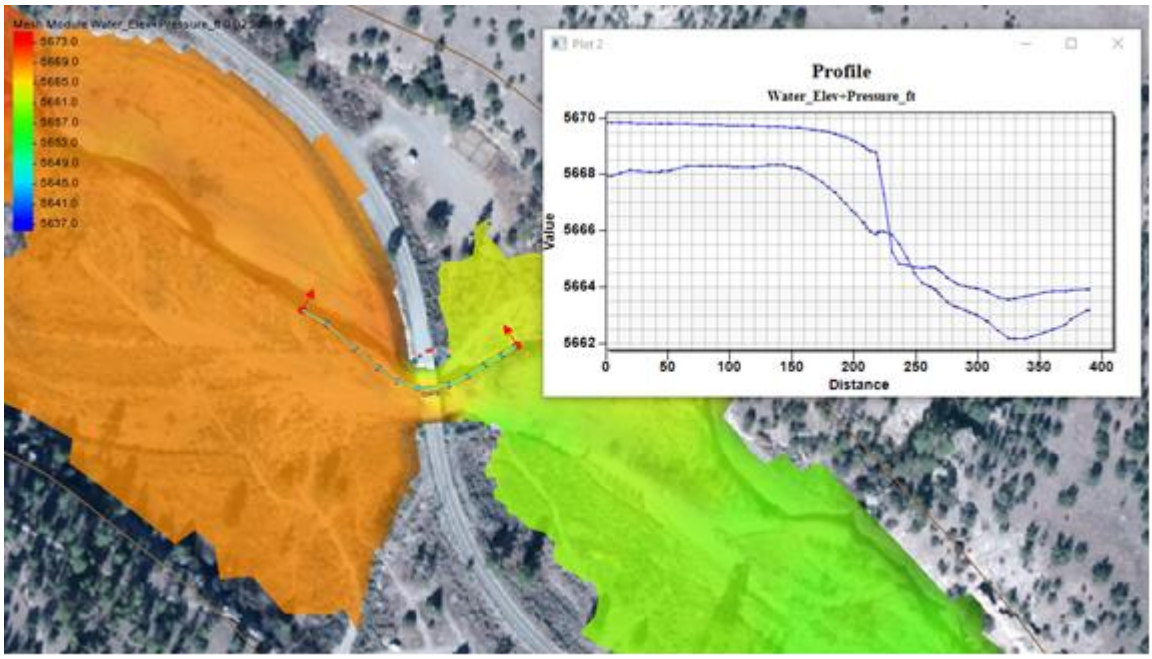
SMS 14.0 Tutorial

SRH-2D Dynamic Input File

Advanced Control of an SRH-2D Simulation



Objectives

This tutorial demonstrates how to use the SRH-2D dynamic input file to control simulation behavior.

Prerequisite Tutorials

- Overview
- SRH-2D
- SRH-2D Simulations

Required Components

- SMS Core
- SRH-2D Model & Interface

Time

- 10–20 minutes

AQUAVEO™

1 Introduction

This tutorial demonstrates how to use the dynamic input file features with SRH-2D in SMS. The dynamic input file provides several advanced options when working with an SRH-2D simulation. As the name suggests, the dynamic input file allows for changes to the simulation while it is running.

This tutorial illustrates three applications of the dynamic file which are supported in the SMS interface. The dynamic input file is not directly accessed by the user but manages the changes made to the simulation in the background.

This tutorial makes use of the Gila River simulation to illustrate these features. Refer to the “SRH-2D Simulations” tutorial for an introduction to this site and simulation.

2 Getting Started

Start by importing a project file containing an existing simulation:

1. If necessary, launch SMS.
2. If SMS is already open, close any existing data by selecting *File* | **New**.
3. If a dialog appears asking to save changes, click **Don’t Save** to clear all data.

The graphics window of SMS should refresh to show an empty space.

4. Select *File* | **Open…** to bring up the *Open* dialog.
5. Select “Project Files (*.sms)” from the *Files of type* drop-down.
6. Browse to the *data_files* folder for this tutorial and select “Gila_Base.sms”.
7. Click **Open** to import the project and exit the *Open* dialog.

The project should appear similar to Figure 1. The project contains a complete SRH-2D simulation similar to the one set up in the “SRH-2D Simulations” tutorial.

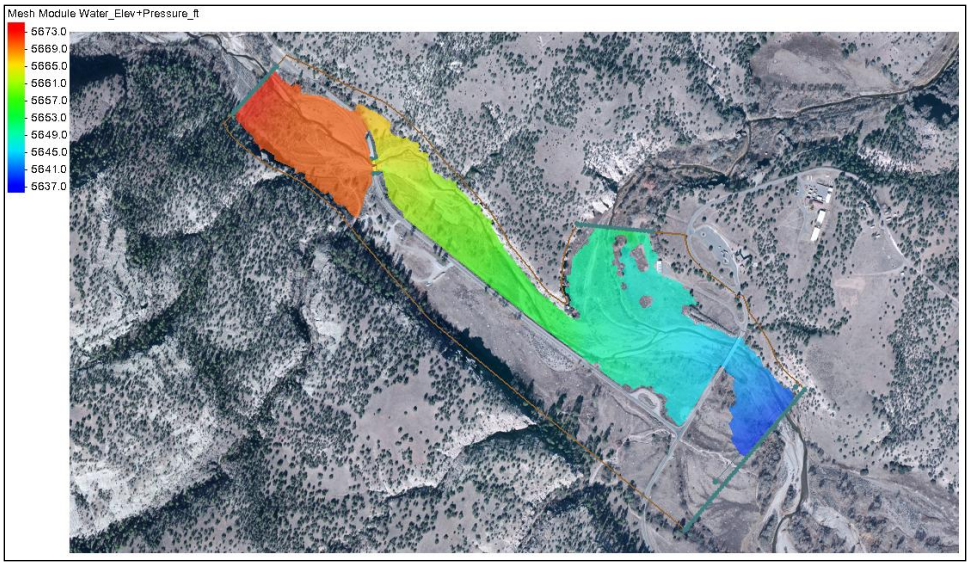


Figure 1 Initial project

3 Running SRH-2D

Before getting started, it is necessary for this tutorial to run SRH-2D in order to obtain a current SRH-2D restart file. To do this:

1. Right-click on "1hr Initial Run" and select **Save Project, Simulation and Run** to execute the simulation.
2. Click **OK** to unload the previous solution if prompted.
3. In the *Simulation Run Queue* dialog, click **Load Solution.**
4. Click **Close** to close the *Simulation Run Queue* dialog.
5. Outside of SMS, open the file explorer.
6. Navigate to the *SRH-2D_DIP\data files\Gila_Base_models\SRH-2D\1 hr Initial Run* folder.
7. Note the location the _RST1.dat file.

This will be used in the next section.

4 SRH-2D Restarting

When defining a simulation from scratch, the user must select a duration for the simulation. This is specified in the simulation model control and is specified in hours. If the simulation represents a hydrograph, the length of the hydrograph is the basis for this duration. There may be additional time needed at the start of the simulation as the flow conditions reach a stable point matching the desired conditions for the beginning of the hydrograph. If the simulation represents constant flow conditions, the user approximates (guesses) a duration that is long enough to reach steady state. If this guess is too low, the simulation does not reach steady state and must be extended. If this guess is too high, extra computation time is required after steady state is achieved.

A typical modeling project will involve dozens of simulation runs including exploratory runs, calibration runs, sensitivity analysis runs and design scenario runs. Therefore, the

initial guess is usually not too critical. If the specified value is too long or too short, the user can simply change the duration for subsequent runs.

However, SRH-2D includes an option to continue a simulation that was too short from where it left off. This requires that:

- The restart simulation has time series boundary conditions even if the value is constant.
- The restart simulation matches the original simulation in all respects except that the user selects the "Restart File" option as the *Initial condition* for the simulation and selects the file created by SRH-2D in the previous simulation run.

For this example, the initial simulation has a duration of 1 hour. Review and modify this simulation using the following steps:

1. Right-click on " 1hr Initial Run" and select *Tools* | **View Simulation Plots** to bring up the *SRH-2D Solution Plots* dialog.
2. From the *Plots* list, select the "Net_Q/INLET_Q" plot.

Note that the simulation did not get to steady state. This plot converges to 0.0 when steady state flow is reached.

3. Click **Close** to exit the *SRH-2D Solution Plots* dialog.
4. Right-click on " 1hr Initial Run" and select **Model Control…** to bring up the *SRH-2D Model Control* dialog.
5. Change the *End time (hours)* to "3.0".
6. Change the *Initial condition* to "Restart File"
7. Click **Select File…** to open the *Select File* dialog.
8. Navigate to the *SRH-2D_DIP\data files\Gila_Base_models\SRH-2D\1 hr Initial Run* folder.
9. Click on "Standard_Run_RST1.dat" to select it.

Note: this file is in the simulation folder for the previously executed simulation.

10. Click **Select** to select the file and close the *Select File* dialog.
11. Click **OK** to close the *SRH-2D Model Control* dialog.
12. Right-click on " 1hr Initial Run" and select **Save Project, Simulation and Run** to execute the simulation again.
13. Click **OK** to unload the previous solution if prompted.

In the *Command line* tab of the *Simulation Run Queue,* note that SRH-2D gives a message that the simulation is starting at time 1.0 hours. The *Start time* specified in the model control dialog is ignored if the *Restart File* option is enabled.

In the *Net Q Plot* tab, note that the plot starts at 1 hour (rather than 0.0) and the vertical range of the plot is only from -0.04 to 0.0. The previous solution was close to converged.

14. Click *Load Solution* to load the solution.
15. Click **Close** to close the *Simulation Run Queue* dialog.

Note: SRH-2D also supports an option to use the water surface value from a restart file as an initial water surface. In versions of SMS prior to version 13.4, the SMS interface used this initial water surface option. From version 13.4 onward, SMS creates an entry

in a dynamic input file (DIP) for this simulation to enable the full restart option, which sets water surface, velocity, and time at the start of the run. SMS supports a separate "Water Surface Elevation Dataset" initial condition, illustrated in the "SRH-2D Variable Water Surface Elevation Initial Condition" tutorial

5 Terminating a Simulation at Convergence

Reviewing the simulation plots for the simulation executed in the previous section show that the simulation actually converged well before the specified 3.0 hours of simulation time. The DIP file can also be used to terminate a simulation when convergence is reached.

To activate this option, do the following:

1. Right-click on "  1hr Initial Run" and select **Model Control…** to bring up the *SRH-2D Model Control* dialog.
2. In the *Advanced* tab, turn on the *Use termination criteria* option.
3. Click **OK** to close the *SRH-2D Model Control* dialog.
4. Right-click on "  1hr Initial Run" and select **Save Project, Simulation and Run** to execute the simulation again.
5. Click **OK** to unload the previous solution if prompted.
6. In the *Simulation Run Queue* dialog, click on the *Net Q Plot* tab.

Note that the time range terminates at around 2.8 hours instead of running the full specified time. This is because SMS detected that the net flow was not changing and triggered an early termination in the DIP file.

7. Click *Load Solution* to load the solution.
8. Click **Close** to close the *Simulation Run Queue* dialog.

6 Modifying the Simulation Time Step

One other feature managed in the DIP file has been added in SMS version 13.4. This is the ability to modify the computation timestep during the simulation execution.

The beginning of a simulation often includes significant changes to the flow condition because the most common initial conditions (dry or flat water surface with zero velocity) are not close to the actual flow conditions. Because these changes are large, a smaller timestep may be needed to maintain stable numerical analysis. However, once the simulation has reached a level of stability, the changes to the flow conditions during the simulation are more gradual and a larger timestep can be used.

To illustrate how this is accomplished in SMS:

1. Right-click on "  1hr Initial Run" and select **Duplicate.**
2. Right-click on "  1hr Initial Run (2)" and select **Rename.**
3. Enter "Varied Time Step" for the new simulationname.
4. Right-click on "  Varied Time Step" and select **Model Control…** to bring up the *SRH-2D Model Control* dialog.
5. Change the *Initial condition* option to "Automatic".

This was the option at the start of this tutorial.

6. In the *Advanced* tab, click the *Use initial and secondary time step* option.
7. For *Secondary time step,* enter “4.0”.
8. For *Activation time for secondary time step,* enter “1.0”.
9. Click **OK** to close the *SRH-2D Model Control* dialog.
10. Right-click on “ Varied Time Step” and select **Save Project, Simulation and Run** to execute the simulation.
11. Click the **Load Solution** button to load the solution.
12. Click **Close** to close the *Simulation Run Queue* dialog

This simulation should run to simulate just over 1.5 hours. The simulation changed to a larger time step at 1.0 hours and terminated automatically when steady state conditions were attained.

7 Comments on Initial Conditions in SRH-2D

The most stable numerical simulation is one that starts with the final answer. If we had the final answer, we wouldn’t need to run the simulation. Therefore, SRH-2D and the SMS interface provide options to provide initial conditions in a number of ways to reduce calculation time and increase flexibility. The responsibility remains on the user to make sure calculations have been completed and are stable.

8 Conclusion

This concludes the “SRH-2D Dynamic Input File” tutorial. Feel free to continue to experiment with the SMS SRH-2D simulation options or exit the program.