework

Edit the generic *Materials Data* from the main menu.

Set your color of choice for *material 01*







Workflow for Using 3D Structure Culverts

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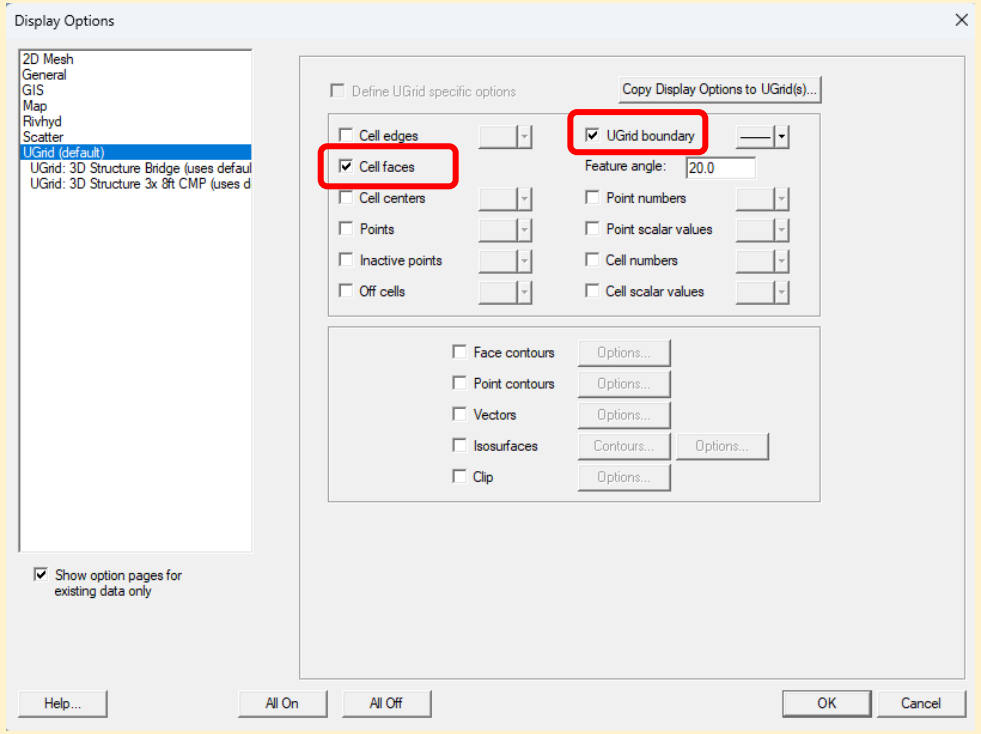
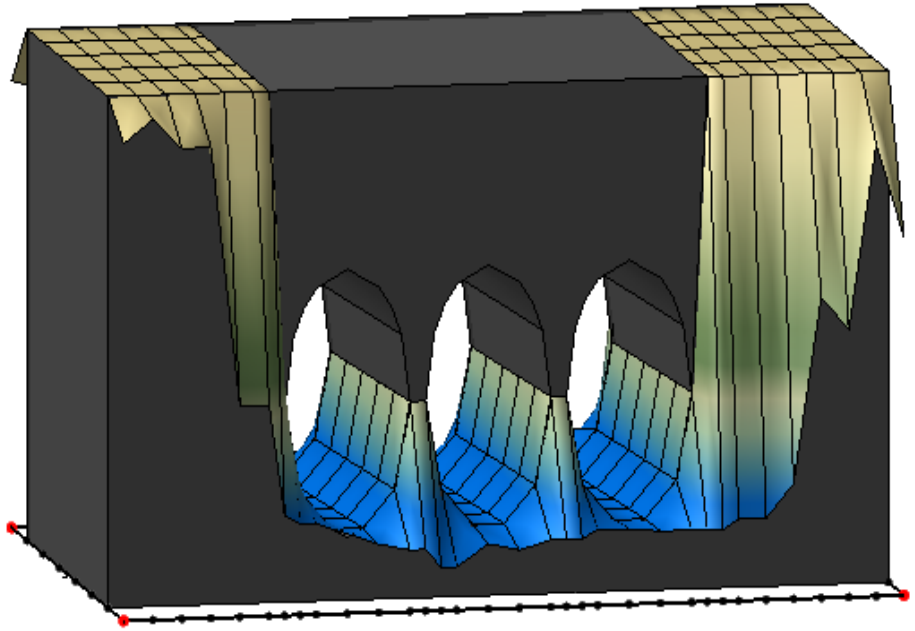
Edit the Display Options for UGRIDs





UGRID 3D Structure with Culvert Mesh

Workflow for Using 3D Structure Culverts

Next Steps…

- Set UGRID parameters to view 3D culvert framework
- Copy culvert footprint to mesh generator coverage and edit coverage

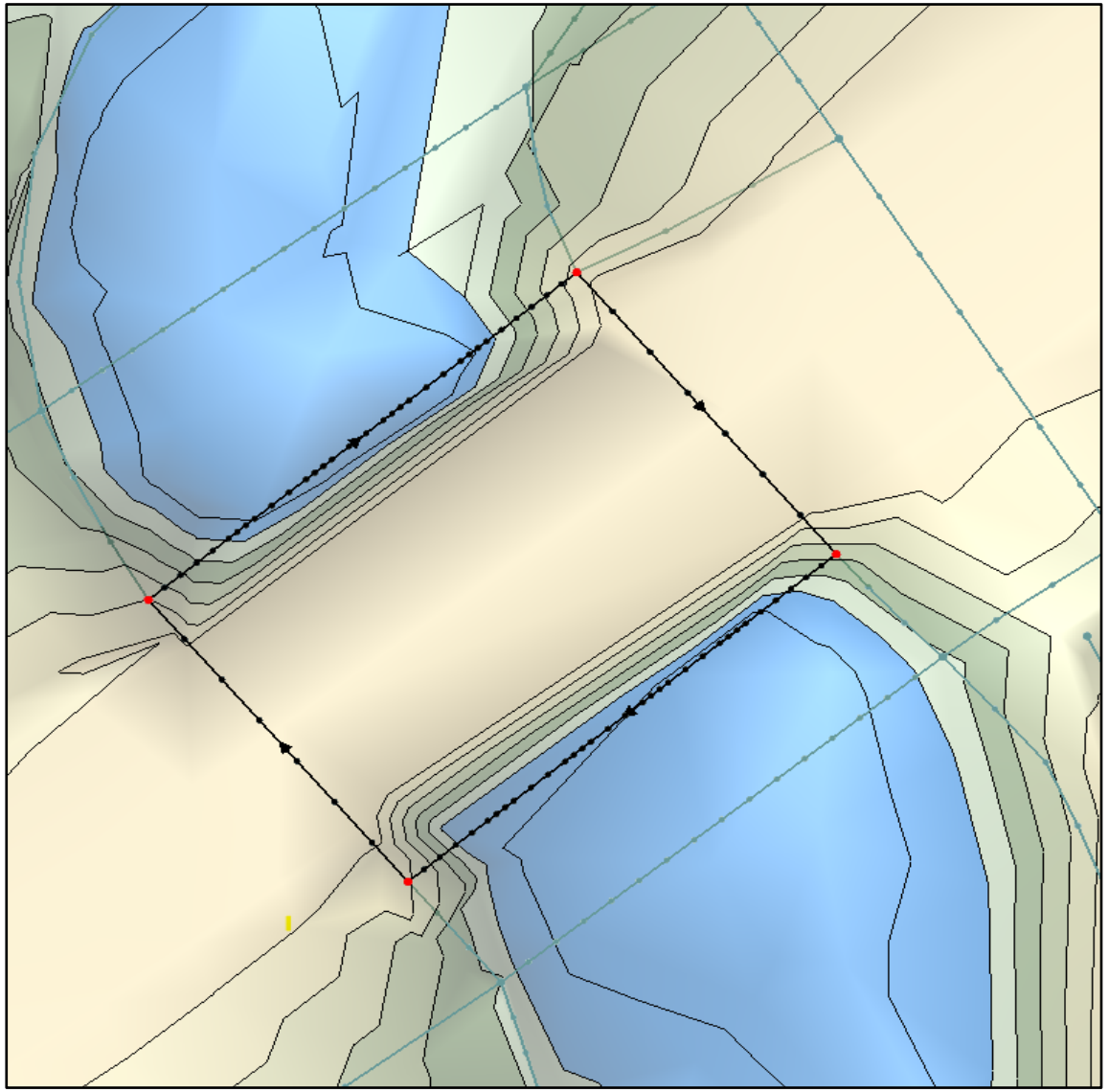
Connect adjoining arcs to culvert polygon.

IMPORTANT! <u>Do Not</u> move any nodes/vertices on the bridge footprint. Arcs may be connected to vertices on the footprint.

Add additional structures as needed.

Clean arcs and build polygons.

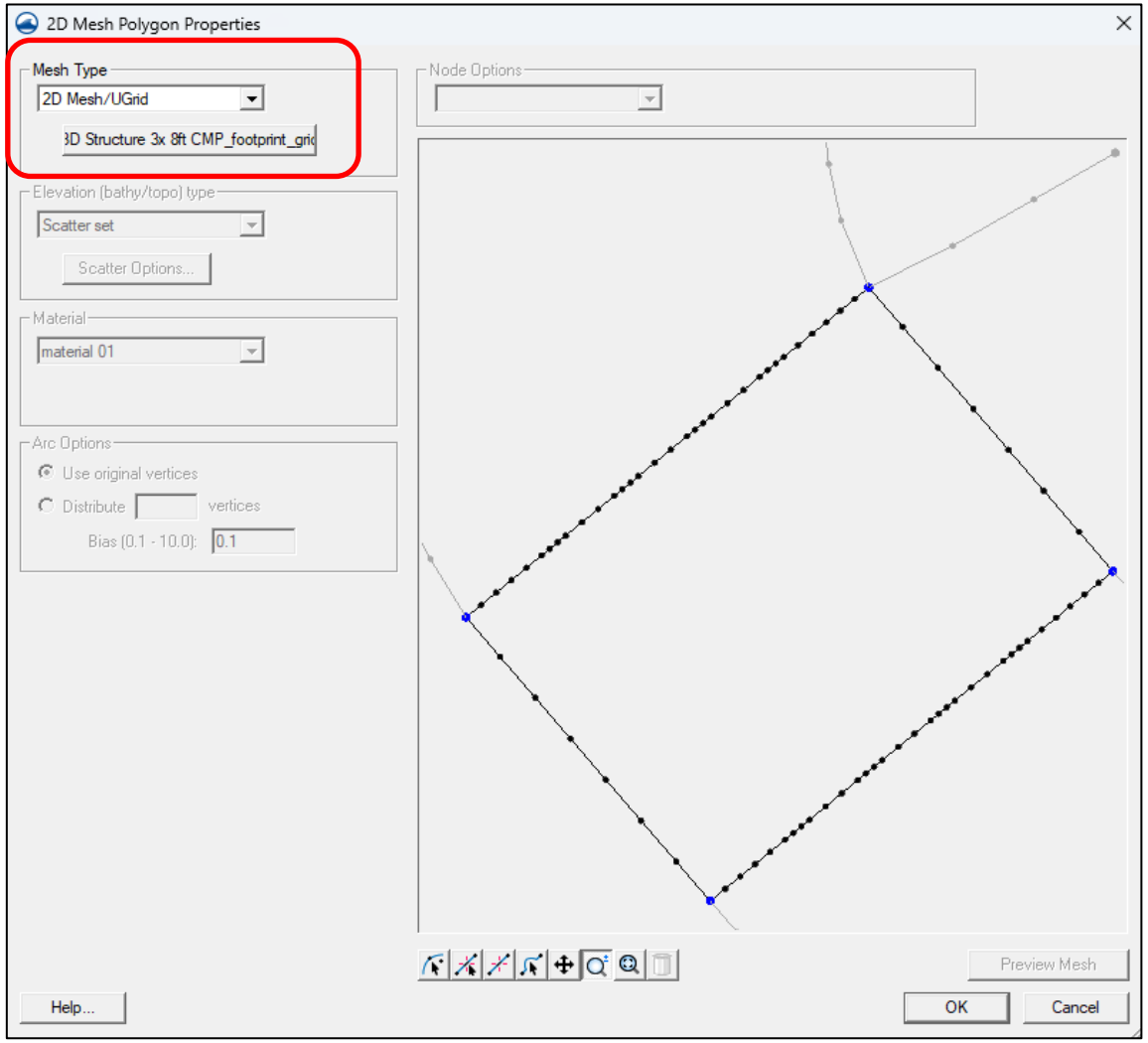
Assign terrain source to polygons (scatter or raster).



Workflow for Using 3D Structure Culverts

Next Steps…

- Set UGRID parameters to view 3D culvert framework
- Copy culvert footprint to mesh generator coverage and edit coverage
- Set culvert footprint mesh type to '2D Mesh/UGRID' and select culvert mesh
- Use the Toolbox: Mesh from coverage tool to generate the mesh
- Link 3D Structure Culverts to the simulation
- Set simulation parameters, run simulation, and review results



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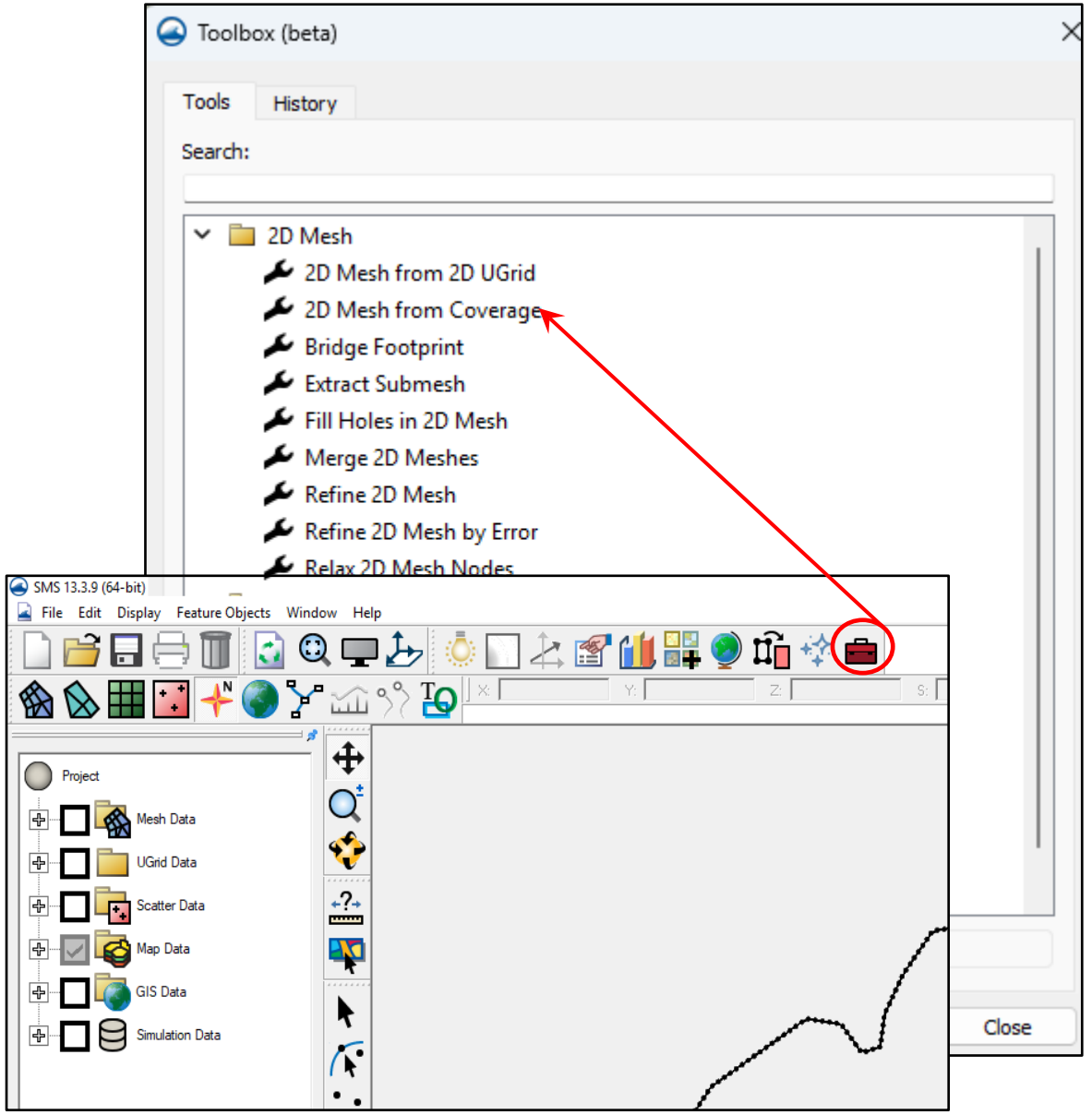

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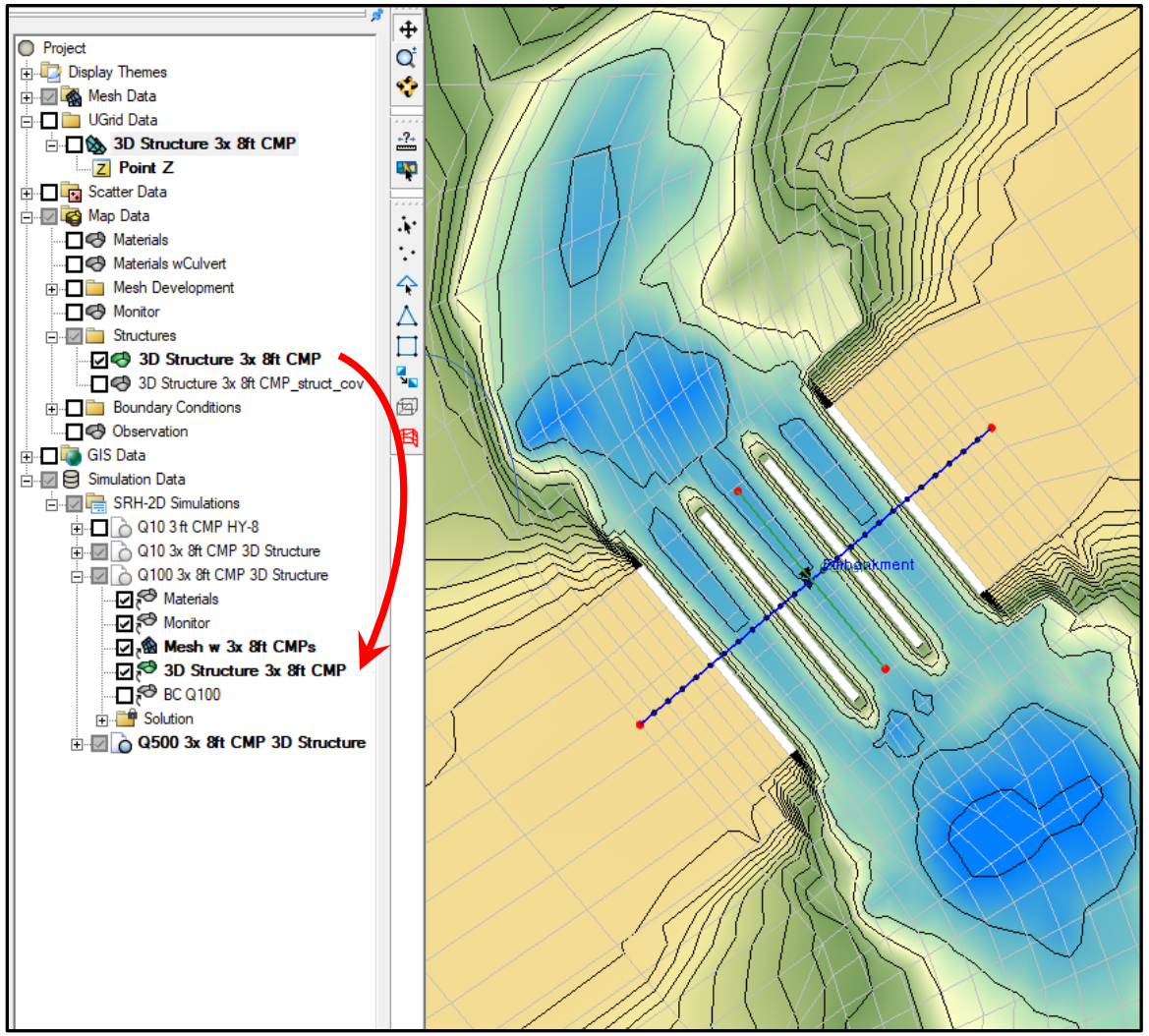

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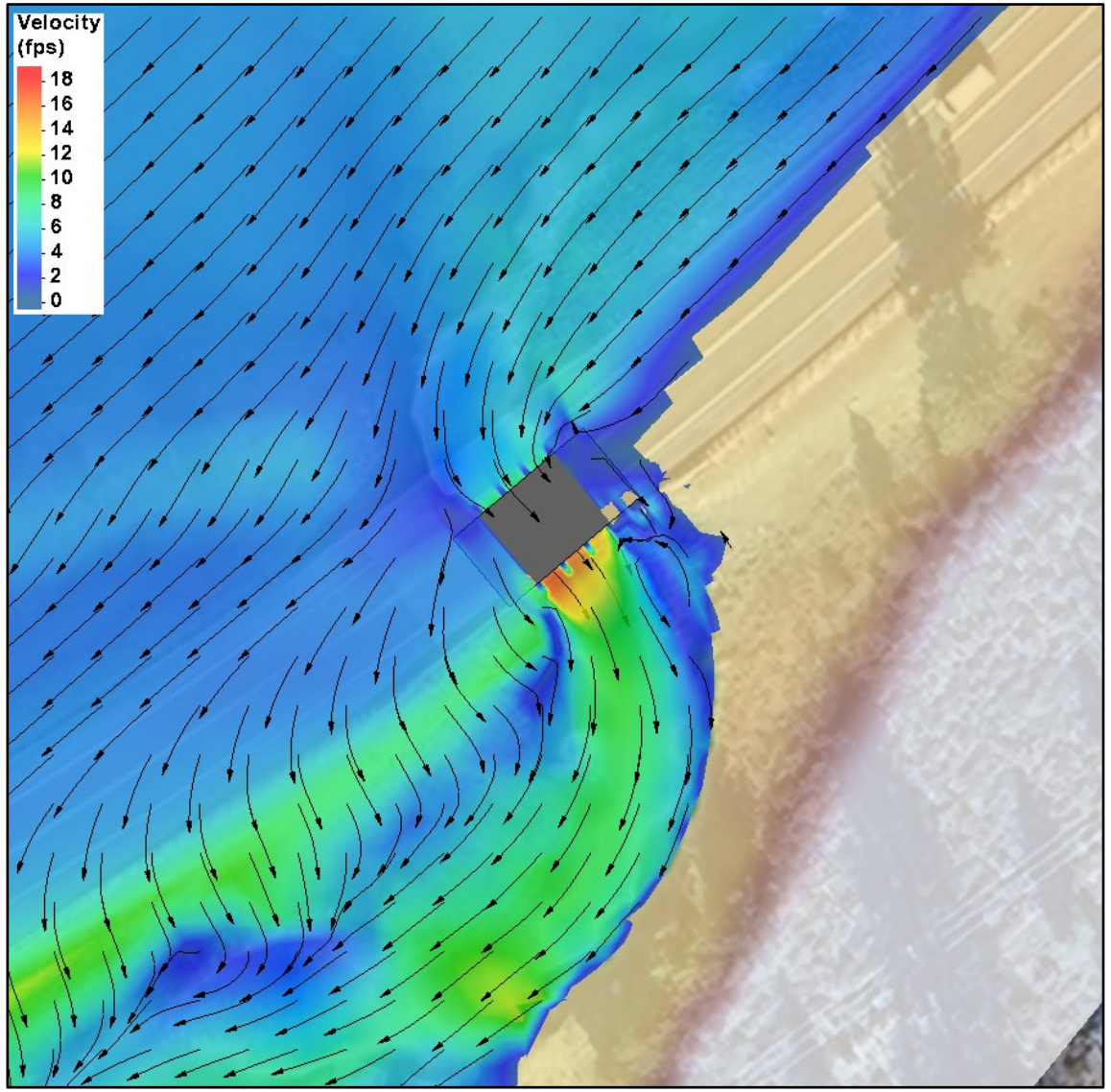

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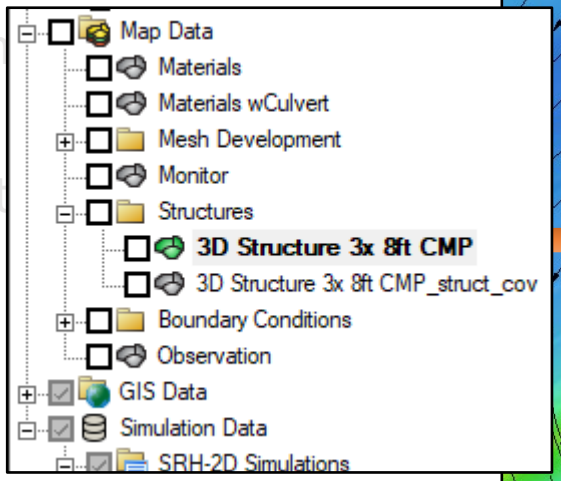

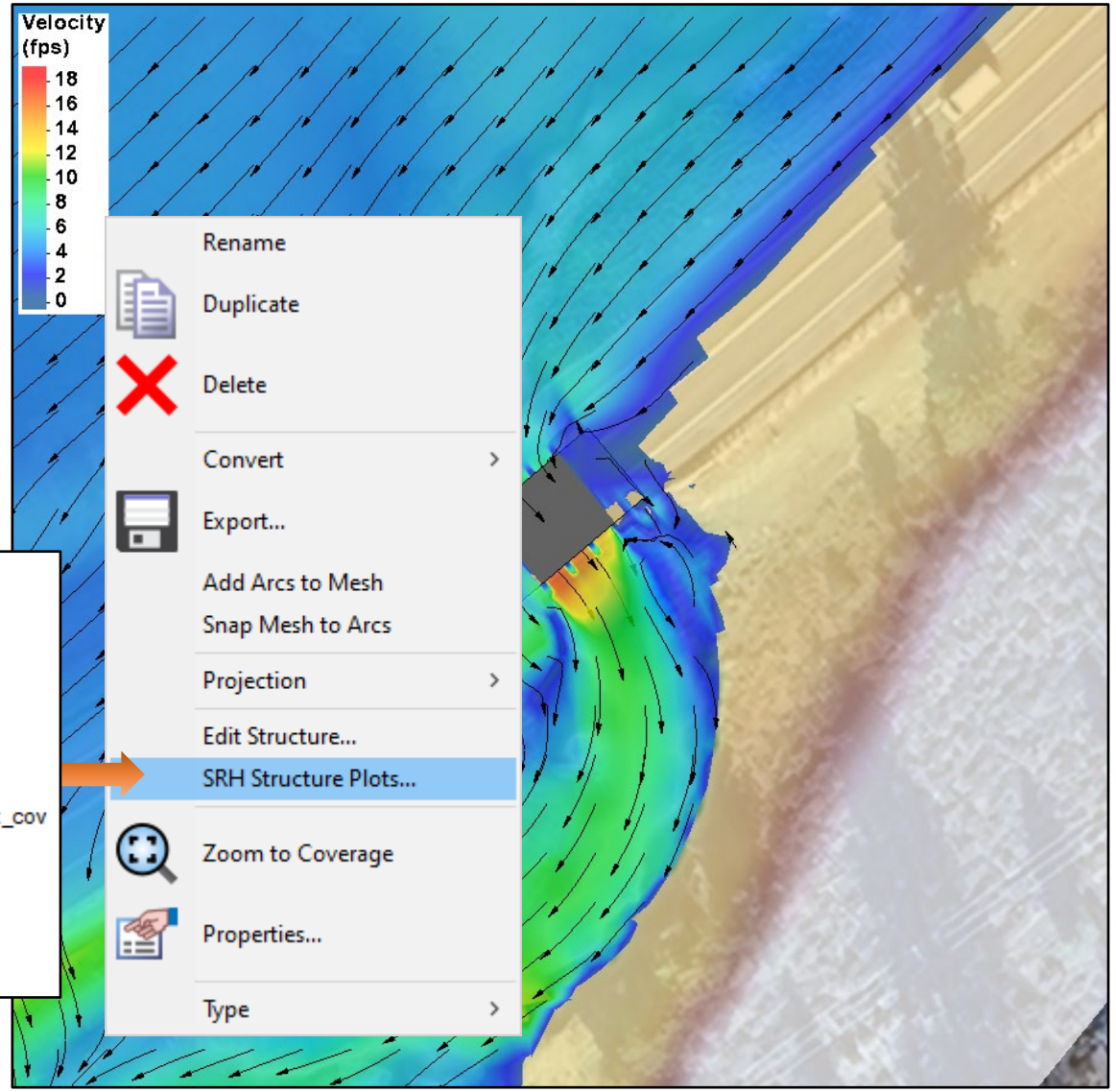

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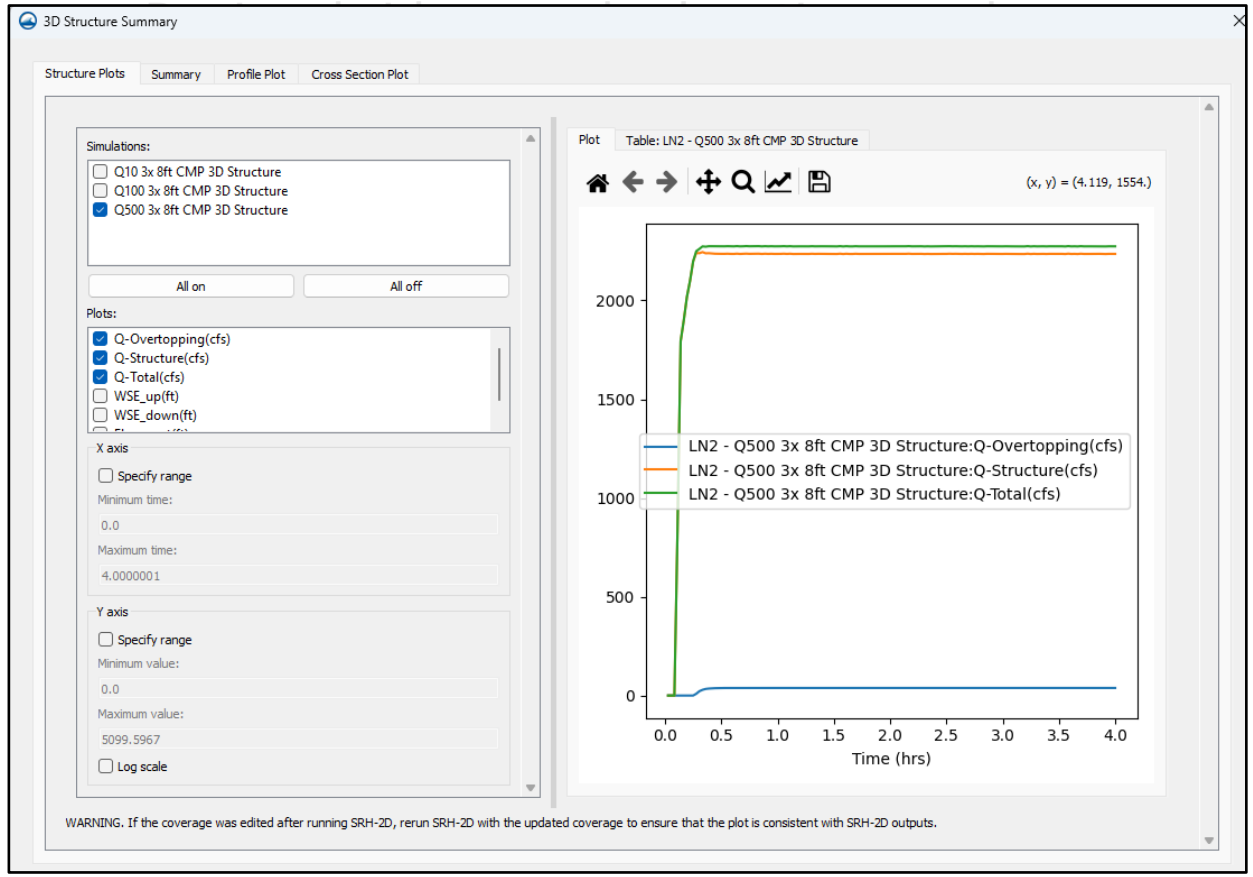
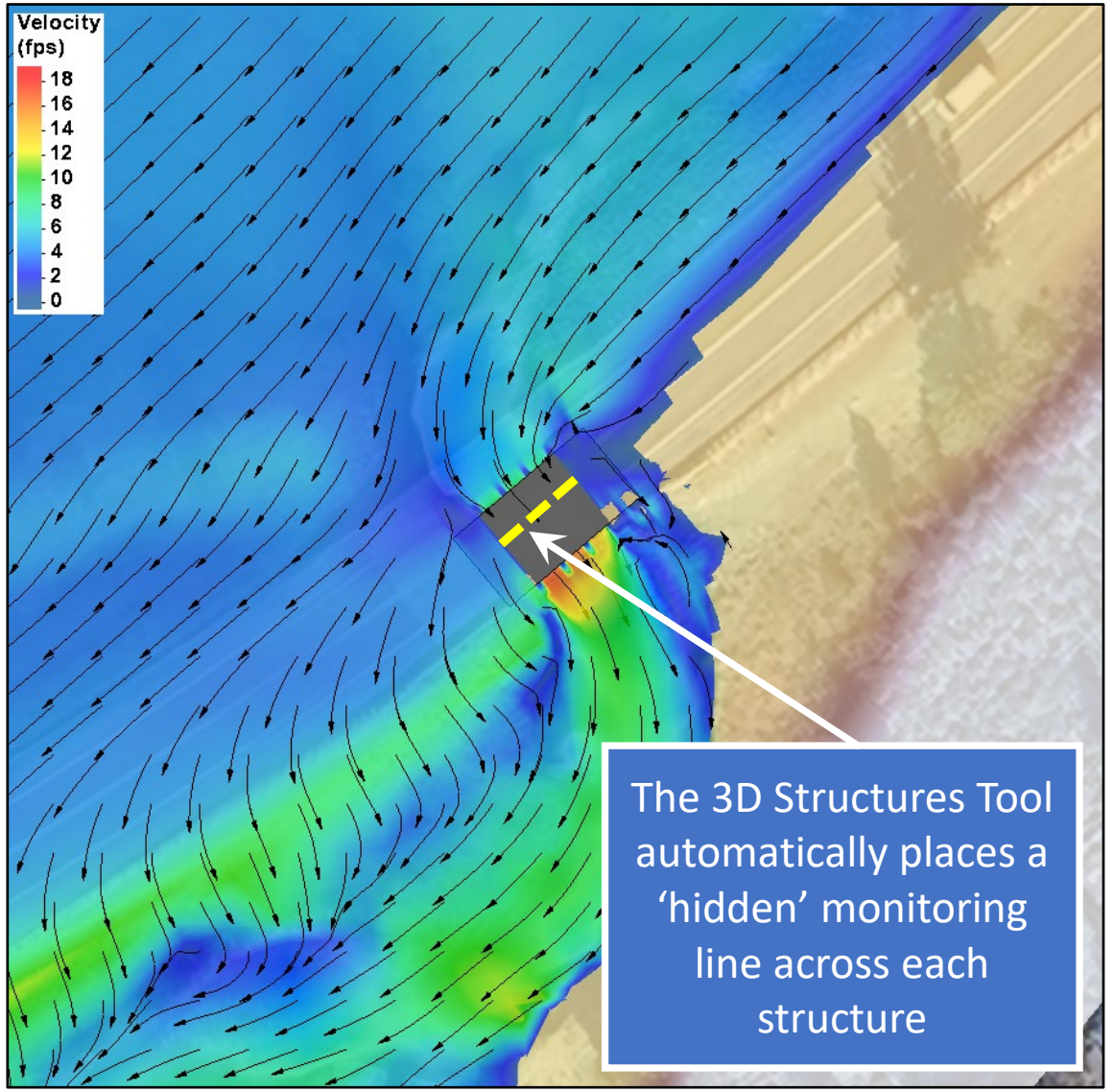


- 'Drag and Drop' or 'Apply To' for each 3D structure
- Set simulation parameters, run simulation, and review results



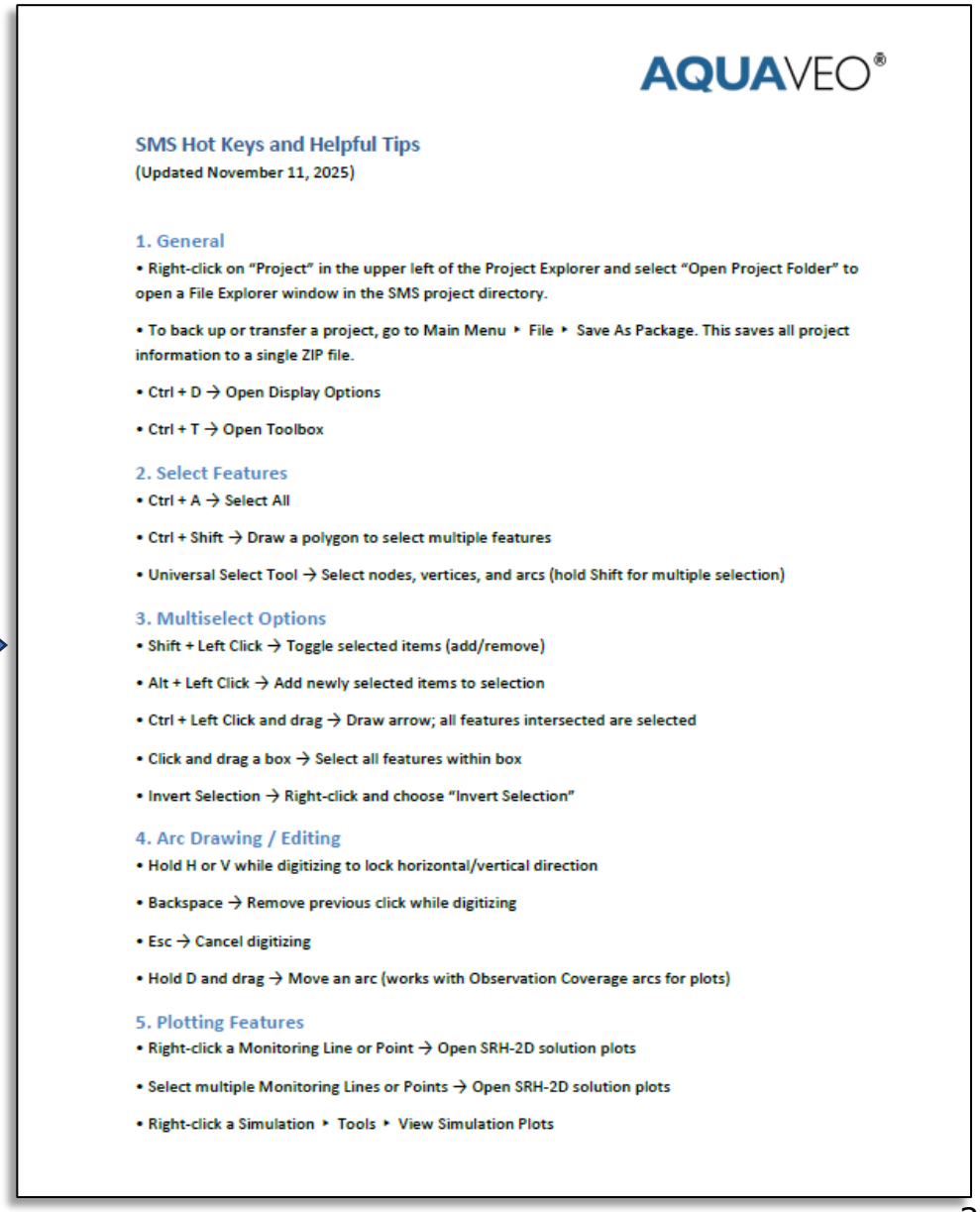
Questions on using 3D Structure Culverts

Tips and Tricks

SMS Hot Keys and Helpful Tips

- General tips
- Select Feature hotkeys
- Multi-select tools
- Arc Drawing
- Plotting Features
- Structures
- View tools
- Simulation tips
- Display settings

Download from the Webinar Series page *Webinar Resources*



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SMS Hot Keys and Helpful Tips

(Updated November 11, 2025)

1. General

• Right-click on "Project" in the upper left of the Project Explorer and select "Open Project Folder" to open a File Explorer window in the SMS project directory.

• To back up or transfer a project, go to Main Menu ▸ File ▸ Save As Package. This saves all project information to a single ZIP file.

• Ctrl + D → Open Display Options

• Ctrl + T → Open Toolbox

2. Select Features

• Ctrl + A → Select All

• Ctrl + Shift → Draw a polygon to select multiple features

• Universal Select Tool → Select nodes, vertices, and arcs (hold Shift for multiple selection)

3. Multiselect Options

• Shift + Left Click → Toggle selected items (add/remove)

• Alt + Left Click → Add newly selected items to selection

• Ctrl + Left Click and drag → Draw arrow; all features intersected are selected

• Click and drag a box → Select all features within box

• Invert Selection → Right-click and choose "Invert Selection"

4. Arc Drawing / Editing

• Hold H or V while digitizing to lock horizontal/vertical direction

• Backspace → Remove previous click while digitizing

• Esc → Cancel digitizing

• Hold D and drag → Move an arc (works with Observation Coverage arcs for plots)

5. Plotting Features

• Right-click a Monitoring Line or Point → Open SRH-2D solution plots

• Select multiple Monitoring Lines or Points → Open SRH-2D solution plots

• Right-click a Simulation ▸ Tools ▸ View Simulation Plots

THANK YOU for participating!
Please contact us with any questions

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