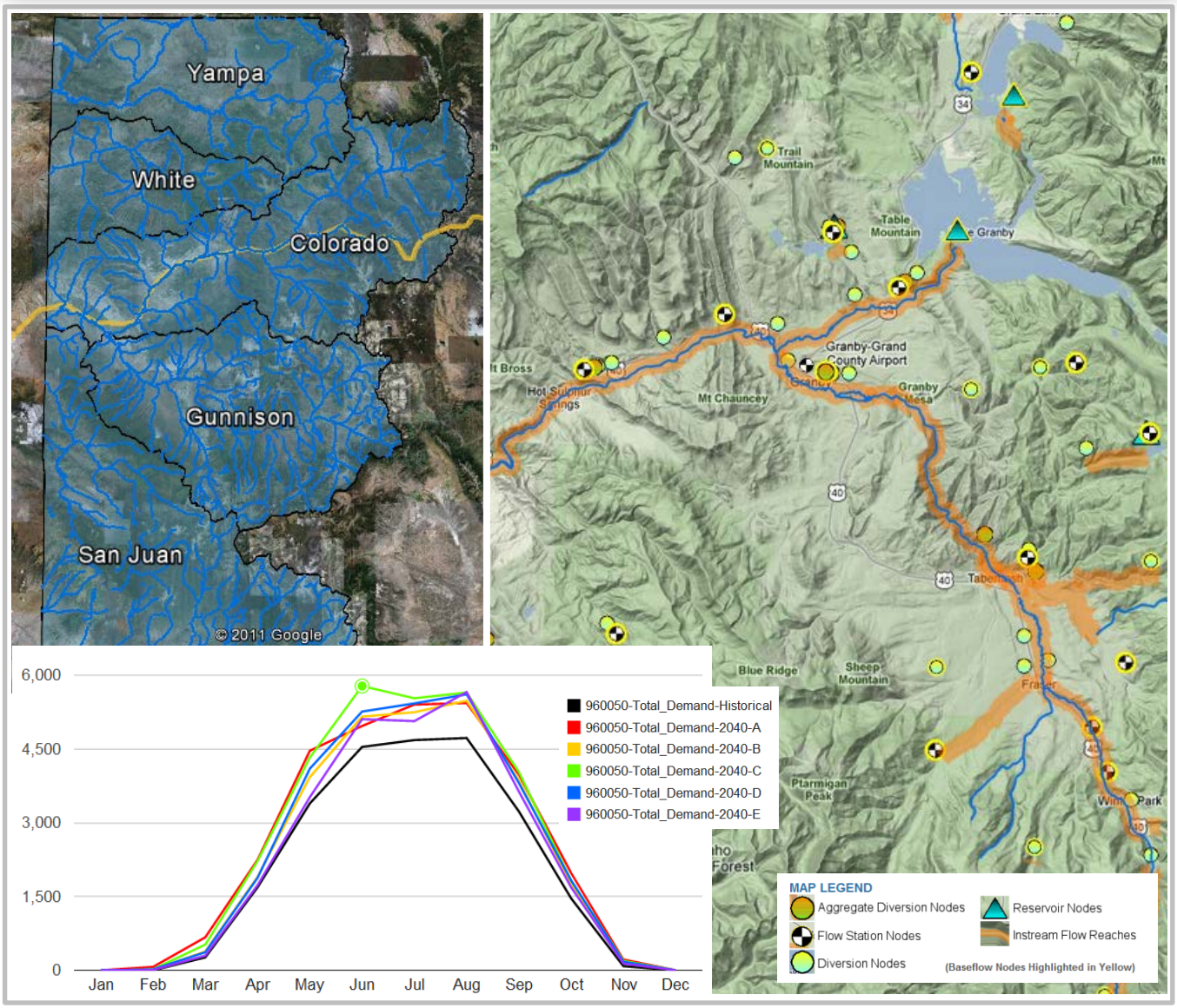
CRWAS Data Viewer

StateMod Results Viewer for the Colorado River Water Availability Study



User Guide

January 10, 2012

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Background

The standard utility for working with StateMod data, TSTool, is most appropriate for performing analysis with model output and extracting modeling time series input. The CRWAS Data Viewer described in this document provides a more simplified interface to view and download StateMod results by:

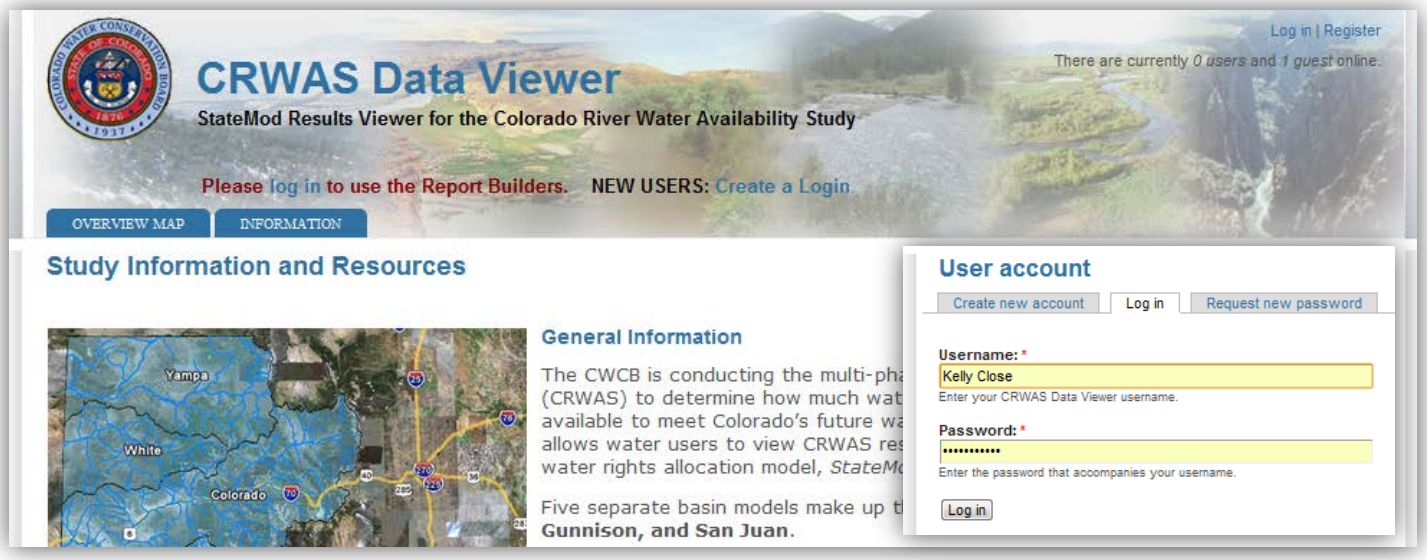
- Exploring model locations on an interactive Map,
- Quickly comparing data from different CRWAS modeled scenarios,
- Comparing time series and average annual data for custom sets of locations, parameters and scenarios,
- Downloading a small subset of model data.

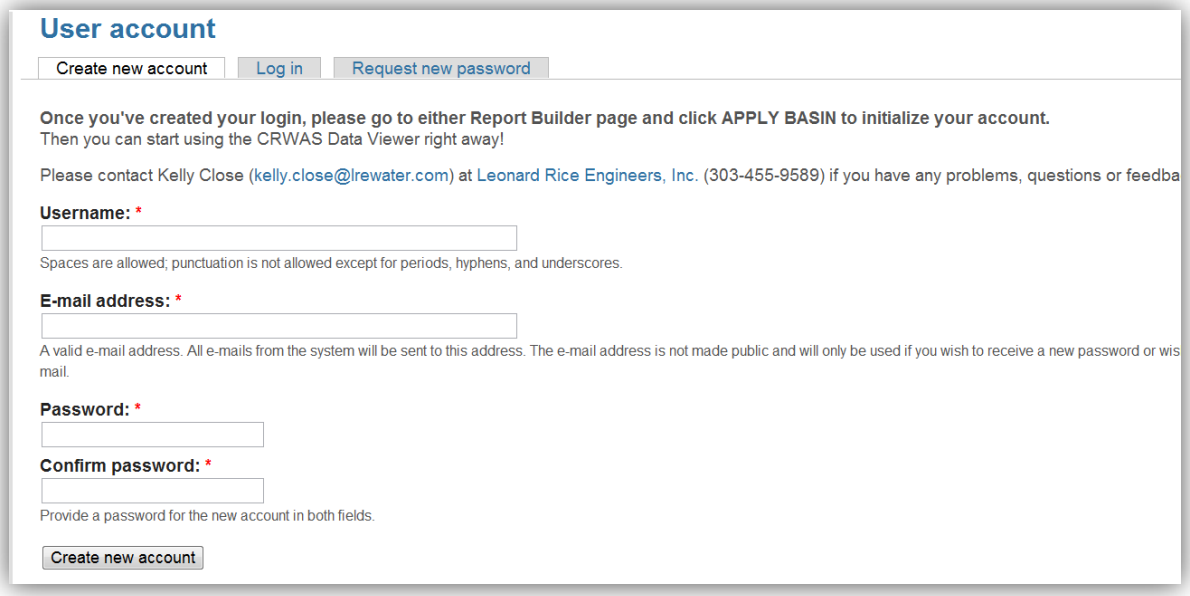
The following sections describe how to access and use the CRWAS Data Viewer, which has three primary functions: 1) A Google Earth Overview Map to locate StateMod nodes of interest, 2) Report Builders to graph, download, and compare CRWAS results, and 3) an Information page containing useful links and information about the CRWAS project. The Data Viewer may be accessed on most computers with an internet connection and a modern browser (released 2010 or later) without installing a new software program. Most features of the Data Viewer will also work on mobile tablet computers.

Creating an Account and Logging In

To access the CRWAS Data Viewer, please type http://www.dataviewer.info/CRWAS into the address bar in your internet browser. General information about the project and an overview map of the models can be accessed without logging in to the site (see sections **Overview Map** and **Study Information and Resources** below for more details).

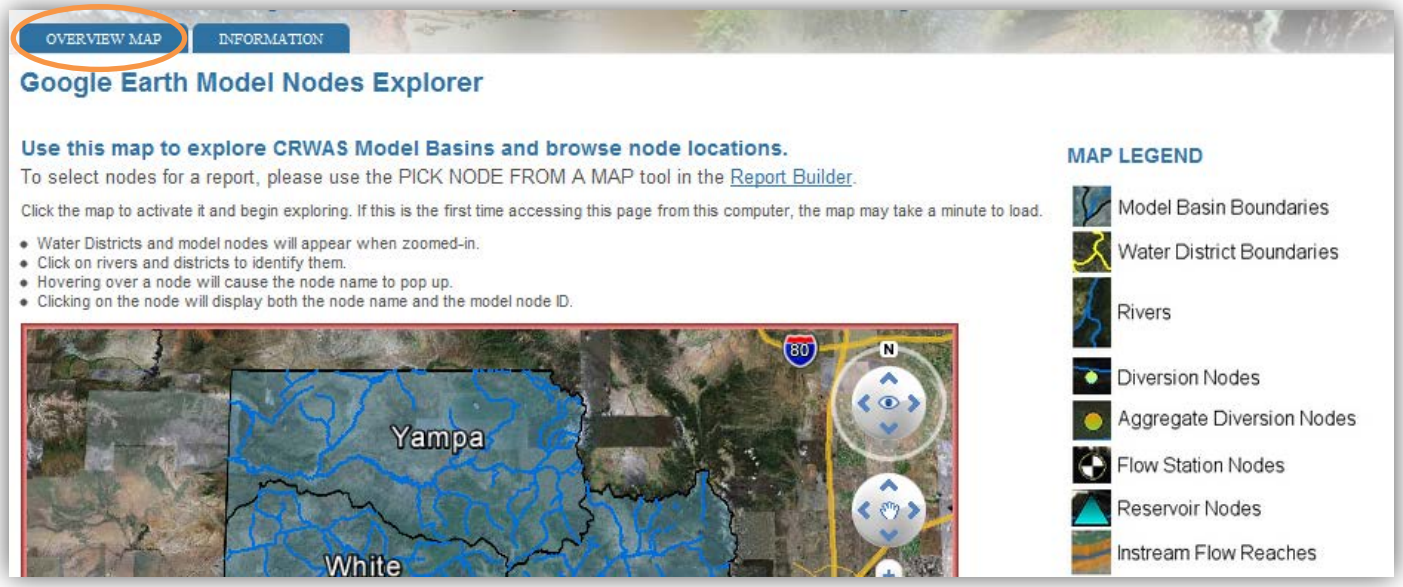
A login is required to view model results. New users may create an immediately useable login by clicking **Create a Login** at the top of the web page and following on-screen instructions to create a new account. Existing users may **log in** to access an existing account. For a new account, it is necessary to provide a username, e-mail address, and password (see screen-shot on the next page).





Overview Map

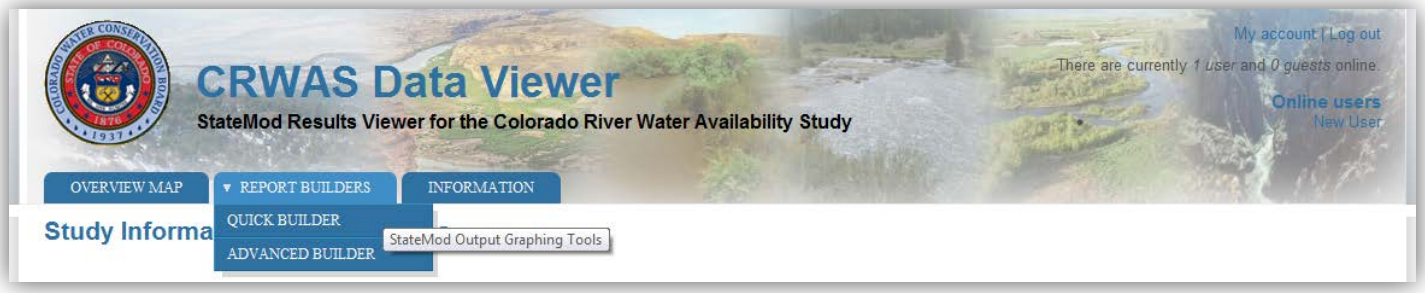
A Google Earth map showing model basins, districts, and node locations is available by clicking the **OVERVIEW MAP** menu. The page includes on-screen tips for help in using the map. *Please note: this map does not link to the data viewing functionality of the site. This Overview Map is intended to provide an intuitive interface for geographically exploring the models without a login, and it includes all five CRWAS basins in a single interface. To see model data for specific nodes, please log in and use the Report Builders (see below).*



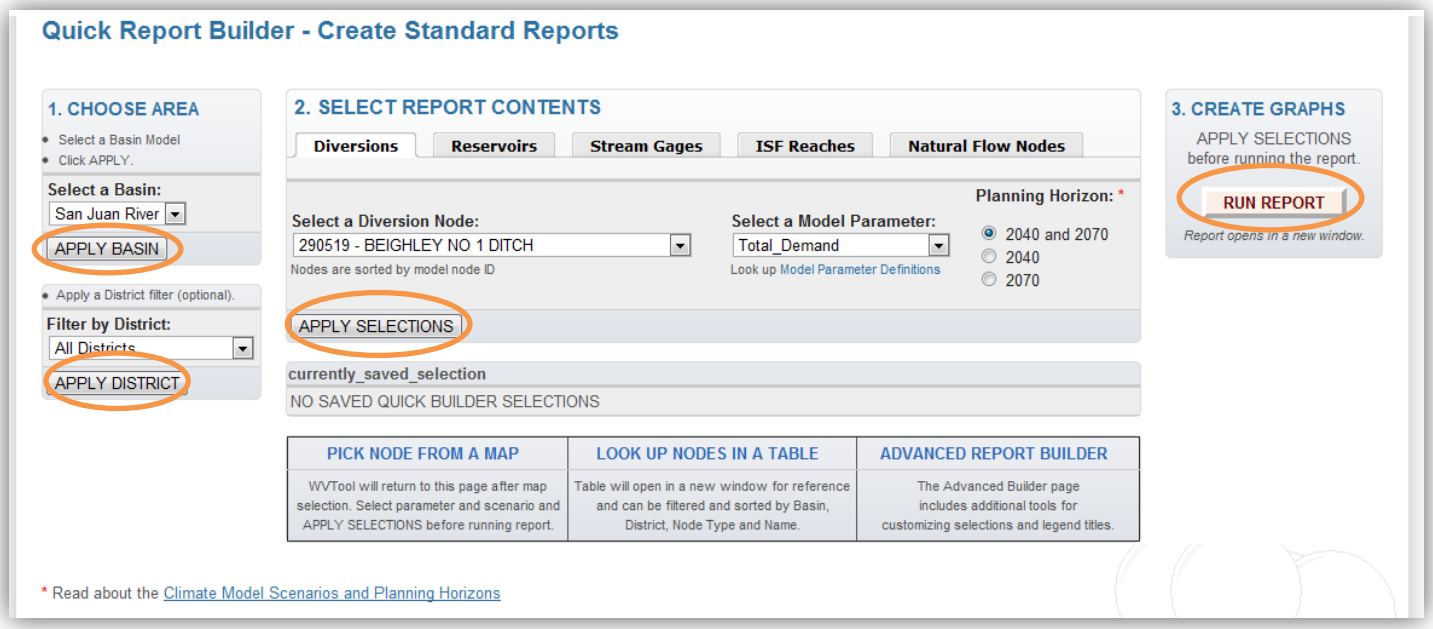
Please note that Google Earth may not be supported in pre-2009, tablet, or non-Windows browsers. Internet Explorer and Firefox may require installation of the Google Earth plug-in to use this page.

Report Builders

After completing the login process, the **REPORT BUILDERS** menu becomes available. The Data Viewer includes both a simple and a more advanced interface for creating graphs of CRWAS model output and downloading results. The simple interface, called **Quick Builder**, allows quick set up for comparing and downloading data from just one model parameter and one location across all CRWAS model scenarios. The **Advanced Builder** allows graphing and downloading data from multiple model locations, parameters, and scenarios.



Quick Builder



Use of the Quick Builder requires three steps, laid out on the web page (shown above) from left to right:

1. **Choose Area:** *Select a Basin* first and click **APPLY BASIN**. This is required to initialize other options on the page. The user may optionally filter nodes by Colorado water district by selecting a district under *Filter by District* and clicking **APPLY DISTRICT**.
2. **Select Report Contents:** In the Quick Builder, the user may *Select a Node (*model location), *Select a Model Parameter*, and specify a *Planning Horizon*.

Select a Node: Tabs along the top of this section are organized by node type - Diversions, Reservoirs, Stream Gages, In-stream Flow (ISF) Reaches, and Natural Flow Nodes. Nodes may be selected from drop-down lists in each tab or from a map (see **Picking Nodes from a Map** below).

Select a Model Parameter: The CRWAS Data Viewer provides results of StateMod model runs that include many model output parameters. Each parameter represents an individual component of the water balance modeled in StateMod. These model parameters can be selected from drop-down lists to the right of each Node list. Parameter definitions are available by clicking the link below each parameter list and in **Appendix A** of this document.

Planning Horizon: The Quick Builder provides the following scenario options for the graphs:

- 2040 & 2070 (data for the Historical and all ten 2040 and 2070 CRWAS climate scenarios),
- 2040 (data for Historical and the five 2040 CRWAS climate scenarios), and
- 2070 (data for Historical and the five 2070 CRWAS climate scenarios).

More information about CRWAS climate scenarios and planning horizons can be accessed by clicking the link at the bottom of the Quick Builder page and in **Appendix B** of this document.

Once the report contents have been selected, click **APPLY SELECTIONS**. *The current Quick Builder selection will be displayed below the APPLY SELECTIONS button*.

3. **Create Graphs:** Click **RUN REPORT** to view model results in a graphical report as described below.

Viewing Graphs and Downloading Data

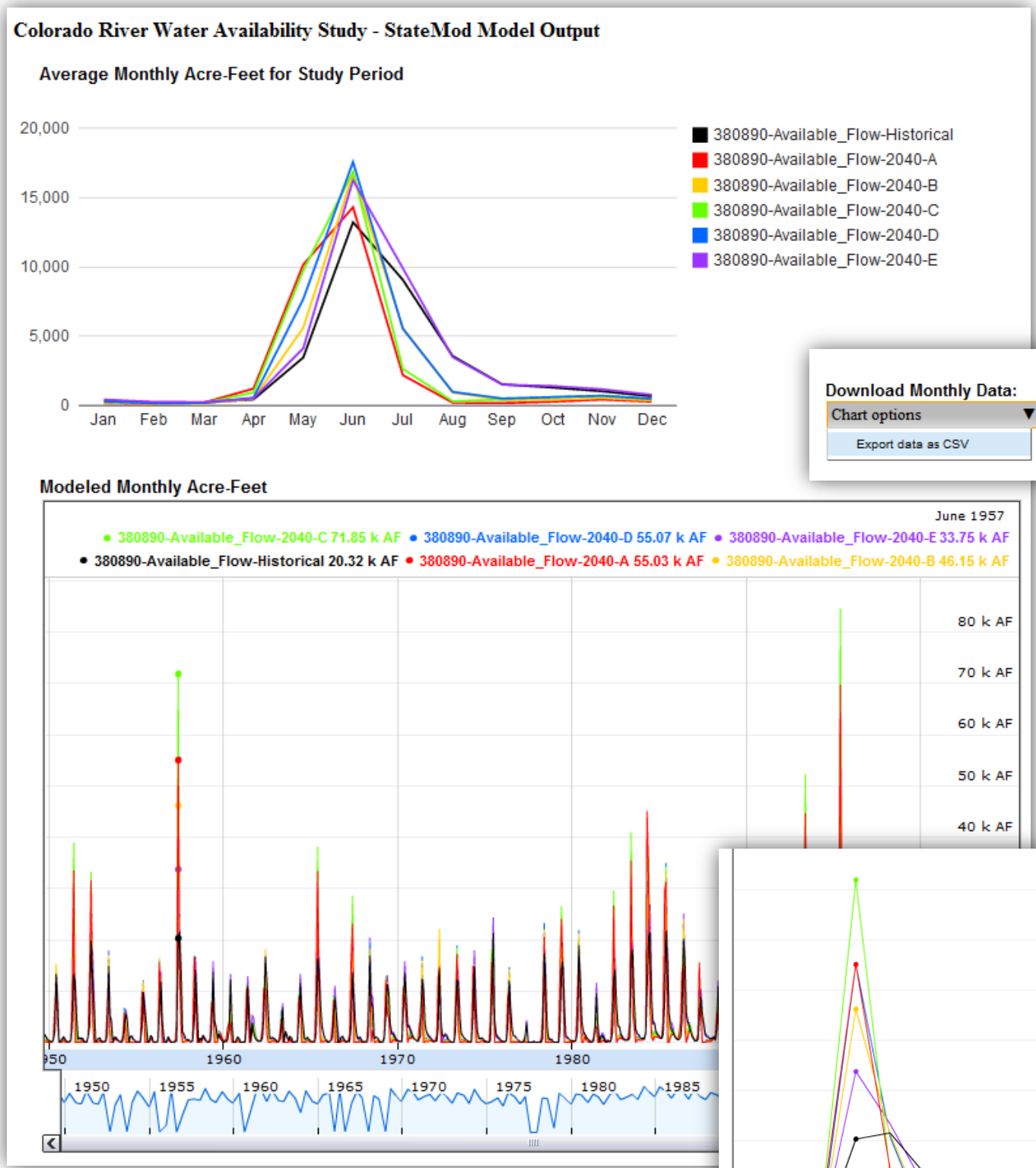
After clicking the **RUN REPORT** button from either the Quick Builder or Advanced Builder, a new browser window will open (Please see the screen shots on the next page for an example). The report window includes, for the data sets selected in the Report Builder:

- A graph showing **Average Monthly Acre-Feet**
- A graph showing **Modeled Monthly Acre-Feet**
- A **Download Monthly Data** button

The graphs on the report page are interactive.

- Hovering the mouse over the Average Monthly graph will create a pop-up with information about specific points on the graph, including the Month, Series Name (legend title) and value.
- Hovering over the Modeled Monthly graph will display the month and year for that vertical position in the top-right corner of the graph and the values for all series in the legend across the top of the graph.
- It is also possible to zoom in to the Modeled Monthly graph by dragging the outside boundaries of the zoom window at the bottom of the graph.

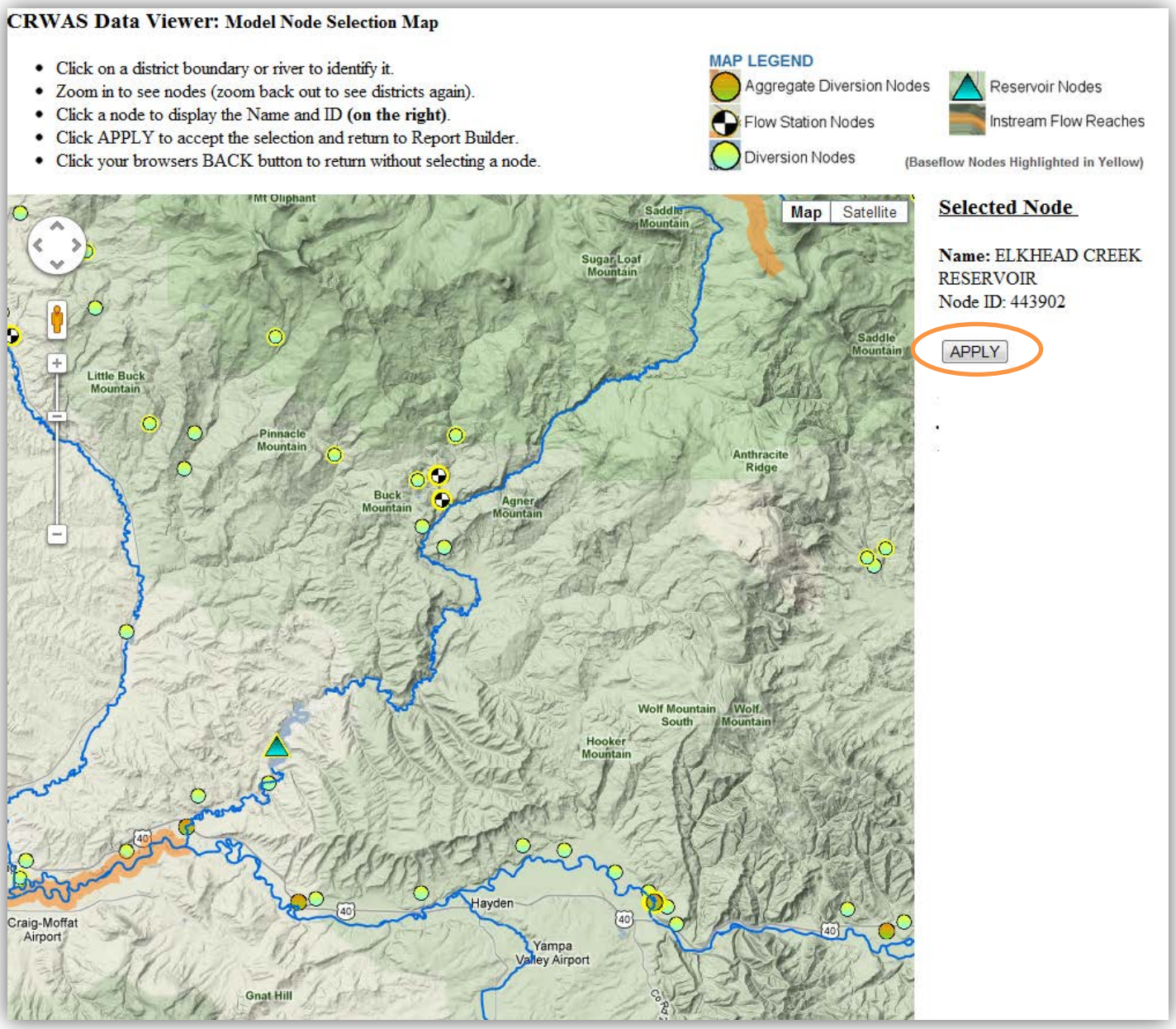
The download button allows the user to save the modeled monthly data to their computer. Click the Chart Options button and select Export Data as CSV to download an Excel compatible file containing the data shown in the graph.



***TIP**: Each RUN REPORT instance generates a new browser window, allowing the user to build multiple reports and compare them side by side.*

Picking Nodes from a Map

An interactive Google Map can be called up for each basin that makes it easy to pick a node if the map location of the node is known to the user. From either the Quick Builder or Advanced Builder, select the **LOOKUP NODES IN A MAP** link. This will temporarily close the Builder and open a map showing all modeled nodes in the selected basin (this map is not affected by the *Filter Districts* option). Follow on-screen instructions for navigating the map and selecting a node. After clicking **APPLY** to select a node, the browser window will return to the Report Builder from which the user started to allow selection of the other report options. Please note that just one node may be selected at a time from this map.

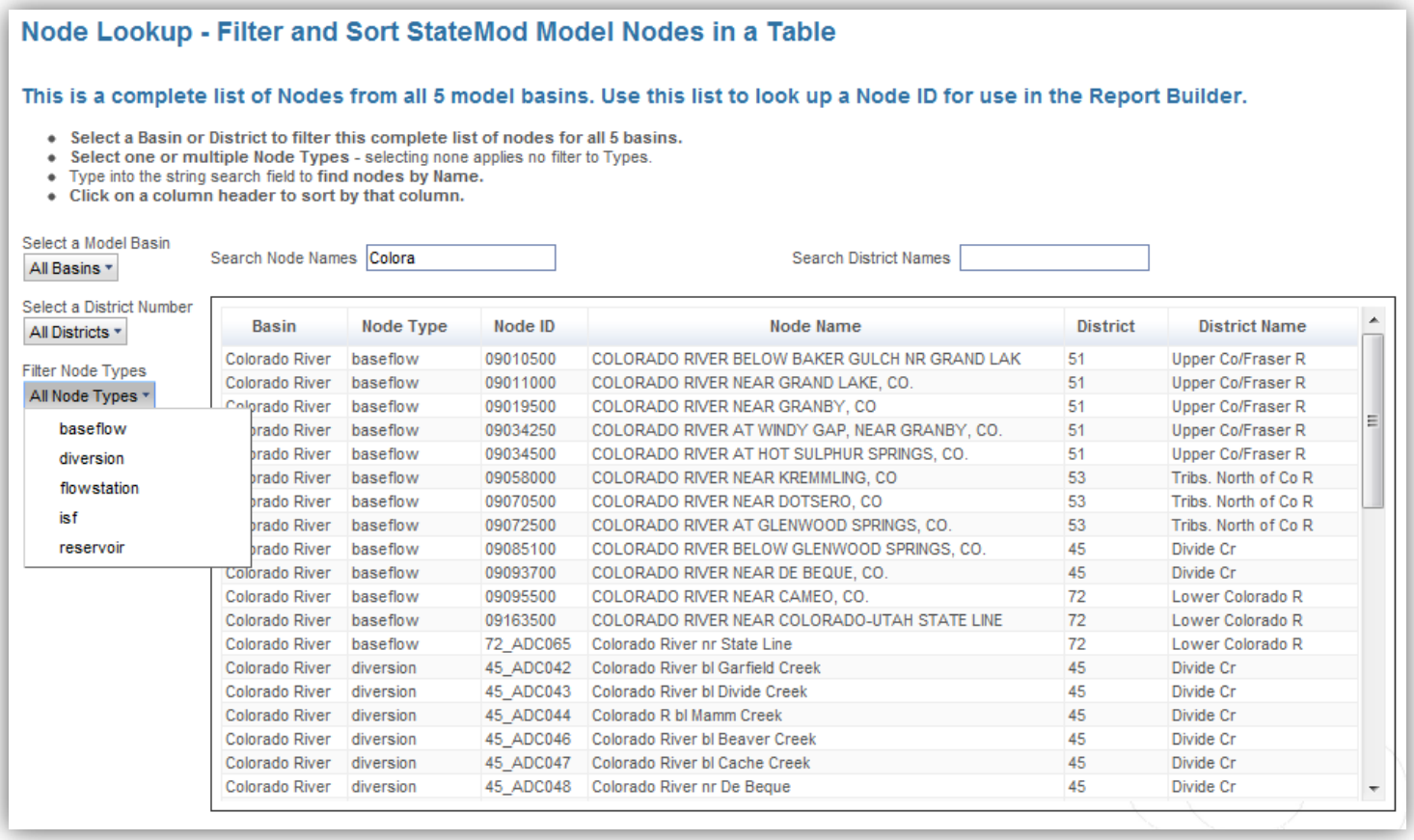


Browsing Nodes in a Table

Nodes may also be searched, sorted, and filtered in an interactive table. While this table is not linked to the report builder, it may be useful to help find the ID for a specific node if the mapped location is not known to the user.

To access the table, select the **LOOK UP NODES IN A TABLE** link available on both the Quick Builder and Advanced Builder pages. This will open a new window that includes a table with all nodes from all CRWAS model basins. Filter the table by Basin, District Number, and Node Type by selecting from the drop-down lists on the left side of the table or search for specific text-strings in either the Node Name or District Name fields by typing into the text boxes at the top of the table.

> ***TIP**: Once a node of interest has been found in the table, write down the Node ID to refer to when using the drop-down lists in the Report Builders. Keep the Nodes table open in a separate browser window for reference while working in the Advanced Builder.*

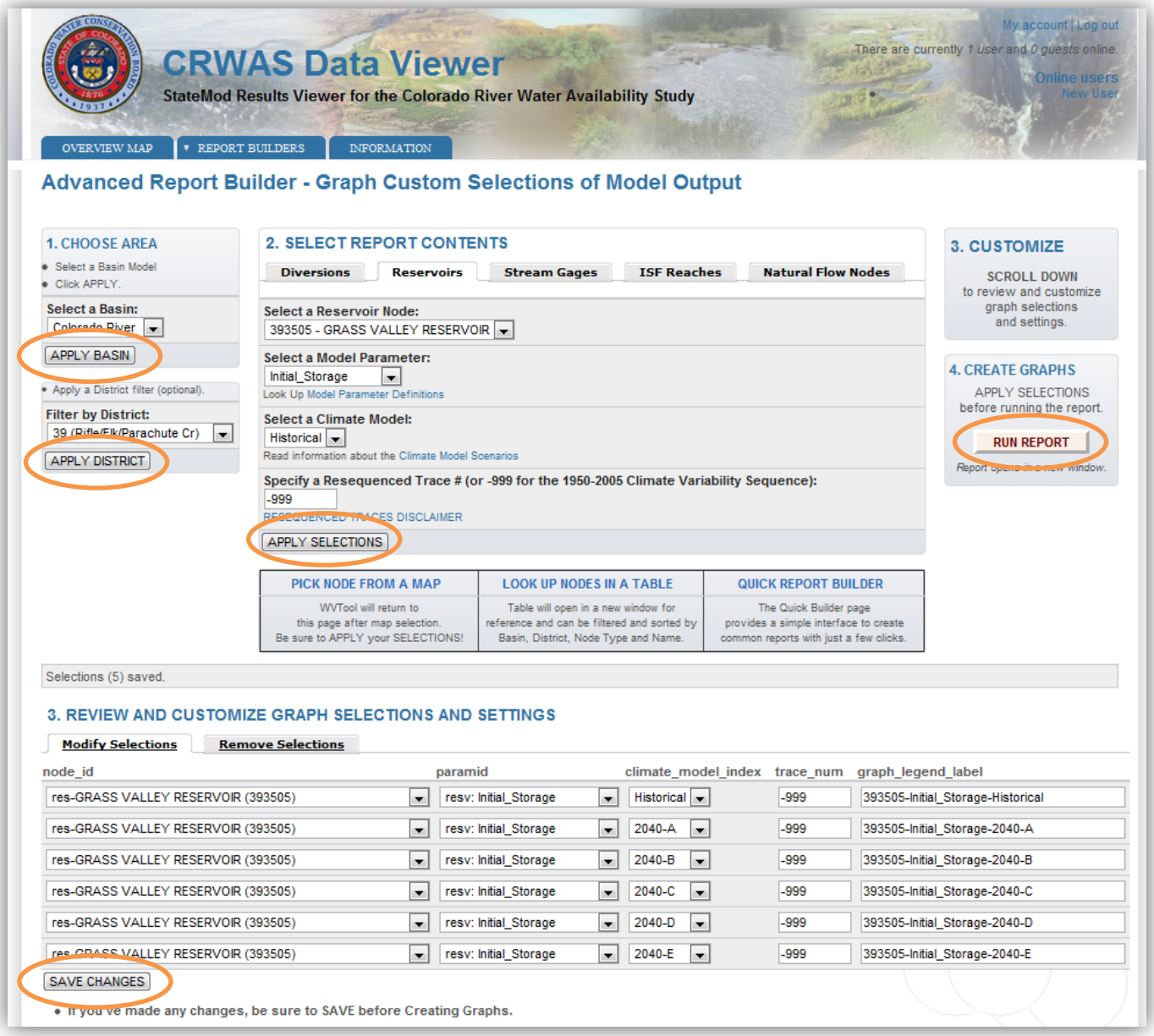


Basin	Node Type	Node ID	Node Name	District	District Name
Colorado River	baseflow	09010500	COLORADO RIVER BELOW BAKER GULCH NR GRAND LAK	51	Upper Co/Fraser R
Colorado River	baseflow	09011000	COLORADO RIVER NEAR GRAND LAKE, CO.	51	Upper Co/Fraser R
Colorado River	baseflow	09019500	COLORADO RIVER NEAR GRANBY, CO	51	Upper Co/Fraser R
Colorado River	baseflow	09034250	COLORADO RIVER AT WINDY GAP, NEAR GRANBY, CO.	51	Upper Co/Fraser R
Colorado River	baseflow	09034500	COLORADO RIVER AT HOT SULPHUR SPRINGS, CO.	51	Upper Co/Fraser R
Colorado River	baseflow	09058000	COLORADO RIVER NEAR KREMMLING, CO	53	Tribs. North of Co R
Colorado River	baseflow	09070500	COLORADO RIVER NEAR DOTSERO, CO	53	Tribs. North of Co R
Colorado River	baseflow	09072500	COLORADO RIVER AT GLENWOOD SPRINGS, CO.	53	Tribs. North of Co R
Colorado River	baseflow	09085100	COLORADO RIVER BELOW GLENWOOD SPRINGS, CO.	45	Divide Cr
Colorado River	baseflow	09093700	COLORADO RIVER NEAR DE BEQUE, CO.	45	Divide Cr
Colorado River	baseflow	09095500	COLORADO RIVER NEAR CAMEO, CO.	72	Lower Colorado R
Colorado River	baseflow	09163500	COLORADO RIVER NEAR COLORADO-UTAH STATE LINE	72	Lower Colorado R
Colorado River	baseflow	72_ADC065	Colorado River nr State Line	72	Lower Colorado R
Colorado River	diversion	45_ADC042	Colorado River bl Garfield Creek	45	Divide Cr
Colorado River	diversion	45_ADC043	Colorado River bl Divide Creek	45	Divide Cr
Colorado River	diversion	45_ADC044	Colorado R bl Mamm Creek	45	Divide Cr
Colorado River	diversion	45_ADC046	Colorado River bl Beaver Creek	45	Divide Cr
Colorado River	diversion	45_ADC047	Colorado River bl Cache Creek	45	Divide Cr
Colorado River	diversion	45_ADC048	Colorado River nr De Beque	45	Divide Cr

Advanced Builder

The **Advanced Report Builder** can be accessed from the **REPORT BUILDER** menu at the top of the web page or by clicking on the **ADVANCED REPORT BUILDER** link on the Quick Builder page. The Advanced Builder layout is similar to the Quick Builder (see a full page screen shot of the Advanced Builder below) but provides additional flexibility and options for customizing the report graphs.

The Advanced Builder allows users to select "data sets" one at a time (see **Adding Data Sets** below). A "data set" in this context refers to a unique combination of model location (node), model parameter, and climate model scenario. Once added, data sets may be edited to reflect a different combination of node, parameter, and climate model scenario and they also be removed one at a time (see **Changing and Removing Data Sets** below).



Adding Data Sets

The Advanced Builder page includes numbered steps laid out from left to right and top to bottom on the web page (shown in the screen-shot on the previous page).

1. **Choose Area:** *Select a Basin* first and click **APPLY BASIN**. This is required to initialize other options on the page. *The underlying database stores selections separately for each basin*. *Data sets from different basins may not be combined in one report.*

   The user may optionally also filter the available nodes in the lists on the page by Colorado water district by specifying a district under the *Filter by District* title and clicking **APPLY DISTRICT**.

2. **Select Report Contents:** In the Advanced Builder, the user will repeat selections in this section to add each new data set to the report. To add a data set, the user must *Select a Node (*model location), *Select a Model Parameter*, *Select a Climate Model*, and *Specify a Resequenced Trace #.*

   Select a Node: Tabs along the top of this section organize locations by node type - Diversions, Reservoirs, Stream Gages, Instream Flow (ISF) Reaches, and Natural Flow Nodes. Nodes may be selected from drop-down lists in each tab or from a map (see **Picking Nodes from a Map** previously covered above).

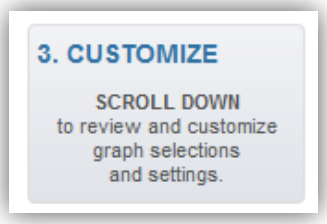
   Select a Model Parameter: StateMod model parameters (various data calculated by the model) can be selected from drop-down lists below each Node list. Parameter definitions are available by clicking the link below each parameter list and in **Appendix A** of this document.

   Select a Climate Model: Select the historical data set or one of the ten 2040 / 2070 CRWAS climate model scenarios from drop-down lists below the parameters. Information about CRWAS Climate Models may be accessed by clicking the link below the list, and in **Appendix B** of this document.

   Specify a Resequenced Trace #: The model results for each of the 100 "*Resequenced Traces*" can be accessed by specifying a Trace number 1 – 100 in the Advanced Builder form. Trace -999 refers to the non-resequenced run for the selected Climate Model. Any number other than 1 – 100 will be treated as -999. Please see **Appendix B** for more information.

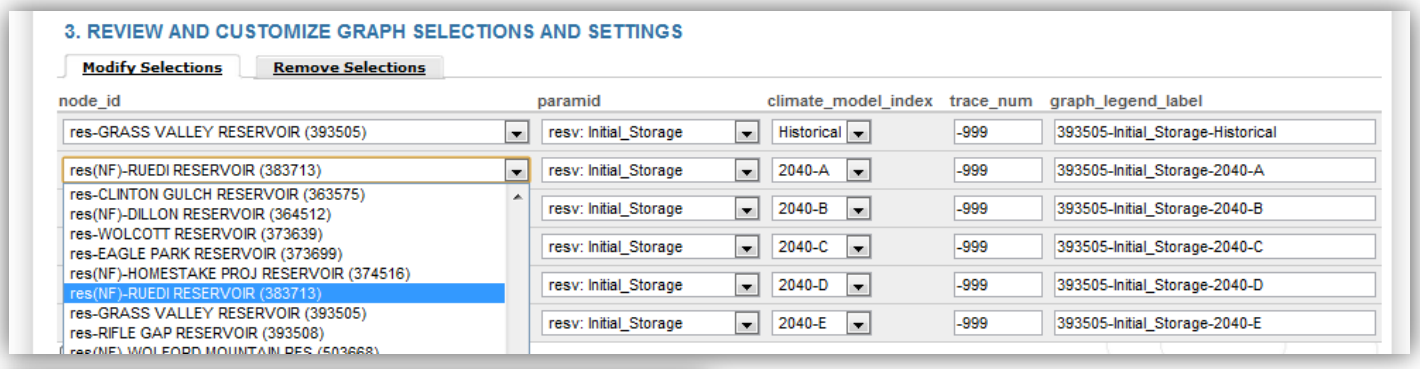
   Once the report contents have been selected click **APPLY SELECTIONS**. *The selected data set will be added to the list at the bottom of the Advanced Builder page*.

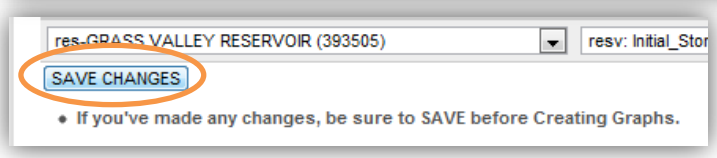
Changing and Removing Data Sets



3. **Customize:** The most powerful aspect of the Advanced Builder is the editable list of data sets at the bottom of the Advanced Builder page. The user may need to scroll down in the browser window to fully view the editable list.

   The editable list under the **REVIEW AND CUSTOMIZE GRAPH SELECTIONS AND SETTINGS** title allows for individually modifying the node, parameter, climate model and trace selections for data set, as well as editing the default graph legend labels.

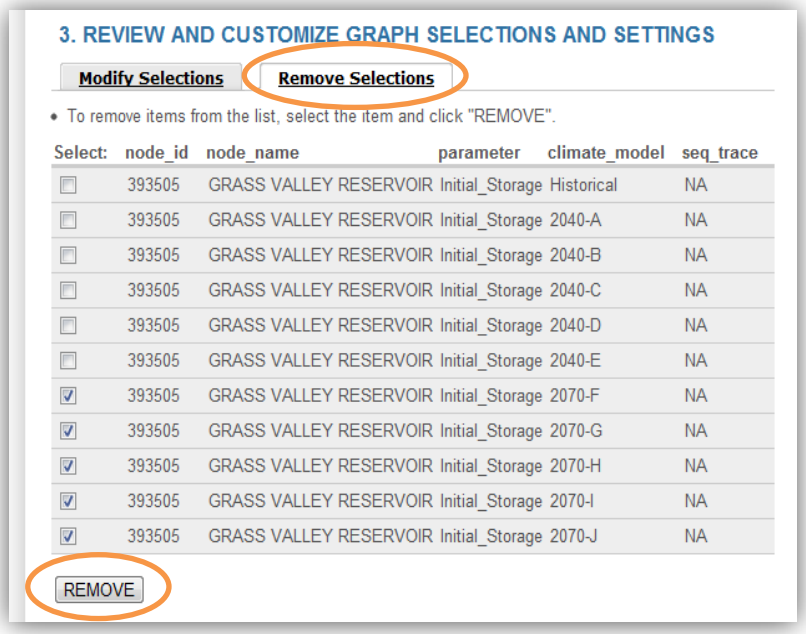




Remember to click **SAVE CHANGES** at the bottom of the editable list after making any changes.

***TIP**: The Advanced Builder initially displays the data sets most recently defined in the Quick Builder. The user may create a Quick Builder selection and then switch to the Advanced Builder to customize it. This can be a fast way to create custom graphs.*

The Review and Customize list includes a second tab labeled **Remove Selections**. In this tab, to remove individual series from the report, check each series to be removed and click the **REMOVE** button.

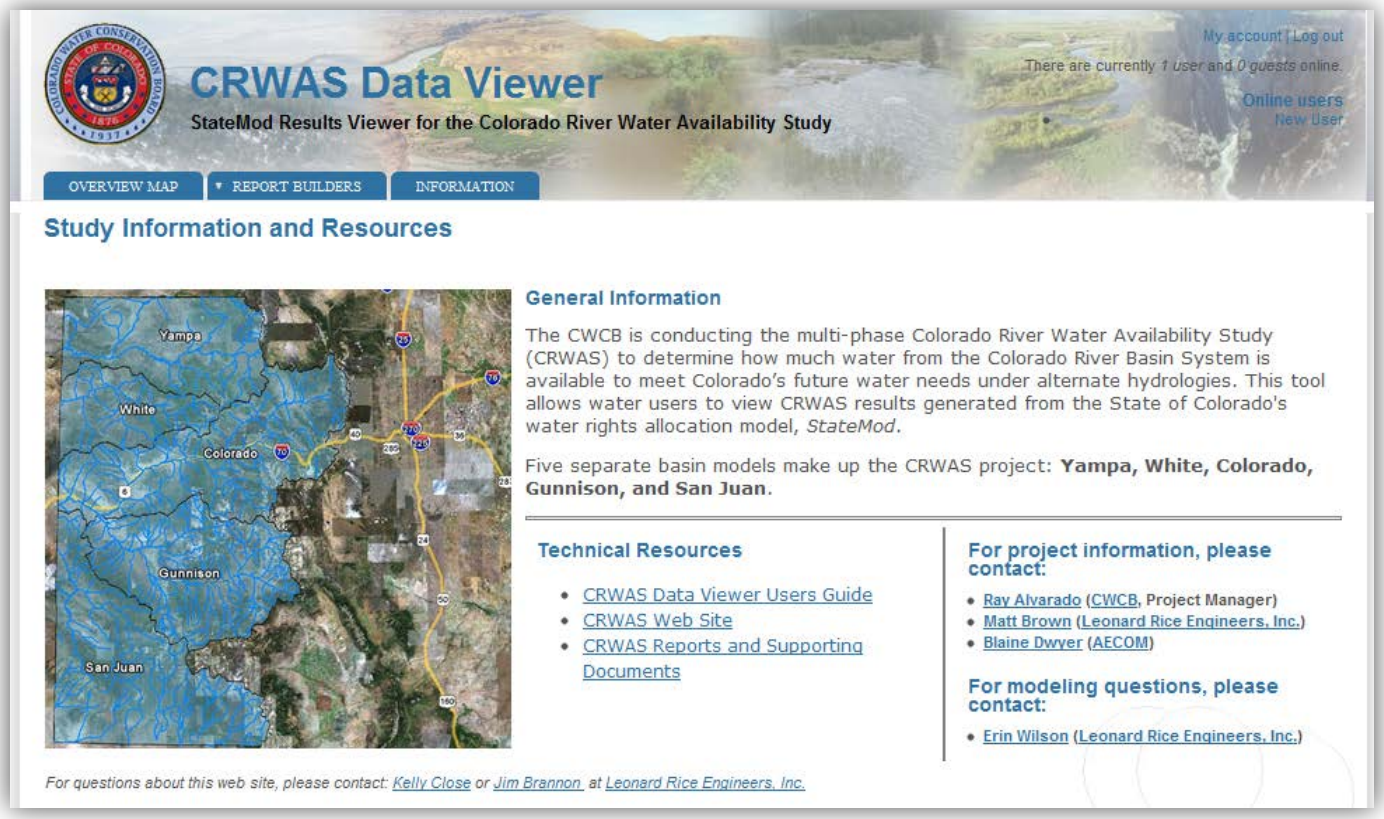


Please Note: the node lists in the Review and Customize section are not affected by the District filter. To allow maximum flexibility for modifying the data set selections, these lists are complete for the selected basin. Nodes in the drop-down list are sorted first by node type and then by Node ID. There is also no "Pick from Map" option for the node selections in these drop-down lists. It may be helpful, however, to use either the PICK NODE FROM MAP or LOOK UP NODES IN A TABLE functions to find the Node ID for your location of interest and then select it manually from the drop-down list.

4. **Create Graphs:** Click **RUN REPORT** to view model results in a graphical report as previously described in the section above, **Viewing Graphs and Downloading Data**.

Study Information and Resources

An information page can be accessed (whether logged in or not) containing general information about the CRWAS project. This page includes links to an online-version of this User Guide, the CRWAS web site, and CRWAS reports and supporting documents. The information page also includes links to contact information for project representatives.



Appendix A. Model Output Parameter Definitions

STATEMOD OUTPUT PARAMETER DEFINITIONS - Diversions

Parameter Name	Description
Total_Demand	Total Structure Demand provided in the demand files
CU_Demand	Consumptive Demand, for example crop irrigation requirement
From_River_By_Priority	Water supply from the river using a direct right
From_River_By_Storage	Water supply from the river by a storage release
From_River_By_Other	Water supply from the river via an exchange or via a plan operating rule
From_River_Loss	River losses from water supplied from storage release or exchange
River_Divert	The sum of water supplies diverted via the river at this node
From_Carrier_By_Priority	Water supply via a carrier from the river using a direct right
From_Carrier_By_Other	Water supply via a carrier from a storage release or exchange
Divert_From_Carrier	Portion of the From_Carrier_by_Other water, amount carried to a structure that is not seen in the river
From_Carrier_Loss	Losses from carried water
Carried_Water	Water carried thorugh this structure to meet another structure demand
From_Soil	Water supplied from the soil zone
Total_Supply	The sum of all water supplies (does not include water carried through this structure to meet another structure demand)
Total_Short	The difference between Total Demand and Total Supply, representing the shortages at the headgate
CU_Short	The difference between the CU_Demand and the Consumptive_Use
Consumptive_Use	Consumptive use of the water supply
To_Soil	Water diverted to the soil zone
Total_Return	Total return flow that will return over all return time periods (not lagged for current time step)
Loss	Water diverted that is not consumed, goes to soil or is returned
Upstream_Inflow	Inflow from upstream nodes to this reach
Reach_Gain	Inflow from gains to this node
Return_Flow	Inflow from returns to this node
River_Inflow	The sum of inflows to this node
River_Outflow	Outflow from this node
Available_Flow	The amount of water legally available to a new junior water right at this location accounting for demands and water rights represented in the model input files

STATEMOD OUTPUT PARAMETER DEFINITIONS - Reservoirs	
Parameter Name	Description
Initial_Storage	Storage at the beginning of month
River_Priority	Water supply from the river by priority reservoir right
River_Storage	Water supply from the river by a storage release
River_Exchange	Water supply from the river by an exchange or operating rule
River_Loss	River losses from water supplied from storage release or exchange
Carrier_Priority	Water supply from a carrier by a priority diversion
Carrier_Storage	Water supply from a storage release or an exchange via carrier
Carrier_Loss	Losses from water carried to reservoir
Total_Supply	Total reservoir supplies
Storage_Use	Releases for downstream use
Storage_Exchange	Releases for exchange
Carrier_Use	Storage release to a carrier canal
Total_Release	Total releases
Evap	Net evaporation
Seep_Loss	Reservoir seepage
Seep_Spill	Sum of reservoir seepage and spills
Sim_EOM	Simulated end-of-month content
Target_Limit	Target storage amount
Fill_Limit	Remaining limit to the fill rule at the beginning of the month
River_Inflow	The sum of inflows to this node
River_Outflow	Outflow from this node

STATEMOD OUTPUT PARAMETER DEFINITIONS - Stream Gages	
Parameter Name	Description
Upstream_Inflow	Inflow from upstream nodes to this reach
Reach_Gain	Inflow from gains to this node
Return_Flow	Inflow from returns to this node
River_Inflow	The sum of inflows to this node
River_Outflow	Outflow from this node
Available_Flow	The amount of water legally available to a new junior water right at this location accounting for demands and water rights represented in the model input files

STATEMOD OUTPUT PARAMETER DEFINITIONS - In-stream Flow Reaches

Parameter Name	Description
Total_Demand	Total Instream Flow Demand provided in the demand file
From_River_By_Priority	Flow allocated to instream flow demand based on instream flow water right
From_River_By_Storage	Water supplied to an instream flow demand from a storage release
From_River_By_Other	Water supplied to an instream flow demand by exchange or plan operating rule
River_Divert	The sum of water supplies diverted at this node (does not include From Carrier by Storage or Priority)
Total_Supply	The sum of all water supplies
Total_Short	to the Instream Flow Demand
Upstream_Inflow	Inflow from upstream nodes to this reach
Reach_Gain	Inflow from gains to this node
Return_Flow	Inflow from returns to this node
River_Inflow	The sum of inflows to this node
River_Outflow	Outflow from this node
Available_Flow	The amount of water legally available to a new junior water right at this location accounting for demands and water rights represented in the model input files

Appendix B. Climate Model Descriptions

The CRWAS Data Viewer provides access to StateMod output for the 11 scenarios used in the study. This appendix includes a brief overview of the basis for these scenarios. For a complete description please refer to the CWCB web site (http://cwcb.state.co.us). In particular, refer to **Phase I – Task 7.2 – Climate Change Literature Review and Methods Evaluation** (April 20, 2009) and **Phase I (b) – Task 3.1 – Projection Selection** (refinement to CRWAS Phase I Task 7.1, 7.2, and 7.5).

The 11 CRWAS scenarios include one Historical scenario (historical flows to represent current conditions) and ten "Climate Model" scenarios. The climate model scenarios are based on ten different sets of adjusted historical flows (see next paragraph) to represent projected future conditions. Five of the ten scenarios focus on the 2040 "planning horizon" and five focus on the 2070 planning horizon (please see documents referenced above for more details).

Adjusted flows used to represent future conditions were based on projections of future temperature and precipitation selected from an archive of regionally downscaled runs (projections), of global climate models (GCM's) available from the World Climate Research Programme (WCRP) archive. Projections selected are listed in the table below with the "model designation" used to label each scenario in the Data Viewer selection controls, on the graphs, and in the downloaded data. Projection names refer to names used in the WCRP archive at http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/.

Model Designation	Projection Name
2040 A	sresa2_miroc3_2_medres1
2040 B	sresa2_mri_cgcm2_3_2a1
2040 C	sresa1b_ncar_ccsm3_02
2040 D	sresb1_cccma_cgcm3_12
2040 E	sresa2_ncar_pcm13
2070 F	sresa2_ncar_ccsm3_04
2070 G	sresa1b_mpi_echam53
2070 H	sresa2_mpi_echam51
2070 I	sresa2_ncar_pcm13
2070 J	sresa2_cccma_cgcm3_12

Resequenced Traces: For each scenario (historical and climate-adjusted), 100 alternate hydrology data sets were developed by re-ordering (resequencing) the original (historical or climate-adjusted) hydrology. The re-ordering process was based on analysis of flow sequences derived from tree ring records beginning in AD 762 (over 1200 years ago). The 100 alternative possible sequences (traces) can reflect the less frequent but more intense droughts and wet spells indicated in the prehistoric record of tree rings. Each trace is equally probable and differs from the original hydrology as well as the other 99 alternate sequences.

Note: Care should be exercised when using these results. The 100 alternate hydrology data sets are intended to be used collectively to characterize statistics of natural streamflow or, when used as input to the StateMod models, to characterize statistics of water rights yields, project performance metrics, and modeled streamflow. No single alternate hydrology trace or subset of traces should be considered representative of future conditions, although the use of individual traces to diagnose the behavior of water rights, operating rules, or infrastructure may be appropriate depending on the user's application.