Technical Documentation Version 7.3

Run Control

Center for Advanced Decision Support for
Water and Environmental Systems (CADSWES)

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The **Run Control** dialog controls the execution of a run, as well as providing the interface for selecting the solution type, timestep, and run times.

1. Controllers

There are three basic solution techniques, or controllers: Simulation, Optimization, and Rulebased Simulation, Rulebased Simulation and Optimization both require the construction of a Simulation model; therefore, all models need a basic simulation component. For this reason, the **Simulation** controller is the default selection when the **Run Control** dialog is first opened. To select a different controller, click on the controller option menu to view the other controller choices.
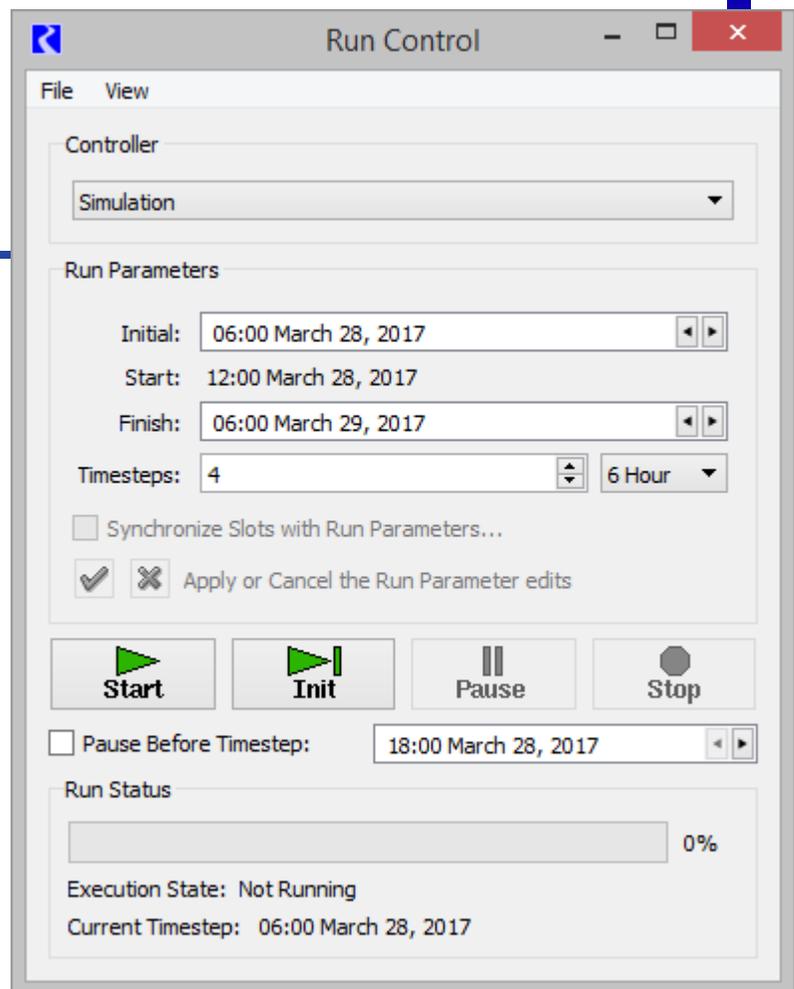
A large number of slots are associated with each controller. When an object is created, it is initialized with the slots belonging to the selected controller. When a new controller is selected after the objects have been constructed, the original slots remain in memory and new slots are allocated for the new controller. This situation may leave many unnecessary slots which affect memory and model size. When building the initial simulation model, the **Simulation** controller must be selected.
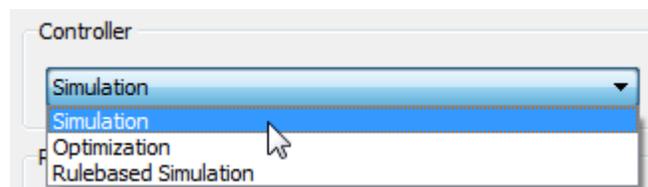
2.   Controller Specific Parameters

Each controller has specific parameters which are set through an extension of the **Run Control** dialog. The additional dialog is invoked using the **View ➥ <Controller> Run Parameters** menu, depending on the selected controller.

2.1 Simulation Run Parameters

Max Iterations(EngrObj Slots): This value represents the maximum number of times a slot can be reset or recalculated on a given timestep.

Series Extension Increment: RiverWare allocates space for the entire run length of each series. If, during the run, timesteps beyond the run are given values, RiverWare has to extend the series and copy over all the existing values, because RiverWare requires that the series values be stored in contiguous memory. This is a time consuming operation, so it is in the users' interest to avoid this operation. Thus, this parameter allows the users to allocate a little extra space if they know that their models will be solving for timesteps beyond the end of the run. This is particularly important where reach routing causes timesteps beyond then end of the run to acquire values. For example, if a reach has a routing coefficient vector of 40 elements, the series extension increment should be at least 40. A second example is if the model solves into the future throughout a defined forecast period. Set the Series Extension Increment equal to the forecast period as that many timestep will be required at the end of the run.

Warn when Values are out of Bounds: Series slots have upper and lower bounds that are used as part of an optimization solution. Using this parameter, you can show a warning message when values set in Simulation or Rulebased Simulation are outside these bounds. For more information, click **HERE (Slots.pdf, Section 4.1.4)**.

Water Quality: Also in this dialog, Water Quality calculations may be enabled and configured. This is described in the water quality documentation **HERE (WaterQuality.pdf, Section 1.)**

Number of Post-Run Dispatch Timesteps: Sometimes, computations are required past the end of the run. This is particularly true for models with lags and forecasting algorithms. For example, if you are trying to determine how much water to release on the run's finish timestep and you have a two timestep lag to the controlling location, you need the downstream reaches to dispatch two timesteps past the end of the run.

The Number of Post-Run Dispatch Timesteps parameter represents the number of timesteps past the run finish timestep for which object dispatching will be allowed. Whether an object dispatches or not still depends on the knowns and unknowns, i.e. the dispatch conditions. Also, additional data may be required for the objects to correctly dispatch and solve. Data defaults (like reservoir diversion) will be

set past the end of the run, too. Note, the Number of Post-Run Dispatch Timesteps is controller specific, that is, it can be different for the Simulation and Rulebased Simulation controllers.

Water Year Start Month: This is the start month of the water year. This is currently only used by the Time Aggregation Series Slot computation, **HERE (Slots.pdf, Section 4.7.1.1)**.

Save All Global Functions Sets with Model: This checkmark specifies that any open Global Functions RPL sets should be saved with the model file. Click **HERE (RPLUserInterface.pdf, Section 1.3)** for more information.

2.2 Rulebased Simulation Run Parameters

Water Quality: Water Quality calculations may be enabled and configured. This is described in the water quality documentation **HERE (WaterQuality.pdf, Section 1.)**

Max Iterations(EngrObj Slots):   Represents the maximum number of times a slot can be reset or recalculated on a given timestep.

Series Extension Increment: RiverWare allocates space for the entire run length of each series. If, during the run, timesteps beyond the run are given values, RiverWare has to extend the series and copy over all the existing values, because RiverWare requires that the series values be stored in contiguous memory. This is a time consuming operation, so it is in the users' interest to avoid this operation. Thus, this parameter allows the users to allocate a little extra space if they know that their models will be solving for timesteps beyond the end of the run. This is particularly important where reach routing causes timesteps beyond then end of the run to acquire values. For example, if a reach has a routing coefficient vector of 40 elements, the series extension increment should be at least 40. A second example is if the model solves into the future throughout a defined forecast period. Set the Series Extension Increment equal to the forecast period as that many timestep will be required at the end of the run.

Warn when Values are out of Bounds: Series slots have upper and lower bounds that are used as part of an optimization solution. Using this setting, you can show a warning message when values set in Simulation or Rulebased Simulation are outside these bounds. For more information, click **HERE (Slots.pdf, Section 4.1.4)**.
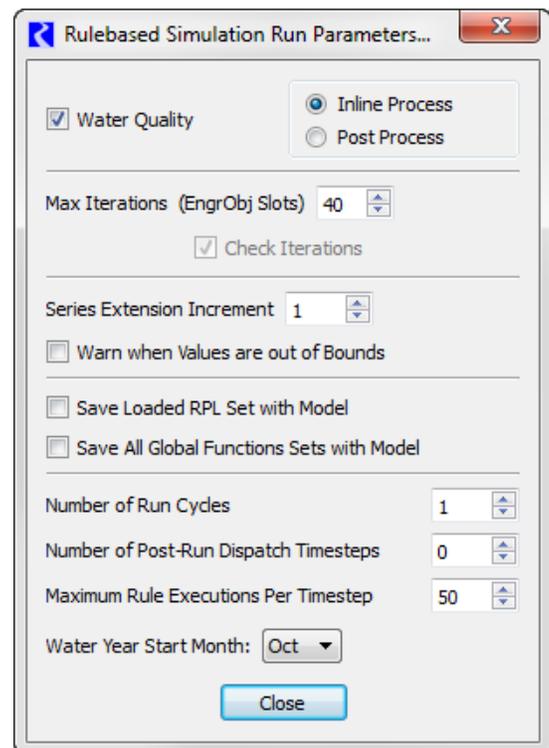
Save Loaded RPL Set with Model: This checkmark specifies that the loaded RBS ruleset should be saved with the model file. Click **HERE (RPLUserInterface.pdf, Section 1.3)** for more information.

Save All Global Functions Sets with Model: This checkmark specifies that any open Global Functions RPL sets should be saved with the model file. Click **HERE (RPLUserInterface.pdf, Section 1.3)** for more information.

Number of Run Cycles: This integer value controls how many times the rulebased simulation controller will cycle through the timesteps. More information can be found **HERE (, Section 1.7.4)**.

Number of Post-Run Dispatch Timesteps: TSometimes, computations are required past the end of the run. This is particularly true for models with lags and forecasting algorithms. For example, if you are trying to determine how much water to release on the run's finish timestep and you have a two timestep lag to the controlling location, you need the downstream reaches to dispatch two timesteps past the end of the run.

The Number of Post-Run Dispatch Timesteps parameter represents the number of timesteps past the run finish timestep for which object dispatching will be allowed. Whether an object dispatches or not still depends on the knowns and unknowns, i.e. the dispatch conditions. Also, additional data may be required for the objects to correctly dispatch and solve. Data defaults (like reservoir diversion) will be set past the end of the run, too. Note, the Number of Post-Run Dispatch Timesteps is controller specific, that is, it can be different for the Simulation and Rulebased Simulation controllers.

In RPL, you can access the timestep represented by the function using the DispatchEndDate function as described **HERE (RPLPredefinedFunctions.pdf, Section 27.)**

Maximum Rule Executions Per Timestep: This value indicates how many times a single rule can execute on each timestep.

Water Year Start Month: This is the start month of the water year. This is currently only used by the Time Aggregation Series Slot computation, **HERE (Slots.pdf, Section 4.7.1.1)**.

2.3 Accounting

If Accounting is enabled, the following parameters are added to either the Simulation or Rulebased Simulation parameters described above:

Max Iterations (Account Slots): This parameters represents the maximum number of times an account slots can be reset or recalculated.

3. Timestep

Many different timesteps are available for simulation. The currently selected timestep is shown on the timestep option menu which is directly beneath the controller option menu. When the **Run Control** dialog is invoked on an empty workspace, it has the default timestep value of **6 Hour**. You must select the desired timestep before building a model. This facilitates data entry by initializing new objects to the desired run times.

4. Run Times

The initial time, end time, and duration of the run are set through text fields on the **Run Control** panel. RiverWare's time management system requires that times for data and for the run be given in actual time (hour, day, month and year), rather than relative time, as is seen in many other modeling systems. The runtime terms are defined by the following diagram:
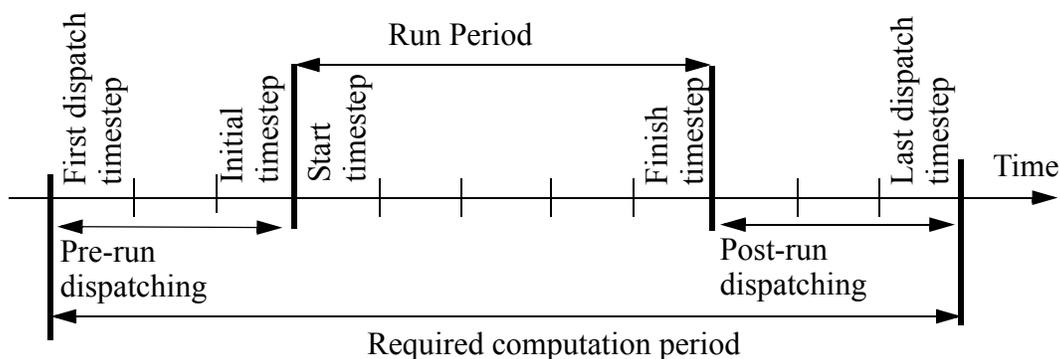
The **Initial** time is the time at which the simulation begins and the beginning of the first timestep. Initial condition data are required at this timestep. Solutions are reported at the end of each timestep. The **Start** time is the end of the first timestep and is the first time at which output is given. The **Finish** time is the end of the last timestep of the run. The **Timesteps** field contains the number of timesteps in the run. For 1, 6, or 12 hour timesteps, the time of day is displayed. RiverWare denotes midnight as 24:00 hours instead of 0:00 in the next day. For all other timesteps, the time of day is not displayed.

Changing the **Initial** time changes the **Finish** time accordingly; run **Timesteps** remain the same.

Valid dates in RiverWare are from **24:00 December 31, 1799** to **23:00 December 31, 3799**
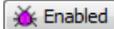
5. Making a Run

The dialog is invoked by selecting **Control** ➥ **Run Control Panel** from the workspace menu bar or by clicking on the Run Control toolbar button.

The buttons are used to control the execution of a model. They are defined as:

✅ Confirm run control changes (i.e., changes to number of timesteps, run parameters, or simulation type).

❌ Reject run control changes.

🔅 Enabled Optionally shown, RPL Debugging is **Enabled** or **Disabled**. For more information click **HERE (RPLDebugging.pdf, Section 2.2)**

Start Execute a run.

Init Execute initialization or the next timestep only. (If no run is in progress, execute initialization. The second click of the Step button executes the first timestep)

Pause Interrupt execution after the current timestep.

Continue Continue execution from the current timestep. (When the run is started the start button becomes the continue button)

Stop Abort execution after the current timestep.

Pause Before Timestep: Pause the run before the specified timestep. This is particularly useful when debugging a model run.

**Execute Initialization Rules**: Specify whether or not to execute Initialization Rules. The toggle is only available when Initialization Rules are defined. Click **HERE (RPLUserInterface.pdf, Section 1.1)** for more information.

When a run is not in progress, only the **Start** and **Step** buttons are available. If changes are made to the run dates, the timesteps, or other Run Control parameters, the **Check** button ✅ must be clicked to enable all the other **Run Control** buttons. The **Continue**, **Step** and **Pause** buttons are then enabled after the **Initializing** period has ended.
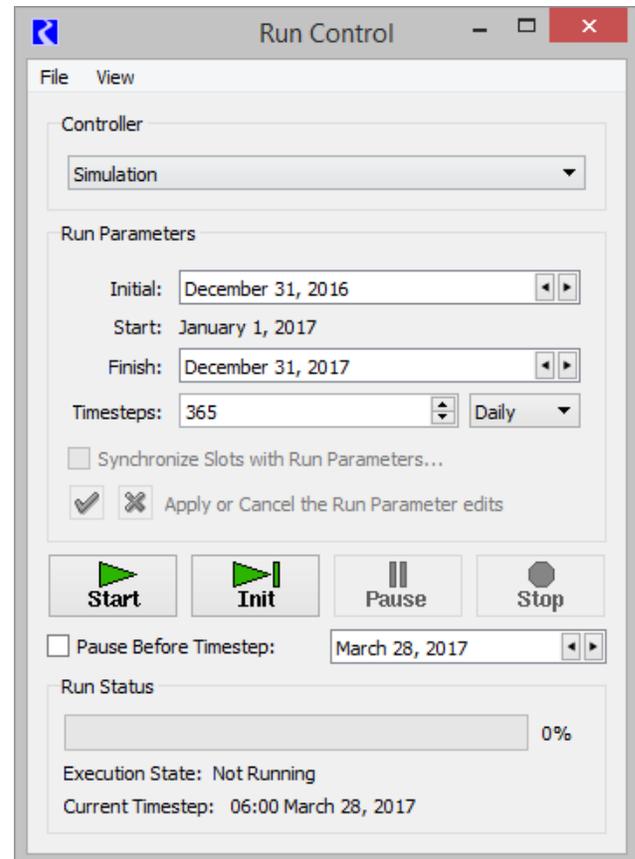
When a run is started, the Run Status area is updated. You can see a separate version of this dialog using the **View ➡ Run Status** menu.

The indicator bar moves from left (start) to right (finish), indicating the progress of the run. The **Execution State:** also indicates the state of the run with a status description. The possible **Execution States** are: **Initializing**, **Running**, **Finished**, **Stopped, Waiting**, **Paused**, and **Aborted**.
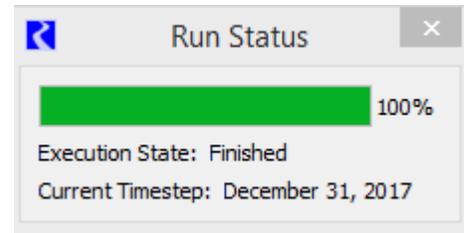
The Controller Clock (date and time of the currently executing timestep expressed in units of the selected timestep size) is displayed under the **Execution State**. Due to time horizon dispatching, discussed **HERE (Simulation.pdf, Section 5.2)**, the Controller Clock may not represent the timesteps of all objects being solved.

6. Aborted Run

If a run cannot continue because of errors, a RiverWare Notice window will be shown and error messages will be posted to the diagnostic output window **HERE (Diagnostics.pdf, Section 1.4)** . The user has the following options from the confirmation window:

- **Time Scroll:** Scroll all time-scrollable windows to the context time. The user can select to scroll all time windows, like the Open Slot dialog, SCT's and the Plot window to this date. This saves the user time when debugging the model.

- **Cancel:** Close the dialog, but do not "Time Scroll."

- **Do not show this notice again**: Request that the dialog not be shown again. If this box is selected, then subsequent aborts will use the same selection (Time Scroll or Cancel) and the dialog will not be shown. This applies only to the current RiverWare session.

7. Synchronization

There are two ways to synchronize all or selected objects to the either the run control or a specified period: by changing the run control and applying the changes through its child dialogs, or by using the **Synchronization Control** dialog. These two methods are described below

7.1 Synchronize from Run Control

On the **Run Control**, after making changes to the run range, the user is presented with the green check and red X to either apply the changes or cancel the changes. Also, the **Synchronize Slots with Run Parameters** toggle is enabled. If checked, when the green check is clicked, the **Synchronize Slots** dialog is opened, shown to the right. This dialog allows the user to configure how the slots should be resized. The default Begin, End and number of Timesteps is taken from the Run Control. The user can optionally synchronize accounting slots with the simulations slots or enter a different time range.
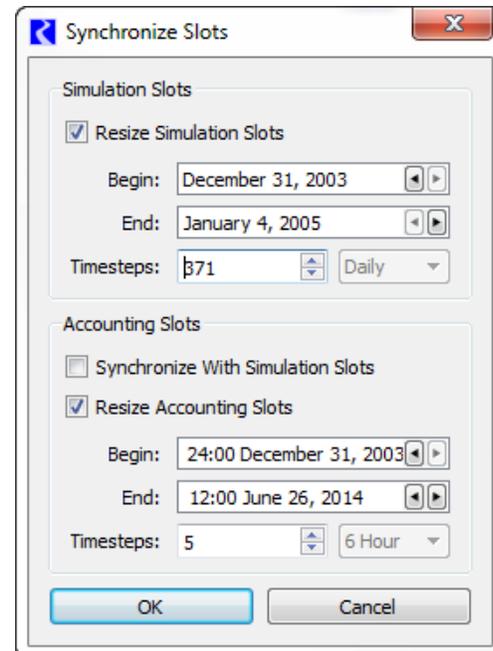
If changes are made to the timestep size, the **Synchronize Slots with Run Parameters** toggle is not available, rather the **Synchronize Timestep Change** dialog is opened when the green check is clicked to apply run parameter changes. This dialog allows the user to optionally synchronize objects with the new timestep. An option allows for exclusion of slots with timesteps different than the original timestep. If the timestep change represents a valid aggregation, options are presented to aggregate input data in slots to the new timestep. Valid aggregations are:

- **1 hour**, **6 hour**, **12 hour**, or **Daily** aggregating to **Monthly**
- **1 hour**, **6 hour**, **12 hour**, **Daily**, or **Monthly** aggregating to **Yearly**

Controls present options for how to treat NaNs when aggregating input data:

- **Ignore NaN/Output values:** NaNs or Output values do not contribute to the aggregated values. Intervals with some inputs and some outputs or NaNs will become inputs at the larger timestep.
- **Do not aggregate intervals having NaN/Output values:** Any interval with NaNs or an output value is not aggregated. Intervals with some inputs and some outputs or NaNs will be NaN at the larger timestep. Note, for the **Last** aggregation function, only the **Last** timestep is considered. Other timesteps do not matter in their NaN/Output status.
- **Error on NaN (excluding pre-simulation timesteps):** An error is issued.
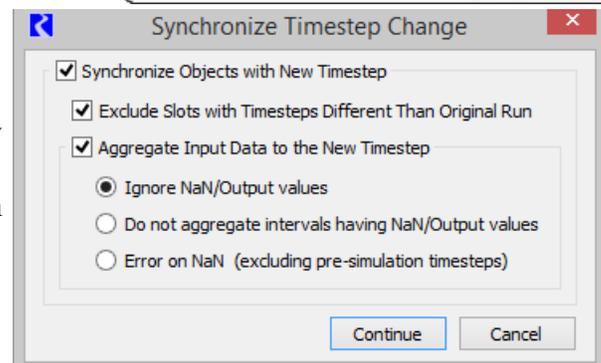
The method by which input data is aggregated is controlled by a slot's unit type as follows:

Aggregation Method	Unit Types	Aggregation Method	Unit Types	
Last	Area	Average	Concentration	PowerPerFlow
	Length		Flow	Temperature
	No Units		Fraction	TemperatureInF
	Volume		LengthPerTemperature	ValuePerFlow
Sum	Energy		Power	ValuePerVolume
	Mass		PowerCost	Velocity
				VelocityPerTemperature_F

Inputs in slots with unit types that are not listed above are not aggregated. An information dialog will indicate slots that were not aggregated.

7.2 Synchronization Control Dialog

The **Synchronization Control** dialog allows the user to synchronize slots without changing the run control. To access this dialog, use the **Workspace ➥ Objects ➥ Synchronize Objects.** The user is able to synchronize all or selected objects to be synchronized to the Run Control or a separate specified time interval as follows
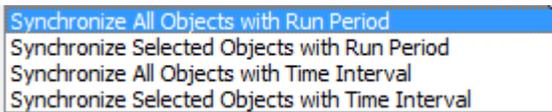
The new time interval must encompass the run control time interval. A toggle button allows users to **Include Accounting Object** in the synchronization action. A second toggle allows the user to **Exclude Slots with Different Timestep** from the synchronization. This option may be useful, in particular, to retain data stored in data objects.