Plot Template Task – Conceptual Design

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1. Introduction

The idea of a plot template is to allow a user to create a plot involving particular slots on particular objects and then generalize this plot as a "template" so it can be easily applied to other objects and slots of the same type.

For example, a user might create a 3X1 plot that has the following curves by plot:

- BigReservoir.Pool Elevation and BigDataObject.FloodGuide
- BigReservoir.Storage and DeepReservoir.Storage
- BigReservoir.Outflow

Turning this plot into a template should give the user the ability to easily substitute reservoirs, for example, into the template:

- SmallReservoir for BigReservoir
- ShallowReservoir for DeepReservoir
- SmallDataObject for BigDataObject

This could then create the 3X1 plot that has the following curves by plot:

- SmallReservoir.Pool Elevation and SmallDataObject.FloodGuide
- SmallReservoir.Storage and ShallowReservoir.Storage
- SmallReservoir.Outflow

Note that the user would not be able to substitute an object of a different type, such as a reach, into this template for the reservoir because the slots specified with the reservoirs are not necessarily applicable to other object types.

Alternately, the user might use the template to substitute slots:

- PoolElevation for Storage
- Inflow for Outflow

This could then create the 3X1 plot that has the following curves by plot:

- BigReservoir.Pool Elevation and BigDataObject.FloodGuide
- BigReservoir.PoolElevation and DeepReservoir.PoolElevation
- BigReservoir.Inflow

In these examples, the template would not be changed, but mapping template items to different objects and slots allows different plots to be created from the template.

2. Requirements

The following requirements have been identified for plot templates:

- A template will be created from an existing plot.
- Templates need to be saved to be accessible for future use.
- Templates should be transferrable between models (export and import).
- Templates, like actual plots, may contain up to nine different plots on the plot page.
- Source data for curves in the plots of a template need to be represented in a manner that readily allows substitution of data from real objects in a model.
- After substitution of data, templates will allow creation of a plot with the newly specified data.
- Templates remain unchanged by substitution of data to create plots.
- Source data specification for a curve in a plot varies according the curve type. Templates will need to present source data for the different curve types as follows:
  - SeriesCurve – slot, column
  - TableCurve – slot, X column, Y column
  - TableContourCurve – slot, X column, Y column, Z column
  - PeriodicCurve – slot, column
  - ParametricCurve – X slot, Y slot
- A slot in source data specifications for curves may be made up of the following substitutable components:
  - Object, slot
  - Object, account, slot
  - Supply
- In addition to curve source data, the template should allow modification of titles associated with the plot.

3. General Approach

Plot templates are closely linked to plots, so they will appear under the Output Manager in RiverWare as a new device type. A template will need to contain all of the information associated with a plot page (1 to 9 plots, with the curve, title, marker, axes, grid, and background color information associated with each), so each template will contain an instance of a plot page as currently defined in RiverWare.

The template will also need to contain additional information for each curve represented in the plots on its plot page. When a plot is turned into a template, information about the "components" of any slot referenced in the curve source data will need to be recorded. A physical slot will need to have the object name and type and the slot name and type recorded. An accounting slot will need to have the object name and type, account name and type, and slot name and type recorded. A supply will need to have the supply name recorded. This information is available from the slot pointer in the curve source data. However, if the template is exported and imported into a different model with different objects, the curve slot pointers will be invalid and no information about the potential substitutable components of the source slots would remain without the additional information recorded in the template.

When a new plot is created from the template, the substituted data specified by the user for a curve in the template will be resolved to a slot pointer in the model for that curve in the new plot. If data does not resolve to a slot pointer, the user can be given an error or warning (note that plots do currently support curves without slot source data and will maintain these unplotted curves as "placeholders" that can be assigned slots later in the plot's Curve Configuration dialog).

4. Plot Template Dialogs

4.1 Save As Template Dialog

Menu items called Create Template will be added to the File menu in the Plot dialog and the Plot Configuration Dialog to allow creation of a template from a plot. This link will bring up a template "save as" dialog to specify information for creating the template.
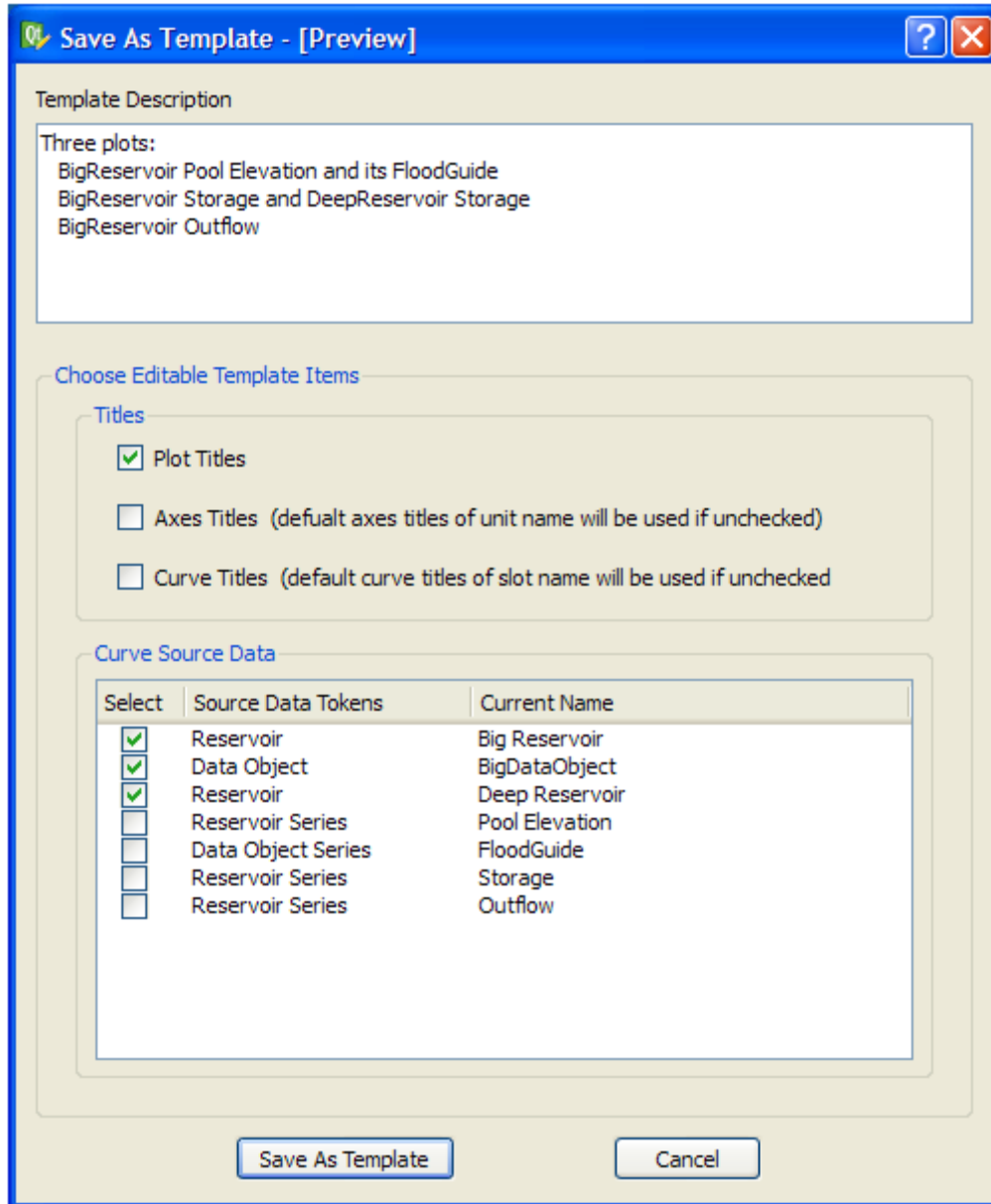
The upper part of the dialog will contain a text box for specifying a multi-line description of the template. This might describe the purpose of the template and its plots.

The center of the dialog will contain a Titles frame where the user can specify via check boxes whether Plot Titles, Axes Titles, or Curve Titles will be editable as text for plots generated from the template. If

Axes Titles and Curve Titles are not checked, they will get the normal default names in the plots generated from the template (unit name for an axis and source slot name for a curve).

The lower section of the dialog will contain a Curve Source Data frame where the user will be presented with a list of potential source data tokens for the plot (objects, accounts, slots, supplies which could be substituted to change the source data for a generated plot). With adjacent check boxes, the user will indicate which of these tokens they would like to have substitutable in generating plots from the template.

The bottom of the dialog will have a "Save As Template" and a "Cancel" button. Save As Template will bring up a dialog with a list of existing templates and a text edit line for the user to enter a name for the template, which will then be saved and added to the Output Manager.

4.2 Plot Template Dialog

The Output Manager currently allows export and import of output devices and this will also apply to plot templates that will reside in the output manager. Generating or Editing a plot template from the Output Manager will open the Plot Template dialog.
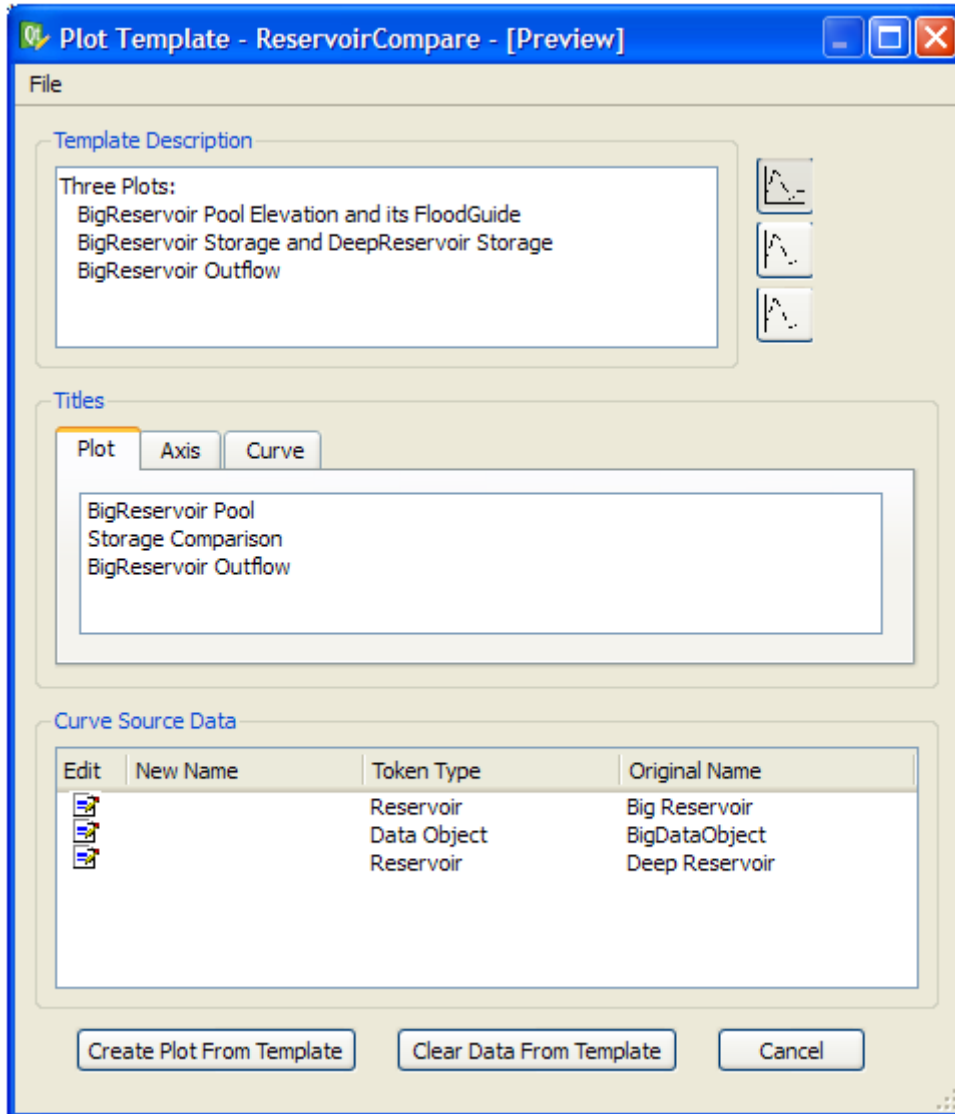
The upper part of the Plot Template dialog will have a non-editable text box that will contain the template's description. An adjacent plot layout symbol will show the layout of plots contained in the template. These will give the user basic information about the template and its purpose.

A Titles frame will follow that will contain a tabbed widget. Potential tabs are Plot, Axis, and Curve depending on what types of titles were specified to be editable when the template was created. Each tab will present a list of the titles in that category, where the user can edit the strings to create new titles for plots generated from the template.

The lower part of the dialog will contain a Curve Source Data frame where the editable curve tokens available in the template will be presented in a list view. The columns will be Edit, New Name, Token Type, and Original Name. The edit column will contain an edit button that will bring up a selector appropriate to the token where the user can select replacement token data (for instance if the token is a reservoir object, the selector will be a GUS selector initialized to allow selection of a reservoir from the model). The selected replacement data will populate the New Name column for the list item. Note that for some slot tokens (such as Table and Periodic), there will also be a column selector (spinner) that will appear in the list view in a column adjacent to the New Name to allow the user to specify the desired slot column for the source data.

The bottom of the dialog will have three buttons:

- Create Plot from Template
- Clear Data from Template
- Cancel

Clear Data from Template will discard any changes or selections the user has made and will restore the original template information in the dialog. Create Plot from Template will copy the plot page that exists underneath the template, assign the specified titles into the plot page copy, resolve the token information into slot pointers for the curves in the plot page copy, present the user with a "save as" dialog to specify the name for the new plot, add the plot to the Output Manager, and bring up the new plot's dialog. Cancel will exit the dialog with no plot being created.

It may be nice to have an optional plot template selection list on the right side of the dialog, similar to the list showing plots that exists for the plot dialog. This would allow the user to click and use different templates as they are creating plots from the plot template dialog.

5. Template Implementation

Implementing the plot template task would require the following changes:

Modify cwOutputDevice class for the new template device

PlotTemplate class

      Create as member of cwOutputDevice hierarchy with the following data and methods:

      Data
            PlotPageInfo (check into registering of these in Output Manager)
            List of curve info for all plots in plot page (list of CurveTemplateInfo structs)
            List of substitutable tokens
      Methods
            virtual generateOutput
            constructor PlotTemplate(PlotPageInfo)
            getType()
            getTypeString
            dump
            createTclCmd
            PlotTemplateInfoCmd
            getCurveTemplateInfo

Save As Template Dialog

      Create .ui file

- Description
- Title Options
- Curve Source Data Options
- Save As Template, Cancel buttons

      Dialog Coding

- Create PlotPageTemplate object from source PlotPageInfo object
- Constructor will interpret source plot's curves into a list of Curve Template structs.
- Constructor will distill Curve Template structs into a list of potential substitutable tokens.
- Save Template code will mark user-indicated titles and tokens as substitutable in the PlotPageTemplate instance, will bring up a dialog with a list of existing templates and a text edit line for the user to enter a unique name for the template, save template with the user-specified name, and add it to Output Manager.

Plot Template Dialog

      Create .ui file

- Description
- Indicator of plot page layout
- Titles edit frame – tabbed dialog of listed editable titles for Plot, Axes, Curves. Tabs enabled depending on template creation specs.
- Curve Source Data Tokens frame – list of editable tokens with the columns Edit button, New Name, Type, Original Name.
- Create Plot From Template, Clear Plot Data from Template, Cancel buttons
- Optional template selection list frame on right side of dialog

Dialog Coding

- Populate widgets from Template class instance
- Tokens will require selectors to be instantiated for editing that is restricted to either the object type, the accounts for an instance of one of the objects using the account, the slot type for an instance of one of the objects using the slot, or the supplies in the model.
- Clear Data from Template button will re-initialize template dialog from Template class, clearing any previous user data selections and title changes.
- Create Plot From Template button will present the user with a "save as" dialog to get a plot name from the user, make a copy of the plot page owned by the template, assign titles specified by the user in the dialog to the plot copy, take the user-specified token information along with the list of curve template information to identify slot pointers for the curves and assign these to the curves in the plot copy, save the plot copy with the user-supplied name, add it to the output manager, and bring up the new plot's dialog.

6. Additional Plotting Work

In addition to creating plot templates, the following plotting work has been identified for completion as part of this task.

6.1 Save or Replace a Single Plot in a Plot Page

This task would create greater flexibility in using plot pages with multiple plots. If single plots have been created separately, this capability would allow them to be easily assembled into a multiple plot page by importing the single plots into the various multiple plot positions. Or one plot in a multiple plot page could be replaced by any plot page containing a single plot in the model. Alternatively, if a plot was created as part of a multiple plot page, a copy could easily be saved separately as a single plot page.

Implementation of this task would include the following changes:

PlotPageInfo simulation class

- Add new method named saveAsNewPlot(newname, row, col) to create a new plot page with the given name and initialize it with the plot information in position (row, col) of the current plot page.
- Add a new method named replacePlot(PlotPageInfo*, row, col) to take the plot information from the given 1 by 1 plot page and copy it into the current plot page at position (row, col).

Create new SinglePlotList dialog

- Present a list of all the 1 by 1 plot pages in the model.
- For "Save" allow them to enter a unique name for the new 1 by 1 plot that will be created.
- For "Replace" allow them to choose one of the items from the list to identify the plot to be copied into their plot page.
- Return new name or existing plot page to the calling code.

PlotDialog

- Add a "Plot" menu with items "Save Selected Plot As…" and "Replace Selected Plot With".
- In context menu for a plot, add items "Save Plot As…" and "Replace Plot With…".
- Write button handler code for these to call the new SinglePlotList dialog and get a new plot name or existing plot page.
- In Save case, call the saveAsNewPlot(newname, row, col) on the dialog's PlotPageInfo class member to create the new plot
- In Replace case, call the replacePlot(PlotPageInfo*, row, col) on the dialog's PlotPageInfo class member to copy in the identified plot.

PlotPage Configuration Dialog

- Add two buttons below Select Graph panel to "Save selected Graph As…" and "Replace Selected Graph With…".

- Write button handler code for these to call the new SinglePlotList dialog and get a new plot name or existing plot page.
- In Save case, call the saveAsNewPlot(newname, row, col) on the dialog's PlotPageInfo class member to create the new plot.
- In Replace case, call the replacePlot(PlotPageInfo*, row, col) on the dialog's PlotPageInfo class member to copy in the identified plot.

7. Time Estimates

Plot Templates

Hours	Task
2	Modify cwOutputDevice class
8	Modify Plot Dialog, PlotConfiguration Dialog, Output Manager Dialog
16	Create Plot Template Class
10	Create Save As Template Dialog
24	Create Plot Template Dialog
4	Testing
6	Documentation
70	Subtotal

Save or Replace Single Plot in a Plot Page

Hours	Task
4	Modify PlotPageInfo class
6	Create Single Plot List Dialog
4	Modify Plot Dialog
4	Modify PlotPage Configuration Dialog
3	Update Documentation
21	Subtotal

Hours	
91	GRAND TOTAL FOR ALL TASKS