Scenario Manager Dynamic GUI Enhancements Design for RiverWare 6.3

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This document describes possible enhancements to the Scenario capabilities within RiverWare to provide more effective use by scenario users and baseline model architects.

Note: The images in this document are preliminary mockups *of the Scenario Manager dialog. These were created before these capabilities had been implemented.*

0.1 Document Status

• 07-20-2012: Ready for review.

0.2 Contents

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1.0 Overview

RiverWare scenario users would benefit from a more effective and dynamic user interface providing immediate feedback to adjustments made to scenario input series slots.

The prior scenario capability (in RiverWare 6.2 and prior versions) allows the user to freely edit the scenario input series slots having values initially assigned from corresponding non-modifiable "baseline" series slots. Operations on scenario series slots included:

- Reverting the scenario slot to the original baseline values.
- Multiplying the scenario series slot values by a specified factor ("scaling").
- Editing the scenario series slot values in the Open Slot Dialog. This also provides certain high-level operations on an arbitrary selection of timesteps within the series, include scaling, "offsetting" (adding an absolute value), and interpolating selected timestep ranges.

Although the user can freely edit scenario input slot values, errors are generated when those values do not conform to the minimum and maximum value limits for those slots. Those limits are constants associated with each baseline slot in the baseline model.

This design introduces several new features for the management of scenario series slots:

1. The scaling operation on scenario series slots -- with a new "offset" capability -- in the Scenario Manager Dialog is specified as a persistent *scaling factor* and *offset term* applied to the original baseline series slot values rather than being applied the current (edited) scenario series slot values. Computation of scenario series values can be expressed as follows:

<scenario series slot> [t] = ([scale factor] * <baseline series slot> [t]) + [offset term].

This is provided as an alternative to unconstrained editing of scenario slots, on a per-slot basis. That is, the user can choose -- independently for each scenario series slot -- whether to directly edit the slot's values *or* have them computed (scaled and offset) from the baseline series slot.

- 2. The scaling factor and offset terms for a single or multiple selected slots can either be entered numerically or can be set using mouse-operated "slider" controls.
- **3.** New optionally-shown columns include columns for the baseline and scenario *slot values* at a single timestep (specified using a timestep date/time spinner). This provides a means for comparison of these two types of values.
- **4.** Graphical "limit status" indications show whether the modified scenario slot values violate the minimum and maximum values configured for the slot.

This new scaling and offset operation replaces the prior "one-shot" scaling operation within the Scenario Manager. However the user can still freely edit scenario series slots in the Open Slot dialog. As mentioned above, the Open Slot dialog supports "one shot" scaling and offset operations on arbitrary timestep selections within the series.

As the user modifies the scale factor and offset term -- applied to the *multiple* selected slots, either by numeric entry or mouse-slider operation -- the representative scenario slot values and the "limit status" indications are dynamically updated.

The user also has the option of having those adjustments "dynamically applied" to the underlying slots such that any plot dialogs and numeric series slot displays showing those slots are dynamically updated to depict the adjusted series values. The implementation is optimized to the extent possible for this dynamic operation. However, especially with large-series models, the user may prefer to disable this dynamic effect (on the underlying slots), and apply changes explicitly by clicking an "Apply" push button. Note that the dynamic effects within the Scenario Manager dialog itself (described above) are unconditionally applied dynamically.

2.0 Scenario Operation Enhancements

Some enhancements have been made also for *setup* of a baseline model for scenario users. Those are described in a subsequent section. However the motivation for these enhancements is primarily an enhanced user experience of *scenario (baseline model) users*.

2.1 Scenario Tab Slot List

Sce	nario	Manager [Scenario: BASELINE]										
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Active Scenario: BASELINE												
Base	eline	CL 1sn 1										
		Slot	Edit N	lode	Factor	Offset	Base Val	Value		Units	Changed	
2		Havasu.Storage	v (Custom			539,000.00	539,000.00	1	acre-ft	Yes	
	Μ	MonthlyHydrology.LittleCoR	V (Custom			5,465.47	5,465.47	1	acre-ft/month	Yes	
	Μ	Powell Forecast Data.HydrologyIncrement	V (Custom			84.00	84.00	1	NONE	Yes	
1	<u> </u>	ArizonaPumpers.Total Depletion Requested		Scaled	1.00	0	10,000.00	10,000.00	1	acre-ft/year		
1	<u> </u>	ArizonaPumpers. Total Diversion Requested		Scaled	0.60	0	10,000.00	6,000.00	1	acre-ft/year	Yes	
2	<u>,</u> M	Mohave.Storage		Scaled	1.40	-10	1,583,000.00	2,216,190.00	~*	acre-ft	Yes	
	M	SNWP Schedule. AnnualNormalDepletionSchedule		Scaled	0.60	25	271,000.00	162,625.00	-1	acre-ft	Yes	
	M	SNWP Schedule. AnnualNormalDiversionSchedule		Scaled	1.00	0	486,000.00	486,000.00	-1	acre-ft		
4		VirginRiver.Inflow		Scaled	1.40	-10	116,409.92	162,963.88	×	acre-ft/year	Yes	
Re	store	Custom Order								Sta	art Adjustme	ent

The list order can be sorted by any column by clicking in the column header. The order can be restored to the default order by clicking the "Restore Default Order" button. That order is set (made constant) when the baseline model is created.

The Scenario Manager supports the *new columns* listed below. Many of the columns are optional, as depicted in the preliminary mockup image to the right. (The optional column checkboxes are new).

- Object Type and Slot Type icon columns
- Object Name. When this is shown the Slot column shows only the "local" slot name (without the containing object name). This makes possible the sorting of the list by the local slot name (e.g. "Inflow").
- Edit Mode. This "checkbox" column supports switching each individual slot between the "Custom" edit mode (where edits to the scenario slot in the Open Slot dialog and SCT are enabled) or "Scaled" edit mode, where the

blumn supports switching e "Custom" edit mode t in the Open Slot dialog ed" edit mode, where the alculated using the scale factor and offset term set for that scenario slot. Only

View

•

Output Manager...
Snapshot Manager...

Show Object Name Column

Show Min/Max Columns (on Scenario Tabs)

Show Comments Column

scenario series slot values are calculated using the scale factor and offset term set for that scenario slot. Only series slots can be switched to "Scaled" edit mode. (The Scenario Manager does also support other types of slots, but those are modifiable only using custom editing). When multiple slot items are selected, toggling an item sets all of the selected slot items to the toggled state.

- Factor and Offset columns.
- Base Value and (Scenario) Value columns. The scenario values are those that are modifiable through operation of this dialog and the Open Slot dialog. In scaling mode during an active scaling operation, the "Value" column shows the dynamic "pre-applied" adjustments to the scenario series.
- Min and Max columns (not depicted above). These show the minimums and maximums (constants) configured for each baseline slot in the baseline model. They are always shown on the baseline tab, but can optionally be hidden on the scenario tabs.
- "Limit Status" (Icon) column. On scenario tabs, this column graphically illustrates whether the scenario slot conforms to the configured minimum and maximum values, and whether those limits are configured for the slot. (On the "baseline" tab, this limit status indication applies to the baseline slots). For each slot, one of nine states are indicated, as illustrated here. The "X" images are bright red. The check marks are green.
 - LIMIT STATUS No Not Max ICONS Max Exc. Exc. -4 -× No Minimum 1 <u>_×</u> Min Not Exceeded 1-× Min Exceeded ×

Max

• Units column. In the prior version of the Scenario Manager dialog, the only numeric columns were the minimum and maximum columns, and units for those entities were shown with the

numeric values in those columns. The new version of the Scenario Manager shows units for the slot's numeric values in its own conditionally shown column.

Multiple text line **tool tips** in the "Limit Status" (Icon) column will show the value-range (minimum and maximum series values) within the series slot. Also the **context** (right-click) **menu** will provide these additional operations:

- Global time-scroll to slot's *minimum* value.
- Global time-scroll to slot's *maximum* value.



2.2 Scenario Series Slot Scaling Adjustments

The "Start Adjustments …" push button below the slot list is enabled when only slot items active in "scaled" edit mode are selected (and at least one is selected). Clicking on that button starts the **"Scenario Slot Adjustment Mode"**. In this mode, the following changes are effected:

- 1. The "comments" panel (below the slot list) is replaced with the scaling and offset control panel. (*See images*).
- **2.** Changes to the "edit mode" of items in the slot list are disabled.
- **3.** [*Tentative*]: Either the slots which had not been selected are hidden *OR* some other visual indication is made active to show which slot items are being adjusted.

This panel contains two main sub-panels: "Scale" and "Offset". The Offset subpanel is initially hidden. It can be shown *only if* all of the slots being operated on have the same unit type (e.g. "Flow") because offset adjustments are, by definition, unit-based. When available, clicking on the "Offset" checkbox shows the offset controls. Hiding the offset controls (by clicking the "Offset" checkbox again) cancels the effect of the offset change.

Both subpanels support both numeric entry and mouse-slider controlled value adjustments. The supported value *range* is also specified by the user as a numeric entry.

Scale Image: Scale Image: Scale
☐ Offset
Apply V Dynamic Apply Accept Cancel
Scale
-25.0
acre-ft/month _50 0 50 Offset Range 50 acre-feet/month
Apply Dynamic Apply Accept Cancel
Offset Slots with differing unit types are selected. Offset adjustments are not available.
Apply V Dynamic Apply Accept Cancel

The Scale slider bar is logarithmic. The valid range is based on the upper value entered by the user. (See the "Scale Range" entry widget). The lower limit of the range is the reciprocal of the specified upper value. Note: although the scale slider bar's positions are interpreted logarithmically, the slider's tick marks are evenly spaced; this is a limitation of the Qt4 slider widget.

The Offset values are in one of the supported units for the single unit type of the scenario slots being operated on. The various slots in that set may have different configured display units, e.g. cfs, cms, or acre-feet/month for

"Flow" units. The user may pick any particular unit for the specification of offset values. Those offset values are reflected in the actual display units for each slot within the "Offset" column in the slot list.

The Offset slider bar is linear, and ranges from the negative value to the positive value of the entered "Offset Range".

When a slider bar has "focus" (e.g. after it has been clicked), the slider "thumb" can be stepped by a small amount by pressing the **right** or **left arrow keys** (i.e. on the keyboard). Holding down those arrow keys for about one second causes them to repeat, effectively animating the motion of the slider thumb and resulting value.

The three **numerically labeled buttons** below the slider function both as a slider "value key" and controls to force the slider to the corresponding positions. The middle position represents the "null transform" for each of these functions, 1.0 and 0.0 respectively for "scale" and "offset".

As described in the Overview, changes to the scale and offset value are immediately reflected in the (scenario) "Value" and "Limit Status" (icon) columns. Also, if the "Dynamic Apply" checkbox is on, changes are also made to the underlying slots so that any numeric or graphical display of those slots (Open Slot dialogs, SCTs, and Plot dialogs) immediately reflect the adjustments. If that checkbox is off, the "Apply" button is enabled to trigger that effect.

The user can either Accept the adjustments made in the current Scenario Slot Adjustment Mode session, or can Cancel those adjustments, by clicking either the "Accept" or "Cancel" push buttons. The "Cancel" button reverts all changes made in this session, even if "Dynamic Apply" had been active or the "Apply" button had been pressed. The intention for those "apply" actions is to (tentatively) view the effects of adjustments to the series slots, as those adjustments are being made.

2.3 Baseline Tab Slot List

Many of the enhancements to the Scenario Manager Dialog's slot list apply also to that list in the baseline tab -- in both "full" and baseline RiverWare models. The new Baseline Value and Limit Status columns can optionally be shown. The Limit Status (icon) column indicates the conformance of the *baseline* slot to the configured minimum and maximum limits.

tive Sc	enario: BASELINE	12				<u>-</u>	2010 C.E.	
laseline								
	Slot	Comments	Base Val		Min	Max	Units	<u> </u>
™	ArizonaPumpers.Total Depletion Requested		10,000.00	1	0.00	12,000.00	acre-ft/year	
۳. 🕅	ArizonaPumpers.Total Diversion Requested		10,000.00	1	0.00	12,000.00	acre-ft/year	
🍕 🎊	VirginRiver.Inflow	Fix This.	75,891.91	∵×	60,000.00	500,000.00	acre-ft/year	
🛄 M	Powell Forecast Data.HydrologyIncrement		85.00	1	0.00	100.00	NONE	
- M	MonthlyHydrology.LittleCoR		5,465.47	1	0.00	300,000.00	acre-ft/month	
- M	SNWP Schedule.AnnualNormalDepletionSchedule		271,000.00			300,000.00	acre-ft	
M	SNWP Schedule.AnnualNormalDiversionSchedule		486,000.00			520,000.00	acre-ft	
🖄 🖄	Havasu.Storage		539,000.00	1	0.00	638,000.00	acre-ft	
1	Mohave.Storage		1,583,000.00	1	0.00	1,583,000.00	acre-ft	
								-
Restore	e Custom Order 👔 😃 Set Custom Order]						
Baselir	ne Comments:							
The Maxi	VirginRiver.Inflow slot in this full (non-baseline) mod imum value should be adjusted before saving this m	el has values odel as a bas	which exceed the eline model.	e con	figured Maxin	num value. (See	the red "X"). Th	at

In the new design, the ability to *define* a custom sort order is supported only in the non-baseline model on the baseline tab. This becomes the "Default Order" in baseline models.

The "Set Custom Order" button is visible only on the Baseline tab in "full version" models (not baseline models). It sets the custom order from the current display order (which results from clicking on any column header). Selected items in the custom order can be moved up or down by clicking the blue up and down arrows.

Note: The prior design supported drag-and-drop operation of slot items to modify the order, but this conflicted with the ability to support *multiple*-item selections which is more important.

2.3.1 Input Slot Support

When composing the list of baseline slots within the Scenario Manager, the user (the baseline model architect) must pick slots within the model which were devised to provide "inputs" (input-flagged values in series slots). It is now possible to use the "Find Inputs" dialog to view a list of such slots, *copy* an arbitrary subset of those slots to the slot clipboard and *paste* them into the Scenario Manager's slot list.

The "Find Inputs" dialog was previously available from the RiverWare Workspace's "Workspace >> Slots" menu. It is now also available from the Scenario Dialog's "View" menu (from which other external dialogs such as the Snapshot Manager can be displayed).

3.0 SCT Support for Scenario Slots

Prior series data display support for scenario series slots was limited to Open Slot dialogs.

It is now possible to show and edit (as appropriate) Baseline and Scenario Slots in an SCT. A "Show Slots in SCT" operation brings up a popup dialog illustrated with this *mockup* image.

The "Append to the single open SCT" option is available if, in fact, there is a single open SCT. (For this purpose, an SCT is not considered to be open if its window is minimized).

This dialog includes a checkbox for the Baseline and each of the loaded Scenarios. When a particular scenario tab is current, the checkbox for that scenario is initially checked.

If multiple checkboxes are checked, e.g. "Baseline" and at least one of the Scenarios, then *SCT Dividers* are added to the SCT before each "group" of slots -- where each group is composed of the selected "baseline/scenario" options for each of the selected slot list items. (In the illustrated example, the popup dialog is indicating that five slot items had been selected).

This is the only way in which Baseline and Scenario Slots can be

Show the 5 selected slots: New SCT Append to the single open SCT Include: Scenario Slot: Scenario One Scenario Slot: Scenario Deta Scenario Slot: Scenario Beta CK Cancel

Show Slots in SCT - [Preview] ? 🗙

added to an SCT. (That is, those types of slots don't show up in the RiverWare Slot Selector dialog). But if the SCT is saved and reloaded (possibly in a subsequent RiverWare session), the SCT will be attempt to locate the relevant Baseline and Scenario slots.

4.0 Development Tasks

4.1 Qt3 to Qt4 Port of the Scenario Manager Slot List

The port of this Qt3 widget to Qt4 has basically been completed. The list was ported from a Q3ListView to a (Qt4) QTreeWidget. This work also provided the following functional enhancements:

- 1. Single item selection (with drag-and-drop list item reordering behavior) was replaced with multiple-item selection with arrow-button based custom reordering and column-click sorting.
- 2. Object Type and Slot Type icon columns, sortable.
- **3.** Optional "Object" column showing the slots' object's names. When this column is shown, the Slot column shows only the "local" slot name (i.e. not also including the object's name).
- 4. Ability to "paste" slots into the slot list from the slot clipboard.

4.2 Scenario Data Model Enhancements

The internal data model support (primarily the Sim/ScenarioSlotData class) requires these additions, including serialization:

- Edit Mode (Custom vs. Scaled) Flag
- Scale Factor (unit-less double)
- Offset Term (double, in standard units of the slot's unit type)

4.3 Scenario Dialog and Slot List Enhancements

The Qt4 port (see above) and preparation of this design laid the groundwork for much of the Scenario dialog and slot list work. This included:

- Construction of the "limit status" icons.
- Optional-column support (via checkbox items under the "View" menu).
- Basic "edit mode" checkable item implementation (in the "Edit Mode" column).
- Prototype baseline and scenario series value display, including display of scaled (computed) scenario slot values from baseline values when in "scaled" edit mode.
- Assessing series slot "limit status", including finding the "minimum" and "maximum" value timestep date/ times within a series slot.

Remaining tasks include:

- **1.** Address problems observed from the Qt4 port:
 - **1.1.** List construction performance optimization. There is a lot of internal Qt processing occurring when the list is constructed.
 - **1.2.** Geometry management problem. The "comments" panel below the slot list is being given too of the available vertical height.
- 2. GUI integration with new scenario slot data model provisions.
- **3.** Timer-based update-performance features. Slot value and scaling/offset change notifications need to be collected and deferred, rather than being fully processed when they are received. (This should be done after the initial implementation of the "scaling and offset control panel").

- **4.** Scenario Slot Adjustment Mode support. Changes in slot list composition and "edit mode" change enabledness.
- **5.** Various minor GUI behaviors:
 - **5.1.** "Edit mode" checkable items -- toggle action needs to effect all selected items.
 - 5.2. Special "Limit Status" column support: dynamic tooltips and context menu operations.
 - **5.3.** Add hook to the "Find Inputs" dialog from the "View" menu.
- 6. Fix: Prevent *accounting* slots from being added to, and included in the slot list.
- 7. Basic completeness, consistency and usability developer-testing and review.

4.4 Scaling and Offset Control Panel Implementation

The basic widget construction has been completed, in the course of writing this design. The following additional tasks are required:

- 1. Management of the panel within the Scenario Manager Dialog.
- 2. GUI behavior implementations
 - **2.1.** Button and Numeric text entry widget handling
 - **2.2.** Slider setup and event handling; public signal generation.
 - **2.3.** Linear to logarithmic *scale* slider value computation.
- **3.** Backup slot cloning; reverting applied changes (for "Cancel").

4.5 Open Slot Dialog Enhancements

- 1. Scenario Slots should not be editable when their "edit mode" is scaled. This requires the addition of a notification (callback) mechanism for changes in this state.
- 2. The Open Slot Dialog's update performance-optimization behavior needs to be tested with series slot value notifications from dynamic value changes caused by scale and offset scrollbar changes.

4.6 Plot Dialog Enhancements

The Plot Dialog lacks update performance-optimization. When receiving a slot-value change notification, the Slot-Plot class (or some class in the plot mechanism) should schedule a timer to effect the update. Subsequent notifications should either reschedule the timer, or just be dropped to allow the update to occur periodically even during busy times. Adding this feature will be of great benefit for RiverWare runtime performance when plot dialogs are displayed -- and even for large multiple-timestep slot edit operations.

4.7 SCT Enhancements

- The RiverWare "locate slot" mechanisms don't currently support baseline and scenario slots -- i.e. retrieving a live (in-memory) slot pointer given the slot's complete name. The SCT's internal slot descriptors, and their Flex/Bison based persistence need to be enhanced to support references to scenario-related slots. The SCT will then need to retrieve those slot pointers from the Sim-library scenario manager and related classes. Also, slot life-cycle mechanisms need to be tested (though the regular Slot deletion callbacks currently used by the SCT should just work without modification for this).
- 2. "Show Slots in SCT" popup dialog implementation (from the Scenario Manager dialog).
- **3.** Ancillary issues:
 - **3.1.** GUI slot row and column slot name text formatting.

3.2. Operations on slots within the SCT for these slots need to be tested, e.g. editability, open slot dialog, plot slot, etc.

5.0 Development Estimates

5.1 Completed Design and Development Work

Section	Days	Description
4.1	4.5	Qt4 Port of the Scenario Manager Slot List
4.3 (part)	4.0	Design work (this document) and mockup prototype development

5.2 Estimated Future Work

Section	Days	Description
4.2	1.0	Scenario Data Model Enhancements
4.3		Scenario Dialog and Slot List Enhancements
4.3 (1)	0.5	Address problems with Qt4 port
4.3 (2)	0.5	GUI integration with slot data model provisions
4.3 (3)	0.5	Timer-based update performance features
4.3 (4)	0.5	"Scenario Slot Adjustment Mode" support
4.3 (5)	0.5	Various minor GUI behaviors
4.3 (6)	negl.	Fix: Prevent accounting slots from being added to, and included in slot list
4.3 (7)	0.5	Basic completion, consistency and usability testing
4.4		Scaling and Offset Control Panel
4.4 (1)	0.5	Management of panel within the Scenario Manager Dialog
4.4 (2)	1.0	GUI behavior implementations
4.4 (3)	1.0	Backup slot cloning; reverting applied changes
4.5	0.5	Open Slot Dialog Enhancements
4.6	1.0	Plot Dialog Enhancements
4.7		SCT Enhancements
4.7 (1)	3.0	Scenario slot reference maintenance
4.7 (2)	0.5	"Show Slots in SCT" popup dialog
4.7 (3)	0.5	Ancillary issues
Also:	4.0	Feature documentation and addressing post-development review issues.
	16.0	Total Estimated Future Work [Days]

--- (end) ---