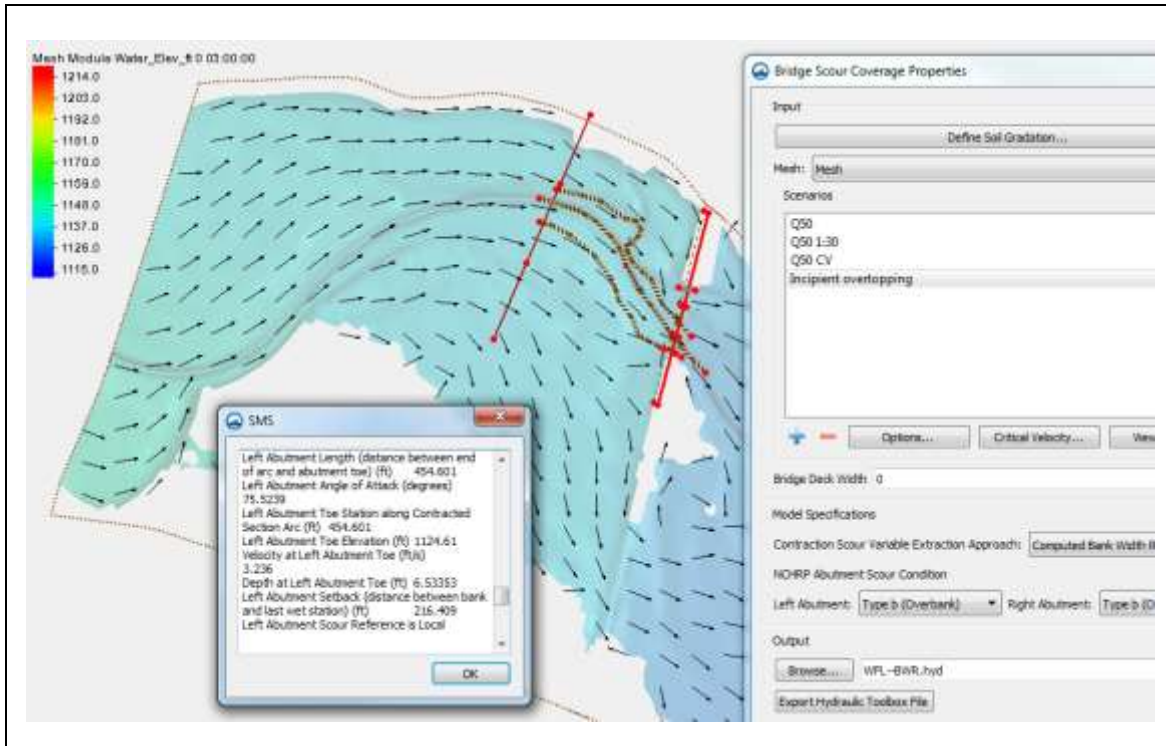


SMS 13.1 Tutorial

Bridge Scour with Multiple Scenarios



Objectives

This tutorial demonstrates how to create a multiple scenario bridge scour analysis using the bridge scour coverage and how to export and review the results to the Hydraulic Toolbox.

Prerequisites

- SMS Overview
- Map Module
- SRH-2D
- Bridge Scour

Requirements

- Map Module
- Mesh Module

Time

- 10–20 minutes

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1 Introduction

Typical scour analyses require the consideration of multiple flow scenarios. This tutorial demonstrates the process of extracting data from multiple 2D hydraulic simulations and exporting the values to the Hydraulic Toolbox to use in analyzing a bridge site for scour.

This tutorial starts with an existing bridge scour project. To review how to set up the arcs for a bridge scour analysis, please refer to the Bridge Scour tutorial.


Bridge scour scenarios will be created in the bridge scour coverage properties. Computations will be completed, and the final scour values will be exported to the Hydraulic Toolbox.

While some explanation is provided about various options and settings, please see the *SMS User Manual* for detailed explanations.

The data used in this tutorial is from the Tazimina River in the state of Alaska in the United States.

2 Getting Started

Start by importing a project file containing the data for this site:

1. Launch the SMS application.
2. Select *File* | **Open...** to bring up the *Open* dialog.
3. Select “Project Files (*.sms)” from the *Files of type* drop-down.
4. Browse to the *data files* folder for this tutorial and select “Tazimina.sms”.
5. Click **Open** to import the project and exit the *Open* dialog.
6. Select the “ Z” dataset to make it active.


The project should appear similar to Figure 1. The bridge scour coverage has already been created with all of the arcs needed.



Figure 1 Initial project

3 Viewing a Scenario

A bridge scour coverage has already been created in the project file with all of the needed arcs and some of the necessary parameters already set. One scenario already exists in the bridge scour tool for the Q50 flow. To view this scenario:

1. Right-click on “ Bridge Scour” and select **Bridge Scour Properties...** to bring up the *Bridge Scour Coverage Properties* dialog.
2. If the *Bridge Scour Coverage Tool Welcome* dialog appears, click **OK**.

Notice the scenario “Q50” has already been created. View the options in this scenario by doing the following:

3. Select the scenario “Q50” in the *Scenarios* section.
4. Select the **Options** button to open the *Edit Bridge Scour Scenario* dialog.

Any of the parameters in this dialog could be changed to edit the existing scenario.

5. Click **Close** to exit the *Edit Bridge Scour Scenario* dialog.

Keep the *Bridge Scour Coverage Properties* dialog open as it is needed to create additional scenarios.


4 Creating Additional Scenarios

The bridge scour tool can make use of multiple scenarios for the same area of study. Adding additional scenarios allows comparison of scour conditions and identifying the worst-case scenario.

4.1 Using a Different Time Step


A scenario can use any of the available time steps from the solution data. The existing scenario represents a flow rate corresponding to the 25-50 year flood. This was simulated in the Q25–50 simulation which uses a step hydrograph starting at the Q25 and then increasing to the Q50 between time 2:00:00 and 3:00:00. Therefore, the Q50 scenario uses the last time step of “05:00:00”.

To create a scenario that uses the flow corresponding to Q25 (a different time step), do the following:

1. Click the **Add**  button to bring up the *Select Tree Item* dialog.
2. Select the “Q25–50” folder item from the list and click **OK** to open the *Edit Bridge Scour Scenario* dialog.
3. For the *Scenario Name*, enter “Q25”.
4. Change the *Time Step* option to “02:00:00”.
5. Click **Close** to exit the *Edit Bridge Scour Scenario* dialog and create the new scenario.

4.2 Using a Different Solution

If multiple simulation solutions are available in a project, any simulation can be used to consider the different flow condition solutions. In this case, there are simulations representing both Q2 and an incipient overtopping condition. To create a scenario for the incipient overtopping, do the following:

1. Click the **Add**  button to bring up the *Select Tree Item* dialog.
2. Select the “Incipient Overtopping” folder item from the list and click **OK** to open the *Edit Bridge Scour Scenario* dialog.

The values have already been set for the new solution data.

3. Select the final time step for this simulation (03:00:00).
4. Select **Close** to close the *Edit Bridge Scour Scenario* dialog.
5. Repeat steps 1–4 to add a scenario for the Q2 simulation.

5 Reviewing Scenario Results

For any scenario available, the results that the bridge scour tool extracts can be reviewed using **View Values...** To illustrate this:

1. In the *Scenarios* section, select the “Q50” scenario and click **View Values...** to compute the bridge scour values and bring the *View Values* dialog. (Note: if needed, resize the dialog to conveniently view the table of values.)
2. If desired, copy the information in this dialog by clicking pressing *Ctrl-A* followed by *Ctrl-C*.
3. Open an external text editor and paste the information using *Ctrl-V*.


4. Click **OK** to close the *View Values* dialog.

If desired, repeat steps 1–4 for each of the other scenarios. The bridge scour tool is not intended to be used as a black box. Rather, it is intended to facilitate the extraction of data from 2D simulations for use in scour calculations in the Hydraulic Toolbox. It is strongly suggested that the values extracted be reviewed to check for obvious errors and verify that values are in a reasonable range.

6 Selecting a 3D Bridge Definition

The Hydraulic Toolbox scour tool can make use of bridge deck geometric to improve the visualized cross section. The bridge deck geometry has no impact on scour calculations.

A 3D bridge component can be selected as the definition of the bridge deck geometry. For this tutorial, a 3D bridge has already been defined. To select this bridge for exporting to the hydraulic toolbox:

1. Click **Select...** in the *Bridge Deck* section of the *Bridge Scour Coverage Properties* dialog. The *Select Tree Item* dialog appears with a list of 3D bridges defined this project.
2. Select the “ I4 Bridge Footprint” bridge coverage in the tree.
3. Click **OK** to close the *Select Tree Item* dialog.

Leave the *Auto compute bridge starting station* on. This option computes an offset to position the 3D bridge geometry along the contracted section. If the bridge is significantly skewed to the river flow, this offset can be manually adjusted to improve the graphical plot. Trial and error may be required in this situation. (Note: remember this has no impact on the scour calculations. It is purely for graphical presentation in the Hydraulic Toolbox.)

7 Exporting the Results

To export the Hydraulic Toolbox file, do the following:

1. Click **Export Hydraulic Toolbox File**.
2. Click **OK** when advised the export is complete.

The results file (in this case, “TaziminaScour.hyd”) can be viewed in Hydraulic Toolbox 4.5 or later. This was installed with SMS and is available from the hydraulics software download page maintained by the Federal Highway Administration.¹

3. Click on the **Launch Hydraulic Toolbox** button to open the Hydraulic Toolbox.
4. Select *File* | **Open** to bring up the *Open* dialog.
5. Select the “TaziminaScour.hyd” file and click **Open** to import the results into the Hydraulic Toolbox.

¹ See <https://www.fhwa.dot.gov/engineering/hydraulics/software.cfm> for more details.

6. In the Hydraulic Toolbox's Project Explorer, double-click on "Bridge Scour Analysis" to open the *Bridge Scour Analysis* dialog.

In the *Multiple Scenarios* section, notice the *Scenario* drop-down. This can be used to select an individual scenario and view the data for that scenario. This is required for entering the specific parameters that don't come from the SMS extraction, i.e. the sediment gradation parameters outside of the main channel such as the overbank gradations or complex pier definitions.

7. Click on the **Bridge Scour Summary Table** button to open the *Bridge Scour Summary Table* dialog.

The *Bridge Scour Summary Table* dialog contains a column for each scenario. Make note of the following:

- The items that are in **bold** show the governing variable in each row. In this case all the bold values are in the columns for Q50 or Incipient Overtopping. Therefore these two scenarios govern the scour predictions.
- Check boxes in the top row allow you to turn on/off a scenario at a time for plotting. If multiple scenarios are plotted, disable the *Color-Filled Plots* option at the bottom of the dialog to reduce clutter.
- Check boxes on the right allow turning on/off individual scour components.

When done, close out of the Hydraulic Toolbox by doing the following:

8. Click **OK** to close the summary table.
9. Click **OK** to close the scour analysis tool.
10. Close the Hydraulic Toolbox application.

Please see the *Bridge Scour* tutorial and the documentation for the Hydraulic Toolbox for information on the various viewing and results assessment options available.

8 Conclusion

This concludes the "Bridge Scour with Multiple Scenarios" tutorial. Feel free to continue to experiment with the SMS bridge scour tool, or exit the program.