Plotting: Editing Multiple Curves and Graphs

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1.0 Introduction

The USACE-SWD has asked for the following enhancements:

- 3a. Add the ability to change the order of items in the plot legend
- 3b. Improve the ability to control plot configuration and attributes. This includes both configuring a single plot and multiple plots. Examples include changing the axis settings and background color for each graph in a 3X3 layout in one location.

This document describes the existing functionality, requirements and proposes an interface design to meet these needs.

2.0 Existing Functionality



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Requirements

To configure the color, line width, style, etc of a curve or marker, the user selects a graph and then used the **Edit** \rightarrow **Curve Configuration** to get a dialog where they can edit the properties. One or more curves/markers on that graph can be edited sequentially.

To configure the Grid, Axis, Background Color, or Title of a graph, the user selects a graph and then chooses one of the four menu items shown

 Sdit
 Graph
 Data
 Window

 Curve Configuration...
 Marker Manager...

 Marker Manager...
 Set Plot Title...

 Set Background Color...
 Grid Configuration...

 Axis Configuration...
 Preferences...

Analogous configuration can be initiated from the right-click context menus.

There is no ability to re-order the items in the legend, they remain in the order they were added.

The current "Curve Membership" dialog, shown to the right for the Pensacola graph, shows a list of curves in a particular graph. It shows the **Label** and data used for the **X** Axis and **Y** Axis. You can edit/configure the curve from here by selecting a curve and clicking the **Edit Curve...** button. If the user clicks on an alternative graph, this dialog closes.

Plot Membe	ership			×
Label	X Axis	Y Axis	Key	*
Inflow	Time	Pensacola.Inflow Sum	1	
Outflow	Time	Pensacola.Outflow	2	
Pool Elevation	Time	Pensacola.Pool Elevation	3	
				*
Add Series Cur	ve Add Ta	able Curve Add Periodic Curv	ve Add Paramet	ric Curve
Add Series Cur	elete Curve	able Curve) Add Periodic Curve	ve) Add Paramet	ric Curve

Markers are currently not shown

in the Plot Membership dialog but are instead shown for each graph in the **Plot Marker Manager** shown to the right. Currently, there is a toggle at the bottom to **Display legend items for markers**. This control affects all markers on the graph.

3.0 Requirements

Following are the requirements for this task:

- The user should be able to re-order the curves and marker in the legend.
- The user should be able to select multiple graphs and then configure the grid, axis, background color and title in one step. For example, in the above screenshot, select both the Pensacola and Hudson graphs and change the background color.
- The user should be able to select multiple curves/markers on different graphs and then configure the curves/markers in one step. For example, in the above screenshot, select both Inflow slot on both graphs and change them to be dashed blue instead of maroon.

Marker Label ^							
1 Bottom of Flood Pool (745)							
2 Top of Flood Control							
Add Marker Delete Marker Edit Marker							
Display legend items for markers							
Close							

4.0 Proposed User Interface

To meet the first requirement, a right click context menu will be added to the legend to "**Reorder Legend**...". A dialog will open where the user can re-order the legend items using up and down arrows as shown in the screenshot to the right. This functionality was implemented for RiverWare 6.9. Additional menu re-ordering will be including in the new "Plot Manager" described below.



Because there is no easy way to select multiple curves or markers

across graphs within the current Plot Page interface, we propose to move configuration of multiple items to a single separate dialog. This new dialog, named the "Plot Manager" (alternative titles: Graph, Curve and Marker Manager; or Configure Multiple Graphs and Curves) will replace both the Plot Membership and the Marker Manager. The Plot Manager will be accessible from the Edit menu and from right click context menus using active text like: Configure multiple Graphs and Curves

Following is a description of the new **Plot Manager** dialog. Because of the editing complexities, the dialog will have two modes: Edit Curves and Edit Graphs. The following table shows the Edit Curves mode. In this mode the Graph information is shown, but is not editable.

		Edit	Curves M	lode		
Graph (row, col)	Туре	Label	X axis	Y axis	Show in Legend	Sample
(1,1)	Graph	Pensacola				
	Curve	Inflow	Time	Pensacola.InflowSum	Yes	
	Curve	Outflow	Time	Pensacola.Outflow	Yes	
	Curve	Pool Elevation	Time	Pensacola.Pool Elevation	Yes	
	Marker	Bottom of Flood Pool (745)		745ft	No	
	Marker	Top of Flood Control		755ft	No	
(2,1)	Graph	Hudson				
	Curve	Inflow	Time	Hudson.InflowSum	Yes	
	Curve	Outflow	Time	Hudson.Outflow	Yes	
	Curve	Pool Elevation	Time	Hudson.Pool Elevation	Yes	
	Marker	Top of Conservation Pool		619ft	No	
	Marker	Top of Flood Control		636ft	No	

Table 1	. Data	shown	in the	new	Plot	Manager	dialog,	Edit	Curves	Mode
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Proposed User Interface

At the bottom of the dialog would be the following controls. The user could turn on or off the controls through the check boxes. Buttons are provided to **Apply to All** or **Apply to Selected**

1	📝 Line Style	👽 Symbol Style	Curve Style
	None	None	Cinear Interpolation
	Solid	Rectangle	Spline Interpolation
	Dashed	Diamond	Points
	O Dotted	Triangle	Step Curve
	O Dash-Dot	Cross	
	Dash-Dot-Dot	X-Cross	
	Line Width 2	Symbol Size 0	
			Selected Close
		CALL CONTRACTOR CALL CONTRACTOR	

Additional functionality could include the ability to change anything in the view including changing Labels, re-assigning slots, setting marker values, adding new curves, and moving curves from one graph to another. These are one-at-a-time options so could be performed directly in the table.

The following table shows the **Edit Graphs** mode. In this mode the Curve information is shown, but is not editable. There could be a user control to not show the curves/markers if desired.

Table 2. Data shown in the new Plot Manager Dialog, Edit Graphs Mode

Edit Graphs Mode							
Graph (row, col)	Туре	Title	Background Color	Sample			
(1,1)	Graph	Pensacola	Grey				
	Curve	Inflow					
	Curve	Outflow					
	Curve	Pool Elevation					
	Marker	Bottom of Flood Pool (745)					
	Marker	Top of Flood Control					
(2,1)	Graph	Hudson	Grey				
	Curve	Inflow					
	Curve	Outflow					
	Curve	Pool Elevation					
	Marker	Top of Conservation Pool					
	Marker	Top of Flood Control					

Buttons at the bottom of the dialog would include functionality to:

- Configure Background Color (enabled when 1 or more graph is selected)
- Configure Axes (enabled when 1 or more graph is selected)
- Configure Grid (enabled when 1 or more graph is selected)

Software Design

A mock-up of the controls is shown below. The user could turn on or off the controls through the check boxes.

Background Color	Axis Left Y Axis	•		Grid		
	Title Linear Label Unit Name Linear		 Lower X Axis Upper X Axis 	Major Tick Grid Minor Tick On On Off Off	Grid	
				Y Grid		
	Bounds Minimum 0 Maximum 200	1	1000 cfs 1000 cfs	 Left Y Axis Right Y Axis 	ajor Tick Grid Minor Tick On Off Off Off	Grid
	Numeric Display Format Decimal Precision O Determined by Plotted Slots Fixed 0		▼ A V	Major Grid Style None Solid Dashed Dotted Dash-Dot Dash-Dot	Minor Grid Style None Solid Dashed Dotted Dash-Dot Dash-Dot-Dot	
	Tick Marks Max Major Ticks: Max Minor Ticks:	8 5	×	Major Grid Width 0 Set Major Grid Color	Apply To Selected	

Editing of the Title is on a per-graph basis, so could be performed directly in the list.

Additional functionality could include the ability to re-arrange the graphs, delete graphs, change the layout, etc.

BTW, the grid configuration can be simplified immensely. Grid lines are either On or Off, there is no difference between Left/Right and Lower/Upper axis. In addition, the Grid Styles can be converted from Radio buttons into combo boxes for improved real estate. The On Off radio buttons can be changed to checkable boxes.

In addition, the Axis combo box could be replaced by a more intuitive control, such as:

Axis: Left / Right / Up / Down

A graphical icon could help to show this layout.

5.0 Software Design

This development essentially represents a centralization of plot configuration editing controls from various single-item editor dialogs into a unified multiple-item editor. Most plot settings, for

Software Design

up to nine separate graphs, will be editable in a single Plot Configuration Manager dialog. Limited simplifications and enhancements will be implemented. Modest functional enhancements include:

- The ability to reorder a graph's curves and markers, as they appear in the graph's legend.
- The ability to show or hide individual curves and markers in the legend. (Currently, the user can show or hide legend items for all markers, as a single setting applied to the whole plot).

5.1 Plot Configuration Hybrid Data Model

The existing plot configuration implementation does not have a conventional model/view architecture. The GUI classes (based on the Qwt plotting library) have their own data model, with much of the configuration information stored in Qwt classes. Configuration edits are applied to that GUI-level data model. The major classes at this level which store user-configuration data are:

- Slot Plot (a QwtPlot subclass) -- a single graph
- Axis Item (four per graph)
- Slot Curve (with six application-level subclasses; a QwtPlotCurve subclass)
- Plot Marker (a QwtPlotMarker subclass)

Plot configuration information stored in those GUI-level classes is saved off to native RiverWare configuration data classes for persistence. These include:

- PlotPageInfo -- a RiverWare output device (cwOutputDevice) subclass supporting up to nine graphs, in a 3x3 layout.
- PlotInfo -- data for a single graph, containing instances of the following classes ...
- CurveInfo -- a slot-based curve (typically for a single slot, but sometimes, two slots are involved).
- MarkerInfo -- a "marker" having a single value along a single axis or two values along orthogonal axes.
- Other supporting classes: LineInfo, SymbolInfo, GridInfo, Date Label Info, Label Orient Info, AxisInfo.

5.2 Plot Configuration "Save" Paradigm

Currently (in RiverWare 6.9 and prior versions) in order to make plot configuration changes permanent, the user has to explicitly "save" the plot to a named plot output device within the River-Ware model. (Internally, this is the process of generating a PlotPageInfo object tree from the set of Slot Plots in a plot dialog). We eventually want to make most aspects of saving of the plot configuration information into a PlotPageInfo output device more automatic (in some way) -- when such an output device is associated with the plot dialog. However, it is undesirable to automatically save aspects of the plot configuration not represented within new Plot Configuration Manager dialog -- e.g. the current zoom level and scroll position. That objective is nominally beyond the scope of this development, as a nontrivial amount of reworking of the "saving" process would

Estimate

be needed. For this development, the "saving" implementation will remain intact. However, we should keep that objective in mind during this development.

5.3 Enhancement Implementation Overview

As stated above, to keep the scope of this development manageable, the GUI configuration reimplementation will affect only edits to the Qwt-based GUI classes (SlotPlot, etc). With this centralization of plot feature configuration edits in place, and usability issues ironed out, we will subsequently consider revisions to the "Saving" paradigm (see the prior section).

The central feature of the Plot Configuration Manager dialog is a Plot Feature Item Table (implemented as a flat, single-level, QTreeView) through which the user selects the features (line items) to be modified when applying various configuration changes. This table will also provide certain directly editable cells -- the effect of which will be immediate (on the Qwt-based GUI classes). At the Qt level, this will be a QAbstractItemModel-based (GUI model/view) implementation, rather than a QTreeWidget item-based implementation. This somewhat lower-level Qt approach is better suited for very specific current and future behavior and appearance requirements of this table (flat treeview).

The Plot Feature Item Table will provide Graph, Curve and Marker multiple-item selection information, for enabling the appropriate configuration setting controls and effecting setting operations. This table will also support asynchronous item selection operations (i.e. from outside of this dialog, e.g. from context menu operations on plot legend items). Other than a change to the "targets" of setting operations, the existing setting logic (of the Qwt-based GUI classes) will be mostly usable in its current form, as it exists in the individual plot item single-instance editors. Applying such settings will have an immediate effect on the Qwt-based GUI classes.

6.0 Estimate

We estimate it will cost \$20,000 to implement this design.