Technical Documentation Version 8.0

Release Notes

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

UNIVERSITY OF COLORADO **BOULDER**

Contents

Chapter 1
What's New in Version 8.0

This document describes new features, enhancements, and changes in RiverWare Version 8.0.

Topics

Special Attention Notes

The section describes special attention notes, which indicate changes in functionality that require you to update models, cause model results to differ, or display a warning message when you first load a model in Version 8.0.

If you have any questions, contact RiverWare Support:

RiverWare-Support@colorado.edu

- The solver used in optimization, CPLEX, has been updated. Optimization results may differ. See "CPLEX version" on page 7 for more information.
- The RPL predefined functions SortPairsAscending and SortPairsDescending were modified to return stable and predictable results in the case where the second item in each pair of lists is the same. This could lead to different model results. See "SortPairsAscending & SortPairsDescending enhancement" on page 11 for more information.
- The HDB Database DMI connection was upgraded from Oracle 12c to Oracle 18c. With this upgrade, HDB connectivity requires either Oracle Client 18 or Oracle Instant Client 18. CADSWES tested with Oracle Client 18.0 and Oracle Instant Client 18.5.
- The name of dispatch methods for most objects has changed. There are no numerical differences but you will need to run your model to recreate dispatching information. See "Dispatch Method Names" on page 5 for more information.

General Notes

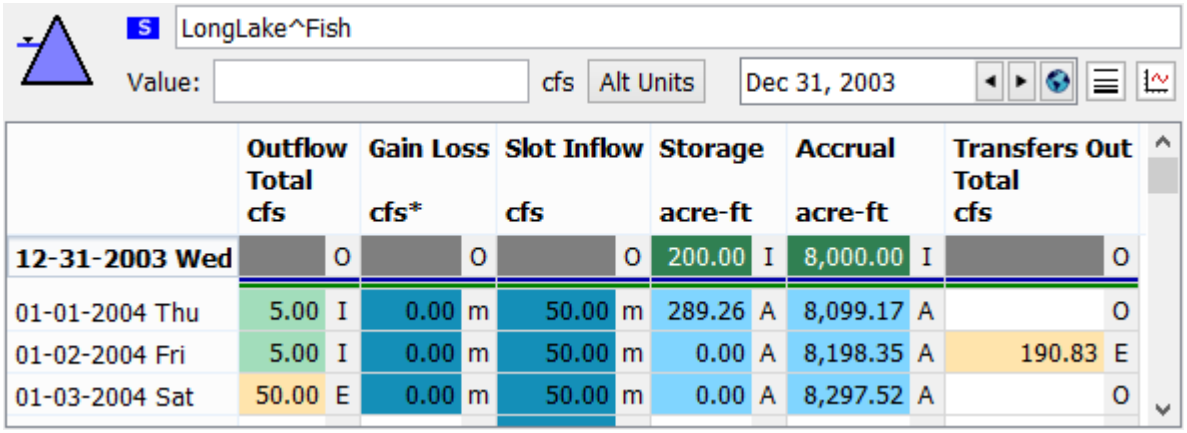
The following general upgrades were implemented in this version of RiverWare:

- **Updated versions of compilers and other third party packages:** This release is built using updated compilers and third party libraries like Qt. All libraries and compiler versions can be seen in the **Help** and then **About RiverWare** menu.
- **64-bit only:** Because of the new compilers, RiverWare is now 64-bit only. 32-bit operating systems are no longer supported.
- **Performance**: Internal algorithms in RPL, string processing, list processing, and account access were improved. Together these enhancements reduced a sample test model run time by about 15%.

Accounting: E flag

Within a Storage account, the Empty Storage, E, flag can be used to release all of the storage through a supply. Previously, this was limited to an outflow supply. Now the E flag can be applied to a transfer supply. Figure 1.1 shows a screenshot of the Edit Account dialog with E flags in use.

Figure 1.1 Empty Storage Flag displayed on the Edit Account dialog box



	Outflow Total cfs		Gain Loss cfs*		Slot Inflow cfs		Storage acre-ft		Accrual acre-ft		Transfers Out Total cfs	
12-31-2003 Wed		O		O		O	200.00	I	8,000.00	I		O
01-01-2004 Thu	5.00	I	0.00	m	50.00	m	289.26	A	8,099.17	A		O
01-02-2004 Fri	5.00	I	0.00	m	50.00	m	0.00	A	8,198.35	A	190.83	E
01-03-2004 Sat	50.00	E	0.00	m	50.00	m	0.00	A	8,297.52	A		O

For more information, see "Using the Empty Storage Flag" in *Accounting*.

Batch Mode: New RCL Commands

Four new commands were added to the RiverWare Command Language (RCL) and can now be used in RCL batch scripts.

- **ConfigureExcelDataset** allows you to modify the Excel workbook file or sheet name for an Excel DMI.
- **LoadDiagSettings** allows you to import preconfigured diagnostic settings from a file.
- **RequiredInfo** allows you to print any specified text from the RCL script to the diagnostic output file.
- **SaveRplSet** allows you to save an open RPL set to a file.

For more information, see "RCL Commands Reference" in *Automation Tools*.

Data Management

This section describes changes to the Data Management Interface (DMI).

HDB Database DMI Connection

The HDB Database DMI connection was upgraded from Oracle 12c to Oracle 18c. With this upgrade, HDB connectivity requires either Oracle Client 18 or Oracle Instant Client 18. CADSWES tested with Oracle Client 18.0 and Oracle Instant Client 18.5.

Interface with Excel

When using the **Read/Write the workbook directly** setting for the Excel Dataset, empty cells no longer generate a warning in the DMI. An empty cell is acceptable for numeric and text values. In a numeric slot this is a NaN; in a

text slot this is an empty string. In addition, the workbook can now be open while the DMI executes. As before, the DMI interacts with the saved Excel file, not the open version which may have changes.

Documentation

The RiverWare HTML-based documentation was enhanced:

- The RiverWare HTML-based documentation now operates correctly in the Google Chrome browser. Previously the menus and links were not working.
- The Firefox browser (version 68.0.1) was not showing icons and arrows when displaying the RiverWare HTML-based documentation. This has been fixed in the latest Firefox patch (68.0.2). Please upgrade Firefox to get this fix.
- In the HTML-based documentation, within the "Accounting", "Objects and Methods", "Optimization", and "Water Quality" chapters of the help, lists of methods and lists of slots were improved with expand/collapse functionality. For an example, see "Storage Account" in *Accounting*.

Multiple Run Management: Stop on Error

Within Distributed MRM run, you can now configure the runs to stop when any distributed run aborts with an error. In the configuration, check the box to **Stop all Distributed Runs on Error.** See "Simulations" in *Solution Approaches* for more information.

Object Viewer

Functionality was added to the Object Viewer to allow you to control how the object tabs are ordered. You can choose from the following object tab ordering modes from the Object Tabs menu:

- Flexible Order: Tabs can be rearranged in any order. Drag the tabs left and right to rearrange them. New object tabs are appended to the right of existing tabs.
- Workspace Custom Ordering: Object tabs are ordered left to right using the custom object order from the workspace's Simulation Object list.
- Order By Name: Object tabs are ordered left to right in case-insensitive lexical order.

For more information, see "Arranging Tabs" in *User Interface*

Objects

This section describes changes to the simulation objects.

Aquifer

On the Aquifer object, the Pumped Flow slot was added to the list of linkable dispatch slots and converted to a Multi Slot. This better mirrors the Pumped Flow slot on the Groundwater Storage object. In addition, proposed links were added to the Smart Linker.

Dispatch Method Names

The dispatch method names for nearly all objects were modified to be more readable. For example, a common reservoir dispatch method is now called "Solve given Inflow, Outflow". When you first load a model saved with output values in version 8.0, no dispatch information will be available. Rerun the model to generate the dispatch information. Also, diagnostic output messages listing dispatch method names will change. Otherwise, there should be no numerical differences with this change.

Output

This section describes changes to Output Devices and other output tools.

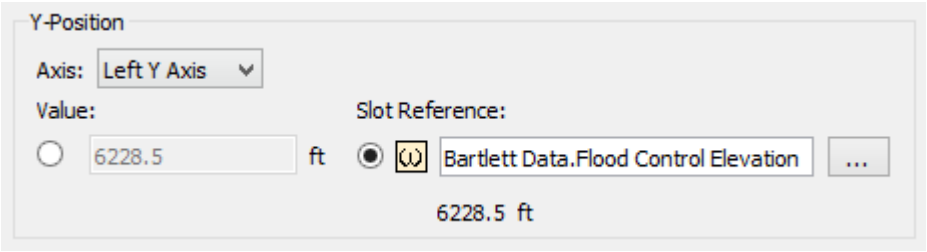
Plotting

The following sections describe changes to plotting including allow slot values in plot markers and using RPL functions in Y-axis bounds.

Plot Markers reference Slot Values

Plotting has been enhanced to provide a new option for associating a plot marker with a slot, for both X and Y-axis marker configurations to provide dynamic marker placement. Figure 1.2 shows the configuration. For more information, see "Marker Configuration" in *Output Utilities and Data Visualization*

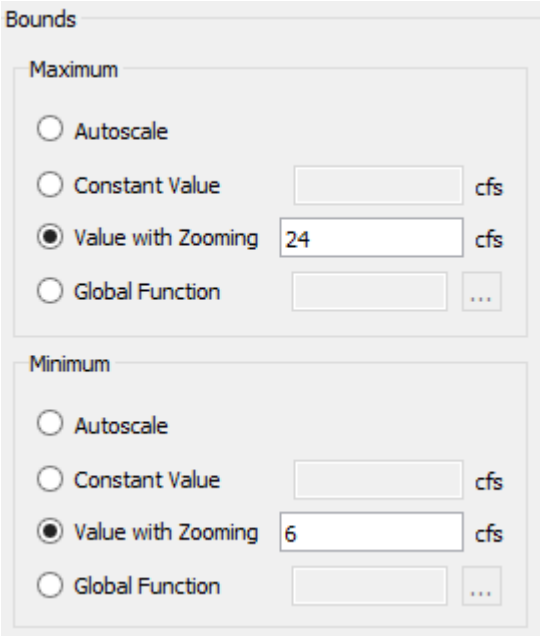
Figure 1.2 Screenshot of the Marker configuration showing a reference to a slot value



Y Axis can reference RPL functions

Plotting has been enhanced to provide new options for configuring the bounds of numeric axes on plots. Now the plot configuration allows the minimum and/or maximum bound, particularly on the Y axis to refer to a global RPL function, static value, value with zooming or to be autoscaled. Figure 1.3 shows the configuration.

Figure 1.3 Screenshot of the numeric axis Bounds configuration



See "Axis bound configuration" in *Output Utilities and Data Visualization* for more information.

RDF Viewer

See "RDF Viewer" on page 7 for more information on the new RDF Viewer to look at the RDF results of MRM runs.

Tabular Series Slot Reports

Within the Tabular Series Slot Report output device, the following enhancements were made:

- When showing series notes as footnotes, you can now select which note groups to include in the report. This allows you to create Note groups that are included in the report, maybe for public release, and other groups that are not included, perhaps for internal usage only.
- You can now select to display NaN values as 0.0 in the report.

Both options can be set up on the Settings tab of the report configuration dialog. See "Settings Tab" in *Output Utilities and Data Visualization* for more information.

Optimization

The following changes were made to RiverWare optimization.

CPLEX version

The RiverWare optimization uses third party software, CPLEX, to perform the individual optimizations within the goal program. The CPLEX version was updated to version 12.9.0.0 for this RiverWare release. In this version, the solver has changed sufficiently to occasionally generate alternative solutions that are within the solver's optimality tolerance. These changes are not a cause for concern: while the solutions may be different, the differences do not have a significant affect on the goal values that are the driver for the solutions. For most test cases, there were no changes. The one test case with differences was thoroughly examined, and the differences were found to be negligible.

Initialization Rules during Optimization run

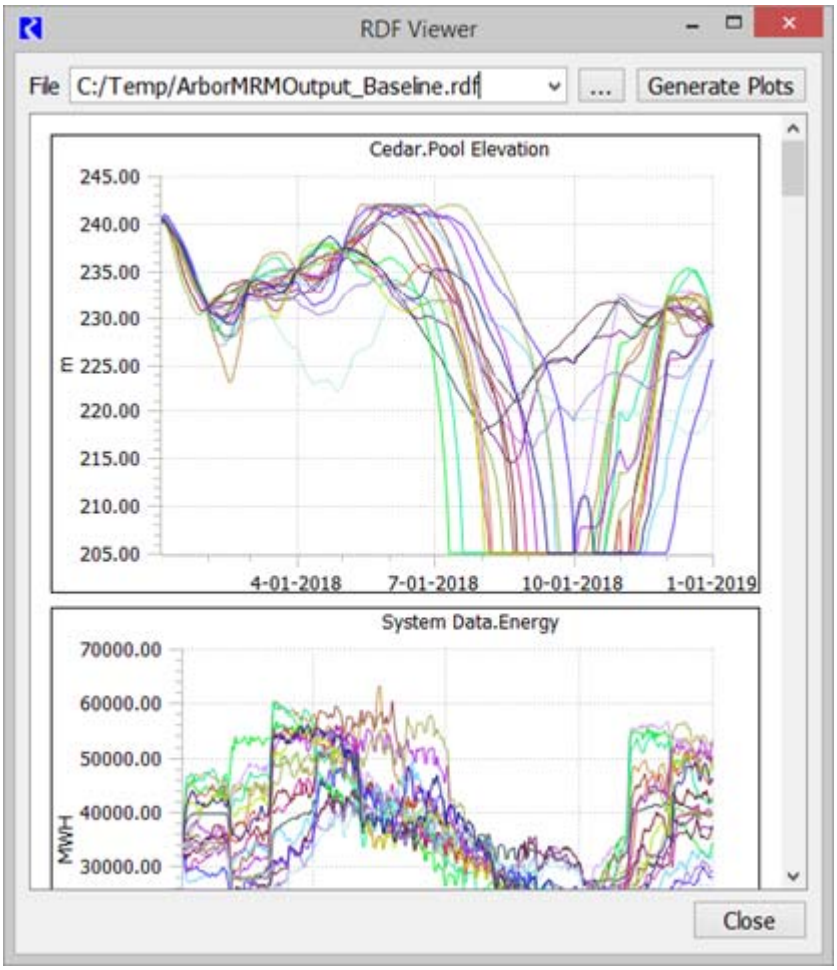
Initialization rules are a set of RPL rules associated with the model that can be executed at the beginning of a run. Now, the initialization rules can be executed as part of an Optimization run. A new check box on the Run Control dialog box allows you to control if the initialization rules are executed. By default the setting is off, the rules will not be executed, to match existing behavior.

See also "Scripts: Action to Set Initialization Rules Execution Flag" on page 11 for information on a script action to control this setting and "IsControllerSim" on page 11 and "IsControllerOpt" on page 11 for new RPL functions that will help with initialization rule development when using with an optimization run.

RDF Viewer

The first version of a new RDF Viewer was created to graphically display results from an MRM run that uses RDF output options. The RDF Viewer is accessible from the MRM run control dialog and displays charts of the trace data contained in a single RDF file, one chart per slot, with the data for each run (trace) plotted. A sample is shown in Figure 1.4. For more information see "RDF Viewer" in *Solution Approaches*.

Figure 1.4 RDF Viewer Sample



RiverWISE: Change Series Units

The RiverWare Interactive Scenario Explorer (RiverWISE) allows stakeholders to view an exported version of a RiverWare model and to explore alternative scenarios within constraints specified by the model developer. See "RiverWISE Model Developer's Guide" in *RiverWISE Model Developer's Guide* for more information on RiverWISE.

RiverWISE was modified with a new **Change Series Units** button. The button has three choices to enable the user to control how flows and volumes are displayed. The options are Standard, Flow, or Volume. For more information see "Series Units" in *RiverWISE Stakeholder's Guide*.

RPL

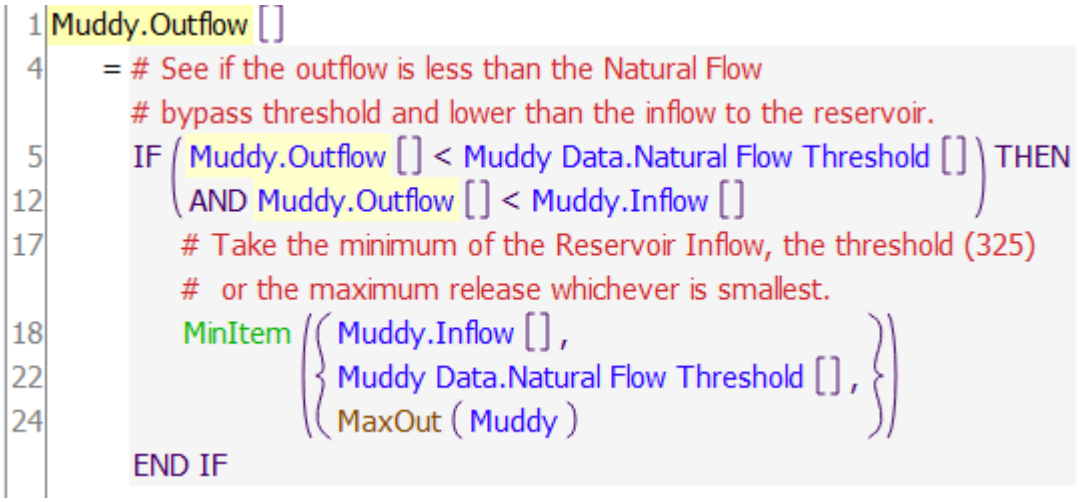
This section describes changes to the RiverWare Policy Language (RPL).

RPL Editor: Highlight Equivalent Expressions

A new setting was added to the RPL Display Settings dialog to "Highlight Elements Equivalent to the Selection". This features highlights elements in the same dialog which are equivalent to the selected expression. For example, in the screenshot in Figure 1.5, Muddy.Outflow is selected on the first line, element 1, but the other instances are also highlighted in a paler color on subsequent rows, element rows 5 and 12.

See "Highlight Elements Equivalent to the Selection" in *RiverWare Policy Language (RPL)* for more information on enabling and using this setting.

Figure 1.5 Sample RPL Logic showing equivalent expressions highlighted



RPL Palette

The RPL Palette was improved with the following changes.

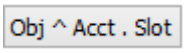
Clipboard Tab

A new **Clipboard** tab was added to the RPL Palette which maintains a list of the last 100 expressions copied. When you copy a RPL expression from anywhere but the clipboard itself, a copy of that expression is added to the clipboard. The clipboard updates to display that expression and you can use the Previous and Next operations to view the entire copy history. Further, you can select and copy an expression or subexpression in this history and paste it into other RPL expressions.

Thus, the clipboard tab can be used as a temporary location to hold copied expressions which you can then paste over other expressions. This is particularly useful in editing RPL expressions for readability or performance.

See "Clipboard Tab" in *RiverWare Policy Language (RPL)* for more information.

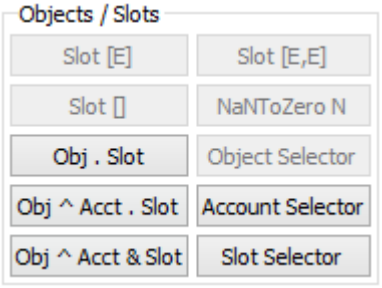
New Obj ^ Account . Slot Button

A new operator/button was added to the palette. The Obj^Account.Slot button, 

evaluates to an account slot given an object, an account name, and a slot name. This is more efficient than the previous approach using the newly named Obj^Account&Slot button (previously named Obj^Slot). We recommend refactoring logic to use this new button whenever possible.

See "Object and Slot Lookup and Assignment Buttons" in *RiverWare Policy Language (RPL)* for more information.

Figure 1.6 Screenshot of new and modified buttons in the Object/Slots area of the palette



New Account Selector Button

A new **Account Selector** button was added to the palette as shown in Figure 1.6. This button allows you to select an account from an object to replace a STRING expression. Use this **Account Selector** with the new Obj^Account.Slot button described above.

See "Object and Slot Lookup and Assignment Buttons" in *RiverWare Policy Language (RPL)* for more information.

Parenthesis and Comments

Usability has been improved when adding comments to an expression with parentheses or adding a parenthesis to an expression with comments.

RPL Precision

The default RPL Precision was changed from 8 digits to 2 digits. This better aligns with the default precision in unit schemes. As before, the precision can be adjusted on the RPL Set's **Adv. Properties** settings. Existing sets will not be modified. This only affects the display precision. As before, full precision is always used in all computations.

Predefined Functions

This section describes new and modified predefined RPL functions.

AggregateSeriesSlot

A new RPL predefined function AggregateSeriesSlot was added. The input arguments are a slot to aggregate, the begin and end timestep, the timestep to aggregate to, and how to treat NaN values. It returns a list of datetimes (the larger timestep) and the values at those timesteps. An initialization rule can then loop over the list and set the values on the slot.

See "AggregateSeriesSlot" in *RiverWare Policy Language (RPL)* for more information.

IsControllerSim

A new RPL predefined function, IsControllerSim, returns TRUE if the current controller is Simulation or Inline Simulation and Accounting.

See "IsControllerSim" in *RiverWare Policy Language (RPL)* for more information.

IsControllerOpt

A new RPL predefined function, IsControllerOpt, returns TRUE if the current controller is Optimization.See "IsControllerOpt" in *RiverWare Policy Language (RPL)* for more information.

SortPairsAscending & SortPairsDescending enhancement

The RPL predefined functions SortPairsAscending and SortPairsDescending were modified to return stable and predictable results in the case where the second item in each pair of lists is the same. Prior to the current work, the return order of values from pairs with the same second value was unspecified and unpredictable; now that order is specified and deterministic. Specifically, for pairs whose second item is the same, SortPairsAscending now returns the first items in their original order and SortPairsDescending returns the first items in the reverse of their original order. Previously, the result tended to be in these orders when the comparisons were equal. Now, the order is guaranteed. This could change model results depending on the RPL logic.

Example 1.1 SortPairs behavior

Given a list = {{1, "c"}, {2, "a"}, {3, "c"}, {4, "a"}}

- SortPairsAscending(list) returns {2, 4, 1, 3}
- SortPairsDescending(list) returns {3, 1, 4, 2}

See "SortPairsAscending, SortPairsDescending" in *RiverWare Policy Language (RPL)* for more information.

Scripts: Action to Set Initialization Rules Execution Flag

The script action "Set Initialization Rules Execution Flag" was enhanced to include a setting for optimization. This allows you to control, from a script, whether the initialization rules will execute before an optimization run as described in "Initialization Rules during Optimization run" on page 7.

Slots: New Time Disaggregation Series Slot

A new slot type called Time Disaggregation Series Slot was added. It is a custom slot which can be created on any object. In the slot's configuration dialog, you specify:

- The slot to disaggregate.
- The timestep size of the disaggregated value. Initially, the timestep is constrained to the following constant size timesteps: 1 Hour and 6 Hour.
- The function to use for disaggregation:
  - Step: use the same value for all smaller timesteps or
  - Interpolate End of Timestep: use a linear interpolation for the smaller timesteps.

See "Time Disaggregation Series Slots" in *User Interface* for more information.

Snapshots

When a snapshot is created, it now gets better coordinates in all three workspace views, Simulation, Accounting and Geospatial. For each view, the snapshot objects are stacked in columns, 10 high, to the right of the lower right corner of the bounding box around existing objects.

Water Quality

This section describes changes to Water Quality functionality.

Salinity

The following three salinity items were addressed:

1. **Mass Comparison Tolerance:** To fix an issue where a slot was not being computed, a new mass based tolerance was introduced into the Reach and Agg Diversion Site salinity methods. This tolerance loosens the criteria for salt mass and concentration comparisons of two values, particularly near zero.
2. **Negative Salt Mass Removal Requests**: The Agg Diversion Site, Salt Mass Removal and Salt Mass Removal With Debt methods were modified to allow negative "Salt Mass Removal Request". Previously a negative value was an error. Now, it is a warning.
3. **Reach Min Salt Concentrations on Reach**: The reach salt dispatch method, Solve Out Salt Given In Salt, was modified such that the Outflow Salt Concentration is computed to be between the Min and Max Concentration slots, if specified. Previously, it was only limited to be less than the Max Concentration. See "Solve Out Salt Given In Salt" in *Water Quality* for more information.

Total Dissolved Gas (TDG)

A new method was added to the Reach Water Quality Routing category: Time Lag TDG with Dispersion and Dissipation. The method routes TDG with three components: Lag Time, Dispersion and Dissipation. See "Time Lag TDG with Dispersion and Dissipation" in *Water Quality* for more information.

Chapter 1
What's New in Version 8.0

Chapter 2
Closed Issue Reports

Table 2.1 summarizes the issues that have been addressed or fixed since the last major release (Version 7.5). Issues are listed in bug number order. For more information on any bug, see the RiverWare.org website.

Table 2.1 Issues addressed since Version 7.5

Number	Summary
6283	POSAT incorrectly reports a goal as not containing a Freeze
6287	RPL statement memory leak
6288	Riverware 7.5 Optimization Fail
6292	Internal error posted in accounting training class model
6297	Can't open older model file
6298	Excel DMI failing with text in timestep row/column
6299	Incorrect Exception Message
6300	The initial workspace window size is sometimes very small
6301	The name field of scalar slots defaults to show the end of the slot name, instead of the beginning when the slot name is longer than the field when first opened.
6302	need way to create table of independent variables in Borg-RW config
6305	Adding comment to RPL hides parentheses.
6307	Performing model comparison leads to error in run
6309	Else If is unavailable on the palette when there is a comment
6310	In RiverWISE edited description disappears during run
6312	SCT Displaying Data Incorrectly
6313	DMI Import of Scalar Slot in RW 7.5
6314	Editing scalar slot units doesn't update in the object dialog
6315	Scalar slot dialog doesn't let users enter NaN
6319	Crash using Name Map in DMI in MRM
6321	“Show many Open Slot dialogs?” confirmation dialog is bogus
6323	RPL Viewer doesn't remember the last tab viewed when closing a tab
6324	Internal error occurred when opening Total Diversion Requested Slot
6325	Selecting Unit Scheme Exceptions changes the display precision
6326	2 Issues: UNION not acting correctly and FIND not working

Chapter 2
Closed Issue Reports

Table 2.1 Issues addressed since Version 7.5

Number	Summary
6328	Crash on run start after running a previous model
6329	Create Similar Slots for Different Objects is not working for time aggregation series slots
6330	Assertion failure in a plot when deleting all slots with left axis unit type
6331	Crashing loading a new model with a DMI Name Map open
6332	Cannot start text by typing "o" in a text series slot
6337	RiverSMART: Entering text doesn't work
6338	In some cases, distributed MRM doesn't simulate all traces
6339	Distrib MRM crashes when no traces are configured
6340	Loading a model after opening the MRM run control causes a beep
6343	Snapshot objects get coordinates of 0, 0 on the geospatial view
6344	Typo in environment variable entry led to model load error
6345	Crash using RPL undo on boolean expressions with parentheses
6347	Output Canvas is not sizing teacup legend correctly for larger fonts
6348	Output Canvas flow line legend not incorporating changes in user units or scale
6349	Crash starting iterative MRM
6350	Crash loading new model while paused in an optimization run
6353	Excel input DMI that reads file directly issues a warning for an empty cell
6354	RPL Viewer unnecessarily shortens RPL Item names in tabs
6355	Opt Crash in Debug with call stack overflow
6357	Crash on model load
6358	Failed to export RiverWise Model
6359	Enter key in CSV, NetCDF config dialogs open the file chooser
6361	LibXL: Reading tables by range corrupts row labels
6363	In Scripts, Set Slot Value with Function sets an incorrect value for unit type of Time
6365	Locator Views not working on geospatial view
6367	RBS run time increases three-fold with SCT and Object Viewer open
6368	Why is the default RPL Set precision set to 8?
6370	Aquifer Pumped Flow can't be linked
6372	Excel Input DMI for MRM crashing when running multiple Traces when copying sheets in Excel
6373	Saving a model in batch mode changes the canvas size
6374	File lock not release after stopping MRM run
6375	A reservoir is dispatching but the required known slots aren't known
6377	Text Series Slot values cannot be deleted in SCT
6378	In SCT entering Text Series Slot text clears out selected cells with the same text

Table 2.1 Issues addressed since Version 7.5

Number	Summary
6379	In SCT starting text series slot text with I or O does not work because it sets a flag
6380	Editing Text Series Slots in the Slot Viewer for multiple timesteps does not always work
6383	Changing order of slot in slot set resets the scroll bar all the way to the top
6385	LibXL: Writing TPS data hangs RiverWare
6389	RPL palette clipboard contents can cause the run to abort
6396	Locator View buttons do not show up when first opening RiverWare

Chapter 2
Closed Issue Reports