RiverWare Model Report Generator

High Level Design

Phil Weinstein, CADSWES

This document provides a high-level design for a configurable RiverWare model report generator. This is a general tool, but supports the specific requirements defined by this document:

- USACE Text Output: Functional Requirements (Draft, 2-12-2009, 8 pages)
  Authors: David Neumann and Edie Zagona (CADSWES), and John Daylor (USACE-Tulsa)

The user can select and specify the order of report sections and model objects, including Computational Subbasins, Simulation Objects, Accounts and Slots. Output for large Series and Table Slots can be truncated to specified timestep or row count limits.

Both plain text and HTML output generation is supported. The user can supply CSS (cascading style sheets) text styles for the HTML output.

Special feature: The output of Reservoir Table Slots having elevation, storage volume, or surface area values can be augmented with equivalent entities based on the Reservoir's Elevation Volume Table Slot and Elevation Area Table Slot.

0.1 Document Status

03-08-2009: Ready for review.
04-02-2009: Revisions after review.

0.2 Other Related Documents

RiverWare Model Report Generation Demo (3-31-2009, minor revision 4-3-2009, 14 pages).
Author: Phil Weinstein (CADSWES).

0.3 Contents Overview

0.4 Contents -- Detail

1.0 Report Configuration and Generation Process

The format and content specification of a generated model report is represented by a report configuration object managed as an “Output Device” through the RiverWare Output Manager. Multiple report configurations can be defined within a RiverWare model. They can be exported as report configuration files which can be imported to other RiverWare models. Report configurations are composed and edited using the RiverWare Report Configuration dialog box.

The generation of a report always results in the creation of an external report file, either in plain text or HTML. An external application to view the report (generally a text editor or web browser) can be launched from RiverWare using some of the facilities of the RiverWare Link to External RPL Documents feature (RiverWare 5.1). This includes use of the File Type Association Manager to associate the filepath of an executable program with the TEXT and HTML file types, for the purpose of opening files of those types.

The path and name of the generated report file is part of the report configuration. (See the “Output” tab within the RiverWare Model Summary Report Configuration dialog box).

From the RiverWare Report Output Manger, the user can create a New Report, or Open an Existing Report. Both of those operations show the RiverWare Model Report Generator dialog box. From there, the user can:

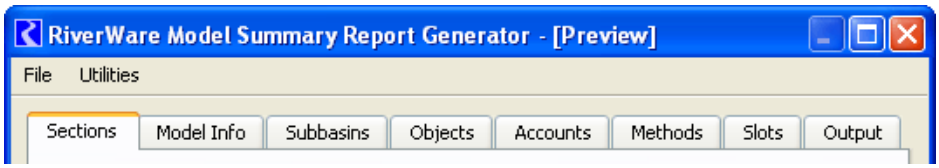
- define and modify the report configuration,
- generate and open (in an external browser application) a report from the configuration,
- open a previously generated report (i.e. the one at the filepath specified by the configuration’s output path value), or
- export the report configuration to a report configuration file.

2.0 RiverWare Model Summary Report Configuration Dialog

The RiverWare Report Configuration dialog box can be shown from the RiverWare workspace File menu, with the “Report Generator...” menu item. This dialog box is organized in six tabs for the purpose of defining the report format and content. Report generation and opening (by launching an external viewer program) is also operated from this dialog box.

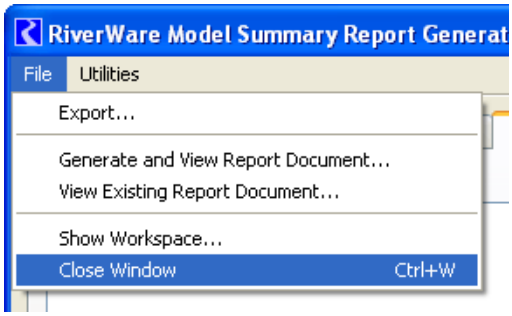
The configuration dialog box tabs are:

- Sections
- Model Info
- Subbasins
- Objects
- Accounts
- Methods
- Slots
- Output



2.1 Config Dialog: Menubar

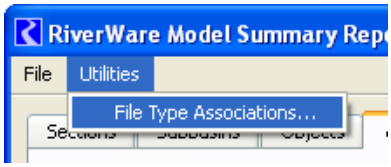
The RiverWare Report Configuration dialog box has a menubar which includes “File” and “Utilities” menus:

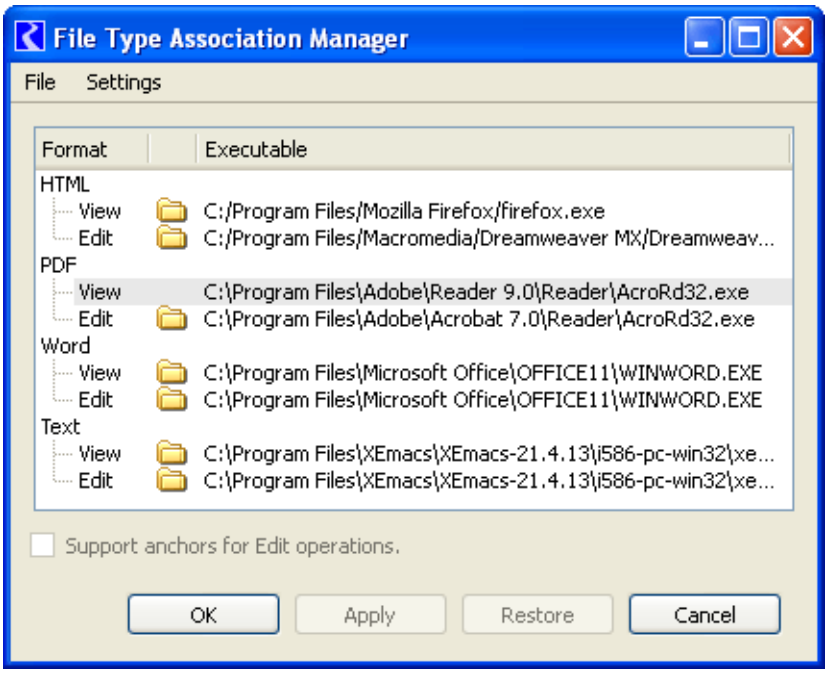


The “Export” item open up a file selector, initialized to the loaded model directory. The exported file can be imported (generally into a different RiverWare model) from the Output Manager.

The “Generate and View Report Document...” and “View Existing Report Document...” items perform the same functions as similarly named push buttons, described below.

The “File Type Associations...” menu item opens up the File Type Association Manager dialog (see below). This was introduced in RiverWare 5.1 as part of the RiverWare Link to External RPL Documents feature to allow the configuration within RiverWare of executables (programs) to be used for editing and viewing documents of various formats.

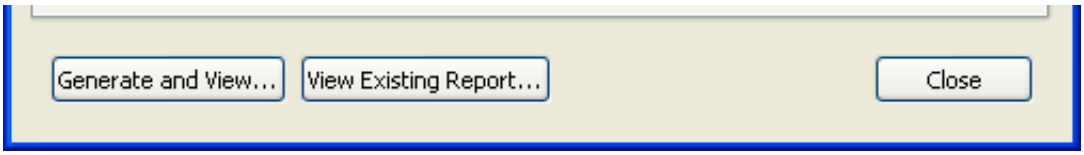




2.2 Config Dialog: Bottom Buttons

The RiverWare Report Configuration dialog box has the following three buttons along the bottom:

- Generate and View...
- View Existing Report...
- Close

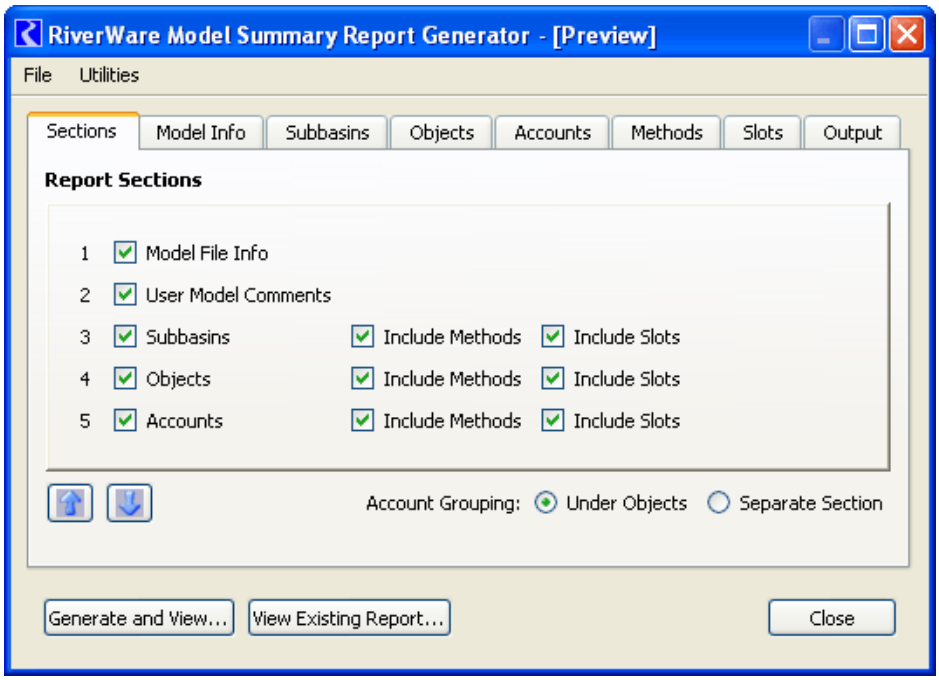


2.3 Config Dialog Tab 1: Sections

The Sections tab allows the user to select which major sections appear in the generated report, and to specify their order.

The blue arrows move the selected item up or down.

This mock-up image doesn't correctly illustrate the organization of data within a table widget, with selectable rows. The one or more selected rows would be moved with the blue arrows.



There are two ways of organizing Accounts within the report.

- Account instance sections can be arranged under their respective Simulation Object sections. If Object Slots are also included in the report, the Slot instance sections would come before the Account instance sections.
- Account instance sections can be arranged together after all of the Object instance sections.

The generated report content of various major sections is described in the Report Generation chapter in this document. The major sections have additional configuration on subsequent tabs of this configuration dialog.

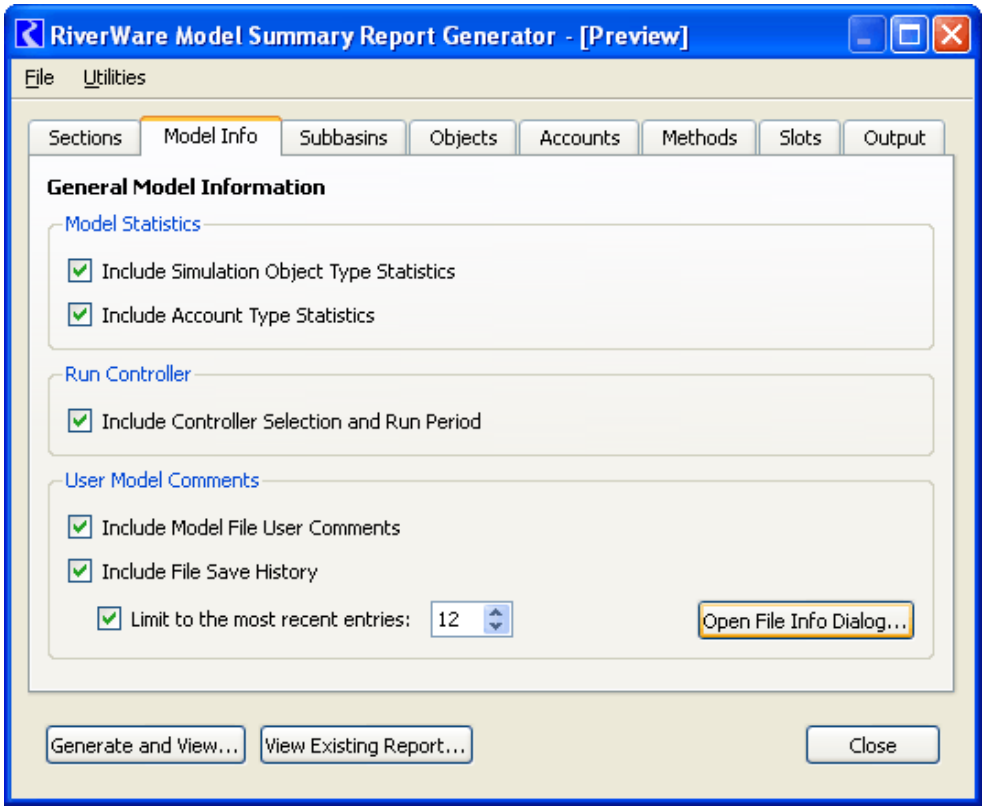
2.4 Config Dialog Tab 2: Model Info

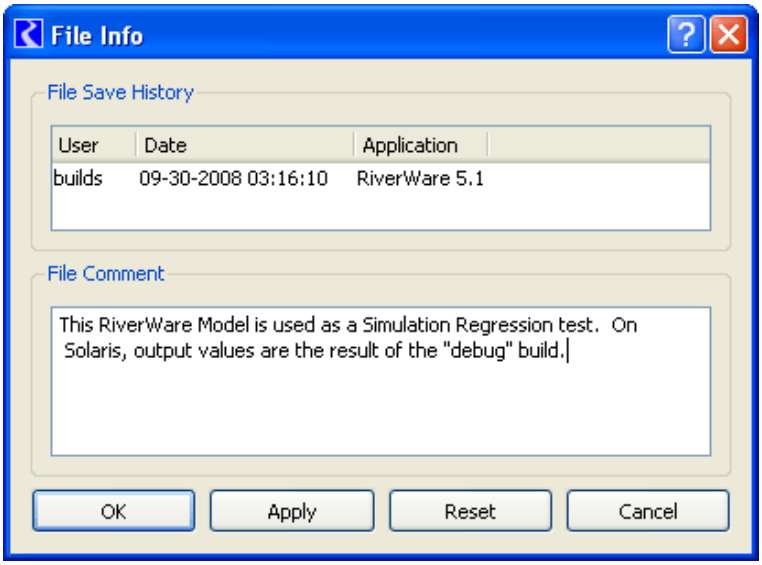
The Model Info tab controls the appearance of various general items in the report.

Clicking the "Open File Info Dialog..." button shows that dialog. *(See below).*

With that dialog, the user may revise the Model File User Comments and examine the File Save History items.

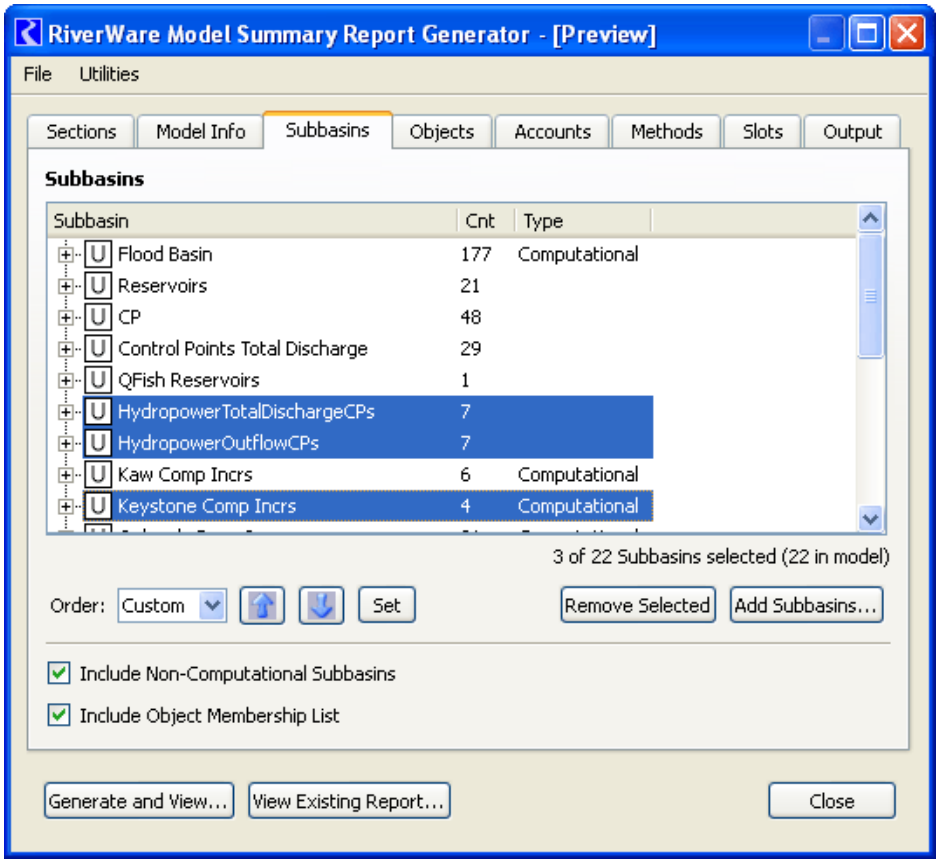
The number of "Save History" items written to the report can be limited to a specified number of most recent items.





2.5 Config Dialog Tab 3: Subbasins

The Subbasins tab indicates which, and in what order Subbasins appear in the subbasins section of the generated report document.



Clicking the "Add Subbasins" button brings up Subbasin Selector. The items selected with selector which are not already in the Subbasins list are added to the list.

The selected Subbasins are removed from the list by clicking the "Remove Selected" button.

Supported orders, selected with the "Order" ComboBox are:

- Custom
- Model
- Name

The **Custom order** is an order created in this dialog, in the displayed list. Selected items can be moved up or down with the blue buttons. The user can click on any of the column headers to sort by the data in that column -- clicking again reverses the order. The displayed order (e.g. as a result of clicking in a column header) can be made the Custom order by clicking the "Set" button. The Set button is active only when the displayed order differs from the Custom Order. The blue arrow buttons are active only when the "Custom" order is selected and when movement of the selected items is possible in the respective direction (e.g. the UP arrow is disabled if the item selection includes the topmost item).

The **Model order** is the order of subbasins as they appear in the Subbasin manager.

The **Name order** is a the ascending alphabetic order by subbasin name.

The **"[X] Include Non-Computational Subbasins"** checkbox allows the user to allow all subbasins to be included in the report, or limit included subbasins to Computational Subbasins (which are the only type of Subbasins which have methods and slots. Other types of subbasins consist only of an ordered list of Simulation Objects).

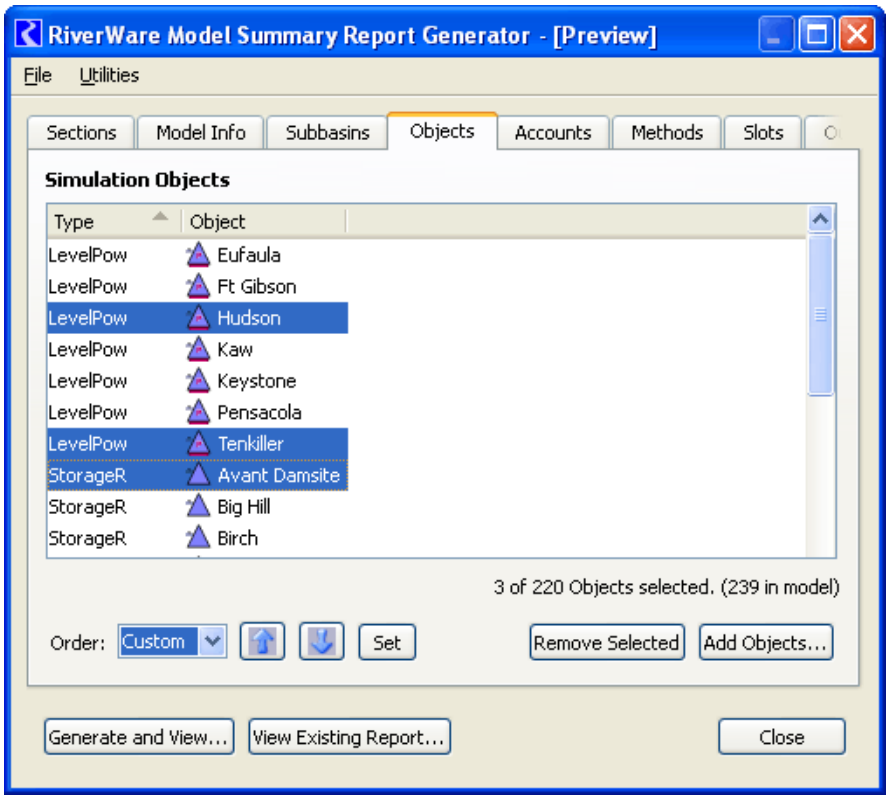
The **"[X] Include Object Membership List"** checkbox causes Subbasin instance sections in the report to include the subbasin's list of Simulation Objects.

Subbasin Methods and Slots are included in Subbasin instance sections if those are checked (for Subbasin) on the Sections Tab *(described in a prior section)*. The specific Subbasin methods and slots included in the report are configured respectively on the Methods and Slots Tabs, using the Subbasin Methods and Subbasin Slots Sub-Tabs. *(Read more in subsequent sections)*.

2.6 Config Dialog Tab 4: Objects

The Objects tab indicates which, and in what order Simulation Objects appear in the Objects section of the generated report document.

All the controls are mostly analogous to the same controls on the Subbasins tab.



Supported SimObj order options are:

- Custom
- Model
- Name
- Type / Name

The first three orderings are described above.

Type / Name order is first sorted by the Object Type (polymorphically, with all Reservoirs grouped together), and then by Object Name.

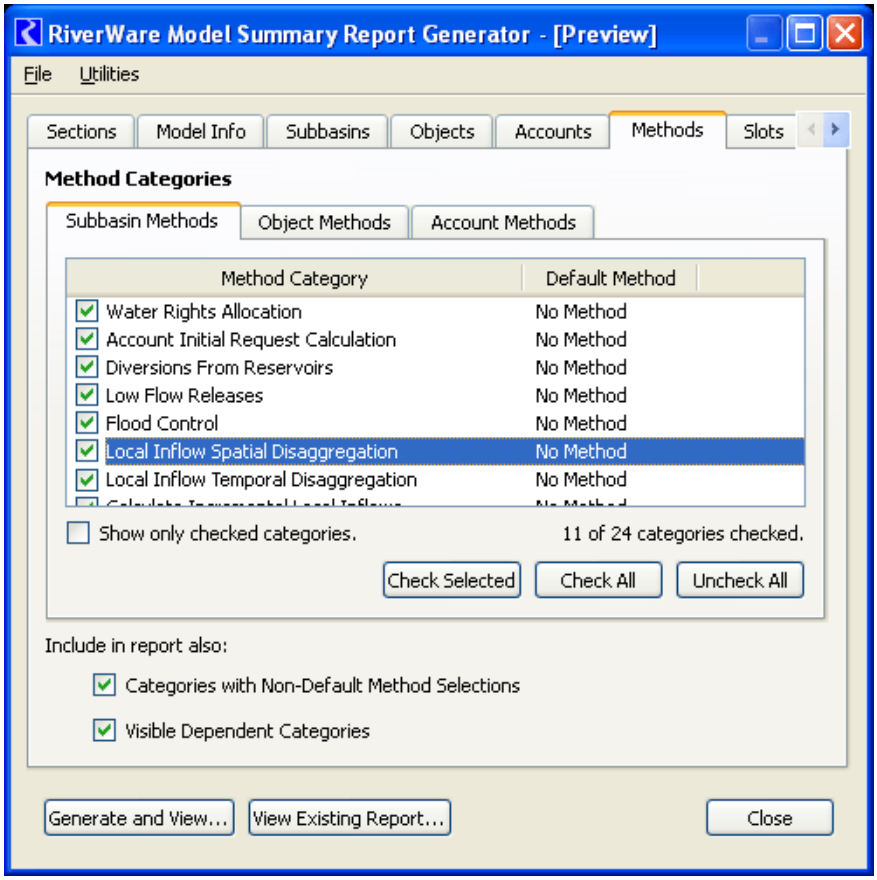
Simulation Object Methods and Slots are included in Object instance sections if those are checked (for Objects) on the Sections Tab *(described in a prior section)*. The specific Object methods and slots included in the report are configured respectively on the Methods and Slots Tabs, using the Object Methods and Object Slots Sub-Tabs. *(Read more in subsequent sections)*.

2.7 Config Dialog Tab 5: Accounts

The Accounts tab *(not illustrated with a mock-up image)* is similar to the Objects tab. Individual Account instances are selected to appear in the report -- either within Object instance sections, or grouped together after the Object instance sections (depending on the setting on the Sections Tab *(described in a prior section)*.

2.8 Config Dialog Tab 6: Methods

The Methods tab defines which Method Categories show up in the generated report.

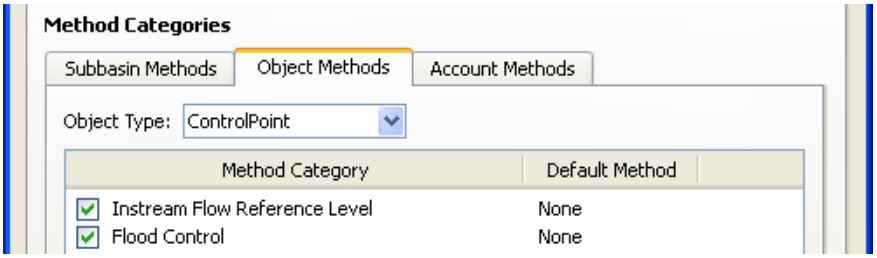


A list of "category entities" is automatically built from the relevant objects (Subbasins, Simulation Objects, or Accounts) selected to be in the report (on prior tabs).

A "category entity" list item represents actually all of the same-named categories on all of the objects of a particular type of object.

A checked method entity indicates that that method is included in the report with all objects which have that category.

If the Subbasin Methods Sub-Tab is selected *(see the second image),* the "category entity" list is built from the Subbasins to appear in the report.



The Object Methods and Account Methods tabs have an additional control: a combo box to select a specific Simulation Object or Account type. The list of methods is built from all the Objects or Accounts of the selected type which have been selected to appear in the report.

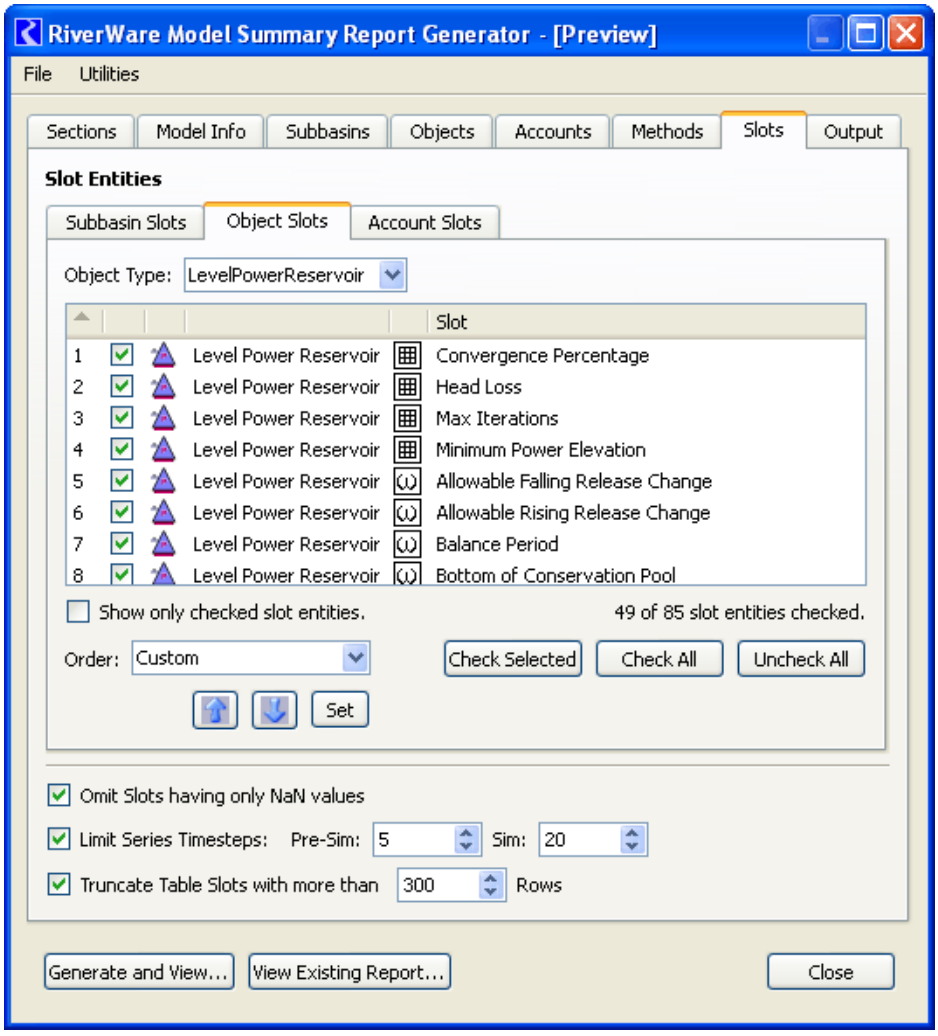
The two checkboxes below the list -- under "Include in report also..." -- provide an alternate way for additional Method Categories to be included in the report -- on a *per object* (Subbasin, SimObj, or Account) *basis.*

- If the **"[X] Categories with Non-Default Method Selections"** checkbox is checked, then -- for any specific object -- categories which have a non-default method selected are included (regardless of any settings in the "category entity list".
- Similarly, if the **"[X] Visible Dependent Categories"** checkbox is checked, those Categories are also included.

2.9 Config Dialog Tab 7: Slots

The Slots tab defines many aspects of how Slots show up in the generated report:

1. Which Physical and Account Slots are included.
2. Whether or not selected Slots should be included even if they have no values (all "NaN").
3. For SeriesSlots selected to be in the report, how many Pre-simulation and Simulation timesteps should be included, if not all timesteps.
4. For Table Slots having many rows, whether such tables should be truncated if the row count exceeds a specified quantity. When a Table Slot is truncated, only it's first and last several rows are show.



The latter two settings are provided because Series Slots and Table Slots can be quite large, and, in the case of Series Slots, it will sometimes be important to show initialization data (generally, pre-simulation timesteps). It may also be useful to show only representative values of large Table Slots. [See Question 4 in the Draft USACE Text Output requirements document: *"Do we need to be able to show initial reservoir storage, PE or other initial conditions?"*].

Similar to the inclusion of Method Categories in a report *(see prior section),* Slots are identified to be included by "Slot Entity" rather than by "Slot Instance". A "Slot Entity" represents similarly -named Slots on the set of objects of one particular type. The displayed list of "Slot Entities" is automatically generated from the set of objects (Subbasins, SimObjs, or Accounts) selected to be in the report (on prior tabs). Only those "Slot Entities" which are checked are included in the report.

The order of these Slot Entity items determines the order of Slots within the Subbasin, Simulation Object and Account sections.

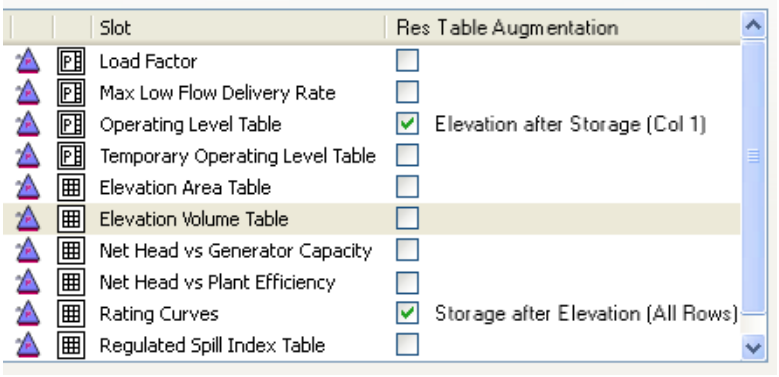
Supported Slot / Slot Entity orders include:

- **Custom Order** -- manipulated with the blue Up and Down arrows, or "Set" after sorting by column.
- **Object Type Order** -- the Object Type order is Slot order saved for the SimObj type.
- **Name** -- the ascending alphabetic order by Slot name.
- **Unit Type / Name** -- sorted first by Unit Type, and then by Slot name.

The text note under the Slot Name list will indicate information about the number of Slots and Slot Names in three parts: (1) the list selection, (2) selected for the report, and (3) in the model. For example:

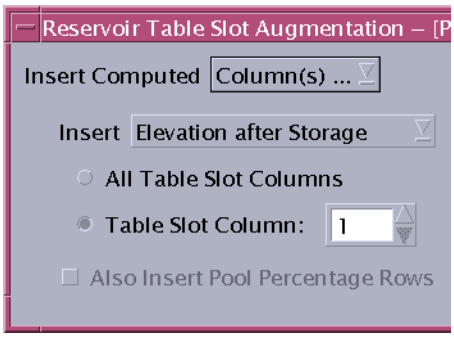
LevelPowerReservoir Objects: Sel: 7 slots (1 name); Report: 77 slots (11 names); Model: 77 slots (11 names).

A special feature for Reservoirs is supported in the Slot Entity list. When a Reservoir Simulation Object Type is selected, the list includes an additional column: **"Res Table Augmentation"**.



Reservoir Table Augmentation can be applied to Reservoir Table Slots including any of the three entities related to each other through the Reservoir Elevation Volume Table Slot or the Elevation Area Table.

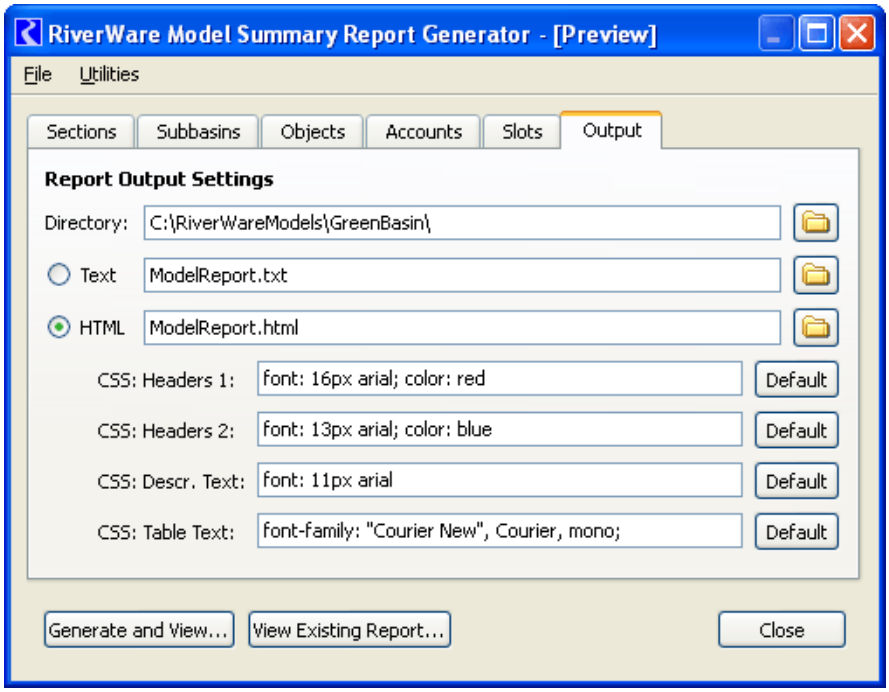
Clicking ON a toggle button brings up the Reservoir Table Augmentation dialog box. *See more details in a subsequent section.*



2.10 Config Dialog Tab 8: Output

The Output tab is used for:

1. Determining the file path of the generated report.
2. Determining the file type of the generated report: either plain text or HTML.
3. In the case of HTML, configuring text attributes for headers, descriptive text and tabular text. Text attributes are entered by the user using CSS (HTML cascading style sheet) syntax.



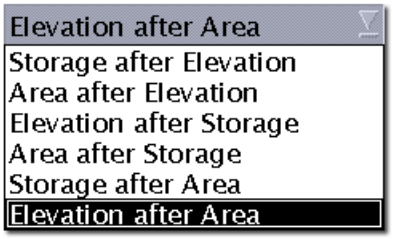
Additionally, a little editor dialog box can be developed to fill in common CSS properties. *(Hooks for a CSS editor are not shown in the accompanying mock-up image).*

3.0 Reservoir Table Augmentation / Dialog

In general, for each Slot included in the report, output for only the Slot's attributes and contained data is included.

An exception to this is the addition of computed rows or columns within Reservoir Table Slots related to (1) elevation, (2) storage volume or (3) surface area.

Special computed rows or columns can be inserted after Table Slot rows or columns containing any of those three entities. These will contain data computed from the Table Slot rows or columns and data in -- or interpolated from -- the Reservoir's **Elevation Volume Table Slot** and **Elevation Area Table Slot.**

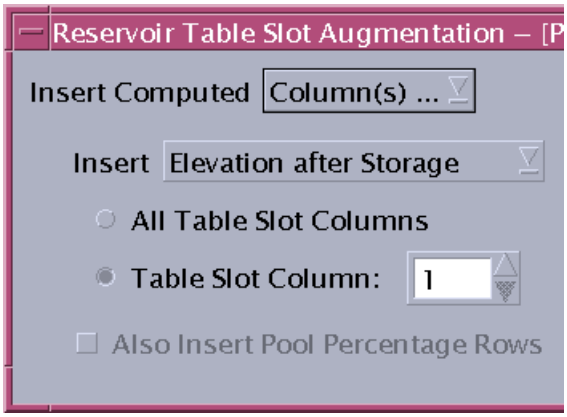


There are two types of support, described in the following sections.

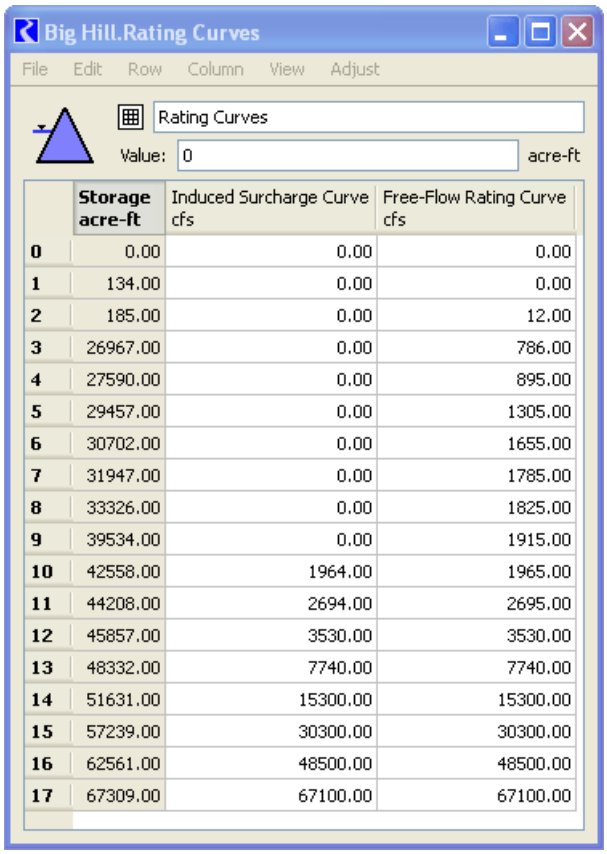
1. Single Row or Column Insertion
2. All-Row or All-Column Insertion

3.1 Single Row or Column Insertion

For Reservoir Table Slots with a single row or column having the relevant data (elevation, storage, or surface area), **a single computed row or column** can be inserted after that Table Slot row or column.



This configuration would result in the insertion of a "Elevation" column after the first ("Storage") column. The Elevation values will be taken from -- or interpolated from -- values in the Reservoir's Elevation Volume Table Slot.

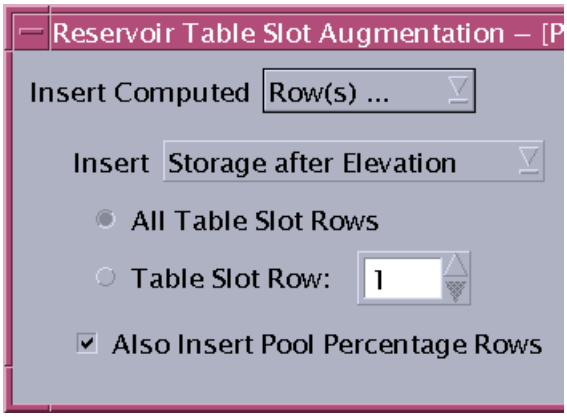


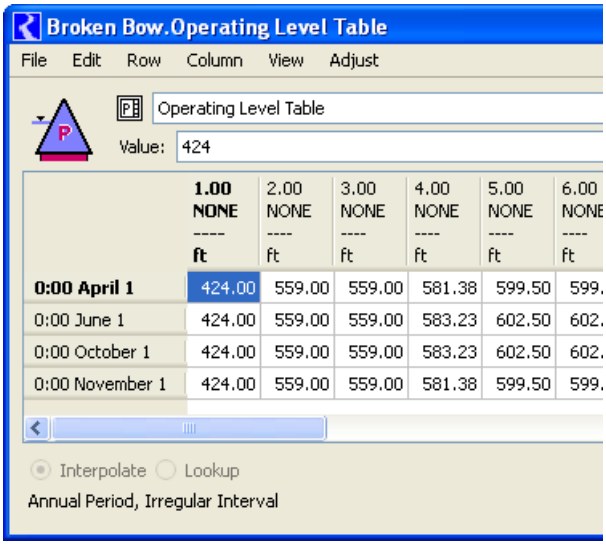
	Storage acre-ft	Induced Surcharge Curve cfs	Free-Flow Rating Curve cfs
0	0.00	0.00	0.00
1	134.00	0.00	0.00
2	185.00	0.00	12.00
3	26967.00	0.00	786.00
4	27590.00	0.00	895.00
5	29457.00	0.00	1305.00
6	30702.00	0.00	1655.00
7	31947.00	0.00	1785.00
8	33326.00	0.00	1825.00
9	39534.00	0.00	1915.00
10	42558.00	1964.00	1965.00
11	44208.00	2694.00	2695.00
12	45857.00	3530.00	3530.00
13	48332.00	7740.00	7740.00
14	51631.00	15300.00	15300.00
15	57239.00	30300.00	30300.00
16	62561.00	48500.00	48500.00
17	67309.00	67100.00	67100.00

The referenced Table Slot Column (in this example, Column 1), only has to have Volume units. It does not have to be a slot column actually labeled "Storage". An error is reported if the referenced Table Slot Column does not have Volume units.

3.2 All-Row or All-Column Insertion

For Reservoir Table Slots having homogenous data of one of the three supported entities, a computed row or column can be inserted **after every Table Slot row or column.**





This configuration would result in extra rows being inserted after every Table Slot row. The values within the table represent elevations [ft]. The added rows would be Storage (volume) rows.

The "**[X] Also Insert Pool Percentage Rows"** checkbox generates one or two (probably two) super-extra rows for each Table Slot row to indicated the percentage of the represented Storage quantity with respect to the Conservation Pool and the Flood Pool. See the specification for this in the USACE Text Output requirements document. The resulting output is illustrated in that document with this mock-up (which shows only one row for both Conservation Pool and Flood Pool data -- but this will likely be split into two distinct rows):

DATE:	Operating Level	1	2	3	4	5	6	7	8
01 Jan	Elev	510.00	565.00	565.00	576.85	585.00	585.00	585.00	587.16
	Storage, ac-ft	2141	797990	797990	1471779	2144315	2144315	2144315	2358315
	% Consv & Flood Pool	0	0	0	50	0	0	0	15
15 Jul	Elev	510.00	565.00	565.00	576.85	585.50	585.50	585.50	587.55
	Storage, ac-ft	2141	797990	797990	1495295	2192600	2192600	2192600	2399770
	% Consv & Flood Pool	0	0	0	50	0	0	0	15
15 Oct	Elev	510.00	565.00	565.00	576.85	585.00	585.00	585.00	587.16
	Storage, ac-ft	2141	797990	797990	1471779	2144315	2144315	2144315	2358315
	% Consv & Flood Pool	0	0	0	50	0	0	0	15

The **"[X] Also Insert Pool Percentage Rows"** operation depends on these three scalar slots on the Reservoir Object having defined values . They represent Operating Levels (the columns of the table shown above).

4.0 Report Generation

Three report file formats are discussed in subsequent sections:

- Supported: Plain text (ASCII)
- Supported: HTML
- **NOT Supported:** XML (but see requirements for requirements).

Some aspects of plain text generation is actually more difficult to implement than HTML generation, because -- for text presented in tables, or otherwise aligned in columns -- the generator must explicitly calculate horizontal geometry and render row and column dividers (with text characters). Also, paragraphs must be explicitly wrapped.

The various report sections -- most of which *conditionally* appear in the report (as specified on the Sections tab in the report configuration dialog) -- are described in the subsequent document sections.

- Report Header and Contents (first section of the report)
- Model File Info
- User Model Comments
- Subbasins
- Simulation Objects
- Accounts
- Slots
- Report Generation Status

Generally, for numeric quantities accompanied by a wordy description, we propose that **the number come first, followed by the description.** This would make it reasonable to present lists of such entities in two columns, with the numeric quantity in a relatively narrow initial column. [NOTE: This differs from the convention used in the USACE SUPER report].

In general, in the report, **1x1 Table Slots** will be presented "as" **Scalar Slots:** when enumerated as table rows, their value would be shown. However, of course, their correct Slot type would be indicated, and, -- in the HTML report -- they would be distinguished using their respective Slot Type *icons* (if those are shown).

4.1 Plain Text (ASCII) Output

Plain text will be formatted with the assumption that the file is presented in a monospaced font (e.g. `Courier`). A font specification is *not* associated with the text file -- that is a property of the plain text viewer being used.

Tables -- and any presentation involving multiple rows of fixed field widths -- need to be processed in two passes: the maximum field width of each column needs to be measured (in number of characters) before the first row can be generated. Columns with numeric data will be right justified.

Lines of text, and paragraphs will be wrapped at 78 characters. There will be no attempt to *strictly* limit the character width of Tables. We may, however, choose to omit certain columns of non-essential or redundant data from the text report.

Only printable ASCII characters will be used, with the exception of Ctrl-L for page breaks. Tab characters will not be used, as their use does not have a specific definition. (Sometimes, a tabstop at every 8 characters is assumed, but that is fragile).

> *QUESTION:* Should the use of page break characters (Ctrl-L) be configurable. Minimally, they will be used after major sections, but they could optionally be inserted after selected types of subsections.

Table rows and columns will be delineated with these four characters: `'+' '-' '|' and '='` in a manner illustrated with this example:

```
+---+------------+-------------------------+-----------------------+
|   | Storage    | Induced Surcharge Curve | Free-Flow Rating Curve |
|   | acre-ft    | cfs                     | cfs                    |
|===|============|=========================|=======================|
| 0 |       0.00 |                    0.00 |                  0.00 |
| 1 |  427485.00 |                    0.00 |              14500.00 |
| 2 |  439168.00 |                  600.00 |              15200.00 |
| 3 |  451267.00 |                 1900.00 |              17800.00 |
| 4 |  482200.00 |                 6600.00 |              23050.00 |
| 5 |  568108.00 |                21400.00 |              39000.00 |
| 6 |  624480.00 |                47700.00 |              47700.00 |
| 7 |  778330.00 |                78800.00 |              78800.00 |
| 8 | 1149840.00 |               151500.00 |             151500.00 |
| 9 | 1187700.00 |               158770.00 |             158770.00 |
+---+------------+-------------------------+-----------------------+
```

4.2 HTML Output

HTML output will support the user supplied **CSS (Cascading Style Sheet) styles** for the following uses, as specified on the Output Tab of the Model Summary Report Configuration Dialog:

- Header 1: Major Section Headers
- Header 2: Subsection Headers
- Descriptive Text: non-tabular text output
- Table Text: tabular text output (generally, should be a monospaced font).

HTML named anchors will be generated for all named RiverWare objects represented by a detail section within the report, and internal **links** to those named anchors will be implemented on *every occurrence* of the corresponding object (SimObj, Account, or Slot) name. For example, the list of Slots included at the head of a SimObj section will include links on the listed Slot names to the individual Slot Instance sections for each of those Slots.

Icon images are shown in the HTML report to indicate **Simulation Object types, Account types,** and **Slot types.** In HTML, images are references to distinct image files. The report generator function writes out those files (as PNG image files) to an automatically created **"reportImages"** subdirectory in the directory to which the report output file is written. When copying an HTML report file, the accompanying image subdirectory (folder) should also be copied. *[This has been implemented in the RiverWare Model Report Generation Demo]*.

4.3 XML Output -- NOT SUPPORTED.

An **XML schema** would need to be defined. Tentatively, this would include:

- Distinct XML elements for the supported RiverWare object types (Subbasins, Simulation Objects, Accounts, Slots),
- Elements or attributes for the types of those object types (SimObj types, Account types, Slot types)
- For Slots, an element for each column (with at least one column represented), with subelements or attributes for:
    - •column label (if multiple columns exist on the slot), or:
    - •numeric column value (optional; with scale and units)
    - •display units (with scale)
    - •display precision
    - •minimum value, maximum value, convergence value (with scale / unit spec, if not in display units).
    - •For Slots with Series, the start and end
- For Slots with named (text) row labels, elements for row labels.
- Elements for Slot data. Attributes for numeric table cells, if used, should be terse, for file size considerations.
- *... more analysis would be need to complete this list.*

If an XML schema would be supported, we should provide an **XLST (or CSS) style sheet** to generate an HTML presentation from the generated XML report file, somewhat similar to the direct HTML generated report (though not necessarily as fully developed, e.g. vis-a-vis internal HTML links to named anchors, and probably lacking much of the redundancy -- see note below). Users would be welcome to adapt the XSLT style sheet for their own purposes.

Also, a development task of defining a *formal schema* (DTD, or something newer) should be included.

A note about redundancy: A canonical XML schema does not contain redundancy -- similar to the idea of "normalization" in database schema design. XML tools (like XLST) have the ability to compile summary statistics from the detail data. However, for the purpose of translating the XML output to a presentation format (typically, HTML), it would be much more convenient to included redundant summary data in the generated XML. We could allow all but the most arcane summary data to be represented redundantly, but such elements should generally be defined as *optional* in the formal schema. Doing so would be helpful if the report output schema is ever adapted as a RiverWare Model Data exchange format.

We should be very careful to not over-design an XML schema for the purpose of report output. Even if we are interested in developing a schema also for RiverWare Model Data exchange, tools could be created to create a model data exchange XML document from a report output XML document. That is, distinct schema, optimized for the two data applications, could be used.

XML output is not explored further in this document.

4.4 Report Section: Header and Contents

- Model Name and Model File Path
- Date and time of report generation.
- List of the major sections within the report. The HTML version implements links to the various sections.

4.5 Report Section: Model File Info

This section will include:

- Table: Simulation Object (SimObj) Types represented within the model -- one Object Type per row. Columns:
    - Object Type (name)
    - Number of SimObjs of that Object Type in the model.
    - Number of SimObjs of that Object Type in the report.
    - Number of Accounts under SimObjs of that Object Type in the report.
- Table: Account Types represented in model (if any). Columns:
    - Account Type (name)
    - Number of Accounts of that Account Type in the model.
    - Number of Accounts of that Account Type in the report.
- Controller Selection
- Run Period

4.6 Report Section: User Model Comments

This section includes the two types of information shown in the RiverWare File Info dialog box (see below).

- Model File User Comments (paragraphs)
- Table: File Save History. Columns:
    - User
    - Save Date and Time,
    - RiverWare Version.

4.7 Subbasins

4.7.1 Subbasins Summary Section

- Number of Subbasins in Model
- Number of Subbasins in Report
- Table with one row per Subbasin in the report. Columns:
  - •Subbasin Name (HTML version implements link to the specific Subbasin section)
  - •Subbasin Type (“Computational”)
  - •Number of Simulation Objects
  - •Number of Slots in Model (in the Subbasin)
  - •Number of Slots in the report (in the Subbasin)

4.7.2 Subbasin Instance Sections

One instance *for each Subbasin,* including:

- **Subbasin Instance Summary Info** (repeat of the information in the *corresponding row* in the summary table from above).
- Table with list of **Simulation Objects within the Subbasin,** Columns:
  - •Simulation Object Type (HTML implements SimObj Type *Icon* and *terse* Type Name)
  - •Simulation Object Name (HTML implements link to the Simulation Object Instance section)
- Table with **Subbasin Methods (for Computational Subbasins),** conditionally excluding Method Categories with default Method selections. Columns:
  - •Method Category
  - •Selected Method for that Category
  - •**QUESTION:** Do the Slots related to the Methods also need to be listed? If so, do so here in additional rows, indented (sort of). *Maybe not in the text report?*
- Table with Subbasin Slots, one Slot per row. Columns *(possibly abbreviated in Text output format):*
  - •Slot Type (HTML implements SimObj Type *Icon* and terse Type Name)
  - •Slot Name (HTML implements a link to the Slot Instance section)
  - •For Scalar Slots (and 1x1 Table Slots): Slot Value
  - •For Scalar Slots (and 1x1 Table Slots): Display Unit and Value
  - •... or Single-Column Slots: Unit Type
  - •For Table Slots: Row and Column Count
  - •For SeriesSlots: Start Date/Time and Number of Timesteps
  - •Number of Non-Nan Values
- Conditionally, a **Slots Instance section** (defined below), if the Subbasin’s Slots are to be included within the Subbasin Instance Section.

4.8 Simulation Objects

The Simulation Objects section has an organization very similar to the Subbasins Section (but lacking the composition of contained Simulation Objects), and including an Accounts section, if applicable.

4.8.1 Simulation Objects Summary Section

- Number of SimObjs in Model
- Number of SimObjs in Report
- Table with one row per SimObj in the report. Columns:
  - SimObj Type (HTML implements SimObj Type *Icon* and *terse* Type Name)
  - SimObj Name (HTML version implements link to the specific SimObj section)
  - Number of Accounts in Model (in the SimObj)
  - Number of Accounts in the report (in the SimObj)
  - Number of Slots in Model (in the SimObj)
  - Number of Slots in the report (in the SimObj)

4.8.2 SimObj Instance Sections

One instance section *for each SimObj,* containing ...

- **SimObj Instance Summary Info** (repeat of the information in the *corresponding row* in the summary table, see above).
- If applicable, Table with list of **Accounts within the SimObj,** Columns:
  - Account Type (HTML implements Account Type *Icon* and *terse* Type Name)
  - Account Name (HTML implements link to the Account Instance section)
  - Number of Supplies TO and FROM the Account
- Conditionally, an **Accounts Instance section** (defined below), if the SimObj's Accounts are to be included within the SimObj Instance Section.
- Table with **SimObj Methods,** conditionally excluding Method Categories with default Method selections. Columns:
  - Method Category
  - Selected Method for that Category
  - **QUESTION:** Do the Slots related to the Methods also need to be listed? If so, do so here in additional rows. Maybe not in the text report?
- Table with SimObj Slots, one Slot per row. Columns *(possibly abbreviated in Text output format):*
  - Slot Type (HTML implements SimObj Type *Icon* and terse Type Name)
  - Slot Name (HTML implements a link to the Slot Instance section)
  - For Scalar Slots (and 1x1 Table Slots): Slot Value
  - For Scalar Slots (and 1x1 Table Slots): Display Unit and Value ... or Single-Column Slots: Unit Type
  - For Table Slots: Row and Column Count
  - For SeriesSlots: Start Date/Time and Number of Timesteps
  - Number of Non-Nan Values
- Conditionally, a **Slots Instance section** (defined below), if the SimObj's Slots are to be included within the SimObj Instance Section.

4.9 Accounts

The Accounts section has an organization similar to the SimObj section (but lacking a composition of contained Accounts).

4.9.1 Accounts Summary Section

- Number of Accounts in Model (or under the current SimObj)
- Number of Accounts in Report (if relevant, only those under the current SimObj).
- Table with one row per Account in the report. Columns:
  - •Account Type (HTML implements Account Type *Icon* and *terse* Type Name)
  - •Account Name (HTML version implements link to the specific Account section)
  - •Number of Supplies TO this Account
  - •Number of Supplies FROM this Account
  - •Number of Slots in Model (in the Account)
  - •Number of Slots in the report (in the Account)

4.9.2 Account Instance Sections

One instance section for each Account, containing the following fields:

- **Account Instance Summary Info** (repeat of the information in the *corresponding row* in the summary table, see above).
- Table of Supplies TO this Account, with an initial terse Supply Type column.
- Table of Supplies FROM this Account, with an initial terse Supply Type column.
- Table with **Account Methods,** conditionally excluding Method Categories with default Method selections. Columns:
  - •Method Category
  - •Selected Method for that Category
  - •**QUESTION:** Do the Slots related to the Methods also need to be listed? If so, do so here in additional rows. Maybe not in the text report? *(Not sure: Do Account Methods have explicitly associated Slots?).*
- Table with Account Slots, one Slot per row. Columns *(possibly abbreviated in Text output format):*
  - •Slot Type (HTML implements SimObj Type *Icon* and terse Type Name)
  - •Slot Name (HTML implements a link to the Slot Instance section)
  - •For Scalar Slots (and 1x1 Table Slots): Slot Value
  - •For Scalar Slots (and 1x1 Table Slots): Display Unit and Value ... or Single-Column Slots: Unit Type
  - •For Table Slots: Row and Column Count
  - •For SeriesSlots: Start Date/Time and Number of Timesteps
  - •Number of Non-Nan Values
- Conditionally, a **Slots Instance section** (defined below), if the Account's Slots are to be included within the Account Instance Section.

4.10 Slots

Slots configured to appear in the report (depending on checkbox settings on the Sections Tab) do so in two ways:

- As a line-item in a Slot List within the containing object instance section, and
- with a Slot Instance Section.

4.10.1 Slots Lists

Instance sections of objects which contain objects include a list of Slots, with the following columns -- *possibly abbreviated for text output.*

- SimObj Type (HTML implements SimObj Type *Icon* and *terse* Type Name)
- SimObj Name (HTML implements a link to the SimObj Instance section)
- Account Type (HTML implements Account Type *Icon* and *terse* Type Name)
- Account Name (HTML implements a link to the Account Instance section)
- Slot Type (HTML implements Slot Type *Icon* and *terse* Type Name)
- Slot Name (HTML implements a link to the Slot Instance section)
- For Scalar Slots (and 1x1 Table Slots): Slot Value
- For Scalar Slots (and 1x1 Table Slots): Display Unit and Value ... or Single-Column Slots: Unit Type
- For non-scalar Slots: Row and Column Count
- For SeriesSlots: Start Date/Time and Number of Timesteps
- Number of Non-Nan Values

4.10.2 Slot Instance Sections

Each Slot Instance section shows the following information, when applicable:

- Containing SimObj Type and Name (HTML implements type icon and link to SimObj instance)
- Containing Account Type and Name (HTML implements type icon and link to Account instance)
- For Scalar and 1x1 Tables: Slot Value
- For each Column (often, just one): Scale and Unit
- For each Column (often, just one): Minimum value, Maximum value, Convergence value / Scale & Units

Slot data is presented in a format appropriate for the particular Slot type, generally tabular.

- List Slots are shown as a list.
- Table Slots are shown as ... tables, possibly truncated (indicated clearly). Tables on Reservoirs may implement Reservoir Table Slot Augmentation. (Described above in this document).
- SeriesSlots show columns for timestep date/times, numeric values and Flag characters (where relevant). For multiple-column SeriesSlots, of course, the timestep date/time is shown only in the first column. Long SeriesSlots may be truncated (indicated clearly).

QUESTION: Should the HTML presentation show cell colors for Flags? Should this be configurable? Currently cell colors are defined only for Accounting Slots, and for Slots in the context of an SCT. (So, this would need to be worked out).

4.11 Report Generation Status

The report ends with a section which summarizes special conditions encountered during the generation of the report, for example:

1. a list of the Slots which were configured to be in the report, but which were omitted because they didn't have any non-NaN values.
2. a list of the TableSlots and SeriesSlots which were truncated (according to configured size limits).

During development, and optionally for debug, certain unspecified diagnostic output will also be shown in this section.

After starting a report generation operation, some of this information will also be presented in a popup dialog informing the user that the report has been generated.

5.0 Development Estimate

Much of the initial exploratory demo development work will be useable for a production quality report feature -- in particular, low-level tabular formatting in both Plain Text and HTML. [See the RiverWare Model Report Generation Demo document, 14 pages]. This addressed only formatting and output capabilities -- for a single Simulation Object -- including the creation of icon image files used in the HTML report and launching an external viewer application after the report document is created. None of this demo development addressed report configuration features.

TABLE 1. Development Tasks and Estimates

Task	Days	Description
1		**Report Configuration Record Development**
1.1	2.0	Basic C++ class design and implementation
1.2	3.0	Serialization Design (XML)
1.3	5.0	Serialization Implementation (XML, probably DOM)
2		**Report Configuration Graphical User Interface (GUI)** (This is basically a "Report Configuration Record" editor).
2.1	1.0	Widget Layout with Qt Designer, starting from the work that has already been done to create the mock-up images for this document.
2.2	1.0	Section Tab, including reordering function.
2.3	0.5	Model Info Tab
2.4	1.5	Subbasins Tab, including adaptation of the Subbasin Panel from the Subbasin Editor for use in this new GUI.
2.5	1.5	Simulation Objects Tab
2.6	2.0	Account Tab. (Needs design completion).
2.7	3.0	Methods Tab, including compilation of a list of "Category Entities" from a set of Subbasins, SimObjs or Accounts.

TABLE 1. Development Tasks and Estimates

2.8	3.0	Slots Tab, including compilation of a list of "Slot Entities" from a set of Subbasins, SimObjs or Accounts.
2.9	1.0	Output Tab -- with some filename assembly methods added to the Report Config class. Assuming just direct user entry of CSS for text attributes.
3		**Reservoir Table Augmentation**
3.1	2.0	Configuration dialog development.
3.2	2.0	Single-Row or Column Insertion "Joining" (Special Report Generation)
3.3	3.0	All-Row / All-Column Insertion "Joining" (Special Report Generation)
4		**Report Generation (HTML and TEXT) -- see "Demo" note above.**
4.1	1.5	Model File Info & User Model Comments calculations and output
4.2	2.0	Subbasin Summary and Instance Sections
4.3	2.0	Simulation Object Summary and Instance Sections
4.4	2.5	Account Summary and Instance Sections
4.5	2.0	Slot Summary and Instance Sections COMPLETION (incl. Series Slots)
4.6	1.0	Report Generation Status Section
5		**Management of Report Generation Config Records as "Output Devices"**
5.1	3.0	Design and Implementation
6		**Completion**
6.1	2.0	Strategic use of CSS to minimize generated HTML file size. (No CSS was deployed in the Demo), including testing with multiple browsers. (Perhaps with a config switch, if any of the CSS seems edgy).
6.2	2.0	Usability testing and enhancements
6.3	2.0	Completeness and Correctness testing and fixes
6.4	2.0	Unknown Problem (code name: Flinch)
6.5	2.0	User Documentation
	55.5	**Total Development Estimate [Days]**

--- (end) ---